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Distribution and seasonal variation of vascular plant species at Jahangirnagar University campus

Raunaq Jahan[*]

Naem Mollah[**]

Munia Tahsin[***]

[**Abstract** : This study represents the current flora composition and its association with the wetland of Jahangirnagar University. Wetlands support various plant and animal species and serve as vital habitats for many organisms, contributing to the overall ecological balance. This study aimed to investigate the flora's association at the lakes' banks. The association of the flora was determined by the relevé method. Two natural and comparatively less disturbed lake banks and one ridge area were chosen for relevé during the rainy and the winter seasons. Three 10x10 m^2 relevé/plots were delineated and tried to cover the presence of the most number of species. A list of plants by strata with Braun-Blanquet ratings had been prepared for each relevé of the study areas. This study revealed that all forms of flora (trees, shrubs, creepers, and herbs) were on the banks of the lakes, and their seasonal variation was slightly remarkable. The results showed that *Mikania micrantha* from the Asteraceae family dominated relevé 1covering 50-75% of the plot area, and its rating was four (highest in this plot) on the Braun-Blanquet scale. *Melastoma malabathricum* and *Clerondendrome viscosum* covered around 25-50% of the area of the plot and rated three on the Braun-Blanquet scale. *Cordia nodosa* and *Dipterocarpus turbinatus* covered 25-50% of the relevé 2 and rated three on the Braun-Blanquet scale. Relevé 3 had 25 to 50% of *Pleioblastus Argentpostriatus* (rated three on the Braun-Blanquet scale) and 5-25% of *Clerondendron Viscosum* and *Mikania micrantha* (rated two on the Braun-Blanquet scale). In winter relevé 1 had the highest abundance of *Brachiaria mutica* (rated four on the Braun-Blanquet scale), and other species like *Melastoma malabathricum, Mikanian micrantha*, *Thunbergia alata,* and *Centella asiatica* had 25-50% of cover (rated three on the Braun-Blanquet scale). Relevé 2 had different species cover, where *Dipterocarpus turbinatus* found more than 75% abundance (rated five on the Braun-Blanquet scale) and *Swietenia mahagoni* covered 50-70% (rated four on the Braun-Blanquet scale). In relevé 3, we found 25-50% cover of *Clerondendrome viscosum* and *Urena lobata* (rated three on the Braun-

[*] Dr. Raunaq Jahan, Associate Professor, Department of Geography and Environment, Jahangirnagar University, email: raunaqjahan@juniv.edu

[**] Naem Mollah, GIS analyst, Center for Environmental and Geographic Information Services (CEGIS), Dhaka

[***] Munia Tahsin, Research Officer, International Centre for Climate Change and Development, IUB, Dhaka

Blanquet scale)*; Lantana camara* and *Ipomoea aquatica* (5-25% cover, rated two on the Braun-Blanquet scale). Wetlands are invaluable assets within the ecosystem of the JU campus, and the records of floral diversity can help conserve the biodiversity of the area.]

Introduction

Preserving urban or semi-urban vegetation has numerous advantages, particularly concerning science, society, economy, and the environment (Hunter, 2007). Jahangirnagar University (JU) campus is a semi-natural and semi-urban area that was an integrated part of the Madhupur Tract harboring the 'Sal' (*Shorea robusta*) forest of this country (Khan et al., 2021). This semi-natural landscape is continuously changing by human activities, as the development of structural establishments is necessary for students' requirements. The increased demand for students' residential halls and faculty buildings, natural green spaces, and water bodies are under threat, and these changes can result in drastic changes to the biodiversity and composition of plant communities and lead to species extinction (McKinney, 2006; Freitas et al., 2020; Khan et al., 2021). All plant species on the JU campus are economically or ecologically important, but mostly medicinal, ornamental, fodder and forage, fruit, vegetable, timber, and fuel wood. Some semi-natural lakes have an impact on wetland ecology and the biological diversity of the area.

Riparian vegetation (including riverine, wetland, and floodplain systems) dynamics also depend on the timing of seasonal flow (Greet et al., 2011). The wetland vegetation is the key component of the ecosystem and fulfills many ecological functions. They provide food and habitat, manage the filtering and cycling of sediments and nutrients, and stabilize the banks (Richardson et al., 2007; Greet et al., 2011).

Theoretical background and aim of the research

Globally, there is a significant disparity in the distribution of plant species, which can be seen in gradients of increasing species diversity from the poles to the equator, in the transition from arid to humid regions, and in the transition from low-lying, flat terrain to the hilly areas with distinct elevational zonation. Geographically, areas of very high species richness that are well-known for their vascular plants are layered across gradients of geographic variety (Körner, 2021). The geographical distribution of plants is significant from the regional level to the local level as some factors (e.g., anthropogenic influences and local climate variability) directly influence their occurrences and distinctness. Jahangirnagar University harbours around 917 species belonging to 574 genera and 145 families of vascular plants (Khan et al., 2021). There were 70.34% wild, 36.21% of the species were alien to Bangladesh, and 63.79% were indigenous (Khan et al., 2021). Due to the general remoteness of this region, the wetlands on the JU campus remain the least explored. Consequently, very little biodiversity survey work has been done in the area, and no systematic surveys have been carried out. This semi-natural landscape also misses plant community surveys in different topographical conditions.

Aim and objectives of the study

The main aim of this study is to explore the wetland vascular plant species of the JU campus and find out the variability of those species in different seasons of the year. The main objectives of the study area are:

- To explore the distribution of vascular plant species at the banks of the lakes at JU campus.

- ❖ To assess the plant community in the Braun Blanquet scale.
- ❖ To observe the seasonal changes of the vascular plant community.

Materials and Methods

Study area

The 282.29-hectare Jahangirnagar University (JU) campus is located 32 km north-west of the city of Dhaka along the Dhaka-Aricha highway, between the latitudes of 23.8671° and 23.8977°E and 90.2588° and 90.2731°N (Fig. 1). This region has mildly undulating landscape made up of red lateritic soil. According to data from the past ten years, monthly average temperatures in the study area are 35.5°C, 30.5°C, and 12°C; monthly average rainfall are 83.15 mm, 228.6 mm, and 9.6 mm, and seasonal humidity are 62%, 86%, and 52.5%, respectively, in summer, rainy and winter seasons. We have chosen two banks of water bodies and one ridge area on the JU campus. The 1st relevé/spot was in the western part of Mir Mosharraf Hossain Hall, located in the southern part of the Jahangirnagar University campus. The second spot is located in the eastern part of the botanical garden, which has semi-natural vegetation covered with some planted tree species, and the third spot is the bank of a lake at the southern part of Agrani Bank (Fig. 1).

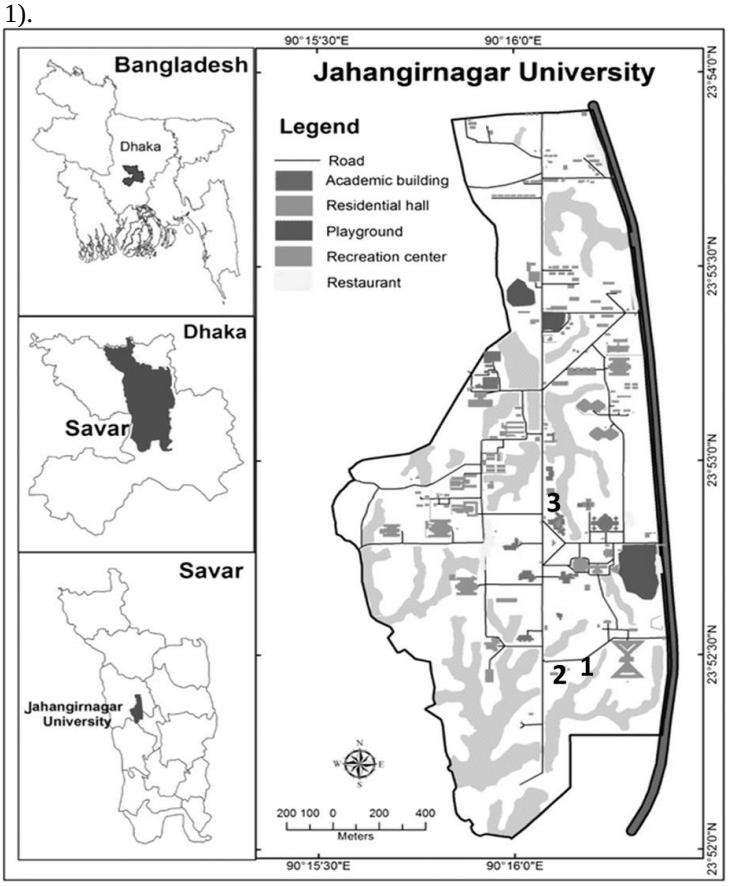

Figure 1: Land covers of Jahangirnagar University Campus and location of three relevé. (Source: modified from Hossain et al., 2018)

Data Sources and Methods

In this study, we followed the field survey and community sampling of flora for our study areas, where topographic conditions and a list of the flora were collected (Table 1). We chose a 10x10 m^2 (100 m^2) area for each relevé and observed the abundance of the species using a Braun-Blanquet method (Braun-Blanquet, 1932, 1964; Poore, 1955; Wikum & Shanholtzer, 1978). We tried to avoid the limitations of counting stems as a sapling method and estimated the cover-abundance scale to estimate species' importance. The cover was determined from estimates of vertical plant shoot-area projection as a percentage of 100 m^2 area. In this method, every listed species has a cover-abundance index as follows:

5, covering more than 75% of the area;
4, any number of individuals covering 50-75% of the area;
3, any number of individuals covering 25-50% of the area;
2, very numerous or covering at least 5-25 % of the area;
1, plentiful but of small cover value or scattered, with cover up to 5%;
+, sparsely or very sparsely present, cover very small
r, Solitary, with a small cover.

The species were recorded using the spatial distribution and abundance information of all three sites for the rainy and winter seasons.

Results

Data obtained in previous studies (Khan et al., 2021) showed that Poaceae is the most dominant species family in the JU campus. Other significant families are Fabaceae, Asteraceae, Malvaceae, Cyperaceae, and Rubiaceae (Fig. 2). According to their study, the wetland and lake bank areas also have dominant species from the Poaceae family (Fig. 3). Poaceae is from the grass family of flowering plants. As can be seen in the study areas, the number of species from Poaceae family is also high, with 67 species. Table 1 shows the list of the species occurrence for three relevé in two seasons.

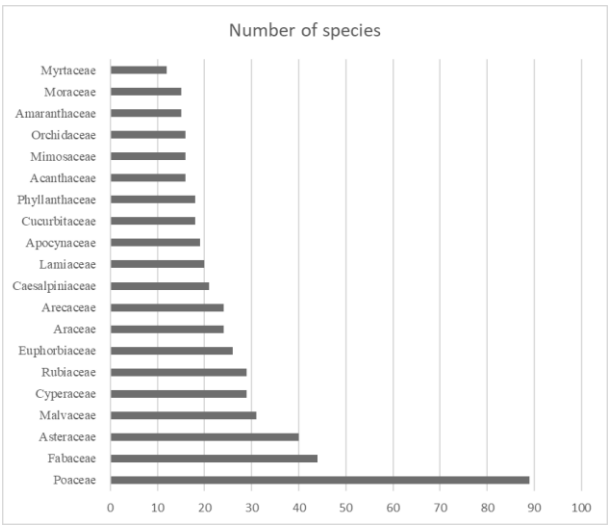

Figure 2: Dominant plant family in JU, source: modified from Khan et al., 2021.

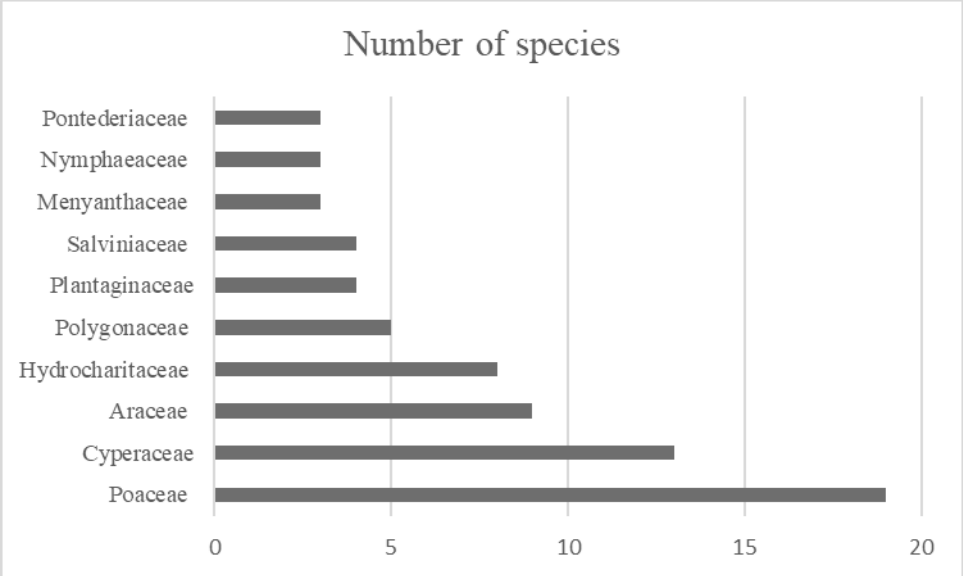

Figure 3: Dominant wetland and lake bank plant family in JU, source: modified from Khan et al., 2021.

Table 1: Identified plant species from three relevé. (Source: Fieldwork, 2023-2024)

No.	Family	*Species name*	Bangla name	Life form	Use	Relevé	Season
1	Poaceae	*Brachiaria mutica*				1	BS
2	Poaceae	*Brachiaria reptans*				1	RS
3	Apiaceae	*Centella asiatica*	Thankuni	Herb, cr; w	M, Vg	1	BS
4	Costaceae	*Cheiloostus spious*	Kemuk			1	RS
5	Poaceae	*Chrysopogon zizanioides*	Binna	grass		1	WS
6	Lamiaceae	*Clerondendrom e viscosum*	Ghetu	Shrub		1	BS
7	Fabaceae	*Crotalia longirostrata*				1	RS
8	Fabaceae	*Desmodium adscendens*		Shrub	M	1	WS
9	Pontederiaceae	*Eichhornia crassipes*	Kachuripan a	Herb, ff; w	Fo	1	WS
10	Poaceae	*Festuca carpatica*		Grass		1	WS
11	Moraceae	*Ficus oppostifolia*	Dumor			1	RS

No.	Family	*Species name*	Bangla name	Life form	Use	Relevé	Season
12	Lamiaceae	*Gmelina arborea*	Gamari	Tree, l; pl-w	T	1	WS
13	Poaceae	*Hymenachne amplexicaulis*	Nordula ghas	Herb, er; w	Fo	1	WS
14	Verbenaceae	*Lantana camara*	potus	Shrub; w	M	1	BS
15	Poaceae	*Leersia virginica*		Grass		1	WS
16	Lygodiaceae	*Lygodium japonicum*	Japanese Climbing Fern	Climbing fern	M	1	WS
17	Lygodiaceae	*Lygodium flexuosum*				1	RS
18	Melastomataceae	*Melastoma malabathricum*	Phutuki			1	BS
19	Asteraceae	*Mikanian micrantha*	Bikash Lota	Climber		1	BS
20	Fabaceae	*Mimosa pudica*	Lojjaboti	Shrub		1	BS
21	Poaceae	*Oplismenus undulatifolius*				1	RS
22	Poaceae	*Panicum virgatum*				1	RS
23	Poaceae	*Paspalum conjugatam*				1	RS
24	Phyllanthaceae	*Phyllanthus urinaria*	Hazarmoni	Shrub	M	1	BS
25	Poaceae	*Setaria barbata*	Bashpata ghas	Herb, er; w	Fo	1	WS
26	Asteraceae	*Synedrella nodiflora*	Bon Genda/ Nak phul	Herb, er; w	M	1	BS
27	Acanthaceae	*Thunbergia alata*		climber		1	WS
28	Malvaceae	*Triumfetta rhomboidea*	Bon Akra			1	RS
29	Malvaceae	*Urena lobata*	Atlera	Shrub; w	Fb, M	1	WS
30	Moraceae	*Astocarpus heterophylus*	Kanthal	Tree, m; pl-w	Fr, T	2	BS
31	Meliaceae	*Azadirachta indica*	Neem	Tree, m; pl-w	M	2	BS
32	Boraginaceae	*Cordia nodosa*				2	RS
33	Dioscoreaceae	*Dioscorea pentaphylla*				2	RS
34	Dipterocarpaceae	*Dipterocarpus turbinatus*	Teligarjan	Tree, l; pl-w	T	2	BS
35	Fabaceae	*Enterolobium contortisiliquum*				2	RS
36	Lamiaceae	*Gmelina arborea*	Gamari	Tree, l; pl-w	T	2	BS

No.	Family	*Species name*	Bangla name	Life form	Use	Relevé	Season
37	Bignoniaceae	*Markhamia lutea*				2	RS
38	Poaceae	*Oplismenus undulatifolius*				2	RS
39	Meliaceae	*Switenia mahagoni*	Meogoni	Tree, l; pl-w	T	2	BS
40	Araceae	*Syngonium podophyllum*	Podolata kachu	Herb, pr; pl-w	O	2	BS
41	Rutaceae	*Zanthoxylum rhetsa*	Bajna	Tree, m; w	M, Oy	2	BS
42	Mimosaceae	*Albizia lebbeck*	Kalo koroi	Tree, l; pl-w	T	3	BS
43	Poaceae	*Axonopus compressus*	Karpet ghas	Herb, er; w	Fo	3	BS
44	Arecaceae	*Borassus flabellifer*	Tal			3	RS
45	Poaceae	*Brachiaria reptans*				3	RS
46	Menispermaceae	*Cissampelos sympodilis*				3	RS
47	Lamiaceae	*Clerondendrom e viscosum*	Ghetu	Shrub		3	BS
48	Cucurbitaceae	*Coccinia grandis*	Telakucha	Herb, vi; w; Climber	M, Vg	3	BS
49	Araceae	*Colocasia eaculenta*	Jangli kachu	Herb, er; w	M, Vg	3	BS
50	Poaceae	*Digitaria sanguinalis*		Grass		3	WS
51	Dryopteridaceae	*Dryopteris filix-mas*	Fern	Herb; Fern	M	3	WS
52	Cystopteridaceae	*Gymnocarpium dryopteris*	Ferns			3	RS
53	Convolvulaceae	*Ipomoea aquatica*	Kalmishak	Herb, cr; pl-w	Vg	3	WS
54	Poaceae	*Isachne miscicola*		Herb; Grass		3	WS
55	Verbenaceae	*Lantana camara*	Kutus kanta	Shrub; w	M	3	BS
56	Asteraceae	*Mikanian micrantha*	Bikash Lota	Climber		3	BS
57	Poaceae	*Pleioblastus argentpostriatus*				3	RS
58	Malvaceae	*Pterygota alata*	Budha narikel	Tree, l; pl	M, T	3	WS
59	Rubiaceae	*Spermacoce latifolia*				3	RS
60	Malvaceae	*Sterculia alata*	Buddho narikel			3	RS
61	Meliaceae	*Switenia mahagoni*	Meogoni	Tree, l; pl-w	T	3	BS

No.	Family	*Species name*	Bangla name	Life form	Use	Relevé	Season
62	Asteraceae	*Synedrella nodiflora*	Bon Genda/ Nak phul	Herb, er; w	M	3	WS
63	Acanthaceae	*Thunbergia alata*		climber		3	WS
64	Cannabaceae	*Trema orientale*		Tree, m; w	Fw	3	WS
65	Malvaceae	*Triumfetta rhomboidea*	Bon Okhra			3	RS
66	Malvaceae	*Urena lobata*	Atlera	Shrub; w	Fb, M	3	WS
67	Ulmaceae	*Trema orientale*	Jibon Brikkho	Tree		3	RS

Notes: Habit: cr- creeper, cv- cultivated, em- emergent, er- erect, w- wild, m- medium, l- large, pl- planted, vi- vine, **Use:** Fb- Fibre, Fw- Fuel wood, Fo- Forage, M- Medicine, O- Ornamental, Oy- Oil yielding, T- Timber, Vg- Vegetable, **Season:** BS- Both season, RS- Rainy season, WS- Winter season.

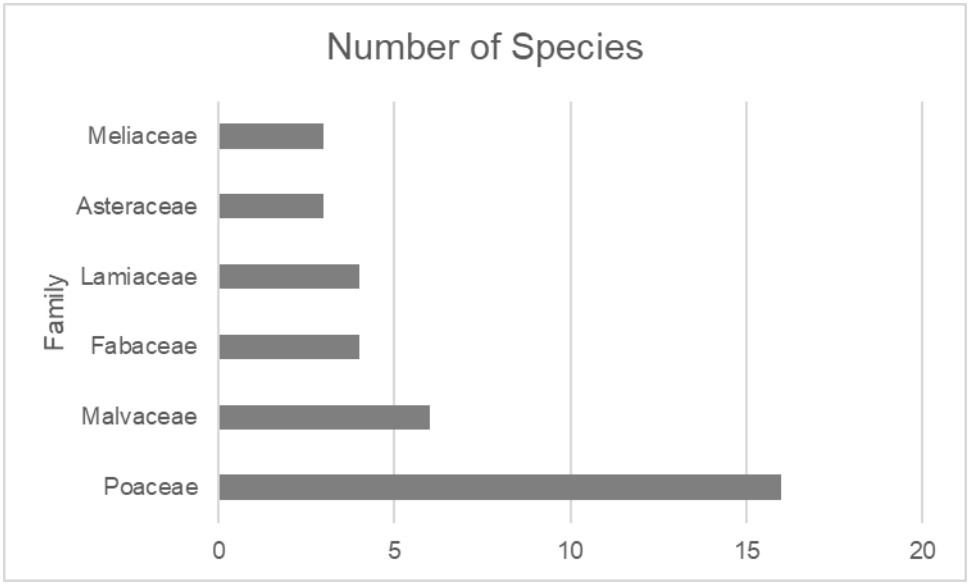

Figure 4: Dominant plant family in three relevé.

Figure 4 shows the dominant families from the study areas and the highest number of species found from the Poaceae family. Besides the number of species, the cover-abundance of the flora has been rated using the Braun-Blanquet scale.

The results revealed that *Mikania micrantha* from the Asteraceae family dominates relevé 1, and its rating value on the Braun-Blanquet scale is four (highest in this plot), covered 50-75% of the plot area. *Melastoma malabathricum* and *Clerondendrome viscosum* covered around 25-50% of the plot and rated three on the Braun-Blanquet scale (Table 2).

Cordia nodosa and *Dipterocarpus turbinatus* covered 25-50% of the relevé 2 and rated three on the Braun-Blanquet scale (Table 3). Relevé 3 contained 25-50% of *Pleioblastus Argentpostriatus* (rated three on the Braun-Blanquet scale) and 5-25% of *Clerondendron Viscosum* and *Mikania micrantha* (rated three on the Braun-Blanquet scale) (Table 4).

Table 2: BRAUN-BLANQUET Method- Relevé 1, 3rd August 2023

Stratum Symbol	BRAUN-BLANQUET Rating Symbol	*Plant species*
Tree (T)	**r**	*Ficus oppostifolia*
Shrub (S)	**3**	*Melastoma malabathricum*
	3	*Clerondendrome viscosum*
	+	*Lantana camara*
	+	*Crotalia longirostrata*
	1	*Synedrella nodiflora*
	+	*Panium virgatum*
	1	*Mimosa pudica*
Herb (H)	**4**	*Mikanian micrantha*
	1	*Brachiaria mutica*
	1	*Paspalum conjugatam*
	+	*Brachiaria reptans*
	r	*Phyllanthus urinaria*
	r	*Cheiloostus spious*
	+	*Lygoium flexuosum*
	1	*Centella asiatica*
	1	*Triumfetta rhomboidea*
	1	*Oplismenus undulatifolius*

Table 3: BRAUN-BLANQUET Method- Relevé 2, 3rd August 2023

Stratum Symbol	BRAUN-BLANQUET Rating Symbol	*Plant species*
Tree (T)	**3**	*Cordia nodosa*
	3	*Dipterocarpus turbinatus*
	2	*Swietenia mahagoni*
	r	*Zanthoxylum rhesta*
	r	*Gmelina arborea*
	r	*Astocarpus heterophylus*
	2	*Markhamia lutea*
	r	*Enterolobium contortisiliquum*
	+	*Azadirachta indica*
Herb (H)	**r**	*Oplismenus undulatifolius*
	1	*Dioscorea pentaphylla*
	+	*Syngonium podophyllum*

Table 4: BRAUN-BLANQUET Method – Relevé 3, 3rd August 2023

Stratum Symbol	BRAUN-BLANQUET Rating Symbol	*Plant species*
Tree (T)	**+**	*Albizia odorastissima*
	r	*Sterculia alota*
	+	*Guaiacum officinale*
	r	*Switenia mahagoni*
	r	*Borassus flabellifer*
Shrub (S)	**2**	*Clerondendron viscosum*
	+	*Brachiaria reptons*
	1	*Colocasia eaculenta*
	+	*Triumfetta rhomboidea*
Herb (H)	**+**	*Coccinia grandis*
	2	*Mikania micrantha*
	1	*Lantana camara*
	+	*Cissampelos sympodilis*
	r	*Gymnocarpium dryopteris*
	1	*Axonopus compressus*
	+	*Spermacoce latifolia*
	3	*Pleioblastus argentpostriatus*

In winter, relevé 1 had the highest abundance of *Brachiaria mutica* (rated four on the Braun-Blanquet scale), and other species like *Melastoma malabathricum*, *Mikanian micrantha*, *Thunbergia alata*, and *Centella asiatica* have 25-50% of cover (rated three on the Braun-Blanquet scale) (Table 5). Relevé 2 had different species cover where *Dipterocarpus turbinatus* found more than 75% abundance (rated five on the Braun-Blanquet scale) and *Swietenia mahagoni* had covered 50-70% (rated four on the Braun-Blanquet scale) (Table 6). Relevé 3 had two dominant species according to cover-abundance, *Clerondendrome viscosum* and *Urena lobata* (rated three on the Braun-Banquet rating scale). The other two species rated two are *Lantana camara* and *Ipomoea aquatica* (Table 7).

Table 5: BRAUN-BLANQUET Method- Relevé 1, January 5 2024

Stratum Symbol	BRAUN-BLANQUET Rating Symbol	*Plant species*
Tree (T)	**r**	*Gmelina arborea*
Shrub (S)	**3**	*Melastoma malabathricum*
	2	*Clerondendrome viscosum*
	+	*Lantana camara*
	+	*Urena lobata*
	+	*Phyllanthus urinaria*
	1	*Mimosa pudica*
	+	*Desmodium adscendens*
Herb (H)	**3**	*Mikanian micrantha*
	3	*Thunbergia alata*
	2	*Lygodium japonicum*
	r	*Synedrella nodiflora*
	4	*Brachiaria mutica*
	1	*Chrysopogon zizanioides*
	2	*Eichhornia crassipes*
	3	*Centella asiatica*
	+	*Festuca carpatica*
	2	*Leersia virginica*
	1	*Setaria barbata*
	1	*Hymenachne amplexicaulis*

Table 6: BRAUN-BLANQUET Method- Relevé 2, January 5, 2024

Stratum Symbol	BRAUN-BLANQUET Rating Symbol	*Plant species*
Tree (T)	**5**	*Dipterocarpus turbinatus*
	4	*Swietenia mahagoni*
	1	*Gmelina arborea*
	2	*Zanthoxylum rhesta*
	+	*Astocarpus heterophylus*
	+	*Azadirachta indica*
Herb (H)	**r**	*Syngonium podophyllum*

Table 7: BRAUN-BLANQUET Method – Relevé 3, January 5, 2024

Stratum Symbol	BRAUN-BLANQUET Rating Symbol	*Plant species*
Tree (T)	**1**	*Pterygota alata*
	1	*Trema orientale*
	1	*Switenia mahagoni*
	r	*Albizia lebbeck*
Shrub (S)	**3**	*Clerondendrome viscosum*
	3	*Urena lobata*
	2	*Lantana camara*
Herb (H)	**2**	*Ipomoea aquatica*
	1	*Synedrella nodiflora*
	r	*Dryopteris filix-mas*
	+	*Thunbergia alata*
	1	*Mikanian micrantha*
	+	*Coccinia grandis*
	2	*Isachne miscicola*
	+	*Colocasia esculenta*
	2	*Digitaria sanguinalis*
	+	*Axonopus compressus*

Discussion and Conclusion:

Three relevé of the study areas were topographically different landforms. Relevé 1 was the valley's lake bank plot, which harbors the most species. Generally, the fine-deposited silt and near-to-water bodies are prime factors for diverse floral distribution. The topographic structure of relevé 3 was part of the backslope linked to the lake and had a diversified species presence. Relevé 2 was a ridge area at the botanical garden and had naturally diversified forest species.

Some dominant species were present in the rainy and winter seasons (BS in Fig. 5), some in the rainy season (RS), and some in the winter (WS) in the study areas. Seven species in both seasons occurred in relevé 2, and five species grew additionally in the rainy season.

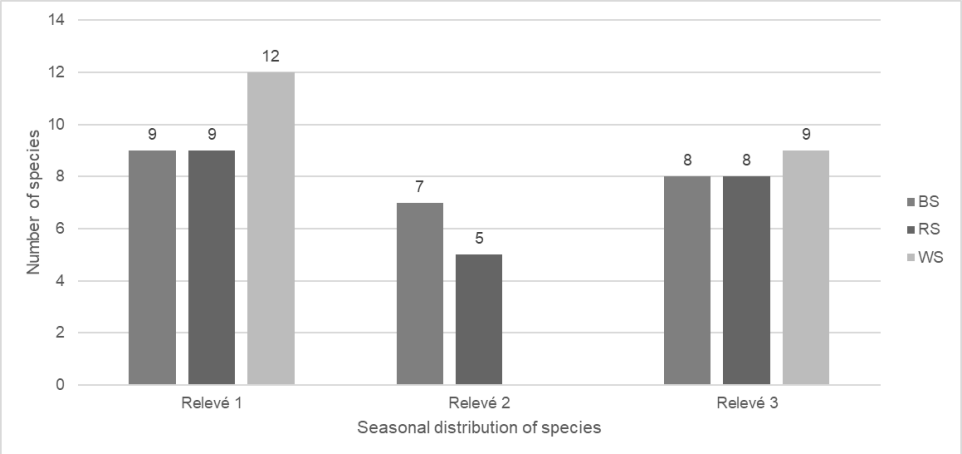

Figure 5: Seasonal distribution of species in three relevé. BS - Both seasons, RS - Rainy season, and WS - Winter season.

Wetlands are often rich in biodiversity, supporting various plant and animal species. A number of rare and endangered species may inhabit the wetlands at Jahangirnagar University. Some medicinal plants like *Azadirachta Indica* (Neem), *Centella asiatica* (Thankuni), *Coccinia Grandis* (Telakucha), *Colocasia Eaculenta* (Jangli kachu), *Dryopteris filix-mas* (Fern), *Lantana camara* (Potus), *Lygodium japonicum* (Japanese Climbing Fern), *Phyllanthus Urinaria* (Hazarmoni), *Pterygota alata* (Budha narikel), *Synedrella Nodiflora* (Bon Genda/ Nak phul), *Urena lobata* (Atlera) grow near the water bodies are essential species. Additionally, the diversity of plants was higher on the lakeside plot compared with the backslope and ridge plots.

As a limitation, the paper surveyed only a few plots from different topographical positions and concentrated on the study area's richest and most undisturbed regions. More plots for each topographic region were avoided because of the lack of time and inaccessibility.

To our knowledge, we did plant community sampling in different topography at the JU campus for the first time, where we found richer biodiversity near the wetlands and valley areas. Seasonality and flood frequency affect the richness of the plants near the wetlands (Pollock et al., 1998; Wright et al., 2003), and these could lead to a diversified plant community.

Wetlands and its related vegetation community provide recreational and educational opportunities for students, faculty, and visitors. They offer spaces for birdwatching, nature walks, and ecological research. By experiencing wetland ecosystems firsthand, individuals can better understand environmental processes and the importance of conservation efforts. Wetlands hold cultural significance and aesthetic value, serving as sources of inspiration for art, literature, and cultural practices. They contribute to the overall beauty and attractiveness of the campus environment, enhancing the quality of life for those who study, work, and live at Jahangirnagar University.

In summary, wetlands are invaluable assets within the ecosystem of the JU campus, and the records of floral diversity can help conserve the area's biodiversity. This type of research will help prioritize the importance of wetlands in protecting biodiversity and formulating the JU campus master plan.

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