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Assessment of Water Quality Parameters in Selected Myristica Swamps, Western Ghats, India

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ABSTRACT

Myristica swamps are one of the most remarkable wetland forest ecosystems in the Western Ghats, India in which members of the Myristicacea family are predominant. Water logged condition and humic deposition changes these swamps into an acidic environment. Amount of rainfall, and water availability throughout the year are the two important abiotic factors necessary for the endurance of Myristica swamps. Every Myristica swamps comprises a central stream and it helps in ensuring a constant water availability. The Hydrology of Myristica swamps is particularly well suited to providing high quality to these streams and providing diverse aquatic habitat. So, physico-chemical parameters of water in Myristica swamps serve as a powerful indicator of environmental conditions that are prevalent in these freshwater ecosystems. The present study was carried out in Shendurney wildlife sanctuary and Kulathupuzha reserve forest, Kerala, India during the pre-monsoon season. The water quality in selected Myristica swamp forests were studied in detail by taking representative water samples. The data on physico-chemical variables of water have been given under the present contribution. The present qualitative study also showed the present aquatic status of myristica swamp, which would be very helpful for future ecological and conservational study of this economically important ecosystem in Western Ghats in India

***Key words**: Myristica swamps, Physico-chemical Parameters, Wetland, Fresh water ecosystem, Western Ghats.*

Introduction

The Western Ghats include a great range of ecosystems, including rare freshwater wetlands with a unique assemblage of floral and animal species. Wetlands are one of the most productive water resources that is flooded or drenched by water, either permanently or seasonally. Wetlands provide varied significant advantages to people all around the world including habitat for aquatic and wildlife as well as maintaining water quality, erosion prevention, flood storage, carbon management, and regeneration (Clarkson *et al*., 2013). Shallow water and abundant nutrient deposition in wetlands uphold vegetational growth which provides habitat and food for a variety of fish, birds, and invertebrates. Because of the anoxic conditions in wetlands, anaerobic nutrient conversions turn nitrates into a harmless gas which improve the quality of water.

A swamp is a forested wetland that is dominated by trees and constantly saturated with mineral rich water. Freshwater swamp forests are those that are permanently or seasonally inundated with freshwater. Freshwater swamps form along large rivers or lakes and rely heavily on rainwater and seasonal flooding to maintain natural water level fluctuations.

Myristica swamp is a kind of forest wetland ecosystems that inundated fully or partially a greater part of the year, characterized by the dominance of Myristicacea family members like Myristica fatua var. Magnifica and *Gymnacranthera farquhariana*. Krishnamurthy (1960) first reported Myristica swamps in the Travancore region of Kerala, and

Champion and Seth (1968) categorised them under the newly designed category of "Myristica Swamp Forests" under the subgroup 4C. They provide habitat to a broad range of plant and animal species and are adapted to the unique anoxic hydric conditions. Once huge in the Western Ghats, Myristica swamps are now being reduced to fragments with increased human pressure including mining, agricultural trespass, and other types of monoculture plantations. Research works on plant and animal diversity of these swamps exist, but gap area is prominent when it comes to the hydrology of these swamps.

Materials and Methods

Study Area

The Myristica swamps at Kulathupuzha and Shendurney wildlife sanctuary were studied. The Myristica swamp forests of the Kulathupuzha region lie in the Southern Forest Circle of Kerala State, India and lies between the geo- coordinates 76° 55′ to77°10′E and 8°45′to 8°55′N. The Myristica swamp patches at Shendurney WLS, located between 8°50′N - 8°55′N latitude and 77°5′E - 77°15′E longitude in Southern parts of Western Ghats, Kollam District, Kerala, India. Description of sampling sites is given in Figure 1.

Description of Sampling Stations and Sample Collection

Eleven stations were designated for this study. Each of this station was approximately distinct from each other. Poovanathu Mood, Plavu kidanna chal, Pullumala pacha, Mottal Mood, Marappalam, Perumpadappy were located within the protected area of Kulathupuzha reserve forest, while Onnam mile, Munkuthu, Kattila Para, Ashokachal, Irikkapara were located in Shendurney WLS. Pu Ar, Channa Mala and Dali Karikkam are the three main streams where Myristica swamps at Kulathupuzha forest range located. The Myristica swamps of Shendurney lie along the two streams - Kunjuman Thodu and Kattilapara. Representative Swamp water samples during the pre-monsoon season were collected from each sampling points using 250 ml sterile sampling bottles dipped into the water.

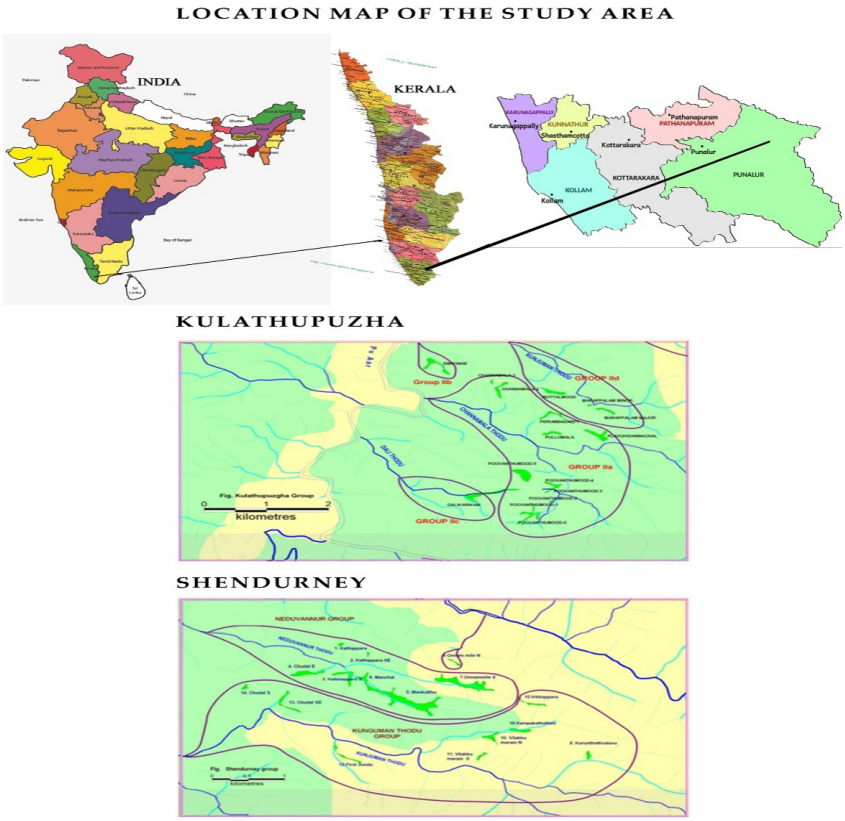

Fig. 1. Location map of the Myristica swamps from Kulathupuzha and Shendurney wildlife sanctuary.

Determination of Physico-chemical Parameters

Parameters such as temperature, pH, Total dissolved solids, conductivity, CO_2, hardness, phosphates, and silicate of the swamp water were determined following standard methods given in APHA (2012) and it is shown in Table 1. Data on temperature and pH were obtained from the field using digital thermometer and pH metre. TDS and conductivity were determined using appropriate calibrated meters such as EC meter, TDS meter respectively. CO_2 and hardness were determined in the laboratory by titrimetric method as described by APHA (2012). The concentrations of phosphates and silicate in the water samples were determined by Atomic Absorption Spectrophotometer.

Results and Discussion

Table 1 shows that all the parameters were within the normal admissible range. A slightly higher temperature was observed in Station 1,2 and 3 in Kulathupuzha region of value 26^0C while others are in allowable threshold limits. In general, various factors such as weather condition, sampling time, removal of shade vegetation, and location have an impact on temperature. Based on the percentage of dissolved oxygen, biological activities, rate of photosynthesis by aquatic plants; the metabolic rates of aquatic organisms the temperature may increase or decrease (Spellman and Drinan, 2012).

The pH values showed different values from S1 to S11, and the average pH of the study area was acidic. Varghese and Kumar (1997) observed in earlier studies on freshwater swamps of Kerala that the moderate acidic to neutral pH was due to the constant water logging effect. The pH value between of 5.59 to 7.4 suggested that the majority of the swamps were acidic to circumneutral (Thacker and Karthick, 2022). High amounts of humus in forest soils are also responsible for low pH (Kaladevi, 2020). Overall, the pH range of 5.59 to 7.4 is acceptable for aquatic life.

The total dissolved solids (TDS) ranging from 31.6 and 91.8 mg/l. The differences in means were not significant across the stations. Too high or too low dissolved solids concentrations may impede the growth and result in the death of many aquatic life (Weber-Scannelland Duffy, 2007). TDS levels are high due to the presence of sodium, magnesium, and calcium chlorides. As a result, electrical conductivity also increases.

During the present study the EC was found highest (152µS/cm)) at S6 and lowest (61.4µS/cm)) at S5 respectively. During the dry season, surface runoff drops, resulting in an increase in EC (Meghla *et al.*, 2013). The hypoxic and water-logged states also have role in pH and electrical conductivity.

Dissolved carbon dioxide values varied between 10- 60 ppm. Levels greater than 35 ppm are regarded as limiting to all aquatic organisms. High levels of carbon dioxide will make the pH more acidic and decrease the oxygen amount. A high quantity of carbon dioxide in an aquatic habitat usually indicates the presence of decomposition (Brinson *et al.*, 1981).

Ideal hardness for an aquatic habitat, according to Huq and Alam (2005), is 123 ppm, and this study revealed that hardness contents were suitable for aquatic life.Hardness in water is due to the natural addition of salts from the soil and geological formations (Joseph and Claramma, 2010).

Table 1. The results of the physico-chemical parameters for the water samples obtained separately from the eleven sampling stations in Myristica swamp.

Sl.No	Stations	Temp	pH	TDS	EC	CO_2	Hardness	Phosphate	Silicate
1	S1	26	6.05	91.8	149	30	18	0.82	9.434
2	S2	26	7.30	52.6	94.9	10	14	0.28	9.334
3	S3	26	6.59	46	80	22	12	0.21	9.467
4	S4	25	6.11	40.2	67.7	10	18	0.07	8.567
5	S5	25	5.65	31.6	61.4	60	14	0.07	8.034
6	S6	25	7.33	34.7	152	10	6	0.09	7.367
7	S7	23	5.82	45.3	82	20	14	0.10	16.766
8	S8	24	5.59	50.7	82	22	22	0.13	9.8
9	S9	25	5.8	33.5	73.5	24	18	0.09	11.066
10	S10	25	6.63	44.9	87	22	14	0.09	9.266
11	S11	25	6.49	44.6	87	22	20	0.13	7.233

The concentrations of phosphate (PO_4) ranged from 0.07to 0.82 mg/l. Bank erosion, land runoffand mixing of freshwateris a major contributor of phosphorus to streams and other water bodies (Satpathy *et al.,* 2010). Total phosphorous concentrations greater than 0.03 mg/l can cause algal blooms in lakes and reservoirs (Gorde and Jadhav, 2013).

The total Silicate concentration of eleven sampling sites ranging from 7.233 to 16.766 mg/l. Temperature and evaporation affect the silica content in freshwater (Atkins, 1926). Dissolved silicate is abundant in natural streams and may operate as a phosphate competitor (Sabur, 2019).

Conclusion

Several factors were known to responsible for the density of aquatic biodiversity in the Myristica swamp, but the important likely factors are physiochemical parameters of water quality. These factors have direct and indirect influence on the diversity and distribution of benthic macro invertebrates. The present study was conducted as a seasonal approach on Myristica swamps in Kulathupuzha and Shendurney to determine the water quality. According to this study aslightly higher temperature was observed in Station 1, 2 and 3 in Kulathupuzha region due to weather condition, sampling time, removal of shade, and location. However, the results of pH are within the standard range and is acceptable for aquatic life. As a result, it is essential to keep the aquatic habitat within this range because high and low pH can be harmful to nature. Comparatively lower TDS values in all the sampling sites indicates less anthropogenic and land use activities in the protected areas of forest. This study disclosesa positive relationship between Electrical conductivity and TDS. Level of dissolved carbon dioxide varied between 10- 60 ppm. Levels greater than 35 ppm are regarded as limiting to all aquatic organisms. The ideal hardness for an aquatic habitatis 123 mg/l and the current study showedthat hardness wassuitable for aquatic life. The concentrations of phosphate ranged from 0.07 to 0.82 mg/l and the permissible limit of phosphate in freshwater is 0.1 mg/l. The silicate content in natural waters is commonly in a range of 5 to 25 mg/l and the concentration of silicate in the present water samples ranges between 7.233 to 16.766 mg/l and it is within the standard limit. During pre-monsoon season, at all the points, temperature, pH, TDS, conductivity, hardness, silicate content was suitable for aquatic life, whereas Total carbon and Phosphate increased a little during pre-monsoon than the standard limits. Studies documenting the hydrology of these ranges not well studied and documented. We noticed that plenty of juveniles of ecologically significant species are present in this swamp forests. This indicates that numerous species use these Myristica swamps as breeding grounds. Therefore, conservation and recognition of these ecosystems is essential and vital.

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