

Species

To Cite:

Makanur NS, Pyarasabadi LI, Mirashi MM, Patgar VG, Betageri S, Kotresha K. Comparative account and diversity of lower and higher plants in two lakes of Haliyal Taluk, Uttara Kannada District, Karnataka. *Species* 2024; 25: e20s1655
doi: <https://doi.org/10.54905/disssi.v25i75.e20s1655>

Author Affiliation:

Taxonomy and Floristic Laboratory, Department of UG, PG and Research Botany, Karnatak University's, Karnatak Science College, Dharwad-580001, Karnataka, India

*Corresponding Author

Taxonomy and Floristic Laboratory, Department of UG, PG and Research Botany, Karnatak University's, Karnatak Science College, Dharwad-580001, Karnataka, India

Peer-Review History

Received: 04 February 2024

Reviewed & Revised: 08/February/2024 to 26/April/2024

Accepted: 30 April 2024

Published: 09 May 2024

Peer-Review Model

External peer-review was done through double-blind method.

Species

pISSN 2319-5746; eISSN 2319-5754



© The Author(s) 2024. Open Access. This article is licensed under a [Creative Commons Attribution License 4.0 \(CC BY 4.0\)](https://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made. To view a copy of this license, visit <http://creativecommons.org/licenses/by/4.0/>.

Comparative account and diversity of lower and higher plants in two lakes of Haliyal Taluk, Uttara Kannada District, Karnataka

Ningaraj S Makanur, Laxmi I Pyarasabadi, Megha M Mirashi, Vanaja G Patgar, Shreyas Betageri*, Kotresha K

ABSTRACT

Vascular plant diversity was conducted in the year 2022-2023 of two lakes in Haliyal taluk, Uttara kannada district with some water and soil parameters to show the diversity in two lakes. Totally 100 plant species were recorded in which lower plants and higher plants were differentiated. More species diversity is in Antrolli lake than Guttigere lake. Antrolli lake records 82 species out of 100 species and Guttigere lake records 48 species out of 100 species. 30 species are common in both lakes. 11 species are endemic and others are exotic. One algae is recorded in both the lakes.

Keywords: Antrolli lake, Guttigere lake, Higher plants, Lower plants, Soil parameters

1. INTRODUCTION

Macrosystems limnology is a framework for studying and managing freshwater ecosystems (rivers, streams, lakes, reservoirs, wetlands, and groundwater) that explicitly recognizes that freshwater ecosystems are shaped by terrestrial, aquatic, and atmospheric components and processes operating at multiple spatial and temporal scales (Ian et al., 2022). Hydrobiological study of two ponds (Laxman Singh Pond and Kyarakoppa Pond) and two lakes (Nuggikeri lake and Devaragudihal lake) situated in Dharwad. Both Kyarakoppa pond and Nuggikeri lake were disturbed by cattle-bathing, washing of clothes and occasional duck hunters. These water bodies supported macrophytes including species of *Hydrilla*, *Vallisneria*, *Najas* and *Nymphaea* (Hegde, 1985). Limnological Study of Lentic Ecosystems in Bodhgaya Block in Gaya District Bihar reports result showed that there is variation in the physicochemical parameters at different spots. His may be due to difference in topography and the nearby soil.

Seasonal variation was also observed regarding some parameters at some spots. Various zooplanktons like rotifers, Protozoans like *Amoeba* and *Paramoecium* along

with guppy fish, frogs, crabs and fresh water snails, Hydra were also observed. Some Aquatic algae *Chara*, *Spirogyra* and *Hydrilla* were also observed (Rajesh, 2020). Recorded limnological study of Nagaral Dam, Chincholi, Kalaburgi, Karnataka, India by monthly analysis of physio-chemical and heavy metal parameters of Calcium, magnesium, Chloride, Nitrate, concluded that too good for drinking and agricultural purpose (Bhat, 2004). Bharathi et al., (2013) records concluded that there is close relation between locations of water body and a level of water pollution. It is studied that there is inverse proportion between quantity of water in the water body or tanks and level of pollution at Anekere, Hassan in the year 2013.

Survey of Wet Land Macrophytes from Wetlands of Haliyal Taluk reported Dicotyledons were predominant in the study areas, from the diversity point of view Cyperaceae was the dominant family, followed by Commelinaceae, Lentibulariaceae and Scropulariaceae. *Azolla bipinnata* was the most common taxa in the studied areas. Eight species documented, have medicinal value. Among the morpho-ecological groups, emergent anchored were the dominant and the least were submerged rooted group. Shannon diversity index revealed comparatively high diversity in the riparian wetland of Bomanahalli dam. WMI scores reveals Yadoga and Murukwad in fairly good condition, whereas Sambrani and Ajgaoh are highly polluted and not suitable for fishing (Singh and Rajan, 2015). Limnological studies of two rivers in Uttara Kannada District, Karnataka state reported 25 physico-chemical factors were analyzed turbidity, dissolved oxygen and sulphate were higher in river Aghanashini than in river Kali.

Bhat, 2004 reported monthly study of phytoplankton for two years in river Aghanashini and Kali revealed that there were 7 phytoplankton groups consisting 40 genera comprising 226 taxa. Among the total genera and species, baillariophyceae (diatoms) was the dominant group comprising 18 (45%) genera and 116 (51.32%) species. Among these rivers, Aghanashini supported more number of genera (39) and species (191), while Kali had less number of genera (25) and species (74). An Ecological Study of Phytoplankton of Four Freshwater Bodies of Dharwad recorded Nuggikeri lake, Mugad lake, Rayapur pond & Kotur pond reported such as topography, climatic conditions, physico-chemical factors, rate of reproduction, death and water movement. In natural waters algae generally show a periodicity corresponding to the different seasons of the year (Dodagoudar, 1989).

Lakes and ponds sustain a rich diversity of large flora and fauna. A reason for biodiversity depletion is destruction of these natural habitats due to urbanization and pollution. Study of biodiversity facilitates in understanding the current scenario and accordingly take action plans to prevent and preserve further environment depletion. The present investigation aimed to study the floral diversity of three lakes of Bangalore - Agara, Madiwala and Kaikondrahalli. Some aquatic plants are sensitive to pollution and used as bioindicator. All the three lakes had abundant growth of *Eichhorina carassipes*, *Ricinus communis* and *Cynodon dactylon*. Excessive growth of *E. carassipes* and *C. dactylon* indicated metal pollution and salinity of water, respectively. The leaf colour of *R. communis* in Madiwala lake was observed to be pale yellow indicating the pollution of the area more compared to Agara region. The establishment of lake restoration projects have restored habitats and biodiversity to some extent. However, a joint effort by ecologists, hydrologists, policy makers, and local residents is required to minimize negative human impacts, maximize the effectiveness of nature reserves and lake restoration (Shloka et al., 2022).

Kukkarahalli lake (Mysuru, Karnataka) diversity of angiosperms has been found to be very rich both in population and species richness (290 species) that show seasonal variation. Among angiosperms, dominance shown by the families such as Poaceae, Fabaceae, Asteraceae, Amaranthaceae, Malvaceae. The present study is highly significant since study finds 129 species of angiosperm which were not recorded in the "Flowering Plants of the Mysore University Campus" (1974) which recorded angiosperms. Lake has large number of herbs than other forms of plants that indicates a high rate of anthropogenic disturbances. Presence of large number of invasive species and weeds are leading to the loss of species diversity in the lake area (Manjunatha et al., 2019).

Mallappa and Takrya, (2022), reported species composition of aquatic macrophytes, seasonal distribution in four lakes in Holalkere that is Gangasamudra lake, Gowdihalli lake, Talikatte lake and Kudineerakatte lake were studied during 2019–2021. Fifteen different species of aquatic macrophytes were recorded from the studied lakes which include one free-floating, Eight Submerged, and Six Emergent Macrophytes present in the lake basin. *Hydrilla verticillata*, *Polygonum glabrum*, *Cyperus longus* and *Ipomea fistulosa* occur throughout the year.

It indicates that aquatic macrophyte species are species to environmental quality. Aquatic Plant Diversity of Lakes in Somwarapete Taluk, Kodagu, Karnataka reported total of 43 species were recorded, belonging to 28 families and 41 genera. The most dominant families were found to be Araceae, Hydrocharitaceae, Asteraceae, and Amranthaceae. After initial identification, the plants were classified according to their habitats, life spans, and IUCN status. Jaccard's index and Sorenson's index were used to learn about the similarity coefficient between the sample sites (Thrupthi and Deviprasad, 2023).

2. MATERIAL AND METHODS

Study Area

Haliyal is a town panchayat city and Taluka in Uttara Kannada District Malenadu region of Karnataka. It is located 103km towards East from district headquarters Karwar. It can be classified as main-road town, Haliyal pin code is 581329. The Sarkar Kere is also known as Guttigere kere situated about 1.1 km north to Haliyal. And water spread area is about 15.4 acre. It is situated at DMS 15°20'31.5"N 74°45'51.9"E. As the lake records 550 m altitude above sea level. Lake is surrounded by farms for agriculture purpose, also constructed canals around the lake for Agriculture usage. It is primarily used as a source of irrigation and secondary for fishery purpose.

In this way lake is characterized by submerged vegetation in absence noted to decline in water level during summer and some anthropogenic activities. Antrolli Kere is situated in Antrolli village right in front of the Muttalmari village. This is about 5.9 km North to Haliyal. The total area of this lake is 5 acre and has lush greenery surrounding. It is situated at DMS 15°20'31.5"N 74°45'51.9"E. As the lake records 550 m altitude above sea level. As the lake records 550 m altitude above sea level. The waster of this lake used for agricultural and fish culture. Lake seems to records some anthropogenic activities (Figure 1).



Figure 1 Map of study area showing Guttigere and Antrolli lakes

Collection & Identification of Samples

Angiosperms species were collected two times in a month of two sets for assessment of diversity and documentation (Herbarium preparation). Angiosperms were identified with the following flora: Cooke (1906) (Flora of Bombay Presidency); Gamble & Fischer (1928) (Flora of Madras presidency); Saldanha, (1984), Saldanha, (1996) (Flora of Karnataka); Bhat, (2014) (Flora of South Kanara); Seethram et al., (2000) (Flora of Gulberga).

Herbarium Preparation

The specimen will pressed and dried with the help of Rao and Jain method (1976). The dried specimens was poisoned with mercuric chloride mixture (2%) to keep away from fungal attack. Than the specimens submitted to the Herbarium of Karnatak Science College (HKSCD) for future references.

Soil & Water Analysis

Soil was collected from various different spots of two lakes separately. Water was collected in different seasons and was analyzed in ICAR Science Centre, University of Agricultural Sciences, Dharwad.

3. RESULTS

Angiospermic survey was conducted monthly two times during summer and rainy season recorded 100 species of Angiosperms (Dicots and Monocots) (Table 1 & Figure 2). Top 10 families are reported in Asteraceae (16), Poaceae (7), Fabaceae (7), Amaranthaceae (4), Boraginaceae (3), Cyperaceae (4), Hydrocharitaceae (4), Euphorbiaceae (3), Menyanthaceae (2), (Table 2). As the plants are diversified more in Antrolli lake than Guttigere Lake. Antrolli Lake records 82 species out of 101 species and Guttigere Lake records 48 species out of 101 species (Figures 3 to 7). 27 species are common Guttigere lake and Antrolli lake. 11 are endemic species (*Azolla pinnata* R. Br., *Elodea canadensis* Michx., *Elodea densa* (Planch.) Casp., *Ipomea aquatica* Forsk., *Lemna* sp., *Ludwigia adscendens* (L.) H. Hara, *Nelumbo nucifera* Gaertn., *Nymphaea pubescens* Willd., *Nymphoides aquatica* (J. F. Gmel.) Kuntze, *Nymphoides indica* (L.) Kuntze, *Vallisneria natans* (Lour.) H. Hara) and others are exotic.

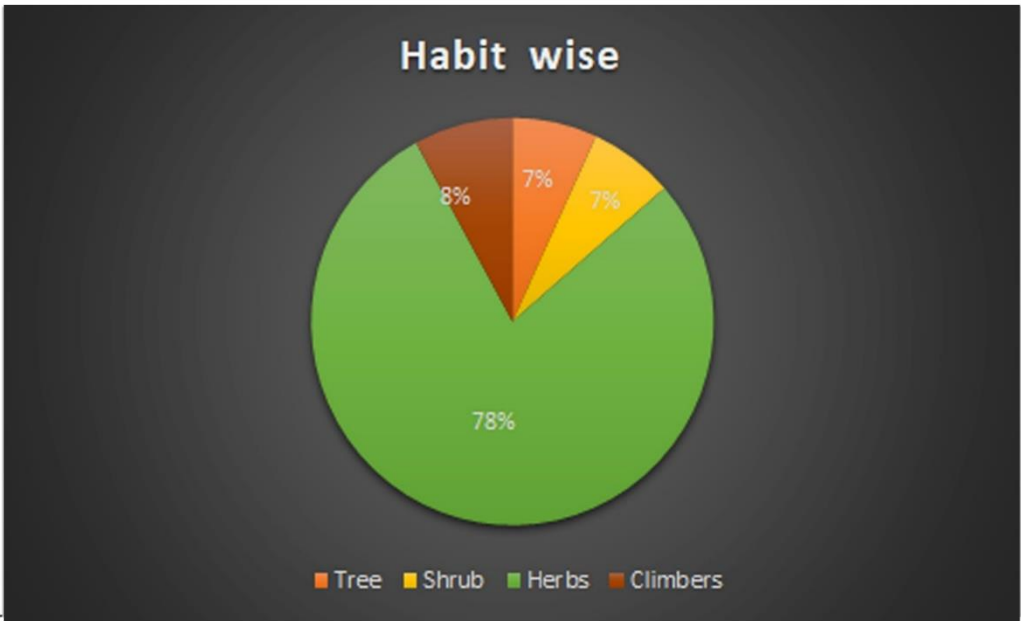


Figure 2 Habit wise plant distribution in Guttigere and Antrolli lakes

Table 1 Habit Wise distribution of Plants from Guttigere Lake & Antrolli Lake

Tree	6
Shrub	6
Herbs	68
Climbers	7
Aquatic	13
Total	100

Table 2 Dominant families of Angiosperms in Guttigere Lake & Antrolli Lake

Family	Number of species
Asteraceae	16
Poaceae	7
Fabaceae	7
Hydrocharitaceae	4
Cyperaceae	4
Amaranthaceae	4
Euphorbiaceae	3
Boraginaceae	3
Menyanthaceae	2

Out of 100 species, 10 are aquatic, 90 species are in (when water becomes less) and around lake, 6 are higher floating and submerged plants (*Azolla pinnata* R. Br., *Ceratophyllum demersum* L., *Chara sp.*, *Hydrilla verticillata* (L.f.) Royle, *Vallisneria natans* (Lour.) H. Hara, *Lemna sp.*) (Fig. 6) (Table 3). *Chara sp.* (Characeae) is collected from both lakes. Soil Sample Analysis and Water Analysis in ICAR Science Centre, Dharwad reported that water and soil test results are good for the growth of plants and fit for drinking. Guttigere lake has black soil and Antrolli lake has red soil. Soil is one of the most valuable resources on the earth, a quality soil is characterized by several physical, chemical and biological properties such as soil colour, soil moisture, soil PH, soil nutrients, soil microorganisms. The quality of bottom lake soil affects water quality, and acts as source of nutrients, also act as biological filter, adsorbing fish excrements, sedimentation of dead planktons, algal products, fresh organic matter settles to the bottom of lake.

In Guttigere lake observed black colour soil on top layer because of sedimentation, in depth observed red colour because of the presence of ferrous iron. Soil moisture content decreased with depth, because of low water holding capacity of red soil. In Antrolli lake observed red colour, sandy clay texture have more (moisture) water holding capacity, which influences crop growth, highly suitable for aquaculture. Soil PH in both Guttigere and Antrolli lakes 7.45 and 7.48 respectively. Ministry of agriculture has reported slightly alkaline soil with PH 7.5 is the more suitable for fish yield. Water PH of both lakes 6.52 in Guttigere and 6.8 in Antrolli. According to Bureau of Indian Standard PH in drinking water is 6.5 to 8.5. Electrical conductivity(S/m) of soil 0.43 and 0.42 in Guttigere and Antrolli lakes, according to (NRCS soil survey hand book) $0 < 2$ electrical conductivity of soil is non saline. Electrical conductivity of water 0.3 in both the lakes, good for irrigation.

Organic carbon act as source of energy for beneficial microorganisms that releases nutrients through biochemical process. $<5\%$ of organic carbon in soil consider as very low productivity and 0.5-1.0% of organic carbon in the soil consider as medium productivity, low fertilized lakes, but excellent for ponds with feeding, this range is acceptable for aquaculture. The amount of organic carbon in Guttigere lake 0.6 mg/L is a high and compare to Antrolli lake 0.36 mg/L. The Mineral nitrogen from decomposition of organic matter by micro-organism, is most important element which influence the productivity of fish pond and very essential for plant growth and production. In moderate level nitrogen is 25-50mg/kg in soil. High level nitrogen 50 -70 mg/kg in soil, very high level is above 70-125mg/ kg. Guttigere lake has 207 mg/kg and Antrolli lake has 103 mg/kg of nitrogen both soil sample are very high content can delay the crop maturity and prolong the growth period.

Phosphorus pentoxide, source of phosphorus is important nutrients, which regulates productivity of natural bodies, bottom soil in Guttigere lake phosphorus medium range is 14.5kg per acre and Antrolli lake have 18.6kg per acre all algae and plants require phosphorus to grow. Improves resistance against disease in some plants, its deficiency leads to the depigmentation of older leaves and leaf edges. Potassium oxide source of potassium (K) content in soil of Guttigere lake 404.7 per acre is higher than Antrolli lake 109 per acre. Potassium requires for many organisms because its play important role in nervous system. Calcium (Ca) play very important role in the soil fertility. Guttigere Lake is high 19.8mg/100gm and in Antrolli lake 6.8mg/100gm. Magnesium (MG) is present in chlorophyll molecule, it activates the number of plants enzymes, if soil has deficiency of Mg which leads to necrotic of plants in soil of Guttigere lake is 8.5mg/100gm and in Antrolli lake 3.1mg/100gm.



Fig. 3: A. *Alternanthera ficoidea* (L.) P. Beauv.; B. *Amaranthus viridis* L.; C. *Anacardium occidentale* L.; D. *Causonis trifolia* (L.) Mabb. & J. Wen.; E. *Chamaecrista mimosoides* (L.) Greene.; F. *Chloris barbata* Sw.; G. *Coldenia procumbens* L.; H. *Crotalaria juncea* L.; I. *Cryptolepis buchananii* R.Br. ex Roem. & Schult.; J. *Cyperus articulatus* L.; K. *Cyperus difformis* L.; L. *Cyperus squarrosus* L.



Fig. 4: **A.** *Dentella repens* var. *repens*,; **B.** *Digitaria ciliaris* (Retz.) Koeler; **C.** *Duranta erecta* L.; **D.** *Echinochloa colomum* (L.) Linn.; **E.** *Eclipta prostrata* (L.) L.; **F.** *Euphorbia hirta* L.; **G.** *Euphorbia prostrata* Aiton,; **H.** *Euploca ovalifolia* (Forsk.) Diane & Hilger,; **I.** *Fimbristylis dichotoma* (L.) Vahl; **J.** *Glinus oppositifolius* (L.) Aug. DC.; **K.** *Gomphrena serrata* L.; **L.** *Grangea maderaspatana* (L.) Poir.



Fig. 5. A. *Heliotropium indicum* L.; B. *Hygrophila auriculata* (Schumach.) Heine; C. *Ipomoea obscura* (L.) Ker Gawl.; D. *Ludwigia adscendens* (L.) H. Hara; E. *Ludwigia perennis* L.; F. *Martynia annua* L. ; G. *Mecardonia procumbens* (Mill.) Small; H. *Nelumbo nucifera* Gaertn.; I. *Nymphaea pubescens* Willd. ; J. *Nymphoides aquatica* (J. F. Gmel.) Kuntze; K. *Nymphoides indica* (L.) Kuntze; L. *Passiflora foetida* L.



Fig. 6. A. *Physalis angulata* L.; B. *Plumbago zeylanica* L.; C. *Polygonum plebeium* R. Br.; D. *Portulaca oleracea* L.; E. *Psidium guajava* L.; F. *Scoparia dulcis* L.; G. *Senna obtusifolia* (L.) H.S. Irwin & Barenby; H. *Solanum nigrum* L.; I. *Solanum torvum* Sw.; J. *Zizipus oenophila* (L.) Miller

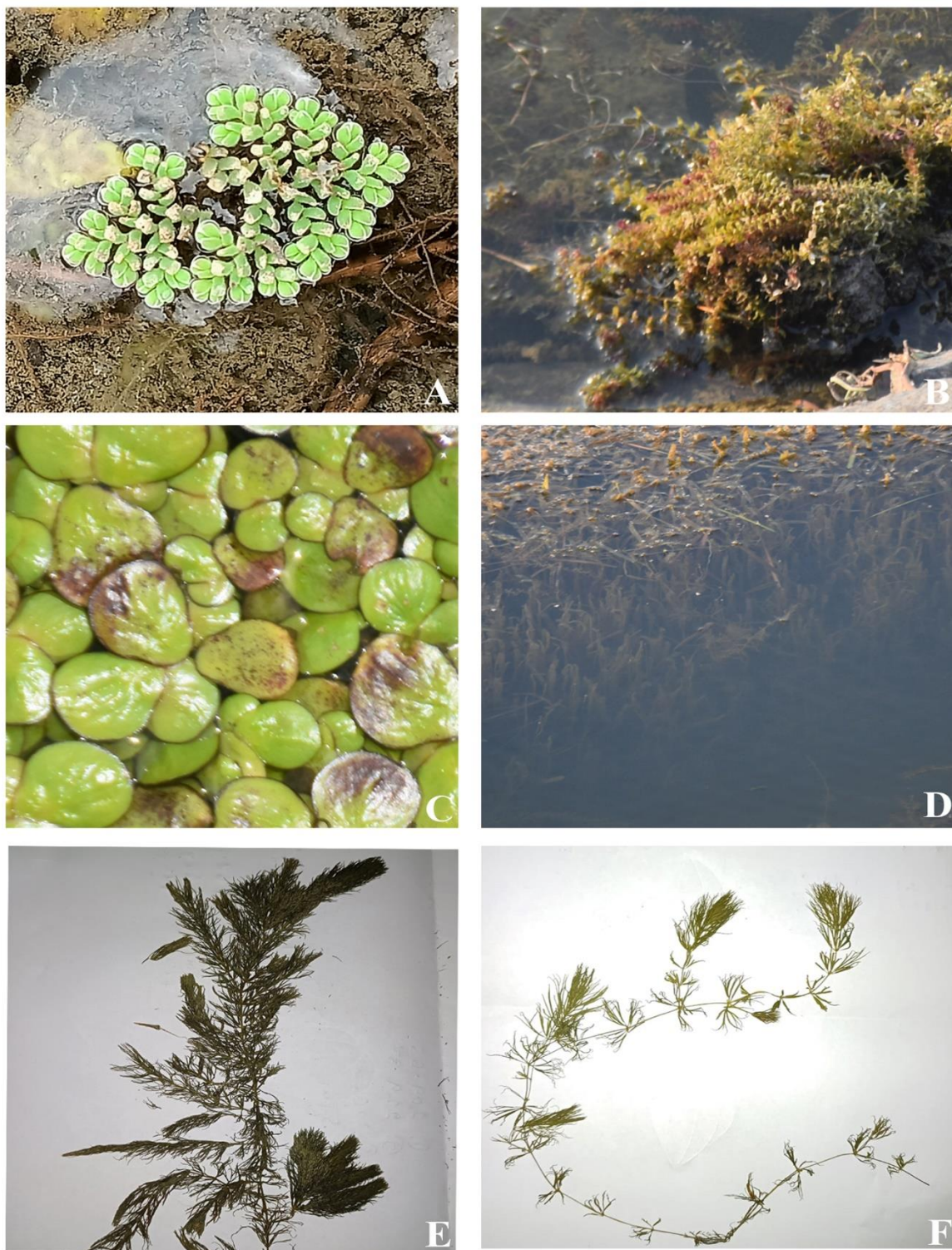


Fig. 7: Higher floating and submerged plants of two lakes: A. *Azolla pinnata* R. Br.; B. *Hydrilla verticiliata* (L.f.) Royle; C. *Lemna* sp.; D. *Vallisneria natans* (Lour.) H. Hara; Lower plants of two lakes: E. *Ceratophyllum demersum* L.; F. *Chara* sp;

Table 3 List of vascular plant species collected from Guttigere lake & Antrolli lake

Sl no.	Scientific name	Family	Common name	spot-1	spot-2	Vernacular name	Flowering season	Accession no.
1	<i>Acemella paniculata</i>	Asteraceae	Tooth ache plant		+	Aachaara jondi	May-July	20136
2	<i>Aeschynomene aspera</i> L.	Fabaceae	Budda pea	-	+	Tanakali	December-March	20167
3	<i>Ageratum conyzoides</i> L.	Asteraceae	Billygoat-weed, chick weed	-	+	Nayi Tulasi,	May-July	20168
4	<i>Alternanthera ficoidea</i> (L.) P. Beauv.	Amaranthaceae	Brazilian Snow Flower	-	+	Kusal	May-July	20169
5	<i>Alternanthera philoxeroides</i> (Mart.) Griseb.	Amaranthaceae	Alligator weed	+	-	Phakchet	March-May	20211
6	<i>Alternanthera sessilis</i> (L.) DC.	Acanthaceae	Sessile Joyweed	+	+	Honagone soppu	May-July	20170
7	<i>Amaranthus viridis</i> L.	Amaranthaceae	Slender amarthus	-	+	Kere soppu	May-July	20171
8	<i>Anacardium occidentale</i> L.	Anacardiaceae	Cashew tree	+	-	Godambi	-	20132
9	<i>Anaphalis lawii</i> Gamble	Asteraceae	Pearly everlasting	-	+	-	May-July	20134
10	<i>Azolla pinnata</i> R. Br.	Salvinaceae	Water valvet	+	+	-	March-May	20139
11	<i>Butea monosperma</i> (Lam.) Kuntze	Fabaceae	Flame-of-the-forest	-	+	Dhak, palash	June-August	20185
12	<i>Calotropis procera</i> (Aiton) W.T.Aiton	Apocynaceae	Giant milkweed	-	+	Bili aekkada gida	March-August	20157
13	<i>Causonis trifolia</i> (L.) Mabb. & J. Wen	Vitaceae	Bagh Grape	-	+	Heggoli	January-April	20172
14	<i>Ceratophyllum demersum</i> L.	Ceratophyllaceae	Hornworts	+	+	-	-	20135
15	<i>Chamaecrista mimosoides</i> (L.) Greene	Fabaceae	Tea Senna, Japanese Tea	-	+	Nela thangadi	July-August	20173
16	<i>Chloris barbata</i> Sw.	Poaceae	Swollen fingergrass	+	-	Uppu Gaddi	May-July	20201
17	<i>Chromolaena odorata</i> (L.) R. M. King & H. Rob.	Asteraceae	Siam weed	-	+	Kamyunist sasya	May-July	20158
18	<i>Coldenia procumbens</i> L.	Boraginaceae	Creeping coldenia	+	+	Hamsapaadi	May-July	20213
19	<i>Commelina forskolii</i> Vahl	Commelinaceae	Forsskal's Dayflower	-	+	Kanpet	July-August	20206
20	<i>Conyza</i> sp.	Asteraceae	Horseweed, butterweed	+	-	Bettada Davana	May-July	20215
21	<i>Crotalaria juncea</i> L.	Fabaceae	devil-bean, rattleweed	+	-	Senabu	March-May	-
22	<i>Cryptolepis buechananii</i> R.Br. ex Roem. & Schult.	Apocynaceae	Indian sarasparilla	-	+	Metaguli	June-August	20137

23	<i>Cucumis</i> sp.	Cucurbitaceae	-	+	-	-	July-August	20219
24	<i>Cyperus articulatus</i> L.	Cyperaceae	Priprioca	+	+	-	May-July	20138
25	<i>Cyperus difformis</i> L.	Cyperaceae	Rice sedge	+	+	-	May-July	20140
26	<i>Cyperus haspan</i> L.	Cyperaceae	Dwarf papyrus	-	+	-	May-July	20187
27	<i>Cyperus squarrosus</i> L.	Cyperaceae	Bearded flatsedge	-	+	-	May-July	20141
28	<i>Dentella repens</i> var. repens	Rubiaceae	Creeping denetlla	-	+	-	May-August	20142
29	<i>Digitaria ciliaris</i> (Retz.) Koeler	Poaceae	Tropical finger-grass	+	+	-	June-August	20202
30	<i>Digitaria radicata</i> (J.Presl) Miq.	Poaceae	Trailing crabgrass	+	+	-	June-August	20203
31	<i>Duranta erecta</i> L.	Verbenaceae	Pigeon berry	-	+	Neelakantha	May-August	20143
32	<i>Echinochloa colonum</i> (L.) Link	Poaceae	Jungle Rice	+	+	-	May-August	20207
33	<i>Eclipta prostrata</i> (L.) L.	Asteraceae	False daisy	-	+	Bhringraj	May-August	20166
34	<i>Eleusine indica</i> (L.) Gaertn.	Poaceae	Wire grass	+	-	Mandla	May-July	-
35	<i>Elodea canadensis</i> Michx.	Hydrocharitaceae	Canadian pondweed	+	-	-	-	20130
36	<i>Elodea densa</i> (Planch.) Casp.	Hydrocharitaceae	Brazilian waterweed	+	-	-	-	20128
37	<i>Emilia sonchifolia</i> (L.) DC.	Asteraceae	Lilac lasselflower	+	+	Elikivi Gida	March-May	20144
38	<i>Erigeron bonariensis</i> L	Asteraceae	Hairy fleabane	-	+	Chigathaari	May-July	20159
39	<i>Euphorbia hirta</i> L.	Euphorbiaceae	Hairy Spurge	+	-	Hachchedida	March-May	20214
40	<i>Euphorbia prostrata</i> Aiton	Euphorbiaceae	Prostrate Spurge	-	+	-	May-July	20174
41	<i>Euphorbia</i> sp.	Euphorbiaceae	Spurge	+	-	-	March-May	-
42	<i>Euploca ovalifolia</i> (Forsk.) Diane & Hilger	Boraginaceae	Payto leche	-	+	-	May-July	20186
43	<i>Evolvulus alsinoides</i> (L.) L.	Convolvulaceae	dwarf morning-glory	-	+	Vishnukranti	September-December	20205
44	<i>Fimbristylis dichotoma</i> (L.) Vahl	Cyperaceae	Eight Day Grass	-	+	-	May-July	20145
45	<i>Glinus oppositifolius</i> (L.) Aug. DC.	Molluginaceae	Bitter Cumin Bitter Leaf	-	+	Kadvi Bhaji	May-July	20165
46	<i>Gomphrena serrata</i> L.	Amaranthaceae	Globe Amaranth	-	+	-	May-July	20189
47	<i>Gnaphalium indicum</i>	Asteraceae	-	+	-	-	July-August	20210
48	<i>Grangea maderaspatana</i> (L.) Poir.	Asteraceae	Madras Carpet	-	+	Mashipatri	May-July	20175

49	<i>Heliotropium indicum</i> L.	Boraginaceae	Indian heliotrophe	+	-	Chelubalada Gida	June-August	20133
50	<i>Hydrilla verticiliata</i> (L.f.) Royle	Hydrocharitaceae	Waterthyme	+	+	-	-	20131
51	<i>Hygrophila auriculata</i> (Schumach.) Heine	Acanthaceae	Margh barbel	+	+	Gokulakanta	September-November	20208
52	<i>Ipomea aquatica</i> Forsk.	Convolvulaceae	Water morning glory	+	+	Neeru Bili gadde hambu	March-May	20121
53	<i>Ipomoea obscura</i> (L.) Ker Gawl.	Convolvulaceae	Small white morning glory	+	+	Ker-gawl	May-July	20176
54	<i>Lantana camara</i> L.	Verbenaceae	Lantana	+	-	Caturang	March-August	20177
55	<i>Lemma</i> sp.	Araceae	Duck weed	+	+	-	-	20204
56	<i>Ludwigia adscendens</i> (L.) H.Hara	Onagraceae	Water primrose	+	-	Jagal (Oria)	February-May	20125
57	<i>Ludwigia perennis</i> L.	Onagraceae	Perennial water primrose	-	+	Neerkarayambu	May-August	20146
58	<i>Martynia annua</i> L.	Martyniaceae	Cats claw	-	+	Garuda Mugu Mullu	June-August	20190
59	<i>Mecardonia procumbens</i> (Mill.) Small	Plantaginaceae	Baby jump-up	+	-	Makardana	March-May	20122
60	<i>Mesospaerum suaveolens</i> (L.) Kuntze	Lamiaceae	Pignut	-	+	Ganga tulasi	June-August	20160
61	<i>Mimosa pudica</i> L.	Fabaceae	Sensitive plant	+	+	Muttidre Muni	June-August	20191
62	<i>Nelumbo nucifera</i> Gaertn.	Nelumbonaceae	Sacred lotus	+	+	Tavare	March-August	20123
63	<i>Nymphaea pubescens</i> Willd.	Nymphaeaceae	Hairy water lily	-	+	Kamal	May-Septemebr	20124
64	<i>Nymphoides aquatica</i> (J.F.Gmel.) Kuntze	Menyanthaceae	Banana lily	+	+	-	March-June	20126
65	<i>Nymphoides indica</i> (L.) Kuntze	Menyanthaceae	Water snow flake	+	+	Barachuli	March-June	20127
66	<i>Ocimum tenuiflorum</i> L.	Lamiceae	Holy basil/ Tulsi	+	+	Tulsi	March-June	20178
67	<i>Oxalis corniculata</i> L.	Oxalidaceae	Creeping woodsorrel	+	+	Amrit Sak	March-August	20179
68	<i>Parthenium hysterophorus</i> L.	Asteraceae	Carrot grass	+	+	Gajar ghas	June-August	20192
69	<i>Paspalum canarae</i> (Steud.) Veldkamp	Poaceae	Crowngrasses	+	+	-	June-August	20200
70	<i>Passiflora foetida</i> L.	Passifloraceae	Bush passion fruit	-	+	Jhumka Lata	June-August	20193
71	<i>Persicaria maculosa</i> Gray	Polygonaceae	Spotted ladys thumb	-	+	Sorale	June-August	20150
72	<i>Phyla nodiflora</i> (L.) Greene	Verbenaceae	Turkey Tangle fog fruit	-	+	Jala hippali	June-August	20147

73	<i>Phyllanthus reticulatus</i> Poir.	Phyllanthaceae	Black honey shrub	-	+	Karihuli	June-August	20148
74	<i>Physalis angulata</i>	Solanaceae	Baloon cherry	-	+	Njodinjotta	June-August	20149
75	<i>Plumbago zeylanica</i> L.	Plumbaginaceae	Ceylon leadwort	-	+	Chita Chitrak	June-August	20194
76	<i>Polygonum plebeium</i> R.Br.	Polygonaceae	Common knotweed	-	+	Gulabi Godhadi	June-August	20180
77	<i>Portulaca oleracea</i> L.	Portulacaceae	Common purslane	-	+	Khursa Kulfa	June-August	20151
78	<i>Pseudoconyza viscosa</i> (Mill.) D'Arcy	Asteraceae	Viscid conayza	-	+	-	March-August	20195
79	<i>Pseudognaphalium viscosum</i> (Kunth) Anderb.	Asteraceae	Cudweeds	-	+	-	March-August	20152
80	<i>Psidium guajava</i> L.	Myrtaceae	Yellow guava	-	+	Peru gida	June-August	20153
81	<i>Ruellia tuberosa</i> L.	Acanthaceae	Minnieroot	-	+	Potpoti Ruwel	June-August	20161
82	<i>Samanea saman</i> (Jacq.) Merr.	Caesalpinaceae	Rain tree	+	-	Male mara	March-May	20129
83	<i>Scoparia dulcis</i> L.	Plantaginaceae	licorice weed	+	+	Mruganmhi Gida	May-August	20181
84	<i>Senna obtusifolia</i> (L.) H.S. Irwin & Barenby	Fabaceae	Sickpool	+	+	-	March-August	20182
85	<i>Solanum lycopersicum</i> L.	Solanaceae	Tomato	-	+	Tamati	March-May	20154
86	<i>Solanum nigrum</i> L.	Solanaceae	Black berry nightshade	-	+	Mokoi	June-August	20196
87	<i>Solanum torvum</i> Sw.	Solanaceae	Devil's fig	-	+	Sundekkayi	June-August	20198
88	<i>Sonchus wightianus</i> DC.	Asteraceae	Wights jaw thistle	+	-	Sahadevi bari	March-May	20220
89	<i>Sorghum bicolor</i> (L.) Moench	Poaceae	Grrom corn	-	+	Jwari	June-August	20216
90	<i>Streblus asper</i> Lour.	Moraceae	Tooth brush tree	-	+	Akhor mara	June-August	20183
91	<i>Synedrella nodiflora</i> (L.) Gaertn.	Asteraceae	Nodeweed	+	+	Mudianpacha	June-August	20199
92	<i>Syzygium jambos</i> (L.) Alston	Myrtaceae	Black palm	+	-	Neerle hannu mara	June-August	20197
93	<i>Tectona grandis</i> L.f.	Lamiaceae	Teak	+	+	Thega/Saguvani	June-August	20218
94	<i>Tridax procumbens</i> L.	Asteraceae	Coatbuttons /tridax daisy	-	+	Gabbusanner savanthi	June-August	20162
95	<i>Triumfetta</i> sp.	Malavaceae	-	-	+	-	-	20164
96	<i>Vallisneria natans</i> (Lour.) H.Hara	Hydrocharitaceae	Eelgrass, tape grass	+	+	-	-	20155
97	<i>Vitex negundo</i> L.	Vitaceae	Chinese chase tree	-	+	Nirgundi	June-August	20184

98	<i>Zizaniopsis</i> Sp.	Poaceae	Water millet	-	+	-	June-August	20163
99	<i>Zizipus oenophila</i> (L.) Miller	Rhamanceae	Indian pulm	-	+	Karkandhauh	March-June	20156
100	<i>Zizipus</i> sp.	Rhamanceae	Indian jujube	-	+	-	June-August	20212

A. - Antrolli Lake, G. - Guttigere Lake, + = Present, - = Absent

Available sulphur in both Guttigere and Antrolli lakes is 11.5mg/100gm. sulphur is essential for plant growth. Zinc is used in agriculture and crop production. Guttigere Lake is 0.31 mg/kg and in the Antrolli lake 0.41 mg/kg. Deficiency of zinc leads to loss in production of grain nutrient content for Agriculture land zinc range between 10-300mg/kg. Copper (Cu) content soil of Guttigere lake 0.61mg/kg and Antrolli lake 0.71mg/kg both soil samples have low amount of copper because of high organic matter, sandy clay soil and high PH is 5-30 mg/kg is required to plant tissue. Iron content in the soil of Guttigere lake is 4.81mg/kg and Antrolli lake is 5.61mg/kg. for good soil at least more than 7.5mg/kg of iron is required to support the growth of plants.

Manganese (Mn) is important micronutrient for plant growth. Mn content in the soil of Guttigere lake is 5.16mg/kg and Antrolli lake is 4.81 mg/kg.at least 20-40mg/kg is required to plant tissue. Mn content in bottom soil of lake not high so did not pose any threat to living organisms. Sodium carbonate mm/L in the Guttigere lake is -3.8 and in Antrolli lake -2.6mm/L, residual Sodium carbonate less than 1.25mm/L is safe for agriculture usage. Sodium is major salt in water content 1.67 and 2.09 mm/L In both Guttigere and Antrolli lake respectively (Table 4).

Table 4 Soil and Water Analysis (Guttigere & Antrolli Lakes) in ICAR Science Centre, Dharwad

Parameters	Guttigere lake	Antrolli lake
Soil color	Black	Red
pH	7.45	7.48
Electric conductivity (S/m)	0.43	0.42
Organic Carbon mg/ L	0.6	0.36
Mineralization Nitrogen	207	103.5
P2O5 per acre	14.5	18.6
K2O per acre	404.7	109
Ca per 100gm	19.8	6.8
Mg per 100gm	8.5	3.1
Available Sulphur	11.5	11.5
Zn mg per Kg	0.31	0.41
Cu mg per Kg	0.61	0.71
Fe mg per Kg	4.81	5.61
Mn mg per Kg	5.16	4.81
Water	Guttigere lake	Antrolli lake
pH	6.52	6.8
Electric conductivity(S/m)	0.3	0.3
Sodium carbonate mm/L	-3.8	-2.6
Sodium	1.67	2.09

Guttigere and Antrolli lake water is used for agricultural purposes. Soil from the Guttigere lake is digged out for various uses during summer season only. Washing clothes during summer and rainy season is common in Antrolli pond as it does not have protection around it. Washing cattle's and vehicles is also regularly done in this pond. Guttigere pond have fencing around it so fewer

activities observed like washing clothes and cattle washing. But people visit there for morning and evening walk around the pond. Fishing is done during February to June when water becomes less. Fishes include Katla, Kannadi, Miragal, Rahoo, Gaskarp, Murgod, Chillapilli and Crabs (Figure 8).

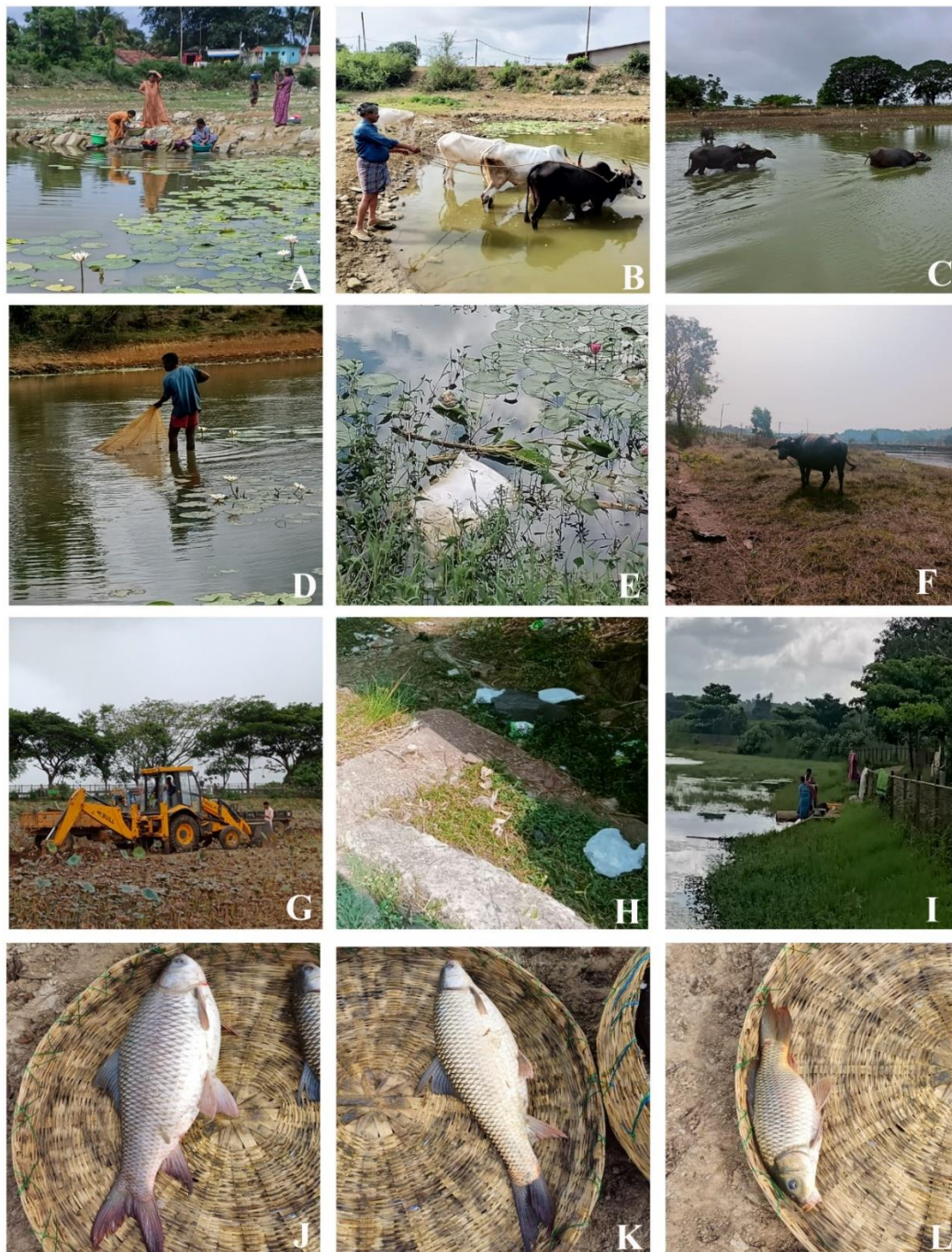


Fig. 8: Antropogenic activites in Two lakes: Atrolli Lake: A. Washing clothes; B. Cattle washing; C. Cattle raring in pond; D. Fishing; E. Plastic wastage; Guttigere Lake: F. Cattle raring; G. Digging in pond; H. Plastic wastage; I. Washing clothes; J. K. & L. Types of Fishes present in two ponds

4. CONCLUSION

Soil from the Guttigere lake is dug out for various uses during summer season. Washing clothes during summer and rainy season is common in Antrolli lake as it does not have protection around it. Washing cattle's and vehicles is also regularly done in this lake. Guttigere lake have fencing around it so fewer activities observed like washing clothes and cattle washing. Fishing is done during February to June when water becomes less. Fishes include Katla, Kannadi, Miragal, Rahoo, Gaskarp, Murgod, Chillapilli and Crabs. Soil of Antrolli (Red) and Guttigere (Black) is good for plants to grow. But major diversity of angiosperms is recorded in Red soil (Antrolli) lake which is good for the growth of plants, as lake is surrounded by farm lands which is useful from this lake.

Conflicts of interests:

The authors declare that there are no conflicts of interests.

Funding:

The study has not received any external funding.

Ethical approval & declaration

In this article, as per the plant & animal regulations in Taxonomy and Floristic Laboratory, Karnatak University's, Karnatak Science College, India, the authors observed the vascular plant diversity in two lakes of Haliyal Taluk, Uttara Kannada District, Karnataka. The ethical guidelines for plants & plant materials are followed in the study for species collection & identification. The Animal ethical guidelines are also followed in the study for species collection, observation & identification.

Data and materials availability

All data associated with this study are present in the paper.

REFERENCES

1. Bharathi HR, Manjappa S, Suresh B. Physio chemical parameters of Anekere Water body Hassan district (Karnataka). *Intertional Journal Pharm Life Sciences* 2013; 4(12):3200-3204.
2. Bhat DM, Limnological studies of two rivers in Uttara Kannada District, Karnataka. *Karnataka University Dharwad*. 2004.
3. Bhat KG. Flora of South Kanara: Dakshina Kannada and Udupi Districts of Karnataka. Udupi: Taxonomy Research Centre, Chitpady, Udupi, 2014.
4. Cooke T. Flora of the presidency of Bombay. Vol. I. II. III. *Botanical Survey of India*. 1906.
5. Dodagoudar SF. An ecological study of phytoplankton of four freshwater Bodies of Dharwad. *Karnataka University Dharwad*. 1989.
6. Gamble JS, & Fischer CEC. Flora of Presidency of Madras. Vol. I. II. III. *Secretary of State for India in Council*. 1928.
7. Hegde GR. Comparison of phytoplankton biomass in four water bodies of Dharwad, Karnataka State (India). *Proceedings Indian Academic Science (Plant Science)* 1985; 94(4-6):583-587.
8. Ian Mm, Emi FC, & Caren S. *Macrosystems Limnology and Beyond: Re-Envisioning the Scale of Limnology*. *Encyclopedia of Inland Waters (Second Edition)*: 2022. 4. 539-548 <https://doi.org/10.1016/B978-0-12-819166-8.00026-8>
9. Mallappa P, Takrya PN. Diversity and Identification of Aquatic Macrophytes of Four Lakes of Holalkere, Chitradurga District, Karnataka, India. *Research Square* 2022; 1-9. doi: 10.21203/rs.3.rs-2232093/v1
10. Manjunatha S, Devabrath AJ, Ramakrishna PP, Chandrashekar R, Amruthesh KN. Diversity of Angiosperms in the Kukkarahalli Lake, Mysuru, Karnataka, India. *Plant Achieves* 2019; 19(2):3555-3564.
11. Rajesh K. Limnological Study of Lentic Ecosystems in Bodhgaya Block in Gaya District Bihar. *Intertional Journal Advances Engineering Management* 2020; 2(11):333-335.
12. Rao R, & JAIN SK. *A Handbook of Field and Herbarium Methods*. *Scholarly Publications*. 1977.
13. Saldanha CJ. Flora of Karnataka. Vol. 1. *Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi*, 1984.
14. Saldanha CJ. Flora of Karnataka. Vol. 2. *Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi*, 1996.
15. Shloka G, Divyashree, Ginjupalli J, Deepa G. Study of Floral Biodiversity of Water Bodies near HSR Layout, Bangalore, to Evaluate Water Pollution. *Appl Ecol Environ Sci* 2022; 10(6):4 17-423. doi: 10.12691/aees-10-6-12.

16. Seetharam, YN, Kotresh K. & Uploankar SB. Flora of Gulbarga district. Gulbarga University, Gulbarga, Karnataka. India. 2000.
17. Singh DM, Rajan SGD. Survey of Wet Land Macrophytes from Wetlands of Haliyal Taluk. International Journal Pure Applied Biosciences 2015; 3(4):16 6-172.
18. Thrupthi GN, Deviprasad AG. Aquatic Plant Diversity of Lakes in Somwarapete Taluk, Kodagu, Karnataka. Asian Journal Environmental Ecology 2023; 20(3):1-10. doi: 10.9734/ajee/2023/v20i3438