

# Woody species diversity of Melkalpoondi Sacred Grove in Tittakudi Taluk of Cuddalore District, Tamil Nadu

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**Abstract:** Sacred groves are ecologically and genetically very important. They possess a great diverse gene pool of many forest species having religious attachment and medicinal values. The present study was conducted in Melkalpoondi, Tittakudi taluk of Cuddalore district, Tamil Nadu, South India. The study aimed at documenting the plant wealth and diversity. Many sacred groves constitute pristine vegetation, and are particularly rich in climax vegetation with rich flora and fauna. This paper deals with the woody plant diversity in the Melkalpoondi sacred grove. A survey was conducted to record the species richness and diversity of woody species such as trees and lianas. This grove is dedicated to Kayilpirantha Aiyanar with an area of over 9 hectares and is situated in the Tittakudi taluk of Cuddalore district, Tamil Nadu, South India. About 46 woody plant species representing 40 genera and 29 families exist in this grove. Of these, 30 species were trees and 16 species were lianas. The dominant families are Mimosaceae (6 species), Fabaceae (4 species), Capparaceae (3 species) and Moraceae (3 species). Apocynaceae, Ebenaceae, Loganiaceae, Rubiaceae and Rutaceae have 2 species in each respectively. Alangiaceae, Anacardiaceae, Arecaceae, Asclepiadaceae, Boraginaceae, Caesalpinaceae, Celastraceae, Combretaceae, Convolvulaceae, Cucurbitaceae, Meliaceae, Menispermaceae, Myrtaceae, Oleaceae, Salvadoraceae, Santalaceae, Sapotaceae, Simaroubaceae, Verbenaceae and Vitaceae have only one species in each of the families. Density, species richness and diversity of trees were recorded for the detailed study of plant diversity. The vegetation types indicate that this grove is to be considered as of the inland tropical deciduous forest type.

**Keywords:** Melkalpoondi, sacred groves, plant biodiversity, conservation, cultural tradition.

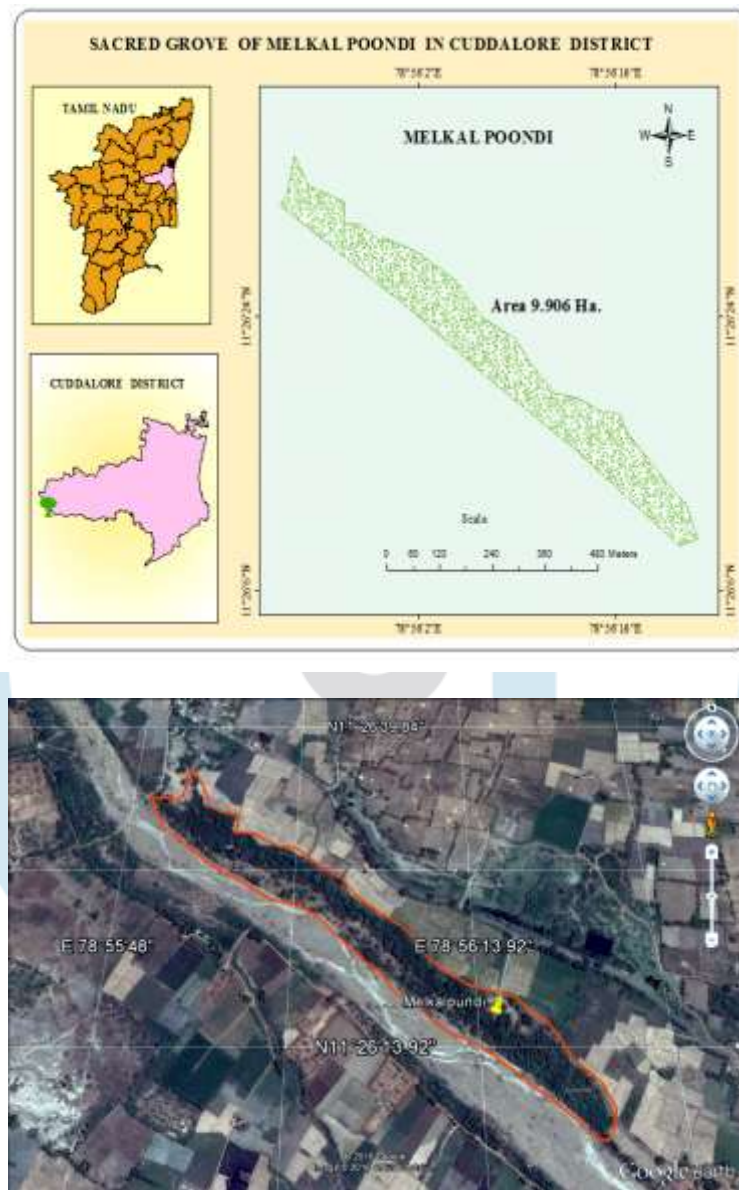
## INTRODUCTION

Ancient societies such as those of Greece, Rome, Asia and Africa had long practiced preserving patches of forests in their original state due to the belief that they were the abodes of gods and goddesses (Gadgil and Vartak, 1975). Sacred groves may be defined as patches of climax vegetation protected on religious grounds and buttressed by cultural mores. Fortunately, in many parts of the world, including India, there are many patches of pristine forests which have been preserved in their original state due to the prevalence of religious beliefs and social customs. These patches of forests are known as sacred groves and are considered to be the abode of ancestral deities and village gods. The names of the sacred groves vary from place to place in various regions of the country (Malhotra *et al.*, 2001). These groves are the repositories of varied biodiversity and thus play an important role in its conservation (Amirthalingam, 2012). The important role played by the sacred groves in preserving biodiversity has long been recognized (Khan *et al.* 2008). Sacred groves are thus veritable natural museums of rare medicinal plants, balancers of the watershed, a gene bank of economic species and a laboratory for environmentalists (Vartak and Kumbhojekar, 1984; Amirthalingam, 1998; Ramanujam, 2000; Sukumaran and Raj, 2010). These sacred groves are kept in a state of good preservation as pockets of native species of plants, animals, insects and micro-organisms. Hence it is necessary to make a detailed study of the Melkalpoondi sacred grove and its plant diversity.

## METHODOLOGY

### Study Area

**Plate 1: Base map and Google earth photo of Melkalpoondi sacred grove**



The present study conducted in Melkalpoondi sacred grove which is an inland Tropical Dry Evergreen Forest type which is situated in Tittakudi taluk of Cuddalore district, Tamil Nadu, South India. The total area of the grove is 9.90 hectares. It lies between the latitude  $11^{\circ}26'16.07''N$  and longitude  $78^{\circ}56'14.89''E$ . Lord Aiyanar is the main deity who is worshipped in the grove. The grove also accommodates various other minor deities like Lord Akashakaruppu, Muthukarupaiya and Kannimargal. The practice of *pooja* is existing in the grove. Statues of elephant and horses in various forms and sizes can be seen in the grove. In the month of Chithirai (April - May) and Vaikasi (June-July) a nine day festival is organized jointly by the Kelkalpoondi, Melakalpoondi and Vadakampoondi villagers. The custom of ear piercing and head tonsuring for children is also carried out in the grove. Animals such as goats and fowls are sacrificed to the subordinate deities and lemons and pumpkins are offered to the main deity in the grove (Plate 2).

## METHODS

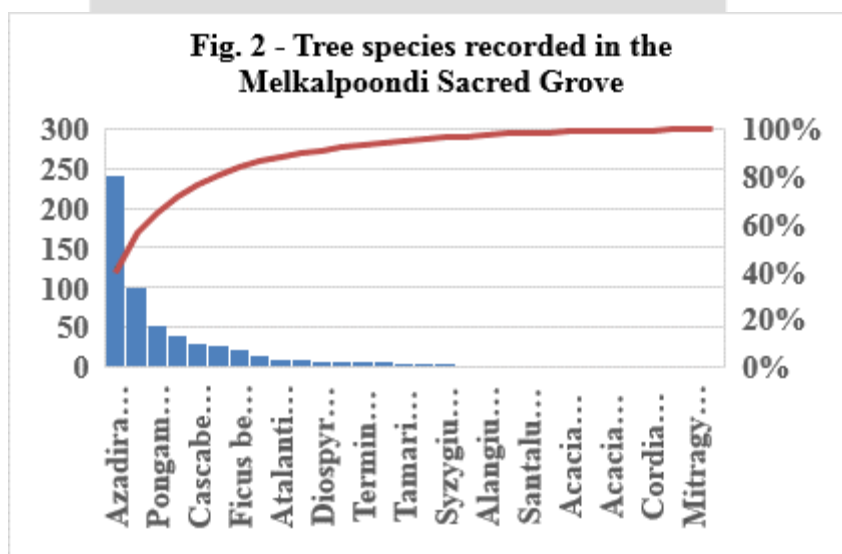
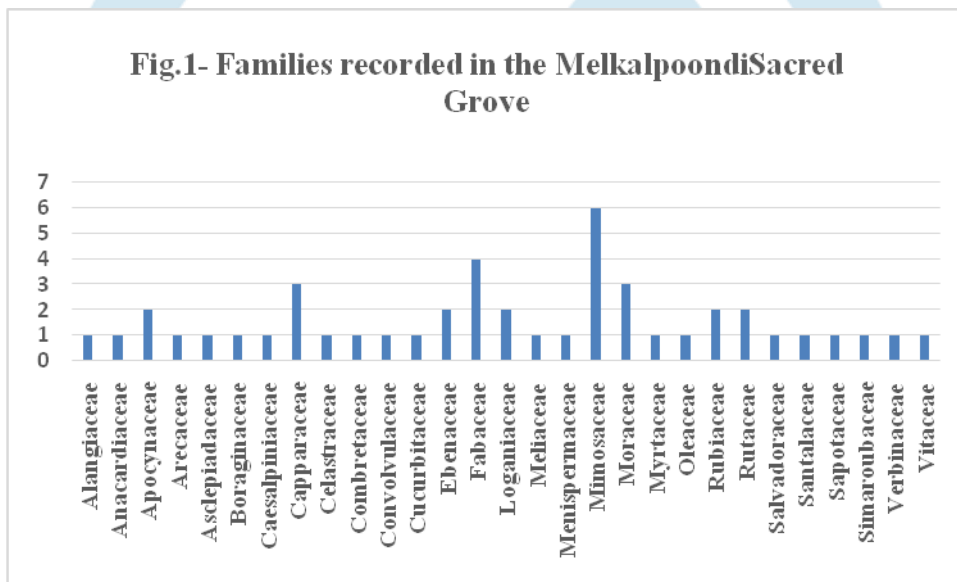
Floristic composition of the grove was analysed during the periodic field visits attempted over different seasons. In this grove, the size of one hectare plot was laid and data collected accordingly. The study plot was further divided into sub-grids of 10 x 10m size to facilitate the inventory. During the inventory, all trees  $\geq 10$ cm girth at breast height (gbh) were measured at 1.5m from ground level and the lianas  $\geq 1$ cm diameter were measured at 1.3 m from the rooting point. Voucher specimens were collected for all the species, methodically processed and identified using regional floras (Gamble and Fischer, 1915–1935; Hooker, 1872–1897; Matthew, 1991) and confirmed with the herbarium repository in the Department of Plant Biology and Plant Biotechnology,

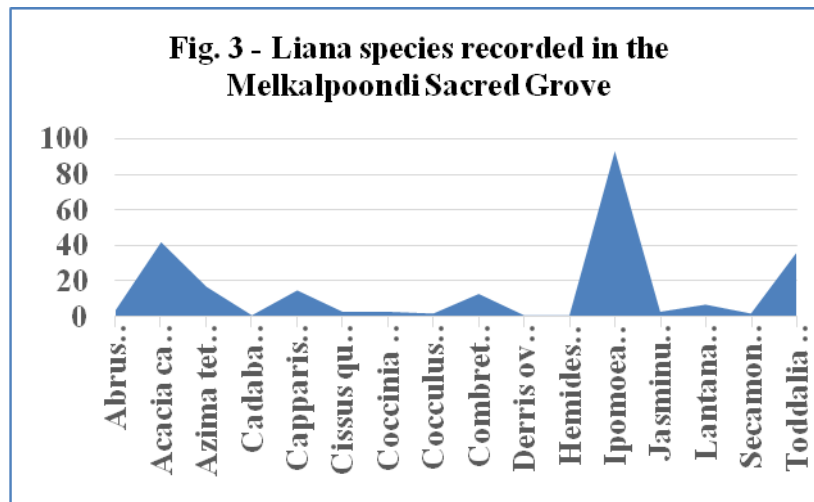
Presidency College, Chennai. The following Diversity indices such as Shannon (H'), Simpson (D) and Fisher's alpha were calculated as per Magurran (2004). Species Importance Value Indices (IVI) was calculated as per Mori *et al.* (1983). A modified Family Importance Value (FIV) was calculated by summing up the relative diversity (number of species in the family/total number of species × 100) and relative density of the individuals (Mori *et al.*, 1983) as it gives the relative contribution of the species to the stand structure.

**RESULTS**

**FLORISTIC ANALYSIS OF MELKALPOONDI SACRED GROVES**

In this grove, 46 woody plant species representing 40 genera and 29 families exist (Fig.1). Of these, 30 species are trees (Fig.2) and 16 species are lianas (Fig.3), (Table 1 & 2). The dominant families are Mimosaceae (6 species), Fabaceae (4 species), Capparaceae (3 species) and Moraceae(3 species). Apocynaceae, Ebenaceae, Loganiaceae, Rubiaceae and Rutaceae have 2 species in each respectively. Alangiaceae, Anacardiaceae, Arecaceae, Asclepiadaceae, Boraginaceae, Caesalpiniaceae, Celastraceae, Combretaceae, Convolvulaceae, Cucurbitaceae, Meliaceae, Menispermaceae, Myrtaceae, Oleaceae, Salvadoraceae, Santalaceae, Sapotaceae, Simaroubaceae, Verbenaceae and Vitaceae have only one species in each of the families.





## DIVERSITY ANALYSIS

Shannon ( $H'$ ) index for the tree and liana species was 0.71 and the Alpha index was 10.4. This shows more dominant species with almost equal contributions among 857 individuals. The Simpson ( $1/D$ ) index was 8.3 and the Berger-Parker dominance ( $1/d$ ) index was 3.5 which are indicating a good diversity in the grove. Hill's number ( $H1$ ) index for the tree and liana species was 73.25 (Table 1).

**Table -1 : Summary of woody species at Melkalpoondi sacred grove**

Variables	Number / Value (Number of individuals)
Species richness	46
Number of the Genera	40
Number of families	29
Number of tree species	30 (614)
Number of liana species	16 (243)
Density ( $ha^{-1}$ )	857
Average tree girth	65.31
Average liana girth	8.22
<b>Diversity indices</b>	
Shannon $H'$ Log Base 10.	1.182
Shannon $H_{max}$ Log Base 10.	1.663
Shannon $J'$	0.711
Alpha	10.404
Simpsons Diversity ( $D$ )	0.12
Simpsons Diversity ( $1/D$ )	8.322
Berger-Parker Dominance ( $d$ )	0.284
Berger-Parker Dominance ( $1/d$ )	3.527
Berger-Parker Dominance ( $d\%$ )	28.355
Hill's Number $H_0$	46
Hill's Number $H_1$	73.257

## PHYTOSOCIOLOGY AND COMMUNITY STRUCTURE

### SPECIES RICHNESS

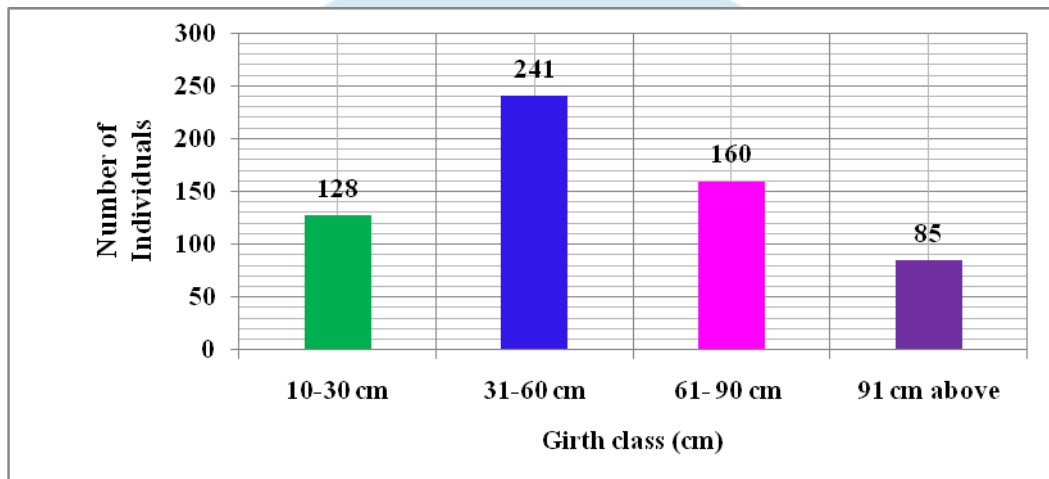
The grove has a stand density of  $857 ha^{-1}$ . It is distinctly dominated by *Diospyros montana*, *Ficus religiosa*, *Borassus flabellifer*, *Santalum album*, *Acacia leucophloea*, *Secamone emetica*, *Cassine glauca*, *Ficus benghalensis*, *Strychnos potatorum*, *Madhuca longifolia*, *Acacia planifrons* and *Acacia nilotica* (Table -2).

## GIRTH CLASS AND STAND DENSITY

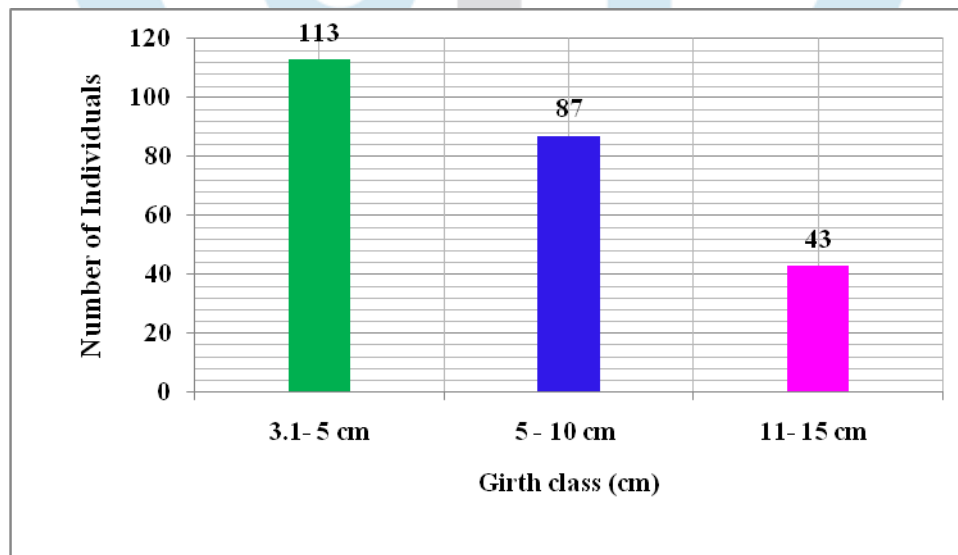
The largest GBH observed was *Ficus religiosa* (540.2 cm), followed by *Madhuca longifolia* (510.2 cm), *Terminalia arjuna* (440.8 cm) and *Syzygium cumini* (426.8 cm). Tree species belonging to 31 to 60 cm gbh class percentage was represented by 241 individuals in the grove; 61 to 90 cm gbh was represented by 160 individuals, 10 to 30 cm gbh was represented by 128 individuals and above 91 cm gbh by 85 individuals (Fig. 4).

GBH dominant liana species was *Toddalia asiatica* (40.3 cm) followed by *Ipomoea staphylina* (40.2 cm), *Secamone emetica* (26.6 cm), *Acacia caesia* (20.2 cm) and *Capparis zeylanica* (18.3 cm). Liana species belonging to 3.1 to 5 cm gbh were represented by 113 individuals followed by 5 to 10 cm gbh with 87 individuals and the lowest gbh 11 to 15 cm was of 43 individuals (Fig. 5).

**Fig. 4: GBH of dominant trees in Kaiyilpirandha Ayyanar grove in Melkalpoondi**



**Fig. 5: GBH of dominant lianas in Kaiyilpirandha Ayyanar grove in Melkalpoondi**



## BASAL AREA OF WOODY SPECIES STANDS

The basal area was 38.8325 m<sup>2</sup> ha<sup>-1</sup> in the area under study. *Madhuca longifolia* had the largest share in the stand basal area (8.3214 m<sup>2</sup> ha<sup>-1</sup>), followed by *Azadirachtaindca* (6.3295 m<sup>2</sup> ha<sup>-1</sup>), *Borassus flabellifer* (6.0612 m<sup>2</sup> ha<sup>-1</sup>), *Terminalia arjuna* (4.6829 m<sup>2</sup> ha<sup>-1</sup>), *Syzygium cumini* (3.68 m<sup>2</sup> ha<sup>-1</sup>) and *Ficus religiosa* (2.3234 m<sup>2</sup> ha<sup>-1</sup>). The lowest basal area was represented by *Ailanthus excels* (0.0106 m<sup>2</sup> ha<sup>-1</sup>) (Table -2).

## IMPORTANT VALUE INDEX



Dominant Important Value Index (IVI) was maximum for *Azadirachta indica* (IVI =63.8947), followed by *Borassus flabellifer* (IVI = 34.4824), *Madhuca longifolia* (IVI =25.9640), *Ipomoea staphylina* (IVI = 19.9825), *Pongamia pinnata* (IVI =17.3530) and *Terminalia arjuna* (IVI = 14.6482). The IVI was minimum for *Derris ovalifolia* (IVI = 0.3701) (Table -2).

**Table -2 : Phytosociology of woody species at Melkalpoondi sacred grove**

S.No	Botanical name	Count	BA	RBA	RD	RF	IVI
1	<i>Abrus precatorius</i> L.	4	0.0009	0.0023	0.4667	0.7595	1.2285
2	<i>Acacia leucophloea</i> (Roxb.) Willd.	1	0.0604	0.1555	0.1167	0.2532	0.5254
3	<i>Acacia planifrons</i> Wight & Arn.	1	0.0338	0.0872	0.1167	0.2532	0.4570
4	<i>Acacia caesia</i> (L.) Willd.	42	0.0238	0.0612	4.9008	4.8101	9.7722
5	<i>Acacia nilotica</i> (L.) Delile	1	0.0594	0.1531	0.1167	0.2532	0.5229
6	<i>Ailanthus excels</i> Roxb.	3	0.0106	0.0273	0.3501	0.7595	1.1369
7	<i>Alangium salvifolium</i> (L. f.) Wangerin	3	0.0463	0.1191	0.3501	0.7595	1.2287
8	<i>Albizia lebeck</i> (L.) Benth.	7	0.3880	0.9992	0.8168	1.7722	3.5882
9	<i>Atalantiamonophylla</i> DC.	10	0.1072	0.2761	1.1669	1.5190	2.9619
10	<i>Azadirachta indica</i> A. Juss.	243	6.3295	16.2995	28.3547	19.2405	63.8947
11	<i>Azima tetracantha</i> Lam.	17	0.0085	0.0220	1.9837	3.2911	5.2968
12	<i>Borassus flabellifer</i> L.	101	6.0612	15.6085	11.7853	7.0886	34.4824
13	<i>Cadaba fruticosa</i> (L.) Druce	1	0.0002	0.0006	0.1167	0.2532	0.3704
14	<i>Capparis zeylanica</i> L.	15	0.0094	0.0242	1.7503	3.2911	5.0656
15	<i>Cascabelathevetia</i> (L.) Lippold	30	0.2162	0.5569	3.5006	4.0506	8.1081
16	<i>Cassine glauca</i> (Rottb.) Kuntze	1	0.0073	0.0187	0.1167	0.2532	0.3886
17	<i>Cissus quadrangularis</i> L.	3	0.0009	0.0024	0.3501	0.5063	0.8587
18	<i>Coccinia grandis</i> (L.) Voigt	3	0.0012	0.0030	0.3501	0.7595	1.1126
19	<i>Cocculushirsutus</i> (L.) W.Theob.	2	0.0006	0.0016	0.2334	0.5063	0.7413
20	<i>Combretum albidum</i> G. Don.	13	0.0078	0.0200	1.5169	1.7722	3.3091
21	<i>Cordia oblonga</i> Willd.	1	0.0368	0.0948	0.1167	0.2532	0.4647
22	<i>Crateva magna</i> (Lour.) DC	10	0.2379	0.6126	1.1669	1.7722	3.5516
23	<i>Derris ovalifolia</i> (Wight & Arn.) Benth.	1	0.0001	0.0003	0.1167	0.2532	0.3701
24	<i>Diospyrosebenum</i> J. Koeng. Ex Retz.	3	0.0411	0.1059	0.3501	0.5063	0.9623
25	<i>Diospyros montana</i> Roxb.	8	0.1033	0.2660	0.9335	1.5190	2.7184
26	<i>Ficus religiosa</i> L.	1	2.3234	5.9831	0.1167	0.2532	6.3529
27	<i>Ficus benghalensis</i> L.	21	1.5787	4.0654	2.4504	0.5063	7.0222

28	<i>Hemidesmus indicus</i> (L.) R. Br. ex Schult.	1	0.0002	0.0006	0.1167	0.2532	0.3704
29	<i>Ipomoea staphylina</i> Roem. & Schult.	93	0.1048	0.2699	10.8518	8.8608	19.9825
30	<i>Jasminum angustifolium</i> (L.) Willd.	3	0.0008	0.0021	0.3501	0.7595	1.1116
31	<i>Lannea coromandelica</i> (Houtt.) Merr.	2	0.0449	0.1156	0.2334	0.2532	0.6021
32	<i>Lantana camara</i> L.	7	0.0028	0.0071	0.8168	0.7595	1.5834
33	<i>Madhuca longifolia</i> (J.Koenig ex L.) J.F.Macbr.	15	8.3214	21.4289	1.7503	2.7848	25.9640
34	<i>Mitragyna parvifolia</i> (Roxb.) Korth.	1	0.0409	0.1054	0.1167	0.2532	0.4753
35	<i>Morinda pubescens</i> J.E. Smith	6	0.0169	0.0435	0.7001	1.0127	1.7562
36	<i>Pongamia pinnata</i> (L.) Pierre	53	1.5844	4.0801	6.1844	7.0886	17.3530
37	<i>Prosopis juliflora</i> (Sw.) Dc.	40	0.2047	0.5272	4.6674	6.8354	12.0301
38	<i>Santalum album</i> L.	3	0.0216	0.0556	0.3501	0.2532	0.6588
39	<i>Secamone emetica</i> (Retz.) R. Br. ex Schult.	2	0.0059	0.0153	0.2334	0.5063	0.7550
40	<i>Streblus asper</i> Lour.	4	0.0279	0.0718	0.4667	0.7595	1.2981
41	<i>Strychnos nux-vomica</i> L.	28	1.2950	3.3347	3.2672	4.0506	10.6526
42	<i>Strychnos potatorum</i> L. f.	1	0.0503	0.1296	0.1167	0.2532	0.4994
43	<i>Syzygium cumini</i> (L.) Skeels	4	3.6810	9.4793	0.4667	1.0127	10.9587
44	<i>Tamarindus indica</i> L.	5	1.0275	2.6459	0.5834	0.7595	3.9888
45	<i>Terminalia arjuna</i> (Roxb. ex DC.) Wt. & Arn	7	4.6829	12.0592	0.8168	1.7722	14.6482
46	<i>Toddalia asiatica</i> (L.) Lam.	36	0.0241	0.0621	4.2007	4.5570	8.8197
	<b>Total</b>	<b>857</b>	<b>38.8325</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>300</b>

BA=Basal Area, RBA = Relative basal area, RD=Relative density, RF =Relative frequency, IVI=Importance value index.

## VEGETATION PROFILE

*Diospyros montana*, *Ficus religiosa*, *Borassus flabellifer*, *Santalum album*, *Acacia leucophloea*, *Secamone emetica*, *Cassine glauca*, *Ficus benghalensis* and *Strychnos potatorum* were the dominant and medium size trees observed here. Tree species like *Ficus religiosa*, followed by *Madhuca longifolia*, *Terminalia arjuna* and *Syzygium cumini* were present as the upper canopy level trees in the grove. Slightly short trees such as *Azadirachta indica*, *Ipomoea staphylina* and *Prosopis juliflora* were sparsely distributed in the grove.

## DISTURBANCE ANALYSIS

As this grove is situated near by the river Vellar, there has been an uncontrolled encroachment observed. The local people have laid illegal pipelines from the river to fetch water. They have also constructed many concrete pump sheds within the

grove. Furthermore, they are also cutting the trees and branches in order to lay electricity lines for the purpose of agriculture. Hence necessary action needs to be taken to rectify their illegal activities and to protect the grove.

## DISCUSSION

The Tropical Deciduous Forest (TDF) sites scattered along the Coromandel coast of India are invariably protected as sacred forests in which different researches have been carried out on plant biodiversity by the researchers including Meher Homji, 1986; Ramujam and Kadamban (2001), Parthasarathy and Karthikeyan, 1997; Mani and Parthasarathy (2007). However, there is no complete documentation and research on the social and biodiversity values till date. To fulfill this scientific gap, the present study has been carried out in ten inland sacred groves from Cuddalore and Villupuram districts of Tamil Nadu.

The present study has enumerated a total of 46 woody plant species representing 40 genera distributed in 29 families. Of these, 30 species are trees and 16 species are lianas, (Table 2). The dominant families are Mimosaceae (6 species), Fabaceae (4 species), Capparaceae (3 species) and Moraceae (3 species). This is closer to the value from India at comparable 1-ha scale.

The total basal area is 38.8325 m<sup>2</sup> ha<sup>-1</sup> in the study area. *Madhuca longifolia* has the largest share in stand basal area (8.3214 m<sup>2</sup> ha<sup>-1</sup>), followed by *Azadirachta indica* (6.3295 m<sup>2</sup> ha<sup>-1</sup>), *Borassus flabellifer* (6.0612 m<sup>2</sup> ha<sup>-1</sup>), *Terminalia arjuna* (4.6829 m<sup>2</sup> ha<sup>-1</sup>), *Syzygium cumini* (3.68 m<sup>2</sup> ha<sup>-1</sup>) and *Ficus religiosa* (2.3234 m<sup>2</sup> ha<sup>-1</sup>). The lowest basal area was represented by *Ailanthus excels* (0.0106 m<sup>2</sup> ha<sup>-1</sup>). This is closer to the tree diversity (stem  $\geq$  10 cm gbh) ranged from a low value of 26.3 $\pm$ 6.7 with a range from 18-37 species per hectare in TDEF, India (Vivek and Parthasarathy, 2015), Similarly, the mean stands 21 $\pm$ 5.5 with a range from 12 - 33 species per ha from Cuddalore and Villupuram districts (Karthiket *al.* 2016) to a higher value of 51.2  $\pm$  9.5 species per ha with a range from 42-66 in the Southern Eastern Ghats (Rao *et al.*, 2011) were recorded.

A total of 46 woody plant species representing 40 genera distributed in 29 families are enumerated on one hectare. Scale recorded is significant (Table 2). There are 30 in woody species and 16 are lianas. The dominant families are Mimosaceae (6 species), Fabaceae (4 species), Capparaceae (3 species) and Moraceae (3 species). Apocynaceae, Ebenaceae, Loganiaceae, Rubiaceae and Rutaceae have 2 species in each respectively. Alangiaceae, Anacardiaceae, Arecaceae, Asclepiadaceae, Boraginaceae, Caesalpiniaceae, Celastraceae, Combretaceae, Convolvulaceae, Cucurbitaceae, Meliaceae, Menispermaceae, Myrtaceae, Oleaceae, Salvadoraceae, Santalaceae, Sapotaceae, Simaroubaceae, Verbenaceae and Vitaceae have only one species in each of the families.

As far as vegetation analysis is concerned, it indicates that the stand density of the grove is ranging from 117 to 285 stems per hectare. It is far below the 1663 stems ha<sup>-1</sup> recorded for Shanmuganathapuram which is a nearby sacred grove (Mani and Parthasarathy 2007).

Based on the data, the patchy vegetation of the grove has a mixture of Bravi-deciduous and Tropical Dry Evergreen trees forming an apparently two layered forest. *Albizia amara*, *Prosopis juliflora*, *Azadirachta indica*, *Cascabelathevetia* and *Wrightia inctoria* are dominant and medium size trees. Tree species like *Tamarindus indica* and *Ficus religiosa* are present as the upper canopy trees in the grove. Slightly short trees such as *Prosopis juliflora*, *Albizia amara*, and *Cascabela thevetia* are sparsely distributed in the grove. This kind of two layered structure is a special type of formation confined only to the south-east coast of India and north-east part of Sri Lanka (Rao and Meher-Homji 1993).

## CONCLUSION

The analysis showed that the stand density and tree diversity of the grove is on the lower side when compared to the other inland Tropical Dry Evergreen Forest type groves of this area. It was revealed that tree diversity varied according to the biogeography and habitat destruction. Another factor that played an important role in affecting the composition of the grove was anthropomorphic activities. The subject grove is also closely linked with the religious and cultural traditions of the local communities. The grove is also performing a very useful function in conserving the biodiversity and providing the natural habitat for various native plants and animals. However, this study has focused on a Tropical Dry Evergreen Forest as it is essential that this type of forest is to be preserved from species extinction. It is also to be noted that the sacred groves accomplish the function as repositories of genetic diversity of native trees.

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**Plate:2- Scenes depicting activity in the Melkalpoondi sacred grove**



**Forest area cleared for laying road**



**Main deity of the grove**



**Cooking pongal inside the grove**



**Discussing with the poojaris about the use of NTFP**



**Cattle grazing inside the grove**



**Paddy fields in the adjoining areas of the groves**