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A Study of the Limno-Chemistry and Plankton Diversity of the Lake Water

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Abstract - A limnology study of the limno-chemistry and plankton diversity of a lake can provide valuable information about the lake's health and ecological balance. Limno-chemistry refers to the chemical characteristics of the lake water, while plankton diversity refers to the variety of microscopic organisms that live in the water. The first step in conducting such a study would be to collect water samples from various points in the lake, ensuring that the samples are representative of the entire lake. These samples can then be analyzed for a variety of limno-chemical parameters, including pH, dissolved oxygen levels, nutrient levels (such as nitrogen and phosphorus), and heavy metal concentrations.

Keyword - limnology, lake

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INTRODUCTION

Living organisms need fresh water as one of their most essential constituents. There has been an increase in the demand for water in the nation as a result of rapid population expansion, urbanization, and industrialization. Earth's seas hold 97% of all water on Earth; glaciers and ice sheets hold only 2%; lakes/ponds and rivers hold just 0.099%; groundwater holds the rest. A mere 0.1% of the freshwater on Earth is used by living beings. Quality control and conservation are necessary because of this. Water is a need for human survival, health, and well-being. Our consumption is expected to rise by 40% over the next two decades. Since most of these water sources have already been seized, there is little left for future generations to benefit from (Edwin, 1997). As long as there is a water supply, we have no choice but to save and save it. The management of water resources has had a significant influence in human development. Today, water is seen as a finite and restricted resource, and its usage is viewed as a major issue. As a result of population increase and urbanization, industrialization, and agricultural advancements during the last century or so, things have changed dramatically. Water shortage is currently an issue in many developing nations, but it is especially acute in those countries. In the absence of water, life as we know it would be impossible on our planet. There is a very limited supply of fresh water. Our lives would not be possible without water. Because of the fast growth in human population and the accompanying processes of industrialization and urbanization, there is a rising need for water across the world. Earth's health and well-being depend on the availability of high-quality drinking water. (Sharma, K.K. and Kour, S.et.al (2015))One of the biggest problems in poor nations is a lack of access to clean water. More than 783 million people in the globe (11 percent of the world's population) do not have access to clean water, 84 percent of whom live in rural areas, according to the Joint Monitoring Programme (JMP) for Water Supply and Sanitation (WHO and UNICEF). In order to sustain life on Earth, water is one of the most crucial renewable natural resources. Because of India's growing population and overall growth, the country's water consumption is rising rapidly. Due to the country's fast population growth and developing economy, water will become more limited in the next decade.

Zooplanktons play a vital role in aquatic food web because they are food for fish and invertebrates predators & they graze heavily on algae, bacteria, protozoans and other invertebrates. water quality will be assessed through the following parameters during the course o study-1-Temperaturein air 2-Temperature in water(24^{O}C) 3-pH(ISI,1991)(6.5-8.5) 4-condactivity (WHO,1984) 5-Total dissolved solids (ICMR,1975,wicox,1955) 500mg/L 6-Transparency 7-Alkalinity 8-Choloride 9-Hardness 10-Dissolved oxygen 11-Free carbon di oxide 12- ortho-Phosphate 13-Sulphate 14- Nitrite-Nitrate 15- Silicate.

Table 1: World's Water Resources

Resources	Volume(W),Thousands of km^3	Annual Rate Removal (Q) (in Thousands of km^3) and process of removal)		Removal period (T), (T=W/Q)
Total water on earth	1,460,000	520	Evaporation	2,800 years
Total water in the Ocean	1,370,000	449	Evaporation	3,100 years
		37	Difference between precipitation and evaporation	37,000 years
Free gravitational water in the earth's crust (to a depth of 5 km)	60,000	13	Underground runoff	4,600 years
Amount of water present in the zone of active water exchange	4,000	13	Underground runoff	300 years
Lakes	750		-------	16,000 years
Glaciers & permanent snow	29,000	1.8	Run off	
Soil & subsoil moisture	65	85	Evaporation & underground run off	
Atmospheric moisture	14	520	Precipitation	9 days
River Waters	1.2	36.3	Run off	12(20) days
Source: UNESCO				

WATER

Water has a unique set of characteristics. At varying temperatures, it is found in all three states: solid, liquid, and gaseous. Most soluble solutes dissolve quickly in water, making it the universal solvent. For many metabolic and biological processes, water is an essential source of inorganic nutrients. Furthermore, water's molecular and cellular characteristics influence many aspects of both the biotic and abiotic components that make up our planet. It is the study of life and its activities in water that is referred to as hydrobiology. Earth's aquatic environment is one of the most important. Water plays a critical part in the cycling of the many inorganic and organic chemicals necessary to perform and support life on Earth. Water is a liquid. An aquatic ecosystem is the smallest unit of aquatic environment.

AQUATIC ECOSYSTEM

There are biotic and abiotic components in an aquatic ecosystem that interact to influence each other's qualities and are essential to the survival of life. Lakes and rivers are the most frequent examples, but it also includes places like lands that are periodically submerged under water. Even aquatic habitats that seem to be hostile may harbour life.

FRESH WATER ECOSYSTEM

A pond, lake, marsh, swamp, or other sort of stagnant or lentic water is one example of a fresh water environment; a river, stream, or spring is an example of a lotic water ecosystem. In the years 2009-10, P.D. Sharma A wide range of physical, chemical, and biological properties characterize lentic habitats. The physical, chemical, and biological characteristics of water may be used to determine its quality (especially plankton). The quality of water is deteriorating as a result of a large population and human indifference. The science of limnology (the study of lakes and other fresh water systems) is crucial in helping to make informed decisions about issues such as pollution management, fish and aquaculture, and other such issues. Studies in limnology give a fundamental grasp of nature and assist to monitor the environment.(Edmondson, W.T. 1959.) Freshwater ecosystems' biotic and abiotic components may be observed for their diurnal, monthly, and seasonal fluctuations as well as their potential link to one another.

In the long run, the primary production of aquatic ecosystems is reduced due to changes in water quality. Because water chemistry exposes a lot about the aquatic ecosystem's metabolism and explains the general hydrobiological interrelationship, it is impossible to completely grasp the biological phenomena without water chemistry expertise. Study after study on various lake systems leads to the creation of broad conceptions about the operation of ponds and lakes and their response to environmental changes.

1. Pond

Land-bound ponds may be filled with water from springs or rivers or from local precipitation (Source:USGS). The physical, chemical, and biological properties of talavs are strongly influenced by the structure of the organism. Ponds may be classed as either oligotrophic or eutrophic depending on a range of factors, such as their creation and chemical or biological state. While some lakes are formed naturally by volcanoes and geological forces, others are generated artificially by reservoirs or basin excavation.

2. Factors Affecting Pond Ecosystem

Climate, ediphic variables, human interaction, and the talav's own qualities will all affect the health of a talav. Help limnologists to better understand pond or lake issues and to forecast the behavior of a pond or lake will come from continually developing information, data and expertise. To conduct a thorough analysis of a pond, it is critical to obtain information about a specific talav. An ecosystem's temperature, geological substrate and soil in the basin, physiography, and the shape of the pond are all critical components.

3. Common Environmental Problems in Pond and its Probable Causes

A talav is naturally enriched with nutrients, organic materials, and silt via the process of eutrophication. Ponds are susceptible to a wide range of physical, chemical, and biological issues that may have a negative impact on their recreational value, water quality, and wildlife habitat. In addition to eutrophication the most typical concerns include algal blooms (extensive and fast development planktonic algae owing to increasing nutrient levels), turbidity, growth of hydrophytes, Oxygen depletion, changes in water level, etc. The Lake Ecosystem's water quality is of the utmost importance.

ZONATION OF LAKES

According to the amount of light, the lake water may be separated into three primary zones:

1. Euphotic zone: Euphotic zone is the term used to describe the whole water column that is lit to the point where photosynthesis may occur. For photosynthetic activity, this zone extends down to around 1 per cent of the surface's light intensity. This is known as the light compensation level, when respiratory loss balances out gains from photosynthetic activity.

It is subdivided horizontally into two subzones

a) Littoral subzone: Rooted plants and benthic algae are the primary inhabitants of this zone, which is also home to a variety of different phytoplankton.

- **Eulittoral region:** Waves are most powerful when they hit a point between high and low water marks at the ocean's edge.
- **Sublittoral region:** From the lower limit of wave movement to the lower limit of rooted vegetation or euphotic depth.

b) Limnetic subzone: Euphotic zone in open sea distant from coast. Phytoplankton and no benthic vegetation are found in this area. Small, shallow ponds may not have this zone.

2. Dysphotic zone: Immediately below the euphotic zone, there is a small, faint light zone with intensities below 1% of surface area. Respiration in this area surpasses the rate of photosynthesis by a wide margin.

3. Aphotic zone or Profundal zone: Aphotic zone or profoundly zone refers to the total depth of water where light cannot penetrate. There are no photosynthetic plants in this area; therefore any prolonged presence of phytoplankton's here might be hazardous to them. Organic detritus and vast numbers of aquatic bacteria and fungus on the bottom sediment breakdown organic detritus, releasing inorganic nutrients that primary producers may utilize to grow their food

Therefore lakes are generally classified based on the productivity into five:

a) Oligotrophic Lakes

b) Eutrophic Lakes

c) Mesotrophic Lakes

d) Hypereutrophic lakes

e) Dystrophic Lakes

a) Oligotrophic Lakes: Because of the low concentrations of nutrients, they have poor primary production and biomass (nitrogen and phosphorous). In the water column, they tend to be oxygen-saturated. For the most part, the shallow water and vegetation surrounding the edge of these lakes is limited to a few feet. It's easy to see through the water here. Lake water's productivity is usually lower than that of river water. Phytoplankton blooms are very uncommon in oligotrophic seas, where species diversity is greater.

b) Eutrophic Lakes: In addition to high nutrient content and biomass yield, they exhibit minimal transparency. During the summer, oxygen concentrations in the hypolimnion may fall to dangerously low levels (as low as 1 mg/L). With moderate slopes and a large literal zone with more marsh flora, these lakes are shallow (typically less than 18 metres deep). In order to decrease light penetration, phytoplankton growth and the presence of more suspended particles have made the water more turbid. This means that phytoplankton production is concentrated in the upper oceans, where it is most abundant. Water's colour may range from green to yellow to brownish green.

c) Mesotrophic Lakes: These lakes are in the process of transitioning from oligotrophic to eutrophic status. During summer stratification, the oxygen concentration in the hypolimnion decreases somewhat. Nutrient content and productivity place them somewhere in the middle of the spectrum between oligotrophic and eutrophic lakes. Grating is more common in these lakes than eutrophic lakes.

d) Hypereutrophic lakes: The most eutrophic lakes are those with high nutrient contents at the other end of the scale. In hypereutrophic lakes, oxygen depletion is a serious problem.

e) Dystrophic Lakes: These lakes (humic and fulvic acids) include organic components produced from external inputs from the watershed, they may be found at any depth of the water column.

Stratification of lakes:

a) Epilimnon:

Wind and waves circulate across a body of water with a consistent temperature (typically warm). A lake's surface size, sunlight, air temperature, and lateral circulation and movement of the surface water all affect the thickness of its epilimnion, which may be very thick or thin. However, in huge lakes, it may reach depths of up to 30 meters.

b) Hypolimnion:

The deeper high density water, This is much colder, although in tropical lakes the temperature difference between surface and bottom water may be only 2- 3 0C.

c) Metalimnion:

An area with rather steep gradation is known as the metalimnion. The gradient is more popularly known as the thermocline than by the scientific term metalimnion.

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ZOOPLANKTON

Marine and freshwater planktonic creatures known as "zooplankton" (from the Greek "zoion" meaning animals and "plankton" meaning "wanderer") float with the water currents. They are plankton-eating microorganisms. Tiny protozoans and metazoans are found in the zooplankton community (e.g. Copepods and some Jelly fish). However, meroplankton is a distinct group of species that are only planktonic for a short period of time before transitioning to either the nekton or the ocean floor. Meroplankton includes the larvae of sea urchins, starfish, crabs, marine worms, and the majority of fishes in the water.(Superna, G. and Sreenivasa, S. (march2014)) Zooplankton is an integral part of the aquatic food chain and plays a crucial role in sustaining the environment. A broad range of perturbations, including high concentrations of nutrient loading, are responded to by these communities, which include zooplankton and play an important part in aquatic food chains.

Zooplankton's ecological importance: Zooplankton play a critical role in the food chain, nutrient recycling, and energy flow in aquatic ecosystems, and are one of the most significant biotic components. Predation and light control the abundance of many omnivore and carnivorous fish that rely on zooplankton as their primary source of food. Since phytoplankton is smaller and more difficult to detect, zooplankton are the best indication of tropical condition. Zooplankton supplies fish with the protein they need to grow rapidly and build their many organs. When it comes to changes in water quality, it's the zooplankton that is the most sensitive to a broad range of factors like nutrient loading, acidity and pollutants; sediment inputs; and changes in the pH of the water. Zooplankton populations have a relatively weak locomotive strength. Zooplanktons are an essential part of aquatic food chains because they provide a variety of nutrients. Animal food like zooplankton, which provides amino acids, fatty acids, vitamins and minerals, is critical to the fish food chain.

CONCLUSION

Zooplanktons play a vital role in aquatic food web because they are food for fish and invertebrates predators & they graze heavily on algae, bacteria, protozoans and other invertebrates. Water has a unique set of characteristics. At varying temperatures, it is found in all three states: solid, liquid, and gaseous. Most soluble solutes dissolve quickly in water, making it the universal solvent. The catchment area of the lakes is dominated by pastures and grazing takes place in this area during summer which affects the nutrients of the lakes to some extent. Due to the dominance of Bacillariophyceae in phytoplankton, more in-depth studies will be needed to reach some clear conclusions on the diversity and productivity of such lakes. We anticipate that increased grazing activity and renewed tourist attraction to these lakes may lead to deterioration of water quality, which needs to be addressed by the concerned agencies at an early stage.

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