AQUATIC PLANT DIVERSITY OF LAKES AROUND GONDIA CITY, MAHARASHTRA, INDIA

Amol Badole[*], Ravindra Zode[**], Walay Tagade[**], Mahesh Kawale[*]

[*] Dhote Bandhu Science College, Gondia, India
[**] Chhotabhai JaverBhai Patel Arts & Commerce College, Tirora, Gondia, India

corresponding author: Mahesh Kawale, e-mail: kawalemahesh@gmail.com

Original scientific paper
Received: May 30th, 2020
Accepted: June 29th, 2020
HAE-1970
https://doi.org/10.33765/thate.11.2.1

ABSTRACT

Gondia is one of the centrally located districts of India. It is famous for its lakes and water bodies. These water bodies exhibit enormous diversity of plants according to geographical location, depth of water body, water regime, chemistry of water, soil and sediment characteristics. Very little work has been done so far on the flora of the water bodies of Gondia district. Therefore, a study has carried out to understand the aquatic plants diversity of selected 5 lakes around Gondia city. For this, well-planned surveys were carried out at selected sites frequently. During visits, data like habit, life span, local names, and life forms of all the plant species present in the water body were collected. During the study, 44 species of 37 genera belonging to 26 families have been recorded from selected sites. Most dominant family was Hydrocharitaceae with 4 genera and 4 species, followed by Asteraceae, Poaceae, Convolvulaceae and Potamogetonaceae with 3 species each. Jaccard and Sorenson similarity indexes showed that Lake I and Lake II have maximum similarity and highest diversity as compared to other sites. The present work revealed the database of aquatic plants in water bodies around Gondia, which will help in future work for the conservation, preservation and growth of the local biodiversity.

***Keywords**: aquatic plants, diversity, Gondia, Jaccard & Sorenson Similarity index, wetlands*

INTRODUCTION

Gondia is a north-eastern border district of Maharashtra state, connected with Chhattisgarh on the eastern side and Madhya Pradesh towards Northern side. Geographically, it is in the centre of India and spread over the area of 5859 km^2, out of which 2833 km^2 are under forest cover. Gondia is important from the biodiversity point of view as it is a site of two protected areas, i.e. Navegaon Bandh National Park and Nagzira Wildlife Sanctuary. Gondia is also famous for its lakes and ponds, therefore it is considered as the lakes district of Maharashtra. One well-known Navegaon Bandh lake with wetland is present in the district. Likewise, every village and town of this district has its own lake or water body. Restoration and recharge of water table is possible due to the lakes, thus the lakes

play an important role in our lives [1]. These water bodies or wetlands exhibit enormous diversity of plants according to geographical location, depth of water body, water regime, chemistry of water, soil and sediment characteristics [2]. Moreover, these water bodies are an integral component of the daily life activities of rural people for their survival, and hence these ecosystems are more vulnerable to eutrophication because of the anthropogenic activities [3]. All these things lead variation in the aquatic plant diversity of water body, which ultimately affects water retaining capacity of wetland day by day.

The researches on aquatic plants have started gaining importance, as they are part of biodiversity. Moreover, they are an important source of food, fodder, herbal medicine and domestic household materials for the people living in its vicinity. There are many aquatic plants which produce corms and rhizomes which are used for an edible purposes in many rural areas. They are also important components of lentic ecosystems. Various researchers have carried out surveys on such aquatic plants in different water bodies across India [4 - 6]. Aquatic plants provide food, oxygen, shelter and breeding place for aquatic animals and maintain the integral balance of the ecosystem [7, 8]. Studies on aquatic plants, especially their ecology, were few in number before 1960s [9]. But, thereafter several studies relating to aquatic and wetland flora have been carried out by many researchers throughout the world, including various parts of India [10 - 15].

Kumar and Chelak [12] studied macrophytic diversity in ponds of Dongargarh city of Chattisgarh and compared their observations with the study conducted earlier and concluded that macrophyte assemblages are changing and are dynamic in different ponds. Two RET (Rare, Endangered and Threatened) species viz. *Wolffia arrhiza* and *Lindernia anagallis* of Araceae and Scrophulariaceae family respectively were documented from Gadakharad lake by Dalasingh et al. [16]. Chen et al. [17] also reported that several hydrophyte families, which were not listed on the Red List of China, have been severely threatened in Japan; they also suggested a comprehensive evaluation of the status of hydrophytes in China. It indicates that for conservation measures to be enacted, it is necessary to describe the actual status of aquatic species; however, the distribution data on aquatic macrophyte flora, which is the most basic information necessary for the threatened species, are relatively limited. For example, no floristic data have been obtained for more than 19 major and hundreds of minor lakes found in Gondia district. Hence, present study has been conducted to understand aquatic plant diversity of 5 selected water bodies of Gondia district.

EXPERIMENTAL

Study Site

Gondia district is situated at 80.1961^0 E longitude and 21.4549^0 N latitude. For the study of aquatic plants, 5 sites were selected around Gondia city and a survey was carried out during the months of July 2019 to February 2020. The selected lakes were Katangi kala (henceforth referred to as Lake I), Lohara (henceforth referred to as Lake II), Fulchur (henceforth referred to as Lake III), Pangdi (henceforth referred to as Lake IV), and Karanja (henceforth referred to as Lake V) (Table 1, Figure 1).

Table 1. Morphometric data of selected sites [18]

Lakes	Surface area, m^2	Max. depth, m	Mean depth, m	Retention time
I	22500	3.50	1.75	8 months
II	89031	3.05	2.00	8 months
III	50000	4.10	2.00	9 months
IV	729300	12.50	5.50	12 months
V	25100	5.49	3.20	12 months

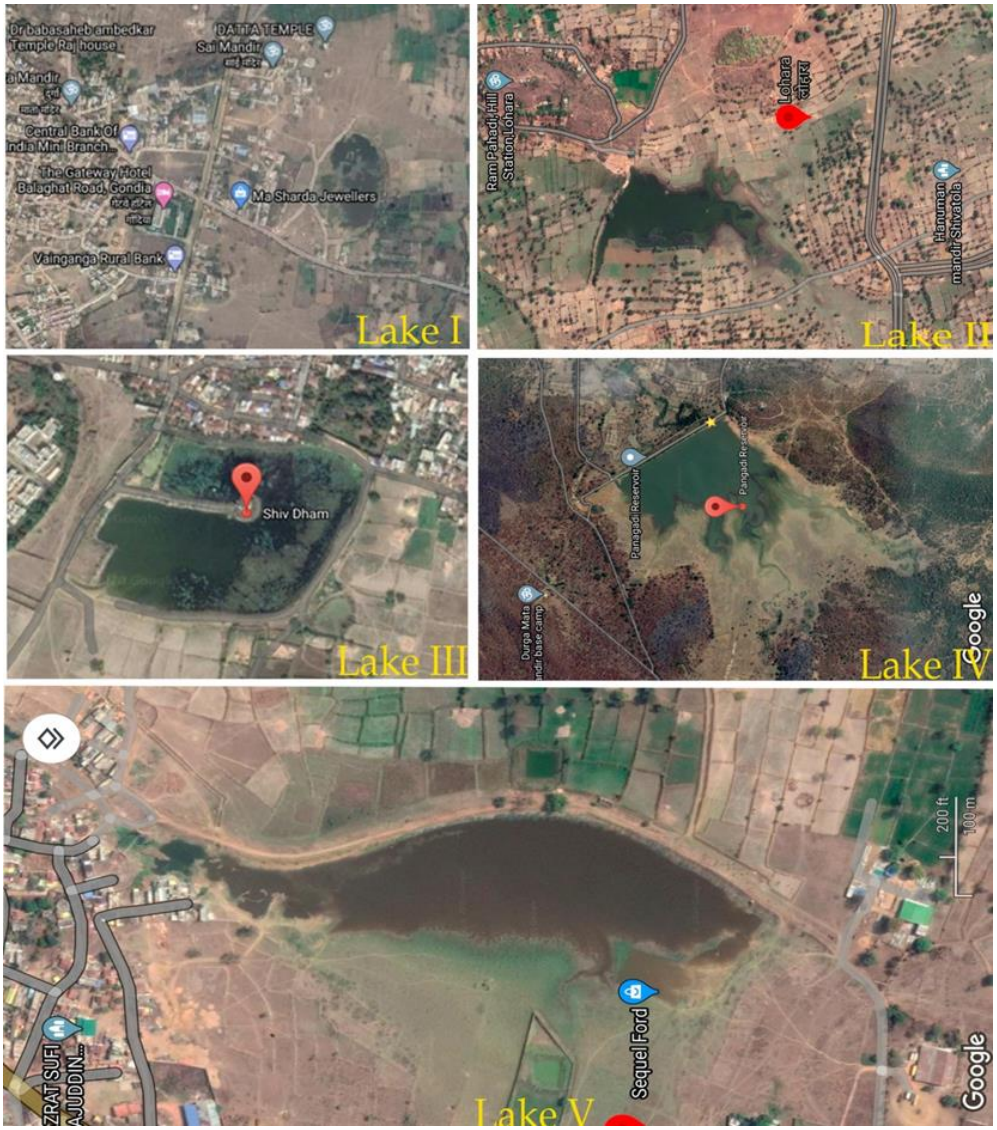


Figure 1. Satellite images of selected sites: Lake I [19], Lake II [20], Lake III [21], Lake IV [22] and Lake V [23]

Collection of aquatic plants

All these lakes were visited regularly during the period of survey and aquatic plants were collected and photographed. Collected plants were brought to the laboratory and identified there by using standard floras like Flora of Maharashtra state, Flora of Nagpur District, Flora of Kolhapur and Flora of Madhya Pradesh [24 - 27].

Analysis of collected data

From the collected species, data like habit, life span, local names gathered and tabulated for analysis. Collected plants (uprooted or detached twig) pressed under newspaper for the herbarium preparation. These collected plants are classified on the basis of their habitat, family, morphological characters. They were also analysed according to the habit of life forms, i.e. whether they are free floating, emergent, submerged or rooted floating, etc. From the data of presence or absence of plants at different sites, Jaccard's similarity index (JSI) [28] was applied and analysed:

$$S_J = a/(a + b + c)$$

where is: S_J - Jaccard's similarity coefficient, a - number of species in both sites, b - number of species absent in A but present in B, c - number of species present in A but absent in B.

The above aquatic plant data was also analysed by Sorensen's similarity index (SSI) [29]. This measure is very much similar to Jaccard's measure:

$$S_S = 2a/(2a + b + c)$$

where is: S_S - Sorensen's similarity coefficient, a - number of species in both sites, b - number of species absent in A but present in B, c - number of species present in A but absent in B.

RESULTS AND DISCUSSION

A total 44 species of aquatic plants representing 37 genera belonging to 26 families have been recorded from the selected 5 sites. Out of these, 41 species of 34 genera covering 24 families were Angiosperm, 2 species of 2 genera representing 1 family were Algae and 1 species of 1 genera representing 1 family was Pteridophyte. Amongst the Angiosperm, 24 dicot species belong to 19 genera and 14 families and 17 monocot species belong to 15 genera and 10 families were found (Figure 2).

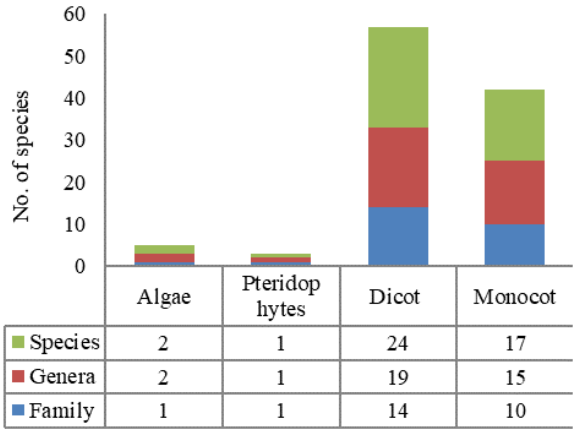


Figure 2. Distribution on the basis of plant types

During the study, 32 genera were represented with single species, 4 genera by 2 species each and 1 genera by 3 species (Table 2). Hydrocharitaceae were found to be the most observed family with 4 genera and 4 species, followed by Asteraceae, Poaceae, Convolvulaceae and Potamogetonaceae with 3 species each. Families like Amaranthaceae, Characeae, Lythraceae, Menyanthaceae, Onagraceae, and Scrophulariaceae were represented by 2 species each and all the remaining families were represented by 1 species only (Tables 2 and 3 and Figure 3). Lakshmanan and Gathi [4] also reported the dominance of Hydrocharitaceae, Poaceae along with Convolvulaceae family in selected wetlands of Tamilnadu.

Table 2. Categorization of families and genera according to number of species

Sr. No.	Categories	No. of families	Sr. No.	Categories	No. of genera
1	Families with 1 species	15	1	Genera with 1 species	32
2	Families with 2 species	6	2	Genera with 2 species	4
3	Families with 3 species	4	3	Genera with 3 species	1
4	Families with 4 species	1	4	Genera with 4 species	0

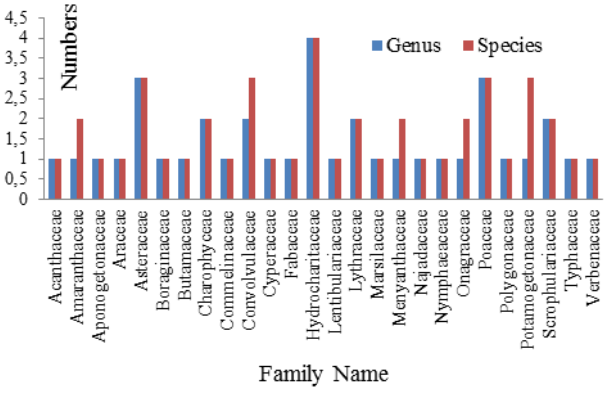


Figure 3. Family-wise distribution of genus and species

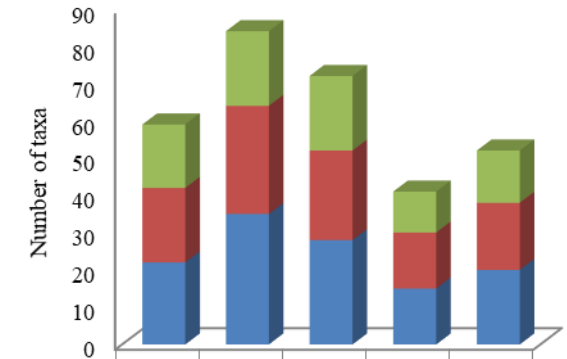
Table 3. Details of plants observed in the study

Sr. No.	Plant name	Family	Vernacular name	Habit	Life span
1	*Aeschynomene aspera*	Fabaceae	Laugauni	Emergent	Perennial
2	*Alternanthera pubescence*	Amaranthaceae	-	Emergent	Perennial
3	*Alternanthera sessilis*	Amaranthaceae	Kanchari	Emergent	Perennial
4	*Amania bacifera*	Lythraceae	Aginbuti	Emergent	Annual
5	*Aponogeton natans*	Aponogetonaceae	-	Rooted floating	Perennial
6	*Blyxa aubertii*	Hydrocharitaceae	-	Rooted floating	Annual
7	*Butomopsis lanceolata*	Butamaceae	-	Rooted floating	Annual
8	*Chara deliculata*	Characeae	-	Submerged	Annual
9	*Commelina benghalensis*	Commelinaceae	Kena	Emergent	Perennial
10	*Eclipta prostrata*	Asteraceae	Bhringranj	Emergent	Annual
11	*Elytrophorus spicatus*	Poaceae	Janglirala	Emergent	Annual
12	*Evolvulus nummularius*	Convolvulaceae	Nimulvel	Emergent	Perennial
13	*Gnaphalium polycaulon*	Asteraceae	-	Emergent	Annual
14	*Grangea maderaspatana*	Asteraceae	Godri	Emergent	Annual
15	*Heliotropium indicum*	Boraginaceae	Burundi	Emergent	Annual
16	*Hydrila verticillata*	Hydrocharitaceae	Seval	Submerged	Perennial
17	*Hygrophila auriculata*	Acanthaceae	Talimkhana	Emergent	Annual
18	*Ipomoea aquatica*	Convolvulaceae	Panivel bhaji	Rooted floating	Perennial
19	*Ipomoea fistula*	Convolvulaceae	Besharam	Emergent	Perennial
20	*Limnophila heterophylla*	Scrophulariaceae	Ambuli	Emergent	Annual
21	*Ludvigia ascendence*	Onagraceae	Kavkula	Rooted floating	Annual
22	*Ludvigia parviflora*	Onagraceae	Pan-lavang	Emergent	Annual
23	*Marsilea quadrifolia*	Marsilaceae	Caupatia	Rooted floating	Annual
24	*Najas graminea*	Najadaceae	-	Submerged	Annual
25	*Nitella gracillis*	Characeae	-	Submerged	Annual
26	*Nymphaea nauchali*	Nymphaeaceae	Kamal	Rooted floating	Perennial
27	*Nymphea* sp.	Nymphaeaceae	-	Free floating	Annual
28	*Nymphoides hydrophylla*	Menyanthaceae	Kamali	Free floating	Annual
29	*Nymphoides indicum*	Menyanthaceae	Kumudini	Free floating	Perennial
30	*Oryza* sp.	Poaceae	Devtandul	Rooted floating	Annual
31	*Ottelia alismoidis*	Hydrocharitaceae	-	Submerged	Annual
32	*Phyla nodiflora*	Verbenaceae	Jalpimpri	Emergent	Perennial
33	*Pistia strtiotes*	Araceae	PanKumbhi	Free floating	Perennial
34	*Polygonum glybrum*	Polygonaceae	Gulabi Godhri	Emergent	Annual
35	*Potamogeton crispus*	Potamogetonaceae	Sawal	Submerged	Perennial
36	*Potamogeton natans*	Potamogetonaceae	-	Rooted floating	Annual
37	*Potamogeton* sp.	Potamogetonaceae	-	Rooted floating	Annual
38	*Rotala fimbriata*	Lythraceae	-	Emergent	Annual
39	*Sacciolepsis intrupta*	Poaceae	-	Rooted floating	Perennial
40	*Schenoplectus* sp.	Cyperaceae	Gad	Emergent	Annual
41	*Striga densifera*	Scrophulariaceae	Agya	Emergent	Annual
42	*Typha angustifolia*	Typhaceae	Pan-kanis	Emergent	Perennial
43	*Utricularia reticulata*	Lentibulariaceae	Nili Papni	Submerged	Annual
44	*Vallisneria spiralis*	Hydrocharitaceae	Seval	Submerged	Perennial

The plant diversity is a strong bio-indicator for lake ecosystems differed in types and response [30]. The aquatic plant species diversity of 5 lakes was found to be healthy as *Pistia strtiotes* was the only invasive alien plant found there. Lake II had the highest number of species (35 spp.), followed by Lake III (28 spp.), Lake I (22 spp.), Lake V (20 spp.) and Lake IV (15 spp.). A total of 35 aquatic plant species (80 % of the total recorded species) were confined only to Lake II, out of the 5 lakes. On the other hand, Lake IV and V had the lowest number of confined species (Figure 4).

It has been observed by Kohtaroh et al. [10] that floristic diversity of any pond depends upon some factors like size, depth or shallowness of the water body, sediment deposition, seed sources, as well as the recent history of the water body regarding any type of excavation. Boyra and Patralekh [31] also

reported that aquatic plants occur mainly in the shallow regions of lakes, ponds or any water body. In the present study, a clear pattern is observed, in which the plant species coverage increased when the depth of lake decreased. It indicates that aquatic plant diversity of Lake IV (15 plant species) is negatively correlated with the lake surface area and depth, whereas Lake II (35 plant species) showed positive correlation with the lake surface area and depth as compared to rest of the lakes (Tables 1 and 4 and Figure 4). Different areas of a lake can have water depths variation because of the diverse topography of the lake bottom. Depth plays a very important role in the growth of aquatic plants, as the factors like water transparency, water temperature, availability of light, and light regime have effect on it [32]. Changes in all of these factors can affect the growth and distribution of submerged plants and structure of communities [33]. There are many reports which showed effects of water depth on the growth of the submerged species *Myriophyllum spicatum* [34, 35], *Potamogeton pectinatus* [36], *Potamogeton maackianus* and *Potamogeton malaianus* [37, 38] and on the community composition of the submerged macrophytes [39].



	Lake I	Lake II	Lake III	Lake IV	Lake V
Families	17	20	20	11	14
Genera	20	29	24	15	18
Species	22	35	28	15	20

Figure 4. Sitewise distribution of taxa

Lake I, II and III are seasonal i.e. they carry water for 8 - 9 months of a year, while Lake IV and V store water throughout year (Table 1). Hence, grazing by domestic cows and buffaloes are observed around Lake I, II and III during certain periods of the year which may increase the plant diversity. This result is in accordance with hypothesis concerning the role of disturbances and productivity in biodiversity [40, 41]. In addition to these, some anthropogenic activities, like fishing, could also be the reason behind variation in aquatic plant diversity in selected lakes. Fishing is carried out in Lake IV and V in most of the part of year which is not found in Lake I, II and III.

Plant species like *Ipomoea fistula*, *Nitella gracillis*, *Evolvulus nummularius*, *Hygrophila auriculata*, *Grangea maderaspatana*, *Ludvigia parviflora* and *Alternanthera sessilis* were observed in all 5 sites. However, species like *Nymphoides indicum*, *Potamogeton crispus*, *Blyxa aubertii*, *Butomopsis lanceolate*, *Striga densifera*, *Limnophila heterophylla* and *Polygonum glybrum* were only found at Lake II. Similarly, plants like *Pistia strtiotes*, *Commelina benghalensis* and *Najas graminea* were found absent in all other lakes except Lake III. *Elytrophorus spicatus* belonging to Poaceae family was found only in Lake IV, even though this site has least plant diversity as compared to other lakes (Table 4).

Significant phyto-social association had been recorded among the different aquatic plants of studied lakes, like *Vallisneria spiralis* was always found in association with *Chara deliculata*. Wherever *Ludvigia parviflora* was found, *Alternanthera sessilis* was also observed nearby. Similarly, *Nymphoides hydrophylla* and *Potamogeton natans*, *Ludvigia ascendence* and *Ipomoea aquatic*, *Nymphaea nauchali* and *Nymphoides hydrophylla*, *Otelia alismoidis* and *Potamogeton natans*, *Hygrophila auriculata* and *Alternanthera pubescence* were also found together in some lakes (Table 4, Figure 5). Zervas et al. [42] studied phytosociological aspect of aquatic vegetation at Greece in large scale and observed many plant associations with *Phyla nodiflora*, *Phragmites australis*, *Lemna minor* etc.

Table 4. Sitewise distribution of aquatic plants

Sr. No.	Plant name	Lake I	Lake II	Lake III	Lake IV	Lake V	Frequency	Different pairs possible among the plant sp.
1	*Aeschynomene aspera*	+	+	+	-	-	3	K+L, L+F, K+F
2	*Alternanthera pubescence*	+	+	+	-	+	4	K+L, L+F, F+Z, K+Z
3	*Alternanthera sessilis*	+	+	+	+	+	5	K+L, L+F, F+P, P+Z, K+Z
4	*Ammania bacifera*	+	+	-	+	-	3	K+L, L+P, K+P
5	*Aponogeton natans*	-	-	+	-	-	1	F
6	*Blyxa aubertii*	-	+	-	-	-	1	L
7	*Butomopsis lanceolata*	-	+	-	-	-	1	L
8	*Chara deliculata*	-	+	+	-	+	3	L+F, F+Z, L+Z
9	*Commelina benghalensis*	-	-	+	-	-	1	F
10	*Eclipta prostrata*	+	+	+	+	-	4	K+L, L+F, F+P, K+P
11	*Elytrophorus spicatus*	-	-	-	+	-	1	P
12	*Evolvulus nummularius*	+	+	+	+	+	5	K+L, L+F, F+P, P+Z, K+Z
13	*Gnaphalium polycaulon*	+	+	-	+	+	4	K+L, L+P, P+Z, K+Z
14	*Grangea maderaspatana*	+	+	+	+	+	5	K+L, L+F, F+P, P+Z, K+Z
15	*Heliotropium indicum*	+	+	_	+	-	3	K+L, L+P, K+P
16	*Hydrila verticillata*	-	+	-	-	+	2	L+Z
17	*Hygrophila auriculata*	+	+	+	+	+	5	K+L, L+F, F+P, P+Z, K+Z
18	*Ipomoea aquatica*	+	+	+	-	+	4	K+L,L+F, F+Z, K+Z
19	*Ipomoea fistula*	+	+	+	+	+	5	K+L, L+F, F+P, P+Z, K+Z
20	*Limnophila heterophylla*	-	+	-	-	-	1	L
21	*Ludvigia ascendence*	-	+	+	-	-	2	L+F
22	*Ludvigia parviflora*	+	+	+	+	+	5	K+L, L+F, F+P, P+Z, K+Z
23	*Marsilea quadrifolia*	+	+	+	-	+	4	K+L, L+F, F+Z, K+Z
24	*Najas graminea*	-	-	+	-	-	1	F
25	*Nitella gracillis*	+	+	+	+	+	5	K+L, L+F, F+P, P+Z, K+Z
26	*Nymphaea nauchali*	+	+	+	-	-	3	K+L, L+F, K+F
27	*Nymphea* sp.	-	-	+	-	+	2	F+Z
28	*Nymphoides hydrophylla*	+	+	+	-	+	4	K+L, L+F, F+Z, K+Z
29	*Nymphoides indicum*	-	+	-	-	-	1	L
30	*Oryza* sp.	-	+	+	-	-	2	L+F
31	*Otelia alismoidis*	-	+	+	-	-	2	L+F
32	*Phyla nodiflora*	+	-	+	+	+	4	K+F, F+P, P+Z, K+Z
33	*Pistia strtiotes*	-	-	+	-	-	1	F
34	*Polygonum glybrum*	-	+	-	-	-	1	L
35	*Potamogeton crispus*	-	+	-	-	-	1	L
36	*Potamogeton natans*	-	+	+	-	-	2	L+F
37	*Potamogeton* sp.	+	+	-	-	-	2	K+L
38	*Rotala fimbriata*	-	-	-	+	+	2	P+Z
39	*Sacciolepsis intrupta*	+	+	-	-	-	2	K+L
40	*Schenoplectus sp.*	+	+	-	-	+	3	K+L, L+Z, K+Z
41	*Striga densifera*	-	+	-	-	-	1	L
42	*Typha angustifolia*	-	-	+	+	+	3	F+P, P+Z, F+Z
43	*Utricularia reticulata*	+	+	+	-	-	3	K+L, L+F, K+F
44	*Vallisneria spiralis*	-	+	+	-	+	3	L+F, F+Z, L+Z
K - Lake I, L - Lake II, F - Lake III, P - Lake IV and Z - Lake V								

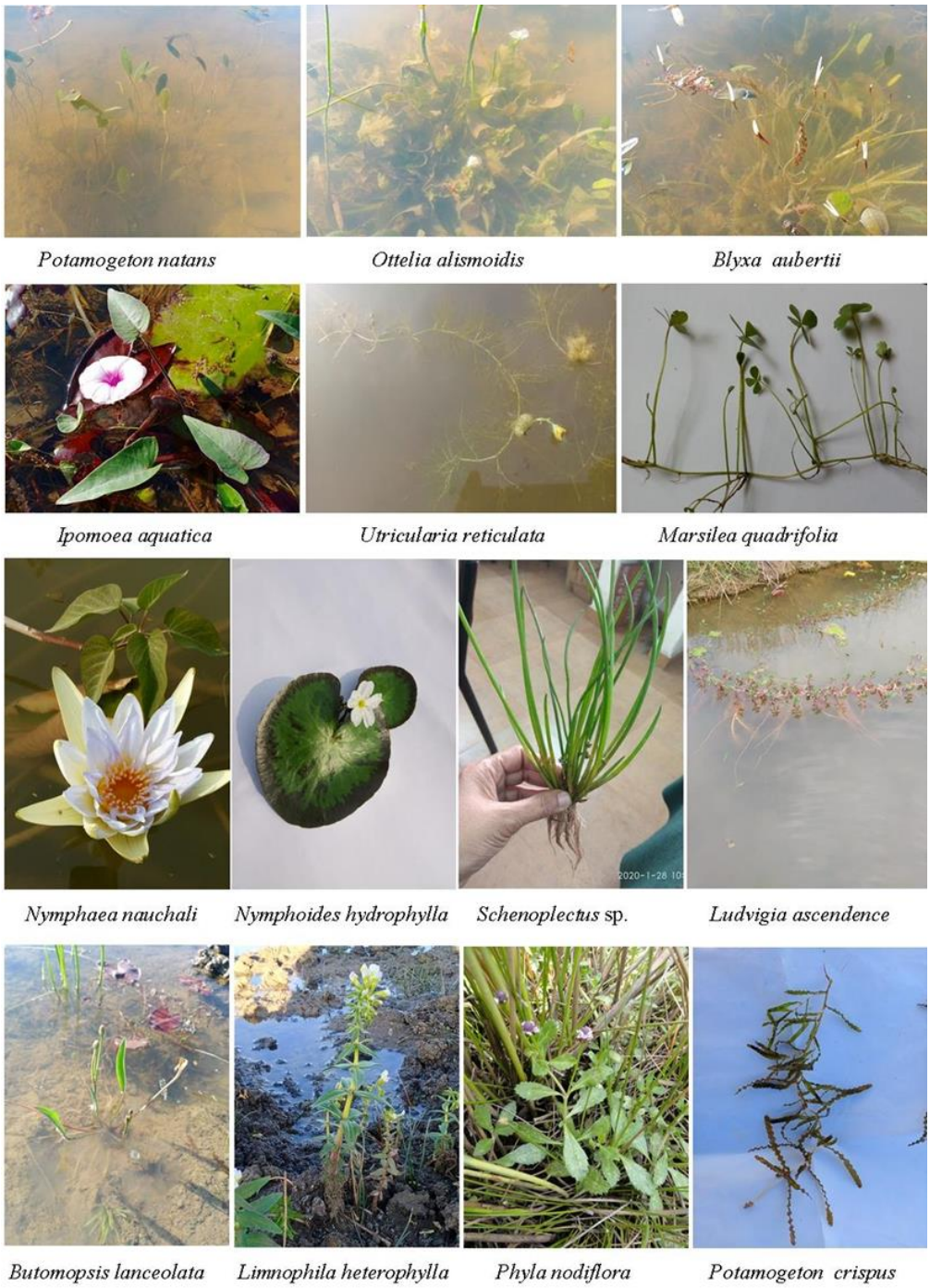
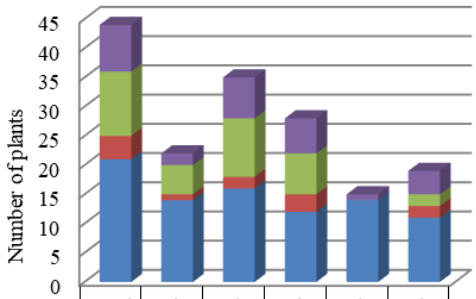


Figure 5. Some plants recorded from selected 5 sites

The inconsistent water depth of the lakes leads to the growth of various species in a specified micro habitat. The collected aquatic plants of these lakes can be classified into different micro-habit groups [43]. Among the total collected plants, 21 (48 %) species belong to the emergent type followed by 11 (25 %) species of the rooted floating type, 8 (18 %) species of the rooted-submerged, and 4 (9 %) species of the free floating type. If observed based on the distribution by lakes, the emergent plants were equally distributed in all lakes, however, the rooted floating and free floating plants were found in negligible numbers in Lake IV and V which are deeper than the other lakes. Submerged plants were also observed in similar numbers in all the lakes (Table 1, Figure 6).

As per the Jaccard's similarity index, Lake I and II have maximum similarity (0.58 %) and highest diversity as compared to other sites.

The sites Lake I and V, Lake II and III, Lake III and V showed equal similarity (0.50 %), but they are less diverse than Lake I and II. The lowest similarity index was observed in Lake II and IV (0.28 %) and Lake III and IV (0.30 %), indicating lesser diversity. Sorenson's similarity index has also given the same observation that Lake I and Lake II have more similarity (0.73 %) and higher diversity, while Lake II and Lake IV indicated low similarity (0.44 %) and less diversity. As per Sorenson's coefficient, lake combinations like I and III, I and IV, II and III, II and V, III and V, IV and V showed similarity index in the range between 0.60 to 0.66 % (Tables 5, 6 and 7).



	Total	Lake I	Lake II	Lake III	Lake IV	Lake V
Submerged	8	2	7	6	1	4
Rooted floating	11	5	10	7	0	2
Free floating	4	1	2	3	0	2
Emergent	21	14	16	12	14	11

Figure 6. Lakewise distribution of plant types

Table 5. Location wise distribution of aquatic plants

Lake I					
Lake II	IIIII IIIII IIIII IIIII I				
Lake III	IIIII	IIIII IIIII IIIII IIIII I			
Lake IV	III	III	IIIII IIIII		
Lake V	IIIII IIIII IIIII	III	IIIII III	IIIII IIIII I	
	IIIII IIIII IIIII IIIII IIIII IIIII IIIII IIIII II	IIIII IIIII IIIII IIIII IIIII IIIII	IIIII IIIII IIIII IIIII II	IIIII IIIII II	
Lakes	Lake I	Lake II	Lake III	Lake IV	Lake V

Table 6. Use of Jaccard's coefficient to find similarity, %

I					
II	21/21+14+1 = 0.58				
III	16/16+12+6 = 0.47	21/21+7+14 = 0.50			
IV	12/12+3+10 = 0.48	11/11+4+24 = 0.28	10/10+5+18 = 0.30		
V	14/14+6+8 = 0.50	16/16+4+17 = 0.43	16/16+4+12 = 0.50	11/11+9+4 = 0.45	
Lakes	Lake I	Lake II	Lake III	Lake IV	Lake V

Table 7. Use of Sorenson's coefficient to find similarity, %

I					
II	2(21)/2(21) +14+1 = 0.73				
III	2(16)/2(16) +12+6 = 0.64	2(21)/2(21) +7+14 = 0.66			
IV	2(12)/2(12) +3+10 = 0.64	2(11)/2(11) +4+24 = 0.44	2(10)/2(10) +5+18 = 0.46		
V	2(14)/2(14) +6+8 = 0.66	2(16)/2(16) +4+17 = 0.60	2(16)/2(16) +4+12 = 0.66	2(11)/2(11) +9+4 = 0.62	
Lakes	Lake I	Lake II	Lake III	Lake IV	Lake V

CONCLUSION

The present work revealed the database of aquatic plants in water bodies around Gondia city which will act as authentic baseline documentation useful for further exploration and conservational studies of the local biodiversity. The vegetation of selected lakes is very interesting and diverse. The total of 44 species of aquatic plants representing 37 genera belonging to 26 families have been recorded. The present research work focuses on the floristic diversity and phytosociological association of the selected lakes. These lakes are good habitats, as there is no excessive growth of any invasive species. The present study also emphasized the influence of morphometric factors, like depth, on aquatic plant diversity. This kind of information is definitely essential for the establishment of truly sustainable management plan for these lakes. It is concluded that the floristic survey and constant monitoring of aquatic and semi-aquatic bodies are the need of the hour in order

to save the aquatic flora and to maintain the wild progenitors of the wetland plants.

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