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Research Article

Exploring the Diversity and Distribution of Macrophytes of Chandanpur Beel and Churamon Beel, North Dinajpur District, West Bengal: Implications for Conservation

Sujit Kumar Mandal[1*], Sudeshna Mukherjee[2]

[1,2]Taxonomy of Angiosperms and Biosystematics Laboratory, Dept. of Botany, Sidho-Kanho-Birsha-University, Purulia, West Bengal, India

**Corresponding Author: smondal.bot@gmail.com*

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Abstract—Aquatic macrophytes are the most diverse group of large photosynthetic organism and fundamental ingredients of any wetland biosphere. Overexploitation of wetlands and discharge of effluents into the water of wetland is the most serious problem nowadays which directly interfering the normal growth and sustainability of the macrophytes. The present research investigates the diversity and distribution pattern of macrophytes of Chandanpur beel and Churamon beel of North Dinajpur District. This investigation disclosed a total of 19 species belonging from 14 different families among which Asteraceae, Commelinaceae, Onagraceae, Poaceae and Polygonaceae showed the equal distribution each comprise 2 sp. whereas rest of the families each contain only 1 sp. Life form (Raunkiaer,1934) and growth form (Cook,1996) classification of macrophytes also have been done. Different quantitative characters viz. frequency, density, abundance, RF, RD, RA and IVI were also evaluated where *Torenia crustacea* showed the highest IVI value (27.19) followed by *Pontederia crassipes* (19.42). Diversity analysis revealed highest species diversity and species richness in Chandanpur beel. The study provides the insight pattern of diversity as well as present status of macrophytes which will be the triggering factor for the implementation effective step regarding conservation of macrophytes in their native area.

Keywords—Macrophytes, Overexploitation, Life forms, Diversity analysis.

1. Introduction

Biodiversity refers as variety of biological diversity which represent the variation among the species of different ecosystem where as floristic analysis is the sum total of vegetation and composition of all the species present in particular geographical location .Biodiversity can be quantifi ed by several number of organizational levels, such as genetic diversity, species richness, population, ecosystems to restore and preserve the biologically important species. Exploration of diversity and its quantification have long impact in the study of vegetation, ecosystem, its conservations as well as the overall sustainable development of any ecosystem. Wetlands are the most distinct and diverse ecosystem, which is inundated with water either seasonally or permanently [1], [2]. Besides that these also consider as the most productive ecosystems that sustain and nurture human life as well as other aquatic organisms.The wetland ecosystem plays a critical role by providing shelter, replenishing and purifying water, maintaining natural cycles, and supporting a wide range of biodiversity[3]. The purpose of investigation of wetland ecosystem is to enlist the floral diversity, details study of diversity with some of their ecological parameters, management, conservation in their native places, and restoration [4],[5]. Macrophytes are obligatory integral key constituent of any of the wetland ecosystem as they play significant role in habitat structuring and constructing ecosystems by providing complexity and heterogeneity in the formation of habitat, along with accumulation of minerals, deposition of sediments, nutrient cycling etc. These are also recognized as a biomonitoring agent which enable the assessment of water quality, reflect the presence and concentration of pollutants. Different anthropogenic sources like industrial and domestic waste water effluent, urban and agricultural runoff, atmospheric deposition, fuel combustion, etc. can raise high threatened condition for prevailing macrophytes of wetlands.

2. Related Work

Studies on various aspects of macrophytes in different parts of West Bengal as well as all over the world were studied by Das *et al.*[6], which revealed the phytosociological attributes and diversity of plant species (tress, shrubs and herbs) in coastal areas of Devbhoomi Dwarka District, and its islands in the Gulf of Kachchh. Shaye *et al.*[7] studied on ecological

significance of floristic composition and life forms of Riyadh region Central Saudi Arabia to investigate floristic composition and plants life form of Riyadh region. Mandal and Mukherjee [8] studied on phytosociological assessment on aquatic macrophytes and diversity in two selected wetlands of Kishanganj district, Bihar to calculate different diversity index such as Shannon, Simpson Dominance index. Mandal and Mukherjee [9] studied the phytoclimate analysis of two selected wetlands of Bihar with the comparative assessment of life form composition and biological spectrum. Maitry *et al.*[10] worked on quantitative assessment of macrophytes diversity and their status in wetlands of GGV,Bilaspur in the form of calculatingdifferent diversity index value. Bujarbarua[11] studied on life form and biological spectrum of Umananda River Island, Guwahati, Assam, for characterization of the phytoclimate.

3. Materials and Methods

3.1 Study site

North Dinajpur district lies between 25.11˚ N to26.49◦ N latitude and between 87.49◦ E to 90.00◦ E longitude. The district covers the total area about 3142 sq. km. Kulik, Nagar and Mahananda are main rivers of this district. The soil type mainly alluvial and mostly sandy to sandy-loam in texture. Raiganj and Islampur are the two subdivision of this district. Both Chandanpur beel and Churamon beel, which were selected for present research belonging from Itahar block of North Dinajpur district.

3.2 Specimen collection and identification

To make the database of floristic composition, species richne ss and diversity, extensive field survey was conducted from November 2021 to February 2024 and species were collected. Some standard taxonomic literatures[12],[13],[14],[15], [16], [17], [18], [19], [20], [21], [22], [23], [24], [25] were consul ted for proper identification of the specimen. Valid scientific name of each specimen were checked by using digital databa se, **POWO** (Plants of the World Online, 2024) [26], **IPNI** (International Plant Names Index, 2024) and **GBIF** (Global Biodiversity Information Facility)[27], [28]**.** Preparedherbari um sheets of the worked out specimen were kept at the repos itory of Taxonomy of Angiosperms and Biosystematics laboratory of S. K. B. University, Purulia.

3.3Phytosociological studies of macrophytes

Phytosociologicalanalysis of macrophytes were under taken during the survey period. Total 8 sites, 4 sites from each of the wetlands were taken, in which 16 quadrats of 2m x 2m size were laid at random places. The plant species present in each quadrats were noted and individual species were counted separately for estimating the parameters such as density, frequency, abundanceafter Philips (1959) [29]. The IVI value (Importance Value Index) measures how dominant a species in a particular ecosystem and is calculated by adding, RA, RD and RF. Different diversity indices (Dominance, Shannon-Wieners, Simpson, Margalef, Equitability and Evenness index) were performed by PAST (Paleontological Statistics) 4.14 software.

3.4 Multivariate analysis

3.4.1 Cluster analysis

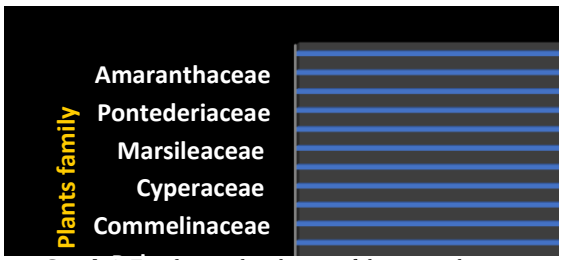
This is a statistical data analysis technique that explores naturally occurring groups within a particular dataset, popularly known as cluster. In this study Bray-Curtis similarity index has been used to construct the dendogram,by using PAST (Paleontological Statistics) 4.14 software.

3.4.2 Principal Component Analysis (PCA)

PCA is a statistical data analysis toolthat investigates multidimentional datasets with quantitative variables. Here it is used to find out the underlying correlations between the plant species and different ecological parameters.

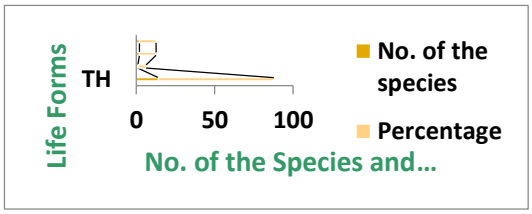
4. Results and Discussion

The present research revealed, a total of 19 species belonging to 14 different families(Table 1).Asteraceae, Commelinaceae ,Onagraceae, Poaceae and Polygonaceae showed equal domin ance over rest of the families as each of this comprise of same number of species (n = 2).



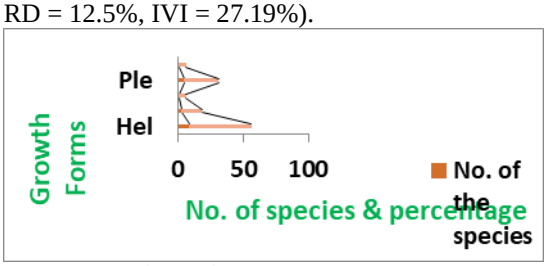
Graph 1. Familywise distribution of the macrophytes.

Macrophytes were also classified according to Raunkiaer's life form(1934). Among which, therophytes showed the highest dominance (73.68%) followed by hydrophytes and hemicryptophytes (10.52% each).



Graph 2. Distribution of life forms (Raunkiaer, 1934)

On the basis of growth form, helophytes showed the highest occurrences (47.36%) followed by pleustophytes (26.31%) and hyperhydrate (15.78%). *Toreniacrustacea*were found dominant among all the species (F= 62.5%, RF = 10.41%, D = 75, RD = 12.5%, IVI = 27.19%).



Graph 3. Growth forms of documented macrophytes (Cook, 1996).

Table 1. Floristic documentation of macrophytes of Chandanpurbeel and Churamonbeel of North Dinajpur District.

Sl. No.	Scientific Names	Family	Life form(LF)	Growth Form(GF)	W_1	W_2
1	*Acmellauliginosa*(Sw.) Cass.	Asteraceae	TH	Hel	+	
2	*Albidellaoligococca*(F.Muell.)Lehtonen	Alismataceae	TH	Hyp		+
3	*Alternantherasessilis*(L.) DC.	Amaranthaceae	TH	Hel	+	
4	*Commelinadiffusa*Burm. f.	Commelinaceae	HCP	Vit		+
5	*Cyperusbrevifolius*(Rottb.) Hassk.	Cyperaceae	TH	Hel		+
6	*Eclipta prostrata* (L.) L.	Asteraceae	CH	Hel	+	+
7	*Hygroryzaaristata*(Retz.)Nees ex Wight &Arn.	Poaceae	TH	Ple		+
8	*Ipomoea aquatica* Forssk.	Convolvulaceae	HCP	Hyp	+	
9	*Ludwigiaadscendens*(L.)H.Hara	Onagraceae	TH	Hyp	+	
10	*Ludwigiaperennis*L.	Onagraceae	TH	Hel	+	+
11	*Marsileaquadrifolia* L.	Marsileaceae	TH	Ple	+	+
12	*Murdanniapauciflora*(G. Bruckn.) G. Bruckn.	Commelinaceae	TH	Hel		+
13	*Nymphoideshydrophyllum* (Lour.) Kuntze	Menyanthaceae	HY	Eph		+
14	*Persicariahydropiper*(L.)Delarbre	Polygonaceae	TH	Hel		+
15	*Phleumpratense* L.	Poaceae	TH	Ple	+	
17	*Pistiastratiotes*L.	Araceae	TH	Ple	+	+
16	*Polygonumaviculare*L.	Polygonaceae	TH	Hel		+
18	*Pontederiacrassipes*Mart**.**	Pontederiaceae	HY	Ple		+
19	*Torenia crustacea* (L.) Cham. &Schltdl.	Linderniaceae	TH	Hel		+

LF= Life form (HCP=Hemicryptophytes, **HY**=Hydrophytes, **CH** = Chamaephytes, **TH** = Therophytes): **GF= Growth form (Eph**= Ephydate, **Hel**=Helophyte, **Hyp**= Hyperhydrate,**Ple**=Pleustophyte, **Vit**= Vittate). **W1:** Chandanpurbeel**, W2:** Churamon beel.

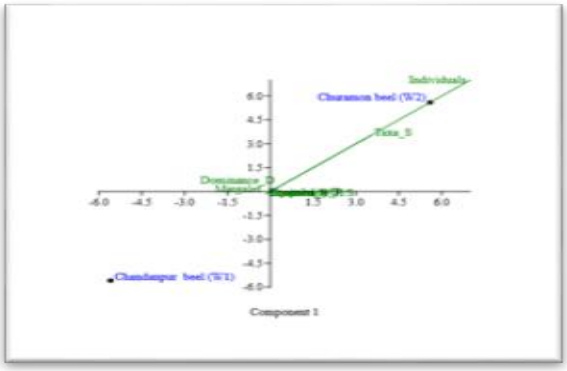
Table 2. Morphometric features of two wetlands in North Dinajpur District.

Name of the wetlands	Latitude	longitude	Altitude	Type of the wetland	Area (acre)	Block
Chandanpurbeel	25.43˚ N	88.10˚ E	8.88 m	Fresh water	250 acres	Itahar
Churamonbeel	25.41˚ N	88.11˚ E	9.26 m	Fresh water	188 acres	Itahar

Table 3. Wetlandwise Diversity-index analysis of the aquatic macrophytes.

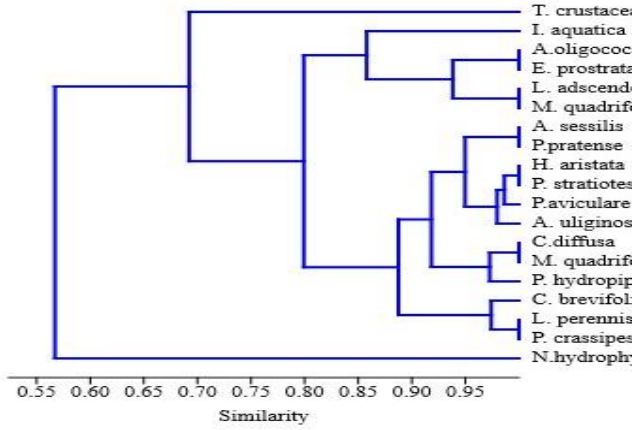
	Chandanpurbeel (W1)	Churamonbeel (W2)
Taxa_S	4	4
Individuals	9	14
Dominance_D	0.1944	0.2527
Simpson_1-D	0.8056	0.7473
Shannon_H	1.477	1.384
Evenness_e^H/S	1.095	0.9979
Equitability_J	1.066	0.9985
Margalef	1.365	1.137

PCA biplot multivariate analysis has also been implemented to explore the multivariate relationship among the different diversity indices in case of two beel. Different diversity indices such as Simpson, Margalef, Shannon-Weiner, including evenness, equitability and no. of individual related to macrophytes of both W1 and W2 were taken to study the correlation among them. PCA illustration showed that some of the species negatively correlated due to dissimilarity in diversity indices in both the W1 and W2.



Graph4.PCA biplot analysis of the different diversity indices of both the studied wetlands.

The species diversity indices analyses revealed high diversity and richness and evenness in Chandanpurbeel (Margalef = 1.36, Simpson = 0.80, Evenness = 1.095 and Shannon-Weiners=1.4). Dendogram analysis have also been performed on the basis of IVI of various aquatic macrophytes, using UPGMA (Unweighted Pair Group Method with Arithmetic Mean) clustering methods with the Bray-Curtis similarity index for studying the hierarchial relationships between the species based on their ecological importance, and similarity in species composition. The species such as *Ecliptaprostrata* and*Marsileaquadrifolia*that are closely grouped in dendogram indicating species with similar ecological characteristic (IVI value) and the length of the branches in the dendogram represents the degree of dissimilarity. Shorter branches indicate greater similarity, while longer branches showing the greater dissimilarity.



Graph 5. Dendogram analysis of macrophytes on the basis of IVI value

5. Conclusion

Present research clearly indicate that macrophytes proliferati on is increasing in both the wetlands, as both of the wetlands show rich macrophytes growth.Analysing of Shannon-Weiner and Simpson diversity index in case of two different wetlands give the conclusion that Chandanpurbeel(W1) contain high species richness and diversity whereas Churamonbeel showed high dominance. In comparison between the two wetlands, the result depicts that Churamonbeel(W2) is some how facing the challenging environment due to some anthropogenic pressure, habit and habitat loss of native flora, and species fragmentation which is real threat to the beel. As a result the forgoing study aims to conduct every immediate and necessary actions for the conservation and sustainable development of the wetland. Continuous observations at regularinterval and proper oversight strategies are required for maintaining the sound health of the wetland. Besides that, quality of water and protection of native biota should be secure by the elimination of alien species.

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Conflict of Interest
The authors declare that they have no conflict of interest

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Authors' Contributions
Author-1provide the concept of the manuscript. Both authors checked the manuscript and approved the final version of the manuscript.
Author-2conducted the field work, calculate the statis tical data and prepared the full manuscript.

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AUTHORS PROFILE

Dr. Sujit Kumar Mandal has obtained his B. Sc.from Bankura Sammilani College, Bankura in 1996. He has completed his M. Sc.,and Ph.D. in Botany from The University of Burdwan in 1998 and 2012, respectively.He is currently attending as Assistant Professor in the Department of Botany from Sidho Kanho Birsha University, West Bengal since 2016. He has revealed aboutn 29 research papers.He has published 07 book chapters in reputed books. His main research is based on Macrophytes diversity associated with Wetlands and Ethnobotany.

Sudeshna Mukherjeehas obtainedher B. Sc., M. Sc., and GATE in Botany from SidhoKanhoBirsha University, Guru Ghasidas Central University, Bilaspur in 2015, 2017, and 2020, respectively. Presently she is a Research Scholar of Botany, Sidho Kanho Birsha University, P. O. Sainik School, Dist. Purulia, West Bengal. She has expressed about 14 research papers in different International and National journals and it's also available online. She has published a few book chapters in reputed books also. Her main research work focuses on study of wetlands and their associated Macrophytes.

