A Comparative Study on the Effect of Organic Matter and pH on The Microbial Diversity in the Different Stations of Marlimund Lake, Ooty, The Nilgiris.

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Abstract: The present study was aimed to investigate the organic matter, pH effect on microbial diversity throughout the year Marlimund lake, Marlimund, Ooty, Nilgiris is an in the Udhagamandalam City in Tamil Nadu State, India. Microorganisms are involved in a variety of biogeochemical processes in natural environments. The dissolved organic matter is primarily composed of soluble portions of the fresh plant and animal residues. The particulate organic matter is partially resistant to microbial decomposition and serves as an important long-term supply of nutrients. Marlimund Reservoir is an important reservoir of water and a typical eutrophic freshwater lake. From the lake, soil samples were collected on a monthly basis, analyzed and recorded. The results were shown organic matter is directly proportioned to microbial diversity. And shows that the analyzed reservoir four Stations was influenced by the bacterial community, pH, and organic matter content, whereas comparatively little change was observed among IV stations in stratified conditions.

Key words: Marlimund lake, Organic matter, pH, Monthly variations and Microbial diversity.

1. INTRODUCTION:

Aquatic ecosystems are dynamics and complex ecosystems that can share physical characteristics like sedimentation-resuspension, gas balance, water circulation, dilution, chemical characteristics like pH, organic matter decomposition and ecological characteristics like food web structure, prey-predator relationship with other aquatic ecosystems. In an aquatic ecosystem individual lakes are often chemically and physically distinct, even within the same geographic region [6]. There is a variety of organisms like flora (plant and bacteria) and fauna lives in water. Prokaryotes are among the most important contributors to the revolution of complex organic compounds and minerals in freshwater sediments [18, 22].

The important factors like pH and Organic matter, determining bacterial community composition in water and soil [2]. The organic fraction of the sediment is mainly of terrestrial origin shows the content of organic matter in the sediment is the highest level in areas with highest Carbon and Nitrogen ratio. The quantities of organic matter from simple nutrient elements Carbon, Nitrogen and Phosphors with repercussion on food chains and the quality of the water [14]. Biotic and abiotic factors regulate temporal and spatial shifts of microbial communities as well as organic matter in lakes is prone to extensive chemical transformations during and after sedimentation in aquatic environments [9]. These processes are mediated by heterotrophic bacteria. Microbial processes in sediments exert widespread geochemical and ecological effects [11]. Mineralization of the organic matter by Microbial and photochemical contributes to the flux of greenhouse gases from the lakes to the atmosphere [12]. Dissolved Organic Carbon and Dissolved Organic Matter have been found to shape microbial community composition depending upon carbon source and concentration [6]. When organic residues decompose, organic carbon and nutrients are either released for plant uptake or transferred to a more stable Soil Organic Matter pool.

Microorganisms are involved in a variety of biogeochemical processes in natural environments [21].This process produces carbon dioxide through microbial respiration and chemical oxidation, which is eventually released into the air. In freshwater Phosphorus (P) is generally considered to be the limiting nutrient for plant growth with small quantities occurring naturally mainly from geological sources. Plants were used nitrates is the primary form of nitrogen as a nutrient to stimulate growth. Excessive amounts of nitrogen may result in phytoplankton or macrophyte proliferations. pH is the measurement of the hydrogen-ion concentration in the water. A pH below 7 is acidic and a pH above 7 to 14 is basic. It is a measure of the soil, water together with its dissolved substances acidity and alkalinity, on a scale from 0 to 14. pH varies depending on the geology of the river catchment, on river flow, and on wastewater discharges, but is generally in the range 6 – 9. It can also be influenced by biological processes, chiefly carbon dioxide uptake by plants during photosynthesis. Microbial communities can drive the recycling of nutrients and regulate the water quality In the freshwater ecosystem [4, 15]. In Aquatic system shown as increasing temperatures tend to result in increasing C : P and N : P of bacterial biomass and that some of these changes are driven by changes in community composition bacterial growth efficiency[16]. The aim of the study was to investigate the seasonal composition of the organic matter, pH and microbial population in the different Stations of Marlimund Lake, Marlimund, Ooty.

STUDY AREA:

The present reports the results of one consecutive year of study February 2016 to February 2017 conducted at different Stations on the Marlimund lake as shown in the location map of the study area: Marlimund Lake is situated in Udhagamandalam, The Nilgiris in Tamil Nadu State, India. Marlimund Lake has Latitude: 11°25'49.44", Longitude: 76°41'49.92" length of 1.61 kilometres and 2209 meters. Above Sea level.

Image: 1India Marlimund lake from Google Maps. Image: 2 Marlimund lake Satellite Image.

Image1 and 2 satellite image of Marlimund lake: Map of India showing the experimental area (Marlimund lake) in this work.

2. MATERIALS & METHOD

2.1 Sampling and analysis of Sediments

Sediment samples were collected every month using Ekman dredge from the water Bodies. Ekman's dredge is commonly used and it suffices for surface layers.

Handling, Transport and storage.

Soil and sediment samples are collected in clean polythene bags and transported to the laboratory as early as possible. pH was analyzed immediately. For organic matter, it's finely ground and a smaller mesh of 0.5mm mesh is used. The soil samples collected from four stations of the reservoir during the study period, February 2016 to February 2017, were used for analysis by following the standard methodology of APHA (1998) (Table 1).

Table 1: Methods adopted for analysis of sediment characteristics.

S.No	Parameters	Method/Instrument
1	pH	pH meter (Hanna Pen type) pH ep® made in Portugal
2	Organic Matter	Organic Matter Walkley and Black method

2.2. Identification of Soil pH: Sample pH is affected by contaminated water, by microbial activity if samples are allowed to sit for several hours before determining pH. (Hanna Instruments. Manual HI8417-HI8519-HI8520-HI8521) the pH is determined by standard protocol using pH meter [3]

2.3. Microbial population calculation: The Microbial population all four station cumulative soil samples and analyzed by serial dilution agar Plate count method and total number of bacterial population were calculated.

The microbial diversity of four different stations was screened by serial dilution agar plating method. Serial dilutions of the sample were prepared up to 10-5 by adding 1 ml water sample to 9 ml sterile distilled water. An amount consisting of 1 ml of each dilution was transferred aseptically onto duplicate sterile Petri dishes and approximately 18-20 ml of molten agar was added into the plate. The sample and agar were mixed thoroughly by rotating the plates several times. The plates were allowed to set and inverted, then the plate were incubated at 37°C for 24-48 hours. Colony counts were made from plates by colony counter and expressed as colony forming units cfu.ml of the sample [17].

The formula for calculation of number of bacteria per milliliter

$$\frac{n}{s \times d} = c$$

c – concentration, cfu/mL

n – number of colonies,
d – dilution blank factor
s – volume transferred to plate

2.4. ORGANIC MATTER ESTIMATION

The Walkley Black Method used for determining thesoil organic matter using volume of acidic dichromate solution reacting with a determined amount of soil in order to oxidize the organic matter. 1.0 g of lake soil into a 250-mL flask. To standardize the Ferrous Sulfate solution titrated the two blank samples (no soil) before proceeding with any unknown samples. Pipette 10.0 mL of the Potassium dichromate solution into each flask containing unknown soil and mix by carefully rotating the flask to wet all of the soil. Under a fume hood, carefully add 20 mL of concentrated Sulfuric Acid to each flask and mix gently and allow the flask for 5 min under the fume hood make up to the final volume is approximately 125-mL. Add 5 or 6 drops of Phenanthroline complex and immediately titrate with the Ferrous Sulfate solution.The solution will take on a green color that will change abruptly to reddish-brown when the endpoint of the titration is reached. [10,13, 20]
The organic matter calculated by using the formula.

$(1 - S / B) \times 10 \times 0.68$ = organic matter (%) of sample

S = Volume of Ferrous Sulfate solution required to titrate the sample, in mL.
B = Average Volume of Ferrous Sulfate solution required to titrate the two blanks, in ml.
10 = conversion factor for units.
0.68 = a factor derived from the conversion of % organic carbon to % organic matter

3. RESULTS AND DISCUSSION:

In Asia, freshwater, an essential element for all forms of life is a crucial resource. The withdrawal of freshwater from rivers, lakes, and underground reservoirs for human consumption has increased. This carries serious consequences to human health, terrestrial and aquatic ecosystems.

3.1 pH and Organic matter:

Lake dynamics are influenced by pH directly affecting the physiology of aquatic organisms. For the optimal growth and survival of Aquatic organisms needs the pH of their water body to be within a certain range [7]. The need for criteria in establishing water-quality standards are critical to the conservation of aquatic life [5]. Natural pH in the range between 6 to 8 in most freshwater lakes, streams, and ponds and acid deposition has many harmful ecological effects when the pH of most aquatic systems falls below 6 and especially below 5. Because of low pH can cause the release of toxic elements and compounds from sediments into the water [8]. A critical low pH range 5 to 6 the survival of limnetic organisms is significantly reduced [19]. The average pH values from four different Station shows pH ranges in Station-IV (6.4), followed by Station –III (6.39), Station –I (6.07), Station –II (5.96). Month wise pH was shown in table 2, from four different Stations on Marlimund Lake.

Organic matter is the decomposed and partially decomposed remains of plants and animals in the soil. Organic Matter is vital because it contains nutrients and maintains the vast population of microscopic organisms in the soil. These microbes are the key to fertility and have a beneficial effect both before and after death. The overall analysis of organic matter from four different Station shows the more percentage in station-IV (55.42), followed by Station –III (35.32), Station –I (28.44), Station –II (20.79). Month wise percentage of Organic matter was shown table 2, from four different Stations of Marlimund Lake.

Table 2: Month wise percentage of Organic matter and pH ranges from four Stations.

Sl. No.	Month	Station I		Station II		Station III		Station IV	
		Organic matter	pH	Organic matter	pH	Organic matter	pH	Organic matter	pH
1	Feb-16	2.00909	5.84	0.38491	6.49	1.319403	6.98	6.191045	5.71
2	Mar-16	2.62727	6.42	6.03019	6.23	3.146269	6.49	4.567164	6.45
3	Apr-16	2.31818	5.62	0.89811	5.79	2.537313	5.92	4.770149	6.13
4	May-16	3.70909	5.21	4.23396	5.62	4.364179	6.38	5.176119	5.71
5	Jun-16	2.93636	5.83	1.15472	5.81	3.958209	6.27	5.785075	5.68
6	Jul-16	3.09091	5.49	3.97736	5.96	1.725373	6.59	5.379104	5.83
7	Aug-16	2.47273	5.87	0.1283	5.26	3.146269	6.16	0.91343	5.91
8	Sep-16	1.08182	5.91	0.64151	6.14	2.334328	6.09	4.567164	6.06
9	Oct-16	0.46364	6.52	1.15472	5.31	2.740299	5.68	5.176119	6.58
10	Nov-16	3.09091	7.63	0.1283	5.49	4.770149	6.74	5.98806	7.81

11	Dec-16	2.93636	5.71	1.41132	6.19	3.958209	6.49	4.973134	7.14
12	Jan-17	2.62727	7.59	1.15472	6.86	1.319403	6.15	3.755224	7.31
13	Feb-17	1.9206	5.26	0. 86493	6.28	1.01296	7.19	5.01408	6.96

3.2 Microbial population: Reservoirs, like freshwater lakes, provide favorable living conditions for a variety of organisms like [8]. physicochemical and biological processes support the diversity of microorganisms in lake profiles providing suitable habitat that enhance their metabolic activities [1]. Freshwater ecosystem Sediments are a major component with many complex interactions with the aquatic system. The microorganisms living in the sediment likely play a key role in the transformation of organic matter in the cycle of nutrients and influenced by the surrounding environment [8]. The overall microbial population from four Stations were shown with pH and Organic matter is directly proportional to the Microbial population. The microbial population of Station-IV (45.6), Station –III (29.52), Station –I (25.08), Station –II (22.76) Cfu/ml. Month wise results were analyzed and tabulated in table 2. The average values and percentage of Bacterial population, Organic matter and pH ranges from all IV stations were shown in Image 3 and Image 4.

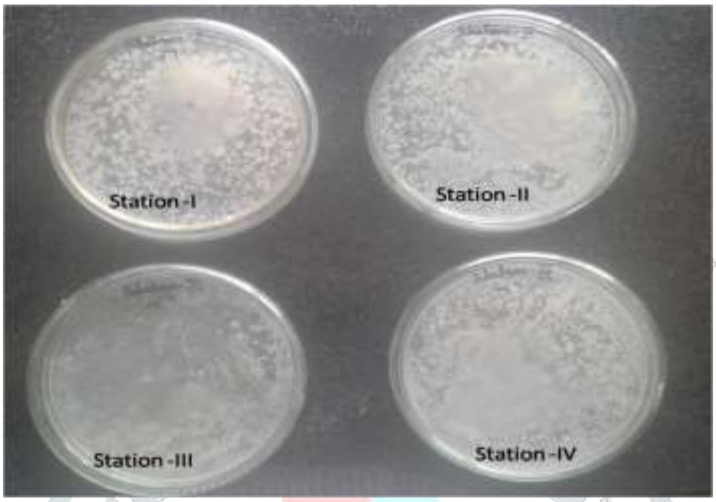

Image 3: Microbial population from four different stations.

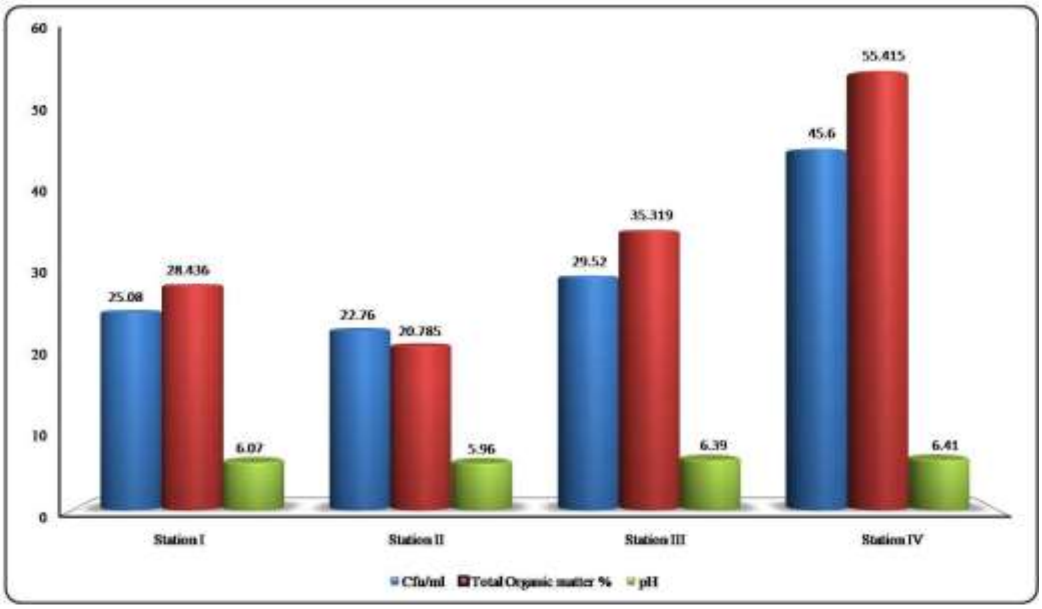

Image 4: The average values and percentage of Bacterial population, Organic matter and pH ranges from all IV station.

4. CONCLUSION:

The role of microorganisms in the cycling of pH and organic matter is a crucial one. The overall microbial population from four stations were shown with pH and Organic matter is directly proportional to the Microbial population in all stations the average percentage of organic matter, pH and microbial diversity was shown Station-IV 55.42%, 6.41 and 45.6 Cfu/ml, Station –III 35.32%, 6.39 and 29.52 Cfu/ml, Station –I (28.44%, 6.07 and 25.08 Cfu/ml and Station –II 20.79%, 5.96 and 22.76 Cfu/ml. To better understand the relationships between the molecular composition of a potentially bioavailable fraction of organic matter and microbial populations. Therefore, Study on the Effect of Organic Matter and pH on the microbial diversity in the different

Stations of Marlimund Lake and function in freshwater sediments is of great importance for gaining a better general understanding of aquatic ecosystems.

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