

STUDIES ON MICROFLORA OF A FRESHWATER LAKE : AN ECOLOGICAL APPROACH

BRAJESH KUMAR TIWARI

**DEPARTMENT OF BOTANY
SCHOOL OF LIFE SCIENCES**

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Hill University

PROFESSOR R. R. MISHRA
M.Sc., Ph.D., F.N.A. Sc., F.N.I.E.
Dean of the School

DEPARTMENT OF BOTANY
SCHOOL OF LIFE SCIENCES
SHILLONG-793014

I certify that the thesis entitled "STUDIES ON MICROFLORA OF A FRESHWATER LAKE: AN ECOLOGICAL APPROACH" submitted by Shri Brajesh Kumar Tiwari, M.Sc. for the degree of Doctor of Philosophy of the North-Eastern Hill University, Shillong embodies the record of original investigation carried out by him under my supervision. He has been duly registered and the thesis presented is worthy of being considered for the award of the Ph.D. degree. This work has not been submitted for any degree of any other University.

Date: December 29, 1980
Place: Shillong.

R.R. Mishra
Signature of the
Supervisor.

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GENERAL INTRODUCTION

One of the most ubiquitous problems of freshwater bodies is their present rate of change in response to man made perturbations. Any management strategy to exploit these resources requires fundamental knowledge of the freshwater ecosystem structure and function. Achlorophyllous microorganisms play basic role in the transformation and cycling of various materials in a given ecosystem. Many of the trophic relations outlined in various models lay considerable emphasis on these tiny organisms as they play an important part in the ecosystem function. But very little information is available so far regarding the quantification of these organisms and their taxonomic composition is further less known.

Freshwater ecosystems comprise about 0.5% of the earth's surface having a volume of $2.84 \times 10^5 \text{ Km}^3$. Although their areal and volumetric extent is relatively small, freshwater bodies are some of the most productive systems on earth. Freshwater resources are least utilized for their productive capacities. Primary productivity estimations based on phytoplankton photosynthesis have received ample attention of limnologists throughout the world (Munawar et al 1972; Kalff, 1967; Vijayraghavan, 1971). The contribution of saprobes towards the productivity of aquatic ecosystems has received little attention (Sorokin and Kadota, 1972). Hynes (1972) emphasized that a major part of carbon in the aquatic ecosystems does not enter the

photosynthetic fixation by phytoplankton. This external source of carbon is available for the organisms of higher trophic levels. The allochthonous carbon passes through the same pathways as carbon fixed by the green cells and, therefore, should be considered as a part of the total production in understanding the metabolisms of aquatic ecosystems. The extraneous input of carbon is relatively more significant in the freshwater lakes surrounded by terrestrial vegetation and receiving litter and surface run-off waters from neighbouring areas. Further, saprobes are more important in the shallow and small water bodies where the allochthonous organic material remains in the direct contact of the epilimion water where the liberation of nutrients is faster due to constant availability of oxygen and is instantaneously available for the utilization by the primary producers. The importance of heterotrophic microbial populations in the functioning of lake ecosystems has been clearly demonstrated by Anderson and Dokulil (1977). They found that biological activity (production/biomass) in the bacteria is ten times higher than that of phytoplankton.

The primary production by bacteria is not much important in natural ecosystems because of the nonavailability of light and anaerobic conditions which are the prerequisites. The secondary production by C-heterotrophic bacteria and fungi is quite significant as 20-40 percent of the total organic nutrients are used by these organisms

(Rheinheimer, 1974). Apart from the above, these bacteria can also fix atmospheric CO_2 to the extent of 6 percent of their biomass production (Kusnetsov and Romanenko, 1966) and may thus contribute even more than the autotrophic production in many lakes receiving extraneous organic materials (Kusnetsov and Romanenko, 1966; Overbeck, 1971; 1972).

Besides being important decomposers and producers in aquatic habitats, many of the microbes are parasites of phytoplanktons / zooplanktons and fishes (Masters, 1976; Green, 1974; Scott and O'Bier, 1962). Many zoosporic Phycomycetes are known to regulate the population and activity of the planktonic communities by causing serious diseases (Redfield and Vincent, 1979). Bacteria and fungi also play important role in the sedimentation. Fungi with the help of their mycelia and many bacteria through slime production can bring about some degree of aggregation of the particles. Also they transform many organic and inorganic dissolved substances into particulate aggregates through their various metabolic activities.

The limnological studies have mainly emphasized the zoological and production biology aspects. The microbiology and biochemistry of natural waters have received little attention. Further, most of the studies on the microbiological aspects deal with the comparison of various water bodies differing in trophic status. Only a

few freshwater lakes such as Windermere and Esthwaite Waters (Jones 1971, 1972a, 1977) in England, Mazurian and Mikolajskie lakes in Poland (Godlewska-Lipowa, 1974a, b 1976a, b) and Mirror Lake in USA (Jordon and Likens, 1975) have been studied in detail for the structural and functional role of the heterotrophic microbial populations.

Data on the role of aquatic bacteria and fungi on the functioning of aquatic ecosystems in India are still virtually non-existent.

Present study deals with the structural and functional aspects of heterotrophic bacteria and fungi in a freshwater lake (Wards Lake) located in Shillong. This lake has been worked out for various microbiological characters with a view to understand the seasonal and spatial distribution of the microbes in the lake water and functions which they perform in the water body under study. To understand the structural aspect of the heterotrophic microbial community the population dynamics of heterotrophic bacteria and fungi has been studied for a period of two years. In order to assess the role of these organisms in the lake ecosystem two major approaches have been adopted. First estimation of the biological activity of these organisms using enzymatic and substrate utilization rate measurements and second the process of decomposition of extraneous plant litters in the lake to know the role of these organisms in decomposition.

Various parts of the investigation have been dealt

in separate chapters each having its own introduction, materials and methods, results and discussions. The relevant literature has also been reviewed in the introduction parts of the different chapters.