1. INTRODUCTION

Since time immemorial, nature and mankind has formed inseparable part of the support system. The fine elements (air, water, land, flora and fauna) of support system are invariably inter-connected, inter-dependent, co-evolved and co-adapted. Deterioration in one element inevitably affects the other four and if the degradation is for a short terminal the life support system has enough resistance, it repairs itself and reverts to its original state. However, if the deterioration continues at the same pace, the whole system is thrown out of gear (Goldman and Horne, 1983).

Water has aptly been called the ‘elixir of life’. Life originated in water and civilizations found roots on the banks of mighty lakes. Since times immemorial, man has been dependent on water bodies for transport, irrigation, drinking water and food primarily as fish. Traditionally, water symbolizes the depths of knowledge and fish signifies faith, eternity, creativity and happiness.

India is a nation of extraordinary diversity. It is area wise, the third largest country in Asia and the seventh largest and second most populous country on earth. It is the giant size of the Indian subcontinent that comprises the one-third size of Asia. It has unique geological history, highly diverse physiography, monsoon climate with extremes of temporal and spatial variability and high biotic diversity. India is thus endowed with equally diverse aquatic habitats. These aquatic habitats and their biota have been extensively investigated since the early 19th century, and interest has grown rapidly in recent years due to the rising demand for water and fish, and the need for managing the water quality. A comprehensive review of the country’s aquatic resources and the status of hydrobiological research (both pure and applied, including physical and chemical limnology) in India has, however, never been
attempted. Many human activities are associated with and dependent upon shallow waters and wetlands. In addition, maximum biodiversity within freshwater ecosystems occur where wetland and littoral habitat interface with pelagic regions (Wetzel, 1999). In many shallow lakes and ponds, the littoral structure and its productivity completely dominate the ecosystem, thereby enhancing the overall productivity and biodiversity. Several limnologists worldwide have highlighted the fact that the ecology of shallow lakes has attracted much less attention compared to deep stratified lakes (Reynolds et al., 1994; Welker and Walz, 1999; Wetzel, 1999). It is however, well known that shallow lakes differ markedly from deep stratified lakes, especially with respect to matter exchange (Lijklema, 1994) and plankton dynamics (Welker and Walz, 1999).

In the present era, global freshwater resources are shrinking in significant quantities. Qualitatively also, these are disappearing due to the settling of silt or decaying of living organisms at the bottom (Rao et al., 1990). Almost half of the world’s lakes are degraded, depleted and contaminated, mainly by human activities. The main causes are siltation, inflow of domestic sewage, agricultural run-off, discharge of industrial effluents, over-fishing, introduction of exotic species and habitat degradation from population growth. The knowledge of common flora and fauna living in a lake, their characteristic habitats and patterns of feeding along with the physical and chemical features of lake comes under the study of a lake.

Limnologists can play a significant role in solving water problems. focus on both quality as well as quantity of freshwater resources. Ecological studies provide information on the intricate interrelationships that exists between physico-chemical and biological factors in natural waters and which profoundly influence the quality of such waters.
The term limnology is derived from Greek words (*limne* = lake, *logy* = study) meaning study of physical phenomenon of lake or pond life. Earlier, it was considered to be a branch of Science which deals exclusively with lakes. Probably the word ‘limnology’ was first time used by Forel (1895, 1904) of Switzerland in his studies on a lake in Geneva. It was considered to be a distinct field of Science after his work. But as the time passed and knowledge of his surroundings slowly increased, he started observing freshwater phenomenon with more accuracy. So, the definition of limnology was modified and it included the study of inland water. Forel may be considered as the founder of modern limnology and the next one was the Forbes (1915) of United States of America. Inland water covers less than 2% of the earth surface and it includes all kinds of water whether running (lotic) or standing (lentic) and other physico-chemical compositions which are wholly or partially included within the land masses. Hence modern day limnology can be defined in several significant ways. It may be defined as the study of the structural and functional interrelationships of organisms of inland waters as they are affected by their dynamic, physical, chemical and biotic environments (Wetzel, 2001). It can also be defined as the study of both freshwater and saline inland water. So, it mainly focuses on the integration of physical, chemical and biological components of the inland aquatic ecosystem. Limnology can be considered as a synthetic science which is primarily of ecological existence, but now it is supposed to be composed of elements beyond the limits of biology. Thus it requires a multidisciplinary approach in which besides physical, chemical and biological studies, it lays stress on geology, geography, meteorology, hydrology, statistics, biochemistry, bacteriology, engineering and environmental studies, etc. Sometimes, it requires references from other sciences like protozoology, helminthology, entomology, acarology, ichthyology, herpetology, ornithology and mammalogy. Research in the field of limnology involves collection of...
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data and establishment of various experiments in order to understand the
complex interactions between aquatic life and its environment (Tiwari et
al., 1991). So, the recognition and formulation of a limnological problem
starts with the monitoring of various limnological parameters. While
studying limnology, three types of basic studies are undertaken –
physical, chemical and biological. Physical studies include
morphometry, bathymetry, temperature, conductivity, turbidity etc.
Chemical studies involve pH, dissolved oxygen, alkalinity, phosphates,
nitrate, total hardness, silicates, chloride, calcium, magnesium, etc. and
biological studies include study of plankton (phytoplankton and
zooplankton), nekton (fish, insects, crustaceans, etc.), benthos
(phytobenthos and zoobenthos) and microorganisms in dead organic
matter like decomposing bacteria and fungi. Basically, it is the science of
the interactions of the aquatic organisms with their environment. In such
an environment, these physical, chemical or biological parameters are
significant from the point of view of the living organisms. Some factors
are more significant while the others are less significant. The aquatic
organisms modify their environment in which they live by their
metabolic activity (Tiwari et al., 1991). So, in understanding limnology,
the integration of the knowledge about aquatic organisms, environmental
factors regulating their metabolism is very much required. The analysis
of biological communities and estimation of water quality are the most
significant contributors in limnology as it can be used as a good tool in
conservation and management practices of a particular water body.

A lake is a body of standing water occupying a basin and lacking
continuity with sea or is a low-lying part of the earth's surface in which
rainwater, surface water run-off, outflow from a river, and water from
other sources accumulates. It comes under the lentic environment where
water is standing but there may be a slight movement of water due to
wave action inside the lake. Lakes are dynamic ecosystem and are
estimated to occupy 8 million km² of the earth’s surface with about 5
millions km² in the tropics and subtropics. The major proportion is made up of bogs (30%), fens (26%), swamps (20%) and flood plains (15%). This estimation was compared with the area that existed in the 19th century and it was found that around 50% of the world wetlands have disappeared during the last century (UNEP, 1994). India has a large number of lakes spread all over the country, from Kashmir to Kerala and from Rajasthan to Assam.

Phytoplankton plays an important role in the biosynthesis of organic matter in an aquatic ecosystem, which directly or indirectly serves for all living organisms of a water body as food and constitutes an important link in the food chain of fishes. Thus, the information of plankton population in relation to hydrobiological factors is of considerable importance. The works on plankton in relation to water quality in northern Himalayan lakes made by various workers are worth mentioning – high altitude lakes (Zutshi et al., 1972; Zutshi, 1991), Kashmir lakes (Zutshi, 1989; Kaul and Handoo, 1989, 1993), lakes of Himalayan region (Zutshi, 1985), Lake Wular (Trisal et al., 1994) and Dal Lake, Srinagar (Kundangar and Sarwar, 1997). These publications cover all aspects of water chemistry and biology, as well as conservation and management (Ando, 1996).

For long-term conservation planning of lakes, spatial data and information are required for any intervention. Wetlands ecosystem in India constitutes an integral part of cultural and biodiversity landscape. However, this information pertains to wetlands above 56 ha in size. Previous research works on wetland conservation in the country has shown conclusively that micro wetlands or satellite wetlands around a bigger wetland act as a constellation of habitat mosaic for resident and migratory waterfowl. This is of special importance for inland wetland habitats in the flyways of migratory birds in the Indo-Gangetic plains and in Deccan Peninsula. Often, the size of these micro wetlands is much
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smaller than 50 ha. Therefore, there is a great need to map wetlands of smaller size less than 50 ha. Spatial information on wetland resources is critical and urgently needed for an effective conservation of the important ecosystem. For a country like India, with its vast biological and cultural diversity, a comprehensive use of remote sensing, geographic information system (GIS) and other related technologies will be of great use in conservation. Classifying and mapping wetlands based on geomorphology, water quality and other biological attributes can lead to qualitative assessment. Results obtained can be used in planning, inventorying and monitoring wetlands in the country.

The major contributions to the development of tropical limnology have been made largely from some African and neotropical countries. In contrast, limnological information available from the third world countries, especially India is fragmentary and as such their contribution to the advancement of tropical limnology is limited.

A review of available literature reveals that the bulk of limnological information is derived from hydrologically stable and permanent freshwater of northern temperate zone. In contrast, Inland waters of tropical zone have received little attention. Consequently our understanding of the characteristic tropical habitat such as seasonally flooding rivers, lakes and large temporary bodies of freshwater that do not occur in temperate zone remains poor.

Himachal Pradesh has enormous aquatic resources in terms of upland rivers, streams, high and low altitude lakes, man-made lakes, reservoirs in the Himalayan region and Western Ghats viz., Suraj Tal, Chandra Tal, Prashar Lake, Manimahesh Lake, Gobindsagar Reservoir, Mahakali Lake, Pong Dam, Dal Lake, Kuntbhyog Lake and Rewalsar Lake which are rich in biodiversity including large population of both indigenous and exotic, cultivable and non-cultivable fish species. Due to increasing demand of water, wetlands are under severe pressure, thus
threatening the biodiversity therein. In the absence of information about their biodiversity regarding distribution, population dynamics and species composition, a successful plan for their conservation and management could never be framed. It is in this direction, present study has been planned and carried out on the three lakes viz., Rewalsar, Kuntbhyog and Prashar in district Mandi of Himachal Pradesh. These are geologically oldest lakes and there are possibilities of supporting a diverse aquatic life (phytoplankton, zooplankton, fishes and benthos). Till now comprehensive hydrobiological studies have not been conducted on these lakes. It is proposed to undertake these studies to evaluate the present status of physico-chemical characteristics, phytoplankton, zooplankton, nekton, productivity and trophic status of these lakes. The main objectives of present investigation are to study:

- physico-chemical characteristics of the lakes,
- the biotic diversity in the lakes,
- seasonal variations in hydrobiological factors,
- interrelationship between the different aquatic communities and the abiotic factors,
- causes and suggest measures to avoid mass mortality of the fishes from time to time,
- productivity of these lakes and determination of their trophic status,
- water quality of these lakes for various purposes,
- diurnal variation in various hydrobiological factors of these lakes, and
- bioindicators of eutrophication.