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TREE SPECIES DIVERSITY AND DISTRIBUTION PATTERNS IN TROPICAL FORESTS OF VIZIANAGARAM DISTRICT, ANDHRA PRADESH, INDIA.

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ABSTRACT

The present paper deals with the Tree Species Diversity and Distribution Patterns in tropical forests of Vizianagaram District, Andhra Pradesh, India. Vizianagaram lies on the East coast of India lies between latitudes 17^0 – 15^1 and 19^0 – 12^1 North and longitudes in between 83^0 – 17^1 and 84^0 – 47^1 East with a total geographical area of 12,376 sq.Km. The area is bounded by Orissa state on the North & West and Bay of Bengal on the East and North east on the south and west Visakhapatnam district. The entire stretch of Eastern Ghats of vizianagaram district is divided in to 6.25 km x 6.25km. The inventory of tree species was done in 66 different forest areas in Vizianagaram district. In each forest area (plot) one belt transect of size 1000x 5m were laid down randomly to study the trees ≥ 15 cm girth at breast height was measure in each of the study area . In the present study, a total of 165 tree species, belonging to 119 genera and 50 families were recorded, among these 160 are dicots and 5 are monocots. The present investigation on phytosociological studies of vizianagaram district of Andhra Pradesh reflects a positive and negative correlation with various parameters which were discussed in this paper.

Key words: Tree species diversity, distribution patterns, vizianagaram district

INTRODUCTION

Biodiversity interacting with the physical environment form the foundation of sustainable development. The worldwide destruction of the natural environment by population explosion, urbanization, industrialization and habitat fragmentation has led to a tremendous loss of biological diversity over the past few decades. Population pressures and concomitant unscientific and unsustainable extraction of resources especially of timber, medicinal herbs, fuel wood and fodder from forests has alarming consequences on conservation of these resources. Over exploitation is likely to severely reduce the population sizes below the critical level and consequently the survival of the species. India was ranked in 11th position among the 12-mega diversity centers in the world and 4th position in Asia in vascular plant diversity. Dry deciduous forests are among the most exploited and endangered ecosystems of the biosphere [1,2]. About 14-40 thousand species per year are estimated to be last due to tropical- forest habitat destruction [3]. In India habitat destructions, over exploitation, environmental pollution and anthropogenic pressures are the major disturbances to forest ecosystem (UNEP-2001). Studies from Forest Survey of India showed an average of 54.7% of forest is effected by fire and 72.1% of forest area is subjected to grazing annually, 3.73 million hectors of forest area are burnt resulting in economic losses of approximately 440 crores. Biodiversity interacting with the physical environment form the foundation of sustainable development. The worldwide destruction of the natural environment by population explosion, urbanization, industrialization and

habitat fragmentation has led to a tremendous loss of biological diversity over the past few decades. The ecological studies have taken up to visualize the positive impact of protection on tree diversity. An understanding of the distribution of tree species and their assemblages must play an important role in elucidating the larger patterns of distribution of diversity. The present investigation deals with the comparison of species diversity indices of plant species i.e., Simpson's index, Shannon –wiener index, species richness with other counter parts. The main aim of the study is to delineate phytosociological attributes and to present a data base on diversity and distribution patterns of trees in Vizianagaram districts.

MATERIALS AND METHODS

Phytosociological studies were carried out during July 2008 to June 2011 to cover over all spectrum of vegetation. The entire stretch of Eastern Ghats of vizianagaram district is divided in to 6.25 km x 6.25km. grid, based on the toposheets obtained . This expertise method of classification is obtained from UAS-ATREE team Bengalore. Each grid would from a sampling unit; the rational of this analysis is to classify vegetation cover in to broad forest type. The inventory of tree species was done in 66 different forest areas in Vizianagaram districts. In each forest area (plot) one belt transect of size 1000x 5m were laid down randomly to study the trees ≥ 15 cm girth at breast height was measure in each of the study area .

One belt transect of 5m x 1000m in each of the 6.25 km x6.25 km (grid) is a sampling protocol with 0.01% of sampling intensity based on random sampling method . Tree layer will be enumerated in the entire belt transect may cover large tract of forest. The study area comprised of 66 belt transects which were laid randomly in 66 forest areas in vizianagaram district thus the data was obtained from a total of 66 sampling plots. All the plots sampled was representative of most common forest typing the Vizianagaram district i.e tropical dry deciduous forests, followed by moist deciduous forests and scrub deciduous forests. In order to revisit these plots for seasonal sampling, latitude, longitude, altitude will be noted using a GPS and other Geo-climatic features will be recorded. The specimens were identified with the help of flora of Andhra Pradesh 3 Volumes [4-6]; Forest Flora of Andhra Pradesh; and local floras like Flora of Srikakulam district, Studies on the Vegetation and Flora of Vizianagaram district [7].

1 Grid = 6.25 Km. X 6.25Km

1 Belt transect (sampling area) = 5m x1000m

Data Analysis

The main purpose of the Phytosociological analysis is to understand floristic, vegetation characteristics, to estimate the species richness and diversity which is existing in the study area. Standard protocols of Curtis and Mclntosh [8] and Mueller-Dombois and Ellenberg (1974) have been adopted to analyze the density, frequency and abundance. For calculation of frequency, density and abundance the following formulas have to be used.

Density =

$$\frac{\text{Total number of Individuals in all sampling units}}{\text{Total number of sampling units studied}}$$

Frequency =

$$\frac{\text{Number of sampling units in which species occur x 100}}{\text{Total number of sampling units}}$$

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. It provides information on the proportion or dominance of the larger and smaller trees in an ecosystem and is one of the most important parameters in estimating the standing biomass in an area.

$$\text{Basal area} = Cbh^2/4\pi$$

Where

Cbh = Circumference of the tree at breast height.

Usually after the quantitative estimation of relative values of density, frequency and dominance, the species are listed in order of decreasing importance.

Important value index (IVI)

The total picture of the relative ecological important and the sociological structure of a given plant species in any community can't be obtained by relative parameters (Relative Frequency, Relative Density, Relative Dominance, etc.,) singly , which give individual clues , although the quantitative value of each such parameter has its own importance . Frequency gives an idea as to how a species is dispersed in the area but we will not get an idea about its number or the area covered. Density on the other handed gives the numerical strength and nothing about the spread or cover. Dominance gives the basal cover only. In order to express the dominance and ecological success of any species with a single value, the concept of important value index have been developed. This index utilizes three characteristics, viz., Relative Frequency, Relative Density and Relative Dominance. On the basis of these analytical quantitative character values, the idea of obtaining a statistical quantity was proposed in order to have a really overall picture of the ecological importance of the species with respect to the community structure, for which the percentage value of Relative Frequency, Relative Density and Relative Dominance are added together. This value out of 300 is called Important Value Index (IVI). It thus incorporate three important parameters that measures of productivity and diversity of every species therefore.

IVI= Relative Density + Relative Frequency + Relative Dominance

Relative density =

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

Relative frequency =

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

Relative dominance =

$$\frac{\text{Total basal area of the species}}{\text{Total basal area of all species}} \times 100$$

Biodiversity indices

Ecologist have developed and proposed a number of indices of species diversity from time to time, the values of which depend upon mathematically combined effects of species richness (S) and evenness (E). The numerical strength and biomass has a direct effect on the functioning of ecosystem in the course of millions of years, numerous biotic communities have evolved and established themselves. It is there four important to know the diversity of these communities in space and time so as to understand their role in the development of the ecosystem , evaluation and in the maintenance of stability for the quantification of diversity and comparison of species diversities between different ecosystems in various climatic conditions, is useful to calculate an index of diversity and dominance .

Species richness (Species diversity)

Species diversity richness is an expression of community structure. It is described as the number of species present in a sample or habitat per unit area. They are certain indices that can bring them to a similar scale. The simplest species richness index is based on the total number of species and the total number of individuals in a given sample or habitat, higher the value greater the species richness. The more different species present the more diverse the community and is generally considered healthier. Richness tends to increase over area; larger areas will harbors more different species probably because of larger variety of micro habitats and resources. Additionally, sampling over a large area increases the chance of find in rare species.

On the other hand, evenness is a measure of how similar the abundances of different species are categories are in a community. Evenness is ranged from zero. When the evenness is close to one, it indicates that each species categories consist of almost same number of individuals. However, when the abundances of species are very dissimilar (Some rare and some common) then the value increases. The commonly used biodiversity index is Shannon–Wiener index and that of dominance index is Simpson's index.

Simpson's Index (1949):

Species dominance is measured by using this index

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

ni = Total number of individuals of each species

N = Total number of individuals of all species

Shannon – wiener Index (1963)

It is also called species diversity index. This index is based on information theory and improves upon the Simpson's by giving more importance to the rare species.

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

ni = Total number of individuals belonging to ith species

N = Total number of individuals in the sample.

Study area

Vizianagaram lies on the East coast of India lies between latitudes 17^0 – 15^1 and 19^0 – 12^1 North and longitudes in between 83^0 – 17^1 and 84^0 – 47^1 East with a total geographical area of 12,376 sq.Km. The area is bounded by Orissa state on the North & West and Bay of Bengal on the East and North east on the south and west Visakhapatnam district. The area is with 34 mandals of Vizianagaram district. The area is devided in to agency area and plain areas. The tribal population residing in the agency is 3, 24, 252 when compared with the total population of 47, 86, 847. The agency area there are several hill peaks in between 900 m to 1115 m. Sankaram of S.kota mandal is 1615 m. Nanda 1162 m, Himagiri 1120 m, Jarada 960 m, Rangavalasa 950 m, Darabanda. The principal rivers flowing in this region are Gosthani (Champavathi), Suvarnamukhi, Vegavathi and Gomukhi. The main rivers, which take. The river Gosthani has its origin in Anantagiri forest area of Srungavarapukota. The Suvarnamukhi River takes its birth in the hills of Salur and takes eastern direction. The climate of the region is generally tropical. The temperature in the hill areas is cooler than in plains because hills receive heavier rainfall. The mean maximum temperature is 30-40^0c April-May and the mean minimum temperature is 17.4^0-C December-January during the summer season till the onset of the South-West monsoon the heat is oppressive and the day temperature is May sometimes go about 43^0 C. The aboriginal culture and the vegetation pattern of the area have been much influenced by the topography and climate. The floristic composition of the forests of the region is quite diverse. Especially, the diversity in the floristic composition and distribution is more in Kurupam, Parvathipuram and Palakonda Forest Ranges. In the interior Eastern Ghat hill ranges dense dry deciduous to moist deciduous forests exists with rare species like ***Shorea robusta, Cycas circinalis***. Several medicinal plants, which are widely used by tribals exist here. The Reserved Forests and the unprotected vegetation of this region are classified into 7 types based on the floristic

composition and nature of their growth in relation to soil and climate. As per classification of Indian Forest types of Champion and Seth (1968) forests types are given in brackets

RESULTS

In the present study, a total of 165 tree species, belonging to 119 genera and 50 families were recorded, and 160 are dicots and 5 are monocots. The taxonomic categorization of the species is presented in Table-1. The predominant species of this category are *Shorea robusta, Xylia xylocarpa, Cleistanthus collinus, Wrightia tinctoria, Lannea coromandelica, Anogeissus latifolia, Dalbergia paniculata, Chloroxylon swietenia, Tamarindus indica and Mangifera indica* etc.

FAMILIES AND GENERA

The total families recorded in the present study are 50. Out of 50, 22 are monotypic, viz., representing only by one species (Table-2). Of these 48 are dicots families: Rubiaceae, Mimosaceae, Euphorbiaceae, Moraceae, Fabaceae, Verbenaceae, Rutaceae, Anacardiaceae, Combretaceae, Ebenaceae, Apocynaceae, Sterculiaceae, Caesalpiniaceae, Annonaceae, Burseraceae, Meliaceae, Flacourtiaceae, Rhamnaceae, Bombacaceae, Sapindaceae, Myrtaceae, Barringtoniaceae, Sapotaceae, Ulmaceae, Loganiaceae, Lythraceae, Dilleniaceae, Magnoliaceae, Capparaceae, Cochlospermaceae, Dipterocarpaceae, Malvaceae, Tiliaceae, Linaceae, Erythroxylaceae, Simaroubaceae, Ochnaceae, Flindersiaceae, Celastraceae, Melastomataceae, Alangiaceae, Oleaceae, Nyctanthaceae, Cordiaceae, Bignoniaceae, Lauraceae, Hernandiaceae and Santalaceae, 2 are monocot families: Poaceae and Arecaceae. The first 10 largest families with more than 6 species (Table -2). Rubiaceae and Mimosaceae are the largest representing families with 13 species each. Euphorbiaceae and Moraceae occupies the second position with 12 species followed by Fabaceae and Verbenaceae (9) each; Rutaceae, Anacardiaceae, Combretaceae and Ebenaceae representing (6) each.

Site –Wise analysis of species

In the present study, tree species of the study area pertaining to has revealed interesting results. Out of the 165 species recorded in study area, this analysis has been presented in Table-3. From the table-3, it is evident that the number of families, genera, species and number of individuals in the study area.

Phytosociological studies

A total of 165 species were recorded from the study. The total density of tree species was 127 plants km-^{1} out of which *Shorea robusta* (5.52%) *Xylia xylocarpa*(4.15%) , *Cleistanthus collinus* (4.01%), *Wrightia tinctoria* (3.64%), *Lannea coromandelica* (3.50%), *Anogeissus latifolia*(3.42%), *Dalbergia paniculata* (3.15%), *Chloroxylon swietenia* (2.70%) *Tamarindus indica* (2.63%) were dominant 10 species in the study area .The total basal area of the species was 3658175cm/km^{-1} out of these *Tamarindus indica* (11.34%) *followed by Shorea robusta* (9.20%), *Mangifera indica* (7.40%), *Anogeissus latifolia and Xylia xylocarpa* (3.95%), *Lannea coromandelica* (3.49%), *Terminalia alata* (3.30%), *Terminalia bellerica* (3.17%), *Dalbergia paniculata* (2.89%) were dominant in vizianagaram district. Important Value Index (IVI) of individual tree species encountered in the study area *Tamarindus indica* as the most important species followed by *Shorea robusta, Mangifera indica, Xylia xylocarpa, Anogeissus latifolia, Lannea coromandelica, Cleistanthus collinus, Dalbergia paniculata, Wrightia tinctoria , Terminalia alata etc* were recorded in (Table-5.)

Frequency of species

The analysis on the frequency classes of species encountered in the area revealed the following results, A class was represented by 109 species followed by 33 under B, 16 under C and 3 under D, 4 species under E this results showing the heterogeneity of vegetation in the both sites (Table-4).

Frequency formulae

From the results obtained it is clearly established that most of the species encountered in site I& II fall under A, B,C , D and E frequency classes and hence the vegetation is relatively heterogeneous .i.e. (A>B>C>D<E). A total of 8442 individuals were recorded in study area respectively. The height and girth based analysis were presented in (Fig: 1 and 2). Fig:1 Shows the height based analysis in different groups (0 - 35 meters) at study in this study area maximum number of plants (5659)were reported in 5-10 meters category followed by 11 - 15(1395) and 0- 5 (1135) groups . From 16 - 20 meters category onwards number of plants decreased with a minimum of plants (5) was present in 31 - 35 meters height category. Few species in this area attained maximum height of 35 meters plant populations in study site was segregated based on this girth classes, and identified the maximum number of plants belongs to the specific groups .Fig-2 Shows the presence of plant species in different girth groups in this study area maximum number of plants (2079) were reported in 30 - 49 cm girth class , followed by 2046 plants at 50 - 69 cm , 1598 plants at 0 - 29 cm girth class , minimum number of plants (546) were present at 90 - 119 cm girth class. Important Value Index (IVI) was divided for 165 species at study area Fig -3 Shows the highest important value index for 10 species at study area , the highest important value index for 10 species, out of 165 species maximum IVI value was obtained for *Tamarindus indica* (15.60) and minimum value for *Terminalia alata* (7.13) .

Figure 1. Height based analysis

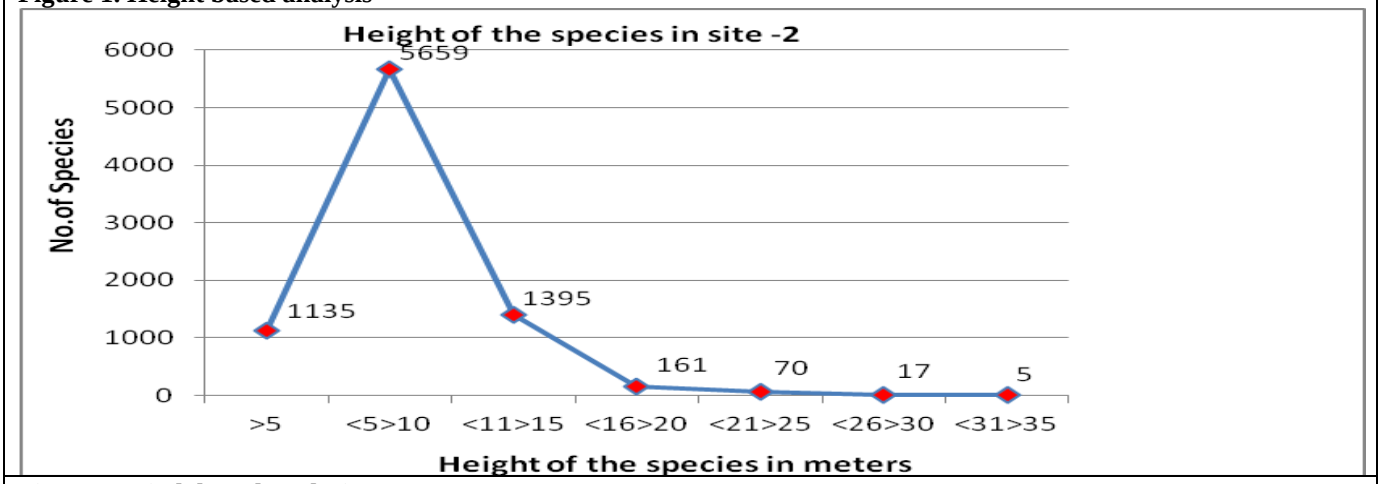


Figure 2. Girth based analysis

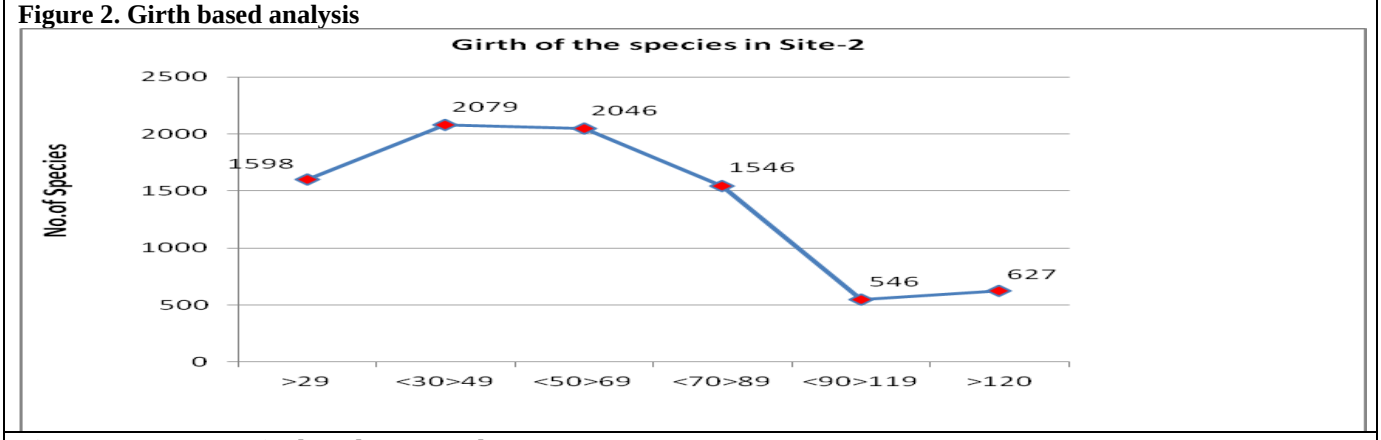
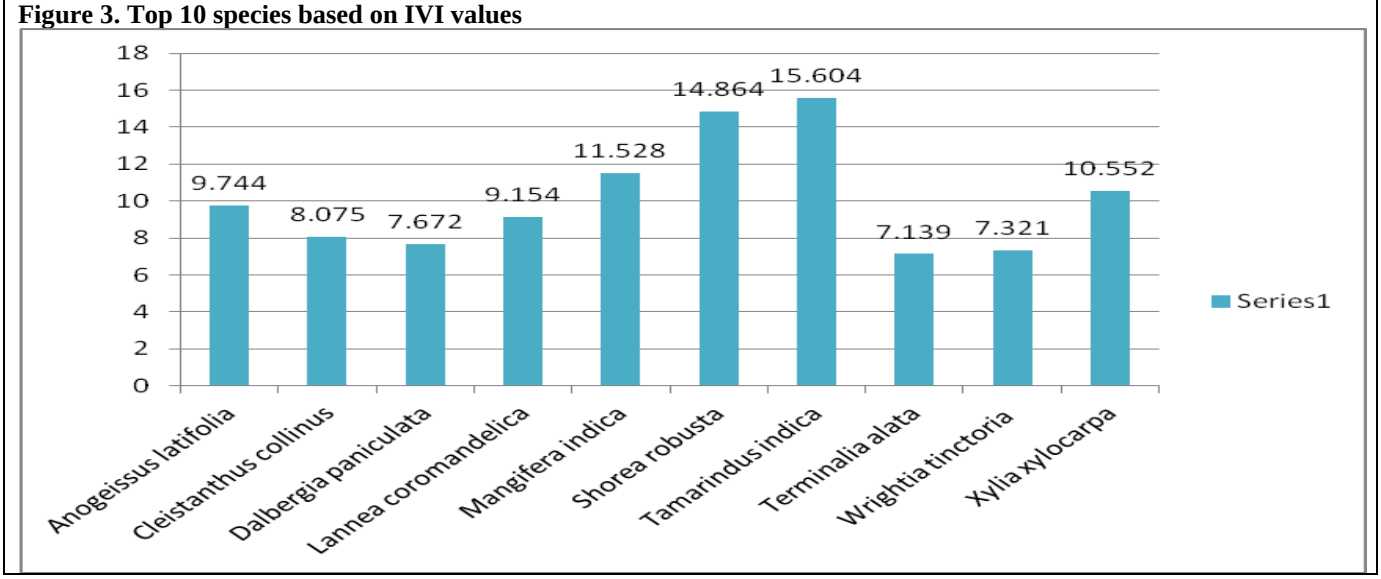


Figure 3. Top 10 species based on IVI values



DISCUSSION

Phytosociological investigations were carried out in Vizianagaram districts of Andhra Pradesh information collected in this area were tabulated .The analysis was made in the study area, to collect the data on the dominant families. Mimosaceae, Euphorbiaceae, Moraceae, Rubiaceae, Verbenaceae and Fabaceae dominating families the study area. In the present study, the basal area for tree species 3658175.717 cm^2/ m^2 in respectively.

More basal area in study area may be attributed to higher plant density.

The Important Value Index (IVI) was calculated to indicate the ecological influence of each species in the forest. It is also used to recognize the pattern of association of dominant species in a community [9,10]. The dominant species were *Shorea robusta, Xylia xylocarpa, Wrightia tinctoria, Cleistanthus collinus, Lannea coromandelica, Anogeissus latifolia and Dalbergia paniculata* etc. Tree species richness varied according to the disturbance gradient in the different stands, a total of 8442 individuals, belonging to 165 species, 119 genera among 50 families from 66 line transects in respectively

In the present study species richness in study sites are also correlated with the taxonomical studies, most of the trees show random distribution and was lowered when compared to that of tropical forests of Indian Eastern Ghats and Western Ghats i.e., the number of species in Nallamalias 69 [11], Kolli hills 25-56 [12], Kalarayan hills 42-47 [13], Shervarayan hills 33-50 [14], the sacred groves of Kerela 14-23 [15], Thirumani Kuzhi sacred groove 38 [16].

The predominance of clumped dispersion of trees obtained in the present study is consistent with the results of various other tropical forests. Uniform patterns were rare in the present study sites as reported in many other tropical studies, irrespective of geographical locations of forest type. the total density of trees is 127.909 plant/ m^2 density ranges from 0.015- 7.061 plant /m^2 is comparable to other tropical forests in India such as Kalrayan hills, Eastern Ghats 367 to 667 stems ha-^{1} [17], three sites in the tropical evergreen forest of Southern Western Ghats namely, Kalakad 574-915 stems ha-^{1}, Kalakad-Mundanthural area 583 stems ha-^{1} [18] and Mylodai, Courtallum reserve forest 482 stems ha^{-1} and that of Uppangala forest in central Western Ghats 635 [19]. Species rarity is low when compared with other tropical forests. *Saraca asoca* is a threatened plant found in Punyagiri hill in the study area with 8 to 10 individuals.

Other threatened tree taxa are *Ougeinia oogeinensis, Pterocarpus marsupium, Santalam album, Shorea robusta Litsea deccanensis Schrebera swietenioides,* and rare plants like *Dalbergia latifolla, Sterculia villosa, Lagerstroemia parviflora, Butea monosperma Callicarpa tomentosa, Capparis grandis, Givotia moluccana Hugonia mystax Maytenus emarginata, Commiphora caudata and Vitex pinnata* are found in study area Calculations of IVI have helped in understanding the ecological significance of the species in the respective vegetation types.

Table 1. Taxonomical analysis of the species

Taxa	Families	Genus	Species
Dicotyledons	48	114	160
Polypetalae	32	69	90
Gamopetalae	13	30	44
Monochlamydae	3	15	26
Monocotyledons	2	5	5
Total	**50**	**119**	**165**

Table 2. Dominant Families With Reference To Species Number

S.No	Family	Species No	Genus No
1	Rubiaceae	13	9
2	Mimosaceae	13	7
3	Euphorbiaceae	12	10
4	Moraceae	12	3
5	Fabaceae	9	6
6	Verbenaceae	9	5
7	Rutaceae	6	6
8	Anacardiaceae	6	5
9	Combretaceae	6	2
10	Ebenaceae	6	2
11	Apocynaceae	5	4
12	Sterculiaceae	5	3
13	Caesalpiniaceae	4	4
14	Annonaceae	4	3
15	Burseraceae	3	3
16	Meliaceae	3	3
17	Arecaceae	3	3
18	Flacourtiaceae	3	2
19	Rhamnaceae	3	1
20	Bombacaceae	2	2
21	Sapindaceae	2	2
22	Myrtaceae	2	2
23	Barringtoniaceae	2	2
24	Sapotaceae	2	2
25	Ulmaceae	2	2
26	Poaceae	2	2
27	Loganiaceae	2	1
28	Lythraceae	2	1

29	Dilleniaceae	1	1
30	Magnoliaceae	1	1
31	Capparaceae	1	1
32	Cochlospermaceae	1	1
33	Dipterocarpaceae	1	1
34	Malvaceae	1	1
35	Tiliaceae	1	1
36	Linaceae	1	1
37	Erythroxylaceae	1	1
38	Simaroubaceae	1	1
39	Ochnaceae	1	1
40	Flindersiaceae	1	1
41	Celastraceae	1	1
42	Melastomataceae	1	1
43	Alangiaceae	1	1
44	Oleaceae	1	1
45	Nyctanthaceae	1	1
46	Cordiaceae	1	1
47	Bignoniaceae	1	1
48	Lauraceae	1	1
49	Hernandiaceae	1	1
50	Santalaceae	1	1

Table 3. Species, Genera and Families of the Study Area

	No .of Species Generas, Families & Number of Individuals	**Total study area**
Number of species	165	165
Number of genera	119	119
Number of families	50	50
Number of individuals	8442	13186

Table 4. Frequency Classes

S. No	**Frequency classes**	**Studyarea**
1	A: 01-20	109
2	B:21-40	33
3	C:41-60	16
4	D:61-80	3
5	E:81-100	4
6	Total	165

Table 5. Phytosociological attributes of tree species in study Area

S.No	Name of the species	Sum of No.of Individuals	Sum of Basal area	TOI	Frequency	Density	Rel. freq	Rel. den	Rel. dom	IVI	ni	ni/N	∑(ni/N)2	ln ni/N	ni/N*lnni/N
1	*Acacia auriculiformis*	2	874.522293	2	3.030	0.030	0.091	0.024	0.024	0.139	2	0.000237	5.61267E-08	-8.34783	-0.00197769
2	*Acacia chundra*	27	2044.585987	13	19.697	0.409	0.592	0.320	0.056	0.967	27	0.003198	1.02291E-05	-5.74514	-0.01837464
3	*Acacia leucophloea*	72	9223.566879	25	37.879	1.091	1.138	0.853	0.252	2.243	72	0.008529	7.27402E-05	-4.76431	-0.04063376
4	*Acacia nilotica*	8	1902.866242	4	6.061	0.121	0.182	0.095	0.052	0.329	8	0.000948	8.98027E-07	-6.96153	-0.00659705
5	*Aegle marmelos*	52	10930.8121	26	39.394	0.788	1.183	0.616	0.299	2.098	52	0.00616	3.79416E-05	-5.08973	-0.0313511
6	*Ailanthus excelsa*	19	6878.980892	8	12.121	0.288	0.364	0.225	0.188	0.777	19	0.002251	5.06543E-06	-6.09654	-0.01372118
7	*Alangium salvifolium*	90	17943.86943	23	34.848	1.364	1.047	1.066	0.491	2.603	90	0.010661	0.000113657	-4.54116	-0.04841327
8	*Albizia amara*	17	5639.092357	6	9.091	0.258	0.273	0.201	0.154	0.629	17	0.002014	4.05515E-06	-6.20776	-0.01250082
9	*Albizia chinensis*	16	9730.812102	12	18.182	0.242	0.546	0.190	0.266	1.002	16	0.001895	3.59211E-06	-6.26839	-0.01188038
10	*Albizia lebbeck*	2	1046.178344	2	3.030	0.030	0.091	0.024	0.029	0.143	2	0.000237	5.61267E-08	-8.34783	-0.00197769
11	*Albizia odoratissima*	105	55087.65924	19	28.788	1.591	0.865	1.244	1.506	3.614	105	0.012438	0.000154699	-4.38701	-0.05456485
12	*Alstonia venenata*	8	1161.863057	5	7.576	0.121	0.228	0.095	0.032	0.354	8	0.000948	8.98027E-07	-6.96153	-0.00659705
13	*Anacardium occidentale*	22	10942.83439	9	13.636	0.333	0.410	0.261	0.299	0.969	22	0.002606	6.79133E-06	-5.94993	-0.01550563
14	*Annona squamosa*	9	1940.605096	5	7.576	0.136	0.228	0.107	0.053	0.387	9	0.001066	1.13657E-06	-6.84375	-0.00729611
15	*Anogeissus acuminata*	47	22061.38535	13	19.697	0.712	0.592	0.557	0.603	1.752	47	0.005567	3.0996E-05	-5.19083	-0.02889942
16	*Anogeissus latifolia*	289	144625.9554	52	78.788	4.379	2.367	3.423	3.953	9.744	289	0.034234	0.001171939	-3.37455	-0.1155229
17	*Antidesma ghaesembilla*	8	1700.955414	3	4.545	0.121	0.137	0.095	0.046	0.278	8	0.000948	8.98027E-07	-6.96153	-0.00659705
18	*Artocarpus heterophyllus*	31	17299.1242	12	18.182	0.470	0.546	0.367	0.473	1.386	31	0.003672	1.34844E-05	-5.60699	-0.02058951
19	*Atalantia monophylla*	17	20145.85987	9	13.636	0.258	0.410	0.201	0.551	1.162	17	0.002014	4.05515E-06	-6.20776	-0.01250082
20	*Azadirachta indica*	50	14693.3121	19	28.788	0.758	0.865	0.592	0.402	1.859	50	0.005923	3.50792E-05	-5.12895	-0.03037759
21	*Bambusa arundinacea*	16	51045.93949	12	18.182	0.242	0.546	0.190	1.395	2.131	16	0.001895	3.59211E-06	-6.26839	-0.01188038
22	*Barringatonia acutangula*	12	9058.359873	8	12.121	0.182	0.364	0.142	0.248	0.754	12	0.001421	2.02056E-06	-6.55607	-0.00931922
23	*Bauhinia racemosa*	26	6093.869427	12	18.182	0.394	0.546	0.308	0.167	1.021	26	0.00308	9.48541E-06	-5.78288	-0.01781033
24	*Bombax ceiba*	31	26311.6242	19	28.788	0.470	0.865	0.367	0.719	1.951	31	0.003672	1.34844E-05	-5.60699	-0.02058951
25	*Borassus flabellifer*	16	13144.66561	8	12.121	0.242	0.364	0.190	0.359	0.913	16	0.001895	3.59211E-06	-6.26839	-0.01188038
26	*Bridelia monoica*	14	4591.480892	9	13.636	0.212	0.410	0.166	0.126	0.701	14	0.001658	2.75021E-06	-6.40192	-0.01061678

27	*Bridelia montana*	76	1835.987261	28	42.424	1.152	1.274	0.900	0.050	2.225	76	0.009003	8.10469E-05	-4.71024	-0.04240445
28	*Bridelia retusa*	184	77111.6242	24	36.364	2.788	1.092	2.180	2.108	5.380	184	0.021796	0.000475056	-3.82604	-0.08339151
29	*Buchanania axillaris*	9	4676.990446	6	9.091	0.136	0.273	0.107	0.128	0.508	9	0.001066	1.13657E-06	-6.84375	-0.00729611
30	*Buchanania lanzan*	96	14725.07962	16	24.242	1.455	0.728	1.137	0.403	2.268	96	0.011372	0.000129316	-4.47663	-0.05090691
31	*Butea monosperma*	3	363.5350318	3	4.545	0.045	0.137	0.036	0.010	0.182	3	0.000355	1.26285E-07	-7.94236	-0.00282245
32	*Callicarpa arborea*	3	201.1146497	2	3.030	0.045	0.091	0.036	0.005	0.132	3	0.000355	1.26285E-07	-7.94236	-0.00282245
33	*Callicarpa tomentosa*	1	147.2133758	1	1.515	0.015	0.046	0.012	0.004	0.061	1	0.000118	1.40317E-08	-9.04097	-0.00107095
34	*Canthium dicoccum*	20	2167.834395	14	21.212	0.303	0.637	0.237	0.059	0.933	20	0.002369	5.61267E-06	-6.04524	-0.01432182
35	*Canthium parviflorum*	15	1030.732484	9	13.636	0.227	0.410	0.178	0.028	0.616	15	0.001777	3.15713E-06	-6.33292	-0.01125253
36	*Capparis grandis*	1	25.79617834	1	1.515	0.015	0.046	0.012	0.001	0.058	1	0.000118	1.40317E-08	-9.04097	-0.00107095
37	*Careya arborea*	44	12353.82166	21	31.818	0.667	0.956	0.521	0.338	1.815	44	0.005212	2.71653E-05	-5.25678	-0.02739855
38	*Carissa spinarum*	2	1024.522293	2	3.030	0.030	0.091	0.024	0.028	0.143	2	0.000237	5.61267E-08	-8.34783	-0.00197769
39	*Caryota urens*	77	71783.35987	15	22.727	1.167	0.683	0.912	1.962	3.557	77	0.009121	8.31938E-05	-4.69717	-0.04284317
40	*Casearia elliptica*	20	1353.980892	12	18.182	0.303	0.546	0.237	0.037	0.820	20	0.002369	5.61267E-06	-6.04524	-0.01432182
41	*Cassia fistula*	138	22752.30892	24	36.364	2.091	1.092	1.635	0.622	3.349	138	0.016347	0.000267219	-4.11372	-0.06724633
42	*Catunaregum spinosa*	18	407.0859873	6	9.091	0.273	0.273	0.213	0.011	0.497	18	0.002132	4.54626E-06	-6.1506	-0.01311429
43	*Ceiba pentandra*	12	21663.8535	3	4.545	0.182	0.137	0.142	0.592	0.871	12	0.001421	2.02056E-06	-6.55607	-0.00931922
44	*Chloroxylon swietenia*	227	62511.6242	56	84.848	3.439	2.549	2.689	1.709	6.947	227	0.026889	0.000723038	-3.61602	-0.09723259
45	*Cipadessa baccifera*	10	1950.398089	3	4.545	0.152	0.137	0.118	0.053	0.308	10	0.001185	1.40317E-06	-6.73839	-0.00798198
46	*Citrus aruntium*	4	286.544586	2	3.030	0.061	0.091	0.047	0.008	0.146	4	0.000474	2.24507E-07	-7.65468	-0.00362695
47	*Cleistanthus collinus*	338	59008.51911	54	81.818	5.121	2.458	4.004	1.613	8.075	338	0.040038	0.001603034	-3.21793	-0.12883912
48	*Cochlospermum religiosum*	139	32888.29618	24	36.364	2.106	1.092	1.647	0.899	3.638	139	0.016465	0.000271106	-4.1065	-0.06761473
49	*Commiphora caudata*	7	1637.022293	3	4.545	0.106	0.137	0.083	0.045	0.264	7	0.000829	6.87552E-07	-7.09506	-0.00588314
50	*Cordia dichotoma*	11	2717.675159	5	7.576	0.167	0.228	0.130	0.074	0.432	11	0.001303	1.69783E-06	-6.64308	-0.00865599
51	*Dalbergia latifolia*	73	20060.11146	12	18.182	1.106	0.546	0.865	0.548	1.959	73	0.008647	7.47748E-05	-4.75052	-0.04107884
52	*Dalbergia paniculata*	266	105452.7866	36	54.545	4.030	1.639	3.151	2.883	7.672	266	0.031509	0.000992825	-3.45748	-0.1089421
53	*Dalbergia sissoo*	17	6426.83121	8	12.121	0.258	0.364	0.201	0.176	0.741	17	0.002014	4.05515E-06	-6.20776	-0.01250082
54	*Dendrocalamus strictus*	6	9622.292994	3	4.545	0.091	0.137	0.071	0.263	0.471	6	0.000711	5.0514E-07	-7.24922	-0.00515225

55	*Dichrostachys cinerea*	26	2883.757962	12	18.182	0.394	0.546	0.308	0.079	0.933	26	0.00308	9.48541E-06	-5.78288	-0.01781033
56	*Dillenia pentagyna*	27	7062.340764	15	22.727	0.409	0.683	0.320	0.193	1.196	27	0.003198	1.02291E-05	-5.74514	-0.01837464
57	*Diospyros chloroxylon*	47	5579.299363	19	28.788	0.712	0.865	0.557	0.153	1.574	47	0.005567	3.0996E-05	-5.19083	-0.02889942
58	*Diospyros melanoxylon*	115	28047.45223	24	36.364	1.742	1.092	1.362	0.767	3.221	115	0.013622	0.000185569	-4.29604	-0.05852225
59	*Diospyros montana*	95	29218.78981	24	36.364	1.439	1.092	1.125	0.799	3.016	95	0.011253	0.000126636	-4.4871	-0.05049447
60	*Diospyros peregrina*	39	56461.70382	13	19.697	0.591	0.592	0.462	1.543	2.597	39	0.00462	2.13422E-05	-5.37741	-0.02484235
61	*Diospyros sylvatica*	194	34864.17197	28	42.424	2.939	1.274	2.298	0.953	4.526	194	0.02298	0.000528096	-3.77312	-0.08670748
62	*Drypetes roxburghii*	6	2922.292994	3	4.545	0.091	0.137	0.071	0.080	0.288	6	0.000711	5.0514E-07	-7.24922	-0.00515225
63	*Erythrina variegata*	7	10318.39172	3	4.545	0.106	0.137	0.083	0.282	0.502	7	0.000829	6.87552E-07	-7.09506	-0.00588314
64	*Erythrina suberosa*	10	3951.433121	4	6.061	0.152	0.182	0.118	0.108	0.409	10	0.001185	1.40317E-06	-6.73839	-0.00798198
65	*Erythroxylum monogynum*	8	451.3535032	3	4.545	0.121	0.137	0.095	0.012	0.244	8	0.000948	8.98027E-07	-6.96153	-0.00659705
66	*Eucalyptus globulus*	5	1085.589172	2	3.030	0.076	0.091	0.059	0.030	0.180	5	0.000592	3.50792E-07	-7.43154	-0.00440153
67	*Ficus mollis*	23	24292.43631	10	15.152	0.348	0.455	0.272	0.664	1.392	23	0.002724	7.42275E-06	-5.90548	-0.01608932
68	*Ficus arnottiana*	6	1668.471338	3	4.545	0.091	0.137	0.071	0.046	0.253	6	0.000711	5.0514E-07	-7.24922	-0.00515225
69	*Ficus benghalensis*	7	7873.646497	2	3.030	0.106	0.091	0.083	0.215	0.389	7	0.000829	6.87552E-07	-7.09506	-0.00588314
70	*Ficus benjamina*	6	1622.611465	4	6.061	0.091	0.182	0.071	0.044	0.297	6	0.000711	5.0514E-07	-7.24922	-0.00515225
71	*Ficus hispida*	17	2343.789809	12	18.182	0.258	0.546	0.201	0.064	0.812	17	0.002014	4.05515E-06	-6.20776	-0.01250082
72	*Ficus microcarpa*	5	880.1751592	3	4.545	0.076	0.137	0.059	0.024	0.220	5	0.000592	3.50792E-07	-7.43154	-0.00440153
73	*Ficus racemosa*	16	5576.035032	6	9.091	0.242	0.273	0.190	0.152	0.615	16	0.001895	3.59211E-06	-6.26839	-0.01188038
74	*Ficus religiosa*	16	14190.20701	8	12.121	0.242	0.364	0.190	0.388	0.942	16	0.001895	3.59211E-06	-6.26839	-0.01188038
75	*Ficus semicordata*	10	1355.652866	5	7.576	0.152	0.228	0.118	0.037	0.383	10	0.001185	1.40317E-06	-6.73839	-0.00798198
76	*Ficus tinctorea*	3	1066.878981	2	3.030	0.045	0.091	0.036	0.029	0.156	3	0.000355	1.26285E-07	-7.94236	-0.00282245
77	*Firmiana colorata*	34	14047.13376	14	21.212	0.515	0.637	0.403	0.384	1.424	34	0.004027	1.62206E-05	-5.51461	-0.02221001
78	*Flacourtia indica*	5	489.2515924	3	4.545	0.076	0.137	0.059	0.013	0.209	5	0.000592	3.50792E-07	-7.43154	-0.00440153
79	*Flacourtia jangomas*	9	1042.754777	6	9.091	0.136	0.273	0.107	0.029	0.408	9	0.001066	1.13657E-06	-6.84375	-0.00729611
80	*Gardenia gummifera*	5	595.8598726	2	3.030	0.076	0.091	0.059	0.016	0.167	5	0.000592	3.50792E-07	-7.43154	-0.00440153
81	*Gardenia latifolia*	88	20478.74204	24	36.364	1.333	1.092	1.042	0.560	2.695	88	0.010424	0.000108661	-4.56364	-0.04757168
82	*Garuga pinnata*	141	60787.89809	29	43.939	2.136	1.320	1.670	1.662	4.652	141	0.016702	0.000278964	-4.09221	-0.068349

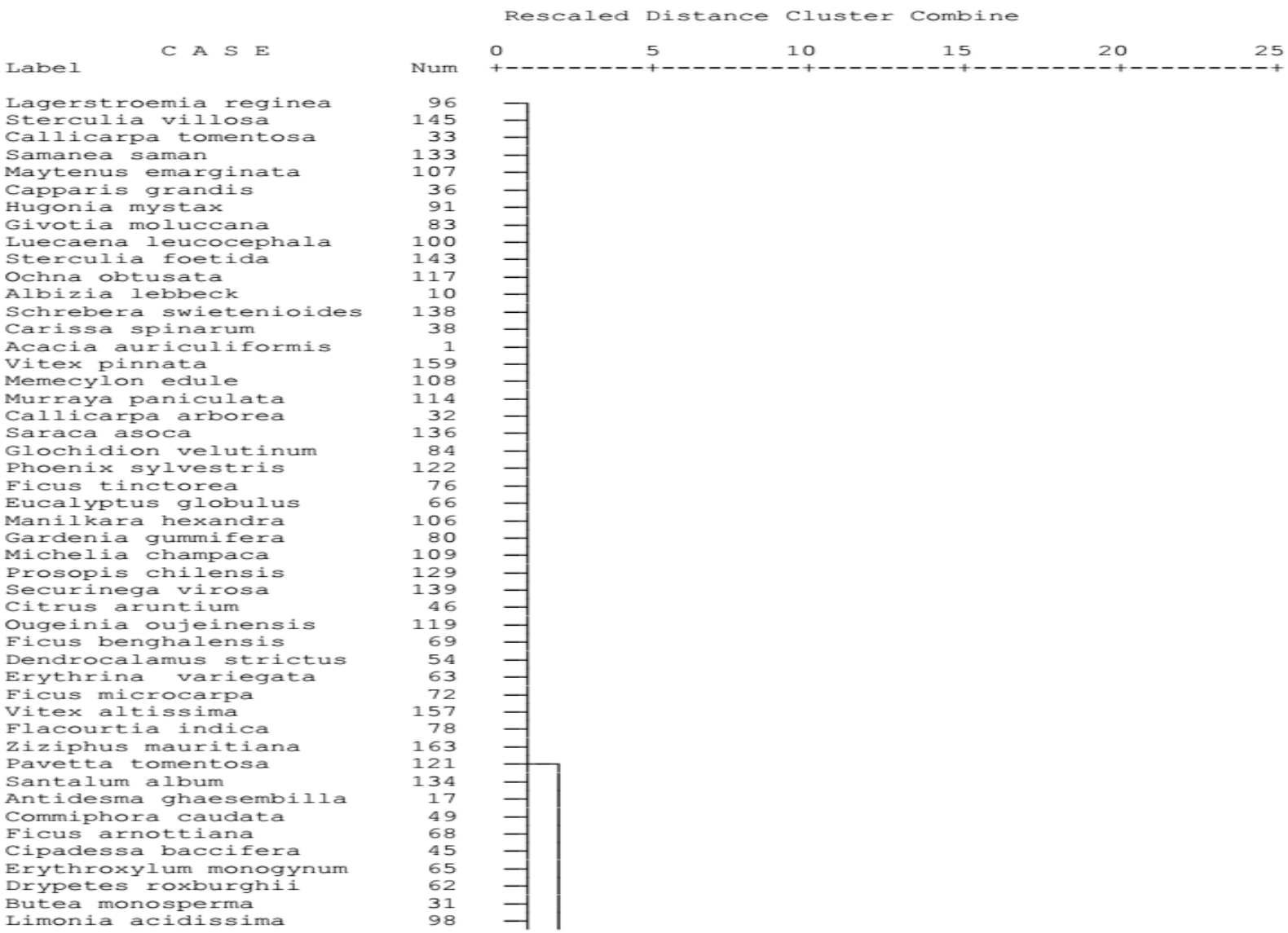
83	*Givotia moluccana*	1	718.5509554	1	1.515	0.015	0.046	0.012	0.020	0.077	1	0.000118	1.40317E-08	-9.04097	-0.00107095
84	*Glochidion velutinum*	3	366.9585987	2	3.030	0.045	0.091	0.036	0.010	0.137	3	0.000355	1.26285E-07	-7.94236	-0.00282245
85	*Gmelina arborea*	37	7278.980892	14	21.212	0.561	0.637	0.438	0.199	1.274	37	0.004383	1.92094E-05	-5.43006	-0.02379911
86	*Grewia tiliaefolia*	125	30042.27707	24	36.364	1.894	1.092	1.481	0.821	3.394	125	0.014807	0.000219245	-4.21266	-0.06237652
87	*Gyrocarpus americanus*	16	878.7420382	6	9.091	0.242	0.273	0.190	0.024	0.487	16	0.001895	3.59211E-06	-6.26839	-0.01188038
88	*Haldinia cordifolia*	30	9793.869427	8	12.121	0.455	0.364	0.355	0.268	0.987	30	0.003554	1.26285E-05	-5.63978	-0.02004185
89	*Holarrhena pubescens*	16	312.6592357	6	9.091	0.242	0.273	0.190	0.009	0.471	16	0.001895	3.59211E-06	-6.26839	-0.01188038
90	*Holoptelea integrifolia*	26	20980.89172	9	13.636	0.394	0.410	0.308	0.574	1.291	26	0.00308	9.48541E-06	-5.78288	-0.01781033
91	*Hugonia mystax*	1	31.84713376	1	1.515	0.015	0.046	0.012	0.001	0.058	1	0.000118	1.40317E-08	-9.04097	-0.00107095
92	*Hymenodictyon orixense*	16	4917.675159	6	9.091	0.242	0.273	0.190	0.134	0.597	16	0.001895	3.59211E-06	-6.26839	-0.01188038
93	*Ixora arborea*	32	1560.66879	12	18.182	0.485	0.546	0.379	0.043	0.968	32	0.003791	1.43684E-05	-5.57524	-0.02113334
94	*Kydia calycina*	11	2530.652866	9	13.636	0.167	0.410	0.130	0.069	0.609	11	0.001303	1.69783E-06	-6.64308	-0.00865599
95	*Lagerstroemia parviflora*	76	35491.00318	29	43.939	1.152	1.320	0.900	0.970	3.190	76	0.009003	8.10469E-05	-4.71024	-0.04240445
96	*Lagerstroemia reginea*	1	240.843949	1	1.515	0.015	0.046	0.012	0.007	0.064	1	0.000118	1.40317E-08	-9.04097	-0.00107095
97	*Lannea coromandelica*	294	127535.828	48	72.727	4.455	2.185	3.483	3.486	9.154	294	0.034826	0.001212841	-3.35739	-0.1169242
98	*Limonia acidissima*	8	3885.429936	3	4.545	0.121	0.137	0.095	0.106	0.338	8	0.000948	8.98027E-07	-6.96153	-0.00659705
99	*Litsea deccanensis*	10	966.7993631	5	7.576	0.152	0.228	0.118	0.026	0.372	10	0.001185	1.40317E-06	-6.73839	-0.00798198
100	*Luecaena leucocephala*	2	281.9267516	2	3.030	0.030	0.091	0.024	0.008	0.122	2	0.000237	5.61267E-08	-8.34783	-0.00197769
101	*Maba buxifolia*	17	1934.872611	6	9.091	0.258	0.273	0.201	0.053	0.527	17	0.002014	4.05515E-06	-6.20776	-0.01250082
102	*Macaranga peltata*	16	3440.843949	8	12.121	0.242	0.364	0.190	0.094	0.648	16	0.001895	3.59211E-06	-6.26839	-0.01188038
103	*Madhuca longifolia*	114	71502.94586	26	39.394	1.727	1.183	1.350	1.955	4.488	114	0.013504	0.000182356	-4.30478	-0.0581313
104	*Mallotus philippensis*	66	14101.43312	23	34.848	1.000	1.047	0.782	0.385	2.214	66	0.007818	6.11219E-05	-4.85132	-0.03792787
105	*Mangifera indica*	213	269465.1274	36	54.545	3.227	1.639	2.523	7.366	11.528	213	0.025231	0.000636603	-3.67968	-0.09284202
106	*Manilkara hexandra*	5	917.0382166	2	3.030	0.076	0.091	0.059	0.025	0.175	5	0.000592	3.50792E-07	-7.43154	-0.00440153
107	*Maytenus emarginata*	1	103.1847134	1	1.515	0.015	0.046	0.012	0.003	0.060	1	0.000118	1.40317E-08	-9.04097	-0.00107095
108	*Memecylon edule*	3	104.2993631	2	3.030	0.045	0.091	0.036	0.003	0.129	3	0.000355	1.26285E-07	-7.94236	-0.00282245
109	*Michelia champaca*	4	1032.006369	2	3.030	0.061	0.091	0.047	0.028	0.167	4	0.000474	2.24507E-07	-7.65468	-0.00362695
110	*Miliusa tomentosa*	10	6983.121019	4	6.061	0.152	0.182	0.118	0.191	0.491	10	0.001185	1.40317E-06	-6.73839	-0.00798198

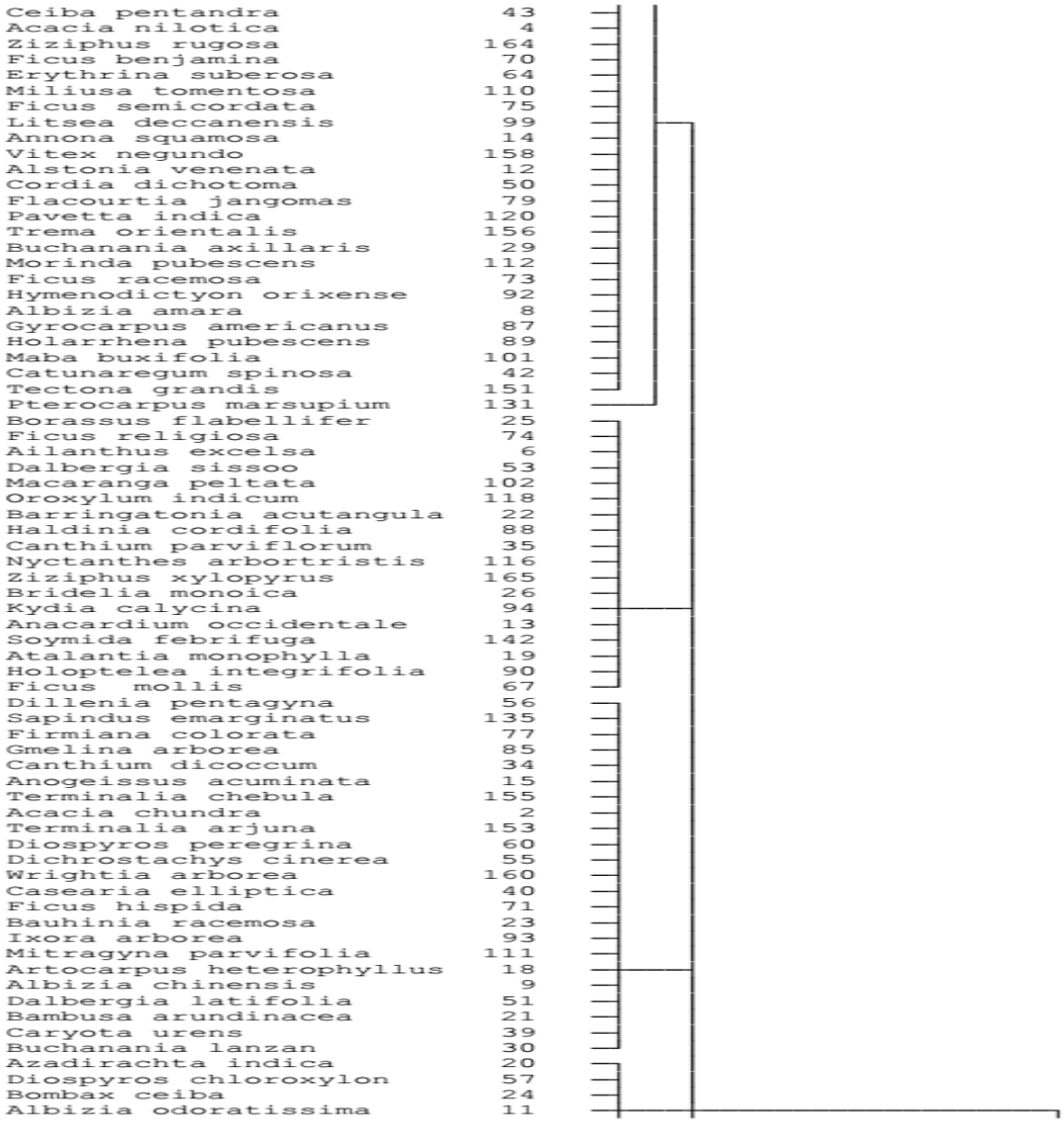
111	*Mitragyna parvifolia*	29	10261.94268	12	18.182	0.439	0.546	0.344	0.281	1.170	29	0.003435	1.18006E-05	-5.67368	-0.01949025
112	*Morinda pubescens*	6	3290.525478	6	9.091	0.091	0.273	0.071	0.090	0.434	6	0.000711	5.0514E-07	-7.24922	-0.00515225
113	*Morinda tinctoria*	113	21555.49363	36	54.545	1.712	1.639	1.339	0.589	3.566	113	0.013385	0.00017917	-4.31359	-0.05773932
114	*Murraya paniculata*	3	123.7261146	2	3.030	0.045	0.091	0.036	0.003	0.130	3	0.000355	1.26285E-07	-7.94236	-0.00282245
115	*Naringi crenulata*	33	3814.888535	24	36.364	0.500	1.092	0.391	0.104	1.588	33	0.003909	1.52805E-05	-5.54447	-0.02167347
116	*Nyctanthes arbortristis*	17	2760.509554	9	13.636	0.258	0.410	0.201	0.075	0.686	17	0.002014	4.05515E-06	-6.20776	-0.01250082
117	*Ochna obtusata*	2	116.2420382	2	3.030	0.030	0.091	0.024	0.003	0.118	2	0.000237	5.61267E-08	-8.34783	-0.00197769
118	*Oroxylum indicum*	14	2317.27707	8	12.121	0.212	0.364	0.166	0.063	0.593	14	0.001658	2.75021E-06	-6.40192	-0.01061678
119	*Ougeinia oujeinensis*	4	2625.318471	2	3.030	0.061	0.091	0.047	0.072	0.210	4	0.000474	2.24507E-07	-7.65468	-0.00362695
120	*Pavetta indica*	8	780.0159236	6	9.091	0.121	0.273	0.095	0.021	0.389	8	0.000948	8.98027E-07	-6.96153	-0.00659705
121	*Pavetta tomentosa*	9	1748.566879	3	4.545	0.136	0.137	0.107	0.048	0.291	9	0.001066	1.13657E-06	-6.84375	-0.00729611
122	*Phoenix sylvestris*	3	526.3535032	2	3.030	0.045	0.091	0.036	0.014	0.141	3	0.000355	1.26285E-07	-7.94236	-0.00282245
123	*Phyllanthus emblica*	38	6126.512739	24	36.364	0.576	1.092	0.450	0.167	1.710	38	0.004501	2.02617E-05	-5.40339	-0.02432229
124	*Polyalthia cerasoides*	24	3958.200637	21	31.818	0.364	0.956	0.284	0.108	1.348	24	0.002843	8.08224E-06	-5.86292	-0.01666786
125	*Polyalthia subarosa*	28	984.9522293	21	31.818	0.424	0.956	0.332	0.027	1.314	28	0.003317	1.10008E-05	-5.70877	-0.01893456
126	*Pongamia pinnata*	48	27438.13694	26	39.394	0.727	1.183	0.569	0.750	2.502	48	0.005686	3.2329E-05	-5.16977	-0.02939459
127	*Premna latifolia*	31	1573.407643	23	34.848	0.470	1.047	0.367	0.043	1.457	31	0.003672	1.34844E-05	-5.60699	-0.02058951
128	*Premna tomentosa*	66	12905.25478	38	57.576	1.000	1.730	0.782	0.353	2.864	66	0.007818	6.11219E-05	-4.85132	-0.03792787
129	*Prosopis chilensis*	4	992.4363057	2	3.030	0.061	0.091	0.047	0.027	0.166	4	0.000474	2.24507E-07	-7.65468	-0.00362695
130	*Protium serratum*	108	37191.16242	35	53.030	1.636	1.593	1.279	1.017	3.889	108	0.012793	0.000163665	-4.35884	-0.05576345
131	*Pterocarpus marsupium*	146	39028.90127	3	4.545	2.212	0.137	1.729	1.067	2.933	146	0.017294	0.000299099	-4.05737	-0.07017007
132	*Pterospermum xylocarpum*	184	44261.94268	37	56.061	2.788	1.684	2.180	1.210	5.074	184	0.021796	0.000475056	-3.82604	-0.08339151
133	*Samanea saman*	1	183.4394904	1	1.515	0.015	0.046	0.012	0.005	0.062	1	0.000118	1.40317E-08	-9.04097	-0.00107095
134	*Santalum album*	9	2202.468153	3	4.545	0.136	0.137	0.107	0.060	0.303	9	0.001066	1.13657E-06	-6.84375	-0.00729611
135	*Sapindus emarginatus*	21	4641.56051	15	22.727	0.318	0.683	0.249	0.127	1.058	21	0.002488	6.18797E-06	-5.99645	-0.01491655
136	*Saraca asoca*	3	242.8343949	2	3.030	0.045	0.091	0.036	0.007	0.133	3	0.000355	1.26285E-07	-7.94236	-0.00282245
137	*Schleichera oleosa*	55	34827.86624	45	68.182	0.833	2.048	0.652	0.952	3.652	55	0.006515	4.24458E-05	-5.03364	-0.03279439
138	*Schrebera swietenioides*	2	1115.047771	2	3.030	0.030	0.091	0.024	0.030	0.145	2	0.000237	5.61267E-08	-8.34783	-0.00197769

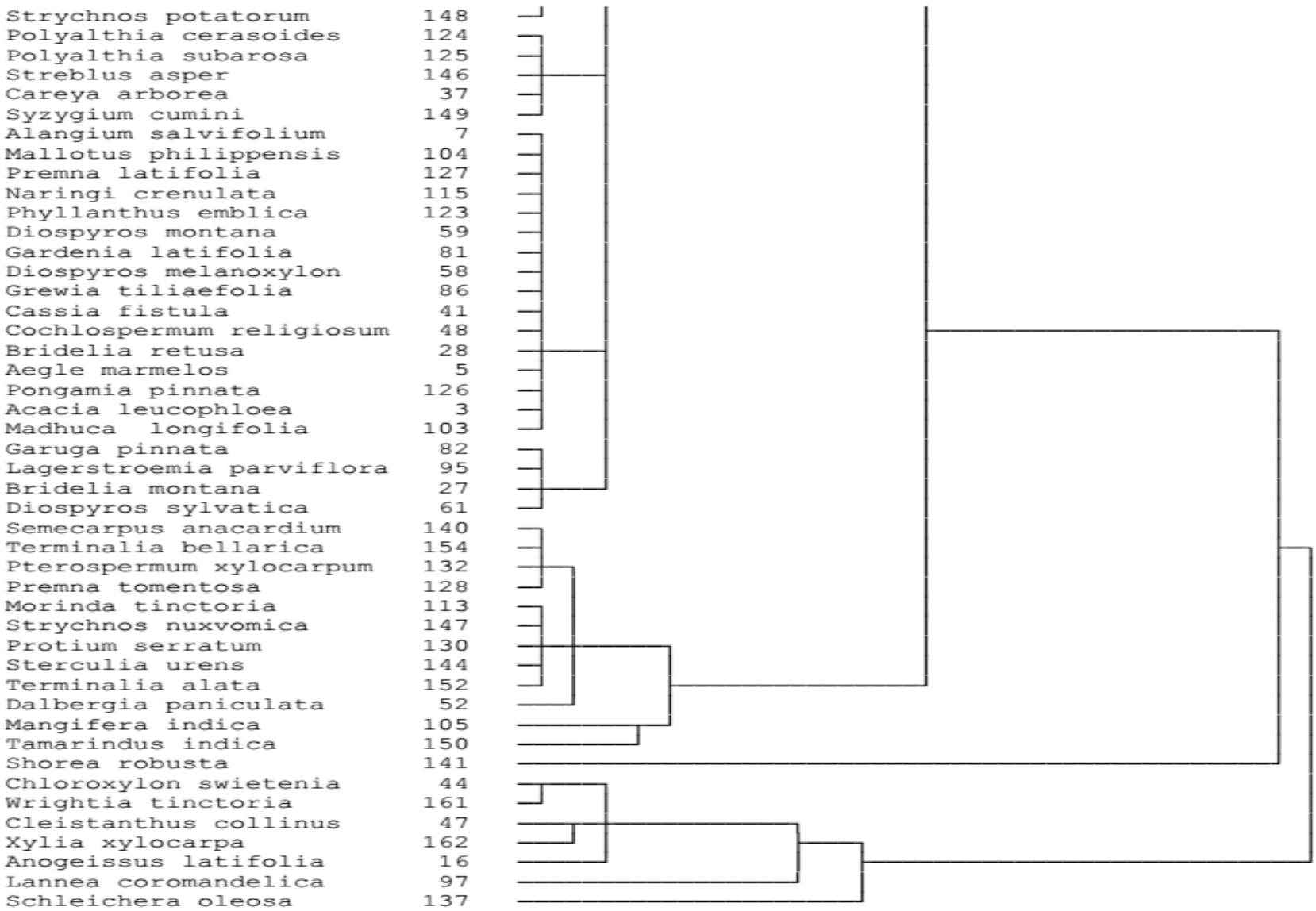
139	*Securinega virosa*	4	1284.55414	2	3.030	0.061	0.091	0.047	0.035	0.174	4	0.000474	2.24507E-07	-7.65468	-0.00362695
140	*Semecarpus anacardium*	135	59797.21338	38	57.576	2.045	1.730	1.599	1.635	4.963	135	0.015991	0.000255727	-4.1357	-0.06613592
141	*Shorea robusta*	466	335151.4331	4	6.061	7.061	0.182	5.520	9.162	14.864	466	0.0552	0.003047061	-2.89679	-0.1599033
142	*Soymida febrifuga*	18	7830.732484	9	13.636	0.273	0.410	0.213	0.214	0.837	18	0.002132	4.54626E-06	-6.1506	-0.01311429
143	*Sterculia foetida*	2	487.6592357	2	3.030	0.030	0.091	0.024	0.013	0.128	2	0.000237	5.61267E-08	-8.34783	-0.00197769
144	*Sterculia urens*	175	58834.79299	34	51.515	2.652	1.548	2.073	1.608	5.229	175	0.02073	0.00042972	-3.87619	-0.08035217
145	*Sterculia villosa*	1	249.6815287	1	1.515	0.015	0.046	0.012	0.007	0.064	1	0.000118	1.40317E-08	-9.04097	-0.00107095
146	*Streblus asper*	36	4043.630573	21	31.818	0.545	0.956	0.426	0.111	1.493	36	0.004264	1.8185E-05	-5.45746	-0.02327273
147	*Strychnos nuxvomica*	68	18897.13376	36	54.545	1.030	1.639	0.805	0.517	2.961	68	0.008055	6.48824E-05	-4.82147	-0.03883674
148	*Strychnos potatorum*	101	20125.07962	18	27.273	1.530	0.819	1.196	0.550	2.566	101	0.011964	0.000143137	-4.42585	-0.05295087
149	*Syzygium cumini*	35	15687.02229	21	31.818	0.530	0.956	0.415	0.429	1.799	35	0.004146	1.71888E-05	-5.48563	-0.02274306
150	*Tamarindus indica*	222	414693.1529	36	54.545	3.364	1.639	2.630	11.336	15.604	222	0.026297	0.000691537	-3.6383	-0.09567661
151	*Tectona grandis*	81	16548.16879	6	9.091	1.227	0.273	0.959	0.452	1.685	81	0.009595	9.20618E-05	-4.64653	-0.04458287
152	*Terminalia alata*	193	120912.3408	34	51.515	2.924	1.548	2.286	3.305	7.139	193	0.022862	0.000522666	-3.77828	-0.08637869
153	*Terminalia arjuna*	18	24859.71338	13	19.697	0.273	0.592	0.213	0.680	1.485	18	0.002132	4.54626E-06	-6.1506	-0.01311429
154	*Terminalia bellerica*	154	116003.1847	38	57.576	2.333	1.730	1.824	3.171	6.725	154	0.018242	0.000332775	-4.00402	-0.07304186
155	*Terminalia chebula*	36	14589.7293	13	19.697	0.545	0.592	0.426	0.399	1.417	36	0.004264	1.8185E-05	-5.45746	-0.02327273
156	*Trema orientalis*	11	1584.55414	6	9.091	0.167	0.273	0.130	0.043	0.447	11	0.001303	1.69783E-06	-6.64308	-0.00865599
157	*Vitex altissima*	5	1022.850318	3	4.545	0.076	0.137	0.059	0.028	0.224	5	0.000592	3.50792E-07	-7.43154	-0.00440153
158	*Vitex negundo*	9	1498.964968	5	7.576	0.136	0.228	0.107	0.041	0.375	9	0.001066	1.13657E-06	-6.84375	-0.00729611
159	*Vitex pinnata*	2	1341.56051	2	3.030	0.030	0.091	0.024	0.037	0.151	2	0.000237	5.61267E-08	-8.34783	-0.00197769
160	*Wrightia arborea*	23	3291.56051	12	18.182	0.348	0.546	0.272	0.090	0.909	23	0.002724	7.42275E-06	-5.90548	-0.01608932
161	*Wrightia tinctoria*	307	41522.92994	56	84.848	4.652	2.549	3.637	1.135	7.321	307	0.036366	0.001322471	-3.31413	-0.12052084
162	*Xylia xylocarpa*	350	144445.7803	54	81.818	5.303	2.458	4.146	3.949	10.552	350	0.041459	0.001718879	-3.18304	-0.13196689
163	*Ziziphus mauritiana*	6	456.0509554	3	4.545	0.091	0.137	0.071	0.012	0.220	6	0.000711	5.0514E-07	-7.24922	-0.00515225
164	*Ziziphus rugosa*	8	949.044586	4	6.061	0.121	0.182	0.095	0.026	0.303	8	0.000948	8.98027E-07	-6.96153	-0.00659705
165	*Ziziphus xylopyrus*	20	3605.89172	9	13.636	0.303	0.410	0.237	0.099	0.745	20	0.002369	5.61267E-06	-6.04524	-0.01432182
	Grand Total	**8442**	**3658175.717**		3328.788	127.909	**100.000**	**100.000**	**100.000**	**300.000**	**8442**				

Table 6. Hierarchical cluster analysis

Dendrogram using Single Linkage




Ceiba pentandra 43
Acacia nilotica 4
Ziziphus rugosa 164
Ficus benjamina 70
Erythrina suberosa 64
Miliusa tomentosa 110
Ficus semicordata 75
Litsea deccanensis 99
Annona squamosa 14
Vitex negundo 158
Alstonia venenata 12
Cordia dichotoma 50
Flacourtia jangomas 79
Pavetta indica 120
Trema orientalis 156
Buchanania axillaris 29
Morinda pubescens 112
Ficus racemosa 73
Hymenodictyon orixense 92
Albizia amara 8
Gyrocarpus americanus 87
Holarrhena pubescens 89
Maba buxifolia 101
Catunaregum spinosa 42
Tectona grandis 151
Pterocarpus marsupium 131
Borassus flabellifer 25
Ficus religiosa 74
Ailanthus excelsa 6
Dalbergia sissoo 53
Macaranga peltata 102
Oroxylum indicum 118
Barringatonia acutangula 22
Haldinia cordifolia 88
Canthium parviflorum 35
Nyctanthes arbortristis 116
Ziziphus xylopyrus 165
Bridelia monoica 26
Kydia calycina 94
Anacardium occidentale 13
Soymida febrifuga 142
Atalantia monophylla 19
Holoptelea integrifolia 90
Ficus mollis 67
Dillenia pentagyna 56
Sapindus emarginatus 135
Firmiana colorata 77
Gmelina arborea 85
Canthium dicoccum 34
Anogeissus acuminata 15
Terminalia chebula 155
Acacia chundra 2
Terminalia arjuna 153
Diospyros peregrina 60
Dichrostachys cinerea 55
Wrightia arborea 160
Casearia elliptica 40
Ficus hispida 71
Bauhinia racemosa 23
Ixora arborea 93
Mitragyna parvifolia 111
Artocarpus heterophyllus 18
Albizia chinensis 9
Dalbergia latifolia 51
Bambusa arundinacea 21
Caryota urens 39
Buchanania lanzan 30
Azadirachta indica 20
Diospyros chloroxylon 57
Bombax ceiba 24
Albizia odoratissima 11


Strychnos potatorum 148
Polyalthia cerasoides 124
Polyalthia subarosa 125
Streblus asper 146
Careya arborea 37
Syzygium cumini 149
Alangium salvifolium 7
Mallotus philippensis 104
Premna latifolia 127
Naringi crenulata 115
Phyllanthus emblica 123
Diospyros montana 59
Gardenia latifolia 81
Diospyros melanoxylon 58
Grewia tiliaefolia 86
Cassia fistula 41
Cochlospermum religiosum 48
Bridelia retusa 28
Aegle marmelos 5
Pongamia pinnata 126
Acacia leucophloea 3
Madhuca longifolia 103
Garuga pinnata 82
Lagerstroemia parviflora 95
Bridelia montana 27
Diospyros sylvatica 61
Semecarpus anacardium 140
Terminalia bellarica 154
Pterospermum xylocarpum 132
Premna tomentosa 128
Morinda tinctoria 113
Strychnos nuxvomica 147
Protium serratum 130
Sterculia urens 144
Terminalia alata 152
Dalbergia paniculata 52
Mangifera indica 105
Tamarindus indica 150
Shorea robusta 141
Chloroxylon swietenia 44
Wrightia tinctoria 161
Cleistanthus collinus 47
Xylia xylocarpa 162
Anogeissus latifolia 16
Lannea coromandelica 97
Schleichera oleosa 137

CONCLUSION

Ecologists have proposed a number of indices of species diversity from time to time, but most commonly used indices are Shannon-Wiener index for diversity, Simpson's index for dominance for evenness. The Diversity, Dominance and Evenness indices varied considerable in study area. The Simpson's Index ranges from 0.00010 to 9.48541, Shannon index ranges from -0.00107095 to-0.08637869 in the study area respectively. In the present study diversity index is less when compared to that of tropical forest of Eastern Ghats, India [20] diversity and dominance index is more when compared with that of tropical semi-evergreen forests in Shervarayan hills Tropical dry deciduous forest, Southern Andhra Pradesh [21] and tropical deciduous forest of Boudh district [22]. The present investigation on phytosociological studies of vizianagaram district of Andhra Pradesh reflects a positive and negative correlation with various parameters which were discussed above. In this study area have more species richness, stand density, basal area. From the results encountered in the present investigation, it is inferred that the forests of vizianagaram district with more species diverse system of the forest area.

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