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Life Form in Hill Forest of Manipur, North-East, India

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Abstract: **To characterize the life form in hill forest of Manipur (24°43´55´´N - 24°46´32´´N latitude and 93°59´17´´E - 94°2´21´´E longitude), North-East, India, two stations have been selected viz. Awaching (Station-I) and Ngariyal ching (Station-II). They are located on Nongmaiching Hill in the Imphal-East District of Manipur. The study was undertaken with the following objectives - 1) to study the floristic composition 2) to classify vegetation into life forms 3) to compare the designated Biological Spectrum with Normal Spectrum and 4) to compare with the phytoclimate of other regions. An explorative survey was undertaken periodically in the selected sites at the altitude varying between 1089 to 1099m asl from year 2008 to 2010. The study was undertaken on the basis of standardized survey effort in a fixed area. The plants were collected and classified into appropriate life-forms based on the perennating buds. Differences in the life-form distribution between the Normal Spectrum and a biological spectrum pointed out the prevalence of Phanero-Therophytic phytoclimate as in the floristic spectrum the most represented life forms were the Phanerophytes and Therophytes. Our spectrum differs significantly from Raunkiær's Normal spectrum mainly due to over representation of both these life-forms. Discerning of the biological spectrum of different regions is used to compare the widely separated plant communities in terms of their climatic adaptability.**

Keywords: **Life form, Raunkiær, Biological Spectrum, Floristic, Manipur, India.**

1. INTRODUCTION

The concept of life form in the study of vegetation was proposed for the first time [10]. He suggested grouping the vegetation type on the physiognomic basis. The life form system is an early and still useful attempt of relating plant morphology and life history to climate. The life-form in its turn is the ultimate manifestation of the sum of all the adaptations undergone by the plant to the climate in which it resides. A "normal spectrum" which could act as a null model against which different life-form spectra could be compared [28]. Raunkiær's normal spectrum indicates a phanerophytic community for the World and deviation from it determines the phytoclimate of the habitats. The occurrence of similar biological spectra in different regions indicates similar climatic conditions. Differences in the life-form distribution between the normal spectrum and a biological spectrum would point out which life-form characterizes the phytoclimate or the vegetation under study.

The percentage of various life form classes put together is the biological spectrum. The Biological spectrum varies in different climate. Conversely the major vegetation formation is also delimited by climate data [11]. Since each forest has a distinct composition, the impact of various land use on the composition of vegetation cover reveals the adaptation characteristics of the plants to the environment. The present paper explores into the floristic composition and life forms of trees, shrubs and herbs at the selected sites. In order to understand the biological spectrum in hill forest of Manipur, North-East India, a study was undertaken with the following objectives – 1) to study the floristic composition 2) to classify vegetation into life forms 3) to compare the designated Biological Spectrum with Normal Spectrum and 4) to compare with the phytoclimate of other regions.

2. STUDY SITE

The Nongmaiching Hill lies between 24°43´55´´N and 24°46´32´´N latitudes and between 93°59´17´´E and 94°2´21´´E longitudes in the Imphal-East District of Manipur North-East India (Figure.1). Two stations have been selected viz. Awaching (Station-I) and Ngariyal ching (Station-II) with altitudes varying from 1089 to 1099m asl. The two stations have different land uses like logged forest, plantation, natural forest and secondary forest. The forests though approximately at the same altitude are separated by only about 3 km distance.

The dominating tree species are *Pinus kesiya, Bombax ceiba*, *Albizia lebbeck*, *Artocarpus integra, Erythrina indica*, and *Rhus insignis* in Awaching station while *Rhus insignis*, *Albizia lebbeck, Melia azadirachta, Bombax* ceiba, Quercus dealbata, Cinnamomum glaucensen, Delonix regia, Eleocarpus floribundus, Erythrina indica, Gmelina *arborea,* and *Syzygium syzyzioides* are predominating in Ngariyal station.. The soil varies from clay loam to sandy loam and temperature ranges from sub-zero to 36 °C with an average annual rainfall of 933 mm at Imphal.

3. MATERIAL AND METHODS

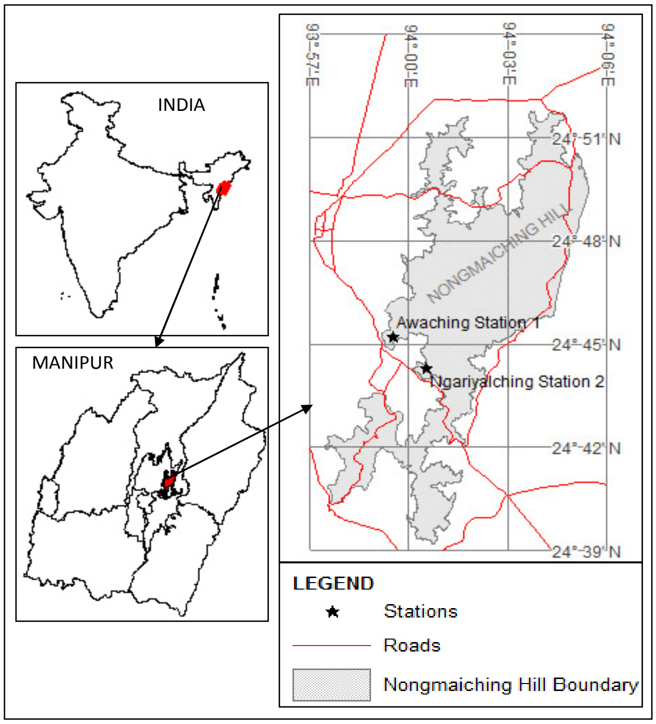

Figure.1. Map showing Awaching Station-1 and NgariyalchingStation-2

Survey for plant collections and observations were carried out from 2008 to 2010 in a transect line made from north to south direction. The following growth forms were recognized – Trees, Shrubs and Herbs. In the forest, the biological life form, habit, height and the location of perennating buds of species were observed. The species were further placed in various life forms classes as per Raunkiær system.

The plant specimens collected during field study were processed for herbarium preservation and taxonomically worked out for confirming identification with the help of pertinent literature [23; 9; 2; 3], BSI Shillong, Kolkota and authentic specimens preserved in the herbarium of State Forest Department and Manipur University.

4. RESULT

Out of the 40 families, 94 species recorded from the two stations of Nongmaiching hill (Table.1.) Families recorded with maximum species were *Asteraceae, Poaceae, Leguminosae, Verbenaceae*, *Cyperaceae, Melastomaceae, Oleaceae, Cyperaceae* and *Musaceae*. The life form exhibited by trees and shrubs comprised of Phanerophytes only but herbs belong to five major life forms *viz*., Phanerophytes (Ph), Chamaephytes(Ch), Hemicryptophytes (H), Cryptophytes(Cr) and Therophytes (Th). Thus, the study reveals that of the species composing the flora, 62.76% are Phanerophytes, 10.64% Chamaephytes, 1.06 Hemicryptophytes 7.45% Cryptophytes, 18.08% Therophytes (Figure.2). From amongst the 24 species of trees, 13 species have been represented at both study areas i.e. *Pinus kesiya, Cinnamomum gloucensen, Erythrina indica*, *Rhus insignis*, *Bombax ceiba, Quercus dealbata, Albizia labbeck. Sapindus trifolitus, Celtis autralis*, etc.

Table.1. An inventory of the floristic composition in Nongmaiching Hill

Sl. No.	Scientific Name	Family	Life form	Station-1	Station -2
1.	Pinus kesiya Royle ex. Gordon	Abietaceae	Ph	+	+
2.	Rungia parvifolia Nees.	Acanthaceae	Ch	-	+
3.	Alangium chinense (Lour) Rehder	Alangiaceae	Ph	-	+
4.	Achryathus aspera L.	Amaranthaceae	Th	+	+
5.	Amaranthus viridis L.	Amaranthaceae	Ph	+	+
6.	Rhus insignis H.R. f.	Anacardiaceae	Ph	+	+
7.	Artabotrys corniculatus R. BM	Annonaceae	Ph	+	-
8.	Centella asiatica L.	Apiaceae	Ch	+	+
9.	Hydrocotyl sibthorpiodes Lam	Apiaceae	Ch	-	+
10.	Plumeria rubra L.	Apocynaceae	Ph	+	-
11.	Allocasia macrorrhizos (Schott) G. Don	Araceae	H	+	+
12.	Ageratum conyzoides L.	Asteraceae	Th	+	+
13.	Bidens pilosa L.	Asteraceae	Th	+	+
14.	Blumea balsamifera L. (D.C.)	Asteraceae	Th	+	+
15.	Dicrocephala latifolia D.C.	Asteraceae	Th	+	+

Sl. No.	Scientific Name	Family	Life form	Station-1	Station -2
16.	Eclipta prostrata L.	Asteraceae	Th	-	+
17.	Galinsoga parviflora Cav.	Asteraceae	Th	+	+
18.	Gynura cusumbua Cass	Asteraceae	Th	+	-
19.	Mikania cordata Busn	Asteraceae	Ph	+	+
20.	Spilanthes sessiles L.	Asteraceae	Th	+	+
21.	Tagetes erecta L.	Asteraceae	Th	+	+
22.	Vernonia cinerea Loes	Asteraceae	Th	+	+
23.	Xanthium nepalance L.	Asteraceae	Th	+	+
24.	Xanthium strumarium L.	Asteraceae	Th	+	+
25.	Artemesia vulgaris L.	Asteraceae	Ph	+	-
26.	Bombax ceiba L.	Bambacaceae	Ph	+	+
27.	Cyperus brevifolius (Rottb) Hassk	Cyperaceae	Cr	+	+
28.	Cyperus difformis L.	Cyperaceae	Cr	-	+
29.	Cyperus rotundus L.	Cyperaceae	Cr	+	-
30.	Dioscorea bulbifera L.	Dioscoreaceae	Cr	+	+
31.	Elaeocarpus floribundus bl. Vern	Elaeocarpaceae	Ph	-	+
32.	Manihot utilissima Adans	Euphorbiaceae	Ph	-	+
33.	Quercus dealbata L.	Fagaceae	Ph	+	+
34.	Castanopsis hytrix A.DC	Fagaceae	Ph	-	+
35.	Leucus decemdentala (Willd)	Lamiaceae	Ch	-	+
36.	Cinnamomum glaucensen (Nees) Hand.-Mazz.	Lauraceae	Ph	+	+
37.	Litsea monopetalo (Roxb) pers.	Lauraceae	Ph	+	-
38.	Albizia chinensis (Osbeck) Merrill	Leguminosae	Ph	+	-
39.	Albizia lebbeck Benth	Leguminosae	Ph	+	+
40.	Delonix regia (Boj) Rof.	Leguminosae	Ph	-	+
41.	Erythrina indica Roxb. Vern	Leguminosae	Ph	+	+
42.	Acacia arabia Willd	Leguminosae	Ph	-	+
43.	Cassia occidentalis L.	Leguminosae	Ph	+	-
44.	Sesbania aegyptiaca Pers.	Leguminosae	Ph	-	+
45.	Mimosa pudica L.	Leguminosae	Ph	+	+
46.	Hibiscus moschalum L.	Malvaceae	Ph	-	+
47.	Hibiscus subdariffa L.	Malvaceae	Ph	-	+
48.	Sida cordifolia Linn.	Malvaceae	Ph	+	+
49.	Osbekia nepalensis H.K.f.	Melastometaceae	Ph	-	+
50.	Oxyspora paniculata D.C.	Melastometaceae	Ph	-	+
51.	Osbeckia chinensis L.	Melastometaceae	Ph	+	+
52.	Osbeckia stellata L.	Melastometaceae	Ph	-	+
53.	Melia azadirachta (L.) Vern	Meliaceae	Ph	+	+
54.	Toona ciliata M. Room	Meliaceae	Ph	+	+
55.	Artocarpus integra Mult.	Moraceae	Ph	+	-
56.	Musa roxburghii Hook.	Musaceae	Ph	+	-
57.	Mussaenda frondosa L.	Musaceae	Ph	+	-

Sl. No.	Scientific Name	Family	Life form	Station-1	Station -2
58.	Thysanolaena maxima (Roxb.)Kuntze	Musaceae	Ph	+	+
59.	Euenia praecox Roxb.	Myrtaceae	Ph	-	-
60.	Egenia candolleana DC	Myrtaceae	Ph	+	+
61.	Syzygium syzyzioides (Miq.) Merr.	Myrtaceae	Ph	+	+
62.	Jasminum amplexicaule G.	Oleaceae	Ph	-	+
63.	Jasminum multiflorum Burn f. (Andr)	Oleaceae	Ph	-	+
64.	Ligustrum jabonicum Thunb.	Oleaceae	Ph	-	+
65.	Oxalis corniculata L.	Oxalidaceae	Cr	+	+
66.	Oxalis richardiana Babu	Oxalidaceae	Cr	+	+
67.	Plantago erosa Wall.	Plantaginaceae	Th	+	+
68.	Paspalum conjugatum Berg.	Poaceae	Th	+	+
69.	Erianthus arundinaceous (Retz) Jesw	Poaceae	Ch	+	+
70.	Dactyloctenium aegypticum Beauv.	Poaceae	Ch	+	+
71.	Seteria glauca Beauv.	Poaceae	Th	+	-
72.	Cynodon dactylon Pers.	Poaceae	Ch	+	+
73.	Chrysopogon aciculatus (Retz) Trin	Poaceae	Ch	+	+
74.	Avena sativa L.	Poaceae	Ph	-	+
75.	Erianthus procerus (Roxb.)	Poaceae	Ph	+	-
76.	Polygonum chinensis L.	Polygonaceae	Ph	+	-
77.	Portulaca oleracea L.	Portulaceae	Ch	+	+
78.	Gravillea robusta A. Cumm	Proteaceae	Ph	+	-
79.	Spermacoce pusilla Wall	Rubiaceae	Th	+	+
80.	Vangureia spinosa Roxb	Rubiaceae	Ph	+	-
81.	Zanthoxylum acanthospodium D.C.	Rutaceae	Ph	+	+
82.	Sapindus trifoliatus L.	Sapindaceae	Ph	+	+
83.	Cestrum nocturnum L.	Solanaceae	Ph	+	+
84.	Solanum nigrum L.	Solanaceae	Ph	-	+
85.	Actinidia callosa L.	Ternstromiacee	Ph	-	+
86.	Celtis austrlis L.	Ulmaceae	Ph	+	+
87.	Gmelina arborea Roxb.	Verbenaceae	Ph	-	+
88.	Duranta repens L.	Verbenaceae	Ph	+	+
89.	Latana camara L.	Verbenaceae	Ph	+	+
90.	Vitex negundo L.	Verbenaceae	Ph	+	-
91.	Vitex triofolia L.	Verbenaceae	Ph	+	+
92.	Stychytarpheta indica Vahl	Verbenaceae	Ch	+	+
93.	Hedychium coronarium Koenig	Zinziberaceae	Cr	-	+
94.	Costus speciosus Koen ex. Retz.	Zinziberaceae	Ph	-	+

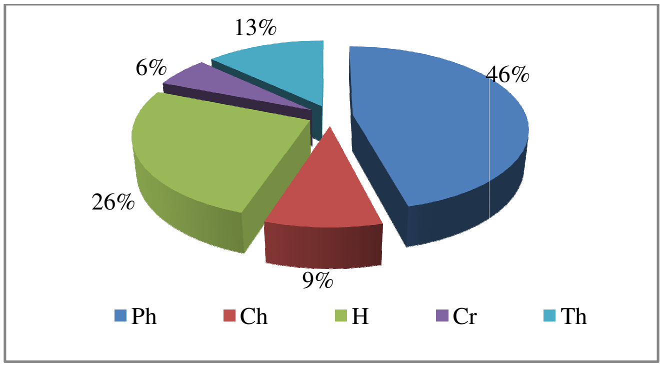

Figure.2. Graphical Representaion of Raunkiær's NormalSpectrum

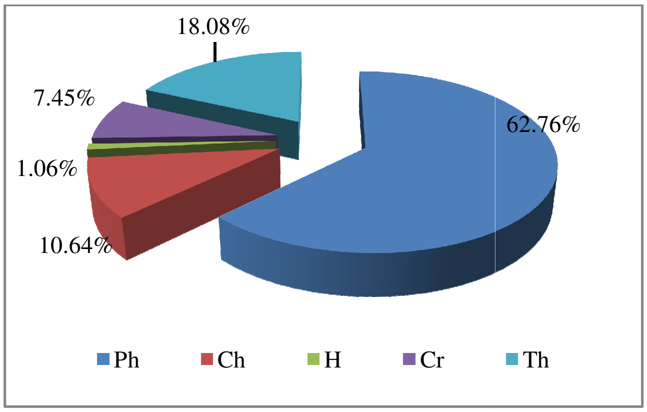

Figure.3. Graphical Representation of Different Life form of Nongmaiching Hill

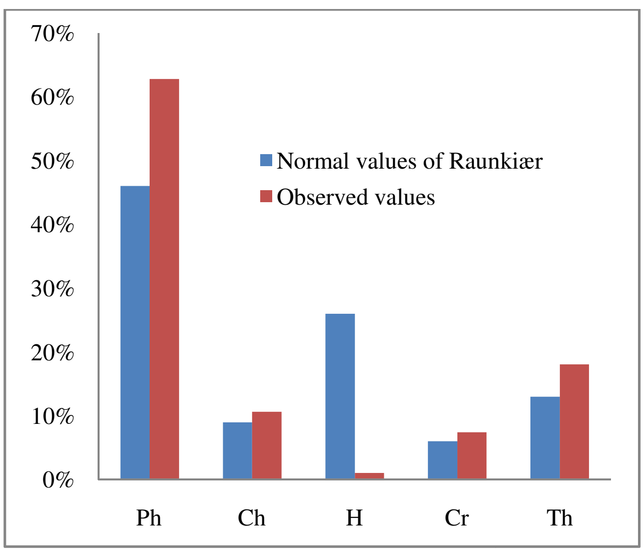

Figure.4. Comparison of Biological Spectrum of Nongmaichin Hill with Raunkiaer's Normal Spectrum

5. DISCUSSION

The study of floristic composition and associated species at a site in qualitative terms may provide the answers to reveal the mystery of the complex dynamics of the ecological changes taking place in space and time. The biological spectrum not only represents the climatic conditions but the most potent environmental factor representing the ecosystem [20].

The proportions of the flora in the various categories (which Raunkiær called the Biological spectrum) vary from one climate to another [35]. Each of the species within the community has large measure of its structural and functional individualism and has more or less different ecological amplitude and modality [36]. As the life form and biological spectrum of a region reflect upon the climate of that region, most of these spectrums for different regions are related to their bioclimatic [4; 37; 20; 1; 27; 19; 13; 14; 7]. Biological spectrum also reflects on the biotic pressure on the grazing lands and consequently on the successive trends when he compared some of these spectrums with the spectrum of Kshipra Watershed area in Madhya Pradesh [8]. The thero-phanerophytic spectrum has been discerned for disturbed wooded areas like forest in Brahmyone hills, Gaya [17] and Northwest catchment of Gola River, Nainital [32].

The native vegetation was disturbed due to having therophytes in an area [18]. Besides these biotic influencing factors, climate changes can also influence plant changes in species composition and dominance-diversity patterns. In climatic conditions, increasing temperature favours early initiation of plants, increasing the length of growing season leading to the increased long growth cycle of plants. The combination of rising temperatures and longer season favours life forms of some dominant alpine plants [15]. Also, environmental heterogeneity is an important mechanism promoting co-existence of similar species. It is widely accepted that two species that cannot coexist locally in a homogenous habitat may nonetheless co-exist stably in a network of many habitat patches. In general, plants with short growth cycle expanded initially during the onset of favourable conditions, and plants with long vegetative growth cycle subsequently exist during rest of the growth period.

Hemicryptophytes are characteristics of temperate regions whereas therophytes are characteristics of desert climate [6 and 34]. Chamaephytes and therophytes are considered as indicators of unfavourable environment [25]. Therophytes develop especially in an area where the native vegetation has been disturbed [5]. The biological spectra of different regions of India have been worked out by different researchers [16; 21; 33; 29; 30; 31; 26; 22]. The life forms are reflected by the bioclimate of the area [16]. Thus, in humid regions, the bioclimate should be phanerophytic, in arid regions and intensively cultivated areas as therophytic and in temperate, high altitudinal zones, arctic regions as chamaephytic. Therophytic proportion in floristic biological spectrum of Jakaram RF, Warangal district in Andhra Pradesh was high (47%) which was receiving annual rainfall of 1000mm [29]. The montane humid forests of Meghalaya receive annual rainfall of 12,000 mm and represents 51% of phanerophytes [12]. So rainfall appears to be most important operative factors in the evolution of biological spectrum. Our study reveals the presence of phaenerophytic climate predominantly.

Analaysis of the present study reveals the phytoclimate to be of Phanero-therophtic type. The climate is ideal for sustaining the forest trees. This can be evidenced from much higher (62.76%) proportion of Phanerophtes than Raunkiær's normal values (46%) as revealed in fig.4. The Hemicryptophytes are much more improverished than the normal condition to keep the forest floor almost bare. The xeric nature of the habitat, which is likely to have emanated from the removal of topsoil by erosion and poor water retention by the substratum even during rainy season, gets reflected in the supra-normal representation of the therophytes in the site. Among herbs, the therophytes predominated the vegetation in all sites. The therophytes presented a higher proportion than expected of the life-form classes. Performance of Chamaephytes affects other associated species through the competitive ability. The sites facing anthropogenic stress show majority of Chamaephytes, Cryptophytes forming next dominant vegetation reflecting the best performance of species belonging to these life forms. Where the food storage organs and buds for making fresh growth are adequately protected. It indicates higher accumulation of organic matter in the roots and rhizomes showing stressed conditions. The dominanace of phanerophytes reveals the significance of trees in ameliorating the micro-climate, controlling the regeneration, establishment of herbaceous plants, maintenance of biodiversity and functioning of the ecosystem are influenced by the phanerophytic phytoclimate, which is of vital importance influencing ecosystem processess. The thero-phanerophytic spectrum has been discerned for disturbed wooded areas like forest in Kerala [24]. However, therophytes as next represented life-form show anthropogenic stress operating in the system.

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