Survival threat to the Flora of Mudumalai Wildlife Sanctuary, India: An Assessment based on Regeneration Status

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ABSTRACT: The present study investigates the regeneration status in tropical dry and moist deciduous forests of Mudumalai Wildlife Sanctuary, Western Ghats, India. A total of 124 tree species were recorded in tropical deciduous forest system. Out of the 104 species (young and mature trees) recorded 28.8% showed good regeneration,5.8% represented fair, 33.7% poor, 29.8% showed no regeneration and 6 (5.8%) were considered as new arrivals in moist deciduous forest. In the case of dry deciduous forest out of 86 (young and mature trees) 33.7 % showed good regeneration, 3.5% fair, 16.3% poor, 17.4% showed no regeneration and 9 species (10.5%) were considered as new arrivals. Absence of Younger type of most of the species infers impact of anthropogenic disturbances such as recurrent forest fires, cattle grazing and biological invasion of exotic weeds on natural regeneration. The basic analysis may be considered here to be driven by two criteria: Species endemism and degree of threat, and therefore survival threat to the flora of the Mudumalai wildlife sanctuary was studied. [Nature and Science. 2008;6(4):42-54]. ISSN: 1545-0740

KEYWORDS: Regeneration, Dry deciduous, Moist deciduous, IVI, forest fires, Mudumalai, India.

INTRODUCTION

The degradation of tropical forests and destruction of habitats due to anthropogenic disturbances are a major cause of decline in global diversity. To compensate this decline, in many areas, restoration of degraded ecosystems is being taken up on a priority basis which will help in long term conservation of biodiversity of protected areas. Floristic inventory is an essential component in proper management measures so that a systematic monitoring process can be evaluated for changes that may have taken place in the protected areas due to biotic pressure from surrounding human influences.

The present study deals with the regeneration status of tree species in dry and moist deciduous forest types of Mudumalai Wildlife Sanctuary, which is a part of Nilgiri Biosphere Reserve and is also under consideration by the UNSECO as World Heritage site. Tropical deciduous forests assume unusual significance for conservation since they are the most used and threatened ecosystems, especially in India (Janzen, D.H, 1986). In accordance with the International effort of large scale permanent plots, Indian Institute of Science and Smithsonian Tropical Research Institute (STRI) established a 50 ha plot in Mudumalai Wildlife Sanctuary for studying dry forests dynamics in 1988 (Sukumar *et al*. 1992, Joshi *et al.* 1997, Condit *et al*. 2000, Plotkin, 2000). The fire frequency in the sanctuary has been studied by Kodandapani *et al*. (2004). The flora of the sanctuary was prepared by Sharma (1977) and Suresh *et al*. (1996). Except these studies, the detailed assessment of regeneration status has not been studied so far in the whole sanctuary. This basic lack of information hampered the conservation prioritization of the area from various threats (Sudhakar & Reddy 2005) and according to the IUCN category of protected areas Mudumalai falls under category IV (Habitat/Species conservation) so such study was considered as significant with regard to the aspect of species conservation.

In general, regeneration of species is affected by anthropogenic factors (Khan and Tripathi 1989; Barik *et al*. 1996). Studies related to this field will contribute in planning, conservation and decision making in natural forest resource management. Natural regeneration is important as it addresses mainstream biodiversity concerns. (Ramesh *et al.* 2006). Such studies are relevant for studying natural regeneration mechanism. So, an attempt has been made to assess the regeneration status of Mudumalai wildlife sanctuary with reference to dry and moist deciduous forests.

STUDY AREA:

Mudumalai Wildlife Sanctuary lies on the northwestern side of Nilgiri hills about 80 km north – west of Coimbatore in the western part of Tamil Nadu, on the interstate boundaries with Karnataka and Kerela states in South India. It is situated between 11°32'-11°43'N, 76°22'-76°45'E. Originally 60 sq kms, the sanctuary was enlarged to 295 km² in 1956 and subsequently to its present size of 321 km². The park is contiguous with Bandipur National Park (874 km²), Wynad Wildlife Sanctuary (344 km²), Sigur and Singara reserve forests. Its topography is extremely varied and comprises of Hills, valleys, Ravines, Water courses and Swamps. The Moyar River finds its way through this sanctuary, gifting it a number of awesome cascades. The main forest types in Mudumalai Wildlife Sanctuary are Dry deciduous and Moist deciduous. Semi-evergreen, riparian and Scrub types are localized in distribution and represents minor part of the study area.

MATERIALS AND METHODS:

Phytosociological studies were carried out using quadrat method since it is the most widely used technique for the plant census. The data was collected from 36 and 25 randomly selected quadrats of 0.1 ha size with a sampling intensity of 0.03% for dry deciduous and moist deciduous types respectively. Trees measuring <30 cm GBH were considered as young ones (saplings) and >30 cm as mature (adults). One quadrat of 10 x 10 m was laid within 0.1 ha quadrat for recording number of young trees. Herbarium specimens were prepared and identified with the help of floras and confirmed with the specimens deposited at Botanical Survey of India, Coimbatore. The spatial location (latitude, longitude and altitude) of each quadrat was collected using a Global Positioning System (GPS). Care has been taken to cover different elevation, slope, aspects, drainage density, rainfall and temperature gradients to study overall spectrum of tree species diversity and regeneration.

The data collected were analyzed to determine Relative values of density, frequency and abundance. The Importance Value Index for each species was also computed as the sum of the relative frequency, relative density and relative basal area (Cottam and Curtis, 1956; Phillips, 1959). The different indices such as Shannon diversity index (Shannon-Weaver, 1949), Simpson dominance index (Simpson, 1949) along with Margalef Species richness index (Margalef, 1958) was determined. Similarity between the two forest types was determined using Sorenson's index of similarity (Sorenson, 1948).

Regeneration status of species was determined based on population size of young ones (saplings) and matured trees (Khan *et al*. 1997; Uma Shankar, 2001; Ashalata *et al*. 2006). If a species is present only in adult form it is considered as not regenerating. Species are considered as 'new' if the species has no adults, but only young ones.

RESULTS AND DISCUSSION:

The present study focuses on the dry deciduous and moist deciduous forest types. To understand the status of regeneration, information on young ones (saplings) and mature trees was taken into account. Species endemism and degree of threat was also considered as one of the aspects to understand the survival threat to the flora of Mudumalai wildlife sanctuary.

A total of 124 tree species were recorded in tropical deciduous forest system. Of the 124 species recorded 104 species were of moist deciduous forest type, within this category 89 were belonging to mature stratum and 21 species to young category. 86 species were belonging to dry deciduous forest type 64 mature trees category and 22 species are belonging to young category.

The highest Shannon and Weiner index was observed for moist deciduous (4.90) followed by dry deciduous (3.94). The high value of 4.90 in case of Moist Deciduous was probably due to the association of various species in and along the riverine tracts. The highest Simpson Index of Dominance also observed for moist deciduous Forest (0.94) followed by dry deciduous (0.86). The highest Margalef index of Species richness was observed for moist deciduous (8.31) followed by dry deciduous type (6.28). Similarity index reveals that 83.9 % of floristic composition of dry deciduous forest is similar with moist deciduous forest. The stand density was 407 ha^{-1} for moist deciduous followed by 406 ha^{-1} for dry deciduous type and mean basal area was 36 m² ha–1 (table1). Growth forms, namely young and mature trees when considered with reference to density, young species were less abundant.

Out of the 104 species (young and mature trees) 28.8% showed good regeneration, 5.8% represented fair, 33.7% poor, 29.8% showed no regeneration and 6 species (5.8%) were considered as new arrivals in moist deciduous forest. In the case of dry deciduous forest 33.7% showed good regeneration, 3.5% fair, 16.3% poor, 17.4% showed no regeneration and 9 (10.5%) species were considered as new arrivals.(table: 3).Complete absence of young tree species in a forest indicates poor regeneration, while presence of sufficient number of young individuals in a given species population indicates successful regeneration (Saxena and Singh 1984). In the present study under investigation out of the 104 species, 70 species showed no young category in moist deciduous type indicating that 67.3% indicating the overall regeneration status of the forest as poor and 44 species were not found in mature category (42.3%) in moist deciduous type and 76 species (88.4%) of mature trees were not found in dry deciduous forest type.

Absence of saplings of most of the species infers impact of anthropogenic disturbances such as recurrent forest fires, cattle grazing and biological invasion of exotic weeds (mainly *Lantana camara*) on natural regeneration. (Chandrasekhar *et al)*. Six species were new (*Bauhinia racemosa*, *Bridelia crenulata*, *Cinnamommum* sp., *Croton oblongifolius*, *Murraya koenigii and Vernonia arborea)* which were not recorded in mature stratum in the moist deciduous type. But, *Murraya koenigii* is a small tree, which may not attain a girth of 30 cm and beyond. In the case of dry deciduous type *Acacia leucophloea*, *Atalantia monophylla*, *Casearia graveolens*, *Cordia wallichii*, *Lagerstroemia parviflora*, *Miliusa tomentosa*, *Soymida febrifuga*, *Tamarindus indica and Terminalia paniculata* were found to be new. Invasion of 'new' species indicates a possible outcome of co-existence.

The dominant tree species (which had higher values of IVI) for dry deciduous forest type are *Anogeissus latifolia*, *Tectona grandis*, *Terminalia alata* and *Phyllanthus emblica*. (table: 2). In young category *Anogeissus latifolia* (n=203), *Terminalia alata* (n=69) and *Tectona grandis* (n=36) represents fewer individuals. In the case of mature tree category *Anogeissus latifolia* (n=143), *Tectona grandis* (n=81) and *Terminalia alata* (n=61) represents high number of individuals.

The dominant tree species for moist deciduous forest are *Tectona grandis*, *Lagerstroemia microcarpa*, *Grewia tilifolia*, *Terminalia alata* and *Syzygium cumini.* (table 2). Analysis of young and mature tree species categories in this forest type also shows interesting results. Young trees showed Tectona *grandis* (n=52), *Grewia tilifolia* (n=56) with fewer individuals and *Lagerstroemia microcarpa* (n=72). In the case of mature trees *Tectona grandis* (n=59), *Lagerstroemia microcarpa* (n=46) and *Grewia tiliifolia* (n=34) (table 3). Based on the relative proportion of young and mature trees the future community structure and regeneration status of dry and moist deciduous forest type could be predicted. Greater number of young category indicates that these species will persist and may determine the future composition of forest type.

In dry deciduous forest, *Shorea roxburghii* represents 1075 individuals in young category, but mature trees are about13. It indicates that in the past, *Shorea roxburghii* was exploited for timber (table 3).

Overall, regeneration was poor indicated by fewer young species in the forest. This may lead to the reduction of mature trees and hence change in the structure of the forest. Due to the less number of the young individuals there may be threat to the most of the tree species in near future. The species diversity was more, however, only a few species had more number of individuals as compared to the other species. Many rare, localized and old growth 'specialists' species may decline over time and regeneration can be adversely affected so there is a need for continuous monitoring of population dynamics on a long term basis in order to know whether a species is increasing, stable or declining. Grazing by resident as well as migratory livestock in and around the forest corridors, have adversely affected the forest regeneration and helped proliferation of weed species such as *Lantana camara*, *Casia tora*, *C. occidentalis* and *Ageratum conyzoides*. Livestock grazing, a major biotic interference in this forest corridor, originates from seven settlements of the Masinagudi group of villages on the eastern and the southeastern fringes of the sanctuary and this interference may in long run hamper the ecodevelopment which may affect long term conservation of species population. The endemic species found here include *Cinnamomum sp*, *Ehretia canarensis and Glohidion velutinum*, *Actinodaphne malabarica*, *Bridelia crenulata*, *Deccania pubescens*, *Eriolaena quenquelocularis*, *and Terminalia paniculata*, *Dolichandrone arcuata*, *Syzygium malabaricum*, *Antidesma menasu*, *Lagerstroemia microcarpa*, *Litsea coriacea* and *Phyllanthus indofisheri*. These species when correlated with regeneration status showed interesting results with in which *Glochidion velutinum* showed poor regeneration status, *Ehretia canarensis* as good followed by *Cinnamomum s* as new, *Actinodaphne malabarica* showed poor regeneration, *Deccania pubescens and Eriolaena quenquelocularis* as not regenerating, *Terminalia paniculata* as good, and *Bridelia crenulata* as new arrival. *Syzygium malabaricum* showed no regeneration and *Antidesma menusa* showed poor where as *Dolichandrone arcuta* showed no regeneration. *Lagerstroemia microcarpa* was showing good regeneration followed by *Litsea coriacea* and *Phyllanthus indofisheri* showed poor regeneration.

Similar studies in other tropical forests shows reversible tendency as compared with present study. Konthoujam Lairembi sacred grove in North-East India, out of the 55 species, 15% showed good regeneration, 22% fair, 22% poor and 16% were not regenerating, while14 species (25%) were represented only by seedlings or saplings. The species falling under the last category were regarded as the new arrivals in this grove. In Mahabali grove out of 38 species, 7 (19%) showed good regeneration, while 6 (16%) and 5 (13%) species exhibited fair and poor regeneration, respectively. Two species (5%) showed no regeneration and 18 species (47%) were 'new' to this grove (Ashalata *et al*. 2006). However in the present study area higher percentage (47.1%) showed no regeneration in moist deciduous forest type emphasizing the need to evaluate the reasons for such higher percentage.

Table 1: Consolidated details of species inventory in dry and moist deciduous forest types of Mudumalai Wildlife sanctuary, Western Ghats

Description	Dry Deciduous	Moist Deciduous	Total
No. Of Sample Points	36	25	61
No. of Tree Species	66	83	124
Density (stems/ha^{-1})	406	407	407
Basal area (m²/ha^{-1})	25	49	36
Species Diversity Index H'	3.94	4.90	4.42
Simpson Index	0.86	0.94	0.9
Margalef Species Richness Index	6.28	8.31	7.3
Similarity Index :			
Dry deciduous	-	83.9	
Moist Deciduous	-	-	

Table 2: Ecological dominance of top ten species in dry deciduous and moist deciduous forest types of Mudumalai Wildlife Sanctuary, Western Ghats

		Dry Deciduous			
Sl.no.	Species	Relative Density	Relative Frequency	Relative Dominance	IVI
1	*Anogeissus latifolia*	35.2	14.4	30.8	80.4
2	*Tectona grandis*	19.8	11.52	33.9	65.3
3	*Terminalia alata*	15.1	10.7	13.0	38.8
4	*Phyllanthus emblica*	1.92	5.76	0.84	8.51
5	*Lagerstroemia microcarpa*	1.98	4.9	1.31	8.23
6	*Shorea roxburghii*	3.22	3.7	1.02	7.94
7	*Dalbergia latifolia*	1.23	4.12	2.53	7.88
8	*Radermachera xylocarpa*	1.57	2.06	2.57	6.20
9	*Ziziphus xylopyrus*	1.98	3.29	0.47	5.75
10	*Buchanania lanzan*	1.03	3.29	0.56	4.88
		Moist Deciduous			
1	*Tectona grandis*	14.6	7.35	21.1	43.0
2	*Lagerstroemia microcarpa*	11.4	6.53	15.2	33.2
3	*Grewia tiliifolia*	8.26	6.94	9.37	24.6
4	*Terminalia alata*	8.55	6.12	8.96	23.6
5	*Syzygium cumini*	7.28	6.12	8.47	21.9
6	*Anogeissus latifolia*	7.28	4.08	3.62	15.0
7	*Radermachera xylocarpa*	4.03	2.45	5.66	12.1
8	*Schleichera oleosa*	2.65	3.67	4.96	11.3
9	*Cassia fistula*	5.21	3.67	0.41	9.30
10	*Bambusa arundinacea*	5.51	2.04	0.40	7.94

Table 3: Percentage proportion of young and mature trees in dry and moist deciduous forest types of Mudumalai Wildlife Sanctuary

		Moist Deciduous Forest					Dry Deciduous Forest					Total	
SL	Species	Young		Mature trees		Status	Young		Mature trees		Status		
		NO.	%	NO.	%		NO.	%	NO.	%		NO.	%
1	*Acacia chundra*	1	7.1	-	-	P	6	39.7	7	51.6	F	14	100
2	Acacia *ferrugenia*	-	-	1	12.9	N	6	71.7	1	17.9	G	8	100
3	*Acacia leucophloea*	-	-	-	-	-	3	100	-	-	NEW	3	100
4	*Albizia amara*	-	-	-	-	-	8	90.9	1	9.1	G	9	100
5	*Actinodaphne malabarica*	1	100	-	-	P	-	-	-	-	-	1	100
6	*Albizia odoratissima*	4	52.8	1	13.2	G	3	36.7	-	-	-	8	100
7	*Anogeissus latifolia*	8	2.1	30	7.7	F	203	52.9	143	37.3	G	383	100
8	*Atalantia monophylla*	1	32.7	-	-	P	3	90.9	-	-	NEW	3	100
9	*Anthocephalus chinense*	1	100	-	-	P	1	100	-	-	P	1	100
10	*Antidesma menasu*	1	100	-	-	P	-	-	-	-	-	1	100
11	*Aporosa lindleyana*	1	100	-	-	P	-	-	-	-	-	1	100
12	*Bauhinia racemosa*	28	63.9	-	-	NEW	14	31.7	2	4.4	G	44	100
13	*Bambusa arundinacea*	436	77.5	22	4.0	G	100	17.8	4	1	G	562	100
14	*Bauhinia malabarica*	1	50	-	-	P	-	-	1	42	N	2	100
15	*Bombax ceiba*	-	-	1	100	N	1	100	-	-	P	2	100
16	*Bridelia crenulata*	16	100	-	-	NEW	-	-	-	-	-	16	100
17	*Bridelia montana*	1	20	-	-	P	3	55.6	1	11.1	G	5	100
18	*Buchanania lanzan*	4	5.5	1	1.4	G	64	88.2	4	5.8	G	72	100
19	*Butea monosperma*	28	84.9	1	3.0	G	3	8.4	1	4.2	G	33	100
20	*Callicarpa tomentosa*	1	33.3	2	66.6	F	-	-	-	-	-	3	100
21	*Careya arborea*	80	77.1	2	1.9	G	19	18.7	3	2.7	G	104	100
22	*Casearia elliptica*	2	53.6	1	26.8	G	3	74.4	1	14.9	G	4	100
23	*Casearia esculenta*	1	50	-	-	P	1	28	-	-	P	2	100
24	*Casearia graveolens*	1	25	-	-	P	3	69.4	-	-	NEW	4	100

25	*Cassia fistula*	356	70.3	21	4.2	G	128	25.2	1	0.3	G	506	100
26	*Cassine glauca*	-	-	1	50	N	1	50	-	-	P	2	100
27	*Celtis tetrandra*	12	80.0	2	10.6	G	1	6. 7	-	-	P	15	100
28	*Celtis timoriensis*	-	-	1	100	N	-	-	-	-	-	1	100
29	*Cinnamomum sp*	108	99.1	-	-	NEW	1	0.9	-	-	P	109	100
30	*Chionanthus malabarica*	-	-	5	26.1	N	14	69.7	1	4.2	G	20	100
31	*Chloroxylon swietenia*	1	9.23	-	-	P	6	51.3	5	48.7	G	11	100
32	*Chukrasia tabularis*	-	-	2	48	N	1	20	2	40	F	5	100
33	*Cleistanthus patulus*	1	50	-	-	P	1	50	-	-	-	2	100
34	*Cordia macleodii*	-	-	2	100	N	-	-	-	-	-	2	100
35	*Cordia obliqua*	-	-	1	100	N	-	-	-	-	-	1	100
36	*Cordia wallichii*	1	25	-	-	P	3	69.4	-	-	NEW	4	100
37	*Croton oblongifolius*	20	100	-	-	NEW	-	-	-	-	-	20	100
38	*Dalbergia lanceolaria*	1	100	-	-	P	-	-	-	-	-	1	100
39	*Dalbergia latifolia*	16	33.3	5	9.9	G	22	46.3	5	10.4	G	48	100
40	*Deccania pubescens*	-	-	1	100	N	-	-	-	-	-	1	100
41	*Diospyros montana*	8	66.7	4	33.3	G	-	-	-	-	-	12	100
42	*Dolichandrone arcuata*	-	-	-	-	-	-	-	1	100	N	1	100
43	*Ehretia canarensis*	3	188	2	100	G	-	-	-	-	-	2	100
44	*Elaeocarpus tuberculatus*	4	76.9	1	23.0	G	-	-	-	-	-	5	100
45	*Eriolaena quenquelocularis*	-	-	1	100	N	-	-	-	-	-	1	100
46	*Erythrina suberosa*	4	90.9	1	22.7	G	-	-	-	-	-	4	100
47	*Erythrina variegata*	4	85.5	1	21.3	G	1	21.4	-	-	P	5	100
48	*Euodia lunu-ankenda*	1	100	-	-	P	-	-	-	-	-	1	100
49	*Ficus benghalensis*	-	-	1	100	N	-	-	-	-	-	1	100
50	*Ficus hispida*	4	55.6	3	44.4	G	-	-	-	-	-	7	100

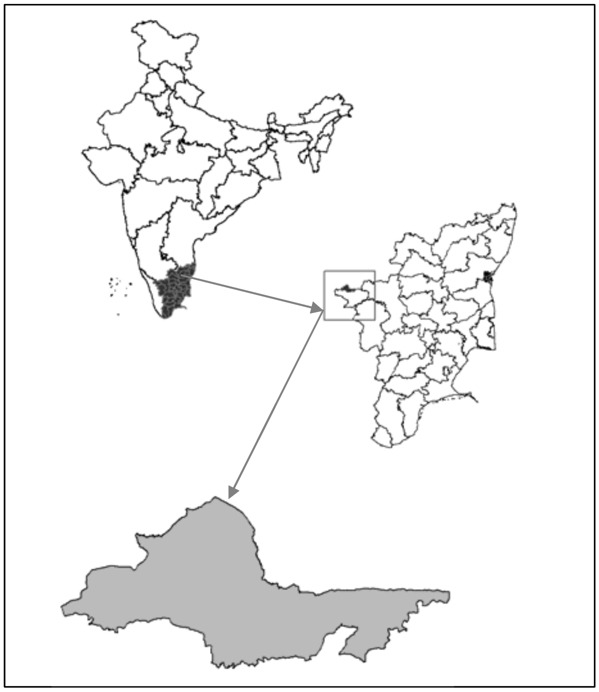
51	*Ficus mysorensis*	1	50	-	-	P	-	-	-	-	-	1	100
52	*Ficus racemosa*	4	66.7	1	16.6	G	1	16.6	-	-	P	6	100
53	*Ficus tsjakela*	1	100	-	-	P	-	-	-	-	-	1	100
54	*Ficus virens*	1	50	-	-	P	1	50	-	-	P	2	100
55	*Firmiana colorata*	2	200	1	100	G	-	-	-	-	-	1	100
56	*Flacourtia montana*	-	-	1	100	N	-	-	-	-	-	1	100
57	*Gardenia gummifera*	4	80.0	1	20.0	G	-	-	-	-	-	5	100
58	*Gardenia latifolia*	1	20	-	-	P	3	55.6	1	20	G	5	100
59	*Givotia rottleriformis*	1	50	-	-	P	-	-	1	28	N	2	100
60	*Glochidion velutinum*	1	100	-	-	P	-	-	-	-	-	1	100
61	*Gmelina arborea*	1	100	-	-	P	-	-	-	-	-	1	100
62	*Grewia tiliifolia*	56	54.3	34	32.5	G	11	10.8	3	2.4	G	103	100
63	*Heterophragma roxburghii*	2	200	1	100	G	-	-	-	-	-	1	100
64	*Holoptelia integrifolia*	1	100	-	-	P	-	-	-	-	-	1	100
65	*Ilex malabarica*	1	25	-	-	P	3	69.4	-	-	NEW	4	100
66	*Kydia calycina*	4	22.0	2	11.0	G	8	45.7	4	21.3	G	18	100
67	*Lagerstroemia microcarpa*	72	48.4	46	31.2	G	22	14.9	8	5.4	G	149	100
68	*Lagerstroemia parviflora*	1	25	-	-	P	3	69.4	-	-	NEW	4	100
69	*Linociera malabarica*	-	-	1	60	N	1	50	-	-	P	2	100
70	*Litsea coriacea*	1	100	-	-	P	-	-	-	-	-	1	100
71	*Litsea deccanensis*	1	100	-	-	P	-	-	-	-	-	1	100
72	*Madhuca indica*	1	50	-	-	P	-	-	1	42	N	2	100
73	*Mallotus intermedius*	-	-	1	100	N	-	-	-	-	-	1	100
74	*Mallotus philippensis*	12	80.0	2	16	G	1	6. 7	-	-	P	15	100
75	*Mallotus tetracoccos*	-	-	1	100	N	1	50	-	-	P	2	100
76	*Mangifera indica*	4	100	-	-	P	-	-	-	-	-	4	100

77	*Meliosma pinnata*	-	-	-	-	-	-	-	1	100	N	1	100
78	*Miliusa tomentosa*	-	-	1	7.0	N	14	97.2	-	-	NEW	14	100
79	*Mitragyna parvifolia*	-	-	-	-	-	3	76.9	1	23.1	G	4	100
80	*Murraya koenigii*	24	100	-	-	NEW	-	-	-	-	-	24	100
81	*Nothopegia beddomei*	-	-	-	-	-	1	100	-	-	P	1	100
82	*Olea dioica*	8	47.2	8	49.5	F	-	-	1	3.3	N	17	100
83	*Ougeinia ougenensis*	4	43.0	3	30.1	G	-	-	3	26.9	N	9	100
84	*Persea macrantha*	-	-	2	100	N	-	-	-	-	-	2	100
85	*Phyllanthus emblica*	8	4.78	4	2.6	G	147	87.9	8	4.6	G	167	100
86	*Phyllanthus indofisheri*	1	7.69	-	-	P	11	85.5	1	4.3	G	13	100
87	*Premna tomentosa*	-	-	-	-	-	-	-	2	100	N	2	100
88	*Pterocarpus marsupium*	-	-	-	-	-	-	-	1	100	N	1	100
89	*Pittosporum floribundum*	-	-	1	100	N	-	-	-	-	-	1	100
90	*Radermachera xylocarpa*	-	-	16	72.0	N	-	-	6	28.0	N	23	100
91	*Santalum album*	-	-	-	-	-	11	62.5	7	37.5	G	18	100
92	*Randia candolleana*	-	-	1	50	N	1	50	-	-	P	2	100
93	*Schefflera venulosa*	-	-	1	100	N	-	-	-	-	-	1	100
94	*Schleichera oleosa*	24	62.0	11	27.9	G	3	7.2	1	2.9	G	39	100
95	*Schrebera swietenioides*	2	16.7	1	10	G	6	46.3	3	27.8	G	12	100
96	*Scolopia crenata*	-	-	1	100	N	-	-	-	-	-	1	100
97	*Shorea roxburghii*	-	-	2	0.2	N	1075	98.7	13	1.2	G	1090	100
98	*Soymida febrifuga*	-	-	-	-	-	6	100	-	-	NEW	6	100
99	*Sterculia guttata*	-	-	1	100	N	-	-	-	-	-	1	100
100	*Sterculia villosa*	-	-	4	100	N	-	-	-	-	-	4	100
101	*Stereospermum angustifolium*	-	-	1	78.2	N	-	-	-	-	-	1	100
102	*Stereospermum personatum*	4	66.7	2	33.3	G	-	-	-	-	-	6	100

103	*Stereospermum suaveolens*	-	-	1	100	N	-	-	-	-	-	1	100
104	*Strychnos potatorum*	-	-	-	-	-	-	-	1	100	N	1	100
105	*Syzygium operculatum*	1	50	-	-	P	-	-	1	28	N	2	100
106	*Syzygium cumini*	28	48.6	30	51.3	F	-	-	-	-	-	58	100
107	*Syzygium malabaricum*	-	-	1	100	N	-	-	-	-	-	1	100
108	*Tamarindus indica*	-	-	-	-	-	3	90.9	-	-	NEW	3	100
109	*Tamilnadia uliginosa*	1	1.04	-	-	P	92	95.5	3	2.6	G	96	100
110	*Tectona grandis*	52	22.8	59	25.9	F	36	15.8	81	35.4	F	228	100
111	*Terminalia alata*	20	10.8	35	18.7	F	69	37.5	61	33.0	G	185	100
112	*Terminalia bellirica*	4	61.0	2	30.5	G	-	-	1	8.5	N	7	100
113	*Terminalia paniculata*	4	16.8	3	11.7	G	17	70.2	-	-	NEW	24	100
114	*Toona ciliata*	-	-	1	100	N	-	-	-	-	-	1	100
115	*Trewia nudiflora*	-	-	1	100	N	-	-	-	-	-	1	100
116	*Trichilia connaroides*	1	100	-	-	P	-	-	-	-	-	1	100
117	*Vernonia arborea*	4	100	-	-	NEW	-	-	-	-	-	4	100
118	*Viburnum punctatum*	1	73.8	-	-	P	-	-	1	41.0	N	1	100
119	*Vitex peduncularis*	1	100	-	-	P	-	-	-	-	-	1	100
120	*Vitex altissima*	1	100	-	-	P	-	-	-	-	-	1	100
121	*Xylosma longifolium*	1	100	-	-	-	-	-	-	-	N	1	100
122	*Wendlandia thyrsoidea*	-	-	1	100	N	-	-	-	-	-	1	100
123	*Ziziphus mauritiana*	1	16.4	-	-	P	6	90.9	1	9.1	G	6	100
124	*Ziziphus xylopyrus*	12	9.9	1	0.8	N	100	82.7	8	6.7	G	121	100

- F – Fair regeneration
- G – Good regeneration
- P – Poor regeneration
- N – No regeneration and
- – Absence of young tree / mature tree.

Fig 1. Location map of Mudumalai Wildlife Sanctuary



CONCLUSIONS:

The overall population structure of tree species reveals that mature populations dominate young populations and the fluctuation in population density is related to the anthropogenic factors. The population size of species that lack young trees may decline in the coming years. The forest type (moist deciduous and dry deciduous) which is characterized by abundance of mature tree strata of the species or absence or very low individuals of young type are expected to face local extinction if species conservation are not given priority at the earliest. Moreover, poor regeneration of tree species due to the existing anthropogenic factors endangers the future maintenance of the tree species which pose survival threat to the Flora of Mudumalai Wildlife Sanctuary.

The present study suggests that high level of disturbances such as extraction of trees for timber, forest fire has brought a decline in plant communities. Regeneration is important as it addresses mainstream biodiversity concerns. In areas where protection measures are strictly employed, successful regeneration of natural forests is necessary, and therefore this study was carried out to know the regenerative capacity of natural forests.

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