

Phytosociology of trees of Gundlabrahmeswaram Wls, Nallamalais, Andhra Pradesh, India

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Abstract

Biodiversity interacting with the physical environment form the foundation of sustainable development. World's forests extended over 4 billion hectares; corresponding to 31 percent of the total land area or an average of 0.6 ha per capita. Tropical forests in India comprising over 60% deciduous forests are poorly understood in terms of phytodiversity, phytosociology, quantification regimes. In peninsular India, quantification phytodiversity inventories are available from the forests of the Western Ghats, whereas study on Eastern Ghats is lacking. Gundla Brahmeswaram WLS the study area for the present work is located in Kurnool District, Andhra Pradesh one of the significant biodiversity rich areas in Southern Eastern Ghats to study the phytosociological attributes of tree species of the 124 tree taxa recorded from the sampled inventory. The tree density of the sampled inventory is 61.97 stem ha⁻¹. IVI is the most important parameter to understand the community organization in relation to the competitive ability. GBM WLS although a protected area, needs further attention in terms of conserving valuable tree resources.

Keywords: Phytodiversity, Phytosociology, Eastern Ghats, Gundlabrahmeswaram, Tree density, IVI

1. Introduction

Biodiversity interacting with the physical environment form the foundation of sustainable development. Cataloguing biodiversity resources, mapping their geographical distribution and quantitative estimation of their natural stands is perhaps the most important information needed for any country in the post-CBD era. 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 and hence warrants immediate attention especially on forestry sector as they harbor amazing biodiversity and has critical role in global climate change scenario.

World's forests extended over 4 billion hectares; corresponding to 31 percent of the total land area or an average of 0.6 ha per capita (FAO, 2010) has become a critical part of the international climate change agenda. The world's tropical forests are experiencing heavy biotic interference leading to deforestation, degradation and destruction over the past few decades. Tropical forests in India comprising over 60% deciduous forests are poorly understood in terms of phytodiversity, phytosociology and quantification regimes. Analysis of the quantitative relationship among the plant species growing in an area reflects structural property of the community. Phytosociological investigation of vegetation serves as a pre-requisite for investigating the details of primary productivity of ecosystems. There is a dearth of such studies on tropical deciduous forests in developing countries like India, data can be used for environmental impact assessment studies in future especially with reference to conservation priority areas like wild life sanctuaries.

In peninsular India, quantitative phytodiversity inventories are available from the forests of the Western Ghats, whereas study on Eastern Ghats is lacking. The wide range of topography, varied climate favours luxurious growth of vegetation and forest. It remain as a neglected area with very few attempts made for such studies in Eastern Ghats of Tamil Nadu (Kadavul and Parthasarathy, 1999a & b; Chittiababu and

Parthasarathy, 2000) ^[11, 12]. These kinds of studies are poorly explored in the State of Andhra Pradesh which covers almost 50% of the forest area in Eastern Ghats. Hence, the present study was undertaken to determine the structure and floristic composition of tree diversity in Gundlabrahmeswaram Wild Life Sanctuary (WLS), part of Southern eastern Ghats of Andhra Pradesh. Gundlabrahmeswaram WLS, the study area for the present work is located in Kurnool district, Andhra Pradesh and is considered as one of the significant biodiversity rich areas in Southern Eastern Ghats. It is part of Nallamalais, one of the Centres of Plant Diversity (CPD) in India. It represents diversified habitats and supports a wide array of plant and animal life and provides basic livelihood for tribal and rural communities. Kumar & Bhanja (1992) ^[14] produced a seed manual for forest trees of Andhra Pradesh. Sandhya Rani & Pullaiah (2002) ^[26] reported 560 tree taxa from Eastern Ghats. Suryanarayana *et al.*, (2002) inventoried the plant wealth of Veligonda hill ranges and reported 1014 species belonging to 558 genera and 149 families. Studies on plant resources (including trees) of Nallamalais Centre of Plant Diversity include Ellis (1982, 1987, 90), Reddy *et al.* (1988), Pullaiah *et al.* (2007), Thulsi Rao *et al.* (2007), Reddy *et al.* (2007), Raju and Pullaiah (1995) ^[22] surveyed the Flora of Kurnool district and reported 1,064 species, of which 208 are trees covering 194 from Nallamalais of Kurnool district. Pullaiah and Sandhya Rani (1999) ^[20] made the floristic studies on trees of Andhra Pradesh and reported 531 tree species covering over 200 trees of Nallamalais.

While working on Flora of Andhra Pradesh, Pullaiah and Chennaiah (1997) ^[18], Pullaiah and Ali Moulali (1997) ^[17], Pullaiah (1997) ^[16-18] and Pullaiah and Karuppusamy (2008) ^[19] reported 2601 species, of which 531 are trees. Sunitha (2002) ^[31] surveyed the sacred groves of Kurnool district and reported 138 tree taxa, of which 119 are from Nallamalais. She made over 100 additions to the Nallamalais after Raju & Pullaiah (1995) ^[22], of which 18 are trees. Shali Saheb (2008) ^[28] studied the medicinal plants of Nallamalais and reported 501 taxa of which 137 are trees. Khadar Basha (2009) ^[13] was

studied quantitative assessment of Nallamalais and reported 249 tree species. Most of the studies have followed the plot methods including square plots of 100mx100m (Gentry, 1988); 10mx10m (Shalisaheb, 2008) to rectangular plots 10x100m by Boom (1986). Shah Hussain *et al.*, (2008) ^[27] describes the species composition and community structure of 23 forest stands in Kumaon Himalaya and reported 19 tree communities and 17 ground vegetation communities by sampling a total of 902 plots in 23 forest strands. Sunitha (2002) ^[31] carried out the phytosociological studies on sacred groves of Ahobilam in Nallamalais and reported 69 tree species from grove area; 34 from unprotected area. Shali Saheb (2008) ^[28] analysed the medicinal plant diversity in three one-hectare plots through ten quadrats of 10 x 10 m and recorded 135 species belonging to 110 genera and 45 families. Khadar Basha (2009) ^[13] recorded a total of 249 tree species from 175 grids comprising 237 species belonging to 139 genera and 54 families and enumerated 59, 319 individuals in a range of 8-871 individuals per grid.

Study Area

Gundlabrahmeswaram Wild Life Sanctuary (GBM-WLS) encompasses an area of 1,194 km² lies between N15° 22' 30" - 15° 53' & E78° 37' 30" - 78° 55' in southern part of Andhra Pradesh. It sprawls in two districts namely Kurnool and Prakasam; covering four forest divisions: Atmakur, Nandyal, Giddalur and Markapur. It is located between two important hill passes known as 'Mantralamma kanuma' and 'Nandi kanuma'. The Northern part of this sanctuary forms a major part of the Nagarjunasagar – Srisailem Tiger Reserve. The hilly terrain of the sanctuary, decked with plateaus, ridges, gorges and deep valleys support a diverse flora and fauna. Altitude of the GBM WLS range between 400-930 above MSL. January, February and March months are usually pleasant with moderate winds from southeast with an average temperature varies from 24 ° to 28 °C. April and May are the hottest months of the year with an average temperature of 32 °C-34 °C. The maximum temperature ranges during this season is 40°C and minimum is 26 °C. The Gundlabrahmeswaram plateau receives about 127 cm of rainfall.

Gundlabrahmeswaram WLS harbor a sacred grove. Sunitha (2002) ^[31] studied the plant biodiversity of sacred groves of Kurnool district covering Gundlabrahmeswaram. The springs, sacred groves and the perennial river 'Gundlakamma' that criss-crosses through the sanctuary add to the beauty of the sanctuary. The river Gundlakamma takes its origin in Nandyal division of Gundlabrahmeswaram and flows through Cumbum. There are many seasonal streams and natural perennial springs in Gundlabrahmeswaram wildlife sanctuary, other springs of due importance are at Rudrakodu, Onkaram and Ahobilam. The forests are broadly categorized into three types: moist deciduous, dry deciduous and scrub type. Moist deciduous type of vegetation confined to small patches and has rich floristic diversity and luxuriant forest growth. Evergreen trees are seen intermixed with deciduous forest. These are confined to perennial water courses. Scrub is usually confined to the base of hills, bordering hamlets and villagers.

Methodology

The main objectives of the present study are: to provide an inventory of trees of the sampled study area, Gundla Brahmeswaram WLS and study of phytosociological attributes of trees. The methodology followed is given here under.

Field Work

In the present study, the 'tree' is referred to a woody plant that generally has a single main stem and a more or less definite crown. In instances where growth form cannot be determined, woody plant equal to or greater than 5m in height at maturity was considered as tree. Field explorations were conducted in the study area for a period of 3 years during 2008-2011 covering all the seasons. A total of 40 plots of size 500x 5m (0.25ha) were laid randomly in the wildlife sanctuary. This accounts to 10ha sampled area. The tree resources were quantitatively assessed through 40 transects of size 500 x 5m covering the whole terrain. These transects are distributed equally in Prakasam and Kurnool districts of Andhra Pradesh. Belt transect of 500x5m was randomly laid in selected points based on heterogeneity of the terrain. In the belt transect all tree species with ≥30cm girth at breast height of 1.37m (gbh) from the ground were measured by using a measuring tape and their height was estimated by ocular estimates. For multiple stemmed trees, bole girths were measured separately; basal area was calculated for each stem. All the tree species were analyzed for abundance, density, frequency and basal area using standard methodologies following Curtis & McIntosh (1950) and Mueller- Dombois & Ellenberg (1974) ^[15]. These are the basis for determining the importance value index and diversity indices.

Importance Value Index (IVI)

$$IVI = \text{Relative dominance} + \text{Relative density} + \text{Relative frequency}$$

Dominance Index (Simpson, 1949) ^[30]

It is a measure of dominance since it weighted towards the abundances of commonest species. It is estimated by using formula:

$$D = \sum (ni/N)^2 \text{ or } Pi^2$$

Diversity Indices

Species diversity indices namely Shannon-Wiener index (Shannon and Weaver, 1962) ^[29], were calculated.

Shannon: Wiener index is a measure of the average degree of 'uncertainty' in predicting to what species an individual chosen at random from a collection of S species and N individuals will belong. It is estimated by using formula:

$$H' = -\sum (ni/N) \ln (ni/N)$$

Where, ni = number of individuals belonging to the species
N = Total number of individuals in the sample

Results

Phytosociological Attributes of Trees

The tree density of the sampled inventory is 61.97 stems ha⁻¹. The tree density compared with Western Ghats, from India from 300 to 635 tree ha⁻¹ (Condit *et al.*, 1996; Pascaland

Pelissier, 1996; Ghate *et al.*, 1998; Ayyappan and Parthasarathy, 1999) ^[1, 4]. Importance Value Index is the most important parameter to understand the community organization in relation to the competitive ability. Table 1 presents the IVI calculated for the tree taxa encountered in the study area. *Anogeissus latifolia* is the most dominant species (IVI=15.39; occupied 5.13% of the total tree species) followed by *Lannea coromandelica* (10.35; 3.45%), *Chloroxylon swietenia* (10.18; 3.39), *Pterocarpus marsupium* (8.36; 2.78%), *Boswellia serrata* (7.60; 2.53%), *Dalbergia lanceolaria* (7.37; 2.45%), *Cleistanthus collinus* (7.07; 2.35%) and *Ziziphus xylopyrus* (6.63; 2.21%). The IVI values revealed that GBM is dominated by relatively few species. It is observed that the top ten dominant tree

species have shared 28.4% of the total IVI values of the study area. The higher value of IVI indicates that all the available resources are being utilized by these species and left over are being trapped by another species as competitors and associates. The high IVI of a species indicated its dominance and ecological success, its good power of regeneration and greater ecological amplitude.

The low dominance is registered with *Pterospermum xylocarpu*, *Ficus arnottiana*, *Euphorbia nivulia* and *Eriolaena lushingtonii* (IVI=0.31) followed by *Kydia calycina*, *Ficus benghalensis* (0.45), *Holoptelea integrifolia* (0.51), *Streblus asper* (0.52), *Ficus racemosa* (0.54) and *Vitex altissima* (0.56). It is observed that the ten low dominant tree species have shared only 1.4% of the total IVI values of the study area.

Table 1: Phytosociological Attributes of Trees of Diversity Indices of the Sampled Inventory in Gundlabrahmeswaram Wls

S. No	Name of the Species	TNI	RD	H'	D	RA	RF	IVI
1	<i>Anogeissus latifolia</i>	682	8.87	-0.214938357	0.0078755520	4.41	2.11	15.39
2	<i>Lannea coromandelica</i>	423	5.50	-0.159603568	0.0030296537	2.73	2.11	10.35
3	<i>Chloroxylon swietenia</i>	401	5.22	-0.154089623	0.0027227076	3.30	1.65	10.18
4	<i>Pterocarpus marsupium</i>	318	4.14	-0.131792039	0.0017122473	2.45	1.77	8.36
5	<i>Boswellia serrata</i>	282	3.67	-0.121280864	0.0013465128	2.11	1.82	7.60
6	<i>Dalbergia lanceolaria</i>	271	3.53	-0.117953123	0.0012435145	1.96	1.88	7.37
7	<i>Cleistanthus collinus</i>	254	3.31	-0.11269507	0.0010923950	2.17	1.60	7.07
8	<i>Ziziphus xylopyrus</i>	234	3.04	-0.106318655	0.0009271371	1.64	1.94	6.63
9	<i>Terminalia alata</i>	218	2.84	-0.101058122	0.0008046838	1.49	2.00	6.32
10	<i>Tectona grandis</i>	207	2.69	-0.097353483	0.0007255259	1.50	1.88	6.07
11	<i>Hardwickia binata</i>	201	2.62	-0.095300959	0.0006840760	1.55	1.77	5.93
12	<i>Phyllanthus emblica</i>	192	2.50	-0.092178245	0.0006241870	1.27	2.05	5.83
13	<i>Cochlospermum religiosum</i>	171	2.23	-0.084673639	0.0004951132	1.70	1.37	5.30
14	<i>Lagerstroemia parviflora</i>	171	2.23	-0.084673639	0.0004951132	1.63	1.43	5.29
15	<i>Morinda pubescens</i>	142	1.85	-0.073747586	0.0003414200	1.17	1.65	4.67
16	<i>Givotia moluccana</i>	137	1.78	-0.071789867	0.0003177996	1.21	1.54	4.53
17	<i>Bridelia cinerascens</i>	108	1.41	-0.059936057	0.0001974967	1.23	1.20	3.83
18	<i>Dolichandrone atrovirens</i>	91	1.18	-0.052529749	0.0001402152	1.14	1.08	3.41
19	<i>Acacia catechu</i>	89	1.16	-0.051632615	0.0001341196	1.33	0.91	3.40
20	<i>Dalbergia paniculata</i>	87	1.13	-0.050729632	0.0001281595	0.99	1.20	3.32
21	<i>Ochna obtusata</i>	87	1.13	-0.050729632	0.0001281595	1.09	1.08	3.31
22	<i>Gardenia latifolia</i>	81	1.05	-0.047984216	0.0001110919	0.84	1.31	3.21
23	<i>Grewia tiliifolia</i>	82	1.07	-0.04844569	0.0001138518	1.09	1.03	3.18
24	<i>Strychnos potatorum</i>	71	0.92	-0.043277625	0.0000853550	0.63	1.54	3.09
25	<i>Holarrhena pubescens</i>	76	0.99	-0.045652338	0.0000978001	0.79	1.31	3.09
26	<i>Grewia flavescens</i>	65	0.85	-0.040367143	0.0000715384	0.54	1.65	3.03
27	<i>Sterculia urens</i>	71	0.92	-0.043277625	0.0000853550	0.68	1.43	3.03
28	<i>Buchanania axillaris</i>	71	0.92	-0.043277625	0.0000853550	1.41	0.68	3.02
29	<i>Mangifera indica</i>	74	0.96	-0.044707753	0.0000927205	0.84	1.20	3.00
30	<i>Gardenia gummifera</i>	73	0.95	-0.044232835	0.0000902315	0.92	1.08	2.95
31	<i>Careya arborea</i>	71	0.92	-0.043277625	0.0000853550	1.13	0.86	2.91
32	<i>Madhuca indica</i>	71	0.92	-0.043277625	0.0000853550	1.06	0.91	2.90
33	<i>Wrightia arborea</i>	67	0.87	-0.041344998	0.0000760084	0.70	1.31	2.88
34	<i>Dalbergia latifolia</i>	61	0.79	-0.038387152	0.0000630046	0.54	1.54	2.87
35	<i>Mitragyna parvifolia</i>	51	0.66	-0.033282394	0.0000440405	0.38	1.82	2.87
36	<i>Polyalthia cerasoides</i>	52	0.68	-0.033803599	0.0000457845	1.78	0.40	2.85
37	<i>Buchanania lanzan</i>	68	0.88	-0.041830998	0.0000782943	1.08	0.86	2.82
38	<i>Tamarindus indica</i>	56	0.73	-0.035863857	0.0000530992	0.48	1.60	2.80
39	<i>Strychnos nux-vomica</i>	58	0.75	-0.036879869	0.0000569598	0.60	1.31	2.67
40	<i>Wrightia tinctoria</i>	51	0.66	-0.033282394	0.0000440405	0.45	1.54	2.65
41	<i>Albizia odoratissima</i>	61	0.79	-0.038387152	0.0000630046	0.86	0.97	2.62
42	<i>Terminalia arjuna</i>	45	0.59	-0.030099719	0.0000342876	0.38	1.60	2.57
43	<i>Haldinia cordifolia</i>	54	0.70	-0.034838549	0.0000493742	0.59	1.25	2.54
44	<i>Eriolaena hookeriana</i>	56	0.73	-0.035863857	0.0000530992	0.70	1.08	2.52
45	<i>Premna tomentosa</i>	56	0.73	-0.035863857	0.0000530992	0.79	0.97	2.49
46	<i>Diospyros melanoxylon</i>	52	0.68	-0.033803599	0.0000457845	0.59	1.20	2.47
47	<i>Ceriscoides turgida</i>	54	0.70	-0.034838549	0.0000493742	0.99	0.74	2.44

48	<i>Cassia fistula</i>	46	0.60	-0.030637043	0.0000358284	1.37	0.46	2.43
49	<i>Garuga pinnata</i>	51	0.66	-0.033282394	0.0000440405	0.64	1.08	2.39
50	<i>Naringi crenulata</i>	45	0.59	-0.030099719	0.0000342876	0.47	1.31	2.36
51	<i>Syzygium cumini</i>	48	0.62	-0.031703264	0.0000390117	0.57	1.14	2.34
52	<i>Bauhinia racemosa</i>	42	0.55	-0.028470131	0.0000298683	0.42	1.37	2.33
53	<i>Schrebera swietenoides</i>	43	0.56	-0.02901633	0.0000313076	0.45	1.31	2.32
54	<i>Schleichera oleosa</i>	31	0.40	-0.022238672	0.0000162718	0.35	1.20	1.95
55	<i>Terminalia bellirica</i>	32	0.42	-0.022823848	0.0000173385	0.40	1.08	1.90
56	<i>Hymenodictyon orixense</i>	34	0.44	-0.023982123	0.0000195736	0.48	0.97	1.89
57	<i>Dillenia pentagyna</i>	29	0.38	-0.021055584	0.0000142399	1.16	0.34	1.87
58	<i>Bombax ceiba</i>	32	0.42	-0.022823848	0.0000173385	0.42	1.03	1.87
59	<i>Semecarpus anacardium</i>	32	0.42	-0.022823848	0.0000173385	0.42	1.03	1.87
60	<i>Nyctanthes arbor-tristis</i>	35	0.46	-0.024555461	0.0000207419	0.60	0.80	1.85
61	<i>Alangium salvifolium</i>	28	0.36	-0.020457383	0.0000132748	1.12	0.34	1.82
62	<i>Melia dubia</i>	28	0.36	-0.020457383	0.0000132748	0.35	1.08	1.80
63	<i>Erythrina stricta</i>	29	0.38	-0.021055584	0.0000142399	0.99	0.40	1.77
64	<i>Aegle marmelos</i>	28	0.36	-0.020457383	0.0000132748	0.96	0.40	1.72
65	<i>Terminalia chebula</i>	27	0.35	-0.019854534	0.0000123435	0.38	0.97	1.70
66	<i>Cassine glauca</i>	30	0.39	-0.021649297	0.0000152389	0.65	0.63	1.67
67	<i>Ximenia americana</i>	25	0.33	-0.018634189	0.0000105826	0.35	0.97	1.65
68	<i>Deccania pubescens</i>	28	0.36	-0.020457383	0.0000132748	0.48	0.80	1.64
69	<i>Butea monosperma</i>	22	0.29	-0.016764038	0.0000081952	1.05	0.29	1.62
70	<i>Albizia thompsonii</i>	19	0.25	-0.014840488	0.0000061125	1.14	0.23	1.61
71	<i>Canthium dicoccum</i>	19	0.25	-0.014840488	0.0000061125	1.14	0.23	1.61
72	<i>Ixora arborea</i>	26	0.34	-0.019246865	0.0000114461	0.48	0.74	1.56
73	<i>Ailanthus excelsa</i>	26	0.34	-0.019246865	0.0000114461	0.69	0.51	1.54
74	<i>Sapindus emarginatus</i>	21	0.27	-0.016129156	0.0000074671	0.30	0.97	1.54
75	<i>Ziziphus mauritiana</i>	21	0.27	-0.016129156	0.0000074671	0.31	0.91	1.50
76	<i>Syzygium alternifolium</i>	22	0.29	-0.016764038	0.0000081952	0.75	0.40	1.44
77	<i>Erythroxylum monogynum</i>	21	0.27	-0.016129156	0.0000074671	0.63	0.46	1.36
78	<i>Gardenia resinifera</i>	18	0.23	-0.014186047	0.0000054860	0.31	0.80	1.34
79	<i>Albizia lebeck</i>	15	0.20	-0.012177571	0.0000038097	0.90	0.23	1.32
80	<i>Balanites aegyptiaca</i>	9	0.12	-0.007904777	0.0000013715	1.08	0.11	1.31
81	<i>Albizia amara</i>	19	0.25	-0.014840488	0.0000061125	0.65	0.40	1.29
82	<i>Soyimida febrifuga</i>	19	0.25	-0.014840488	0.0000061125	0.41	0.63	1.29
83	<i>Stereospermum personatum</i>	17	0.22	-0.013524373	0.0000048934	0.34	0.68	1.24
84	<i>Mallotus philippensis</i>	16	0.21	-0.012855041	0.0000043346	0.29	0.74	1.24
85	<i>Limonia acidissima</i>	18	0.23	-0.014186047	0.0000054860	0.54	0.46	1.23
86	<i>Ficus hispida</i>	12	0.16	-0.010090492	0.0000024382	0.72	0.23	1.10
87	<i>Capparis grandis</i>	7	0.09	-0.006377073	0.0000008297	0.84	0.11	1.04
88	<i>Commiphora caudata</i>	7	0.09	-0.006377073	0.0000008297	0.84	0.11	1.04
89	<i>Wendlandia tinctoria</i>	11	0.14	-0.009374162	0.0000020488	0.66	0.23	1.03
90	<i>Memecylon umbellatum</i>	11	0.14	-0.009374162	0.0000020488	0.29	0.51	0.95
91	<i>Bridelia crenulata</i>	8	0.10	-0.007149079	0.0000010837	0.64	0.17	0.91
92	<i>Phyllanthus indofischeri</i>	8	0.10	-0.007149079	0.0000010837	0.64	0.17	0.91
93	<i>Phyllanthus polyphyllus</i>	8	0.10	-0.007149079	0.0000010837	0.64	0.17	0.91
94	<i>Suregada angustifolia</i>	9	0.12	-0.007904777	0.0000013715	0.54	0.23	0.88
95	<i>Vitex pinnata</i>	9	0.12	-0.007904777	0.0000013715	0.27	0.46	0.84
96	<i>Dolichandrone falcata</i>	9	0.12	-0.007904777	0.0000013715	0.43	0.29	0.83
97	<i>Manilkara hexandra</i>	9	0.12	-0.007904777	0.0000013715	0.31	0.40	0.82
98	<i>Vitex leucoxydon</i>	7	0.09	-0.006377073	0.0000008297	0.56	0.17	0.82
99	<i>Mallotus rhamniifolius</i>	9	0.12	-0.007904777	0.0000013715	0.36	0.34	0.82
100	<i>Pongamia pinnata</i>	3	0.04	-0.003063792	0.0000001524	0.72	0.06	0.81
101	<i>Diospyros chloroxydon</i>	8	0.10	-0.007149079	0.0000010837	0.48	0.23	0.81
102	<i>Gyrocarpus americanus</i>	8	0.10	-0.007149079	0.0000010837	0.38	0.29	0.77
103	<i>Ficus mollis</i>	7	0.09	-0.006377073	0.0000008297	0.42	0.23	0.74
104	<i>Euphorbia antiquorum</i>	7	0.09	-0.006377073	0.0000008297	0.28	0.34	0.71
105	<i>Cordia dichotoma</i>	6	0.08	-0.005586415	0.0000006096	0.36	0.23	0.66
106	<i>Morinda angustifolia</i>	6	0.08	-0.005586415	0.0000006096	0.36	0.23	0.66
107	<i>Oroxylum indicum</i>	6	0.08	-0.005586415	0.0000006096	0.36	0.23	0.66
108	<i>Gmelina arborea</i>	6	0.08	-0.005586415	0.0000006096	0.29	0.29	0.65
109	<i>Azadirachta indica</i>	4	0.05	-0.003935319	0.0000002709	0.48	0.11	0.64
110	<i>Cleistanthus patulus</i>	4	0.05	-0.003935319	0.0000002709	0.48	0.11	0.64
111	<i>Acacia leucophloea</i>	2	0.03	-0.002148049	0.0000000677	0.48	0.06	0.56
112	<i>Casearia tomentosa</i>	2	0.03	-0.002148049	0.0000000677	0.48	0.06	0.56

113	<i>Ficus rumphii</i>	2	0.03	-0.002148049	0.0000000677	0.48	0.06	0.56
114	<i>Sterculia villosa</i>	2	0.03	-0.002148049	0.0000000677	0.48	0.06	0.56
115	<i>Vitex altissima</i>	2	0.03	-0.002148049	0.0000000677	0.48	0.06	0.56
116	<i>Ficus racemosa</i>	4	0.05	-0.003935319	0.0000002709	0.32	0.17	0.54
117	<i>Streblus asper</i>	4	0.05	-0.003935319	0.0000002709	0.24	0.23	0.52
118	<i>Holoptelea integrifolia</i>	3	0.04	-0.003063792	0.0000001524	0.36	0.11	0.51
119	<i>Ficus benghalensis</i>	3	0.04	-0.003063792	0.0000001524	0.24	0.17	0.45
120	<i>Kydia calycina</i>	3	0.04	-0.003063792	0.0000001524	0.24	0.17	0.45
121	<i>Eriolaena lushingtonii</i>	1	0.01	-0.001164219	0.0000000169	0.24	0.06	0.31
122	<i>Euphorbia nivulia</i>	1	0.01	-0.001164219	0.0000000169	0.24	0.06	0.31
123	<i>Ficus arnottiana</i>	1	0.01	-0.001164219	0.0000000169	0.24	0.06	0.31
124	<i>Pterospermum xylocarpum</i>	1	0.01	-0.001164219	0.0000000169	0.24	0.06	0.31

Abbreviations: TNI-Total Number of Individuals, RD-Relative Density, H'- Shannon-Wiener Index, D- Simpson Index RA-Relative Abundance, RF-Relative Frequency, IVI-Importance Value Index

Table 2: Diversity of Tree Species in the Sampled Inventory

VARIABLES	VALUE
No. of Species	124
No. of Genera	89
No. of Families	39
Stems ha ⁻¹	61.97
Basal Area m ² ha ⁻¹	4.69
Shannon-Wiener	4.07
Simpson	0.027

Species abundance

Anogeissus latifolia was the most abundant species (8.8%, 682 stems) in the study area followed by *Lannea coromandelica* (5.5%, 423 stems), *Chloroxylon swietenia* (5.2%, 401), *Pterocarpus marsupium* (4.1%, 318 stems), *Bosewellia serrata* (3.6%, 282 stems), *Dalbergia lanceolaria* (3.5%, 271 stems) and *Cleistanthus collinus* (3.3%, 234 stems). Whereas 4 species represents only single individual including are *Eriolaena lushingtonii*, *Euphorbia nivulia*, *Ficus arnottiana* and *Pterospermum xylocarpum*. It is observed that the top ten abundant species have shared nearly 42.8% of the total density of the study area. According to Beard (1955), formation series, edaphic factors as well as annual rainfall are responsible for the difference in forest structure among various tropical dry deciduous forest formations. Sagar *et al.* (2003) as observed in the dry forests of Vindhyan hills, that few dominant tree species are better evolved to these dry conditions and can utilize the resources in a better way.

Species dominance and diversity

The diversity index is a mathematical expression that combine three components of community structure, i.e. richness (number of species present), evenness (the distribution of individuals among species) and abundance (total number of plants present). The Simpson_1-D dominance value of study area is 0.027, Shannon_H diversity 4.07.

Conclusions

A total of 124 tree species were recorded in the sampled inventory of Gundlabrahmeswaram wildlife sanctuary. The dominant families are: Fabaceae-Faboideae with 17 species followed by Euphorbiaceae and Rubiaceae 13 species each. Of the 39 families, 17 are monotypic, represented with only one species. A total of 4 endemic taxa are recorded from the study area: 3 are endemic to peninsular India such as *Bridelia cinerascens*, *Dolichandrone atrovirens* and *Hardwickia binata* and *Albizia thompsonii* is endemic to Eastern Ghats. Of the

124 tree taxa, 71% trees are with deciduous nature. Of the 124 tree taxa recorded from the sampled inventory, 120 taxa are having one or other use value. This comprises 96.7% of the total recorded trees of GBM. Of the 124 tree species, 17 taxa (13.7%) yield edible fruits (eaten both by humans and animals), 31 (25.0%) with timber value, 93 (76.61%) with medicinal value, 6 (4.83%) with fiber value, 54 (43.54%) with fuel wood value and 33 taxa (26.6%) of miscellaneous uses. Pertaining to phytosociological attributes, the mean stem density of the sampled inventory is 61.97 stems ha⁻¹ The Simpson dominance value of study area is 0.027 and Shannon diversity 4.07. The tree density of the sampled inventory is 61.97 stems ha⁻¹. The mean basal area of the sampled inventory is 4.69 m² ha⁻¹. *Anogeissus latifolia* is the most dominant species (IVI=15.39; occupied 5.13% of the total tree species) followed by *Lannea coromandelica* (10.35; 3.45%). It is observed that the top ten dominant tree species have shared 28.4% of the total IVI values of the study area.

Anogeissus latifolia was the most abundant species (8.8%, 682 stems) in the study area followed by *Lannea coromandelica* (5.5%, 423 stems), *Chloroxylon swietenia* (5.2%, 401), *Pterocarpus marsupium* (4.1%, 318 stems), *Bosewellia serrata* (3.6%, 282 stems), *Dalbergia lanceolaria* (3.5%, 271 stems) and *Cleistanthus collinus* (3.3%, 234 stems). Whereas 4 species represents only single individual including are *Eriolaena lushingtonii*, *Euphorbia nivulia*, *Ficus arnottiana* and *Pterospermum xylocarpum*.

GBM WLS although a protected area, needs further attention in terms of conserving valuable tree resources. Good marketing avenues have to be created for the local communities regarding trees of medicinal value. Intensive training programmes have to be organized for tribal and other communities by governmental and non-governmental agencies regarding the sustainable collection, utilization and conservation of tree resources.

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