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Limnological studies of Bisnoor Pachdhar Reservoir in relation to phytoplankton diversity

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Abstract

In India, the inland water resources, whether lentic or lotic suffer a lot due to environmental degradation. Water and life have indivisible relationships and are considered as two sides of the same coin. Aquatic ecosystem is an integral part of the nature of the region. Almost all human activities have harmful impact on freshwater bodies. Limnology has great scope in the healthy existence of natural and man-made water bodies and in harvesting the natural resources at sustainable level. Our present work focused on the taxonomic composition and abundance of phytolankton in relation to Physico-chemical characteristics of water in different sites of Bisnoor pachdhar reservoir, Betul district. During the period of investigation, the seasonal variations of the following physico-chemical parameters were studied. They were atmospheric temperature, water temperature, pH, electrical conductivity, total dissolved solids, alkalinity, dissolved oxygen, hardness, chloride, total hardness, calcium, magnesium, dissolved oxygen, biological, nitrate, nitrite, phosphate. The total phytoplankton percentage contribution was observed seasonally.

Water is considered as one of the most basic and important material for all living organism. Our dependence on fresh water resources has accelerated in the last century due to rapid world population growth and economic development. As a result, fresh water resources have deteriorated both in quantity and quality in many areas of the world.

Limnology is the science of water bodies particularly lakes, Reservoir, ponds, river, including their hydro-biological, physic-chemical and biological aspects. Limnology was studied with reference to the organism especially plankton Hensen[13] and Fritsch[10]. The main feature of Limnology is the biogenic material balance of natural waters. Limnology has come a long way since the time Forel[9] in understanding the dynamic of a standing water bodies subsequently.

The aquatic diversity is highly sensitive and it is influenced by various factors such as population, anthropogenic activities, geological factors, rapid urbanization, agricultural developments, global markets, industrial

development and poor waste water regulation are the main sources that affect the quality and quantity of water[22]. The health of water bodies and their diversity depends on health of almost every component of the ecosystem[19].

The physico-chemical means are useful in detecting the effects of pollution on the water quality but changes in the trophic conditions of water are reflected in the biotic community structure including species pattern, distribution and diversity[15].

Phytoplanktons not only serve as food for aquatic animal, but also play an important role in maintaining the biological balance and quality of water[4]. Present study is aimed at studying seasonal variation in physicochemical parameters and planktonic diversity as well as density at different parts of Bisnoor Pachdhar reservoir. In the present investigation, an attempt has been made to determine seasonal fluctuations in phytoplankton distribution, abundance and diversity along with their major taxonomic groups. The objective of present investigation, to understand exciting features of distribution, composition, diversity and ecology of phytoplankton as well as physico-chemical property of Bisnoor Pachdhar reservoir reservoirs their role in biological productivity.

Study area :

Bisnoor Pachdhar dam is a medium sized irrigation reservoir situated at near pachdhar village of Bhensadehi tehsil, Betul district Madhya Pradesh India. It is situated tapti river basin at latitude 21° 38' 00'' longitude 78° 01' 15''. The main purpose of construction of this reservoir was to uplift the economic condition of the natives and to eliminate the scarcity irrigation and water problems in the drought. The catchment area of the reservoir is 8.31 Sq km metres and the length is 4800 metres. Water samples were collected from three different sampling stations (dam site, mid site and tail end of the reservoir).

Water samples were collected seasonally at 7.00 AM from Bisnoor Pachdhar reservoir, Betul district, Madhya Pradesh at three different locations such as Dam side, Mid site, Tail end site. Surface water samples at 0.5 m depth were aseptically collected for physico-chemical. Water samples were transported and stored at 4°C in the laboratory. The physico-chemical parameters of triplicate water samples were analysed using the standard methods[3].

Phytoplanktons were taken by filtering water through plankton sampler made up of nylon (No: 25, Mesh size 40µm). The absolute volume of the filtered sample was 100 ml which was transferred to plastic bottle and labelled mentioning the time, date and place of sampling. The samples were preserved on the field with 2 ml of 4% formalin and added Lugol's iodine solution 1ml/100 ml of sample to arrest cell activity, for sedimentation and better staining. The sample bottles were then transported to the laboratory for plankton analysis and the preserved sample was reduced to 10 ml. 1ml was pipetted out from the 10 ml (after it has been shaken) and qualitative and quantitative estimation of phytoplankton was carried out with the help of 'Sedgwick Rafter' counting cell under an optical microscope (100x magnifications)[23].

The systematic identification of the phytoplankton up to the level of species was done adopting the standard keys of Edmondson[8], Whitford, Palmer[27] and Anand[1]. Average of 10 replicates for each sample was taken into account and the density of phytoplankton was expressed in number of organisms per litre. Following the method of Rao[20] a drop of sample from each of the vials was mounted on a clean micro-slide and a cover glass was put over it. The entire cover glass area was scanned for the Phytoplankton under 10 different microscopic fields of magnification 15x10 and the individual Phytoplankton species were counted as recorded in the frequency chart provided for instance in respect of Binoor pachdhar reservoir.

The water temperature varied between 14°C during winter and 33.4 °C during summer. The average temperature of all the four seasons was 25.9 °C. The peak temperature was recorded during summer and lowest during winter which is a normal feature in fresh water bodies. Temperature is an important limiting factor, which control the biogeochemical activities in the water. Generally, the surface water temperature is influenced by the strength of solar radiation, evaporation and fresh water influx[7].

Specific Electrical conductivity values ranged from 223µS/cm during winter to 477µS/cm during pre-monsoon. The average value for the four seasons was 320µS/cm. Electrical conductivity depends on the attendance of ions, their total concentration, relative concentrations and temperature of measurement. High value of electrical conductivity in summer could be due to inflow of high quantum of domestic and agriculture waste and low values might be due to higher temperature and stabilization of water due to increased concentration of salts because of discharged domestic waste and organic matter in the waterbodies[11].

pH ranged from 7.13units to 8.6 units during winter and summer respectively. The average pH value for all the different seasons was 8.07 units which is slightly alkaline. The term pH is used to indicate the acidity or alkalinity of a substance. The desirable pH may range from 6.5 to 8.5 and there is strictly no relaxation for this limit[5]. The largest variety of aquatic flora and fauna prefer a range of 6.5 units to 8.0 units. While pH is outside this range, diversity within the water body may decrease due to physiological stress and result in reduced reproduction. Extremes in pH can produce conditions that are toxic to aquatic life[6].

Alkalinity ranged from 74mg/L during winter to 118.mg/L during monsoon. The average alkalinity of the four seasons was 94.18 mg/L. Alkalinity of water is a calculate of weak acid present in it and the cations balanced against them. Total alkalinity is the total concentration of carbonates and bicarbonates. Total alkalinity depends on the concentration of the substance which would raise the pH of the water. High levels of alkalinity indicate the presence of strongly alkaline constituent from the catchment area. The degradation of plants, might also be one of the reasons for increase in carbonate and bicarbonate levels, thereby showing an increase in alkalinity[25]. Dissolved oxygen (DO) ranged from 6.8mg/L during summer to 11.2mg/L during monsoon. The average Dissolved oxygen of the four seasons was 8.53 mg/L. More organic waste in water

results in to decrease in average dissolved oxygen concentrations. However, in water bodies where a large proportion of the organic matter is brought in from outside the water bodies, the oxygen production and consumption are not balanced and dissolved oxygen may decrease[17]. Dissolved oxygen levels are influenced by water temperature, types and numbers of aquatic plants, light penetration and amounts of dissolved or suspended organic matter. Dissolved levels between 5.0 and 8.0mg/L are satisfactory for survival and growth of aquatic organisms. The low DO during summer could be related to lesser input of freshwater and also due to the biochemical oxidation of organic matter and the combined effects of temperature and photosynthetic activity.

TDS values ranged from 138ppm to 222ppm between summer and monsoon respectively. The average TDS value for the four seasons was 186.7 mg/L. Variations in TDS may be due to the inflow of industrial, animal and agriculture wastes and also by evaporation and less rainfall[24].

Total hardness values ranged from 84mg/L during summer to 180 mg/L during post monsoon . The average TH value for all the four seasons was 123.mg/L. Water is commonly classified in terms of the degree of hardness namely 0-75, 75-150, 150-300 and above 300 mg/L as soft, moderately hard, hard and very hard respectively[21].

Calcium values ranged from 28.2mg/ L to71.5mg/L during summer to monsoon respectively. The average calcium value for all the four seasons was 53.3.mg/L. Calcium is essential for all organisms, being an important cell wall constituent and regulates various physiological functions in animals[16].

Nitrite ranged from 0.03mg/L to 0.1mg/L during summer. The average nitrite value for all the four seasons was 0.06mg/L. The higher concentration of nitrite and its seasonal variations could be attributed to the variation in phytoplankton, excretion and oxidation of ammonia and reduction of nitrate to nitrite[14].

Nitrate values ranged from 0.10mg/L during winter to 0.29mg/L during summer. The average nitrate value was 0.20mg/L for all the four seasons. Nitrate is the most highly oxidized form of nitrogen compounds commonly present in natural waters, because it is a product of aerobic decomposition of organic nitrogenous matter. Significant sources of nitrates are fertilizers, decayed vegetable and animal matter, domestic and industrial effluents and atmospheric washouts[11].

Phosphate values ranged from 0.221mg/L to 0.521mg/L during postmonsoon and pre-monsoon respectively. The average phosphate value for all the four seasons was 33mg/L. Phosphate is a nutrient for plant growth and a fundamental element in the metabolic reaction of plants and animals. It controls algal growth and primary productivity. Excess amounts of phosphorus can cause eutrophication leading to excessive algal growth called algal blooms[11]. Excess nitrogen and phosphorus in the water causes algae to grow faster than ecosystems can handle. Significant increase in algae harm water quality, food resources and habitats, and decrease the

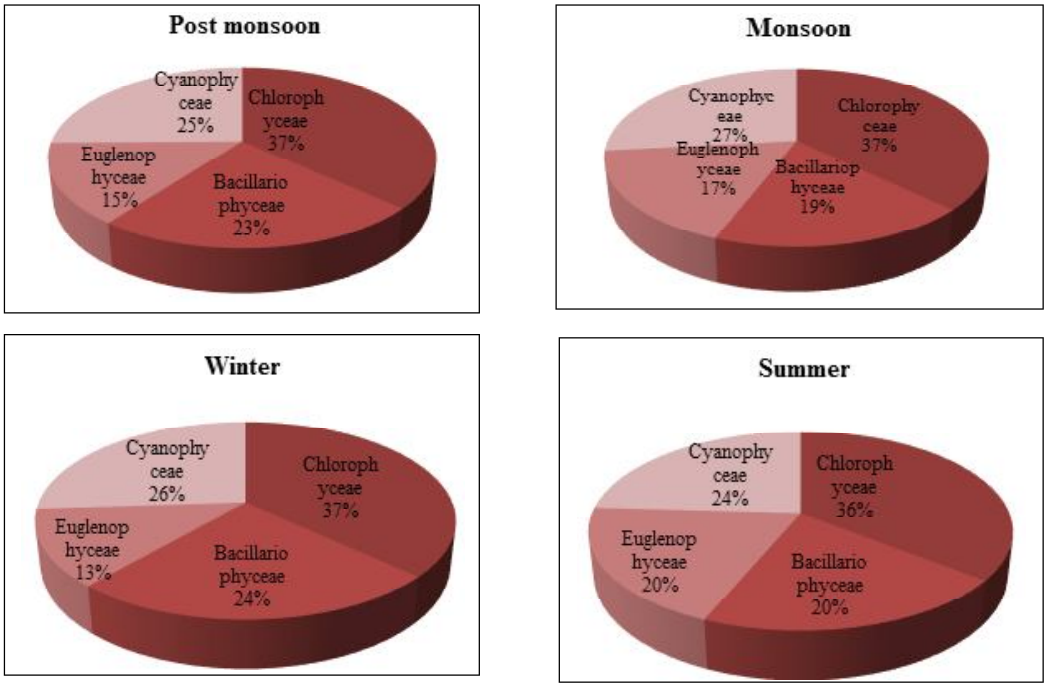

Fig. 1 Seasonal Variation of phytoplankton diversity at Dam site of Bisnoor Pachdhar Reservoir.

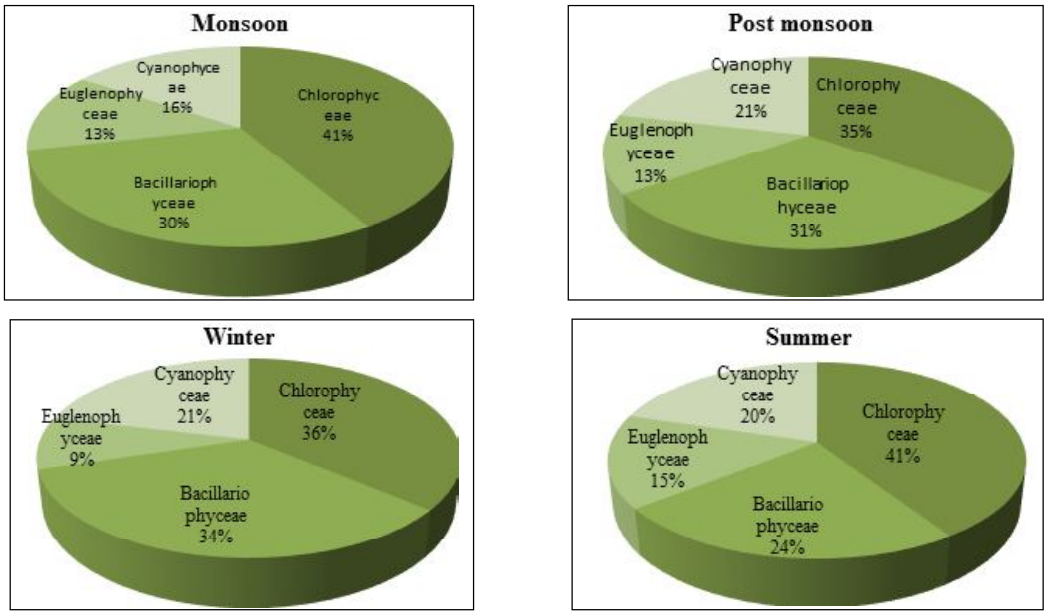

Fig. 2 Seasonal Variation of phytoplankton diversity at Mid site of Bisnoor Pachdhar Dam.

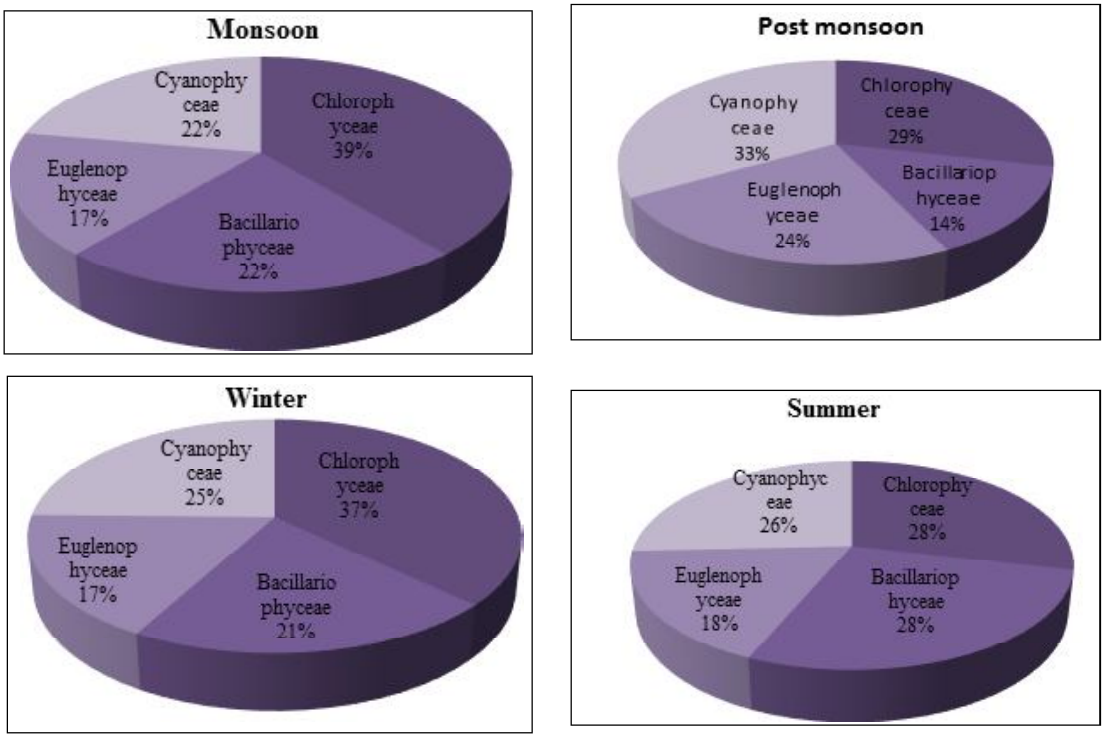

Fig. 3 Seasonal Variation of phytoplankton diversity at Mid site of Bisnoor Pachdhar Reservoir

oxygen that fish and other aquatic life need to survive.

The percentage distribution of different phytoplanktonic species recorded in three different sites of Bisnoor Pachdhar Reservoir is presented in figure 1. In dam site, the percent distribution of the Chlorophyceae (37%), Cyanophyceae (27%), Bacillariophyceae (19%), and Euglenophyceae (17%) during monsoon season, in post monsoon chlrophyceae (37%), Cyanophyceae (25%), Bacillariophyceae (23%), Euglenophyceae (15%) during post monsoon season. While in the winter season the contribution of chlrophyceae (37%), Cyanophyceae (26%), Bacillariophyceae (24%), Euglenophyceae (13 %) was recorded and during summer season the percentage composition of chlrophyceae (36%), Cyanophyceae (24%), Bacillariophyceae (20%), and Euglenophyceae (20%) was recorded at dam site of the reservoir.

The seasonal percentage contribution Chlorophyceae (41%), Bacillariophyceae (30%), Cyanophyceae (16%) and Euglenophyceae (13%) during monsoon season. However, during post monsoon season chlrophyceae (35%), Bacillariophyceae (31%) Cyanophyceae (21%), and Euglenophyceae (13 %) was recorded. In the period of winter chlrophyceae (36%),%), Bacillariophyceae

(34%), Cyanophyceae (21%) and Euglenophyceae (9%) was recorded. During the summer season Chlorophyceae (41%), Bacillariophyceae (24%) Cyanophyceae (20%) and Euglenophyceae (15%) was recorded at mid site of Bisnoor pachdhar reservoir (Fig. 2).

In tail end site, the percent distribution of the Chlorophyceae (39%), Cyanophyceae (22%), Bacillariophyceae (22%) and Euglenophyceae (17%) during monsoon season. While in the post monsoon Cyanophyceae (33%), Chlrophyceae (29%), Euglenophyceae (24%), Bacillariophyceae (14%) and during winter season the contribution of chlrophyceae (37%), Cyanophyceae (25%), Bacillariophyceae (21%),Euglenophyceae (17 %) was recorded. In the period of summer season chlrophyceae (28%), Bacillariophyceae (28%), Cyanophyceae (26%), and Euglenophyceae (18%) was recorded at tail end site of the reservoir (Depicted in fig. 3).

Various physico-chemical characteristics of Pachdhar reservoir like total dissolved solids, electric conductivity, pH, alkalinity, hardness, calcium, magnesium, nitrite, nitrate and phosphorous have been compared with the trophic status this reservoir, can safely be placed under the category of oligo-mesotrophic water bodies with moderate quantity of nutrients to support relatively good biota in the reservoir. Based on the present investigation, it can be concluded that there is seasonal variation in the diversity of phytoplankton. Diversity is also affected by anthropogenic activities.

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