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Phyto-diversity and biological spectrum analysis of a dry deciduous forest in Birbhum District, West Bengal, India

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Abstract

The research work presented was initiated to get information and report on biodiversity and floristic analysis of Illambazar (Choupahari) forest of the district Birbhum, West Bengal, India. A total of 75 angiospermic taxa were recorded from the study area which spread over 70 dicot species, 58 dicot genera and 25 dicot families. Monocotsare represented by 5 species, 5 genera and 4 families. Dominant families are Fabaceae, Asteraceae, Rubiaceae, Combretaceae, Malvaceae, Mimosaceae and Euphorbiaceae. The current study describes the many living forms and biological range found in the Birbhum district's Illambazar forest. It is said that the life form spectrum is a highly accurate predictor of both macro and microclimate. It was reported that the number of phanerophytes (50.66%) and therophytes (36%) was significantly higher than Raunkiaer's usual spectrum, which represents the phytoclimate and adaptations to the region's arid conditions.The area's phytoclimate is phanero-therophytic, which is associated with arid bio climates in nature, as indicated by the predominance of phanerotherophytes.

Key words : Biological spectrum, Birbhum district, Phyto-Climate, Phanero-therophytic, Vegetation.

Tropical and subtropical forests are often considered one of the most species-diverse terrestrial ecosystems. Their immense biodiversity generates various natural resources which help sustain the livelihood of local communities[5]. However, many tropical forests are under great anthropogenic pressure and require proper management measures to maintain overall biodiversity, productivity, and sustainability. Due to deforestation for the purpose of extracting timber and other forest products, the majority of these forests are disappearing at an alarming rate[24]. Further argued that seasonally dry deciduous forests are the most disturbed and least protected ecosystems on the earth[14].

Life-form studies are important to find the Phyto-climate of the area as structure and rate of change of composition are sensitive

indicators of whole environment. The biological system is thus useful as an index of the health status of a forest. When worked out at periodic intervals, biological spectrum may set the guidelines for the eco-restoration and optimization of a community[12].

The term "life forms" refers to all the ways in which an organism's persisting organs have evolved in direct response to its surroundings[8]. After that developed the concept of life form[28]. According to Raunkiaer's system the plant species can be divided into five main classes according to the increased protection of the renewing buds *i. e*. Phanerophytes (plant with its resting buds located above ground and exposed to air), chamaephytes (plant with its resting buds near the ground), hemicryptophytes (plant with its resting buds) and cryptophytes (plant subterranean or under water resting buds) therophytes (plant that complete their life cycle within a season and remaining dormant as seed).

The term "biological spectrum" refers to the percentage distribution of the different living forms in the local flora. It serves as a gauge of the current state of the ecosystem. Of the various classification and description systems created by numerous ecologists, this one is the most commonly used[19,27]. In India, several workers have studied the biological spectrum of different regions[27,32,33]. Various regions of West Bengal have conducted studies on the biological spectrum[1,2,3,29]. Birbhum district of West Bengal harbours floristically important Northern Tropical Dry deciduous forest[7]. Almost all of the studies made so far from the State of West Bengal or the District of Birbhum were focused on simple documentation of plant use knowledge[9,16,15,17,21,23,25,26,34]. A very few reports are there in respect of quantitative vegetational analysis or phytosociological study of forest areas of Birbhum district or West Bengal[4,22]. Therefore, the huge essence of knowledge for biodiversity prospecting or vegetation analysis is largely unexplored. Because of this, the present work was under taken in the Illambazar forest of Birbhum district to study the assemblage of different life-forms and to prepare the biological spectrum to the existing Phyto-climate of the area.

Study area :

Birbhum district lies between 23°32'30" and 24°35'00" North latitude and 88°01'40" and 87°05'25" East longitude. The district is a part of lateritic zone of West Bengal.

Forest vegetation of Birbhum district as a whole is of Tropical Dry Deciduous type[7] with a few representatives of the evergreen tree species occurring here and there. Total forest area of the Birbhum district is about 159.26 sq km. Many of the forest plants are used as non-timber forest products by tribal people of the district). According to Census 2011 information the location code or village code of Chaupahari Jangal village is 318023. Chaupahari Jangal village is located in Illambazar subdivision of Birbhum district in West Bengal, India. The total geographical area of village is 1737.86 hectares. Chaupahari Jangal has a total population of 4,445 peoples, out of which male population is 2,240 while female population is 2,205. Bolpur is nearest town to Chaupahari Jangal for all major economic activities, which is approximately 18 km away.

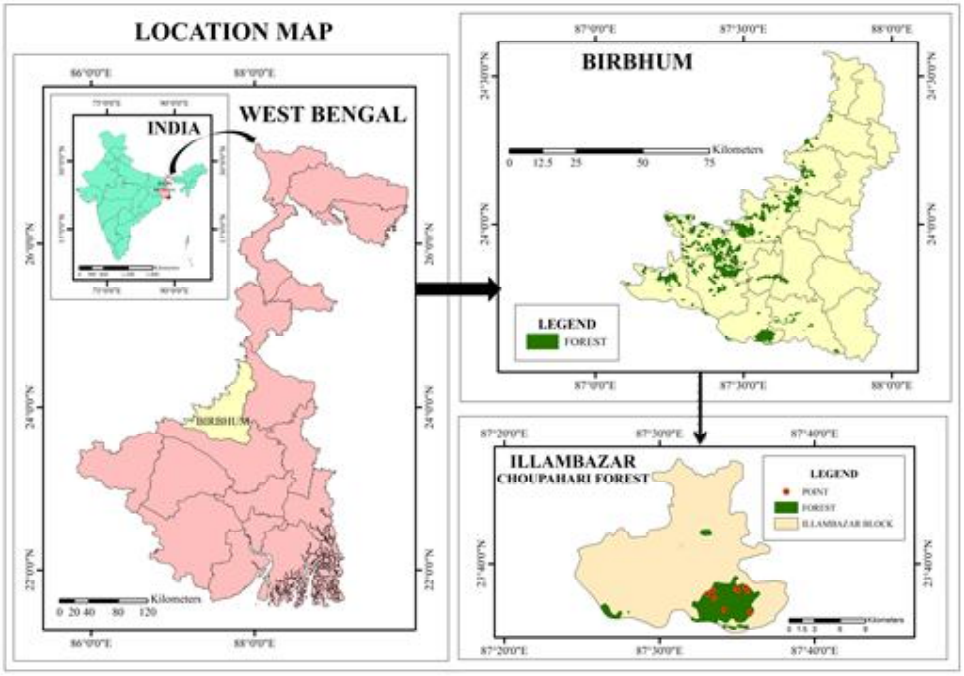

Figure 1. Study area of Illambazar (Choupahari forest)

Regular field surveys were conducted for last two tears (2022-2023) in different pockets of Illambazar forest to document Phyto-resources of Birbhum district, West Bengal. The sampling was done at monthly interval following Misra's formula[13]. Data on floristic composition, life forms (on the basis of nature of perennating buds of plant species) were recorded. All species were assigned to suitable life forms such as Phanerophytes (Ph), Therophytes (Th), Chamaephytes (Ch), Hemicryptophytes (He), Cryptophytes (Cr) and biological spectrum was prepared. This was compared with the Raunkiaer[28] normal biological spectrum.

Calculating the percentage distribution of all the species of concern in various life forms allowed for the construction of the study area's biological spectrum. The biological spectrum of the plant species was created based on the life forms by taking the percentage value of each life form and tabulating the results (Table-1).

$$\text{Biological spectrum (\%)} = \frac{\text{Total no of species in a life form class}}{\text{Total number of species found in the study area}} \times 100$$

After determination the values were compared with the normal biological spectrum of Raunkiaer[28] to determine the phytoclimate of the study area.

The collected plant specimens have carefully been identified with the help of different floras[6,11,18,20,30,31]. The collected plant specimens have been preserved as herbarium

Table-1. Floristic composition, Habit and Life-form of the Species in study area

Sl.No.	Name of the Plant	Family	Habit	Life-form
1.	*Achyranthus aspera* L.	Amaranthaceae	Herb	Chameophytes
2.	*Aerva lanata* (L.) Juss.	Amaranthaceae	Herb	Therophytes
3.	*Amaranthus viridis* L.	Amaranthaceae	Herb	Therophytes
4.	*Gomphrena celosioides* Mart.	Amaranthaceae	Herb	Therophytes
5.	*Buchnania lanzan* Spreng.	Anacardiaceae	Tree	Phanerophyte
6.	*Daemia extensa* (Jacq.) R. Br. ex Schult.	Apocynaceae	Climber	Therophytes
7.	*Hemidesmus indicus* (L.) R. Br. ex Schult.	Apocynaceae	Climber	Phanerophyte
8.	*Holarrhena antidysenterica* (L.) Wall.	Apocynaceae	Tree	Phanerophyte
9.	*Phoenix sylvestris* (L.) Roxb.	Arecaceae	Tree	Phanerophyte
10.	*Aristolochia indica* L.	Aristolochiaceae	Climber	Therophytes
11.	*Blumea lacera* (Burm.f.) DC.	Asteraceae	Herb	Therophytes
12.	*Tridax procumbens* L.	Asteraceae	Herb	Therophytes
13.	*Vernonia cinerea* (L.) Less.	Asteraceae	Herb	Therophytes
14.	*Cochlospermum religiosum* (L.) Alston	Bixaceae	Tree	Phanerophyte
15.	*Cleome viscosa* L.	Cleomaceae	Herb	Therophytes
16.	*Terminalia arjuna* (Roxb.) Wight & Arn.	Combretaceae	Tree	Phanerophyte
17.	*Terminalia bellirica* (Gaertn.) Roxb.	Combretaceae	Tree	Phanerophyte
18.	*Terminalia chebula* Retz.	Combretaceae	Tree	Phanerophyte
19.	*Commelina benghalensis* Forssk.	Commelinaceae	Herb	Therophytes
20.	*Ipomoea aquatica* Forssk.	Convolvulaceae	Climber	Therophytes
21.	*Ipomoea cairica* (L.) Sweet	Convolvulaceae	Climber	Therophytes
22.	*Merremia hederacea* (Burm.f.) Hallier f.	Convolvulaceae	Climber	Therophytes
23.	*Merremia tridentata* (L.) Hallier f.	Convolvulaceae	Climber	Therophytes
24.	*Evolvulus alsinoides* L.	Convolvulaceae	Herb	Therophytes
25.	*Evolvulus nummularius* (L.) L.	Convolvulaceae	Herb	Therophytes
26.	*Cyperus iria* L.	Cyperaceae	Herb	Hemicryptophytes
27.	*Dillenia indica* L.	Dilleniaceae	Tree	Phanerophyte

28.	*Dioscorea alata* L.	Dioscoreaceae	Climber	Phanerophyte
29.	*Dioscorea bulbifera* L.	Dioscoreaceae	Climber	Phanerophyte
30.	*Shorea robusta* Roth	Dipterocarpaceae	Tree	Phanerophyte
31.	*Diospyros malabarica* (Desr.) Kostel.	Ebenaceae	Tree	Phanerophyte
32.	*Diospyros melanoxylon* Roxb.	Ebenaceae	Tree	Phanerophyte
33.	*Acalypha indica* L.	Euphorbiaceae	Herb	Therophytes
34.	*Croton bonplandianm* Baill.	Euphorbiaceae	Herb	Therophytes
35.	*Euphorbia hirta* L.	Euphorbiaceae	Herb	Therophytes
36.	*Phyllanthus fraternus* G.L.Webster	Euphorbiaceae	Herb	Therophytes
37.	*Phyllanthus simplex* Retz.	Euphorbiaceae	Herb	Therophytes
38.	*Abrus precatorius* L.	Fabaceae	Climber	Phanerophyte
39.	*Desmodium triflorum* (L.) DC.	Fabaceae	Herb	Therophytes
40.	*Tephrosia purpurea* (L.) Pers.	Fabaceae	Herb	Chameophytes
41.	*Acacia auriculiformis* A.Cunn. ex Benth	Fabaceae	Tree	Phanerophyte
42.	*Vachellia nilotica* (L.) P.J.H. Hurter & Mabb.	Fabaceae	Tree	Phanerophyte
43.	*Butea monosperma (Lam.)* Kuntze	Fabaceae	Tree	Phanerophyte
44.	*Dalbergia sissoo* Roxb. ex DC.	Fabaceae	Tree	Phanerophyte
45.	*Delonix regia* (Bojer ex Hook.) Raf.	Fabaceae	Tree	Phanerophyte
46.	*Tamarindus indica* L.	Fabaceae	Tree	Phanerophyte
47.	*Vitex negundo* L.	Lamiaceae	Shrub	Phanerophyte
48.	*Tectona grandis* L.f.	Lamiaceae	Tree	Phanerophyte
49.	*Lagerstroemia speciosa* Pers.	Lythraceae	Tree	Phanerophyte
50.	*Melochia corchorifolia* L.	Malvaceae	Herb	Therophytes
51.	*Sida acuta* Burm.f.	Malvaceae	Herb	Therophytes
52.	*Sida cordata* (Burm.f.) Borss.Waalk.	Malvaceae	Herb	Therophytes
53.	*Sida rhombifolia* L.	Malvaceae	Herb	Therophytes
54.	*Abutilon indicum* (L.) Sweet	Malvaceae	Shrub	Phanerophyte
55.	*Urena lobata* L.	Malvaceae	Shrub	Phanerophyte
56.	*Bombax ceiba* L.	Malvaceae	Tree	Phanerophyte
57.	*Ceiba pentandra* (L.) *Gaertn.*	Malvaceae	Tree	Phanerophyte
58.	*Ludwigia perennis* L.	Onagraceae	Herb	Chameophytes
59.	*Scoparia dulcis* L.	Plantaginaceae	Herb	Chameophytes
61.	*Cynodon dactylon* (L. Pers.)	Poaceae	Herb	Hemicryptophytes

62.	*Dactyloctenium aegyptium* (L.) Willd.	Poaceae	Herb	Hemicryptophytes
63.	*Ziziphus oenopolia* (L.) Mill.	Rhamnaceae	Shrub	Phanerophyte
64.	*Oxalis corniculata* L.	Oxalidaceae	Herb	Cryptophytes
65.	*Fimbristylis miliacea* (L.) Vahl	Cyperaceae	Herb	Cryptophytes
66.	*Carrisa spinarum* L.	Apocynaceae	Shrub	Phanerophyte
67.	*Meyna laxiflora Robyns*	Rubiaceae	Shrub	Phanerophyte
68.	*Pavetta indica* L.	Rubiaceae	Shrub	Phanerophyte
69.	*Mitragyna parvifolia* Korth.	Rubiaceae	Tree	Phanerophyte
70.	*Morinda citrifolia* L.	Rubiaceae	Tree	Phanerophyte
71.	*Suregada multiflora* (A. Juss.) Baill.	Rubiaceae	Tree	Phanerophyte
72.	*Glycosmis pentaphylla* (Retz.) DC.	Rutaceae	Shrub	Phanerophyte
73.	*Madhuca longifolia* J. F. Macbr.	Sapotaceae	Tree	Phanerophyte
74.	*Mimusops elengi* L.	Sapotaceae	Tree	Phanerophyte
75.	*Phyla nodiflora* (L.) Greene	Verbenaceae	Herb	Therophytes

Table-2. Comparative account of floristic composition of the forest

Category	Dicotyledons	Percentage (%)	Monoco-tyledons	Percentage (%)
Family	26	86.66	4	13.33
Genera	59	90.76	6	9.23
Species	70	93.33	5	6.67

Dominant families are Fabaceae, Asteraceae, Rubiaceae, Combretaceae, Malvaceae. Among these 75 plant species 9 plants belongs to Fabaceae, 8 plants belong to Malvaceae, 6 plants belongs to Convolvulaceae and Rubiaceae lastly Euphorbiaceae is represented by 5 plant species (Table-3).

Table-3. Percentage showing dominating families in study site.

Family	Number of species	Percentage %
Fabaceae	9	36
Malvaceae	8	32
Convolvulaceae	6	24
Rubiaceae	6	24
Euphorbiaceae	5	20

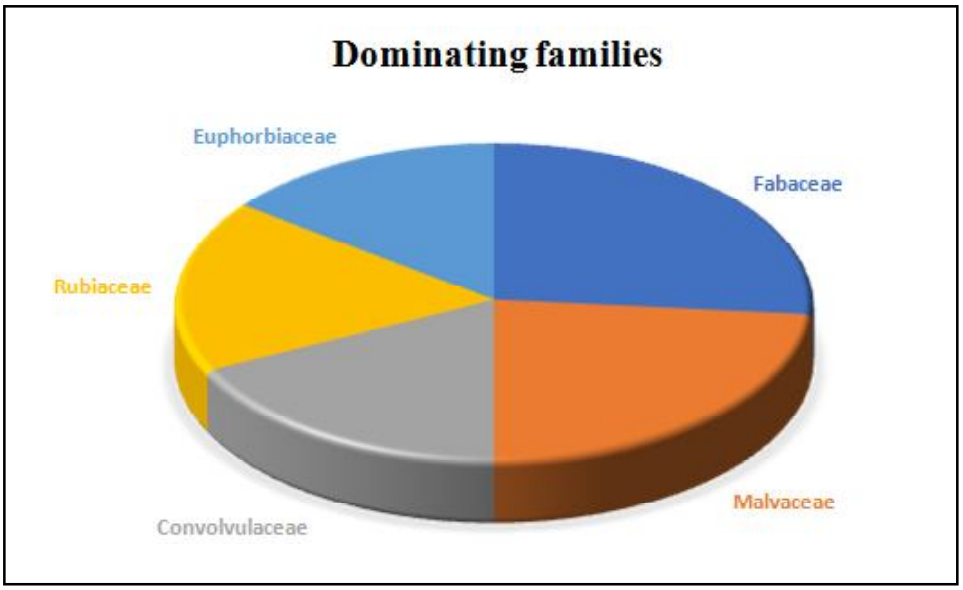

Fig. 2. Pie diagram showing percentage contribution of dominating families.

Habitually, these 75 plant species are of 4 types like, Trees- 26 species, Shrub- 8 species, Herb-31 species and Climber 10 species (Table-4).

Table-4. Percentage composition of Plant species and different plant groups

Habit	Number	Percentage (%)
Climbers	10	13.33
Herbs	31	41.33
Shrubs	08	10.66
Trees	26	34.66

Table-5. Different Life form Classes of the Flora of Birbhum District

Sl. No.	Life-form Classes	Species recorded	Percentage (%) of species	Raunkiaer's Normal Spectrum (%)
1.	Phanerophytes (Ph)	38	50.66	46
2.	Therophytes (Th)	27	36	13
3.	Chameophytes (Ch)	4	5.33	9
4.	Cryptophytes (Cr)	2	2.66	6
5.	Hemicryptophytes (He)	4	5.33	26

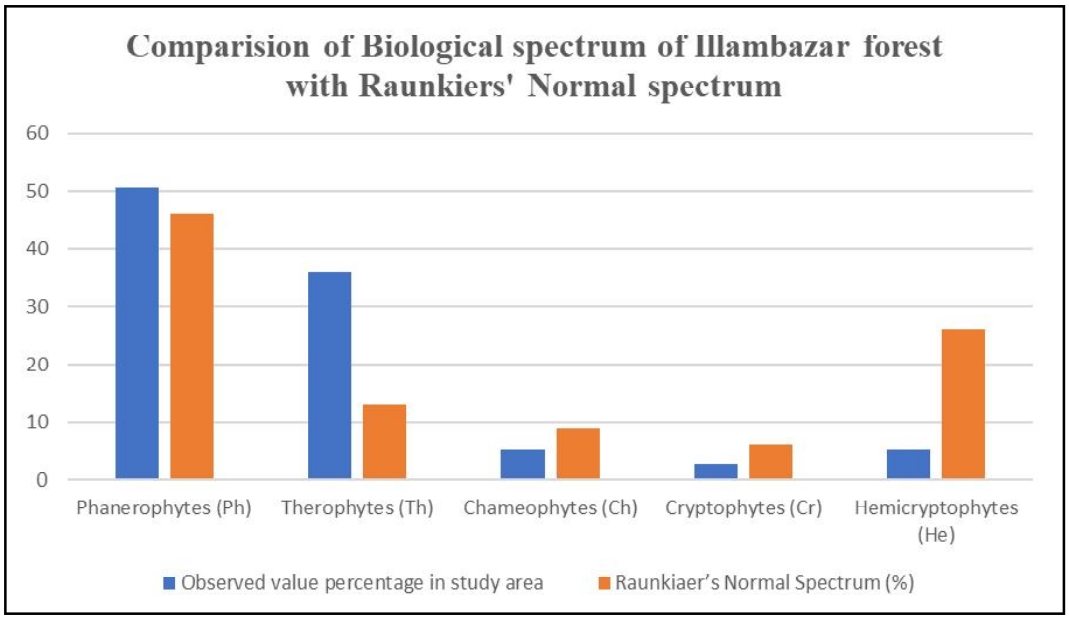

Fig 3-Biological spectrum of Life- forms of Illambazar forest and its Comparison with the Raunkiers Normal spectrum Representing World Flora.

specimens following the standard method[10] and kept in the Bankura Sammilani College Herbarium, Department of Botany, Bankura Sammilani College for future references.

Altogether 75 plant species have been recorded from the study area for regular interval of field visits indicating that the study area is very much enrich in angiospermic flora diversity (Table-1). These recorded plant taxa spread over 70 dicot species, 58 dicot genera and 25 dicot families. Monocots are represented by 5 each from species and genera and 4 families (Table-2).

From the life form analysis percentage it was revealed that the recorded 75 taxa come under 5 different life form classes. The most dominant life form category were represented by Phanerophytes 38 taxa (50.66%) followed by therophytes 27 representative (36%), Chameophytes 4 representatives (5.33), Cryptophytes 2 representatives (2.66%) and 4 representatives (4%) of Hemicryptophytes. The biological spectrum in the present study reflects variation from the normal biological spectrum of Raunkiaer (Fig. 4). The result showed much higher value of phanerophytes than the normal value which is an indicator for the functioning of a forest ecosystem.

Second largest abundance of therophytes indicated warm and arid climatic conditions of the study site. However, Chameophytes, cryptophytes and hemicryptophytes percentage showed lesser than the normal spectrum. The study site's edaphic factor is probably severely deranged as a result of the low amount of

chamaephytes. The fact that the value of cryptophytes is below average indicates that certain plants are using this stress to hide their perennating buds. Last but not least, the hemicryptophytes are considerably poorer than average, keeping the forest floor nearly bare. It is notable that the research site seems to be somewhat disturbed because there is enough rainfall throughout the monsoon season to sustain phanerophytes.

From the study it can be concluded that the Illambazar forest area is very much enriched in angiospermic flora diversity as 75 different plant species recorded from field study. The preponderance of phenerophytes and therophytes in forest environments indicates unfavorable development conditions. Such unfavorable development conditions could be caused by anthropogenic activities and natural succession processes. The reduction of forest biomass through grazing, lopping, surface burning, and litter removal at specific times is a persistent disturbance that compromises the ecosystem's stability in the region. The current research suggests that plant species in forested areas should be conserved. Rare species should be preserved right away, and measures should be done to improve the development of young individuals. Above all, the local population has to be informed about sustainable plant species harvesting.

Phaneropods, or woody plants with buds that are more than 25 cm above the ground and are exposed to the atmosphere in unfavorable conditions, predominate. The bioclimatic factors that determine the plant status of a region are associated with the geographic distribution of these varieties. Therophytes, or annual summer plants that persist in unfavorable conditions as seeds, make up the next dominant class. Nonetheless, the research site's edaphic factor is probably severely deranged as a result of the low amount of chamaephytes. The fact that the value of cryptophytes is below average indicates that certain plants have adapted to hide their perennating buds in order to withstand the current stress. Last but not least, the hemicryptophytes are considerably poorer than average, keeping the forest floor nearly bare. It is notable that the research site seems to be somewhat disturbed because there is enough rainfall throughout the monsoon season to support phanerophytes.

Conflict of Interest

It is certified that the authors have no conflict of interest regarding the publishing of this paper and has authorized the final manuscript.

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