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

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 was made randomly.

Place and Duration of Study: Dhanamanjuri University Campus is located at the intersection of 24.82ºN Latitude and 93.94ºE Longitude. The study was carried out from March to September, 2023.

Methodology: Life forms were determined in the study area after detailed floristic studies. Vegetation classification on a physiognomic basis as per Raunkiaer's system as modified by Ellenberg and Mueller-Dombois. Frequency, density, abundance and basal area were calculatedfor quantitative analysis. 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 distributed over 74 families. Due to predominance of Phanerophytes (54.1%) and Therophytes (22.4 %) over the other life-forms, the study site was assigned to the "Phanero-Therophytic" Phytoclimate. The values of the Shannon- Weiner Index and Simpson Index were found to be 1.5202 and 3.101 respectively. For the degree of association between two randomly selected species $\chi 2$ value was calculated to be 0.101 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 terminology as "Phanero-Therophytic" 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.

Key words: Life-form, Biological Spectrum, 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. The vegetation covering an area has a definite structure and composition closely associated with that particular area's biotic and abiotic factors. Due to changes in habitat, certain species or whole group 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. Acommunity'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 (1934) life-form system and its further extension by Braun-Blanquet (1951) have found the widest application worldwide, making the system of Raunkiaer the most accepted one. According to this system, plant species are grouped into 5 broad life-forms categories based on the position of perennating buds on plants and the degree of their protection during adverse conditions. The five categories are Phanerophytes, Chamaephytes, Hemicryptophytes, 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 expressed in numbers of percentage (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 (Arila & Gupta, 2016). The dominant life-forms would reflect the probable climatic condition to which the plants try to adapt to prevailing climatic stress. The dominant life-form is called as phytoclimate (Devi & Sharma, 2004).

The critical role of species composition in the dynamics and functioning of an ecosystem has been recognised 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 its compositional change over time constitute the most important biodiversity parameters, with wide applications such 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 underthe Imphal west district extending within the geographical coordination of 24.82ºN latitude and 93.94º E longitude, at 780meters above mean sea level. It is bounded by National Highway No. 2 in the east, Thangmeiband Road in the west and north, and the Naga Turel (river) in the south. The study was carried out from February to September, 2023 and during the study period, the temperature ranged between 27.67ºC (maximum) and 18.55ºC (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 bud were critically examined in the field. The vegetationclassification on 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-form class was determined using the formula:

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

Then, the biological spectrum for the study site was prepared and has been compared with the Raunkiaer’s normal spectrum and the spectra available for other locations of the world.Specimens of all plants were identified with 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, distributed randomly. The size and the number of quadrats have been determined using the "-Species Area Curve Analysis-" (Cain, 1938; Oosting, 1958). For quantitative analysis, frequency, density, abundance and basal area were calculated. Using the ratio of abundance to frequency, the distribution pattern of the different species present in the site was studied (Whitford, 1949). To have an overall picture of the ecological importance of species for the community structure, IVI (Importance Value Index) of individual species presentin the site was calculated by adding the percentage values of the relative density, relative frequency and relative dominance (Misra, 1968)

Using the Shannon-Wiener Information Function (Shannon and Weaver, 1963), the species diversity was calculated as:
$H^{-} = -S \sum_{i=1}^{S}[\left(\frac{Ni}{N}\right)\log(\frac{Ni}{N})]$
Where:
H - = Shannon index of general diversity.
Ni= 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 of dominance (Cd) was measured (Simpson, 1949).
Cd = $\sum_{i=1}^{s}(\frac{Ni}{N})^2$
Where:
Cd = Concentration of dominance.
Ni= 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), several indices of association (I.A.) have been suggested to study whether species are associated in their distribution or not (Muller-Dombois and Ellenberg, 1974). The simplest to apply is 'Jaccards' Index(Jaccard, 1901) based on presence (*IAp*) data:

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

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 (Dice, 1945). A 2 x 2 contingency table is prepared which has four cells a, b, c and d, as follows:

Table 1: 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

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

Then the χ^2 value is calculated using the formula

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

The χ^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:

Jaccard index, IAp= c/(a+b+c) ×100% = 16/(3+25+16)×100%

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

A simple index of association

IASM = (a+d)/n (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), *Neolamarckiacadamba*(Roxb.) Bossers (Rubiaceae) etc. are found in the study site.

Table 2: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 thyrsiformis* (Roxb. ex Hardw.) Mabb.	Acanthaceae	S	Ch
4	*Thunbergia coccinea* Wall. ex D. Don	Acanthaceae	CL	Ph
5	*Alternanthera philoxeroides* (Mart.) Griseb.	Amaranthaceae	H	G
6	*Amaranthus viridis* L.	Amaranthaceae	H	Th
7	*Spinacia oleracea* L.	Amaranthaceae	H	Th
8	*Amaryllis belladonna* L.	Amaryllidaceae	H	G
9	*Lannea coromandelica* (Houtt.) Merr.	Anacardiaceae	T	Ph
10	*Mangifera indica* L.	Anacardiaceae	T	Ph
11	*Annona squamosa* L.	Annonaceae	S/T	Ph
12	*Allamanda cathartica* L.	Apocynaceae	S/T	Ph
13	*Alstonia scholaris* (L.) R.Br.	Apocynaceae	T	Ph
14	*Asclepias curassavica* L.	Apocynaceae	SS	Ch
15	*Catharanthus roseus* (L.) G. Don	Apocynaceae	SS	Ch
16	*Nerium oleander* L.	Apocynaceae	S	Ph
17	*Plumeria rubra* L.	Apocynaceae	T	Ph
18	*Alocasia cucullata* (Lour.) G. Don	Araceae	SS	G
19	*Alocasia macrorrhizos* (L.) G. Don	Araceae	SS	G
20	*Colocasia esculenta* (L.) Schott	Araceae	H	G
21	*Syngonium podophyllum* Schott	Araceae	CL	Ch
22	*Araucaria bidwillii* Hook.	Araucariaceae	T	Ph
23	*Araucaria columnaris*(G. Forst.) Hook.	Araucariaceae	T	Ph
24	*Areca catechu* L.	Arecaceae	T	Ph
25	*Chrysalidocarpus lutescens* H.Wendl.	Arecaceae	T	Ph

26	*Diplazium esculentum* (Retz.) Sw.	Aspleniaceae	H	Ch
27	*Agave americana* L.	Asparagaceae	H	H
28	*Dracaena reflexa* Lam.	Asparagaceae	H	H
29	*Dracaena trifasciata* (Prain) Mabb.	Asparagaceae	H	H
30	*Acmella oleracea* (L.) R.K. Jansen	Asteraceae	H	Th
31	*Ageratum conyzoides* L.	Asteraceae	H	Th
32	*Bidens pilosa* L.	Asteraceae	H	Th
33	*Gynura cusimbua* (D.Don) S. Moore	Asteraceae	H	Th
34	*Mikania micrantha* Kunth	Asteraceae	SS	H
35	*Parthenium hysterophorus* L.	Asteraceae	H	Th
36	*Synedrella nodiflora* (L.) Gaertn.	Asteraceae	H	Th
37	*Tagetes erecta* L.	Asteraceae	H	Th
38	*Xanthium strumarium* L.	Asteraceae	H	Th
39	*Impatiens balsamina* L.	Balsaminaceae	H	Th
40	*Jacaranda mimosifolia*D. Don	Bignoniaceae	T	Ph
41	*Kigelia africana* (Lam.) Benth.	Bignoniaceae	T	Ph
42	*Millingtonia hortensis* L.f.	Bignoniaceae	T	Ph
43	*Spathodea campanulata* P. Beauv.	Bignoniaceae	T	Ph
44	*Bixa orellana* L.	Bixaceae	S	Ph
45	*Cardamine hirsuta* L.	Brassicaceae	H	Th
46	*Mesua ferrea* L.	Calophyllaceae	T	Ph
47	*Trachelium caeruleum* L.	Campanulaceae	SS	Ch
48	*Cannabis sativa* L.	Cannabaceae	H	Th
49	*Trema orientale* (L.) Blume	Cannabaceae	T	Ph
50	*Lonicera japonica* Thunb.	Caprifoliaceae	S/CL	Ph
51	*Carica papaya* L.	Caricaceae	T	Ph
52	*Garcinia xanthochymus*Hook.f. ex T. Anderson	Clusiaceae	T	Ph
53	*Terminalia arjuna* (Roxb. ex DC.) Wight & Arn.	Combretaceae	T	Ph
54	*Terminalia citrina* (Gaertn.) Roxb.	Combretaceae	T	Ph
55	*Ipomoea aquatica* Forsk.	Convolvulaceae	H	Ch
56	*Ipomoea batatas* (L.) Lam.	Convolvulaceae	H	G
57	*Ipomoea triloba* L.	Convolvulaceae	H	Ch
58	*Alangium chinense* (Lour.) Harms	Cornaceae	S	Ph
59	*Kalanchoe pinnata* (Lam.) Pers.	Crassulaceae	H	Th
60	*Benincasa hispida* (Thunb.) Cogn.	Cucurbitaceae	H	Th
61	*Coccinia grandis* (L.) Voigt	Cucurbitaceae	CL	G
62	*Cucumis melo* L.	Cucurbitaceae	H	Th
63	*Lagenaria siceraria* (Molina) Standl.	Cucurbitaceae	H	Th
64	*Momordica charantia* L.	Cucurbitaceae	CL	Th
65	*Hesperocyparis arizonica*(Greene) Bartel	Cupressaceae	T	Ph
66	*Cycas rumphii* Miq.	Cycadaceae	S/T	Ph
67	*Cyperus esculentus* L.	Cyperaceae	H	G
68	*Pteridium aquilinum* (L.) Kuhn	Dennstaedtiaceae	H	G
69	*Dillenia indica* L.	Dilleniaceae	T	Ph
70	*Elaeagnus umbellata* Thunb.	Elaeagnaceae	S	Ph
71	*Equisetum arvense* L.	Equisetaceae	H	G
72	*Jatropha curcas* L.	Euphorbiaceae	S	Ph
73	*Mallotus philippensis* (Lam.) Müll. Arg.	Euphorbiaceae	S/T	Ph
74	*Ricinus communis* L.	Euphorbiaceae	S/T	Ph
75	*Acacia acoma* Maslin	Fabaceae	S	Ph
76	*Acacia auriculiformis* A. Cunn. ex Benth.	Fabaceae	T	Ph

77	*Bauhinia variegata* L.	Fabaceae	S/T	Ph
78	*Calliandra haematocephala*Hassk.	Fabaceae		Ph
79	*Cassia fistula* L	Fabaceae	T	Ph
80	*Cassia javanica* L.	Fabaceae	T	Ph
81	*Chamaecrista fasciculata* (Michx.) Greene	Fabaceae	H	Th
82	*Crotalaria pallida* Aiton	Fabaceae	H	Th
83	*Delonix regia* (Bojer ex Hook.) Raf.	Fabaceae	T	Ph
84	*Enterolobium contortisiliquum* (Vell.) Morong	Fabaceae	T	Ph
85	*Erythrina stricta* Roxb.	Fabaceae	T	Ph
86	*Mimosa pudica* L.	Fabaceae	S	Ch
87	*Mucunamonosperma* Roxb. ex Wight	Fabaceae	CL	Th
88	*Parkia timoriana* (DC.) Merr.	Fabaceae	T	Ph
89	*Phaseolus vulgaris* L.	Fabaceae	H	Th
90	*Psophocarpus tetragonolobus* (L.) DC.	Fabaceae	CL	G
91	*Samaneasaman* (Jacq.) Merr.	Fabaceae	T	Ph
92	*Saraca asoca* (Roxb.) W.J. de Wilde	Fabaceae	T	Ph
93	*Senna sulfurea* (DC. ex Collad.) H.S. Irwin & Barneby	Fabaceae	T	Ph
94	*Senna tora* (L.) Roxb.	Fabaceae	H	Th
95	*Sesbania sesban* (L.) Merr.	Fabaceae	S	Ph
96	*Lithocarpus pachyphyllus* (Kurz) Rehder	Fagaceae	T	Ph
97	*Iris foetidissima* L.	Iridaceae	H	G
98	*Anisomeles indica* (L.) Kuntze	Lamiaceae	H	Th
99	*Gmelina arborea* Roxb. ex Sm.	Lamiaceae	T	Ph
100	*Premna mollissima* Roth	Lamiaceae	S/T	Ph
101	*Premna serratifolia* L.	Lamiaceae	S/T	Ph
102	*Tectona grandis* L.f.	Lamiaceae	T	Ph
103	*Vitex trifolia* L.	Lamiaceae	S/T	Ph
104	*Cinnamomum camphora* (L.) J. Presl	Lauraceae	T	Ph
105	*Litsea cubeba* (Lour.) Pers. var. *cubeba*	Lauraceae	T	Ph
106	*Litsea monopetala* (Roxb.) Pers.	Lauraceae	T	Ph
107	*Cupheacarthagenensis*(Jacq.) J.F. Macbr	Lythraceae	H	H
108	*Lagerstroemia speciosa* (L.) Pers.	Lythraceae	T	Ph
109	*Phoebe bootanica* (Meisn.) M. Gangop.	Lythraceae	T	Ph
110	*Punica granatum* L.	Lythraceae	T	Ph
111	*Magnolia champaca* (L.) Baill. ex Pierre	Magnoliaceae	T	Ph
112	*Hibiscus cannabinus* L.	Malvaceae	H	Th
113	*Hibiscus*x *rosa-sinensis* L.	Malvaceae	S	Ch
114	*Sida rhombifolia* L.	Malvaceae	S	Th
115	*Urena lobata* L.	Malvaceae	S	Th
116	*Azadirachta indica* A. Juss.	Meliaceae	T	Ph
117	*Toona ciliata* M. Roem.	Meliaceae	T	Ph
118	*Artocarpus heterophyllus* Lam.	Moraceae	T	Ph
119	*Artocarpus lacucha* Buch.-Ham.	Moraceae	T	Ph
120	*Ficus benghalensis* L.	Moraceae	T	Ph
121	*Ficus elastica* Roxb. ex Hornem.	Moraceae	T	Ph
122	*Ficus racemosa* L.	Moraceae	T	Ph
123	*Ficus rumphii* Blume	Moraceae	T	Ph
124	*Morus alba* L.	Moraceae	T	Ph
125	*Musa sp*. L.	Musaceae	H	Ph
126	*Eucalyptus globulus* Labill.	Myrtaceae	T	Ph
127	*Melaleuca citrina* (Curtis) Dum. Cours.	Myrtaceae	S/T	Ph

128	*Psidium guajava* L.	Myrtaceae	T	Ph
129	*Syzygium cumini* (L.) Skeels	Myrtaceae	T	Ph
130	*Syzygium jambos* (L.) Alston	Myrtaceae	T	Ph
131	*Nelumbo nucifera* Gaertn.	Nelumbonaceae	H	G
132	*Bougainvillea spectabilis* Willd.	Nyctaginaceae	CL	Ph
133	*Mirabilis jalapa* L.	Nyctaginaceae	H	Th
134	*Jasminum sambac* (L.) Aiton	Oleaceae	S	Ph
135	*Nyctanthes arbor-tristis* L.	Oleaceae	S/T	Ph
136	*Ludwigia octovalvis* (Jacq.) P.H. Raven	Onagraceae	SS	Th
137	*Papilionanthe teres* (Roxb.) Schltr.	Orchidaceae	SS	G
138	*Passiflora edulis* Sims	Passifloraceae	CL	Ph
139	*Eurya japonica* Thunb.	Pentaphylacaceae	T	Ph
140	*Phyllanthus emblica* L.	Phyllanthaceae	T	Ph
141	*Peperomia pellucida* (L.) Kunth	Piperaceae	H	Th
142	*Plantago major* L.	Plantaginaceae	H	Th
143	*Axonopus compressus* (Sw.) P. Beauv.	Poaceae	H	G
144	*Bambusa bambos* (L.) Voss	Poaceae	H	H
145	*Cynodon dactylon* (L.) Pers.	Poaceae	H	G
146	*Dactyloctenium aegyptium* (L.) Willd.	Poaceae	H	Th
147	*Digitaria sanguinalis* (L.) Scop.	Poaceae	H	Th
148	*Eleusine indica* (L.) Gaertn.	Poaceae	H	Th
149	*Panicum trichoides* Sw.	Poaceae	H	Th
150	*Paspalum conjugatum* P.J. Bergius	Poaceae	H	Ch
151	*Paspalum scrobiculatum* L.	Poaceae	H	H
152	*Puccinellia distans* (Jacq.) Parl.	Poaceae	H	H7
153	*Setaria viridis* (L.) P. Beauv.	Poaceae	H	Th
154	*Podocarpus neriifolius* D. Don	Podocarpaceae	T	Ph
155	*Fallopia dumetorum* (L.) Holub	Polygonaceae	CL	Th
156	*Persicaria lapathifolia* (L.) Delarbre	Polygonaceae	H	Th
157	*Polygonum sp.* L.	Polygonaceae	H	Th
158	*Pontederia hastata* L.	Pontederiaceae	H	G
159	*Ardisia colorata* G. Lodd.	Primulaceae	S	Ph
160	*Adiantum raddianum* C. Presl	Pteridaceae	H	G
161	*Ziziphus mauritiana* Lam.	Rhamnaceae	T	Ph
162	*Fragaria vesca* L.	Rosaceae	H	Th
163	*Rosa alba* P. Gaertn. B. Mey. & Scherb.	Rosaceae	S	Ch
164	*Rosa indica* L.	Rosaceae	S	Ch
165	*Ixora chinensis* Lam.	Rubiaceae	S	Ph
166	*Meyna spinosa* Roxb. ex Link	Rubiaceae	S/T	Ph
167	*Mussaenda glabra* Vahl	Rubiaceae	S	Ph
168	*Neolamarckia cadamba* (Roxb.) Bosser	Rubiaceae	T	Ph
169	*Aegle marmelos* (L.) Corrêa	Rutaceae	T	Ph
170	*Bergera koenigii* L.	Rutaceae	S	Ph
171	*Citrus maxima* (Burm.) Merr.	Rutaceae	T	Ph
172	*Flacourtia jangomas* (Lour.) Raeusch.	Salicaceae	T	Ph
173	*Xylosma longifolia* Clos	Salicaceae	T	Ph
174	*Datura stramonium* L.	Solanaceae	H	Ch
175	*Petunia × atkinsiana* (Sweet) D. Don ex W.H. Baxter	Solanaceae	H	Th
176	*Solanum nigrum* L.	Solanaceae	H	Th
177	*Solanum torvum* Sw.	Solanaceae	H	Ph
178	*Symplocos paniculata* (Thunb.) Miq.	Symplocaceae		Ph

179	*Duranta erecta* L.	Verbenaceae	S	Ph
180	*Lantana camara* L.	Verbenaceae	S	Ph
181	*Stachytarpheta cayennensis* (Rich.) Vahl	Verbenaceae	H	Ch
182	*Sambucus canadensis* L.	Viburnaceae	S	Ph
183	*Hedychium coronarium* J. Koenig	Zingiberaceae	H	G

*(H= Herb, S= Shrub, SS-Sub-shrub, Cl=Climber, T= Tree, Ph = Phanerophytes, G=Geophytes, Ch= Chamaephytes, Th= Therophytes, H= Hemicryptophytes)

Table 3:Comparative account of the Biological Spectrum of the present study site with those of Normal Biological Spectrum

Life-form	Normal spectrum of the world (%)	Biological spectrum of the present study site (%)
Phanerophytes	46	54.1
Chamaephytes	9	9.3
Hemicryptophytes	26	3.8
Geophytes	6	10.4
Therophytes	13	22.4
TOTAL	100	100

Table 4: Life- form (%) of some studied sites of the world

Study Site	Life-form (%)					Source
	Ph	Ch	H	G	Th	
Normal spectrum of the world	46	9	26	6	13	Raunkiaer (1934)
Canchipur Grassland (Manipur), India	0	9.26	11.11	14.81	64.81	Devi *et al.* (2000)
Emas National Park, Brazil	31.6	12.8	49.9	2.0	3.7	Batalha and Martins (2002)
Tons Valley, Garhwal Himalaya (Uttaranchal)	29.06	22.19	2.11	2.64	17.83	Rana *et al*. (2002)
Sub-tropical forest (Manipur), India	66.9	8.06	4.03	4.83	16.1	Usharani (2004)
Thoubal Grassland (Manipur), India	0	4.84	11.29	14.52	69.35	Devi *et al.* (2004)
Sarsawa Hills Forest (Pakistan)	67.88	0.0	22.87	0.97	8.25	Nazir and Malik (2006)
Teak Dipterocarpus forest, Indo-Myanmar border	63.2	8.1	2.04	6.12	20.4	Ranita *et al.* (2010)
Dry Deciduous Forest Karnataka (India)	29	12	13	1	45	Sidanand and Kotresha (2012)
Lamberi Forest Rajouri, J&K (India)	40.09	13.51	11.26	2.25	27.03	Sharma *et al.* (2014)
Hill forest of Manipur (India)	62.76	10.64	1.06	7.45	18.08	Devi *et al.* (2014)
Amambilok Sacred Grove, Andro, Manipur (India)	55.41	6.36	10.19	8.28	19.74	Imosana and Gupta (2015)
Tropical dry deciduous forest Madhya Pradesh (India)	55.0	6.25	1.25	3.75	32.5	Thakur (2015)

Subtropical Montane Forest, Manipur (India)	53.49	10.46	11.62	8.14	16.28	Easter and Gupta (2016)
Grassland community of Odisha (India)	3.7	14.8	11.1	7.4	63.0	Barik and (2018)
Subtropical forest Manipur (India)	52.83	5.66	9.43	8.18	23.90	Sophia *et al.* (2019)
Riyadh region, Central Saudi Arabia	9.0	30.0	8.0	0.0	52.0	Al Shaye *et al.* (2020)
Kankupura, North Gujarat (India)	42.55	46.81	2.13	0	8.51	Patel (2021)
D.M. University Campus (Manipur), India	54.1	9.3	3.8	10.4	22.4	Present study

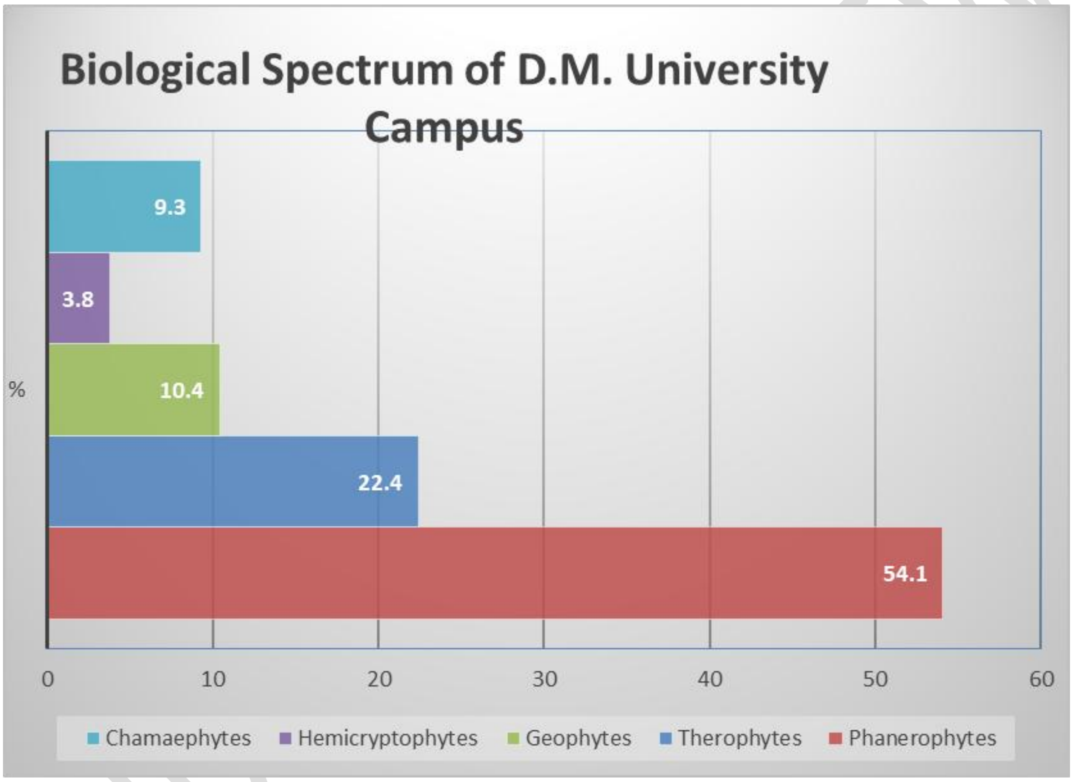

Fig 1: Biological Spectrum of D.M University Campus

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

At the site, during our study of 30random quadrats of 50cm x 50cm,15 plant species belonging to 12 families were encountered.Asteraceae was the dominant family with 2 species. The highest IVI value was that of *Cynodon dactylon* (L.) Pers. followed by *Alternanthera philoxeroides* (Mart.) Griseb. and the least value was that of*Persicaria lapathifolia* (L.) Delarbre (Table 4). Among the 15 species, 8 plant species show IVI value greater than 10 (IVI > 10). The IVI value of a species signifies its dominance and ecological success, and potential and ecological amplitude in the area, thus helping to identify the richly and poorly established plant species in the study area. Accordingly,*Cynodon dactylon* (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 aligns with several other findings which reported that most species exhibit a contagious distribution patternin natural vegetation (Sharma *et al*., 2018). The General index of diversity (Shannon-Weiner Index) value was 1.5202, and the Concentration of Dominance (Simpson Index) value was 3.101.

For χ^2test, the calculated value is 0.101. Checking the Chi-square table for one degree of freedom at P < 0.001, 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. Bergiusare 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 terminology' as "Phanero-Therophytic" phytoclimate. The study has also 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 thatspecies with lower IVIs should be prioritized for conservation, and those with higher IVIs shouldbe tracked to maintain diversity.

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