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RESEARCH ARTICLE

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Species diversity and community structure of trees and shrubs of Japfü mountain, Kohima: Nagaland

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ABSTRACT : The present study entitled " Diversity and Phytosociological Analysis of Trees and Shrubs species of Japfü Mountain, Kohima: Nagaland" was conducted in Japfü Mountain in Kohima district of Nagaland state in order to investigate the altitudinal variation of diversity and community structure of trees and shrubs species. The study area was divided into four sites based on the increasing ranges of altitude *viz.*, site-I (1600-2000 m), Site-II (2000-2400 m), Site-III (2400-2800 m) and Site-IV (>2800m). A total of 816 individuals from 40 tree species belonging to 18 families and 32 genera, 1451 individuals from 20 shrubs species belonging to 14 families and 17 genera were recorded from the study area. Results from the tree layer showed that the dominant species at site-I was *Alnus nepalensis* with IVI (89.32), Site-II and Site-III were both dominated by *Quercus lamellosa* with IVI value 48.6 and 104.89, respectively whereas Site-IV was dominated by *Rhododendron macabeanum* with an IVI (131.13). Considering the shrub layer, the dominant species form Site-I was *Debregeasia longifolia* with IVI (85.4), Site-II was dominated by *Eupatorium odoratum* with IVI (77.95), Site-III by *Polygonum molle* with IVI (181.9) whereas *Gaultheria fragrantissima* dominated Site-IV with IVI (191.43). Family Ericaceae had the maximum tree as well as shrub species.

KEY WORDS : Diversity, Phytosociology, Japfü Mountain, IVI, Tree, Shrubs

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INTRODUCTION

A species is the basic unit of biological classification and a taxonomic rank which is often defined as a group of individuals that actually or potentially interbreeds in nature. In this sense, a species is the biggest gene pool possible under natural conditions. Vegetation is a key factor in determining the structure of any ecosystem (Gaur, 1999; Bhatt and Purohit, 2009 and Khali and Bhatt, 2014). One of the important factors in determining the biodiversity of a region is evaluating the species content of the area. The species diversity and community structure of a region can be analyzed by the quantitative study of vegetation called phytosociology. Phytosociology is often called the "Braun-Blanquet approach" (Westhoff

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and Maarel, 1973). It is the branch of science dealing with the plant communities, their composition and development and the relationships between the species within them whereits principal goals are the delimitation and characterization of vegetation types based on the complete floristic (species) composition. Nagaland, one of the eight states of Northeast India is endowed with a rich floristic composition. The state is beautifully adorned with scenic views of mountains and landscapes with varying patterns and heights. Though geographically being a small state, Nagaland has several types of forests, mainly because the state is mostly tropical, and the altitudes range from a few hundred meters to about four thousand meters. The state has a rich floristic composition yet anthropogenic activities such as reckless and uncontrolled cutting of trees for timber, firewood, continued Jhum cultivation and annual fire in vast tracts of land, forests got degraded and barren, which accelerated diminishing of most of the original characteristics of the forests.

Study area:

Japfü Mountain is located at 25^{0}39$^/$ North Latitude and 94^{0}05$^/$ East Longitude from Kohima district of Nagaland State. The Mountain is encompassed by two villages in Kohima namely, Kigwema and Phesama village. Mt. Japfu is also the second highest mountain peak in Nagaland and the highest peak in the Barail mountain range that stretches from Assam to Nagaland. The mountain stands at a height of 3048 m asl. The vegetation type here is sub-tropical broadleaf on the slopes and temperate broadleaf on the highest parts (Chankija, 2016).

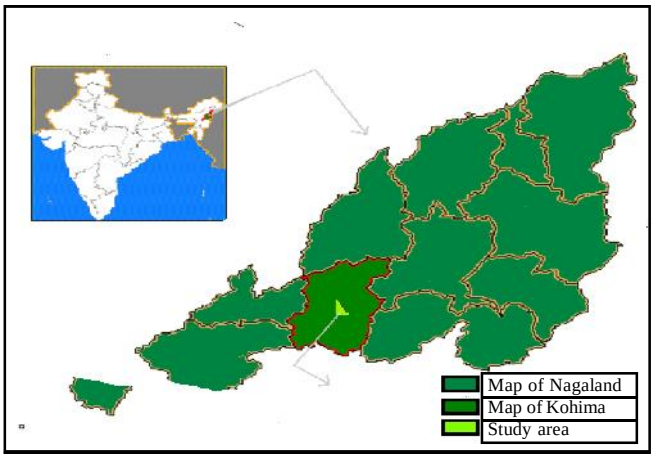

Fig. A : Map of the study area

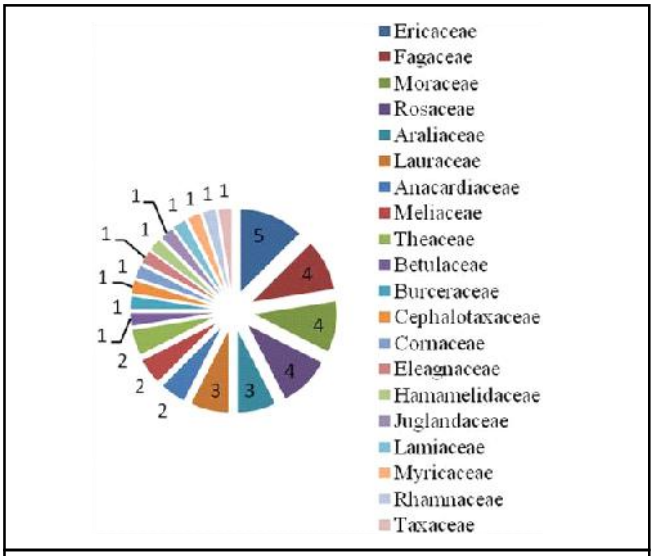

Fig. B : Pie chart showing the dominant tree families along with their species number

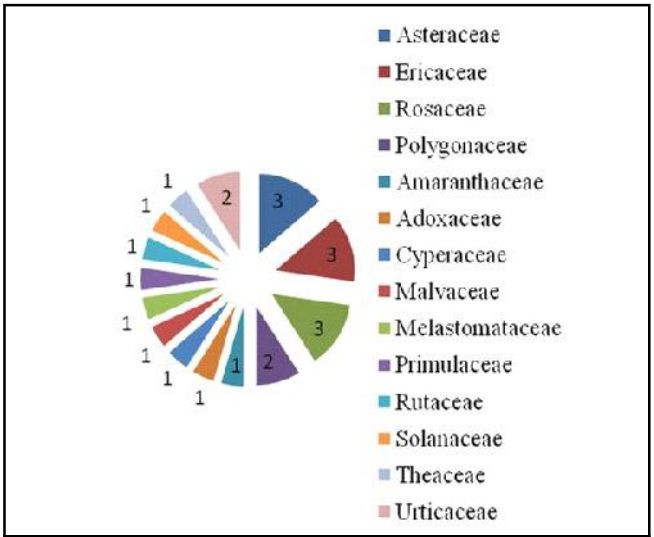

Fig. C : Pie chart showing the dominant shrub families along with their species number

An interesting feature of this mountain is that it is home to the world's tallest known Rhododendron tree (*Rhododendron arboreum)*, the Scarlet Rhododendron (Guinness book of world records). This mountain range receives heavy rainfall during summer while the coldest months are from December to February where snowfall occurs occasionally at higher altitudes.

EXPERIMENTAL METHODS

The studies on Species diversity and community

structure of trees and shrubs were carried out in Japfü Mountain, Kohima: Nagaland during the month of January to march 2017. The study area was divided into 4 sites based on the increasing ranges of altitudes *viz.*, Site-I (1600-2000) m asl, Site-II (2000-2500) m asl, Site-III (2400-2800) m asl and Site-IV (>2800) m asl. A total of 40 quadrates of trees of the size (20×20) m and 29 quadrates of shrubs of the size (10×10) m were taken in all the four sites. The quadrates were taken with spacing of at least (50-100) m. The location and altitude of the study area were recorded using Global Positioning System (GPS). The unidentified specimens were processed into herbarium sheets and thereby identified by approaching various taxonomists and botanists and cross checking the species from the internet.

Data analysis :

The vegetation data were computed and analysed in order to determine the frequency, density and abundance. For the calculation of frequency, density and dominance, the following formulas were used;

$$\text{Density} = \frac{\text{Total number of individuals in all sampling units}}{\text{Total number of sampling units studied}}$$

$$\text{Frequency} = \frac{\text{Number of sampling units in which species occurred}}{\text{Total number of sampling units studied}} \times 100$$

$$\text{Dominance} = \frac{\text{Total covered basal area of species}}{\text{Total area sampled}}$$

Basal area :

It is the area occupied by the base of a tree, is considered as a good indicator of the size, volume or weight of a tree. The basal area was calculated by using the formula

$BA = Cbh^2/4\pi$,

where, 'Cbh' circumference at breast height

Important value index (IVI) :

Important value is a measure of how dominant a species is in a given forest area. It is a standard tool used by foresters to inventory a forest. Foresters do not generally inventory a forest by counting all the trees, but by locating points in the forest and sampling a specified area around those points. Three kinds of data are collected namely Relative frequency, Relative density and Relative dominance where each of these values is expressed as a per cent and ranges from 0 to 100. The Important value is the sum of these three measures and can range from 0 to 300. This value of 300 is called Important Value Index (IVI). It does incorporate three important parameters;

$$\text{Relative density} = \frac{\text{Density value of species}}{\text{Sum of density value of all species}} \times 100$$

$$\text{Relative frequency} = \frac{\text{Frequency value of species}}{\text{Sum of frequency value of all species}} \times 100$$

$$\text{Relative dominance} = \frac{\text{Dominance of species}}{\text{Sum of dominance value of all species}} \times 100$$

Diversity index :

A diversity index is a quantitative measure that reflects how many different types (such as species) there are in a dataset (a community) and simultaneously takes into account how evenly the basic entities (such as individuals) are distributed among those types. The ability to quantify diversity in this manner is an important tool for biologists in order to understand the community structure. The commonly used biodiversity index is Shannon–Wiener index and that of dominance index is Simpson's index.

Simpson's index (1949):

Simpson's index measures the species dominance of a particular area studied and it is calculated by the formula;

$Cd = \Sigma (ni/N)^2$

ni = Total number of individuals of each species

N = Total number of individuals of all species

Shannon – wiener index (1963):

The Shannon-wiener index (H) is commonly used to characterize species diversity in a community. Shannon's index accounts for both abundance and evenness of the species present. It is calculated by the formula;

$H = \Sigma (ni/N)\log(ni/N)$

ni = Total number of individuals belonging to i^{th} species

N = Total number of individuals in the sample

EXPERIMENTAL RESULTS AND ANALYSIS

A total of 816 individuals from 40 tree species

belonging to 18 families, 1,451 individuals from 21 shrub species belonging to 14 families were recorded from the 69 vegetative units. The dominant family from the tree layer was Ericaceae with a total of 5 species followed by Fagaceae, Moraceae and Rosaceae with a total of 4 species each. The dominant family from the shrub layer was also Ericaceae with a total of 4 species followed by Asteraceae and Rosaceae with a total 3 species each.

Phytosociological aspects of trees and shrubs :

Site-I (1600-2000) m asl :

In Site-I, a total of 443 individuals from 23 tree species belonging to15 families were recorded. The species with the highest basal area (cm^2) was of *Alnus nepalensis* (22473.04) while *Ziziphus mauritiana* reported the least basal area (13.46). *Leucosceptrum c*anum was found to have the highest density (11.18) while *Canarium strictum*, *Cornus capitata* and *Macropanax dispermus* had the least density (0.06). The highest frequency was of *Leucosceptrum canum* (82.35) while *Canarium strictum*, *Cinnamomum zeylanicum*, *Cornus capitata*, *Engelhardtia spicata*, *Ficus carica*, *Ficus glomerata*, *Machilus thunbergii*, *Macropanax dispermus*, *Pyrus pashia*, *Rhus javanicum*, *Spondias axillaris*, *Ziziphus mauritiana* had the least frequency (5.88). The species with the highest dominance was *Alnus nepalensis* (3.30) while the least was of *Prunus avium* (0.01).The species with the highest IVI was *Alnus nepalensis* (89.32) followed by *Leucosceptrum canum* (69.87) whereas the least was

Table 1 : Phytosociological attributes of site-I (Trees)

Trees	T. No. of individuals	Av. BA (cm^2)	D	F	D/A	R D	RF	RD/RA	IVI
Alnus nepalensis	91	22473.04	5.35	70.59	3.30	20.54	18.46	47.01	89.32
Canarium strictum	1	644.90	0.06	5.88	0.09	0.23	1.54	1.35	3.21
Cinnamomum zeylanicum	4	733.80	0.24	5.88	0.11	0.90	1.54	1.54	4.08
Cornus capitata	1	1127.46	0.06	5.88	0.17	0.23	1.54	2.36	4.29
Docynia indica	23	4129.33	1.35	47.06	0.61	5.19	12.31	8.64	26.14
Elaeagnus conferta	4	2753.50	0.24	17.65	0.40	0.90	4.62	5.76	11.68
Engelhardtia spicata	1	575.23	0.06	5.88	0.08	0.23	1.54	1.20	3.05
Ficus carica	2	1165.68	0.12	5.88	0.17	0.45	1.54	2.44	4.60
Ficus glomerata	2	509.55	0.12	5.88	0.07	0.45	1.54	1.07	3.13
Ficus erecta	3	1769.59	0.18	5.88	0.26	0.68	1.54	3.70	6.18
Leucosceptrum canum	190	2431.05	11.18	82.35	0.36	42.89	21.54	5.09	69.87
Litseae monopetala	37	402.36	2.18	29.41	0.06	8.35	7.69	0.84	16.94
Machilus thunbergii	2	509.55	0.12	5.88	0.07	0.45	1.54	1.07	3.13
Macropanax dispermus	1	1387.26	0.06	5.88	0.20	0.23	1.54	2.90	4.87
Melia azedarach	9	1632.16	0.53	11.76	0.24	2.03	3.08	3.41	8.76
Prunus avium	20	87.96	1.18	11.76	0.01	4.51	3.08	0.18	7.79
Prunus campanulata	8	2579.05	0.47	11.76	0.38	1.81	3.08	5.40	10.66
Pyrus pashia	5	53.82	0.29	5.88	0.01	1.13	1.54	0.11	2.79
Quercus serrata	10	1086.65	0.59	11.76	0.16	2.26	3.08	2.27	7.77
Rhus javanicum	6	267.83	0.35	5.88	0.04	1.35	1.54	0.56	3.49
Spondias axillaris	2	535.35	0.12	5.88	0.08	0.45	1.54	1.12	3.19
Toona ciliata	18	967.91	1.06	11.76	0.14	4.06	3.08	2.02	9.31
Ziziphus mauritiana	3	13.46	0.18	5.88	0.00	0.68	1.54	0.03	2.25
Total	443	47836.49	26.06	382.35	7.03	100.00	100.00	100.00	300.00

Ziziphus mauritiana (2.25) (Table 1).

Considering the shrub layer, the species with the highest basal area (cm^2) was *Debregeasia longifolia* (2615.7) while the lowest was of *Ageratum conyzoides* (0.3). The species with the highest density was found to be *Eupatorium odoratum* (31.77) while the least was *Carex baccans* (0.23). The species with the highest frequency was *Eupatorium odoratum* (100) while the least was *Ageratum conyzoides, Carex baccans, Gaultheria fragrantissima, Osbeckia stellata* (7.69). *Debregeasia longifolia* reported to have the highest dominance (2.0121) while the least was *Ageratum conyzoides* (0.0002). *Debregeasia longifolia* also reported the highest IVI (85.392), followed by *Eupatorium odoratum* (73.291) whereas *Osbeckia stellata* reported with the least IVI (2.134) (Table 2).

Site-II (2000-2400) m asl :

In Site-II, 215 individuals from 19 tree species belonging to 13 families were recorded. The species with the highest basal area (cm^2) was *Quercus lamellosa* (19304.89) while *Taxus baccata* had the least (71.65). The density was highest in *Rhododendron arboreum* (5.667) while it was lowest in *Ficus erecta, Lithocarpus pachyphylla, Quercus serrata* and *Taxus baccata* (0.08). *Rhododendron arboreum* was found to have the highest frequency (41.67) while *Exbucklandia populnea, Ficus erecta, Lithocarpus pachyphylla, Quercus serrata* and *Taxus baccata* had the lowest frequencies (8.333). The dominance was highest in *Quercus lamellosa* (4.02) whereas *Taxus baccata* had the least dominance (0.01).*Quercus lamellosa* reported the highest IVI (48.6) followed by *Rhododendron arboreum* (45.2) whereas *Taxus baccata* reported the least IVI (2.7) (Table 3).

Considering the shrub layer, the species with the highest basal area (cm^2) was of *Polygonum molle* (17.8) whereas the least was of *Carex baccans, Osbeckia stellata* and *Pollygonum chinense* (0.32). The highest density was of *Eupatorium odoratum* (17.89) and the lowest was of *Carex baccans* (0.22). *Eupatorium odoratum* also reported the highest frequency (77.78) while *Bidens pilosa, carex baccans, Osbeckia stellata, Polygonum chinense* and *Solanum xanthocarpum* reported the lowest frequency (11.111). *Polygonum molle* reported the highest dominance (0.0198) while the lowest were *Carex baccans, Osbeckia stellata, Pollygonum chinense* (0.0004). *Eupatorium odoratum*

Table 2 : Phytosociological attributes of Site-I (Shrubs)

Shrubs	T. No. of individuals	Av. BA (cm^2)	D	F	D	RD	RF	RD/RA	IVI
Ageratum conyzoides	50	0.3	3.85	7.69	0.0002	5.988	1.754	0.009	7.751
Ardissia crenata	13	4.6	1.00	15.38	0.0035	1.557	3.509	0.127	5.193
Bidens pilosa	75	130.1	5.77	38.46	0.1000	8.982	8.772	3.597	21.352
Carex baccans	3	1.3	0.23	7.69	0.0010	0.359	1.754	0.036	2.150
Debregeasia longifolia	21	2615.7	1.62	46.15	2.0121	2.515	10.526	72.35	85.392
Eupatorium odoratum	413	36.9	31.77	100.00	0.0284	49.462	22.807	1.022	73.291
Gaultheria fragrantissima	40	15.6	3.08	7.69	0.0120	4.790	1.754	0.431	6.976
Osbeckia stellata	3	0.7	0.23	7.69	0.0006	0.359	1.754	0.020	2.134
Polygonum chinense	10	2.0	0.77	15.38	0.0015	1.198	3.509	0.054	4.760
Polygonum molle	85	7.6	6.54	38.46	0.0059	10.180	8.772	0.211	19.163
Rubus elliptica	30	6.6	2.31	30.77	0.0051	3.593	7.018	0.183	10.793
Rubus moluccanus	25	3.6	1.92	30.77	0.0028	2.994	7.018	0.099	10.111
Rubus nivius	17	7.8	1.31	23.08	0.0060	2.036	5.263	0.216	7.515
Solanum xanthocarpum	26	3.0	2.00	23.08	0.0023	3.114	5.263	0.084	8.461
Viburnum foetidum	2	286.6	0.15	7.69	0.2205	0.240	1.754	7.927	9.921
Zanthoxylum oxyphyllum	22	492.8	1.69	38.46	0.3791	2.635	8.772	13.63	25.038
Total	833	3615.3	64.23	438.46	2.7810	100	100	100	300

reported the highest IVI (77.95) followed by *Polygonum molle* (66.79) (Table 4).

Site-III (2000-2400) m asl :

In Site-III, a total of 75 individuals from 6 tree species belonging to 4 families were recorded. *Quercus lamellose*

Table 3: Phytosociological attributes of Site-II (Trees)

Trees	T. No. of individuals	Av.BA (cm²)	D	F	D/A	RD	RF	RD/RA	IVI
Alnus nepalensis	23	1753.9	1.92	33.33	0.37	10.70	8.511	3.30	22.5
Brassaiopsis glomerulata	4	485.6	0.33	16.67	0.10	1.86	4.255	0.91	7.0
Brassaiopsis hainla	23	107.6	1.92	16.67	0.02	10.70	4.255	0.20	15.2
Canarium strictum	12	357.4	1.00	33.33	0.07	5.58	8.511	0.67	14.8
Castanopsis hystrix	11	4952.96	0.92	25.00	1.03	5.12	6.383	9.33	20.8
Engelhardtia spicata	2	906.1	0.17	16.67	0.19	0.93	4.255	1.71	6.9
Eurya accuminata	4	699.31	0.33	16.67	0.15	1.86	4.255	1.32	7.4
Exbucklandia populnea	2	435.99	0.17	8.33	0.09	0.93	2.128	0.82	3.9
Ficus erecta	1	390.13	0.08	8.33	0.08	0.47	2.128	0.73	3.3
Leucosceptrum canum	2	1521.4	0.17	16.67	0.32	0.93	4.255	2.86	8.1
Lithocarpus pachyphylla	1	379.06	0.08	8.33	0.08	0.47	2.128	0.71	3.3
Lyonia ovalifolia	14	565.8	1.17	33.33	0.12	6.51	8.511	1.07	16.1
Myrica esculenta	4	12842.3	0.33	16.67	2.68	1.86	4.255	24.18	30.3
Quercus lamellosa	8	19304.89	0.67	33.33	4.02	3.72	8.511	36.35	48.6
Quercus serrata	1	277.14	0.08	8.33	0.06	0.47	2.128	0.52	3.1
Rhododendron arboreum	68	1555.5	5.67	41.67	0.32	31.63	10.638	2.93	45.2
Rhododendron barbatum	26	1133.3	2.17	25.00	0.24	12.09	6.383	2.13	20.6
Schima wallichi	8	5371.8	0.67	25.00	1.12	3.72	6.383	10.11	20.2
Taxus baccata	1	71.65	0.08	8.33	0.01	0.47	2.128	0.13	2.7
Total	215	53111.83	17.92	391.67	11.06	100	100	100	300

Table 4 : Phytosociological attributes of Site-II (Shrubs)

Shrubs	T. No. of individuals	Av. BA(cm^2)	D	F	D/A	RD	RF	RD/RA	IVI
Bidens pillosa	4	3.9	0.44	11.11	0.0043	1.11	4	8.50	13.62
Carex baccans	2	0.32	0.22	11.11	0.0004	0.56	4	0.70	5.25
Eupatorium odoratum	161	2.34	17.89	77.78	0.0026	44.85	28	5.10	77.95
Gaultheria fragrantissima	79	10.3	8.78	33.33	0.0114	22.01	12	22.46	56.47
Osbeckia stellata	6	0.32	0.67	11.11	0.0004	1.67	4	0.70	6.37
Polygonum chinense	14	0.32	1.56	11.11	0.0004	3.90	4	0.70	8.60
Polygonum molle	43	17.8	4.78	44.44	0.0198	11.98	16	38.81	66.79
Rubus elliptica	6	2.32	0.67	22.22	0.0026	1.67	8	5.06	14.73
Rubus nivius	8	5.2	0.89	22.22	0.0058	2.23	8	11.34	21.57
Sida rhombifolia	28	1.04	3.11	22.22	0.0012	7.80	8	2.27	18.07
Solanum xanthocarpum	8	2	0.89	11.11	0.0022	2.23	4	4.36	10.59
Total	359	45.86	39.89	277.78	0.0510	100	100	100	300

had the highest basal area (cm^2) (38447.4) while *Rhododendron arboreum* had the lowest (279). *Quercus lamellosa* also had the highest density (2.57) whereas *Cephalotaxus griffithii* and *Rhododendron arboreum* had the lowest (1). Frequency was reported to be highest in *Rhododendron falconeri* (57.14) whereas the lowest was in *Cephalotaxus griffithii* and *Rhododendron arboreum* (14.29). The highest dominance was found to be of *Quercus lamellosa* (13.73) and the lowest in *Rhododendron arboreum* (0.10).*Quercus lamellosa* reported the highest IVI (104.89) followed by *Rhododendron falconeri* (52.77) while *Rhododendron arboreum* reported the least (13.78) (Table 5).

In site-III, only two shrub species were recorded with a total of 64 individuals from two families' *viz.*, *Eupatorium odoratum* and *Polygonum molle*. *Polygonum molle* had the higher basal area (7.7) and density (9.25). Frequency value was similar for both the two shrub species (75). *Polygonum molle* also had the

Table 5 : Phytosociological attributes of Site-III (Trees)

Trees	T. No. of individuals	Av. BA (cm^2)	D	F	D	RD	RF	RD	IVI
Cephalotaxus griffithii	7	405.4	1	14.29	0.14	9.33	6.67	0.64	16.64
Quercus lamellosa	18	38447.4	2.57	42.86	13.73	24.00	20.00	60.89	104.89
Rhododendron arboreum	5	279.0	0.71	14.29	0.10	6.67	6.67	0.44	13.78
Rhododendron falconeri	17	2172.3	2.43	57.14	0.78	22.67	26.67	3.44	52.77
Rhododendron maceabeanum	16	20877.8	2.29	42.86	7.46	21.33	20	33.06	74.40
Taxus baccata	12	963.3	1.71	42.86	0.34	16.00	20	1.53	37.53
Total	75	63145.2	10.71	214.29	22.55	100	100	100	300

Table 6 : Phytosociological attributes of Site-III (Shrubs)

Shrubs	T. No. of individuals	Av. BA (cm^2)	D	F	D/A	RD	RF	RD/RF	IVI
Eupatorium odoratum	27	2.7	6.75	75	0.00675	42.1875	50	25.96154	118.149
Polygonum molle	37	7.7	9.25	75	0.01925	57.8125	50	74.03846	181.851
Total	64	10.4	16	150	0.026	100	100	100	300

Table 7 : Phytoscociological attributes of Site-IV (Trees)

Trees	T. No. of individuals	Av. BA (cm^2)	D	F	D/A	RD	RF	RD/RA	IVI
Rhododendron aeboreum	4	113.97	1	25	0.00191	4.81927	12.5	26.3660	43.68533
Rhododendron falconeri	7	114.97	1.75	25	0.00193	8.43373	12.5	26.5973	47.53113
Rhododendron macabeanum	47	118.9	11.7	100	0.00200	56.6265	50	27.5065	134.1331
Rhododendron barbatum	25	84.4	6.25	50	0.00142	30.1204	25	19.5252	74.64575
Total	83	432.24	20.75	200	0.00726	100	100	100	300

Table 8 : Phytosociological attributes of Site-IV (Shrubs)

Shrubs	T. No. of individuals	Av. BA (cm^2)	D	F	D/A	RD	RF	RD/RA	IVI
Gaultheria fragrantissima	135	3.57	45	100	0.012	69.23	60	62.2	191.43
Gaultheria griffithiana	60	2.17	20	66.67	0.007	30.77	40	37.8	108.57
Total	195	3.57	65	100	0.012	100	100	100	300

Table 9 : Showing the diversity indices (IVI, Shannon-wiener's diversity and Simpson's dominance index) for trees and shrubs

Sites	IVI		Shannon wiener's diversity index		Simpson's Dominance index	
	Trees	Shrubs	Trees	Shrubs	Trees	Shrubs
Site-I	89.32	85.4	2	1.78	0.24	0.276
Site-II	48.6	77.9	2.287	1.66	0.512	0.27
Site-III	104.9	181.9	1.704	0.68	0.193	0.51
Site-IV	134.13	191.4	1.038	1.038	0.42	0.42

higher dominance (0.01925), relative density (57.8125) and Relative dominance (181.851). The relative frequency was similar for both the shrub species (50). *Eupatorium odoratum* had a density (6.75), dominance (0.00675), relative dominance (42.1875). The IVI was higher in *Polygonum molle* (181.851) while in *Eupatorium odoratum*, it was (118.149) (Table 6).

Site-IV (>2800) m asl :

In Site-IV, a total of 83 individuals from 4 species belonging to the same family (*Ericaceae*) were recorded. The basal area (cm^2) was highest in *Rhododendron macabeanum* (118.9) while it was least in *Rhododendron barbatum* (84.4). The density was highest in *Rhododendron macabeanum* (11.75) where it was least in *Rhododendron arboreum* (1). *Rhododendron macabeanum* had the highest frequency (100) while it was least in *Rhododendron arboreum* and *Rhododendron falconeri* (25). *Rhododendron macabeanum* had the highest dominance (0.002) while the lowest was *Rhododendron arboreum* (0.00191). IVI was highest in *Rhododendron macabeanum* (134.1331) while it was lowest in *Rhododendron arboreum* (43.68533) (Table 7).

In Site-IV, two shrub species were identified *viz.*, *Gaultheria fragrantissima and Gaultheria griffithiana*. *Gaultheria fragrantissima* had the maximum basal area (cm^2) (3.57), density (45) and dominance (0.012) followed by *Gaultheria griffithiana* with a basal area (cm^2) (0.0001), density (20), frequency (66.67), dominance (0.007). *Gaultheria fragrantissima* had an IVI (191.43) whereas *Gaultheria griffithiana* (108.57) (Table 8).

Diversity decreased as the elevation increased. Structure, composition, diversity and distribution of vegetation also show variation in response to variables like productivity, Geographical location, human forest interaction and evolutionary competition (Woodward, 1988; Eriksson, 1996 and Criddle *et al*., 2003). Other abiotic factor that varies with elevation and can be important determinants of species richness includes area, cloud cover and soil quality as well. Importance value index (IVI) discloses a complete picture of phytosociological character of a species in the community (Hossain *et al*., 2004). The importance value index determines the extent of dominance of a species in the structure of a forest stand (Curtis and McIntosh, 1951). The foothills of the mountain are dominated by *Alnus nepalensis*, while the mid-hills by *Quercus lamellosa* and species of *Rhododendron* dominated the highest elevations.

Conclusion :

The rich edaphic factor coupled with the climate makes the mountain harbour a diverse range of plants species. Many medicinal plants, orchids, climbers, ferns and herbs were encountered throughout the study some of which were yet to be identified and documented. The count of a total of 2267 individuals from 40 tree species and 21 shrub species belonging to 32 families and 49genera from the 69 vegetative units in the study area revealed the strength and richness of diversity and gave a glimpse of the representation of the rest of the species thriving in the mountain. The mountain provides an important platform for researchers, botanists, trekkers and nature lovers. At the same time, the need to protect, conserve and uplift the wealthy heritage of the mountain has been felt the need of the hour.

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