REVIEW OF LITERATURE
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Without knowledge of water chemistry, it is difficult to understand the biological phenomenon fully, because the chemistry of water reveals much about the metabolism of the ecosystem and explains general hydrobiological inter-relationships. The Physico-chemical characteristics of water and the dependence of all life processes on these factors make it desirable to take water as an environment. Productivity of water is mainly influenced by physico-chemical features such as dissolved solids, dissolved oxygen, turbidity, temperature, hardness, alkalinity and nutrients etc.
Hutchinson (1957) remarked that, a skillful limnologist can probably learn more about the nature of a lake from a series of oxygen determinations than from any other kind of chemical data. The physico-chemical factors directly influence the aquatic biota. Therefore, it attracted several biologists who made commendable contribution on the biological aspects of water bodies. Notable contributions on this aspects are of, Edmondson, 1959; Wetzel, 1975; Parparov, 1990; Peterson, 1990; Ioriya et al., 1998; Wojciechowska et al; 1998.

Recently several authors have investigated the present status of various lakes throughout the world, in the light of conservation. Prominant among them are, Izaquirre et al. (1998); Ioriya et al. (1998); Tittel et al. (1998); Makarewicz et al. (1998); Noges et al. (1998); Duigan et al. (1999); Larson et al. (1999); Donachie et al. (1999); Wojciechowska et al. (1998); investigated some of the physical and chemical characteristics of 58 lakes in alpine, subalpine and forest vegetation zones between 1989 to 1993. Noges et al. (1998) studied the plankton seasonal dynamics and its controlling factors in shallow polymictic eutrophic lake Vortsjaerv, Estonia. Ioriya et al. (1998) investigated the changes in chemical and biological characteristics of water environment at a newly constructed reservoir Sapporo (Japan) for over eight years from the begining of water storage and they observed deterioration in water within two years, phytoplankton composition in three years and zooplankton composition in four years.


Moitra and Bhomik (1968) studied the three main zooplanktonic components, rotifers, cladocera and copepods as dominating groups in a freshwater fish pond in Kalyani, West Bengal. Zutshi et al. (1972); Qadri and Yousuf (1978, 1979) have described the seasonal hydrological conditions of many freshwater bodies. Seasonal variations in the density of rotifer population and physico-chemical parameters of Matyatal, Panna (M.P.) have been studied by Nayak et al. (1982). Rao et al. (1987, 1988, 1989) studied various aspects of the Gandhisagar reservoir.
The effects of herbivorous zooplankton on the sedimentation of particles out of the euphotic zone are examined with mathematical models, a large-scale field experiment and descriptive data from a eutrophic lake by Sarnelle (1999). The theory is rooted in the population dynamics of phytoplankton and zooplankton and so explicitly accounts for the potential effect of zooplankton grazing on primary production and the connection between the rate at which phytoplankton cells sink and sustainable zooplankton biomass. The models predict positive, negative, or unimodal zooplankton effects, depending on the values of four parameters: rate of direct phytoplankton sinking, fraction of zooplankton faecal material existing the euphotic zone, zooplankton assimilation efficiency, and system productivity. Models were parameterized with data from a eutrophic lake to make a priori predictions about the shape and direction of zooplankton effects. Predictions were tested against the results of an independent experiment in which a gradient of *Daphnia* biomass was established in large enclosures. *Daphnia* negatively affected sedimentation rates of carbon, Nitrogen and phosphorous in the enclosure experiment, which confirmed model predictions. *Daphnia* had a strong negative effect on phytoplankton biomass, and phytoplankton biomass was positively correlated with sedimentation in the enclosures. Experimental results were congruent with relationship between *Daphnia* biomass and sedimentation rate in the lake. Successful application of the theory suggests that these models may be of utility for assessing the direction of zooplankton effects on vertical flux in other systems. More generally, the models help to
identify parameters that should be measured in studies of zooplankton effect on downward particle flux.

Ennola et al. (1998) performed zooplankton population analysis with the extended Kalman filtering technique.

The geological and biological history of Assam great lakes, especially the lake Biwa in Japan, are reviewed by Kawanabe (1996). Recent historical changes in the lake, including detrimental impacts on native fauna and water quality are also summarised.

Bioecological findings of four waterbodies of Osmanabad district are carried out by Jadhav and Nanware (1996) to know the micro-organism compositions of parasitic importance.

Linear models were developed for predicting mean Secchi disk depth readings as a measure of water clarity for summer months in lake Mendota, Wisconsin by Lathrop et al. (1999). The 20 year (1976-1995) data set also included external phosphorous loadings in lake phosphorous concentration as indices of lake nutrient status and monthly water column stabilities and *Daphnia* biomasses as indices of lake mixing and algal grazing potentials respectively. The results suggested that summer water clarity in eutrophic lake Mendota is controlled by interacting ecosystem process linked to land use activities, lake food web dynamics and climate.
The vertical distribution of zooplankton is a relatively well documented phenomenon (Wetzel 1975, Margalef, 1984) and is of great ecological complexity since it is related to various environmental, physical and chemical factors such as light, thermic outline, transparency and dissolved oxygen concentration. It is also related to biological factors, the most important of which being the search for food and flight from possible predators (Esteves, 1988).

The limnological characteristics and vertical distribution of phytoplankton in lake Akan-panke were surveyed by Hino et al. (1998) to clarify the metabolism in an oligotrophic lake.

Freshwater protozoan communities of Bhopal lakes have been studied by Katiyar (1995), Katiyar and Belsare (1997). The protozoan colonization rate in both these lakes was high during the hot season and low during the cold season.

The seasonal fluctuations in population density of ciliates in relation to temperature, dissolved oxygen, pH, acidity, and alkalinity, were studied by Pathak (1999). The population was more dense in winter, moderate in summer and less in monsoon with more varieties in summer and less in monsoon.

Seasonal changes in the composition of species, their abundance and biomass of planktonic ciliates in the Gdansk Basin, Southern Baltic were studied by Witek (1998). A total of 40 ciliate taxa were observed.
Effect of water temperature and light intensity on growth rate and death rate of freshwater dinoflagellate *Peridinium bipes* was examined by Kishimoto *et al.* (1998) in the Asahi Reservoir, Nara Prefecture containing average values of dissolved nitrogen and dissolved phosphorus and water temperature above 5°C and the light intensity more than 5 μE m⁻² sec⁻¹.

Littoral protozoan assemblages from two Mexican hyposalaine crater lakes (Lakes Alchichica and Atexcac) located in the Oriental valley, centre of Mexico, were studied using the polyurethane foam units colonization method. Eighty seven species were observed in both lakes. Ciliates and flagellates species dominated the assemblages composition. The flagellates, *Bodo caudatus* and *Spumella termo* and the ciliates, *Cyclidium glaucoma* were the most abundant species in Alchichica while in Atexcac the flagellates *Cryptomonas ovata* and *B caudatus* and the ciliates *C. glaucoma* and *Stylonychia notophora* were most abundant. The salinity of the lakes ranged between 6 and 7.1 g/l with pH 8.4 to 9.0.

The spatial variation of zooplanktonic groups (cladocerans, rotifers, nauplii and adults of copepods) in the Bora reservoir was studied by Bini *et al.* (1997) using questatistical tools. The variation in the density of cladocerans and nauplii and adults of copepods was structured along the geographic space in the form of gradients, which implied the rejection of the hypothesis of spatial homogeneity.
Maier et al. (1998) studied physical and chemical conditions and the crustacean communities in temporary ponds in a military area in South Germany. All ponds were turbid, without higher aquatic plants but contained unique crustacean community with endangered species such as the anostracan, Branchipus schaefferi, the Copepods, Cyclops frucifer and Metacyclops minutus and the cladocerans Daphnia obtusa, Moina brachiata and Macrothrix hirsuticornis. Branchipus was only present in ponds which dried out and where drying occurred. Day-night fluctuations of temperature were up to 15°C in summer.

Cladocera forms an important component of zooplankton and forms the most dominant group of fish food organisms. These have been described from all over the world including the Indian subcontinent (Edmondson, 1959; Dussart, 1970; Frey, 1971; Hebert, 1978, Penak, 1978). Out of the eleven families of cladocera, 8 families have been reported from Indian waters which represents about one-fourth of the world cladoceran fauna. The Indian cladocera have been recorded mainly from West Bengal, Bihar, Punjab, Kashmir, Karnataka, Kerala, Tamilnadu, Madhya pradesh, Rajasthan, Maharashtra and Meghalaya (Alikunhi, 1952; Chacko and Ganapati, 1949; Biswas, 1971; Nayar, 1971; Michael, 1973; Murugan, 1975; Patil, 1976; Shrigur et al. 1977; Sharma, 1978, 1979; Tonapi, 1980; Sharma et al. 1983, 1984; Babar and Choubey, 1987; Rao and Choubey, 1997). Rao and Choubey, (1997) have studied the cladocerans from 36 lentic localities dealing with aspects of systemic
records, density, population dynamics and ecological observations.

The cladocerans from 13 Northern German lakes of different trophic levels were analysed using the bosminid and chyldrid remains in the superficial sediment as an integrated sample of the total lake faunas by Hofmann (1996).

The interactions between calanoid and cyclopoid copepods were examined in the 11 year field study of an eutrophic lake in Germany by Adrian (1987). He observed a diminishing ratio of calanoids to cyclopoids, however, these changes could not be explained by the interaction between calanoids and cyclopoids alone.

Production biology of copepods and cladocerans in three South East Sri Lankan low-land reservoirs and its comparison to other tropical freshwater bodies was carried out by Bandu - Amarasinghe et al. (1997). Mean zooplankton production biomass and annual zooplankton production were found to be positively related to mean phytoplankton biomass and mean phytoplankton biomass proved to be a good predictor of mean zooplankton biomass (r = 0.58) and a moderate good predictor of annual zooplankton biomass (r = 0.43).

Effect of altitude and physical heterogeneity (temperature, pH and surface area) on crustacean zooplankton in 17 fishless subartic ponds was investigated by Rautio (1998).

Williamson et al. (1999) investigated that dissolved
organic carbon (DOC) usually declines with the acidification, as DOC is the primary factor regulating variation, in the depth of penetration of ultraviolet radiation (UVR) in lakes. Sommaruga et al. (1999) have studied dissolved organic carbon concentration and phytoplankton biomass in high-mountain lakes of the Austrian Alps.

Juergens et al. (1999) conducted an enclosure study in lake Soebygaard, a shallow hypertrophic Danish lake to examine the impact of metazooplankton on the composition and population dynamics of planktonic ciliates.

Williamson et al. (1999) have also argued that a paradigm that includes coloured dissolved organic carbon (c DOC) as well as nutrients are useful in predicting and understanding the response of lake ecosystem to multiple stressors.

Summer water quality responses to phosphorous, Daphnia grazing and internal mixing in lake Mendota (Wisconsin USA) was investigated by Lathrop et al. (1999). They developed linear models for predicting mean Secchi disk depth readings as a measure of water quality. Arnott et al. (1998) assessed crustacean zooplankton richness in eight Canadian shield lakes at different temporal and spatial scales using three methods of estimations: Cumulative, asymptotic and Chao's index.

Long term seasonal variations in water-column
methane oxidation were studied in the eutrophic, shallow lake Kasumigaura, Japan - during 1991 to 1996 and the existence of methane oxidation activity in the Oxic lake water was confirmed (1998). Methane oxidation was found to be distinctly seasonal, with low activity from January to April and high activity from August to November.

Baruah et al. (1998) have made hydrobiological investigations on some fresh water ponds in relation to pisciculture. The analysis of water quality of ponds (numbering 22) revealed temperature range of 17-22.5°C, pH 6.6 - 8.5, dissolved oxygen level 1.2 - 8.3 mg/l, CO₂ 3.3 - 13.9 mg/l, alkalinity 36.1 - 166.7 mg/l, hardness 7.22 - 78.3 mg/l, turbidity 1.1 - 100.00 NTU and conductivity 39.9 - 285.9 µ mhos/cm. Thirteen species of zooplankton were observed belonging to protozoa, rotifera and crustacea. Eleven microzoobenthic invertebrate fauna were recorded belonging to annelida, arthropoda and mollusca and numerous larvae belonging to Chironomus, Plecoptera, Odonata and Coleoptera.

Choi (1998) examined the consequences of rapid climate change on lake ecosystems in terms of two main effects: variability effects and magnitude effects.

The scale and magnitude of probable impact of human activities over a decade (1983 - 1994) on the freshwater lake Priyadarshini at Schirmacher Oasis, East Antarctica, was assessed
through an ecological study conducted over an annual cycle during January 1993 to January 1994 by Ingole and Dhargalkar (1998). Fluctuations in the hydrobiological parameters were closely related to meteorological conditions over the area. Biological productivity of the lake was dependent on the availability of ice-free water and increase in atmospheric temperature.

Limnological studies on two ecologically different water bodies at Dumka (Bihar) with special reference to their chemistry and primary productivity for a period of one year during different seasons of 1994 were carried out by Kumar et al. (1996). The study showed that the primary productivity of the water bodies depended mainly upon the intensity and quality of light, the carbon supply, the availability of nutrients as well as the biomass. The primary productivity was found to be more in sewage-fed water body due to presence of adequate nutrients and carbon dioxide. The presence of high rates of primary productivity further indicated that the eutrophication had been at a faster rate in Singhara Pokhar pond which received domestic sewage than Barabandh pond where there was only bathing and washing of clothes activities were predominant.

Many studies on the phytoplankton composition, nutrient status and productivity have been carried out in standing water bodies of India (Sreenivasan, 1963; 1964; 1972, Khan and Quyyum 1971; Mathew, 1975; Pathak, 1979; Ayyappan and Chandreshekhar Gupta, 1985; Prasad, 1990; Birasal, 1996; Vijaykumar et al., 1991;
Occurrence of various rotifers in different lakes are well studied by several authors (Galkovskaya, 1998; Holst et al., 1998; Ventelae, et al. 1998; Snell and Serra, 1998).

In India the major contributions in the rotifer study are those of Arora (1962; 1963a; 1963 b; 1965; 1966 a; 1966 b; 1966c); Dhanapathi (1973; 1974 a; 1974 b; 1975 a; 1975 b; 1976 a; 1976 b; 1976 c; 1977; 1978 a 1978 b; 1997; 2000); Nasar (1968; 1969; 1973); Sharma (1976; 1979a; 1979 b; 1979 c; 1979 d; 1980) and Vasisht (1967; 1969; 1970; 1971a; 1971 b; 1971 c). Sharma and Michael (1980) listed 241 species from India. However, Sudzuki (1989) has listed 260 species of rotifers from India. From Andhra Pradesh, Dhanapathi and Sarama (2000) has reported 91 species belonging to 18 families of which 18 species are new records to India.

Majority of rotifers recorded from India are tropicopolitan and at present some of the new species described from India appear to be pantropical (Dhanapathi, 2000).

There is a considerable literature pertaining to the relation between abundance and occurrence of rotifers and abiotic factors such as temperature, pH, dissolved oxygen, alkalinity, chloride etc. along with suitable food availability. However, information concerning the oxygen demand of rotifers at high temperatures is still
scanty in India except for a few reports such as Arora (1964) and Dhanapathi (1997).

The elevation of pH associated with timing was directly implicated in the reconstruction of the species composition of rotifer communities by way of changes in the food base was observed by Ejsmont-Karabin (1996).

Rotifer responses to increased acidity was studied by Frost et al. (1978). Many species decreased in abundance under reduced pH conditions but other rotifers increased at the same time such that there were ultimately increases with acidification in total rotifer biomass, and quite conspicuously, in the proportion that rotifers comprised of total zooplankton biomass. Ten different species decreased at some stage during the acidification (e.g., Kellicottia longispina, Asplanchna priodonta and Keratella cochlearis) while four species increased dramatically (e.g., Synchaeta sp and Keratella taurocephala). Diversity and zoogeography of rotifera in a flood plain lake of the Ichilo river, Bolivia was investigated by Segers et al. (1998).

Influence of 46 different environmental factors on the rotifer assemblage in an artificial lake was evaluated by Devetter (1998). This study showed that the rotifers in the reservoir were controlled by both abiotic and biotic factors.
Rotifer fauna of Venezuela was analysed in the light of previously existing literature and observations. A total of 268 taxa belonging to 44 genera were recorded (Vasquez et al., 1998).

A survey of rotifers from a small pond from central Mexico was carried out by Sarma and Mannel (1998). They recorded a total of 78 species with 20 new record for Mexico. The main source of variation of rotifer species distribution in lake Arcas - 2, a small Karstic lake near Cuenca (Spain), was explored by means of principal components factor and canonical correlation analysis by Armengol et al. (1998).

Pollard et al. (1998) studied the effects of turbidity and biotic factors on the rotifer and cladoceran community in an Ohio reservoir (USA). They examined patterns of rotifer and cladoceran abundance and population dynamics along a turbidity gradient over a period of 4 years in an Ohio reservoir. The result suggested that there was no effect of turbidity on rotifer abundance. Further they suggested that interannual variation in *Daphnia* abundance could be variations in fish biomass.

Population dynamics of planktonic rotifers in lake Loosdrecht, the Netherlands, in relation to their potential food predators was studied Ooms-Wilms et al. (1999).

Vijverberg and Boersma (1997) tested the hypothesis
that small bodied species became increasingly abundant and dominant over large bodied species with increasing eutrophication by studying long term dynamics of small bodied and large bodied cladocerans in the shallow lake, Tjeukemeer. However, the hypothesis could not be proved due to negative relation between hydrobiological conditions and abundance of fish with chlorophyll content.