Cataloguing Phytosociological Pattern of Flora in Nilgiris Biosphere Reserve, Western Ghats, Southern India

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Abstract

Background

During April, 2021-April, 2022, the field survey was conducted in Mettupalyam Forest range of Coimbatore Forest Division which is an integral part of Nilgiris Biosphere Reserve and it was approached in a systematic random sampling method with 60 sample plots of 20x 20 m and 8 transect line survey at 0.2% sampling intensity were laid out in which study area were catalogued with 54 trees, 25 shrubs, 22 herbs and 22 grasses.

Results

The result revealed that the maximum dominance were observed in *Atlantia monophylla* (32.20), *Lantana camara* (43.02), *Abutilon indicum* (54.87) and *Oplismenus burmanii* (19.34%) and minimum in *Glycosmis pentaphylla* (12.32), *Euphorbia heterophylla* (2.18), *Mimosa pudica* (2.82) and *Melinis repens* (0.18%) in tree, shrubs, herbs and grass layer, respectively. Furthermore, the highest Shannon D index (H = 3.08) observed in TL, followed by GL (H = 2.76), HL (2.28) and SL (2.25) along with Simpson index also higher in GL (1-D = 0.92), TL (1-D = 0.91), HL (1-D = 0.86) and SL (1-D = 0.84), respectively.

Conclusion

Cataloguing flora in Mettupalayam Reserve Forest is the pioneer study which gives scientific and baseline information for conservation of flora in the forest.

Introduction

As per the India State of Forest Report 2021, the total forest cover of the country is 713,789 km^2 which is 21.71% of India's total geographical area. From this the Tropical Forest covers 8% of the land surface and yet support a high level of biological variety, with nearly half of all known species and a huge number of undiscovered species. Tropical forests are one of the most diverse terrestrial ecosystems, supporting a wide range of living forms and contributing significantly to world biodiversity (Dirzo and Raven, 2003; Houghton, 2005; Wilson, 1988). Which are ecologically highly imperative; nonetheless, they are under threat from population growth, urbanization, deforestation, agriculture, degradation, loss of habitat, legal and illicit logging, mining, fire and climate change (May and Stumpf, 2000; Singh et al., 2006; Goparaju and Jha, 2010). Plant diversity is a nebulous concept that encompasses heterogeneity and wide variation (Mudgal, 1997; Shameem et al. 2010; Chaudry *et al*. 2011). The vegetation patterns fluctuate from season to season in a cyclic fashion over the years in a succession manner, and the fluctuations showed that each species population is responding to prevailing temperature, humidity and sunlight as adjusted by the vegetation (Heady 1958). The pattern of species distribution in a community is altered by the development and deterioration of plant species (Watt, 2007). The necessity of measuring species richness is crucial for ensuring biodiversity protection (Rahman et al. 2011). In this regard, floristic assessment of the forest is indispensable in detecting the risk of extinction, arrival of invasive species and changes in plant diversity over time. Relatively wide range of studies has been done in determining the floristic composition and structure of forest in Western Ghats. An extensive assessment of the distribution of vascular plants in Western Ghats have been conducted in Mudanthurai Tiger Reserve, Agasthyamalai Biosphere Reserve carried out by Ganesh et al. (1996); Rao and Raghavendra (2012). However, Mettupalayam Reserve Forest, Western Ghats holds significant population of fauna owing to its diverse distribution of flora butthere is no scientific and systematic study on documentation of floristic composition in Mettupalayam Reserve Forest. In this context, there is a need to generate the data up- to-date on floristic composition of the reserve forest. The present study focuses on the specific objectives of determining the floristic composition, structure and composition. It is anticipated that the research findings were provides the scientific and baseline information for conservation of flora and fauna in the Reserve Forest.

Materials And Methods

Study area

The field survey was conducted in Mettupalyam Forest range of Coimbatore Forest Division during April 2021 –April 2022. This division falls between 10°37’and 11°31’North latitude and 76°39’and77°5’ East longitude. Greater part of the division is situated southwardly extending in the Western Ghats with the North-western parts forming the lower ranges of the Nilgiris. The study area was approached in a systematic random sampling method. Transect lines and Sample plots were laid out in 6 beats of Mettupalayam range *viz.*,Jaccanari, Sundapatti, Nellimalai, Hulikal, Kandiyur and Kallar, their forest types were classified according Champion and Seth (1968).

Assessment of Phytosociological characters

A transect line with 2 km length was marked in the study area for exploration and documentation of flora. Size and number of sample plots were determined using the species effort curve technique (Misra, 1968 and Daniels *et al.,* 1996). Based on species effort curve, sample plots (Quadrat) size of 20 x 20 m (Trees), 10x 10 m (Shrubs), 5 x 5 m (Herbs) and 1x1 m (Grasses) were placed and systematically surveyed. Sampling intensity at 0.2% was used. Sample plots were laid on opposite to each other direction and the distance between the sample plots were fixed as 200 m and 50 m distance from transect line. A total of 80 sample plots and 8 transect lines were laid out in the study area. In each plot, dbh (diameter at breast height; 1.3 m above the ground) and height of all the trees having dbh ≥ 10 cm were recorded. And their GPS points were observed by using Gramin 60 version GPS. By using the geo referencing point the transect line and sample plots were marked on the Google Earth Map (Fig 1). All the flora in the plots were identified and recorded by local/ scientific names and the samples were collected and identified by using a hand book of some south Indian grasses (Achariyar, 1921) and google lens application.

Materials and Methods

Data Analysis

1. The important Phytosociological characters like density, frequency and abundance, relative density, relative frequency, relative dominance and Important Value Index (IVI) of plant species were determined as per Curtis and McIntosh (1951). The quantitative characters within the study area were assessed by using the following formula

$$\text{Density} = \frac{\text{Total number of individuals of a species in all quadrants}}{\text{Total number of quadrats studied}}$$

$$\text{Frequency (\%)} = \frac{\text{Number of quadrants in which the species occurred}}{\text{Total number of quadrats studied}} \times 100$$

$$\text{Abundance} = \frac{\text{Total number of individuals of a species in all quadrants}}{\text{Total number of quadrats in which the species occurred}}$$

$$\text{Relative density (\%)} = \frac{\text{Number of individual of the species}}{\text{Number of individual of all the species}} \times 100$$

$$\text{Relative frequency (\%)} = \frac{\text{Number of occurrence of the species}}{\text{Number of occurrence of all the species}} \times 100$$

$$\text{Relative dominance (\%)} = \frac{\text{Total basal area of the species}}{\text{Total basal area of all the species}} \times 100$$

$$\text{IVI} = \text{RD (\%)} + \text{RF (\%)} + \text{Rd (\%)}$$

2. The species diversity indices

The following diversity indices were done by using PAST software, version 4.03.

i) Simpson index $D = \frac{\sum n_i(n_i - 1)}{N(N-1)}$, D = Simpson index of dominance; ni = the total number of trees of each individual species; N = the total number of trees of all species. As D increases, diversity decreases and Simpson's index was therefore usually expressed as 1 – D or 1/ D (Simpson, 1949).

ii) Shannon- Weiner index H' = – ∑ pi In pi, H' = Shannon index of diversity; pi = the proportion of important value of the i^{th} species (pi = ni / N, ni is the important value index of it^{h} species and N is the important value index of all the species); Ln = Natural logarithm on proportion of each species (Shannon and Weaver, 1963).

iii) Pielou's evenness index J = H/ In S, H = - $\sum P_i$ In $P_{i,}$ S= Individuals of all the species; Ln = Natural logarithm on individuals of all the species (Pielou, 1975).

iv) Margalef's index Dmg = (S-1)/ In N, S = Total number of species; N = Total number of individuals; Ln = Natural logarithm on total number of individuals (Margalef, 1968).

v) Chao 1 estimator Q2= Number of species occurring in two samples, F1= the number of singleton species, F2= the number of doubleton species (Chao, 1980).

Results

Density, Frequency, Abundance and Dominance (IVI) of flora

Tree Layer (TL)

A total of 54 species were catalogued which belongs to 25 families, the highest number of species was registered in Fabaceae family (Fig. 2). On the species level *Atlantia monophylla* (9.19) was the most dominant species whereas the lowest density was recorded in *Ailanthus triphysa* and *Vitex altissima* (0.02) (Fig. 3). With respect to frequency, *Atlantia monophylla* showed maximum 92.59% followed by *Sapindus emarginatus* and *Ziziphus glabrata* with the value of 75.93% and minimum values were observed in ten species *viz., Albizia lebbeck, Ailanthus triphysa, Butea monosperma, Cassia spectabilis, Dalbergia latifolia, Diospyros montana, Glycosmis pentaphylla, Mallotus phillippensis, Terminalia chebula* and *Vitex altissima* with the frequency of 1.85% respectively (Fig. 4). *Bambusa bambos* (12.50) had highest abundance followed by *Atlantia monophylla* (9.92) and lowest was recorded in *Acacia planifrons* (0.66) (Fig. 5). *Atalantia monophylla* showed highest IVI (32.20) followed by *Chloroxylon sweitinea* (14.38), *Sapindus emarginatus* (12.32) while the lowest was observed in *Glycosmis pentaphylla* (1.19) (Table. 1). The results revealed that *Atlantia monophylla* had maximum dominance in Mettupalayam Reserve Forest.

Shrub Layer (SL)

A sum of 25 shrubs were recorded in the shrub layer which belongs to 17 families, the higher number of species were observed in Euphorbiaceae family (Fig.2a). The maximum density (27.17) was recorded for *Lantana camara* followed by *Solanum violaceum* (14.09), *Chromolaena odorata* (13.37) (Fig. 3a). The lowest value was registered in *Calotropis procera* (0.07). *Jasminum angustifolium* and *Lantana camara* had highest frequency percentage of 94.44 followed by *Solanum violaceum* (79.63%) and *Carmona retusa* showed lowest frequency percentage of 1.85 (Fig. 3b). Abundance of *Lantana camara* exhibited maximum value of 28.76 followed by *Chromolaena odorata* (19.00), *Solanum violaceum* (17.70) compared to *Euphorbia heterophylla* (1.00) (Fig. 3c) which leads to increase the Importance Value of *Lantana camara, Solanum violaceum* and *Chromolaena odorata* as 43.02, 26.72 and 25.03 respectively (Table.2).

Herb Layer (HL)

Twenty-two herb species were documented in the herb layer which belongs to 16 families and Euphorbiaceae had higher number of species (Fig.2b). The highest herb density had been recorded in *Abutilon indicum* (2.56) followed by *Randia tomentosa* (1.70), *Barleria prionitis* (1.43) and *Sida cordifolia* (0.93) which were commonly distributed whereas the lowest density was observed in *Mimosa pudica,* *Euphorbia hirta* and *Centella asiatica* with the density of 0.04 (Fig 3a). The species with high frequency in the forests was *Abutilon indicum* (94.44%) followed by *Barleria prionitis* (88.89%) and *Sida cordifolia* (64.81%) (Fig 3b). This is because of maximum number of individuals per unit area. This high number could be due to the seeds were rapidly distributed through wind and other combine factors like dormancy, germination capacity, soil moisture content and survival of fitness. Six species *viz., Centella asiatica, Dichondra repens, Euphorbia hirta, Heliotropium indicum, Mimosa pudica* and *Ocimum tenuiflorum* registered low frequency of 1.85% in the forest. *Ocimum tenuiflorum* had higher abundance (3.00) whereas *Parthenium hysterophorus* showed lower abundance (1.13) in the forests (Fig. 3c). The maximum IVI of herb species was recorded in *Abutilon indicum, Barleria prionitis, Randia tomentorum* and *Sida cordifolia* while minimum percentage was observed in two species *viz., Heliotropium indicum* and *Mimosa pudica* (2.82) (Table.3).

Grass layer (GL)

With respect to grass layer, *Oplismenus burmanii* possess maximum density (19.34%) followed by *Apluda mutica* (9.10%), *Chrysopogon aciculatus* (8.06 %), *Cynodon dactylon* (7.43%), *Heteropogon contortus* (7.52%) whereas *Melinis repens* registered minimum density (0.18%) (Table 4).

ii) Species diversity, Abundance and Evenness

Among the four different types of flora, TL registered maximum taxa (54) followed by SL (25), GL (24) and HL (22). The expected species richness was similar to the observed species richness except TL (55.67). The highest Margalef species richness (MI) was observed in TL as 6.94 followed by HL (3.36), GL (3.16) and SL (2.84). The number of individuals was more than 1000 in TL, SL and GL while it was lowest in HL. Species dominance was low in TL (0.09) and GL (0.08) compared to HL (0.14) which leads to increase species diversity index. Further, species diversity and similarity index were found high in TL and GL. The highest Simpson index was observed in GL (1-D=0.92), TL (1-D=0.91), HL (1-D=0.86) and SL (1-D=0.84). The maximum Shannon D index (H=3.08) observed in TL, followed by GL (H=2.76), HL (2.28) and SL (2.25) respectively. The species evenness index reveals less evenness in GL (J=0.66), HL (E=0.45), TL (J=0.40) and SL (J=0.38) which indicates, the species is not evenly distributed in the forest. These results indicate that the species are moderately distributed in all sites of the forest. Berger parker dominance was higher in SL (0.32) which leads to decrease diversity indices (Table.5).

Discussion

Phytosociological pattern of Flora

In the present study, maximum dominance was exhibited by *Atlantia monophylla*. This is because it grows well on all type of soils and dispersed by ants and birds for longer distance which enhances local colonization process and plant diversity (Fig. 3a). The high frequency and abundance of this species is most likely due to the presence of seeds, that are easily distributed as well as it has the ability to regenerate quickly (Fig. 3b). Similar reports were also given by Curtish and McIntosh (1951); Rosenzweig (1995); Abdullahi (2010); Bijalwan (2010); Panda et al., 2013; Ravindra and Ayodhya, 2013; Mandal and Joshi, 2014; Zhigila et al. (2015) which compares the ecological significance of species and indicates the extent of dominance of a species in the structural system of a vegetation stand. *Lantana camara* showed higher dominance in shrub layer (Fig. 3a) which might be due to biological attributes *viz.*, fitness homeostasis, phenotypic plasticity, dispersal benefits from destructive foraging activities, widespread geographic range, vegetative reproduction, fire tolerance, better competitive ability than native flora, and allelopathy are some of the biological attributes that contribute to Lantana's success as an invader species and abundant wind dispersed seeds which provides a greater reproductive capacity. *Lantana camara* invasions in natural communities are frequently linked to a reduction in species diversity as well as changes in ecosystem structure and function. Similar dominance of *Lantana camara* was also reported in moist deciduous forest of Odisha by Reddy and Pattanaik (2009); Khanduri et al. (2017); Tiwari and Ravikumar (2018) In herb layer the higher dominance was shown by *Abutilon indicum* (Fig. 3a) which is due to survival, establishment and vigorous growth pattern of this species. The similar finding was given by Mohammed *et al.* (2014) for Kanawa forest.

Oplismenus burmanii possess maximum density followed by *Apulda mutica*, *Chrysopogon aciculatus*, *Cynodon dactylon* and *Heteropogon contortus* because it is attributed due to the fact that buried seeds could survive in the soil for long periods of time and they germinate under favourable climatic condition; Moreover, these grasses are spread by rhizomes and interconnected stands with extensive root systems which provides a rapid growth and makes them spread and proliferative. Consistent result was observed by Khanduri et al. (2017) for *Apluda mutica, Anaphalis busua* and *Echinochloa colonae* in Garhwal Himalaya. The species richness was more in Tree layer when compared to other three layers. Higher species richness may be contributed to location, soil characteristics, soil type, and climatic conditions which inturn has increased the species diversity. The results were in concurrent with the findings of Timilsina et al. (2007) who observed that the number of species in tree layer was high in Sal Forest western terai of Nepal. Species accumulation curve shows diversity indices of flora in Mettupalayam Reserve Forest (Fig. 5).

In comparison to the other three layers, the tree layer diversity perspective may be more in terms of Shannon index of diversity values ranged from 2.25 to 3.08 (Fig. 7). The present findings were contrast with the result of Okechalu *et al.* (2020) who recorded that Shannon value fluctuated from 1.57 to 2.17 for Pandam Wildlife Park. The Simpson index was ranged from 0.84 to 0.92 and it was consistent with the work of Abdullahi (2010); Ogunjemite, (2017); Ikayaagba *et al.* 2019; Abba, 2014 and Sahu *et al.* (2019).

Conclusion

Corridor management and conservation requires authenticate and consistent information on structural composition of flora and their diversity pattern. This is the pioneer research on cataloguing flora in Mettupalaym Reserve Forest. Floral composition and stand structure serving as important indicators in the formation of conservation measures. This study provides scientific and baseline information on the availability of flora and its distribution pattern. Hence, it will used for management and conservation of native species.

Declarations

1. **Ethics approval and consent to participate:** yes, I have approved my manuscript to be publishing in this journal.
2. **Consent for publication:** I, the undersigned, give my consent for the publication of identifiable details, Viz., image, details within the main text to be published in this journal.
3. **Data availability:** All relevant data are within the paper
4. **Competing interest:** The authors declare no conflict of interest
5. **Funding:** Tamil Nadu Forest Department
6. **Authors contribution :** M.P.- Conceptualization, writing- original draft, validation, software and formal analysis ; M.P. Divya; K.Baranidharan.,S.Geetha; K.N.Ganesan; R.Ravi; S.Manivasakan; Conceptualization, Investigation writing-review & editing and funding acquisition.
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Tables 1-3

Table 1. Phytosociological attributes of Trees

Sl. No	Tree species	F	D	F (%)	A	IVI
1.	*Acacia koenji*	Fabaceae	0.11	5.56	2.00	1.56
2.	*Acacia leucophloea*	Fabaceae	0.09	3.70	2.50	3.01
3.	*Acacia planifrons*	Fabaceae	0.39	59.26	0.66	7.41
4.	*Aegelmarmelos*	Rutaceae	0.06	3.70	1.50	1.61
5.	*Aibizialebbeck*	Fabaceae	0.09	1.85	5.00	3.28
6.	*Ailanthus excelsa*	Simaroubaceae	0.30	16.67	1.78	5.03
7.	*Ailanthus triphysa*	Simaroubaceae	0.02	1.85	1.00	3.05
8.	*Alangiumsalvifolium*	Cornaceae	0.41	9.26	4.40	3.13
9.	*Albizia amara*	Fabaceae	1.81	46.30	3.92	9.75
10.	*Atlantiamonophylla*	Rutaceae	9.19	92.59	9.92	32.20
11.	*Azadirachta indica*	Meliaceae	0.52	40.74	1.27	6.33
12.	*Bahuniaracemosa*	Fabaceae	0.65	57.41	1.13	8.87
13.	*Bamboosa bamboo*	Poaceae	2.78	22.22	12.50	10.61
14.	*Butea monosperma*	Fabaceae	0.02	1.85	1.00	1.97
15.	*Cassia fistula*	Fabaceae	0.20	18.52	1.10	3.85
16.	*Cassia spectabilis*	Fabaceae	0.04	1.85	2.00	1.39
17.	*Celtis philipensis*	Cannabaceae	0.39	12.96	3.00	3.50
18.	*Chloroxylon swetinea*	Rutaceae	2.85	66.67	4.28	14.38
19.	*Commiphoracaudata*	Burseraceae	0.15	11.11	1.33	4.22
20.	*Cordia gharaf*	Boraginaceae	0.17	9.26	1.80	2.57
21.	*Dalbergia latifolia*	Fabaceae	0.02	1.85	1.00	1.49
22.	*Dalbergia paniculata*	Fabaceae	0.26	18.52	1.40	3.99
23.	*Delonix regia*	Fabaceae	0.13	7.41	1.75	3.79
24.	*Diospyros montana*	Ebenaceae	0.04	1.85	2.00	1.31
25.	*Erythroxylon monogynum*	Erythroxylaceae	1.50	64.81	2.31	9.79
26.	*Glycosmis pentaphylla*	Rutaceae	0.02	1.85	1.00	1.19
27.	*Gmelina arborea*	Lamiaceae	0.50	29.63	1.69	4.96
28.	*Gyrocarpus americanus*	Hernandiaceae	0.50	25.93	1.93	5.58

29.	*Hardwickiabinata*	Fabaceae	0.13	9.26	1.40	3.81
30.	*Holoptelea integrifolia*	*Ulmaceae*	0.52	29.63	1.75	6.61
31.	*Limoniaacidissima*	Rutaceae	0.06	3.70	1.50	1.24
32.	*Mallotusphilippensis*	Euphorbiaceae	0.06	1.85	3.00	2.62
33.	*Morindacitrifolia*	Rubiaceae	0.04	3.70	1.00	2.30
34.	*Morinda tinctoria*	Rubiaceae	0.04	3.70	1.00	2.27
35.	*Murayakoenigii*	Rutaceae	1.20	33.33	3.61	6.78
36.	*Phyllanthus embellica*	Phyllanthaceae	0.33	14.81	2.25	3.35
37.	*Pongamiabinata*	Fabaceae	0.24	18.52	1.30	3.61
38.	*Premna tomentosa*	Lamiaceae	0.48	35.19	1.37	5.07
39.	*Prosopis juliflora*	Fabaceae	2.06	29.63	6.94	8.87
40.	*Pterocarpus marsupium*	Fabaceae	0.43	27.78	1.53	4.89
41.	*Rhus mysorensis*	Anacardiaceae.	0.30	27.78	1.07	4.00
42.	*Spathodeacampanulata*	Bignoniaceae	0.06	3.70	1.50	2.17
43.	*Sapindusemarginatus*	Sapindaceae	1.91	75.93	2.51	12.32
44.	*Senegalia pennata*	Fabaceae	1.39	74.07	1.88	10.19
45.	*Spondiasmangifera*	Anacardiaceae	1.17	68.52	1.70	10.16
46.	*Strychnosnux vomica*	Loganiaceae	0.78	50.00	1.56	7.58
47.	*Syzygiumcumini*	Myrtaceae	0.17	14.81	1.13	3.88
48.	*Tamarindus indica*	Fabaceae	0.65	53.70	1.21	8.78
49.	*Tectona grandis*	Lamiaceae	1.06	18.52	5.70	7.22
50.	*Terminalia arjuna*	Combretaceae	0.70	22.22	3.17	6.17
51.	*Terminalia chebula*	Combretaceae	0.04	1.85	2.00	2.61
52.	*Vitex altissima*	Lamiaceae	0.02	1.85	1.00	1.75
53.	*Wrightia tinctoria*	Apocynaceae	0.07	3.70	2.00	1.62
54.	*Ziziphus glabrata*	Rhamnaceae	1.30	75.93	1.71	10.31

F- Family, D- Density,F- Frequency(%), A-Abundance, IVI- Importance Value Index

Table 2. Phytosociological attributes of Shrubs

Sl. No	shrubs	F	D	F (%)	A	IVI
1.	*Calotropis procera*	Apocynaceae	0.07	3.70	2.00	2.75
2.	*Carissa carandus*	Apocynaceae	0.43	22.22	1.92	6.01
3.	*Carmona retusa*	Boraginaceae	0.13	1.85	7.00	4.14
4.	*Cassia auriculata*	Caesalpinioideae	0.80	42.59	1.87	8.80
5.	*Catunaregam spinosa*	Rubiaceae	0.20	12.96	1.57	5.74
6.	*Chromolaena odorata*	Asteraceae	13.37	70.37	19.00	25.03
7.	*Dodonaeaviscosa*	Sapindaceae	1.35	59.26	2.28	10.96
8.	*Euphorbia antiquorum*	Euphorbiaceae	0.15	11.11	1.33	8.99
9.	*Euphorbia heterophylla*	Euphorbiaceae	0.02	1.85	1.00	2.18
10.	*Euphorbia tirucalli*	Euphorbiaceae	0.13	11.11	1.17	5.15
11.	*Flueggealeucopyrus*	Phyllanthaceae	0.87	64.81	1.34	11.24
12.	*Grevilia hirsuta*	Proteaceae	0.30	24.07	1.23	5.53
13.	*Hugoniamystax*	Linaceae	1.56	55.56	2.80	12.03
14.	*Jasminum angustifolium*	Oleaceae	4.43	94.44	4.69	18.59
15.	*Jatropha gossypifolia*	Euphorbiaceae	1.74	70.37	2.47	11.43
16.	*Lantana camara*	Verbenaceae	27.17	94.44	28.76	43.02
17.	*Opuntia littoralis*	Cactaceae	1.11	59.26	1.88	10.52
18.	*Opuntia stricta*	Cactaceae	0.15	9.26	1.60	4.50
19.	*Pavetta indica*	Rubiaceae	5.46	42.59	12.83	14.09
20.	*Pterolobiumhexapetalum*	Caesalpiniaceae	3.04	59.26	5.13	15.26
21.	*Randia tomentosa*	Rubiaceae	1.74	64.81	2.69	12.59
22.	*Solanum violaceum*	Solanaceae	14.09	79.63	17.70	26.72
23.	*Glycosmis pentaphylla*	*Rutaceae*	3.28	42.59	7.70	12.03
24.	*Toddalia asiatica*	Rutaceae	2.83	57.41	4.94	13.19
25.	*Ziziphus oenoplia*	Rhamnaceae	1.13	42.59	2.65	9.52

Table 3. Phytosociological attributes of Herbs

Sl.No	Herbs	F	D	F (%)	A	IVI
1.	*Abutilon indicum*	Malvaceae	2.56	94.44	2.71	54.87
2.	*Acalypha indica*	Euphorbiaceae	0.76	64.81	1.17	24.39
3.	*Ageratum conyzoides*	Asteraceae	0.07	3.70	2.00	5.64
4.	*Argemone mexicanna*	Papaveraceae	0.07	3.70	2.00	5.64
5.	*Barleriaprionitis*	Acanthaceae	1.43	88.89	1.60	35.88
6.	*Centella asiatica*	Apiaceae	0.04	1.85	2.00	4.90
7.	*Cissus quadrangularis*	Vitaceae	0.09	7.41	1.25	10.70
8.	*Commelina benghalensis*	Commelinaceae	0.54	38.89	1.38	17.14
9.	*Dichondra repens*	Convolvulaceae	0.04	1.85	2.00	4.90
10.	*Digera arvensis*	Amaranthaceae	0.11	7.41	1.50	6.73
11.	*Euphorbia geniculata*	Euphorbiaceae	0.13	9.26	1.40	6.23
12.	*Euphorbia hirta*	Euphorbiaceae	0.04	1.85	2.00	3.86
13.	*Heliotropium indicum*	Boraginaceae	0.04	1.85	2.00	2.82
14.	*Ipomoea nil*	Convolvulaceae	0.39	24.07	1.62	10.70
15.	*Medicago denticulata*	Fabaceae	0.13	9.26	1.40	5.19
16.	*Mimosa pudica*	Fabaceae	0.04	1.85	2.00	2.82
17.	*Ocimumtenuiflorum*	Lamiaceae	0.06	1.85	3.00	7.18
18.	*Parthenium hysterophorus*	Asteraceae	0.31	27.78	1.13	12.72
19.	*Randiadumetorum*	Rubiaceae	1.70	59.26	2.88	35.18
20.	*Sida cordifolia*	Malvaceae	0.93	64.81	1.43	28.20
21.	*Solanum trilobatum*	Solanaceae	0.13	5.56	2.33	8.65
22.	*Tribulus terrestris*	Zygophyllaceae	0.07	3.70	2.00	5.64

Tables 4-5

Table 4 and 5 are not available with this version.

Figures 5 And 7

Fig. 5 and Fig. 7 are not available with this version.

Figures

Figure 1

Map view of transect lines and sample plot locations of Mettupalyam Reserve Forest

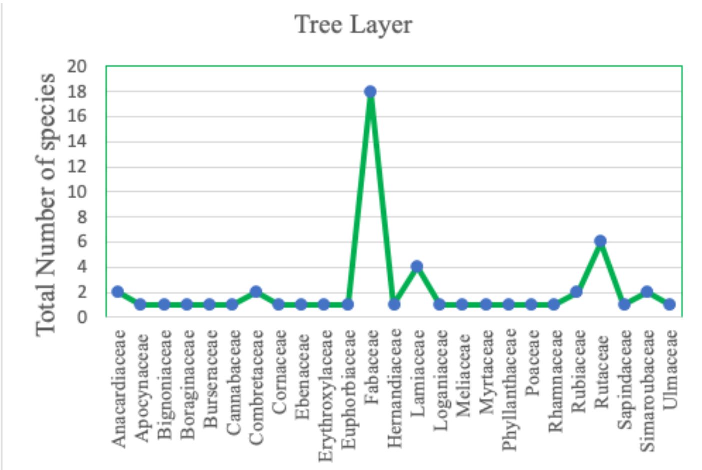

Fig 2a. Distribution of family in Tree Layer

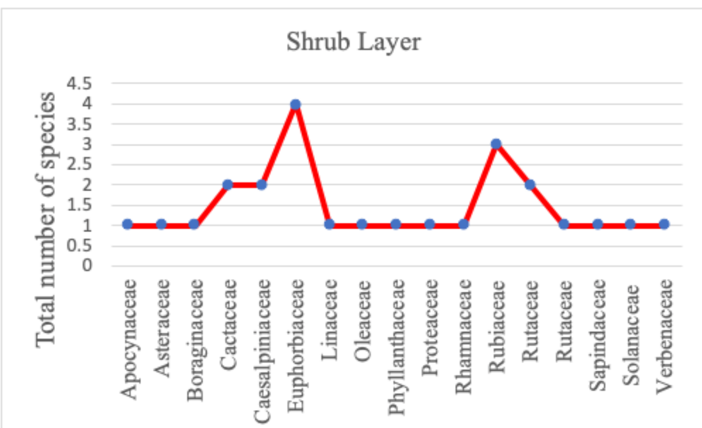

Fig 2b. Distribution of family in Shrub Layer

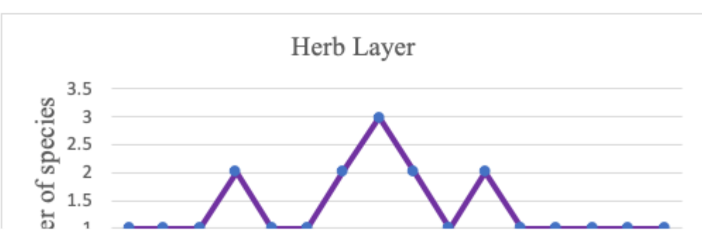

Figure 2

2a. Distribution of family in Tree Layer

2b. Distribution of family in Shrub Layer

2c Distribution of family in Herb Layer

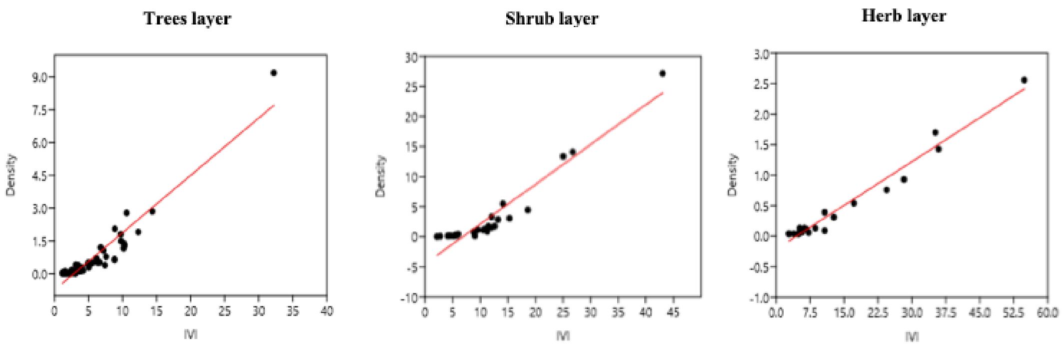

Fig.3a. Density Vs IVI, *Atlantiamonophylla*(Tree); *Lantana camara* (Shrub); *Abutilon indicum* (Herb) showing dominance in Mettupalyam Reserve Forest.

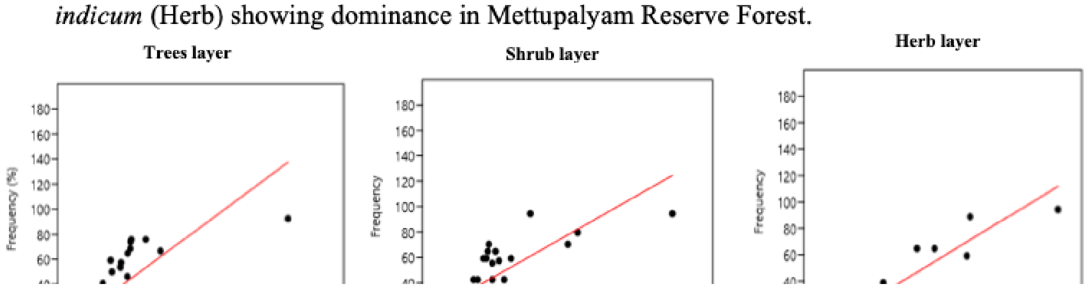

Figure 3

3a. Density Vs IVI, Atlantiamonophylla(Tree); Lantana camara (Shrub); Abutilon indicum (Herb) showing dominance in Mettupalyam Reserve Forest.

3b. Frequency (%) Vs IVI, Maximum Frequency percentage shown by Atlantiamonophylla(Tree); Jasminum angustifolium and Lantana camara (Shrubs); Abutilon indicum and Barleriaprionitis(Herbs).

3c. Abundance Vs IVI, Maximum Abundance shown by Bambusa bambos (Tree); Lantana camara and Chromolaena odorata (Shrubs); Ocimumtenuiflorum, Randia tomentosa, Abutilon indicum, Solanum trilobatum, Ageratum conyzoides, Argemone mexicanna, Dichondra repens, Euphorbia hirta, Heliotropium indicum, Mimosa pudica and Tribulus terrestris (Herbs). The maximum outliers observed in Herb layer.

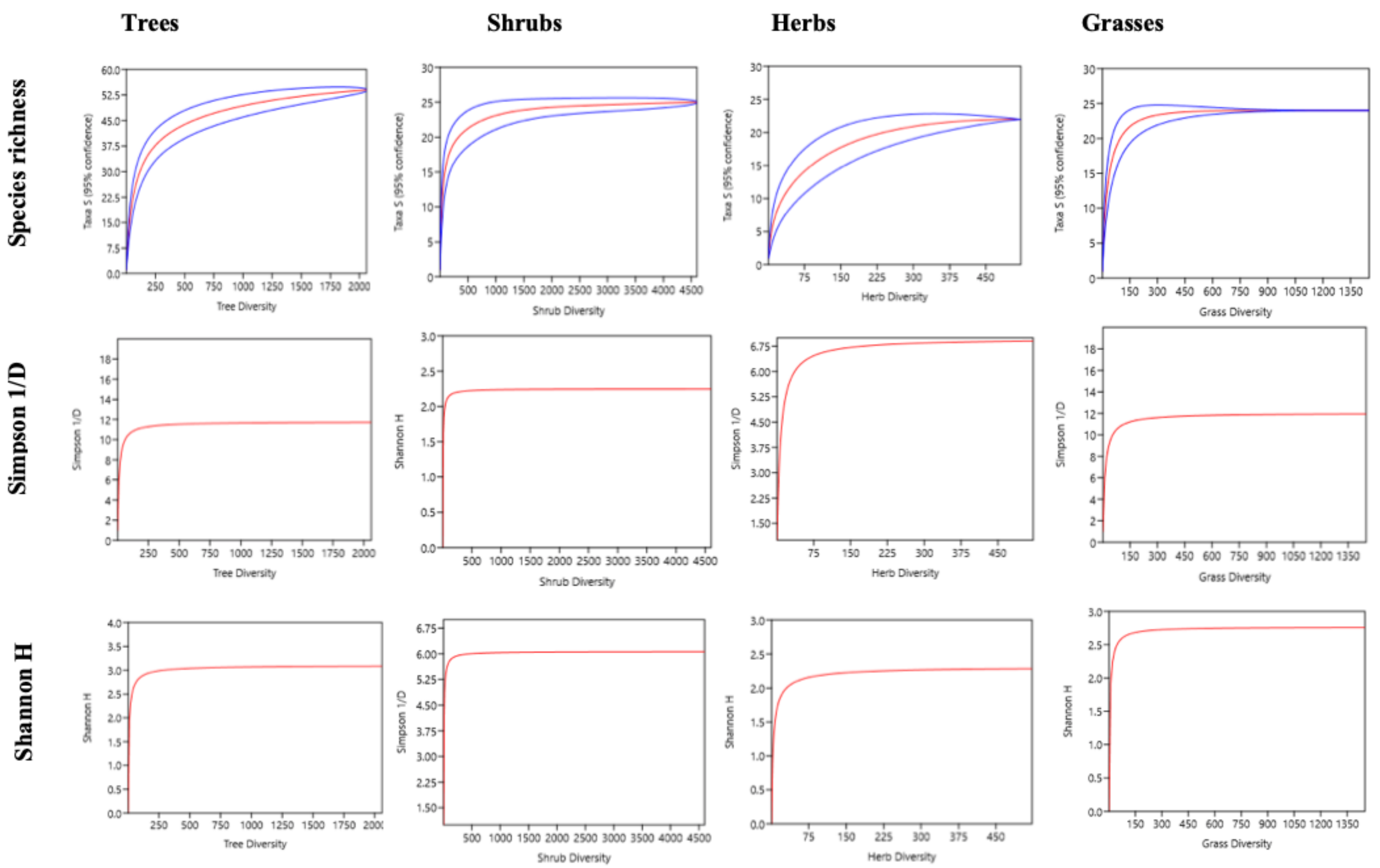

Figure 4

Species accumulation curve shows diversity index of MRF