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Research article

Diversity and tree population structure of tropical dry evergreen forests in Sivagangai district of Tamil Nadu, India

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Abstract: Vegetation structure and species composition were studied in the four selected undocumented sacred groves (tropical dry evergreen forest patches) in the Karaikudi taluk of Sivagangai district of Tamil Nadu, India. A total of 106 plant species were recorded in all the sacred groves. The number of species and diversity indices of trees and understory (which includes tree seedlings and saplings, climbers and shrubs) community showed greater values in site III (Thiruparkkadal Chellayae Amman Kovil sacred grove) compared to other study sites. In contrast, a reverse trend was observed in the case of herbaceous community. *Albizia amara* was the dominant tree species in site I (Vidathudaiyar kovil sacred grove**)** and site IV (Aakkamudaiyar kovil sacred grove) followed by *Acacia leucophloea*. In site II, (Koodaiyakkaruppar kovil sacred grove), *Drypetes sepiaria* was the dominant tree species. *Ficus benghalensis* is the dominant species in site III. The understory community was dominated by *Acacia leucophloea* in sites I, II and III, whereas in site IV, *Randia spinosa* was dominant. *Tephrosia purpurea* was the dominant species in the herbaceous community in site I while in site II, grasses were dominant. *Leucas aspera* was the dominant species in the herbaceous community of site III and site IV. These sacred groves still possess a sizable proportion of the region's characteristic flora. They also have rich cultural tradition associated with them. These sacred groves should be protected to conserve the regional flora adjacent to human habitats as well as to sink carbon during global warming.

Keywords: Sacred groves - Plant diversity - Traditional practices - Tropical forest - Floristic composition.

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INTRODUCTION

The growing threat of biodiversity loss in the world receives more attention from ecologists and conservationists who seek effective ways to conserve biodiversity. One of the approaches that have received great attention in the recent past is the role of traditional, cultural practices and beliefs in protecting and managing biodiversity (Byers *et al.* 2001, Infield 2001, Fabricius 2004, Berkes & Davidson 2006, Garnett *et al.* 2007, Gao *et al.* 2013, Kandari *et al.* 2014, Tamalene *et al.* 2014, Daye & Healey 2015). Sacred groves are small or large patches of natural virgin vegetation protected or conserved by the indigenous community or local people. The sacred groves are reported to have both social functions and ecological services not only in India but throughout the world (Jim 2003, Bhagwat & Rutte 2006, Wassie *et al.* 2010, Hu *et al.* 2011, Tamalene *et al.* 2014, Daye & Healey 2015, Shrestha *et al.* 2015). Generally, most of the groves represent the vegetation in its climax stage of that area. These groves are the store houses or shelter of many rare and endemic flora and fauna and a veritable gene pool (Mgumia & Oba 2003, Khan *et al*. 2008, Swain *et al*. 2008, Rawat *et al*. 2011, Kibet 2011). The values of the sacred groves are manifold: aesthetic, ecological, economic and socio-cultural. Despite being at various stages of decline and degradation, sacred groves still have one or more of these values.

The sacred groves have been preserved and maintained for several decades or even centuries all over the world (Ramakrishnan *et al*. 1998) and particularly in wide variety of habitats in 33 countries (Bhagwat & Rutte

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2006). Approximately 13720 sacred groves have been documented from all over India so far and experts estimate that the actual number could be much higher in the range of 100000–150000 (Malhotra *et al.* 2007, Pandey 2010). A list of 528 sacred groves of Tamil Nadu with their location, area and deities in each district was prepared by Amirthalingam (1998). The sacred groves selected in the present study are not in the above-mentioned list. No published documentation is available on plant biodiversity and socio-cultural aspects of these sacred groves. In recent years, significance of biodiversity maintenance, management and socio cultural perspectives of sacred groves have been widely discussed (Mgumia & Oba 2003, Soury *et al.* 2007, Salick *et al.* 2007, Hu *et al.* 2011, Wassie *et al.* 2010) particularly in Africa and Asia (Wadley & Colfer 2004, Chun & Tak 2009, Luo *et al.* 2009, Yuan & Liu 2009, Page *et al.* 2010, Gao *et al.* 2013, Khandari *et al.* 2014, Shrestha *et al.* 2015). Vegetation analysis of sacred groves in many parts of India has been carried out by many workers (Khan *et al*. 2008, Page *et al*. 2010, Agnihotri *et al*. 2010, Rawat *et al*. 2011; Singh *et al*. 2011, Kumar *et al*. 2011, Parthasarathy *et al.* 2012, Ray *et al.* 2014, Bawri *et al.* 2015). Tree diversity in the sacred groves of Tamil Nadu has been studied by Parthasarathy & Karthikeyan (1997), Swamy *et al.* (1998), Swamy *et al. (*2003), Kumar (2006) and Sukumaran & Jeeva (2008). The objective of the present study was to generate data on the vegetation structure and plant species diversity of four undocumented and unexplored sacred groves found in Karaikudi taluk, Sivagangai District of Tamil Nadu.

MATERIALS AND METHODS

Study Area

Four tropical dry evergreen forests (sacred groves) selected for the present study are in the Sakkottai Union, Karaikudi taluk of Sivagangai district of Tamil Nadu. Vidathudaiyar kovil sacred grove (Site I; N 10°057´85" E78°49´466") is near Puliankudiiruppu and Mullangkadu villages. The total area of the sacred grove is 10 ha. A well-built temple is present on one side of the sacred grove around which about 20 m area has been cleared. However, more than 9 ha are covered by natural vegetation. The sacred grove is maintained by family trustee of Kattayan, Pottukkathan and Kovilpattiyan groups. The main deity in the sacred grove is Vidathudaiyar. Koodaiyakkaruppar kovil sacred grove (Site II; N 10°13´546" E78°87´260") is near Puliankudiiruppu. The total area of the sacred grove is 22 ha. It is a catchment area for the adjacent water reservoir. Koodaiyakkaruppar is the main deity of this sacred grove. Thiruparkkadal Chellayae Amman Kovil sacred grove (Site III; N10°13´486" E78°87´654") has an area of 2.5 ha. The sacred grove is maintained by family trustee of Chinnavidaththan groups. The main deity in this sacred grove is Chellayae Amman. Aakkamudaiyar kovil sacred grove (Site IV; N10°11´196" E78°90´836") in Peerkkalaikadu village has an area of 2.7 ha. The sacredness is associated with a small pond in the grove. The grove is maintained by family trustee of Puliayankaruppan and Kuttiyan groups. The main deity in this grove is Aakkamudaiyar.

Climate

The average annual rainfall was 2043 mm. Maximum rainfall occurred during October to December. Average maximum and minimum temperatures were 40°C and 26°C during summer and 29°C and 22°C in winter. Soil is of sandy loam type in sites I to III, but in site IV, it is more clayey. Based on Champion and Seth (1968) classification, the vegetation of these sacred groves comes under tropical dry evergreen forests.

Sampling

One hectare plot was sampled for density, frequency and basal area measurement of trees [individuals with >30 cm girth at breast height]. Twenty quadrats (5×5 m^2) were laid to enumerate shrubs and lianas (climbers of all sizes) whose base inside the quadrats. The same number of quadrats (1×1 m^2) was laid down randomly within the plot to study the herbs at each site. Vegetation analysis was done during the month of October and November 2010, which is the rainy season, during which herbaceous growth is maximum. Important value index was calculated as the summation of relative density, relative basal area and relative frequency. The plant samples were identified in the field with the help of Gamble's (1925) and Matthew's (1988) floras and confirmed with BSI, Coimbatore. The diversity indices were calculated using PAST software.

RESULTS

A total of 106 species were recorded from the four selected sacred groves in Sivagangai district of Tamil Nadu. The number of species was greater in sites III and IV compared to other study sites (Table 1). Understory

population showed greater number of species in study site III followed by site IV and site I. However, herbaceous community contribution was greater in site IV compared to other study sites. The diversity index of tree community showed greater value in site III compared to other study sites. A similar trend was observed in the case of understory community also. However, a reverse trend was observed in the case of herbaceous community with reference to diversity index. The dominance index was greater in study sites, I and II compared to other study sites for both tree community and understory species. However, the dominance index of herbaceous community was greater in the study sites III and IV compared to other study sites.

Table 1. Consolidated details of phytosociological analysis of the selected sacred groves in the Karaikudi taluk of Sivagangai District, Tamil Nadu, India.

	Site I	Site II	Site III	Site IV
No. of species				
Trees (No./ha)	14	8	15	12
Understory (No./0.05 ha)	25	19	29	27
Herb (No./20 m^2)	33	33	31	38
Total no. of species	65	55	68	68
Density				
Trees (No./ha)	162	144	126	154
Understory (No./25 m^2)	15.4	16.3	20.2	21.7
Herb (No./m^2)	22.1	20.1	31.1	27.9
Shannon index				
Trees	1.90	1.69	2.33	2.28
Understory	2.91	2.68	3.03	3.03
Herb	2.87	3.09	2.68	2.69
Dominance index				
Trees	0.22	0.23	0.13	0.12
Understory	0.07	0.08	0.06	0.06
Herb	0.09	0.07	0.12	0.13
Tree basal area ($m^2.ha^{-1}$)	7.72	6.55	12.31	6.87

Albizia amara was the dominant tree species in sites I and IV followed by *Acacia leucophloea* (Table 2). In site II, *Drypetes sepiaria* was the dominant species followed by *Acacia leucophloea*, *Dalbergia sissoo* and *Azadirachta indica*. *Ficus benghalensis* is the dominant species in site III followed by *Acacia leucophloea*, *Prosopis juliflora* and *Acacia arabica*. The understory plant community was dominated by *Acacia leucophloea* in sites I, II and III, whereas in site IV, *Randia spinosa* was dominant. *Tephrosia purpurea* was the dominant species of herbaceous community in site I and is followed by *Croton sparsiflorus* and *Leucas aspera* while in site II, grasses were dominant. *Leucas aspera* was the dominant species in the herbaceous community of site III and site IV followed by *Tephrosia purpurea* and *Croton sparsiflorus*.

Table 2. Importance value index of different life forms (tree, understory and herbs) in the four selected sacred groves in the Karaikudi taluk of Sivagangai District of Tamil Nadu, India.

Name of the species	Site I	Site II	Site III	Site IV
Tree community				
Acacia leucophloea (Roxb.) Willd.	86.20	53.57	65.77	48.17
Acacia arabica (Lam.) Willd.	-	-	24.55	-
Aegle marmelos (L.) Corr.	2.82	-	-	-
Albizia amara Willd.	101.81	15.18	-	64.88
Albizia lebbeck (L.) Benth.	-	-	16.81	-
Atalantia monophylla (L.) Corr.	-	3.92	-	-
Azadirachta indica A. Juss.	21.99	34.22	23.74	26.30
Chloroxylon swietenia DC.	6.65	-	-	29.31
Crataeva religiosa Forst.	-	-	3.74	-
Dalbergia sissoo Roxb. ex DC.	-	50.74	-	7.82
Dichrostachys cinerea (L.) W & A	17.60	4.76	10.74	-
Drypetes sepiaria Roxb.	-	115.36	3.66	22.64
Eucalyptus globulus Labill.	3.70	-	-	-
Feronia elephantum Corr.	2.56	-	-	-
Ficus benghalensis L.	14.70	-	58.72	-

Ficus racemosa L.	3.08	-	-	-
Lannea coromandelica (Houtt.) Merr.	-	-	4.96	22.76
Madhuca longifolia L.	-	-	-	4.70
Morinda pubescens J.E. Smith	4.19	22.26	12.97	14.27
Prosopis juliflora L.	25.16	-	35.57	30.32
Senna polyantha (Collad.) H.S.Irwin & Barneby	6.72	-		
Senna siamea (Lam) H.S.Irwin & Barneby			17.97	13.18
Syzygium cuminii (L.) Skeels	-	-	7.46	-
Tamarindus indica L.	-	-	8.03	-
Tectona grandis L.f.	2.82	-	-	-
Thespesia populnea (L.) Soland. ex Correa	-	-	-	15.66
Thevetia peruviana (Pers.) K. Schum	-	-	5.33	-
Understory community				
Acacia leucophloea (Roxb.) Willd.	31.42	48.01	45.47	28.70
Acacia speciosa Willd.	3.70	-	-	-
Acacia tomentosa Willd.	-	-	5.29	-
Adenanthera pavonia L.	2.52	3.45	-	-
Adhatoda vasica Nees	-	-	8.11	-
Albizia amara Willd.	29.22	-	-	28.19
Albizia lebbeck (L.) Benth.	-	-	-	7.71
Argemone mexicana L.	3.18	-	-	5.56
Atalantia monophylla (L.) Corr.	-	-	3.04	-
Azadirachta indica A. Juss.	12.92	28.88	6.73	4.18
Calotropis gigantea (L.) R. Br.	-	-	13.84	-
Carissa carandas L.	12.35	4.28	-	-
Cassia auriculata L.	23.85	14.10	13.14	8.65
Cassia fistula L.	6.24	8.75	3.93	11.88
Cassia sp.	-	-	13.05	-
Chloroxylon swietenia DC.	6.04	-	-	13.21
Coccinia indica W. & A.	2.52	2.93	7.80	8.21
Crotalaria laburnifolia L.	-	-	2.43	-
Datura metel L.	3.66	-	4.18	2.21
Dichrostachys cinerea (L.) W. & A.	17.70	7.96	3.85	4.02
Drypetes sepiaria Roxb.	-	26.47	-	13.73
Euphorbia antiquorum L.	24.64	20.03	15.35	5.57
Ficus benghalensis L.	-	-	6.35	-
Gloriosa superba L.	2.27	2.89	0.33	-
Jasminum sp.	-	-	-	3.67
Jatropha glandulifera Roxb.	6.66	-	4.17	4.48
Lannea coromandelica (Houtt.) Merr.	-	-	-	3.74
Mangifera indica L.	-	-	-	3.00
Memecylon umbellatum Burm.f.	20.26	22.30	2.43	10.57
Morinda pubescens JE Smith	8.74	19.21	16.18	11.55
Nerium odoratum Lam.	-	-	10.67	6.11
Pandanus tectorius Soland. ex. Parkinson	-	-	15.11	-
Pavetta indica L.	12.53	25.69	4.78	16.77
Phoenix sylvestris Roxb.	6.00	5.16	12.18	-
Prosopis juliflora L.	22.23	20.15	28.76	20.70
Randia spinosa (Thunb.) Poir.	2.61	20.59	-	38.28
Scoparia dulcis L.	-	-	2.95	-
Thespesia populnea (L.) Soland. ex Correa	-	-	-	4.53
Toddalia asiatica (L) Lam.	2.38	-	6.87	-
Torenia asiatica L.	-	-	3.12	15.56
Vitex negundo L.	28.04	14.85	24.11	12.18
Ziziphus jujuba L.	8.33	4.31	15.78	7.02
Herbaceous community				
Abrus precatorius L.	-	2.02	-	-
Abutilon indicum G. Don.	2.99	3.57	-	-
Acalypha indica L.	14.07	10.34	7.77	25.51

Achyranthes aspera L.	5.38	10.47	5.40	1.99
Aloe vera (L.) Burm. f.	-	-	3.38	2.13
Amaranthus sp.	8.85	16.28	7.77	13.03
Aristolochia bracteata Retz.	2.33	-	-	-
Asparagus racemosus Willd.	3.06	2.02	1.40	3.01
Boerhaavia diffusa L.	4.85	7.32	1.96	4.99
Borreria hispida (L.) K. Sch.	-	5.43	1.40	-
Borreria ocymoides (Burm.f.) DC.	-	2.37	-	-
Cassia sp.	8.77	8.04	2.42	-
Chloris barbata Sw.	2.75	4.13	-	2.34
Cissus quadrangularis L.	-	3.57	-	1.72
Cleome viscosa L.	2.33	-	1.60	-
Clitoria ternatea L.	1.93	2.60	-	1.30
Crotalaria retusa L.	-	-	-	1.51
Croton sparsiflorus Mor.	44.36	14.22	20.34	38.90
Cyperus sp.	-	-	7.86	-
Digitaria marginata Link	-	2.02	-	1.51
Duranta repens L.	1.75	7.13	-	1.51
Echinops echinatus Roxb.	4.99	-	-	1.54
Euphorbia sp.	7.20	5.43	2.80	4.73
Evolvulus alsinoides L.	5.27	4.85	3.37	4.23
Grasses (unidentified)	19.85	49.65	11.84	4.82
Haplanthus verticillaris Nees	1.66	-	-	1.46
Heliotropium strigosum Willd.	3.46	-	1.40	1.51
Indigofera enneaphylla L.	5.26	2.37	1.59	1.51
Justicia betonica L.	4.99	2.37	2.60	3.85
Kyllinga brevifolia Rottb.	-	10.21	-	-
Lactuca sativa L.	1.39	2.37	4.20	1.30
Leucas aspera Spr.	44.23	30.79	81.12	81.94
Malva sylvestris L.	-	-	-	1.30
Mimosa pudica L.	5.79	5.84	2.91	4.46
Mollugo nudicaulis Lam.	4.99	6.42	4.20	4.73
Ocimum basilicum L.	-	-	.40	-
Ocimum sanctum L.	7.75	4.59	10.15	5.24
Oldenlandia umbellata L.	-	-	2.80	1.51
Phyllanthus maderaspatensis L.	12.11	15.30	19.46	7.41
Physalis minima L.	-	-	6.02	1.30
Pilea microphylla (L.) Liebm.	-	-	-	1.51
Polycarpea corymbosa Lam.	-	-	-	3.98
Sida acuta Burm.f.	2.90	5.86	8.43	5.58
Sida cordifolia L.	2.79	-	-	1.69
Solanum trilobatum L.	2.37	6.02	-	1.99
Solanum xanthocarpum Sch. & Wendl.	3.86	-	2.41	2.59
Tephrosia purpurea (L.) Pers.	54.07	26.33	51.36	43.81
Tridax procumbens L.	1.66	5.43	9.18	6.61
Typha angustata B. & Ch.	-	14.70	-	-
Unidentified	-	-	12.44	-

With increasing tree size classes, species richness (number of species per hectare) decrease in sites I and II while sites III and IV did not show any specific trend (Table 3). Similarly, density also didn't show any specific trend. The size class distributions of dominant tree species in the study sites are presented in figure 1–4. Few species showed 'L-shaped' curves. The 'L-shaped' curves represent a good regeneration status of those species. Some species showed 'J-shaped' curves and they are at moderate levels in terms of regeneration status. However, several species didn't show any specific pattern.

Similarity index values among the study sites in different life forms are presented in Table 4. The study site IV showed more than 50% similarity in tree community with all other study sites. Study site II showed lower similarity values with sites I and III. Understory plant community showed greater similarity among the study sites than that of tree community. However, herbaceous community showed greatest similarity among all the life

forms. Site I showed more than 72–79% similarity with other study sites. Lower similarity was observed between site II and site IV.

Table 3. Diameter class-wise (DBH) species richness (no. of species) and density (No./ha) of trees (>10 cm DBH) in the four selected sacred groves in the Karaikudi taluk of Sivagangai district of Tamil Nadu, India.

Diameter class (cm)	Number of species				Density			
	Site I	Site II	Site III	Site IV	Site I	Site II	Site III	Site IV
10–20	10	7	10	13	92	40	64	98
20–30	9	6	6	10	37	64	11	49
30–40	3	6	3	1	4	30	4	2
40–50	3	4	7	4	27	9	18	7
50–60	-	1	7	4	-	1	26	6
60–70	-	-	-	-	-	-	-	-
70–80	1	-	-	-	1	-	-	-
80–90	1	-	-	1	1	-	-	1
90–100	-	-	1	-	-	-	3	-

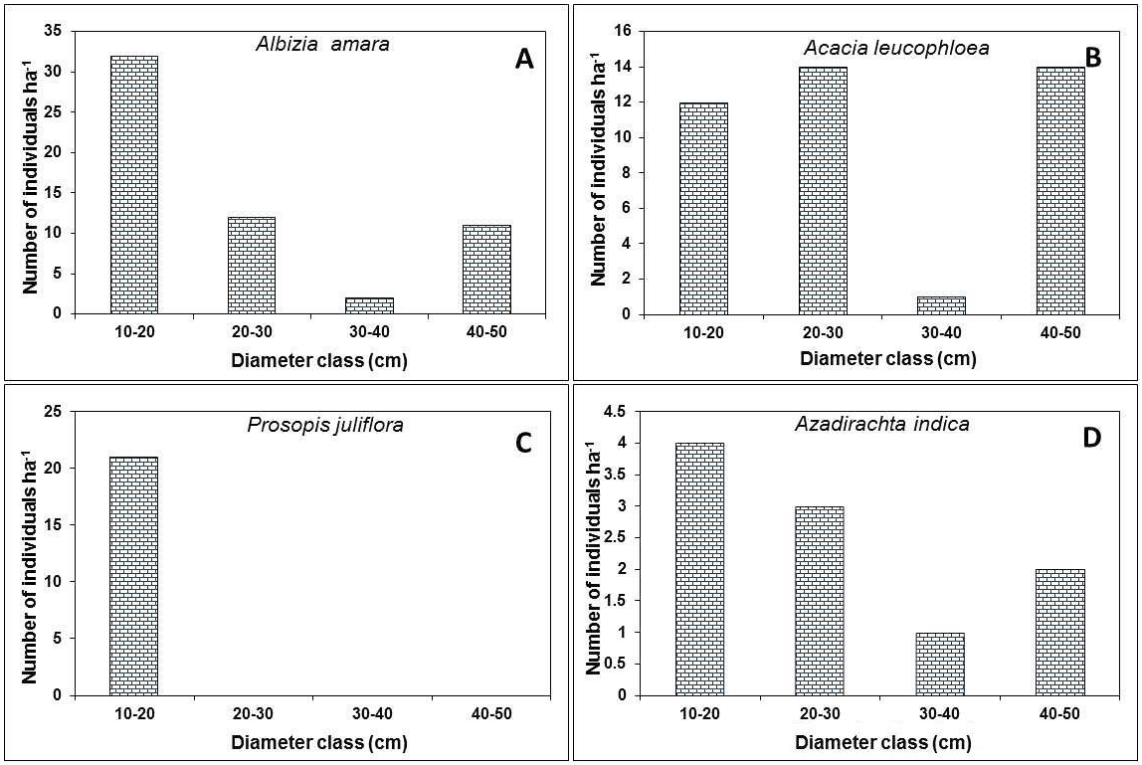

Figure 1. Diameter class wise (DBH) distribution of some dominant species in the selected sacred grove (Site I) in the Karaikudi taluk of Sivagangai District, Tamil Nadu, India.

Table 4. Similarity index of tree (T), understory (U) and herbaceous (H) community in the selected sacred groves in the Karaikudi taluk of Sivagangai District, Tamil Nadu, India.

	Site I	Site II	Site III	Site IV
Site I	-	0.455T 0.739U 0.746H	0.482T 0.654U 0.718H	0.518 T 0.717 U 0.794H
Site II		-	0.435T 0.612U 0.677H	0.571T 0.638U 0.649H
Site III			-	0.500T 0.607U 0.704H
Site IV				-

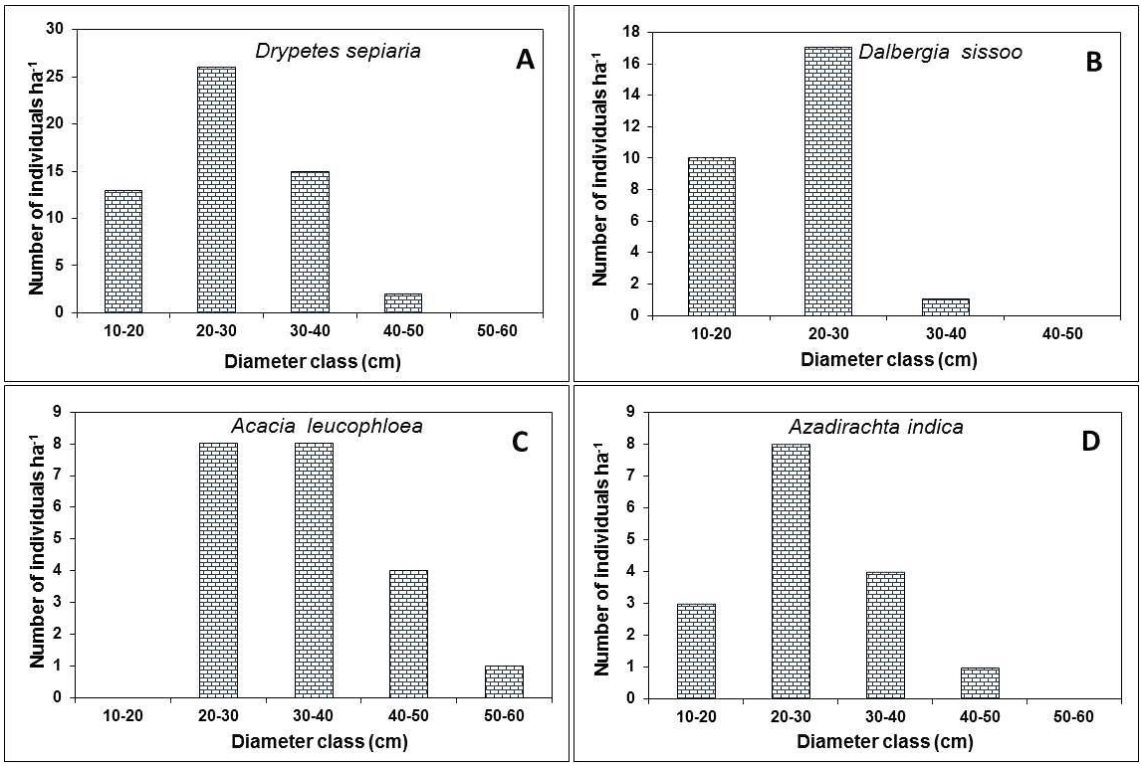

Figure 2. Diameter class wise (DBH) distribution of some dominant species in the selected sacred grove (Site II) in the Karaikudi taluk of Sivagangai District, Tamil Nadu, India.

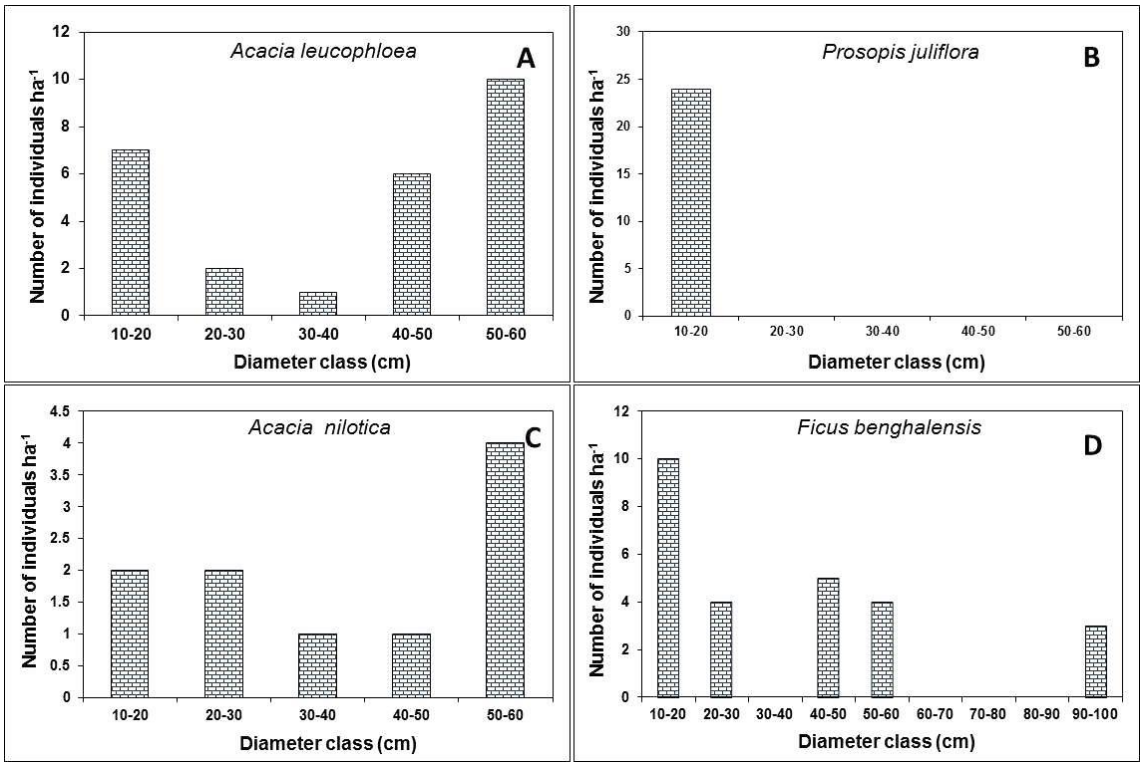

Figure 3. Diameter class wise (DBH) distribution of some dominant species in the selected sacred grove (Site III) in the Karaikudi taluk of Sivagangai District, Tamil Nadu, India.

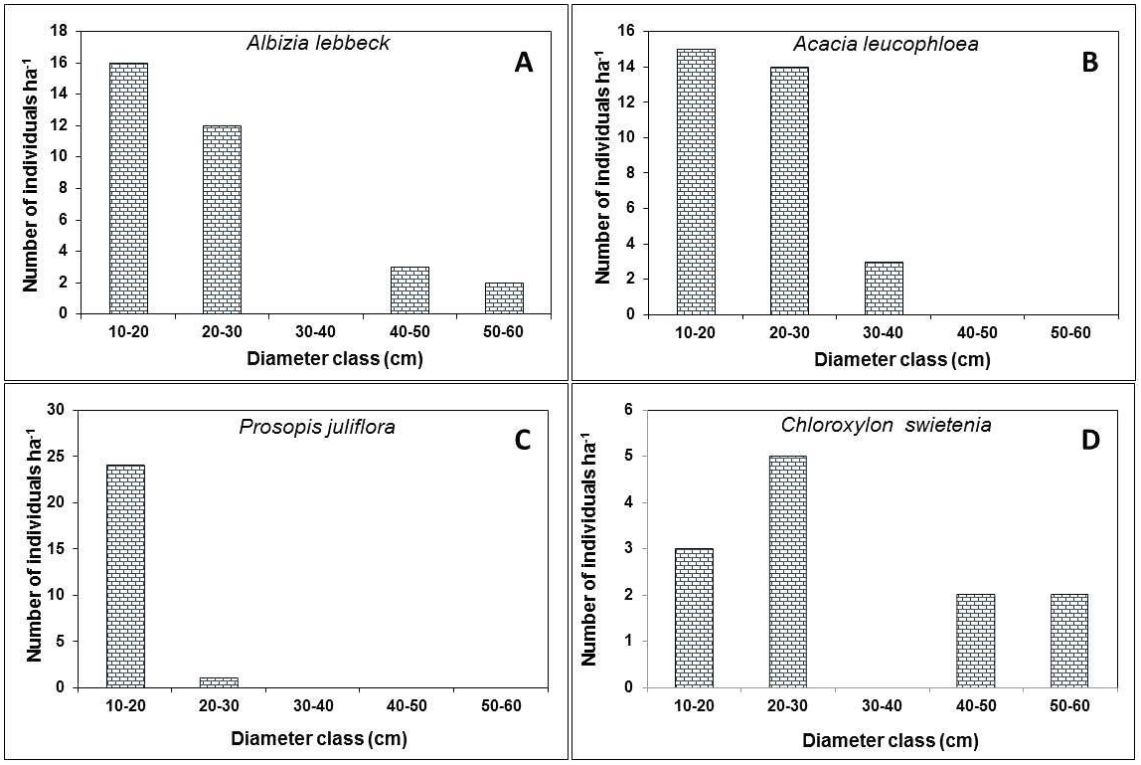

Figure 4. Diameter class wise (DBH) distribution of some dominant species in the selected sacred grove (Site IV) in the Karaikudi taluk of Sivagangai District, Tamil Nadu, India.

DISCUSSION AND CONCLUSION

A total of 106 plant species were recorded from the four selected tropical dry evergreen forests (sacred groves) in the Sivagangai District of Tamil Nadu. Similarly, 83 species were identified in Nakuleshwar sacred groves (Singh *et al*. 2011). A total of 189 plant species were recorded in 6 selected sacred groves of Tamil Nadu (Kumar 2006). Ramanujam & Kadamban (2001) reported 74 species in Oorani sacred grove (Pondicherry) and 136 species in Olagapuram sacred grove (Pondicherry). The number of tree species (species richness) >30 cm GBH in all the study sites ranged from 8–15 ha^{-1} and this is at lower side of the range when compared to other sacred groves of several other regions in Tamil Nadu and Kerala. The species richness in Thirumanikuzhi sacred grove was 38 and Kuzhanthaikuppam sacred grove was 52 (Parthasarathy & Karthikeyan 1997), in Puthupet sacred grove 52 (Parthasarathy & Sethi 1997), in three sacred groves of Kerala 20-23 (Chandrashekara & Sankar 1998) and in six sacred groves of Tamil Nadu 11–17 (Kumar 2006), in Ayyanar Kovil sacred groves of Madurai district 56 (Ganesan *et al*. 2009), in 10 sacred groves in Chittoor district of Andhra Pradesh 42–66 ha^{-1} species (Rao *et al*. 2011). The tree diversity index (Shannon index) in the present study was in the range of 1.7–2.3, which is comparable to Thirumanikuzhi and Kuzhanthaikuppam sacred groves (Parthasarathy & Karthikeyan 1997). However, the tree species diversity is higher than Puthupet sacred grove (Visalakshi 1995, Parthasarathy & Sethi 1997). The low value of tree species richness in the present study may be attributed to anthropogenic pressures such as lopping, extraction of minor forest produce (fruits, seeds etc.) and cattle grazing. These attributes may also be some of the reasons that might have resulted in poor tree regeneration through seedling recruitment and also stunted growth in lopped trees, thus leading to small openings in the canopy of sacred groves studied. Invasion by *Prosopis juliflora* in the periphery of the sacred grove inhibits the regeneration of native species due to allelopathic effect which is also one of the reasons. The dominance index value of trees in the present study was from 0.12–0.23 which is comparatively lesser than the dominance index recorded in Kuzhanthaikuppam sacred grove (Parthasarathy & Karthikeyan 1997) and Puthupet sacred grove (Parthasarathy & Sethi 1997). However, the dominance index value is comparable to that of Thirumanikuzhi sacred grove (Parthasarathy & Karthikeyan 1997). The higher dominance value in the present study is due to the dominance of single species in the sacred groves. Lower number of herbaceous species in the present study may be due to grazing, trampling, edaphic and climatic factors. Herbs which grow immediately after monsoon seasons become the victims of anthropogenic and adverse climatic factors.

Tree density in the present study ranges from 126–162 ha^{-1} which is comparable to the density of Marakkanam reserve forest near Pondicherry (Visalakshi 1995). However, the tree density range recorded in the present study is at lower range when compared to the sacred groves of Thirumanikuzhi sacred grove and Kuzhanthaikuppam sacred grove (Parthasarathy & Karthikeyan 1997), Puthupet sacred grove (Parthasarathy & Sethi 1997), and Chittoor sacred groves, Andhra Pradesh (929 –1018 ha^{-1}, Rao *et al*. 2011). Such low density of tree species in the present study is governed by a complex array of environmental factors besides human interferences as suggested by Visalakshi (1995). Ground clearing and ground fires occur during occasional rituals and annual festivals (by the visiting devotees) and these may influence the tree density of the sacred groves. Man-made disturbances such as cattle grazing, criss-crossing foot path, lopping of small branches for fodder may also be reasons for low tree density. The canopy gaps were invaded by exotic weed like *Prosopis juliflora*, thus influencing the course of natural regeneration of sacred groves (Ramakrishnan *et al.* 1998). Menace of invasion by alien weeds was also reported in many sacred groves in India (Parthasarathy & Karthikeyan 1997, Ramakrishnan *et al.* 1998, Ramanujam & Kadamban 2001, Swamy *et al*. 2003).

In the present study, *Ficus benghalensis* was found to be the keystone species in the sacred groves because it supports birds and insects. Similarly, *Ficus benghalensis* in sacred groves at Suriampettai play the role of a keystone species providing a niche for the large number of birds and plants (King *et al*. 1997). In addition to that, several (more than 7) honey combs were present in a single tree of *Ficus benghalensis* at the study site III. *Gloriosa superba* and *Asparagus racemosus* were found to be threatened plants as they are tuber-bearing climbers and are of medicinal importance. Uprooting these threatened plants for medicinal uses will make them disappear from these sacred groves.

These sacred groves still possess a sizable proportion of the region's characteristic flora. They also have rich cultural tradition associated with them. People's changing attitudes, erosion of traditional beliefs and faiths, and cattle grazing have caused degradation of sacred groves over the years. These sacred groves would be protected to conserve the regional flora adjacent to human habitats as well as to sink carbon during global warming. This study also suggests that reduction of grazing and restriction of ground clearance during the festival times are essential to enhance the regeneration potential of these sacred groves.

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