RESEARCH ARTICLE

Bioresources as the tool for Biodiversity Management

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ABSTRACT

Water management in general takes account of biodiversity and conservation aspects, but further some protective measures are needed. Cost of water management directly or indirectly influences the aquatic ecosystem. Biotic and abiotic factors are both independent and interdependent resources. Multispecies communities like plankton, fishes and macrophytes are bioresources which are essential for the stabilization of ecosystem. Bioindicators and bioresources are both responsible to maintain the food chain of pond ecosystem. Species composition and biomass distribution are important for affecting the transfer of energy in food chain of pond. Phytoplankton represents the base of primary producer in aquatic ecosystem and plays a major role in the global cycling of carbon, nitrogen, phosphorous and other elements; and by this they help in regulation of the earth's climate. Bioresources are the natural bioindicators of pollution in the water body. Bioindicators are anthropogenically induced which affects biomolecules, their biochemical and physiological parameters that are casually linked to the different levels of biological organisation. Sometimes the reason behind loss of biodiversity is due to competition between bioresources in a limited space. Present investigation is an attempt to study and understand the basic status in hydrobiology and productivity possibility of reservoir.

Keywords: Bioresources, Bioindicators, Biodiversity, Management, Biomass Distribution

INTRODUCTION

Water is the mirror of civilization, since the origin of life. Almost all the living organisms prefer to live in water. Availability and

quality of water are important for determination of the quality of aquatic environment. Management of water resources and biodiversity of aquatic body is important for society. Fresh water formation are the cheapest and most accessible source for maintaining biodiversity by management of bioresources as they make the water reservoir polluted or pollution free by showing their presence or absence. According to Bourdean and Threshow (1978) pollution is an environmental change which alters species diversity for a particular biotype, also causing successive changes in the nutrient status of the water area associated with changes in the biota.

The onset of entropy is characterised by a marked increase in primary production site usually in the form of phytoplankton with the frequent occurrence of algae blooms. Increase in primary productivity leads to a corresponding increase in the secondary productivity. As the increase in phytoplankton occurs, in most cases it decreases the transparency which may render water harmful to fish and cattle. Wetzel (2006) has described that limnology is the study of functional relationship and productivity of fresh water biotic environmental parameter.

MATERIAL AND METHODS

Samples were collected randomly in each month from January, 2014 to December, 2014 from the selected sites of Jawaharlal Bal Udyan wetlands of Bhopal. The plankton forms were collected by using a small meshed plankton net of nylobolting silk (25 number) followed by filtrating a known volume of water sample through it. Then the plankton net was transferred in 50 ml bottle and the plankton samples were preserved in 5% neutralized formalin and a few drops of glycerine were also added to it after collection. The sample was allowed to stand for a day to acquire further concentration. After having the planktons settle down at the bottom of the bottle, the supernatant plankton free water was removed with the help of a pipette and the sample was reduced to a described volume. Monthly and seasonal variation in various physico-chemical characteristics and their correlation with the biotic communities: abundance distribution and occurrence of phyto and zooplankton; qualitative observation on available macrophytes; and fish fauna of the pond. These studies helped to understand the proper biomaintenance of aquatic body with respect to their biodiversity.

Primary productivity was determined by measuring oxygen produced during photosynthesis. Volumetric estimation was done in the laboratory. Phytoplankton and Zooplankton were collected by filtration method and for quantitative study of phytoplankton and zooplankton each replicate was counted under research microscope by drop count sedimentation method. Phytoplanktons were counted species wise seasonally. Identification of Zooplankton and Phytoplankton was done according to Needham & Needham (1962) and Adoni (1985).

Macrophytes were collected from 2-3 meters from the shore line of the pond. Fishes were collected by fishermen as it was a fish stocking pond. According to Patil et al. (1983), the maximum value of water temperature is observed in summer and the minimum in winter. Present study also showed a significant correlation between air temperature and pH(r+0.58. Ω≤0.05).Hence with the increase in temperature, pH moves towards alkaline side thus accelerating the rate of photosynthesis due to consumption of carbon dioxide.

However in the present investigation water temperature shows negative correlation with dissolved oxygen(r=-0.58, p≤o.1).During the course of study it was observed that during the period of high temperature, low oxygen content was present. In the pond, carbon dioxide was present throughout the year. It ranges from 0.3mg/L - 1mg/L. The maximum value was recorded during August and minimum value during April.

RESULTS AND DISCUSSION

During studies, maximum atmospheric temperature was registered during May. Water temperature also reached its maximum during summer. The air and water temperature is closely associated with each other in the case of the smaller size of the water body (Welch, 1952; Anderson, 1970; Hopkins 1971). According to them smaller the water body, the more quickly it would react to the change in atmospheric temperature. It is evident that sunshine hours and temperature, influences the solubility of gases in water particularly that of carbon dioxide and oxygen, high temperature accelerate the process of decay of organic matter resulting in liberation of large quantities of CO_2, so the consumption of CO_2 was depended on the bioresources (Phytoplankton, Zooplankton, macrophytes and fishes) present in the water body. Oxygen is the important fundamental parameter of fresh water bodies and is essential for the metabolism of the aquatic bioresources that are housing aerobic respiratory biochemistry. Dissolved oxygen provides valuable information about the biological reaction going in water body. In the pond, the dissolved oxygen was found to fluctuate from 5.3 mg/L and 12.4 mg/L.

Water acts as a medium for growth and development of aquatic biota, so there was a need to know the actual role of bioresources in maintaining biodiversity of a Jawahar Bal Udyan Pond in Bhopal. Species composition and their metabolic activity can affect the pattern of aquatic life. The bioresources shows the variation due to sewage entrance and due to these, during the study period it was observed that limno-chemical properties of an aquatic body could be changed to determine the nature of aquatic body. Weltch (1935) has remarked that it should be understood in advance that each physical and chemical influence described is not purely physical or chemical. This may be because of the increased metabolic activity of the biota. This was observed also by Pearsall (1921); Bohra & Bhargava (1977) and Vass & Sachlan (1953). Transparency is an index of productivity because it controls the structural and behavioural characteristic of bioresources. It adversely affects the primary productivity. During the course of present study the maximum transparency measured by Secchi disc was recorded during March. The maximum value in visibility during the summer may be attributed to the absence of macrophytes and low level of water. All living organisms depend upon oxygen in order to maintain metabolic process that produce energy for growth; so for biodiversity maintenance, bioresources management worked as a tool to maintain the higher form of biological life in water as they are all dependent for food on each other to maintain their energy level in a system. According to Jhingran (1982) in natural water, carbon dioxide is liberated from various sources; due to activity of animals and plants, bacterial decomposition of organic matter.

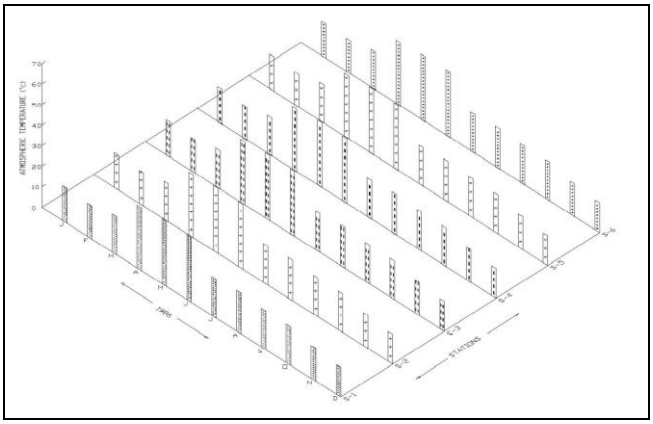


Fig. 1 : Annual atmospheric temperature of water body at different stations

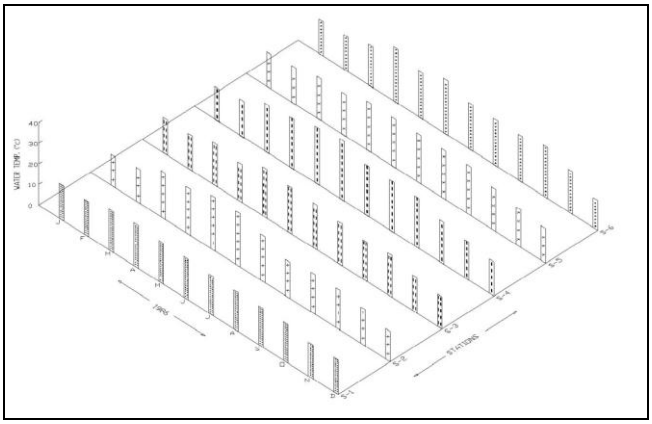


Fig. 2: Annual water temperature of water body at different stations

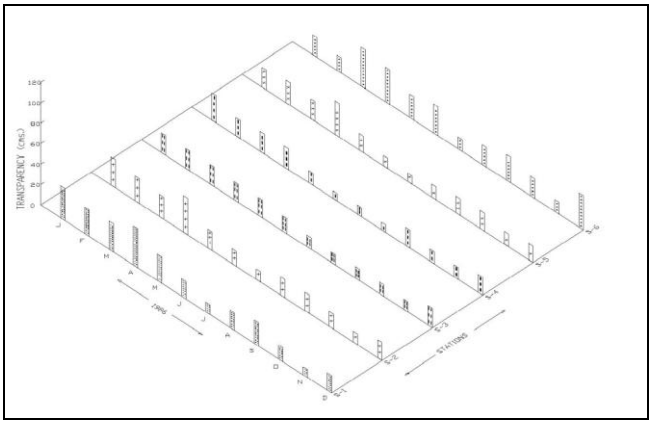
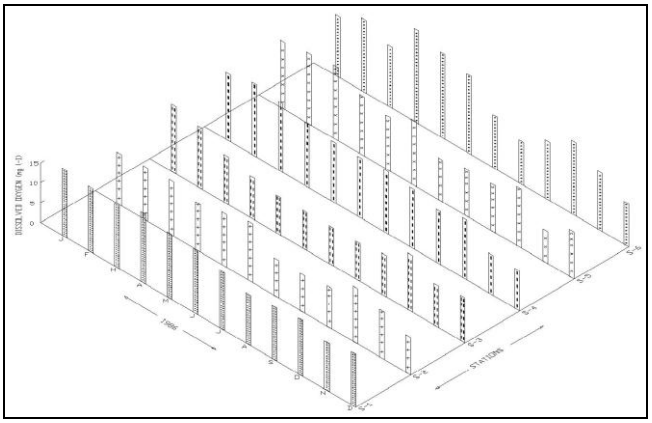


Fig. 3: Annual water transparency of water body at different stations



Fig, 4: Annual dissolved oxygen variation of water body at different stations

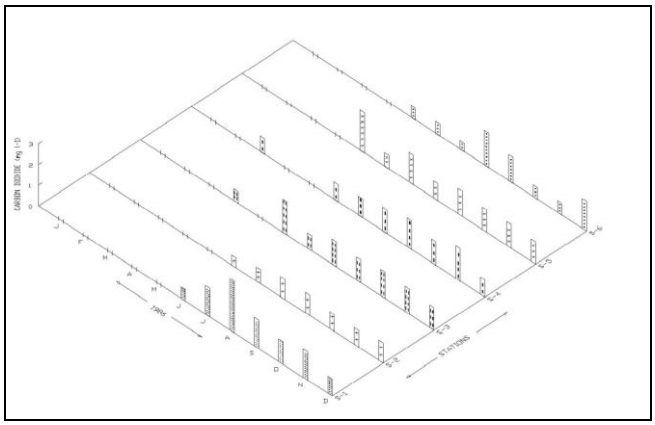


Fig. 5: Annual carbon dioxide variation of water body at different stations

The light and dark bottle method of measuring community metabolism by change in dissolved oxygen has been very valuable in measuring biological diversity in a water body. Biological productivity is a concept of organic synthesis potential which measures the ability of biological population as the bioresources present in the water body. Seasonal studies were done. High rate of productivity during summer was probably due to bright sunshine maintaining high temperature. The lower value of productivity during monsoon may be because of the increase in turbidity. Respiration rate was highest during winter; in present study this may be due to low temperature. Sreenivasan (1964) in Amravathy reservoir observed maximum production in April. Khan and Siddiqui (1971) also recorded high gross primary production value from March to May in pond Moat, Aligarh. Similar in Sathiar reservoir, Kannar and Jobs (1980) observed that production was high between April and July. From the present study it was evident that productivity rates increases from winter and reach at its peak in summer. Phytoplankton contributed much on the environmental factor as they affect the dynamics of the aquatic system. Numerical species diversity is the most reliable method to show relationship between species population and whole communities, often provide more reliable indicators than single species (Odum 1971).

Phytoplanktons were mostly represented by the group Chlorophyceae, Bacillariophyceae, Cyanophyceae and Euglenophyceae. In total 20 taxa were observed at this pond. Maximum were recorded during January, February, April, May, October and November; while minimum 12 taxa were recorded during June and July. According to Senthilkumar and Shivkumar (2008); the phytoplankton density was high during summer and low during the winter season.

Valecha (1985) identified 48 species in the lower lake of Bhopal. During the present study total plankton population was highest (28000 organisms /litre) in May and lowest (10600 organisms/litre) in July. No definite increasing and decreasing pattern was observed during study period. During the present study the group Chlorophyceae dominated throughout the year. According to Valecha (1985) the dominance of Chlorophyceac in Lower Lake, Bhopal was observed. According to Tas and Gonulol(2007), the shallow lake of Turkey has a high biodiversity due to species richness as they identified total 104 taxa of phytoplanktons in the shallow lake.

Zooplankton community is a major link in the energy transfer at secondary level; and being heterotrophic in nature plays a key role in the cycle of organic matter in the aquatic ecosystem. These organisms either directly or indirectly act as food for fishes and other fish food organisms. Zooplankton acts as indicator of trophic condition of the environment; as they are easier to identify and respond more quickly to environmental changes then the fishes. Moreover the environmental selection depending upon various physico-chemical and biological factors, not only restricts the number of species and their biomass but also triggers their seasonal polymorphism.

Zooplankton community belongs to three major groups i.e. Rotifer, Cladocera and Copepoda. Maximum density of Zooplankton (867 organisms/litre) was noted in March and minimum density of Zooplankton was recorded in June (247 organisms/litre). Chourasia and Adoni (1985) observed Zooplankton component of the Eagar Lake mainly consisting of the four major group i.e. Protozoa, Rotifer, Cledocera and Copepoda. Hawkins (1988) concluded that Zooplankton population consisted of Rotifiers, Cladocera and Copepoda. According to Wanganeo (2007) and Khan (2014); Zooplankton fauna or their association can be used as useful means for the assessment of water pollution.

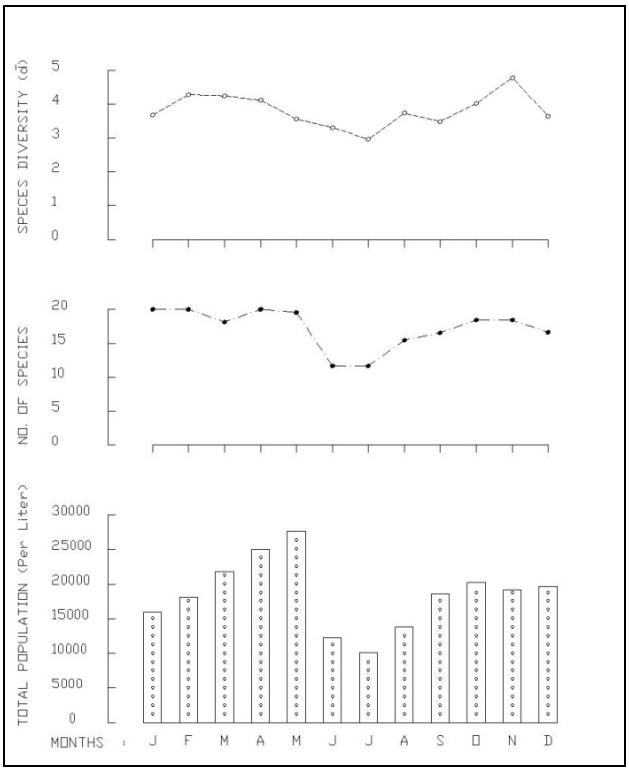


Fig. 6: Total Population, total Species & Species Diversity of Phytoplankton

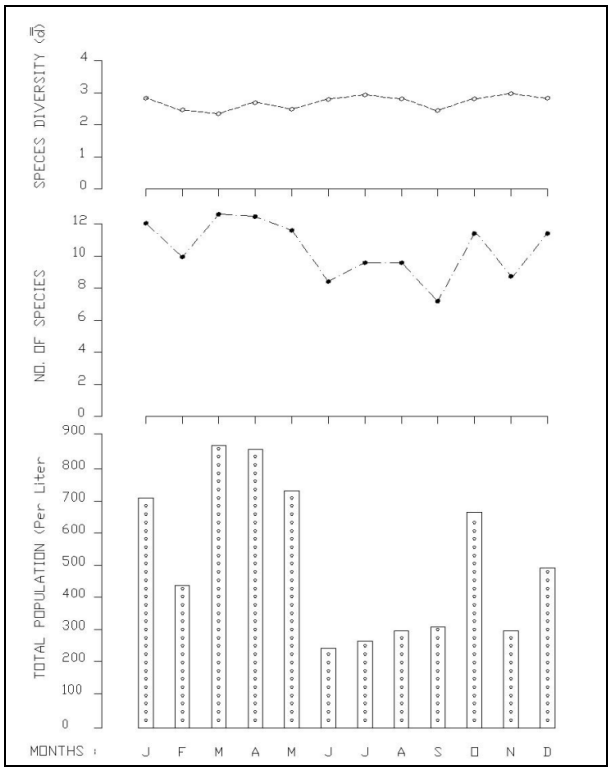


Fig. 7: Total Population, total Species & Species Diversity of Zooplankton

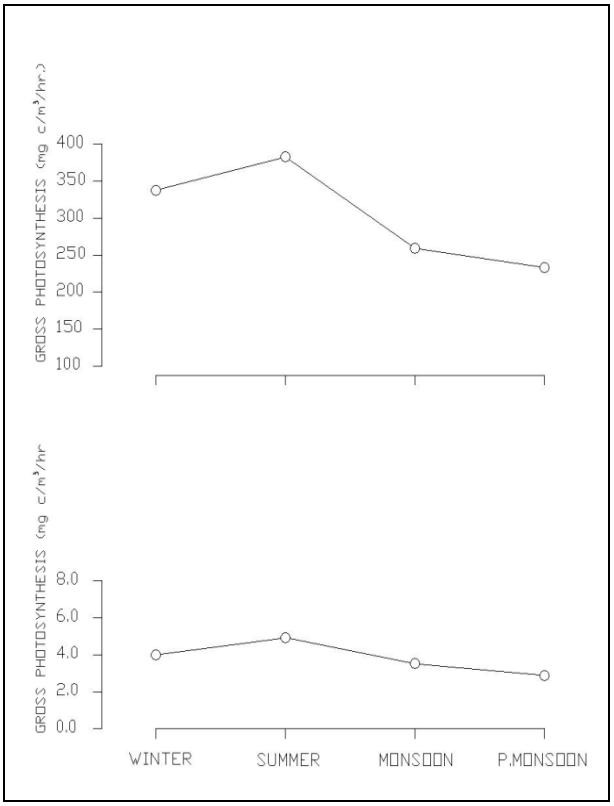


Fig. 8: Seasonal Variation in Primary Productivity, 1986

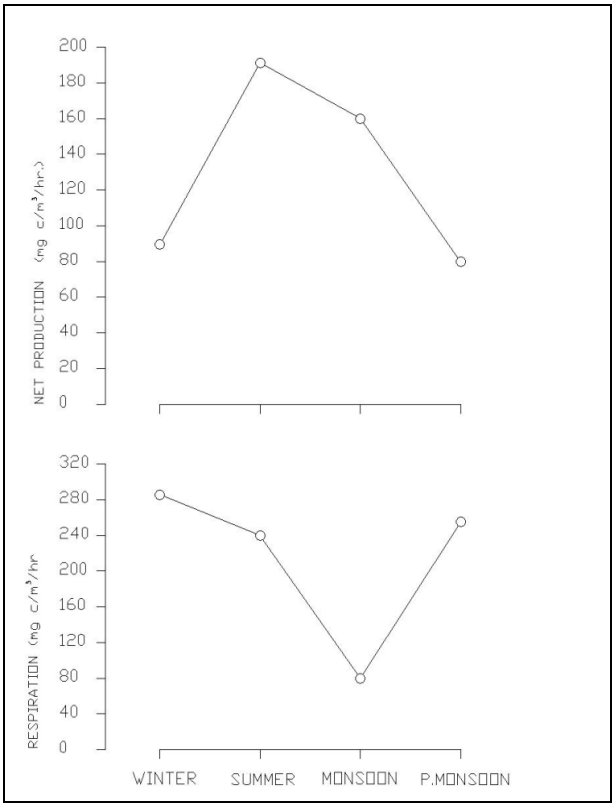


Fig. 9: Seasonal Variation in Primary Productivity, 1986

Aquatic macrophytes were observed especially in the form of various aquatic weeds. Lalman and Dixit(1986) reviewed the morphometry of lake and distribution of macrophytes of Tarairegion of North Eastern Uttar Pradesh. The macrophytes were collected from whole water body and classified according to their biological types. Total nine species of macrophytes were encountered.

The qualitative survey was done during present study. Total nine species were found in Jawahar Bal Udyan pond which were categorised into three forms i.e. emerged, submerged and free-floating. Singh and Rai (1984) observed hydrophytes in engineering college Lake Jabalpur. Joshi et al. (1987) noted the absence of both chara and nitella which may be considered to be an indicator of eutrophy. The ultimate aim of studying fishery bioresources of the pond was that fish forms a major part of the valuable edible material and also has a great economic value to the general public.

In the present study five families and nine species of fishes had been encountered throughout the period of investigation. Low production of fishes was associated with high turbidity condition. Jhigrar (1982) noted that fishes die at about 11pH. According to Singhai (1986) Zooplankton was useful food for fish growth while the phytoplankton had harmful effect on fishes. During the study period, pond was used as a stocking pond for fish production to increase the production as well as maintaining the biota of the water body.

CONCLUSION

Bioresources are beneficial as bioindicators which increases the productivity of water as water is a natural resource. With the increase in the nutrients, the number of phytoplankton also increases thereby increasing the primary productivity of water. This also increases the fish fauna of the water body.

REFERENCES

Adoni AD (1985) Workbook of Limnology. Pratibha Publications, Sagar.

Anderson RS (1970) Physical and Chemical Limnology of two mountain lakes in Benff National Park, *Alberta. J. Fish Res. Bd. Canada*. 20:233-249

Bhatnagar GP (1984) Limnology of lower Lake, Bhopal with reference to sewage pollution and eutrophication technical report Mat 1979-April 1982. On UNESCO MAN AND BIOSPHERE PROGRAMME Department of Limnology Bhopal University Bhopal MP. Bohre and Bhargava 1977.

Bohra OP and Bhargava SC (1977) Abiotic factors, Cholorophyll pigment and primary production in two lakes of Jodhpur. *Geobios*, 4: 215-216

Bourdean P and Threshow, M (1978) Ecosystem response to pollution IN: Principoles of Ecotoxicology. Ed GC Butler John Wiley and Sons 313-330.

Chourasia SK and Adoni AD(1987) Rotifiers as indicator of entrophication, perspectives in Hydrobiology, Vikram University Sec IV(28/147-149).

Hawkins PR (1988) The zooplankton of small tropical Reservoir (Soloman Dam, North Queensland). *Hydrobiologia*, 157:105-118. Singh and Rai (1984).

Hopkins CL (1971) The annual temperature regime of a small stream in New Zealand. *Hydrobiol*., 37(3&4): 397-408

Jhingran VG (1982)Fish and Fisheries of India. Hindustan publishing Corporation, India Delhi , pg-666

Joshi Gunwant, Adoni, AD and Vaishya A.K. (1987) Ecology of Sagar Lake perspectives in Hydrobiology. Vikram University, Ujjain (MP) India Section IV(29)(51-155)

Kannar and SV (1980) Diuranol seasonal and vertical study of primary production in Sathair Reservoir, *Hydrobiologai*, 70:171-178.

Khan AA and Siddiqui AQ (1971) Primary production in a tropical fish pond at Aligarh, India. *Hydrobiologia*, 37(3-4): 447-456

Lalman and Dixit AM (1986) Ecological exploration of aquatic bodies of Tarai region of North- eastern U.P. II. Morphometry of lakes and distribution of macrophytes. *J. Hydrobiol*. 8(5):17-23

Needham JG and Needham PR (1962) A guide to the study of fresh water biology. Holden Bay, San Francisco, U.S.A. pg-108.

Odum EP (1971) Fundamentals of Ecology. W.B. Saunders Co., Philadelphia.

Patil SG etal 1983 Ranital (Jabalpur) a sewage polluted water body as evidenced by chemical and biological indicator of pollution. J. Environ Biol.4(2):43-49

Pearsall WH (1921) Proc. Roy. Soc. B 92: 259-284

Senthilkumar and Shivkumar (2008) Studies on phytoplankton diversity in response to abiotic factors in Veeranam lake in the Cuddalore district of Tamil Nadu. *Journal of Environmental Biology,* 29(5) 747-752;

Singh DF and Rai MK (1984) Studies on ecology of Engineering College lake of Jabalpur. *J. Environ. Biol*. 5(3): 165-168.

Singhai Sadhana (1986) Hydrobiological and ecological studies of newly made Tawa reservoir at Ranipur. Ph.D. Thesis, Dr. H.S. Gour Univ., Sagar.

Sreenivasan A (1964) The limnology, primary production and fish production in a tropical pond. *Limnol. Oceanogr.*, 9: 391-396

Tas Beyhan and Arif Gonulol (2007) An ecologic and taxonomic study on phytoplankton of a shallow lake, *Turkey. J. Environ. Biol*., 28, 439-445.

Valecha V (1985) Ecology of phytoplankton of Lower Lake of Bhopal. PhD Thesis Bhopal University of Bhopal.

Vass KF and Sachlan M (1953) Limnological study on diurnal fluctuations in Indonesia. *Verch. Int. Ver. Limnol*., 12: 309-319

Wanganeo A (2007) Plankton: its uses for the benefit of mankind and its utility in water management. I.T. *Scholars Academic Journal of Biosciences* (SAJB)09: 43-50.).

Welch (1935) Limnology. N.Y. McGraw Hill, pg 538.

Welch (1952) Limnology,MC Grow Hill Book Co, New York. Pp273 Anderson 1970

Wetzel RG (2006) Limnology, 3rd Edn. Academic Press, New York.