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# Study of Hydrophytes in Lakes of Bhadrawati Region, District-Chandrapur, Maharashtra, India

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***Abstract***

*Hydrophytes play a crucial role in aquatic ecosystems as good indicators of water pollution. The present survey was carried out from September 2023 to August 2024. During this study period, a total of 25 macrophytes belonging to 4 free-floating species, 7 free-floating suspended submerged species, 05 rooted floating leaves species, 6 rooted submerged species, and 3 rooted emergent species were observed in six lakes (Dhoodhala lake, Lendara lake, Mashanghat [Malhar] lake, Dolara lake, Lonara lake, and Mohabala lake) of Bhadrawati tahsil, District Chandrapur, Maharashtra, India. In Dhoodhala lake,* Ceratophyllum sp. *was found dominant, followed by* Trapa sp., Nymphoides hydrophylla, Nymphoides indicum, Sagitaria obtusifolia, Hydrilla vercillata, Utricularia sp., Nymphaea sp., Vallisneria spiralis, *and macroalgae were observed, e.g.,* Chara sp., Nigella sp. *Lendara Lake was found to have* Ceratophyllum sp. *dominant during the study period. In Mashanghat Lake, also known as Malhar Lake, found dominant* Ceratophyllum sp., *followed by* Salvinia natans, Salvinia molesta, Pistia stratiotes, Spirodella polyrhiza, Azolla pinnata, *and* Lemna minor. *In Dolara Lake, abundant growth of Pistia stratiotes was found. Lake Lonara was less polluted.* Hydrilla verticilliata *and* Najas minor *were dominant, followed by* Elodea sp. Nymphoides sp., Najas matina, *and* Vallisneria spiralis *grow well. Pistia stratiotes is not found in Lonara Lake. In Mohabala lake, dominant growth of* Vallisneria spiralis, Hydrilla verticillata, Ottelia alismoides, Pomatogeton sp., Nymphya sp. Nymphoides hydrophylla, Nymphoides indica, Najas minor, Spirodella polyrhiza, Lemna sp., Azolla sp., Wolffia sp., Sagitaria obtusifolia, Vallisneria sp., Utricularia sp., Blyxa aubertii *Rich., and* Pistia stratiotes *were not found in Mohabala Lake.*

**Keywords:** Hydrophytes, aquatic macrophytes, water, pollution, Bhadrawati

## INTRODUCTION

The environment is composed of three important components of the ecosystem, viz., air, water, and soil. Water is an essential component of the earth, and numerous cycles depend on the quality of water. Hydrophytes or aquatic macrophytes are those plants that completely grow in water bodies, and they are good indicators for water pollution. They help in maintaining the mineral cycle, pollution, growth of phytoplanktons, e.g., *Coleochate sp.*, phytoplankton completely grow on *Hydrilla sp.*, *Nymphyea sp.,* etc. They also play a major role in the primary productivity of water bodies. Water-loving plants help to regulate the water ecosystem. Bhadrawati is a Tahsil place in Chandrapur district [1]. Hydrophytes play an important role in the water ecosystem. They play a crucial role in the absorption of nutrients from sediments. They maintain the stability of water ecosystems due to nutrient regulation. Plants' roots accumulate heavy metals and remove pollutants from water bodies. Hydrophytes are also used as food for some aquatic

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animals. Some hydrophytes are used as medicines. Hydrophytes generate large amounts of organic matter upon decomposition, which changes water quality. Hydrophytes remove biochemical oxygen demand (BOD) and chemical oxygen demand (COD), nitrogen, and phosphorus from wastewater [2].

Many researchers carried out their work on aquatic macrophytes in Maharashtra, India such as [3–9], etc., and in the Chandrapur region, some workers carried out their studies on aquatic macrophytes such as [10–14].

## MATERIAL AND METHODS

The present study was carried out from September 2023 to August 2024 in the Bhadrawati region. The Bhadrawati region is rich in a diversity of aquatic macrophytes. A total of six lakes in the Bhadrawati region were studied in different seasons. Observation of aquatic macrophytes was done. Photographs were taken at the study sites and identified using available standard literature and flora such as Introduction of Aquatic and Semi-Aquatic Plants of India [5]. The present study was carried out in six lakes of the Bhadrawati region, i.e., Dhoodhala Lake, Lendara Lake, Mashanghat (Malhar) Lake, Dolara Lake, Lonara Lake, and Mohabala lake [15–18]. The Map Bhadrawati region is shown in Figure 1.


**Figure 1.** Map of Bhadrawati region: result and discussion.

In the present investigation, 25 species belonging to 22 genera, 14 families. Five forms of aquatic macrophytes were observed in six lakes of the Bhadrawati region (Tables 1 & 2 and Figures 2–5). Dhoodhala Lake was found enriched in the diversity of macrophytes. A total of 21 species belonging to 19 genera belongs to 14 families were observed. Among all aquatic macrophytes, *Ceratophyllum sp.* was found dominant, followed by *Trapa sp*., followed by *Nymphoides hydrophylla, Nymphoides indicum, Sagitaria obtusifolia, Hydrilla vercillata, Utricularia sp., Nymphaea sp., Vallisneria spiralis,* and macroalgae were observed, e.g., *Chara sp., Nigella sp*. The luxurious growth of these macrophytes might be due to the presence of sulfates and nitrates in the water body.

 

**Table 1.** List of aquatic macrophytes of six different lakes of Bhadrawati.

| S.N. | Botanical Name of Plants | Vernacular Names of Plants | Family | Life Form | IUCN Rank |
|---|---|---|---|---|---|
| 1. | *Azolla pinnata R. Br.* | Ajola | Salviniaceae | Free floating | Least concern. |
| 2. | *Lemna minor L.* | Khudepana, Gurihudi | Lemnaceae | Free floating | Least concern. |
| 3. | *Wolffia sp.* | Postupana, Sujipana | Lemnaceae | Free floating | Least concern. |
| 4. | *Spirodella polyrhiza (L.) Schleid.* | Tipapana | Araceae | Free floating | Least concern. |
| 5. | *Nelumbo nucifera Gaertn.* | Kamal, Kanwal, Padma | Nelumbonaceae/ Nymphaeaceae | Free-floating suspended submerged | Data deficient. |
| 6. | *Nymphoides hydrophylla (Lour.) Kuntze* | Pansewali | Menyanthaceae | Free-floating suspended submerged | Least concern. |
| 7. | *Nymphoides indica (L.) Kuntze* | Kumudini | Menyanthaceae | Free-floating suspended submerged | Least concern. |
| 8. | *Pistia stratiotes L.* | Akashmuli, Tokapana, Golappana | Araceae | Free-floating suspended submerged | Least concern. |
| 9. | *Salvania natans (L.) All.* | Kapipana, Jalfarn | Salviniaceae | Free-floating suspended submerged | Least concern. |
| 10. | *Salvania molestra Mitchella* | Kapipana | Salviniaceae | Free-floating suspended submerged | Invasive species. |
| 11. | *Utricularia vulgaris L.* | Kanta jhanji, Rakshuse | Lentibulariaceae | Free-floating suspended submerged | Least concern but endangered in some regions. |
| 12. | *Vallisneria spiralis L.* | Seval, Jalliil | Hydrocharitaceae | Rooted submerged | Least concern. |
| 13. | *Hydrilla verticillata (L.f.) Royle* | Jhsnji, Baichcha | Hydrocharitaceae | Rooted submerged | Least concern. |
| 14. | *Elodea sp.* | | Hydrocharitaceae | Rooted submerged | Least concern. |
| 15. | *Ceratophyllum demersum L.* | Kanta jhaji, Sevar | Ceratophyllaceae | Rooted submerged | Least concern. |
| 16. | *Najas minor All.* | – | Hydrocharitaceae | Rooted submerged | Least concern. |
| 17. | *Najas marina L.* | – | Hydrocharitaceae | Rooted submerged | Least concern. |
| 18. | *Marsilea quadrifolia L.* | Susnisak | Marsileaceae | Rooted emergent | Least concern. |
| 19. | *Ipomoea aquatic Forssk.* | Kalmi | Convolvulaceae | Rooted emergent | Least concern. |
| 20. | *Sagitaria obtusifolia L.* | Chhotakut, Tirpata | Alismataceae | Rooted emergent | Least concern rare or threatened in some region. |
| 21. | *Trapa natans L.* | Paniphal, Singhara, Singhada | Trapaceae | Rooted floating leaves weed | Least concern. |
| 22. | *Nymphaea sp.* | Nilkamal, Kamal, Nilpadama | Nymphaeaceae | Rooted floating leaves weed | Least concern. |
| 23. | *Ottelia alismoides (L.) Pers.* | Jal palak, Olek-alsem | Hydrocharitaceae | Rooted floating leaves weed | Least concern. |
| 24. | *Pomatogeton crispus L.* | Chardal, Paanee Jhaar | Potamogetnaceae | Rooted floating leaves weed | Least concern. |
| 25. | *Blyxa aubertii Rich.* | Lasune | Hydrocharitaceae | Rooted floating leaves weed | Least concern. |

 

**Table 2.** A list of aquatic macrophytes which were present during the study period in six lakes of Bhadrawati.

| S.N. | Botanical Name of Plants | Dhoodhala Lake | Lendara Lake | Mashanghat (Malhar) Lake | Dolara Lake | Lonara Lake | Mohabala Lake |
|---|---|---|---|---|---|---|---|
| 1. | *Azolla pinnata R.Br.* | +++ | + | +++ | ++ | ++ | +++ |
| 2. | *Ceratophyllum demersum L.* | +++ | ++ | +++ | ++ | – | + |
| 3. | *Elodea sp.* | – | – | – | – | ++ | – |
| 4. | *Hydrilla verticillata (L.f.) Royle* | + | – | – | – | +++ | +++ |
| 5. | *Ipomoea aquatic Forssk.* | +++ | ++ | +++ | ++ | ++ | ++ |
| 6. | *Lemna minor L.* | +++ | ++ | ++ | ++ | + | + |
| 7. | *Marselia quadrifolia L.* | + | + | – | + | + | + |
| 8. | *Nymphoides hydrophylla (Lour.) Kuntze* | ++ | + | ++ | + | + | + |
| 9. | *Nymphoides indica (L.) Kuntze* | ++ | – | – | – | ++ | ++ |
| 10. | *Nymphaea sp.* | ++ | – | ++ | – | ++ | +++ |
| 11. | *Nelumbo nucifera Gaertn.* | – | – | – | – | – | – |
| 12. | *Ottelia alismoides (L.) Pers.* | – | – | – | – | – | ++ |
| 13. | *Pistia stratiotes L.* | ++ | + | ++ | +++ | – | – |
| 14. | *Pomatogeton crispus L.* | + | – | – | – | – | ++ |
| 15. | *Spirodella polyrhiza (L.) Schleid.* | +++ | ++ | +++ | ++ | ++ | ++ |
| 16. | *Najas minor All.* | – | – | – | – | +++ | +++ |
| 17. | *Najas marina L.* | – | – | – | – | ++ | – |
| 18. | *Salvania natans (L.) All.* | ++ | + | +++ | + | ++ | ++ |
| 19. | *Salvania molestra Mitchella* | + | – | +++ | – | – | – |
| 20. | *Sagitaria obtusifolia L.* | ++ | – | + | – | – | + |
| 21. | *Trapa natans L.* | +++ | – | ++ | – | + | – |
| 22. | *Utricularia vulgaris L.* | +++ | – | – | – | + | +++ |
| 23. | *Vallisneria spiralis L.* | + | – | – | – | +++ | +++ |
| 24. | *Wolffia sp.* | ++ | + | ++ | + | ++ | ++ |
| 25. | *Blyxa aubertii Rich.* | – | – | – | – | – | + |

*Note: (Abundent: +++, Moderate: ++, Few: +, Absent: –).*

Lendara Lake was the least diverse compared to other lakes under study. Lendara Lake has abundant growth of *Microcystis sp*., and the growth of aquatic macrophytes was suppressed. *Ceratophyllum sp.* was observed during the study period. It might be due to a lack of nitrates and sulfates in the water body and the environmental status of the lake.

In Mashanghat Lake, also known as Malhar Lake, *Ceratophyllum sp.,* followed by *Salvinia natans, Salvinia molesta, Pistia stratiotes, Spirodella polyrhiza, Azolla pinnata, Lemna minor* were observed during the study period. It might be due to the nutritional environmental status of the lake.

In Dolara Lake, abundant growth of *Pistia stratiotes* was found, which affects other aquatic macrophytes growth and development. It might be due to sulfates and nitrates in the water body.

Lonara Lake was less polluted as compared to other lakes under study area, and aquatic macrophytes grew well throughout the study period. *Hydrilla verticilliata* and *Najas minor* were dominant, followed

 

by *Elodea sp. Nymphoides sp., Najas matina,* and *Vallisneria spiralis* grew well. *Pistia stratiotes is* not found in Lonara Lake. It might be due to *Pistia stratiotes referring* slightly acidic water, and Lonara Lake is less acidic, which is essential for the growth of *Pistia stratiotes.* It might be due to the oligotrophic nature of the water body.

Mohabala lake was less polluted as compared to rest of the lakes of the Bhadrawati region have dominant growth of *Vallisneria spiralis, Hydrilla verticillata*, *Ottelia alismoides, Pomatogeton sp., Nymphya sp., Nymphoides hydrophylla, Nymphoides indica, Najas minor, Spirodella polyrhiza, Lemna sp., Azolla sp., Wolffia sp., Sagitaria obtusifolia, Vallisneria sp., Utricularia sp., Blyxa aubertii* Rich., and *Pistia stratiotes,* not found in Mohabala lake. *Hydrilla verticillata* and *Ottelia alismoides* are good bioindicators for water pollution. It might be due to the oligotrophic nature of the water body.

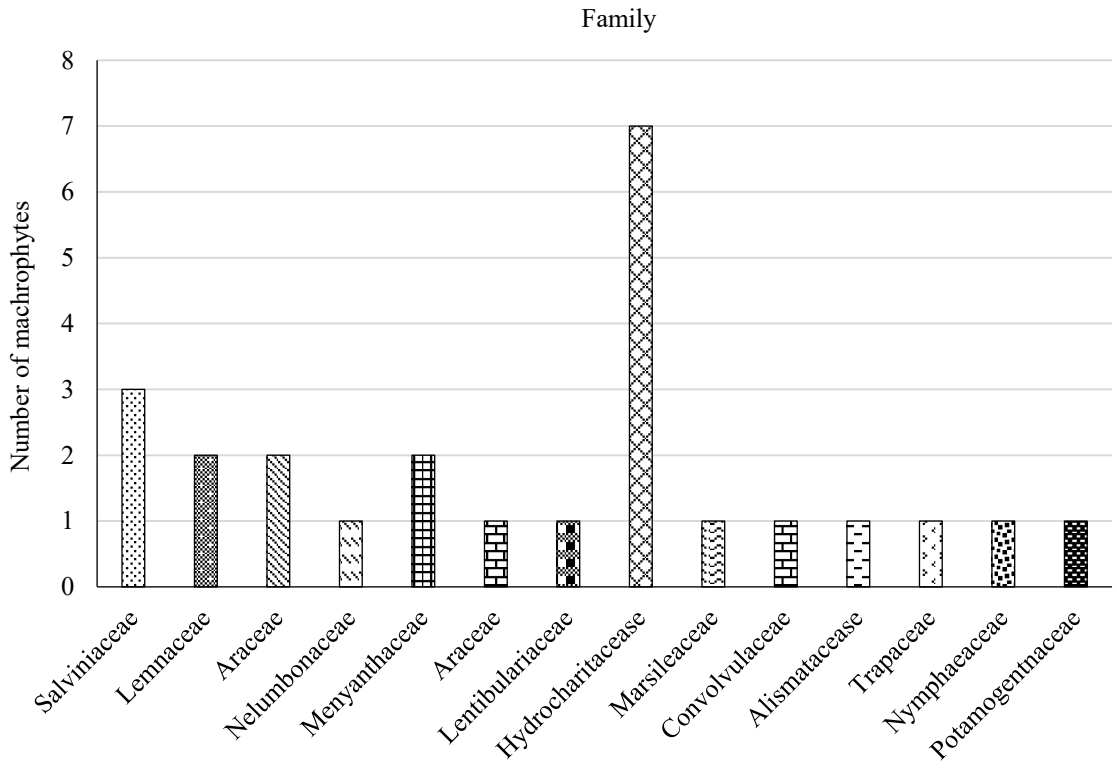


**Figure 2.** Shows the number of macrophytes and their families; Hydrocharitaceae members were present the most, and Nelumbonaceae, Araceae, Lentibulariaceae, Marsileaceae, Convolvulaceae, Alismataceae, Trapaceae, Nymphaeaceae, and Potamogetonaceae were present the least.

Macrophytes were recorded with a total of 15 species belonging to 11 families under three sites in Washim district [19]. Macrophytes reported 25 families and 40 genera in Chamorshi tahsil in Gadchiroli District, Maharashtra (India) [20]. Aquatic plants were recorded as 15 species belonging to 5 groups of macrophytes [2]. Macrophytes reported 16 macrophytes. Among 16 macrophytes, 9 were free floating, 4 were submerged, 2 were marginal hydrophytes in Sakya Sagar Lake, Shivpuri, Madhya Pradesh [1].

A total of 60 macrophyte families were reported. Cyperaceae was dominant, 2 species were pteridophytes, 6 were submerged, 6 were free floating, and 5 were fixed floating species of Puri district, Odisha, India [4]. Recorded a total of 16 species of aquatic weeds, i.e., free floating, submerged, rooted floating, rooted submerged, rooted emergent, and marginal plants in Kosari lake of Chamorshi tahsil in Gadchiroli District, Maharashtra, India [15]. Studied 4 groups of aquatic macrophytes in Chora village lake of Bhadrawati tahsil, District-Chandrapur, Maharashtra, India [11]. Recorded total of 157 aquatic weeds out of 157 plants, *Ipomoea aquatica, Eichhornia crassipes, Chara sp., Alternanthera*

 

*philoxeroides, Potamogeton sp., Ceratophyllum sp., Vallisnaria spiralis, Nelumbo nucifera, Typha angustata,* and *Salvinia sp*. were found in the studied water bodies of Washim region in Maharashtra, India [10].

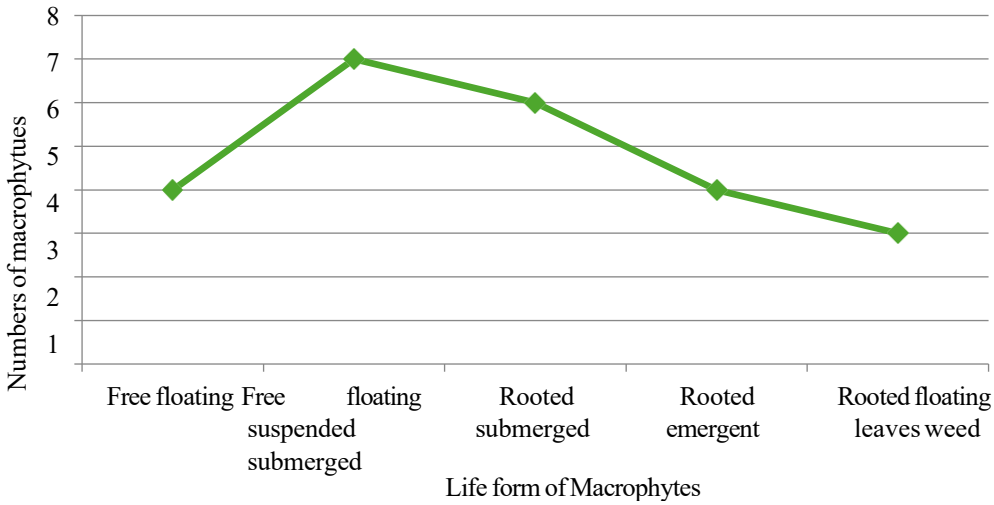


**Figure 3.** Shows the number of macrophytes and life form, high growth showed in free-floating suspended submerged, and least growth showed in rooted floating leaves weeds.


**Figure 4(A).** Dhoodhala Lake.


**Figure 4(B).** Lendara Lake.

 


**Figure 4(C).** Mashanghat (Malhar) Lake.


**Figure 4(D).** Dolara Lake.


**Figure 4(E).** Lonara Lake.


**Figure 4(F).** Mohabala Lake.

**Figure 4(A–F).** Names and photos of lakes of Bhadrawati Tahsil, District-Chandrapur, Maharashtra.

 


**Figure 5(A).** *Azolla pinnata* R. Br.


**Figure 5(B).** *Spirodella polyrhiza* (L.)


**Figure 5(C).** *Lemna minor* L. and *Wolffia sp.*

 


**Figure 5(D).** *Nymphoides hydrophylla* (Lour.) Kuntze.


**Figure 5(E).** *Nelumbo nucifera* Gaertn.


**Figure 5(F).** *Nymphoides indica* (L.) Kuntze.


**Figure 5(G).** *Salvania natans* (L.) All.


**Figure 5(H).** *Pistia stratiotes* L.


**Figure 5(I).** *Salvania molestra* Mitchella.


**Figure 5(J).** *Utricularia vulgaris* L.

 


**Figure 5(K).** *Vallisneria spiralis* L.


**Figure 5(L).** Hydrilla verticillata (L.f.) Royale.


**Figure 5(M).** Najas minor all.

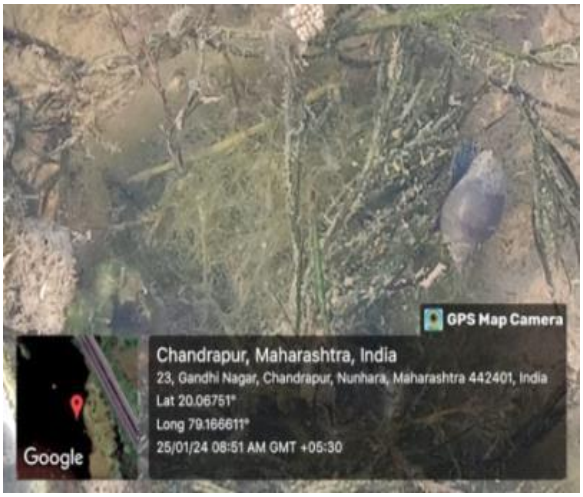


**Figure 5(N).** Elodea sp.


**Figure 5(O).** Ceratophyllum demersum L.


**Figure 5(P).** Najas marina.

 

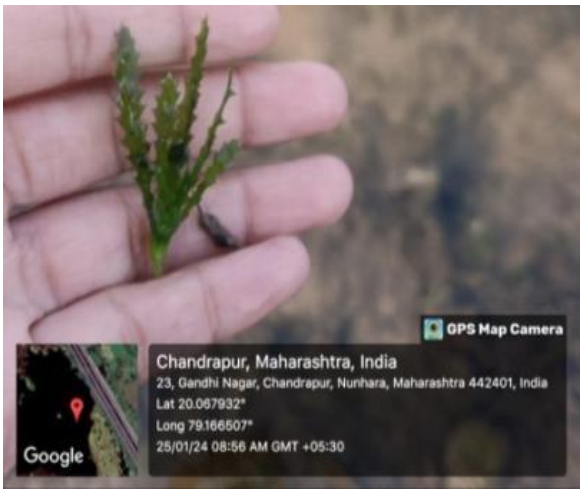


**Figure 5(Q).** Najas marina L.

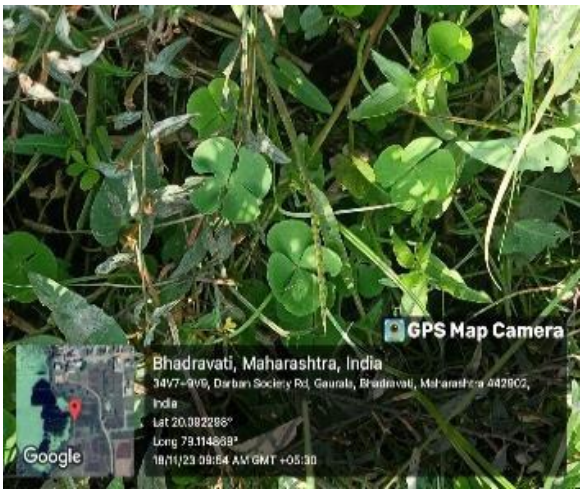


**Figure 5(R).** Sagitaria obtusifolia L.


**Figure 5(S).** *Ipomoea aquatica* Forssk.


**Figure 5(T).** *Ipomoea aquatica* Forssk.

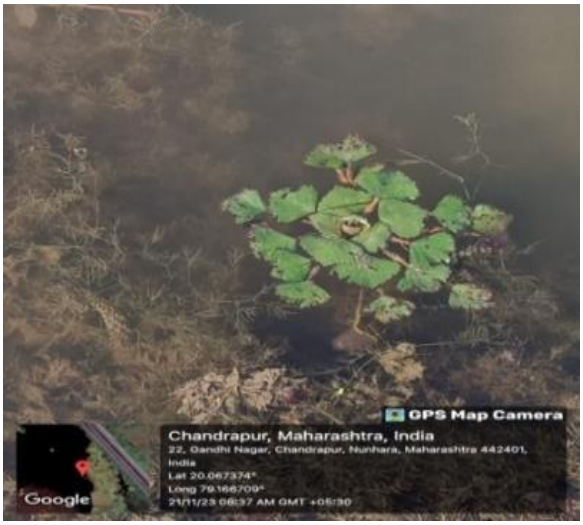


**Figure 5(U).** *Trapa natans* L.


**Figure 5(V).** Nymphaea sp.

 


**Figure 5(W).** *Nymphaea sp.*

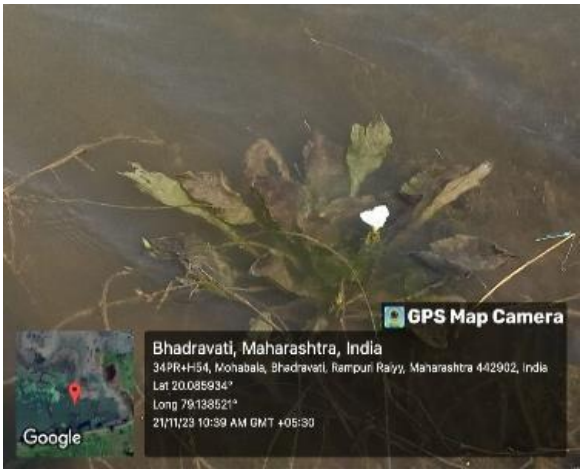


**Figure 5(X).** *Ottelia alismoides* (L.) Pers.

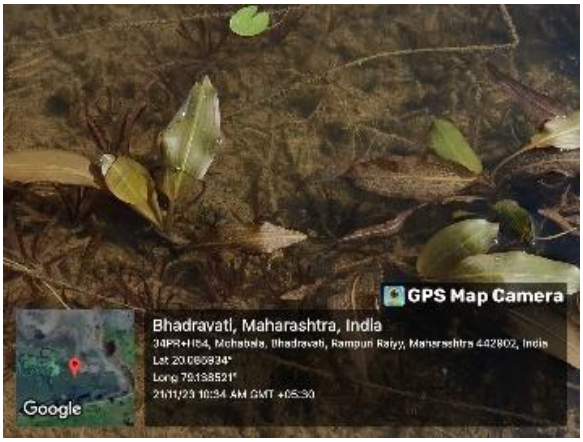


**Figure 5(Y).** *Blyxa aubertii* Rich.


**Figure 5(Z).** *Pomatogeton crispus* L.

**Figure 5.** Names and photos of macrophytes of lakes of Bhadrawati Tahsil, District-Chandrapur, Maharashtra.

## CONCLUSIONS

The present study records the diversity of aquatic plants with the distribution of different species in different lakes of Bhadrawati Tahsil. The current study revealed the diverse groups of hydrophytes in six lakes of Bhadrawati Tahsil, District-Chandrapur. A total of 25 aquatic macrophytes belonging to different categories were observed. Hydrocharitaceae is dominant among all families observed during the study, followed by Salviniaceae, Lemnaceae, Araceae, and least presence, Nelumbonaceae, Menyanthaceae, Lentibulariaceae, Ceratophyllaceae, Marsileaceae, Convolvulaceae, and Potamogetonaceae. Hydrophytes are vital for healthy ecospheres.

According to the IUCN (International Union for Conservation of Nature) Red List status, *Pomatogeton crispus, Elodea sp., Ottelia alismoides,* and *Blyxa aubertii* are listed in least concern.

### Conflict of Interest

The author declares that there are no conflicts of interest regarding the publication of this work.

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