

Phytosociological Studies of the Flora of Dhanamanjuri University Campus in Imphal West District (Manipur), India

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## ABSTRACT

**Aims:** To study the life forms and biological spectrum of the vegetation of Dhanamanjuri University Campus, Manipur, to determine its phytoclimate and species diversity.

**Study Design:** The vegetation of the whole university campus was studied and the site selection ~~within the campus~~ was made randomly.

**Place and Duration of Study:** Dhanamanjuri University Campus is located at the intersection of 24.82°N Latitude and 93.94°E Longitude. The study was carried out ~~during from~~ March to September, 2023.

**Methodology:** ~~Life-Life~~ forms were determined in the study area after detailed floristic studies. The ~~classification of veget~~ ~~vegetation classification on a physiognomic basis has been done as per Raunkiaer's system as~~ ~~vegetation classification on a physiognomic basis as per Raunkiaer's system~~ modified by Ellenberg and Mueller-Dombois. ~~For quantitative analysis, frequency, density, abundance, and basal area were calculated~~ ~~frequency, density, abundance, and basal area were calculated for quantitative analysis.~~ ~~For diversity studies, Both Shannon-Weiner Index and Simpson index were calculated~~ ~~Both Shannon-Weiner Index and Simpson index were calculated for diversity studies.~~ The degree of association between two randomly selected species was studied with a simple index of association IASM.

**Results:** The biological spectrum of Dhanamanjuri University Campus consists of 183 plant species belonging to 163 genera ~~that are~~ distributed over 74 families. Due to ~~the predominance of Phanerophytes (54.1%) and Therophytes (22.4 %) over the other life forms, the study site got's~~ ~~predominance of Phanerophytes (54.1%) and Therophytes (22.4 %) over the other life-forms, the study site was~~ assigned to the ~~'Phanero-Therophytic'~~ ~~'Therophytic'~~ Phytoclimate. The values of ~~the~~ Shannon-Weiner Index and Simpson Index were found to be 1.5202 and 3.101<sub>1</sub> respectively. For the degree of association between two randomly selected species,  $\chi^2$  value was calculated to be 0.101<sub>1</sub>, inferring that the two species are not associated with each other, rather they are independently distributed in the site.

**Conclusion:** The current study has described the vegetation of ~~the~~ Dhanamanjuri University Campus, as per ~~Raunkiaer's~~ ~~Raunkiaer's~~ terminology, as ~~"Phanero-Therophytic or"~~ ~~"Phanero-Therophytic or"~~ phytoclimate. The study also shed light on various phytosociological attributes of plants growing ~~on the~~ campus, thus shedding more light on the diversity and distribution patterns of the plants growing there.

**Keywords:** Life-form, Biological Spectrum, ~~phytoclimate~~ ~~paleoclimate~~, IVI, Shannon-Weiner Index, Index of association.

## 1. Introduction

Vegetation can be defined as an assemblage of plants growing together in a particular location. ~~Vegetation~~ The vegetation covering an area has a definite structure and composition, ~~which is closely associated with the biotic and abiotic factors of that particular area~~ closely associated with that particular area's biotic and abiotic factors. Due to changes in habitat, certain species or whole groups of plants may disappear or get replaced by others. Such changes can be studied by doing vegetation analysis. For vegetation study, Raunkiaer (1934), for the first time, put forward the idea of life-forms and biological spectrum. A ~~life-form in a community is generally defined as the sum of adaptations of plant~~ community's life form is generally defined as the sum of plant adaptations to certain ecological conditions and is an important part of vegetation analysis. Over the years, many different systems of classification of plant life-forms have been revised by many ecologists. However, ~~Raunkiaer's~~ 's ~~Raunkiaer's~~ (1934) life-form system and its further extension by Braun-Blanquet (1951) have found the widest application ~~throughout the world, making the system of Raunkiaer as worldwide, making the system of Raunkiaer~~ the most accepted one. According to this system, plant species are grouped into 5 broad life-forms categories ~~on the basis of~~ based on the position of perennating buds on plants and the degree of their protection during adverse conditions. The five categories are Phanerophytes, Chamaephytes, Hemicytophytes, Cryptophytes and Therophytes. A biological spectrum is formed when all species of higher plants of a community are classified into life-forms, and their ratio are expressed in numbers of percentages (Rana *et al.*, 2002). According to Raunkiaer (1934), the bioclimate of a region is characterized by the life-forms whose percentage value is much higher than the normal spectrum (Ariya & Gupta, 2016). The dominant life-forms would reflect the probable climatic condition to which the plants try to adapt ~~themselves~~ to prevailing climatic stress. The dominant life-form is ~~termed as~~ called phytoclimate (Devi & Sharma, 2004).

The critical role of species composition in the dynamics and functioning of an ecosystem ~~has been sufficiently recognised~~ been recognized in various scientific studies in the past few decades (Power 1995, Hobbie 1996). Community structure, composition, and vegetative function, which are the most important attributes of an ecosystem, ~~shows~~ variations in response to environmental as well as anthropogenic variables (Gairola *et al.*, 2008; Timilsina *et al.*, 2007; Shaheen *et al.*, 2012). Therefore ~~taxonomic diversity within an ecosystem and their compositional change over time within the ecosystem constitute the most important biodiversity parameters, having wide applications such,~~ taxonomic diversity within an ecosystem and its compositional change over time constitute the most important biodiversity parameters, with wide applications such as environmental monitoring and conservation evaluation (Magurran, 1988; Pressey *et al.*, 1994).

### 1.2 STUDY SITE

The study site, Dhanamanjuri University Campus, is located at the heart of Imphal city, the capital of Manipur, North-east India. It comes under the Imphal west district, extending within the geographical coordination of 24.82°N latitude and 93.94° E longitude, at ~~an elevation of~~ 780 meters above mean sea level. It is bounded by National ~~highway~~ Highway No. 2 in the east, Thangmeiband ~~road~~ Road in the west and north, and the Naga Turel (river) in the south. The study was carried out ~~during from~~ February to September, 2023, and during the study period, the temperature ranged between 27.67°C (maximum) and 18.55°C (minimum) with an average precipitation of 170.65mm and average relative humidity of 88.21%.

## 2. MATERIALS AND METHODS

Life-forms were determined in the study area after detailed floristic studies. For each plant species, the form, habit, and nature of perennating buds were critically examined in the field. The ~~classification of vegetation on a physiognomic basis has been done as per Raunkiaer's system~~ ~~as vegetation classification on a physiognomic basis has been done as per Raunkiaer's~~ ~~system~~ ~~modified by Ellenberg and Mueller-Dombois (1974).~~ Accordingly, life-form was assigned to all the plants. After having assigned a life-form to all the plants, ~~the~~ percentage of each ~~life-life~~ form class was determined using the formula:

$$\text{Percentage of life-form} = \frac{\text{no. of species falling in particular life form}}{\text{total no. of species in all life forms}} \times 100$$

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Then, the biological spectrum for the study site was prepared and has been compared with the ~~Raunkiaer's~~ ~~Raunkiaer's~~ normal spectrum ~~as well as with~~ the spectra available for other locations of the world. Specimens of all plants were identified with ~~the aid of~~ relevant floras and available revisions.

Phytosociological attributes of plants growing in a site within the University campus were estimated by taking 30 quadrates of 50cm x 50cm, ~~which were~~ distributed randomly. The size and the number of quadrats have been determined using the "Species Area Curve Analysis" (Cain, 1938 ~~and~~ Oosting, 1958). ~~For quantitative analysis, frequency, density, abundance and basal area were calculated~~ ~~frequency, density, abundance, and basal area were calculated for quantitative analysis.~~ Using the ratio of abundance to frequency, the distribution pattern of the different species present in the site was studied (Whitford, 1949). ~~So as to~~ have an overall picture of ~~the~~ ecological importance of species ~~with respect to~~ for the community structure, ~~the~~ IVI (Importance Value Index) of individual species present in the site ~~were was~~ calculated by adding the percentage values of the relative density, relative frequency, and relative dominance (Misra, 1968)

Using ~~the Shannon-Shannon~~-Wiener Information Function (Shannon and Weaver 1963), the species diversity was calculated as follows:

$$H' = -S \sum_{i=1}^S \left[ \left( \frac{N_i}{N} \right) \log \left( \frac{N_i}{N} \right) \right]$$

Where:

H' = Shannon index of general diversity.

N<sub>i</sub> = Importance value or biomass or total number of individuals of each species.

N = Total importance value or biomass or total number of individuals of all species.

With ~~the~~ Simpson index, the ~~concentration~~-Concentration of dominance (Cd) was measured (Simpson 1949).

$$Cd = \sum_{i=1}^S \left( \frac{N_i}{N} \right)^2$$

Where:

Cd = Concentration of dominance.

N<sub>i</sub> = Importance value or biomass or total number of individuals of each species.

N = Total importance value or biomass or total number of individuals of all species.

With 50 random quadrats of 50cm x 50cm for studying the degree of association between two species (Sp. 1 and Sp. 2), ~~a number of several~~ indices of association (~~I.A.A.~~) have been suggested to study whether species are associated in their distribution or not (Muller-Dombois and Ellenberg, 1974). ~~On~~ ~~the~~ simplest to apply is ~~Jaccards'~~ ~~Jaccards'~~ Index based on presence (I Ap) data:

$$I Ap = \frac{c}{a + b + c} \times 100\%$$

a= no. of the quadrat in which Sp. 1 occurs alone  
 b=no. of the quadrat in which Sp. 2 occurs alone  
 c= no. of the quadrat in which both the species occur together

In another formula, which is also based on species presence, an additional parameter, d, which represents the joint absence of the two species (the number of quadrats in which both the species are absent together), is also put under consideration, as it is necessary for statistical evaluations (de Vries formula). A 2 x 2 contingency table is prepared, which has four cells, a, b, c, and d, as follows:

Chart1: Quadrats wise species distribution

Species 1	Species 2		
	+	-	
+	a	b	a+b
-	c	d	c+d
	a+c	b+d	n= a+b+c+d

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A simple index of association  $IASM = \frac{a+d}{n}$

Then, the  $\chi^2$  value is calculated using the formula

$$\chi^2 = \sum \frac{(ad-bc)^2}{(a+b)(c+d)(a+c)(b+d)}$$

The  $\chi^2$  value is looked up in Chi-square table for one degree of freedom and compared the value at  $P < 0.001$  and  $P < 0.05$ .

For the index of association:

$$\text{Jaccard index, } IAp = \frac{c}{(a+b+c)} \times 100\% = \frac{16}{(3+25+16)} \times 100\%$$

(Where a=3, b=25 and c= 16) =36.30%

A simple index of association

$$IASM = (a+d)/n \text{ (where a= 16; b= 25; c= 3; d= 6 and n = 50)}$$

$$IASM = 0.44$$

### 3. RESULTS AND DISCUSSION

The biological spectrum of Dhanamanjuri University Campus, situated in Imphal West District (Manipur), consists of 183 plant species belonging to 163 genera that are distributed over 74 families. With 21 species, the family Fabaceae is the dominant family, followed by Poaceae with 11 species, Asteraceae with 9 species, and Moraceae with 7 species, respectively. Many economically important plant species, namely *Bixa orellana* L. (Bixaceae), *Nyctanthes arbor-tristis* L. (Oleaceae), *Terminalia citrina* (Gaertn.) Roxb. (Combretaceae), *Tectona grandis* L.f. (Lamiaceae), *Ficus elastica* Roxb. ex Hornem. (Moraceae), *Saraca asoca* (Roxb.) W.J. de Wilde (Fabaceae), *Neolamarckia cadamba* (Roxb.) Bossers (Rubiaceae), etc. are found in the study site.

Table 1: Distribution of different life-forms in the study area.

Sl. No.	Botanical name	Family	Habit	Life-form
1	Barleria cristata L.	Acanthaceae	H	Ch
2	Justicia adhatoda L.	Acanthaceae	S	Ch
3	Phlogacanthus thyrsoformis (Roxb. ex Hardw.) Mabb.	Acanthaceae	S	Ch

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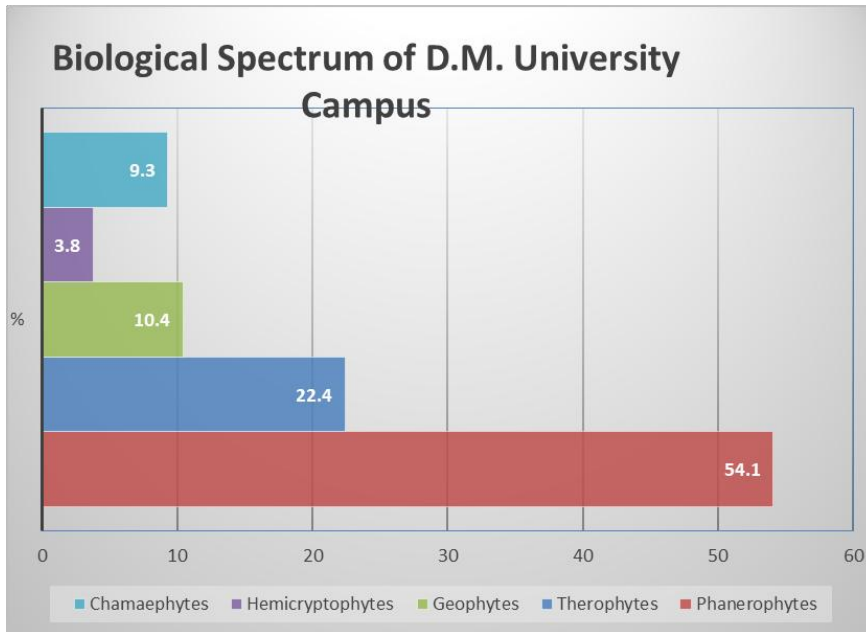


Fig 1: Biological Spectrum Of D.M University Campus

The highest percentage to the Biological Spectrum of the present study site was contributed by Phanerophytes (54.1%) which was higher than the percentage value of Phanerophytes (46%) in the Normal Spectrum of Raunkiaer (1934). Therophytes (22.4%) contributed the second largest, followed successively by Geophytes (10.4%), Chamaephytes (9.3%) and Hemicryptophytes (3.8%). (Table 2) Hemicryptophytes shows the maximum departure from the Normal percentage value of Hemicryptophytes (26%).

The predominance of Phanerophytes in the present study site is a characteristic of sub-tropical climate with anthropogenic disturbance. The presence of Geophytes (10.4%), which is more than the Normal Spectrum (6%), could be attributed to the moist soil conditions, as has been suggested by Raunkiaer (1934). The percentage of Chamaephytes (10.4%) was very close to the Normal Spectrum (9%). The percentage of Hemicryptophytes (3.8%) was much lower than the Normal Spectrum (26%), and this could be due to not-so-cold and non-arid conditions in the area as Hemicryptophytes are usually dominant in cold and arid regions as they reserve water by losing their leaves or reducing the sizes of leaves, reducing vegetative growth and have overwintering buds located on the soil surface. This feature is an effective strategy for their survival. Due to the predominance of Phanerophytes (54.1%) and Therophytes (22.4%) over the other life-forms, the present study site could be assigned to the 'Phanero-Therophytic' Phytoclimate.

Table: 4. Phytosociological attributes estimation: Relative frequency, relative density, relative dominance, abundance, A/F ratio, and IVI (Important Value Index) values of different species present in the selected study site within the campus

Name of the species	Relative frequency	Relative density	Relative dominance	Abundance	A/F ratio	IVI

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1. <i>Acmella oleracea</i> (L.) R.K. Jansen	7.42	2.24	3.51	3.46	0.46	13.4
2. <i>Alternanthera philoxeroides</i> (Mart.) Griseb.	17.25	15.69	22.51	9.53	0.55	55.45
3. <i>Digitariasanguinalis</i> (L.) Scop.	13.80	11.03	10.05	8.37	0.60	34.88
4. <i>Cynodondactylon</i> (L.) Pers.	17.25	52.86	16.88	3.21	1.86	86.99
5. <i>Ageratum conyzoides</i> L.	10.35	4.05	3.71	4.11	0.39	18.11
6. <i>Mikania micrantha</i> Kunth	2.29	0.49	0.45	2.25	0.98	3.23
7. <i>Colocasia esculenta</i> (L.) Schott	6.90	1.41	26.53	2.16	0.31	34.84
8. <i>Commelinabenghalensis</i> L.	5.17	1.25	0.402	2.55	0.49	6.82
9. <i>Ipomoea aquatica</i> Forsk	7.42	2.56	11.91	3.16	0.48	21.89
10. <i>Diplazium esculentum</i> (Retz.) Sw.	0.56	0.16	0.30	3.00	5.35	1.02
11. <i>Persicarialapathifolia</i> (L.) Delarbre	0.56	0.10	0.15	2.0	3.57	0.81
12. <i>Ludwigiaoctovalvis</i> (Jacq.) P.H. Raven	2.86	0.37	0.72	1.40	0.48	3.95
13. <i>Urena lobata</i> L.	0.56	0.054	0.60	1.00	1.78	1.214
14. <i>Sesbania sesban</i> (Linn.) Merr.	5.17	6.521	2.01	2.11	0.40	13.70
15. <i>Cuphea carthagenesis</i> (Jacq.) J.F. Macbr.	2.29	0.92	0.29	4.25	1.85	3.5

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At the site, during our study of 30 random quadrats of 50cm x 50cm, a total of 15 plant species belonging to 12 families were encountered, and 15 plant species belonging to 12 families were encountered. Asteraceae was the dominant family with 2 species. Highest-The highest IVI value was that of *Cynodondactylon* (L.) Pers. followed by *Alternanthera philoxeroides* (Mart.) Griseb. and the least value was that of *Persicarialapathifolia* (L.) Delarbre (Table 4). Among the 15 species, 8 plant species show an IVI value greater than 10 (IVI > 10). The IVI value of a species signifies its dominance and ecological success, its potential and its potential, and potential and ecological amplitude in the area, thus helping to identify the richly and poorly established plant species in the study area. Accordingly, *Cynodondactylon* (L.) Pers., with an IVI value of 86.99, is the highly established plant species in the study area. Using A/F (Abundance to frequency ratio), the distribution pattern of the species in the site was assessed. Depending on the ratios, distribution may be regular (ratio < 0.025), random (ratio = 0.025 -0.05), and contagious (ratio > 0.05). Since all the A/F ratio values are > 0.05 in our study site (Table 4), the distribution pattern of species in the study site is stated to be contagious. This result is in line aligns with several other findings, which reported that most species exhibit a contagious distribution pattern. Most species exhibit a contagious distribution, pattern majority of species exhibit a contagious pattern of distribution in natural vegetation (Sharma et al., 2018). The General index of diversity (Shannon- Weiner Index) value was found to be 1.5202 and, the Concentration of Dominance (Simpson Index) value was found to be 1.5202, and the Concentration of Dominance (Simpson Index) value was 3.101.

For the  $\chi^2$  test, the calculated value is 0.101. Checking the Chi-square table for one degree of freedom at  $P < 0.001$ , which is equal to 10.82, and at  $P < 0.05$ , which is equal to 3.84, the calculated value of 0.101 was found to be lower than both of them, equal to 10.82, and at  $P < 0.05$ , equal to 3.84, the calculated value of 0.101 was lower than both values. Therefore, it is concluded that the two species, *Eleusine indica* (L.) Gaertn and *Paspalum conjugatum* P.J. Bergius are not associated with each other; rather, they are independently distributed in the site.

#### 4. CONCLUSION

In conclusion, the current study has described the vegetation of the Dhanamanjuri University Campus, as per Raunkiaer's Phanero-Therophytic phytoclimate. The study has also further gathered information on various selected phytosociological attributes of plants growing in a site within the campus, thus shedding more light on the diversity and distribution patterns of the plants growing there. The study findings hold significant importance from a conservative and management standpoint as it could be suggested that for species with lower IVIs is to be given priority for conservation and for those with higher IVIs is to species with lower IVIs should be prioritized for conservation, and those with higher IVIs should be tracked to maintain diversity.

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