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DIVERSITY OF MICRO AND MACROPHYTES OF PURLE POND SHIVAMOGGA KARNATAKA INDIA

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Abstract

Ponds are small water bodies of standing water found in variety of habitats which supports wide range of life forms, including plants, animals, microorganisms and physical factors. The present work was an attempt to identify diversity of plants in Purle pond of Shivamogga district. The nineteen plant (micro-macrophytes) species were identified among which algae (03), bryophytes (02), pteridophytes (02) and angiosperms (12) belongs to the 16 family and 19 genera. These were classified into floating (04), free-floating (04), submerged (04), emerged (03) and (04) amphibious in nature. The amount of minerals and nutrients present in water Calcium (2.935±02), Magnesium (7.338±00), Potassium (6.255±01), Iron (5.745±00), Nitrate (4.892±01) and Chloride (0.881±00) mg/l respectively. Minerals and nutrients present in the Purle pond support the aquatic life, further Purle pond is moderately polluted, with domestic effluents, solid waste leachets and agricultural runoff.

Key words: **Azolla, Hydrilla, Eichhornia, Minerals, Nutrients, Physico-chemical and Pond.**

INTRODUCTION

Water is one of the most important precious natural resources required essentially for the survival and health of living organisms[1] (Suresh, 2015). Majority of the ponds in India are shallow and perennial freshwater bodies[2] (Paul 2022). A freshwater pond ecosystem is a dynamic and interconnected environment that supports a wide array of life forms. It consists of various components, including water, plants, animals, microorganisms, and physical features such as sediment and rocks. Ponds are small bodies of standing water, often shallow, and can be found in a variety of landscapes, from forests to grasslands. Physical factors like sunlight, temperature, and water quality influence the pond ecosystem. Aquatic plants (Micro and macrophytes) are a diverse group of vegetation that thrive in aquatic environments such as ponds, lakes, rivers, and wetlands. They play a crucial role in maintaining the health of aquatic ecosystems by providing habitat, oxygenation, and nutrient cycling. These plants have adapted various strategies to survive in water, including specialized roots, buoyant leaves, and adaptations for photosynthesis[3] (Ryan M. Wersal and John D. Madsen, 2012). Metals and minerals present in biological system play a significant role in the metabolism of plants and humans. Plants are the rich sources of all the elements essential for human beings. The importance of mineral elements in maintaining good health is well known[4] (Mathad and Rathod 2016). The microphytes includes algae, particularly green algae (*Spirogyra*)

pond silk and (*Nostoc*) blue green algae some species of diatoms. The macrophytes includes aquatic angiosperms, pteridophytes and macro algae, which classified into emergent, submerged, floating and free-floating types, each serving distinct ecological functions. Aquatic plants also have aesthetic value and are commonly used in landscaping and aqua scaping. But the ponds can experience changes in the various physical factors due to weather, human activities, and natural processes. Understanding these dynamics is essential for maintaining the health of pond ecosystems and preserving their biodiversity. The present work was under taken to study of diversity of aquatic plants and physico- chemical parameters of Purle pond.

MATERIALS AND METHOD

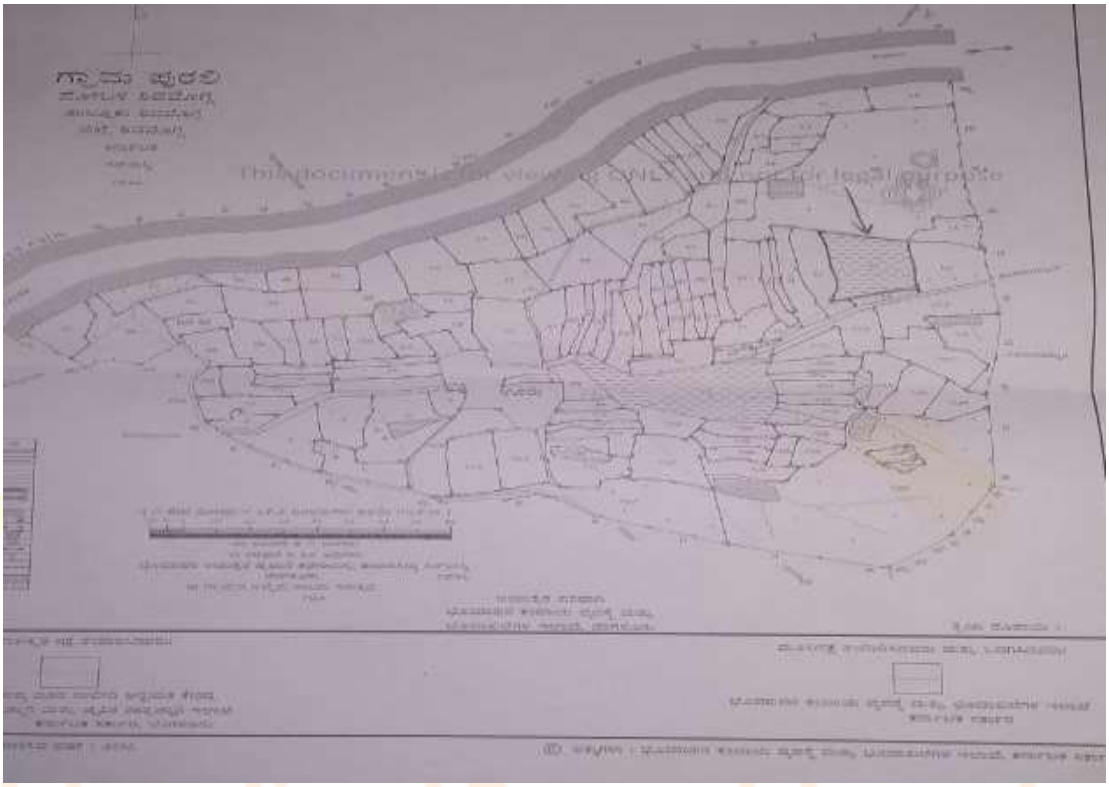

Fig.1. Satellite image of Purle pond

Study area:

Purle pond is situated at Latitude 13.933179 and Longitude 75.613906, 2 km away from heart of Shivamogga city, Karnataka. The total area of the pond is 55 hectares of which water spreads over an area of 43 hectares with average depth of 6 feet. Purle pond is one of the largest ponds of the city. It is annual water body which receives the water from Tunga canal and waste water from Shivamogga township. It is surrounded by dense human population and its water is used for domestic purposes like washing of clothes, vehicles, domestic animals and for fisci culture

Methodology:

Collection of materials

The water sample and collection of plants were collected during the month of June to August 2023. After collecting the samples were carried to the laboratory.

Collection of plants

Micro and macrophytes are collected using long handled hooks nets or by hand and taken out and thoroughly washed excess water is absorbed on a cloth or filter paper kept in polyethene on cloth or filter paper. Micro and Macrophytes were collection by hand and put into polytene bags and for identification.

Collection of water

Water sample were collected by gap sample method at interval of 15 days for a period of three months, samples were collected in 5 Liter capacity black can and carry to 'OM' laboratory in Shivamogga to analyze the various parameters.

Study of minerals and nutrients

Minerals and nutrients study carried out by following the procedure of[4]

Acid digestion

1 ml water sample by weight was taken in a beaker and 3:3 ml of conc. Sulphuric and perchloric acid are added. The samples were heated to get clear solutions, subsequently it was cooled by adding distilled water and the samples were filtered with Whatman filter paper. Then final volume made to 1000 ml with the help of distilled water. The water samples were subjected to the mineral and nutrient analysis using Atomic Absorption Spectrophotometer equipped with Acetylene (C_2H_2) flame and air, nitrous oxide (N_2O_2) as oxidising agent.

Study of physico-chemical parameters

Physico-chemical parameters were carried out by following the procedure of[5].

Temperature, pH, turbidity, total dissolve solids, total alkinity, total hardness *etc*.

Statistical analysis

The study of physico-chemical, mineral and nutrients analysis were performed in triplicates for each. The results were expressed as mean ± Standard error mean and Significant value P <0.001. P <0.01. Using one way ANOVA. (Graph Pad Instat 3) and Microsoft excel.

Results

The study of diversity of plants and physical factors of Purle pond were done by regular field visits during the year 2023. The plants were identified by Dr. Gopal T D, Department of Botany, Sahyadri Science College, Shivamogga and World Flora Online.

Fig. 2. GPS IMAGE OF PURLE POND

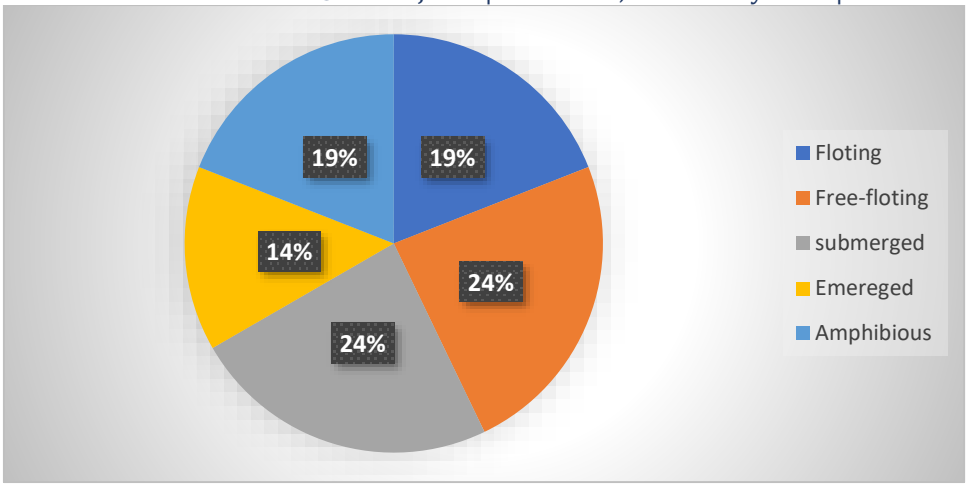

Fig. 3. Classification of nature of plants in Purle pond

The nineteen plant (micro-macrophytes) species were identified among which algae (03) bryophytes (02) pteridophytes (02) and angiosperms (12) belongs to the 16 family and 19 genera. These classified into floating (04), free-floating (05), submerged (05), emerged (03) and (04) amphibious in nature were tabulated in Table -1 and presented in (Fig.3).

Table-1. Diversity of plant species found in Purle pond

Scientific name	Family	Floating	Free Floating	Sub Merged	Emerged	Amphibious In nature
Algae						
Nostoc	Cyanophyceae					✓
Spirogyra	Zygnemataceae		✓			
Chara	Charophyceae		✓			
Bryophytes						
Riccia species	Ricciaceae					✓
Polytrichum species	Politrichaceae					✓
Pteridophytes						
Azolla pinnata R. Br.	Salviniaceae	✓	✓			
Marsilea quadrifolia L.	Marsileaceae			✓		✓
Angiosperms						
Alternanthera philoxeroides (Mart) Griseb	Amaranthaceae	✓			✓	
Bergia capensis L.	Elatinaceae				✓	
Ceratophýllum demérsum L	Ceratophyllaceae		✓			
Colocasia esculenta (L.) Schott	Araceae				✓	
Cyperus species	Cyperaceae			✓		
Eichhornia crassipes (Mart) Solms.	Pontederiaceae	✓	✓			
Hydrilla verticillata (L. f.) Royale	Hydrocharitaceae			✓		
Ludwigia species	Onagraceae			✓		
Lemna minor	Araceae		✓			

Nymphaea alba L	Nymphaeaceae	✓				
Pistia stratiotes L.	Araceae			✓		
Polygonum species	Polygonaceae					✓

Minerals and nutrients of Purle pond

Pond water contains a variety of minerals that are essential for the health of aquatic life and overall pond ecosystem function. These are either naturally occurring or introduced through runoff, animal waste, and other sources. Concentration of the minerals and nutrients present in Purle pond were tabulated in (Table-2).

Calcium (Ca^{2+}): It is highly implicated in the maintenance of firmness of fruits, related to cell wall stability and membrane integrity in plants[4]. Calcium is a major constituent of most igneous, metamorphic and sedimentary rocks and is also present in the form of adsorbed ions on negatively charged minerals surfaces of soil. Calcium is one of the important nutrients: It is also one of the most abundant cations in surface water. The concentration of calcium in the water sample is 2.9935±02mg/l.

Magnesium (Mg^{2+}): It is an important component of chlorophyll in plants, which activates many enzymes involved in photosynthesis and respiration[4]. It is main cause by far the greatest portion of the hardness occurring in natural waters. The concentration of magnesium in the water sample is 7.338±00mg/l.

Iron (Fe^{2+})**:** It is an important component of cytochromes, electron transport, activates some enzymes, plays a role in chlorophyll synthesis[4]. Iron is a biologically important and essential element for all living organisms. The concentration of iron in the water sample is 5.745±00mg/l.

Potassium (K^{2+})**:** Potassium act as Cofactor that functions in protein synthesis, activation of enzymes, major solute functioning in water balance affecting osmosis in plants. Potassium required for glycogenesis, cellular enzymatic reactions[5]. Like nitrogen and phosphorous it an important mineral present in water and soil of any ecosystem. It plays important role in growth and development of plants and animals. The range of potassium in the water sample is 6.255±01mg/l.

Nitrate (NO_3^-**):** Nitrate represents the final stage of mineralization of nitrogenous organic matter such as dead green plants and animals. As such higher value of nitrate in the way may be indicative of sewage pollution. Nitrate concentration in the water sample is 4.892±01mg/l.

Chloride (Cl^-**):** Chloride are the major anion commonly found in all-natural water. chloride concentration increases proportionately with mineral content. High concentration of chloride in water is due to the anthropogenic activities such as discharge of sewage and industrial effluents etc., The concentration of chloride in the water sample is 0.881±00mg/l.

Table-2. Minerals and nutrients present in Purle pond mg/L

Sl. No.	Parameters	Standard values based on IS (Sn)	Unit weight (Wn)	Milligrams /Liter mg/l
1	Calcium	75	0.002935	2.935±02, P<0.01.**
2	Magnesium	30	0.007338	7.338±00, P <0.01.*
3	Iron	0.3	0.005745	5.745±00, P <0.01.*
4	Potassium	62	0.006255	6.255±01, P <0.01.**
5	Nitrate	45	0.004892	4.892±01, P <0.01.*
6	Chloride	250	0.000881	0.881±00, P <0.01.***

Mean ± Standard error mean

Physico-chemical parameters of Purle pond

Physicochemical properties have great impact on quality and suitability for aquatic diversity. These properties include temperature, pH, alkinity, turbidity, total dissolved solids (TDS) and total hardness tabulated in (Table-3).

Temperature: The real-time temperature (22°C), with patchy rain, humidity 89%, wind 8.6km/h, pressure (1009mb), UV (08).

pH: One of the important parameters of water whose determination facilities a quick evaluation of acidic and alkaline nature of water. The pH is affected by organic and inorganic solutes present in the water. Any alteration in water pH is accompanied by the changes in other physico-chemical parameters. pH of the water sample is 8.5

Table-3. Physico-chemical parameters of Purle pond

Sl. No	Parameters	Standard values based on IS (Sn)	Unit weight (Wn)	Milligrams/Liter mg/l
1	pH	8.5	0.025899	2.589±01, P<0.01.**
2	Turbidity	5	0.044028	4.082±01, P <0.01.*
3	Total dissolved salts	500	0.00044	0.044±00, P <0.01.*
4	Total alkinity	200	0.001101	1.110±02, P <0.01.**
5	Total hardness	300	0.000734	0.734±01, P <0.01.*

Mean ± Standard error mean, P <0.01.* P <0.001.**

Turbidity: Suspension of particles in water interfering with passage of light is called turbidity. Turbid water is undesirable from aesthetic point of view in drinking water supplies and may also affect product in industries. The range of turbidity in the water sample is 4.082±01mg/l.

Total dissolved solids: The total dissolved solids are the measure of the amount of dissolved material in water, whether ionized or non-ionized. Presence of such solutes alters the physical and chemical properties of water. The range of total dissolvedsolids in the water sample is 0.044±00mg/l.

Total alkalinity: Total alkalinity is the buffering capacity of water. It is constituted principally by carbonates and bicarbonates of calcium, magnesium, potassium and sodium, which appear in the water in the form of natural salts. The range of total alkalinity in the study water sample is 1.110±02mg/l.

Total hardness: Water hardness is the capacity is of water to react with soap to produce lather. Hardness of the water is not a specific element but a variable accounted by a complex mixture of cations and anions. The range of total hardness in the water sample is 0.734±01mg/l.

Discussion

Aquatic plants are a significant source of food, fodder, and herbal medicine for people living near water bodies[8]. Aquatic macrophytes act as microhabitat for the fauna of wetlands due to the diversity of growth forms which outcomes in a greater niche modification. It is very important to conserve the natural ecosystems that are deteriorating at an alarming rate otherwise the remnants will significantly lose their ability to sustain the present biological diversity[2,8]. The macrophytes have capacity to improve the water quality by absorbing nutrients, with their effective root system. At the same time death and decay of the macrophytes increases nutrient concentration and it leads to the eutrophication. *Eichhornia crassipes* and *Hydrilla verticillata*[9,2] are capable in improving water quality by reducing nutrient concentration. The macrophytes such as *Hydrilla*, *Ceratophyllum* and *Eichhornia* grown in ponds have the ability to maintain water quality[10,2]. Some Pteridophytes such as *Azolla pinnata* R. Br., *Marsilea* were also found abundant in the perennial ponds studied (Table 1). Wetlands play a significant role in achieving Sustainable Development Goals in ecosystems and their biodiversity. However, this goal is curtailed by the threats faced by the wetland ecosystem due to human intervention[2]. Quality of water is a criterion for evaluating the suitability of water for drinking, domestic work and irrigation purpose whereas the quality of

surface pond aswell as ground water depends on various chemical constituents and their concentration[11]. Purle pond currently utilized for domestic use.

BENEFITS OF AQUATIC PLANTS

- Algae control: plant absorb nutrients in the water from fish waste and reduces nutrients availability slowing algae blooms.
- Food or fish and other wildlife: fish, turtles, insects, ducks and some mammalsfeed on aquatic plants.
- Improved water quality: many water plants not only absorb nutrients from the water; they also absorb pollutants and heavy metals too.
- Erosion control: emergent and shoreline plants, often have very large root structures. This enables them to reduce wave action and stabilize the shore creating the most effective erosion control we can get in a pond
- Aquatic plants in the pond improve its aesthetics. Many emergent and shoreland plants offer four seasons of interest at the providing attractive flowers, interesting structure, color and depth. (beth clawson).

IMPACTS

- Aquatic plant produces dense mats of vegetation that interfere with navigation and recreational activities such as boating, swimming, fishing, and water- skiing. Impact power generation and irrigation by clogging equipment. Degrade water quality by raising pH, decreasing oxygen and increasing temperature.
- The cause of dense plant growth is complex. Often it is attributed to increased nutrient input from around the lake or in the watershed from sources such as failing septic system, fertilizer runoff, or agricultural waste. These increased nutrients can cause the natural process of lake aging (eutrophication) to proceed at an accelerated rate, and increased plant and algal growth is part of this process.

CONCLUSION

The present work was an attempt to identify diversity of plants in Purle pond of Shivamogga district. The nineteen plant (micro-macrophytes) species were identified from 16 family and 19 genera. It showed the presence of all types of plants i.e. Algae, bryophytes, pteridophytes and angiosperms. Purle pond is moderately polluted, with domestic effluents, solid waste leachets and agricultural runoff.

Conflict of interest statement

We declare that we have no conflict of interest.

Acknowledgement

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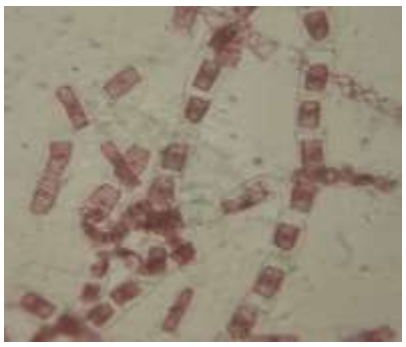

Spirogyra

Marsilea quadrifolia

Azolla pinnata

Alternanthera philoxeroides

Bergia capensis

Eichhornia crassipes

Cyperus species

Pistia stratiotes

Nymphaea alba

Colocasia esculenta

Lemna minor

Polygonum species

Photographs of some plants