

Diversified Hydrophytes in Different Aquatic Habitats of Puri District, Odisha, India

Bandita Kumari Dalasingh¹, Sagarika Parida¹, Dipankar Bhattacharyay², Gyanranjan Mahalik^{1,*}

¹Department of Botany, School of Applied Sciences, Centurion University of Technology and Management, Odisha, India

²School of Applied Sciences, Centurion University of Technology and Management, Odisha, India

Received October 6, 2019; Revised October 30, 2019; Accepted November 10, 2019

Copyright©2019 by authors, all rights reserved. Authors agree that this article remains permanently open access under the terms of the Creative Commons Attribution License 4.0 International License

Abstract Hydrophytes are water loving plants that regulate the aquatic ecosystem. Variety and variability of hydrophytic plants have a great role in balanced aquatic ecosystem. The study revealed that a total 60 species of hydrophytes belonging to 39 genera and 25 families were identified. Among these, Cyperaceae was the dominant family comprising 17 species, out of which, monocots represented by 33 species belonging to 19 genera and 9 families; dicots represented by 24 species belonging to 17 genera and 14 families; pteridophyta represented by 3 species belonging to 3 genera and 2 families. The monocotyledon was found to be the dominant class. In the documented species, 55 herbs, 2 shrubs and 3 ferns were recorded with a variable habitat viz. 35 marshy, 8 amphibious, 6 submerged, 6 free floating and 5 fixed floating species. Documented plants were preserved as herbarium with their botanical names, family, local names and habitat. Two RET (Rare, Endanger and Threatened) category plant species viz. *Wolffia arrhiza* (L.) Horkel ex Wimm. and *Lindernia anagallis* (Burm.f.) Pennell belonging to Araceae and Scrophulariaceae family respectively were documented from Gadakharad village during the study which is the unexplored area and no documentation was done previously. Therefore, these species should be conserved by taking proper care of the water body otherwise the day will come and these two plants will be in verge of extinction. The present work exhibited the database of hydrophytes in Puri district of Odisha which will help in future work for its conversation and to maintain the local biodiversity.

Keywords Amphibious, Cyperaceae, Monocots, Pteridophyta, Hydrophytes, RET (Rare, Endanger and Threatened)

1. Introduction

Phytodiversity refers to the variety and variability of

plants, i.e. the number of types or taxa in a given region or group which can be measured at any level from overall global diversity to ecosystem, community, species, populations, individuals and even to genes within a single individual that help us to understand the basic aspects of biology such as speciation, isolation, endemism and evolution [1]. The hydrosphere of the earth is composed of all water bodies includes oceans, rivers, ponds, lakes, ditches, streams etc. [2]. Aquatic plants are plants that have adapted to living in aquatic environments is called hydrophytes which can only grow in water or in soil that is permanently saturated with water and can able to change the physico-chemical characteristics of pond water. It plays a major role in primary productivity of the aquatic ecosystem. The hydrophytes are submerged, free floating, fixed floating, marshy and amphibious in nature [3]. They are one of the important biotic entities in aquatic ecosystem which provide food, oxygen and shelter to the other aquatic organisms [4] and are essential to prevent too much turbidity and erosion of soil and to maintain the delicate balance of nutrients in water [5]. Works on floristic study of composition of hydrophytes in different water reservoirs in different parts of Abroad, India and Odisha were carried out by several workers [6-8]. Many water bodies present in Puri district and its adjoining territory containing a wide scope of hydrophytes which has not been investigated. So a broad investigation of hydrophytes of this area was done to observe the detail record of the distribution of hydrophytes, their habitat ecology and association. This may have economic and medicinal significance.

2. Materials and Methods

2.1. Study Area

Puri is a coastal district of the Odisha state of India. This district comprises 1722 revenue villages (fig.1). Puri district is located between 19.817743 latitude and

85.828629 longitudes. It is located in India, in the cities place category with the GPS coordinates of $19^{\circ} 49' 3.8748''$ N and $85^{\circ} 49' 43.0644''$ E. The climate of this district is

characterized by seasonal climatic condition and intermediate temperature. The summer months are hot while the winter months are cool.





Figure 1. Map of study area

2.2. Survey

The studies of hydrophytes were conducted during September 2017 to May 2019 in Puri district of Odisha, India. The climate of this study area is characterized by seasonal climatic condition and intermediate temperature. The summer months are hot while the winter months are cool. Many water bodies are present in the study area that favors the occurrence of a rich aquatic flora which get filled up with water during monsoon season, water may persist for a considerably long-time whereas some are dry out during summer season. Total of 20 water bodies were observed during the survey of hydrophytes in 5 villages having total 9 large and 11 small ponds (Table 1) in different seasons especially immediate after rainy season in the month of September and during summer season at fortnightly interval. Specimens were collected in lowering and fruiting time carefully for authenticated identification of the species and photographs were taken at the survey site to document the hydrophytes for its abundance and distribution (Figure 2). Special emphasis was given to find

out the RET (Rare, Endangered and Threatened) plants. The collected specimens were identified taxonomically with the help of “The Botany of Bihar and Orissa” [9] and “The Flora of Orissa” [8]. The identified plants species were authenticated and deposited in the form of herbarium at Department of Botany, School of Applied Sciences, Centurion University of Technology and Management, Odisha, India.

Table 1. Villages having different types of water body

Sl.No.	Village Name	Ponds	
		Large pond	Small pond
	Garhkharad	2	3
	Badurabara	2	2
	Biratoi	2	1
	Bajapadar	2	3
	Telangapada	1	2
	Total	9	11



Figure 2. During field survey and plant collection

3. Results and Discussion

The results of the present study revealed that a total number of 60 species were recorded belonging to 39 genera of 25 families surveyed from 11 small and 9 large ponds from 5 villages of Puri district (Table 1). List of hydrophytes including their genus, species, family, local name and habitat were recorded (Table 2) and plant group, i.e. pteridophyta, dicotyledon and monocotyledon was given in figure 3. The dominant families are Cyperaceae with 4 genera and 17 species, followed by Poaceae with 5 genera and 5 species, Onagraceae and Scrophulariaceae

belongs to 1 genera and 3 species each, Asteraceae and Hydrocharitaceae belongs to 3 genera and 3 species each, Amaranthaceae, Commelinaceae, Convolvulaceae and Nymphaeaceae belongs to 1 genera and 2 species each, Araceae, Rubiaceae and Salviniaceae belongs to 2 genera and 2 species each, whereas 12 families represented by a single species each i.e. Aponogetonaceae, Characeae, Fabaceae, Lentibulariaceae, Lythraceae, Marsileaceae, Menyanthaceae, Nelumbonaceae, Polygonaceae, Pontederiaceae, Typhaceae, Verbenaceae (Figure 4 & Table 3).

Table 2. List of Hydrophytic plants of Puri, Odisha

Sl. No.	Botanical Name	Family	Local Name	Habitat
1.	<i>Alternanthera philoxeroides</i> (Mart.) Griseb.	Amaranthaceae	-	Amphibious
2.	<i>Alternanthera sessilis</i> (L.) R. Br. ex DC.	Amaranthaceae	Madaranga saga	Marshy
3.	<i>Aponogeton natans</i> (L.) Engl. & K.Krause	Aponogetonaceae	Ghechu	Submerged
4.	<i>Pistia stratiotes</i> L.	Araceae	Bora jhanji	Free floating
5.	<i>Wolffia arrhiza</i> (L.) Horkel ex Wimm.	Araceae	Panidala	Free floating
6.	<i>Eclipta prostrata</i> (L.) L.	Asteraceae	Bhringraj	Marshy
7.	<i>Emilia sonchifolia</i> (L.) DC. ex Wight	Asteraceae	Sarkara	Marshy
8.	<i>Spilanthes paniculata</i> Wall. ex DC.	Asteraceae	-	Marshy
9.	<i>Chara vulgaris</i> L.	Characeae	-	Submerged
10.	<i>Commelina benghalensis</i> L.	Commelinaceae	Kaniseera	Marshy
11.	<i>Commelina paludosa</i> Bl.	Commelinaceae	-	Marshy
12.	<i>Ipomoea aquatica</i> Forssk.	Convolvulaceae	-	Marshy
13.	<i>Ipomoea carnea</i> Jacq.	Convolvulaceae	Amari	Marshy
14.	<i>Bulbostylis barbata</i> (Rottb.) C.B. Clarke	Cyperaceae	-	Marshy
15.	<i>Bulbostylis capillaris</i> (L.) Kunth ex C.B. Clarke	Cyperaceae	-	Marshy
16.	<i>Bulbostylis densa</i> (Wall.) Hand.-Mazz.	Cyperaceae	-	Marshy
17.	<i>Cyperus amabilis</i> Vahl	Cyperaceae	-	Marshy
18.	<i>Cyperus brevifolius</i> (Rottb.) Hassk.	Cyperaceae	Harit mutha	Marshy
19.	<i>Cyperus compressus</i> L.	Cyperaceae	-	Marshy
20.	<i>Cyperus distans</i> L.f.	Cyperaceae	-	Marshy
21.	<i>Cyperus halpan</i> L.	Cyperaceae	-	Marshy
22.	<i>Cyperus haspan</i> L.	Cyperaceae	-	Marshy
23.	<i>Cyperus iria</i> L.	Cyperaceae	Swanti	Marshy
24.	<i>Cyperus kyllingia</i> Endl.	Cyperaceae	-	Marshy
25.	<i>Cyperus polystachyos</i> Rottb.	Cyperaceae	-	Marshy
26.	<i>Cyperus rotundus</i> L.	Cyperaceae	Mutha	Marshy
27.	<i>Fimbristylis argentea</i> (Rottb.) Vahl	Cyperaceae	-	Marshy
28.	<i>Fimbristylis dichotoma</i> (L.) Vahl	Cyperaceae	-	Marshy
29.	<i>Fimbristylis miliacea</i> (L.) Vahl	Cyperaceae	Swanli	Marshy
30.	<i>Schoenoplectiella articulata</i> (L.) Lye	Cyperaceae	-	Marshy
31.	<i>Aeschynomene aspera</i> L.	Fabaceae	Sola	Amphibious
32.	<i>Hydrilla verticillata</i> (L.f.) Royle	Hydrocharitaceae	Chingudia dala	Submerged
33.	<i>Najas graminea</i> Delile	Hydrocharitaceae	-	Submerged
34.	<i>Ottelia alismoides</i> (L.) Pers.	Hydrocharitaceae	Pani kundri	Submerged

35.	<i>Utricularia stellaris</i> L.f.	Lentibulariaceae	Bhaturia dala	Submerged
36.	<i>Trapa natans</i> L. Var. <i>bispinosa</i> (Roxb.) Makino	Lythraceae	Pani singada	Free floating
37.	<i>Marsilea quadrifolia</i> L.	Marsileaceae	-	Amphibious
38.	<i>Nymphoides hydrophylla</i> (Lour.) Kuntze	Menyanthaceae	Chandra-malla	Fixed floating
39.	<i>Nelumbo nucifera</i> Gaertn.	Nelumbonaceae	Padma	Fixed floating
40.	<i>Nymphaea pubescens</i> Willd.	Nymphaeaceae	Nilakain	Fixed floating
41.	<i>Nymphaea pubescens</i> Willd.	Nymphaeaceae	Dhalakain	Fixed floating
42.	<i>Ludwigia adscendens</i> (L.) H.Hara	Onagraceae	Jagal	Fixed floating
43.	<i>Ludwigia octovalvis</i> (Jacq.) P.H.Raven	Onagraceae	Panilabanga	Amphibious
44.	<i>Ludwigia perennis</i> L.	Onagraceae	-	Amphibious
45.	<i>Alloteropsis cimicina</i> (L.) Stapf	Poaceae	-	Amphibious
46.	<i>Brachiaria mutica</i> (Forssk.) Stapf	Poaceae	Para grass	Marshy
47.	<i>Echinochloa colona</i> (L.) Link	Poaceae	Swanghasa	Marshy
48.	<i>Oryza rufipogon</i> Griff.	Poaceae	Balunga	Marshy
49.	<i>Paspalum distichum</i> L.	Poaceae	-	Marshy
50.	<i>Polygonum plebeium</i> R.Br.	Polygonaceae	Muthi saga	Amphibious
51.	<i>Eichhornia crassipes</i> (Mart.) Solms	Pontederiaceae	Bilati dala	Free floating
52.	<i>Dentella repens</i> (L.) J.R.Forst. & G.Forst.	Rubiaceae	-	Marshy
53.	<i>Hedyotis corymbosa</i> (L.) Lam.	Rubiaceae	Taraka punji	Marshy
54.	<i>Azolla pinnata</i> R. Br.	Salviniaceae	Chuni dala	Free floating
55.	<i>Salvinia cucullata</i> Roxb. ex Bory	Salviniaceae	-	Free floating
56.	<i>Lindernia anagallis</i> (Burm. f.) Pennell	Scrophulariaceae	-	Marshy
57.	<i>Lindernia ciliata</i> (Colsm.) Pennell	Scrophulariaceae	-	Marshy
58.	<i>Lindernia crustacea</i> (L.) F.Muell.	Scrophulariaceae	-	Marshy
59.	<i>Typha angustata</i> Bory & Chaub.	Typhaceae	Hangla	Amphibious
60.	<i>Phyla nodiflora</i> (L.) Greene	Verbenaceae	Jala pippali gosingi	Marshy

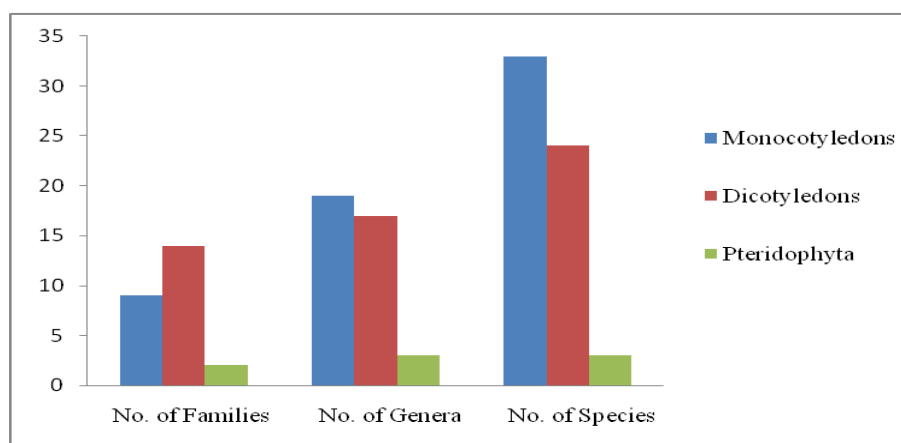


Figure 3. List of division-wise distribution of hydrophytic plants present in Puri district, Odisha

Table 3. List of habitat-wise distribution of hydrophytic plants present in Puri district, Odisha

Habitat	No. of Families	No. of Genera	No. of Species
Marshy	9	18	35
Amphibious	7	7	8
Submerged	4	6	6
Free floating	4	6	6
Fixed floating	4	4	5

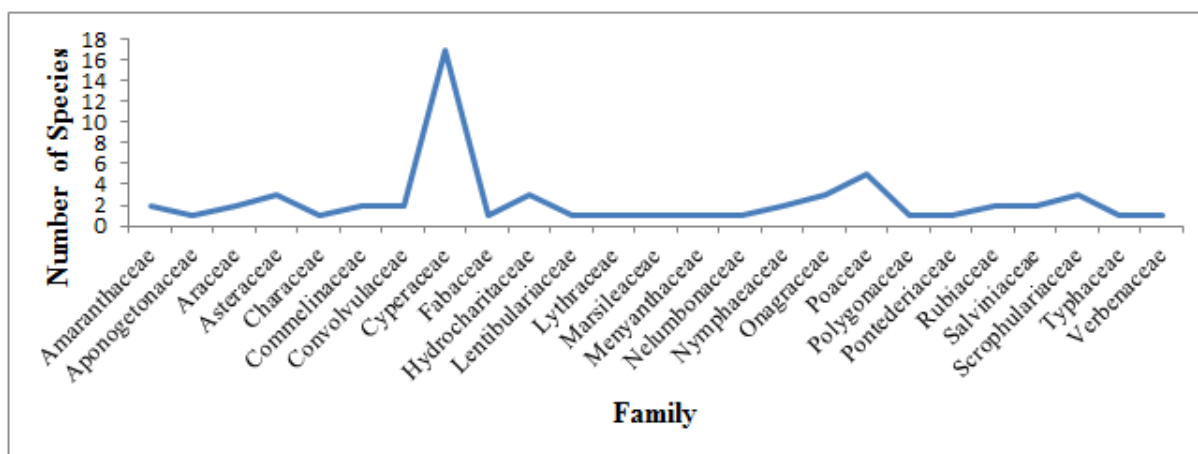


Figure 4. List of family-wise distribution of hydrophytic plants present in Puri district, Odisha

Several works on aquatic flora were carried out in India and also in the different districts of Odisha. Earlier a total of 8 plant species belonging to 8 different genera and 8 families were reported in Tripura, India [10]. Aquatic macrophytes comprises a total of 132 species included 129 flowering plants and 3 Pteridophyte taxa spread in 82 genera and 41 families were recorded in Balasore district of Odisha, eastern India. The most specious families were Cyperaceae with 27 species followed by Poaceae (24) and the other dominant families are Linderniaceae, Fabaceae, Onagraceae, Polygonaceae, Commelinaceae, and Scrophulariaceae [11]. Floral diversity of Bhubaneswar and its adjoining villages, Odisha composed of a total number of 102 species were recorded belonging to 64 genera of 34 families, of which 8 species are submerged hydrophytes, 9 species are free floating, 9 species are fixed floating, 21 species are amphibious hydrophytes and 55 species are marshy hydrophytes [12]. The floral diversity and distribution of vascular macrophytes in Ansupa Lake, Odisha composed of a total of 244 macrophyte species that included 182 semi-aquatic and 62 obligatory aquatic macrophytes. Out of which, 35% submerged, 15% free floating, 31% rooted floating and 19% marshy plant species [13].

During survey the most dominant genera are *Cyperus* (Cyperaceae) with 10 species recorded, followed by *Bulbostylis* (Cyperaceae), *Fimbristylis* (Cyperaceae), *Ludwigia* (Onagraceae) and *Lindernia* (Scrophulariaceae) with 3 species each, 4 genera: *Alternanthera* (Amaranthaceae), *Commelina* (Commelinaceae), *Ipomoea* (Convolvulaceae) and *Nymphaea* (Nymphaeaceae) were represented by 2 species each, 30 genera: *Aponogeton* (Aponogetonaceae), *Pistia* (Araceae), *Wolffia* (Araceae), *Eclipta* (Asteraceae), *Emilia* (Asteraceae), *Spilanthes* (Asteraceae), *Chara* (Characeae), *Schoenoplectiella* (Cyperaceae), *Aeschynomene* (Fabaceae), *Hydrilla* (Hydrocharitaceae), *Najas* (Hydrocharitaceae), *Ottelia* (Hydrocharitaceae), *Utricularia* (Lentibulariaceae), *Trapa* (Lythraceae), *Marsilea* (Marsileaceae), *Nymphoides*

(Menyanthaceae), *Nelumbo* (Nelumbaceae), *Alloteropsis* (Poaceae), *Brachiaria* (Poaceae), *Echinochloa* (Poaceae), *Oryza* (Poaceae), *Paspalum* (Poaceae), *Polygonum* (Polygonaceae), *Eichhornia* (Pontederiaceae), *Dentella* (Rubiaceae), *Hedyotis* (Rubiaceae), *Azolla* (Salviniaceae), *Salvinia* (Salviniaceae), *Typha* (Typhaceae) and *Phyla* (Verbenaceae) were represented by single species each.

The total observed species, monocots were represented by 33 species belonging to 19 genera and 9 families, while dicots contributed by 24 species belonging to 17 genera and 14 families and 3 species belonging to 3 genera and 2 families of Pteridophyta were recorded.

The present work was carried out for the first time to study about the occurrence of different hydrophytes with special reference to rare species in Gadakhara dvillage of Puri district of Odisha. The occurrence of RET (Rare, Endanger and Threatened) category plant species viz. *Wolffia arrhiza* (L.) Horkel ex Wimm. and *Lindernia anagallis* (Burm.f.) Pennell belonging to Araceae and Scrophulariaceae family respectively. These RET Category species were noticed and documented for the first time in this area. There is a need to protect and conserve these species for the future generation to balance fresh water ecosystem and this will definitely help to maintain other ecosystem and their by inducing the sustainability.

4. Conclusions

Global biodiversity monitoring is providing information on the number and distribution of species, enabling governments to protect villages with high levels of biodiversity and containing rare and threatened species. The current study revealed that wide ranges of hydrophytes are documented in different water bodies of Puri district especially in the village of Gadakhara. The present study gives an idea of existing plants in this study area which revealed that, 60 hydrophytes belonging to 39 genera under 25 families were studied out of that two RET species viz.

Wolffia arrhiza (L.) Horkel ex Wimm. and *Lindernia anagallis* (Burm.f.) Pennell belonging to Araceae and Scrophulariaceae family respectively were first time recorded in Gadakharad village. The data presented in this work are original and first hand. This study provides basic information on the present status and composition of hydrophytes in Puri district of Odisha. There is a need to be protected and conserve this species for the future generation. The present work exhibited the database of hydrophytes which will help in future work for its conservation, preservation and addition of the local biodiversity.

Acknowledgements

The authors would like to thank the villagers of the survey area of Puri district, Odisha. The authors are also grateful to the HOD, Department of Botany and Dean, School of Applied Sciences, Centurion University of Technology and Management (CUTM), Odisha, India for their kind help and suggestions to carry out research work successfully.

REFERENCES

- [1] A. K. Mishra, M.P. Sharma, H. Singh. Floristic diversity of Delhi, India: A checklist, International Journal of Herbal Medicine, Vol. 3(4 Part A), 8-18, 2015.
- [2] T. Jagdishprasad. Biodiversity of aquatic plants of Shivnibandh lake of Sakoli tehsil of Bhandara district of MS, India, International Journal of Life Sciences, Vol. A, 2, 211-213, 2014.
- [3] P. I. Khaparde, N. V. Harney. Macrophytes diversity of Ghodpeth Lake near Bhadravati, District-Chandrapur (M.S.), India. International Research Journal of Science & Engineering, Vol. 6, No. 2, 40-42, 2018.
- [4] B. M. Reddy, A. Chaturvedi. Study of Aquatic and Associated Macrophytes from the major Rivers of the Chandrapur District, Maharashtra. International Journal of Science, Environment and Technology, Vol. 5, No. 6, 3774-3782, 2016.
- [5] K. Ishaq, S. K. Marwat, N. K. Mandokhel. Preliminary Study of Aquatic and Marshland Angiosperms of Zhob District, Balochistan, Pakistan, Pakistan Journal of Botany, Vol. 49, No. 2, 715-723, 2017.
- [6] H. B. Pattnaik, G. L. Patro, G. C. Tosh. Major distribution of aquatic weed flora in the district Ganjam, Odisha, Proceeding 8th Annual Conference, Odisha Botanical Society (Rayagada), 1983.
- [7] M. Mohanty, B. P. Choudhury. Addition to Hydrophytes of Cuttack. Bulletin of Environmental studies, Vol. 1, 9-12, 1984.
- [8] H. O. Saxena, M. Brahmam. The Flora of Orissa, Vol. 1-4. Regional Research Laboratory (CSIR), Bhubaneswar and Orissa forest Development Corporation Ltd., Bhubaneswar, 1994.
- [9] H. H. Haines. The Botany of Bihar and Odisha. 1-6 parts, London, 1925.
- [10] S. Bhowmik, and B. K. Datta. Elemental analysis of some ethnomedicinally important hydrophytes and marsh plants of India used in traditional medicine. Asian Pacific Journal of Tropical Biomedicine, Vol. 2, No. 3, S1227-S1231, 2012.
- [11] K. A. Sujana, R. Saravanan, A. D. Pandey. Distribution of Aquatic Macrophytes in Balasore District, Odisha, In Aquatic Ecosystem: Biodiversity, Ecology and Conservation, 1-12, 2015.
- [12] S. Subhadarsini, S. K. Nayak, K. B. Satapathy. Study of Floral Diversity with Special Reference to Hydrophytes in Bhubaneswar and its Adjoining Villages, Odisha, India, International Research Journal of Biological Sciences, Vol. 5, No. 9, 1-7, 2016.
- [13] M. Panda, R. N. Samal, K. S. Bhatta, S. Lenka, J. Rout, H. K. Patra, S. Nanda. Diversity and distribution of vascular macrophytes in Ansupa Lake, Odisha, India, Bonorowo Wetlands, Vol. 8, No. 1, 1-12, 2018.