JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

ASCERTAINMENT OF PHYTOCLIMATE WITH THE AID OF LIFE FORM, GROWTH FORM AND LEAF SIZE SPECTRA OF MACROPHYTES IN JOLOHARI BEEL AND NEHALI BEEL, NORTH DINAJPUR DISTRICT,WEST BENGAL

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

[1]Research Scholar, [2]Assistant Professor
Taxonomy of Angiosperms and Biosystematics Laboratory, Department of Botany,
Sidho-Kanho-Birsha-University, Purulia, West Bengal, India

Abstract: Macrophytes diversity and their vegetation is the fundamental key component of any wetland ecosystem. Extensive field survey conducted to document the floristic characteristics of the macrophytes to determine the phytoclimate. Study reveals the enlisting a total of 16 macrophytes belonging to 14 angiosperm families. Analysis of biological spectrum showed the Therophytes (81.25%) were the most dominant life form of the area. So that it directly depicts the therophytic phytoclimate. Total 6 types of leaf size spectra have been found during study. Among these leptophyll (44%) showed the dominance followed by mesophyll (19%) and notophyll (13%). Dominance of therophytes and leptophylls indicate that the vegetation is under biotic pressure due to various anthropogenic activities and the area is subtropical type.

Key words: Phytoclimate, Biological spectrum, Leptophyll, Therophyte, Subtropic.

I. INTRODUCTION

Wetlands are area of most diverse ecosystem that is saturated with water either seasonally or permanently (Mandal and Mukherjee, 2023).Wetland ecosystem play a significant role in nurturing the widespread biodiversity (Mishra and Singh, 2022) which can also be consider as most productive habitats on earth by providing shelters for various aquatic animals and breeding ground for migratory birds (Quirino et al, 2022). Macrophytes are large macroscopic hydrophytes which are the complimentary biotic constituents and integral part of wetland ecosystem (Reshi et al, 2021;Paul, 2022). Macrophytes serve as biological indicator of water quality by showing their presence, absence or overdominance. Besides all of these they also play vital role in phytoremediation, fish-farming, natural sponge as well as purifier of wastewater and plant biomass waste used as biofuel. Assessment of macrophytes, its diversity and some phytosociological parameters such as growth form, life form and leaf spectrum are very important tool to predict the phytoclimate (both micro and macro) of that particular environment as well as understanding of plant's ecophysiological process. Leaf size spectrum also indicates different anthropogenic activities and the grazing pressure in the area (Khan et al, 2022; Tasker et al, 2022).

The purpose of the ongoing research is to enlist the current presence of macrophytes, their growth form (Cook, 1996), life form (Raunkiaer, 1934) and leaf size spectrum along with all other ecological parameters quantitatively. So, that the study will be impactful to determine the current status of vegetation of that particular area.

II. MATERIAL AND METHODS

A. Study area

The selected study area is the North Dinajpur district of West Bengal. North Dinajpur district lies between 25.11˚N to 26.49˚ N latitude and between 87.49˚ E to 90.00˚ E longitude, which covers the total area of 3142 sq. km. The district is surrounded by Thakurgaon, Panchagarh, and Bangladesh on the East, Darjeeling district and Jalpaiguri district on the North, Malda district and South Dinajpur district on the south, Purnia, Kishanganj and Katihar districts of Bihar on the West. Kulik and Mahananda are most famous rivers of the district. The district is rich in alluvial soil and the climate of this district is characterized by a hot summer with high humidity, abundant rainfall, and cold winter. For the present study two wetlands, Jolohari beel and Nehali beel were selected from Raiganj and Itahar block of North Dinajpur district.

Jolohari Beel

This is a man made, perennial wetland which is situated under Joyhat mouza in Itahar block. The location of this wetland is 88.12◦ E longitude and 25.29◦ N latitude covering an area of about 9.37 acres. This wetland is under public ownership and the neighbouring villages of this wetland are Kaziapara, Gholhat, Dakkhinshyampur and Madaihat.

Figure 1a: Field survey in Jolohari beel. Figure 1b:Vegetation of Jolohari beel.

Nehali Beel

This wetland is situated at Tenahari village of Raiganj block, under the Maraikura Gram Panchayat. This wetland is under government ownership. It is located at 88.09 E longitude and 25.57 N latitude and it covers about 200-500 acres land. The wetland is surrounded by villages like Hathia, Nuripur, Taherpur, Dakshin Bishnupur, Maraikura and Noyapara.

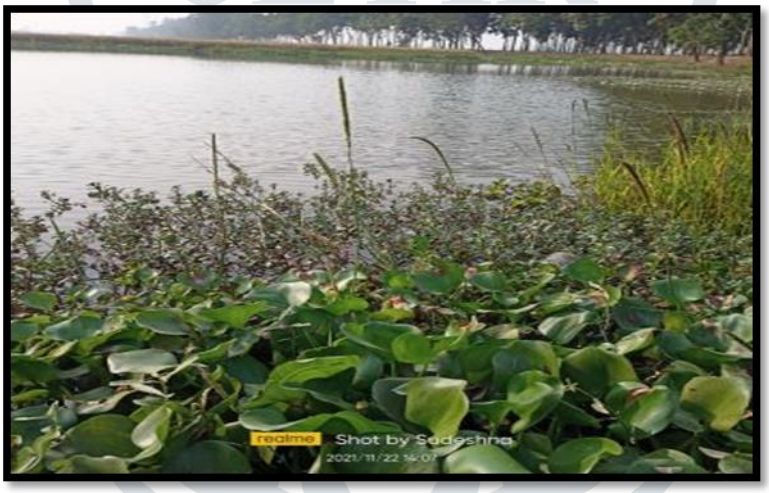

Figure 2: A view of Nehali beel.

B. Methodology

For the assessment of phytoclimate of the investigated area extensive field survey were conducted from November 2021 to July 2023, to collect the macrophytes from the two selected wetlands which are Jolohari beel and Nehali beel of North Dinajpur district.

Macrophytes were studied in details during survey by enlisting their habit, habitat, vegetational diversity, prevailing seasons along with the nature of perennating buds in relation to the soil surface. Further studies have been done in the laboratory after worked out of the collected specimen by following standard literatures (Bujarbarua, 2018; Sen and Bhakat, 2020; Shaye et al, 2020; Chaudhary and Sitre, 2021; Chilawar and Telang, 2021; Kalita, 2021;Shelekar et al,2022; Ashrafuzzaman et al, 2023; Awo et al, 2023;Bhanja et al, 2023; Mjelde et al, 2023; Mondal and Palit, 2023; Mukherjee and Mandal, 2023 a; 2023 b; Paradiya et al, 2023; Patel and Patel, 2023; Radhanpuri, 2023, Troia, 2023; Vukov et al, 2023) and valid scientific names were checked by **POWO** (Plants Of the World Online, 2023), and **WFO (**World Flora Online, 2023), then preserved in the form of herbarium specimens at Taxonomy of Angiosperms and Biosystematics laboratory of SKBU, Purulia. Collected plant specimens were classified on the basis of growth form according to Cook (1996) and into different category of life form following by Raunkiaer (1934) and Muller and Ellenberg (1974).

Leaf size spectra

Leaf size spectra helps to understand the physiological process of plants and plant communities. Plants were classified as (a)Leptophyll (<25mm^2), (b)Nanophyll (25-225mm^2), **(c)**Microphyll (225-2025mm^2), (d)Notophyll (2,025-4500 mm^2), (e) Mesophyll (4500-18225 mm^2), (f) Macrophyll (18225-164,025 mm^2) (g) Megaphyll (> 164,025mm^2) (Raunkiaer ,1934 and Hussain,1989).

$$\textbf{\% Life form} = \frac{\text{No.of sp.in any life form}}{\text{Total no.of sp.in all life form}} \times 100$$

III. RESULTS AND DISCUSSION

In the present study, a total of 16 species were recorded belonging to 14 angiosperms families. Poaceae and Cyperaceae both showed the similar dominance (13%) over Alismataceae and Amaranthaceae (7%) followed by all of the rest of the 10 families which are Commelinaceae, Hydrocharitaceae, Convolvulaceae, Plantaginaceae, Onagraceae, and Marsileaceae (each comprise of 6%) [Table 1].

Table 1: Floristic documentation of macrophytes of Jolohari beel and Nehali beel.

NO.	Scientific Name	Family	Life form (LF)	Growth form (GF)	Leaf size spectra	W_1	W_2
1	*Albidella oligococca*(F. Muell.) Lehtonen	Alismataceae	TH	Hyp	Me		+
2	*Alternanthera philoxeroides* (Mart.) Griseb.	Amaranthaceae	TH	Hyp	Mi	+	
3	*Cyanotis axillaris*(L.)D. Don ex Sweet	Commelinaceae	TH	Hyp	Na	+	
4	*Cyperus iria* L.	Cyperaceae	TH	Hel	Le	+	
5	*Hydrilla verticillata*(L. f.) Royle	Hydrocharitaceae	TH	Vit	Le		+
6	*Hygroryza aristata* (Retz.)Nees ex Wright &Arn.	Poaceae	TH	Ple	No		+
7	*Ipomoea aquatica* Forssk.	Convolvulaceae	HCP	Hyp	Me	+	+
8	*Limnophila heterophylla* (Roxb.) Benth.	Plantaginaceae	TH	Eph	Le	+	
9	*Ludwigia adscendens*(L.)H. Hara	Onagraceae	TH	Hel	No	+	+
10	*Marsilea quadrifolia* L.	Marsileaceae	TH	Ple	Mi	+	
11	*Persicaria pulchra* Sojak	Polygonaceae	TH	Hel	Le		+
12	*Phleum pratense* L.	Poaceae	TH	Ple	Le	+	
13	*Pistia stratiotes* L.	Araceae	TH	Ple	Me	+	
14	*Pontederia hastata* L.	Pontederiaceae	HY	Ple	Ma	+	+
15	*Schoenoplectiella articulata*(L.)Lye	Cyperaceae	TH	Hel	Le		+
16	*Utricularia aurea* Lour.	Lentibulariace	CP	Pla	Le	+	+

LF=Life form (CP=Chamaephytes, **HCP**=Hemicryptophytes, **HY**=Hydrophytes, **TH** = Therophytes: **GF =Growth form (Eph**= Ephydate, **Hel**=Helophyte, **Hyp**= Hyperhydrate, **Pla** =Plankton, **Ple** = Pleustophyte, **V it** = Vittate). **Leaf spectra: Le**- Lepto phyll, **Na-** Nanophyll, **Mi**-Microphyll, **No**-Notophyll, **Me**-Mesophyll, **Ma**- Macrophyll. **W1:** Jolohari beel, **W2:** Nehali beel.

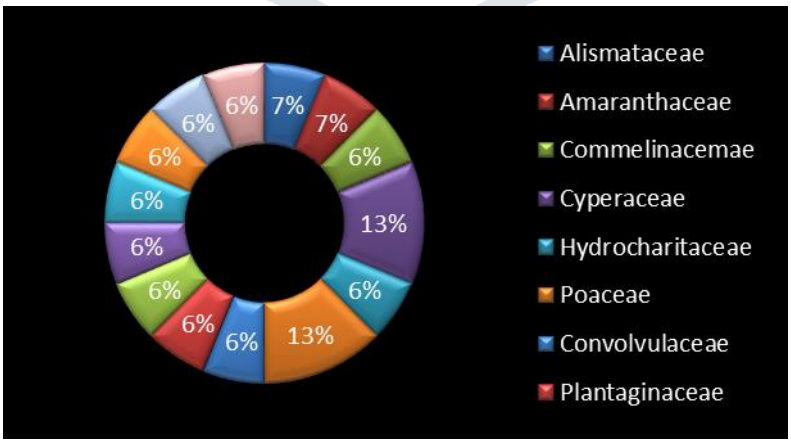

Figure 3: Familywise distribution of collected macrophytes.

3.1 Biological spectrum: Macrophytes were classified according to their biological spectrum which shows that Therophytes 13 (81.25%) were the dominant followed by Hemicryptophytes 1, Hydrophytes 1 and Chamaephytes 1 (each 6%). It reveals that therophytes constitute the highest percentage than the Raunkiaer's normal spectrum (i.e. 81.25%> 13%) among the 4 types of life form. This result ascertain that the phytoclimate of the region is therophytic. Comparative analysis of biological spectrum with

Raunkiaer's normal spectrum (1934) also disclose that highest divergence showed by Therophytes i. e. 68.25%. However, the overall dominance of therophytes (13 species, 81.25%) depicts that environment possess very dry and cold season which is unfavourable for the species inhabiting that particular area and also the macrophytes of research area are under biotic pressure.

Table 2: Comparision between Biological spectrum of macrophytes of Jolohari beel and Nehali beel and Raunkiaer;s normal spectrum(1934) along with their deviation.

Life form	TH	HCP	HY	CP
Biological spectrum from present study (%)	81.25	6.25	6.25	6.25
Raunkiaer's normal spectrum(%)	13	26	2	9
Percentage Deviation	68.25	-19.75	4.25	-2.75

Table 3:Determination of phytoclimate with the help of biological spectrum of macrophytes of Jolohari beel and Nehali beel.

	Biological spectrum %				
Name of the wetlands	TH	HCP	HY	CP	Phytoclimate
Jolohari Beel	72.72	9.09	9.09	9.09	Therophytic
Nehali Beel	66.66	11.11	11.11	11.11	Therophytic

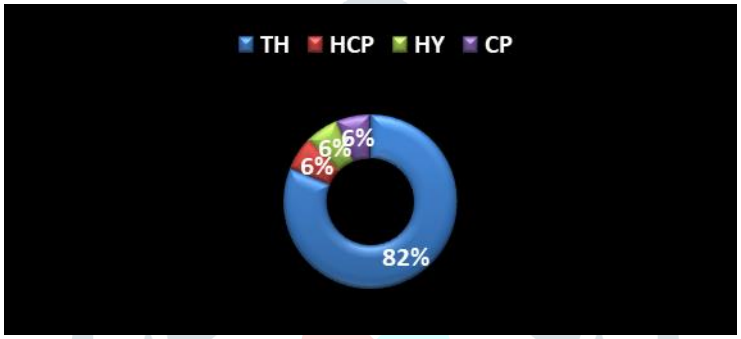

Figure 4: Biological spectrum of collected macrophytes of Jolohari beel and Nehali beel.

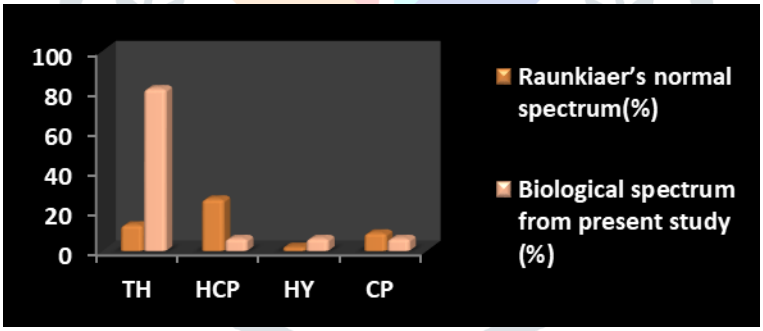

Figure 5: Comparison of biological spectrum with Raunkiaer"s normal spectrum(1934).

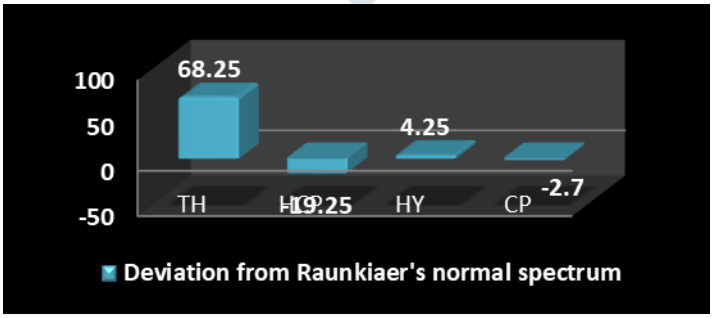

Figure 6: Deviation of biological spectrum from normal Raunkiaer' spectrum(1934).

3.2 Growth Form: Floristic analysis of plant specimen also include the growth form, according to which collected macrophytes were classified into 6 different categories (Cook, 1996). Pleustophytes (31%) shows the dominance over both Plankton and Helophytes (25%) followed by Vittate(7%) and both Ephydate and Hyperhydrates (6% each).

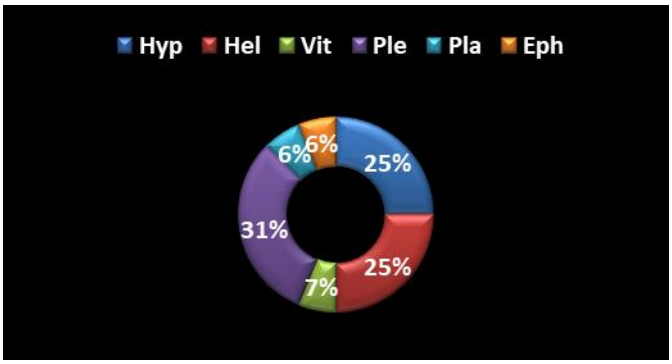

Figure 7: Percentagewise growth form distribution of collected macrophytes.

3.3 Leaf size spectra: The leaf size spectra analysis showed the overall 6 category, these were found to be high followed by Leptophyll 7(44%), Mesophyll 3(19%), Notophyll 2(13%), Microphyll 2(12%) and minimum percentage shown by both Nanophyll 1(6%) and Macrophyll 1(6%). Hence, the leaf spectra study revealed that the vegetation of the study area is Leptophyllous in nature.

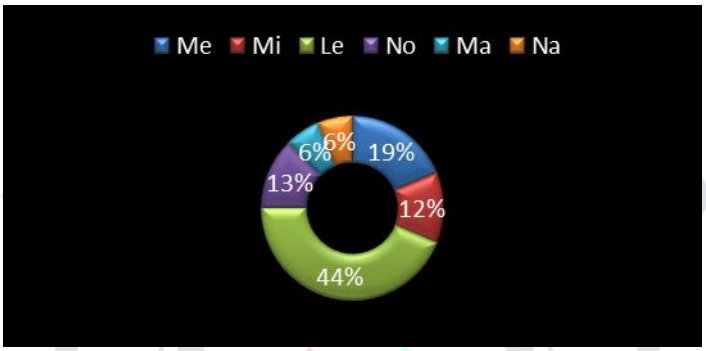

Figure 8: Percentage wise Leaf size spectra of collected macrophytes.

IV. CONCLUSION

The present investigation deals with the ascertainment of phytoclimate of the study area by using the tool of Raunkiaer's normal spectrum as well as the comparative study of biological spectrum of macrophytes. To analyse the floristic characteristics of macrophytes the thorough study of life form, growth form and leaf size spectra are very important as it provides the overall view of the particular environment. Research revealed the therophytic phytoclimate, which is the characteristic of subtropics and all these informations will be very effective and impactful database for further research and detection of bioclimate.

Immediate necessary steps should be taken by the local people for the conservation and sustainable development of the wetlands, otherwise different anthropogenic activities will disrupt the current occurrences and status of macrophytes along with the phytoclimate.

V. ACKNOWLEDGMENT

The authors extend their thanks to the local people specially Debashis Sonnasi, Raiganj, North Dinajpur District, for providing valuable information and continuous cooperation for primary data source during extensive field survey.

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