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Plant Diversity and Community Structure of Tropical Semi-Evergreen Forests on the Southwest Coast of India

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ABSTRACT: This study examines the plant diversity and community structure of a tropical semi-evergreen forest in a sacred grove on the southwest coast of India, encompassing 0.2 hectares. A total of 102 plant species were recorded, including two unidentified orchids. The species composition was categorized into 36 trees (35.29%), 18 shrubs (17.65%), 26 herbs (25.49%), and 22 climbers (21.57%). The forest exhibited a three-layered structure: canopy (>15 m), sub-canopy (8–15 m), and under-canopy (<8 m). The Rubiaceae family was the most diverse, with 8 species, followed by Euphorbiaceae and Verbenaceae, each with 6 species. Species richness generally decreased with increasing diameter at breast height (dbh), with an exception for mature trees over 180 cm dbh. Most species displayed a clumped distribution (approximately 80%), while 6–10% had a random distribution. Tree density varied from 5 to 155 trees per hectare, with a mean of 935 trees per hectare across 36 species. *Hemicyclea sepiaria* was the most dominant species (Importance Value Index, IVI = 40.50), followed by *Manikara hexandra* (IVI = 25.19), while *Psidium guajava* had the lowest IVI (1.73). These results highlight the intricate structure and significant biodiversity of the sacred grove, emphasizing its ecological value and role in conserving tropical semi-evergreen forests.

1. INTRODUCTION

Tropical forests, known for their high terrestrial biodiversity and complexity (Basham et al., 2023), have experienced significant reductions in area due to natural and human disturbances (Dar and Parthasarathy, 2023; Giresse et al., 2023). Activities such as deforestation and habitat destruction have notably decreased species richness and ecosystem health (Parthasarathy and Babu, 2020; Ahmed and Dhiman, 2024; Babu et al., 2024; Starlin and Rani, 2024). Remaining forest patches are often small, degraded, and isolated, challenging their biota to adapt and maintain ecological functions in altered landscapes (Melo et al., 2013; Jeeshma et al., 2025). Consequently, assessing plant diversity and community traits in these residual areas is crucial, especially in tropical developing regions where deforestation and fragmentation are prevalent (Borges et al., 2024).

Forest biodiversity is a vital resource for humanity, with traditional practices playing a crucial role in its conservation (Sukumaran et al., 2021; Bhatt et al., 2024; Starlin et al., 2025). Indigenous communities worldwide have historically lived in harmony with nature, employing sustainable practices to protect biodiversity (Singh et al., 2022; Kalra et al., 2024). However, these resources are increasingly threatened, particularly in biodiversity-rich tropical regions, leading to significant local, regional, and global concerns (Stella and Rani, 2023; Sparsa and Parida, 2024; Abhinand and Rani, 2025). In response, governments have established

protected areas, but indigenous practices, such as the conservation of small forest patches dedicated to local deities, have long contributed to biodiversity preservation (Patwardhan et al., 2021). These forest patches, known as "sacred groves," are rich in biodiversity and reflect the cultural and spiritual values of indigenous peoples who protect them through nature worship (Baidya and Devi, 2024). Sacred groves serve as crucial reservoirs of local flora and fauna, preserving remnants of native vegetation and contributing to environmental stability (Kumar et al., 2022). They represent the enduring efforts of local communities to safeguard their natural landscapes amidst increasing pressures from agriculture and urbanization (King et al., 1997; Vinuba et al., 2023; Rani, 2024).

Sacred groves within the West Coast tropical semi-evergreen forests of Tamil Nadu are significant biodiversity reservoirs (Sukumaran et al., 2008). Preserved through cultural and religious practices, these groves provide refuge for rare and endemic plant species and contribute to seed dispersal and ecosystem stability (Sukumaran et al., 2010; Rajasri et al., 2017). Despite their ecological importance, there is a notable lack of quantitative research on the plant diversity, population structure, and regeneration patterns within these sacred groves, especially in Kanyakumari district (Sukumaran et al., 2019). This study aims to address this gap by providing a comprehensive quantitative analysis of plant diversity, structural attributes, and regeneration patterns in these sacred groves. While previous research has highlighted species richness and ethnobotanical value, detailed phytosociological data are scarce. This research will offer the first detailed quantitative insights into these aspects, which is crucial for developing effective conservation strategies and emphasizing the importance of preserving these ecologically valuable forest remnants.

2. MATERIALS AND METHODS

2.1 Study Area

The study was conducted in the 'Muppuram' sacred forest, located on the southwest coast of Kanyakumari district, straddling the Kerala-Tamil Nadu boundary at Kollencode, and managed by the Tamil Nadu Devasam Board (8.2880° N, 77.1125° E). Covering approximately 4.4 hectares, the grove has been significantly altered, with 60% converted to a coconut-based agroforestry system, and a temple construction reducing the forest area to one acre with canopy openings. The forest, classified as West Coast semi-evergreen forest (2A/C3, Champion and Seth, 1968), features a canopy of evergreen species reaching up to 30 meters in height, with notable species including *Artocarpus heterophyllus*, *Artocarpus hirsutus*, *Hemicyclea sepiaria*, *Manilkara hexandra*, *Mangifera indica*, and *Schleichera oleosa*. The dense shrub stratum is primarily composed of evergreen species, and the forest supports a variety of epiphytes such as orchids and *Dendrophthae falcata*. Common lianas and climbers are present, and xerophytic angiosperms like *Euphorbia antiquorum*, *Opuntia dillenii*, and *Sansevieria roxburghiana* are found on the forest floor. The area also includes a perennial freshwater source utilized by local residents.

2.2 Plant Diversity and Community Attributes

Phytosociological studies were conducted from 2023 to 2025 using the quadrat method. Twenty 10 m × 10 m quadrats were randomly established to assess trees with a girth at breast height (gbh) ≥ 20 cm, while sixty 5 m × 5 m quadrats were used for shrubs and saplings, and sixty 1 m × 1 m quadrats for herbs and seedlings, nested within the tree quadrats. Density (trees ha⁻¹) and basal area were calculated for each species, and the Importance Value Index (IVI) was computed following Phillips (1959). Species richness, dominance, and diversity were evaluated using Margalef's index (1958), Shannon's diversity index (Shannon and Weaver, 1963), Simpson's dominance index (Simpson, 1949), and Pielou's evenness index (1969).

$$\text{Frequency (\%)} = \frac{\text{Number of quadrats of occurrence of a species}}{\text{Total number of quadrats studied}} \times 100$$
$$\text{Density (\%)} = \frac{\text{Total number of individuals of a species}}{\text{Total number of quadrats studied}} \times 100$$

Basal cover = Density $\times$ Average basal area of individuals of a species

Number of individuals of a species

Abundance = $\frac{\text{Number of individuals of a species}}{\text{Number of quadrats of occurrences of the species}} \times 100$

Number of quadrats of occurrences of the species

RDm = Total basal area for a species/total basal area for all species $\times 100$

RD = Number of individuals of a species/total number of all individuals $\times 100$

RF = Frequency of a species/sum frequencies of all species $\times 100$

Thus, Importance value index = RDm + RD + RF

Abundance (A)

Whitford's index = $\frac{\text{Abundance (A)}}{\text{Frequency (F)}} \times 100$

Frequency (F)

Species richness index (Margalef 1958) = $S - 1 / \ln N$

where, S is the total number of species, N is total number of individuals and $\ln$ is log2.

Diversity index (Shannon and Weaver 1963)

$$H' = - \sum_{i=1}^s p_i \ln p_i$$

where, H' is the Shannon–Weiner diversity index, p_i is the proportion of IVI of a species i.e. (n_i / N) .

Dominance index (Simpson 1949)

$$Cd = \sum_{i=1}^s (p_i)^2$$

Species Accumulation Curve was generated using EstimateS (Version 6.0b1, 2000), the curve was plotted against area for the plots. The Chao1 species number for 0.1 ha subplots was used to estimate species accumulation.

2.3 Taxonomic Evaluation

Plant species were taxonomically identified using various floras (Gamble and Fischer, 1915–1935; Matthew, 1995; Daniel and Umamaheshwari, 2001) and field keys (Pascal and Ramesh, 1987). Identifications were confirmed through consultations with herbaria at the Botanical Survey of India, Southern Circle, Coimbatore; Kerala Forest Research Institute, Peechi; Tropical Botanical Garden and Research Institute, Trivandrum; and the Department of Botany, Nesamony Memorial Christian College. Nomenclature followed regional flora guidelines. Voucher specimens were prepared according to Henderson (2005) and deposited in the PTMTM College Herbarium, Kamuthi, Tamil Nadu, India.

3. RESULTS AND DISCUSSION

3.1 Species richness and Distribution

In the study of the sacred forest covering 0.2 ha, a total of 102 plant species were identified, with five species, including two orchids, remaining unidentified. The species composition was categorized into 36 trees (35.29%), 18 shrubs (17.65%), 26 herbs

(25.49%), and 22 climbers (21.57%). The forest structure was stratified into three distinct layers: canopy (>15 m), sub-canopy (8–15 m), and under-canopy (<8 m). The canopy layer was dominated by species such as *Artocarpus heterophyllus* and *Ficus benghalensis*, while the sub-canopy included *Albizia lebbek* and *Mangifera indica*. The under-canopy featured species like *Flacourtia indica* and *Syzygium amotianum*. This stratification highlights the diverse structural complexity within the forest, which supports a range of plant life forms.

The observed tree species richness (number of species per 100 m²) indicates a mosaic of high- and low-diversity areas within the forest, highlighting its fragmented nature (Figure 1). This richness is comparable to other studies, with Ramanujam and Cyril (2003) reporting 111 species in sacred groves along the southeast coast of India and Ramanujam and Kadamban (2001) documenting 169 species in tropical dry evergreen forests. Similarly, the 54 woody species reported by Parthasarathy and Karthikeyan (1997) in the Coromandel coast align with the findings of this study. The present study, which recorded 36 tree species, is consistent with Kalita and Yumnam (2024), who documented 39 species in the tropical moist deciduous forests of Gotanagar Reserve Forest, Assam, India. Tree distribution across strata showed a predominance of trees in the 10–20 m height class, with fewer in the 30–40 m class, corroborating the observations Onyekwelu et al. (2022) in southwestern Nigeria. The diverse plant strata and the significant species richness underscore the ecological importance of the sacred forest. Despite its small size and fragmentation, the forest retains considerable biodiversity, reflecting its ongoing conservation value (Page et al., 2010).

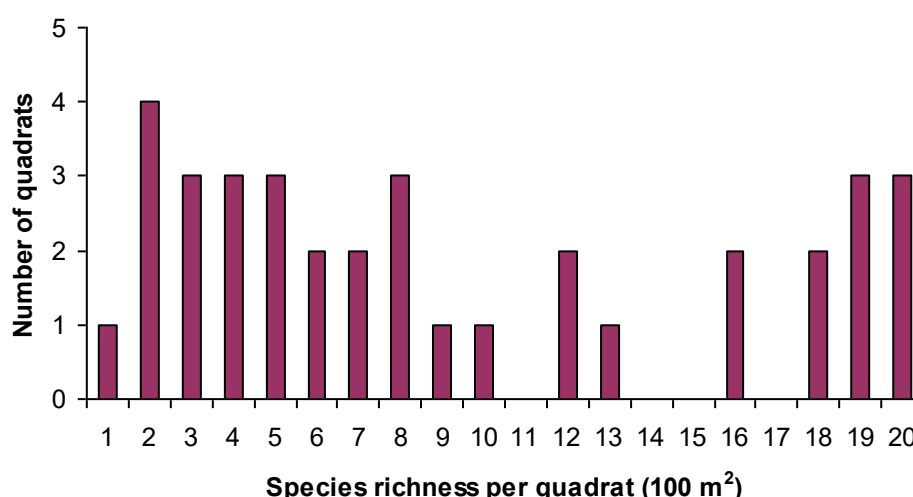


Figure 1 Spatial distribution of tree species richness in the study area

Table 1 Important value indices (IVI) of plant species recorded in the sacred forest

Botanical Name	Family	IVI
Trees		
<i>Adenanthera pavonia</i> Linn.	Mimosaceae	12.60
<i>Albizia lebbek</i> Benth.	Mimosaceae	6.77
<i>Anacardium occidentale</i> Linn.	Anacardiaceae	9.10
<i>Annona squamosa</i> Linn.	Anonaceae	2.94
<i>Areca catechu</i>	Arecaceae	3.48
<i>Artocarpus heterophyllus</i> Lam.	Moraceae	8.91

<i>Artocarpus hirsutus</i> Lam.	Moraceae	3.89
<i>Buchanania barberi</i> Gamble.	Anacardiaceae	2.62
<i>Carica papaya</i> Linn.	Caricaceae	1.75
<i>Cocos nucifera</i>	Arecaceae	3.89
<i>Ficus bengalensis</i> Linn.	Moraceae	24.58
<i>Ficus religiosa</i> Linn.	Moraceae	7.60
<i>Flacourtia indica</i> Roxb.	Bixaceae	7.63
<i>Gliricida sepium</i> Jacq.	Fabaceae	23.48
<i>Glycosmis arborea</i> Roxb.	Rutaceae	3.41
<i>Hemicyclia sepiaria</i> W.& A.	Euphorbiaceae	49.50
<i>Hydnocarpus lancifolia</i> Dennst.	Bixaceae	3.71
<i>Litsea glabrata</i> (Wall. ex Nees) Hook.f.	Lauraceae	2.31
<i>Mangifera indica</i> Linn.	Anacardiaceae	2.73
<i>Manilkara hexandra</i> Roxb.	Sapotaceae	25.19
<i>Michelia champaca</i> Linn.	Magnoliaceae	3.10
<i>Morinda tinctoria</i> Roxb.	Rubiaceae	21.28
<i>Phyllanthus emblica</i> Linn.	Euphorbiaceae	1.97
<i>Psidium guajava</i>	Myrtaceae	1.73
<i>Randia uliginosa</i> DC.	Rubiaceae	17.80
<i>Santalum album</i> Linn.	Santalaceae	6.33

Table 1 (Continued)

Botanical Name	Family	IVI
<i>Schleichera oleosa</i> W.	Sapindaceae	12.04
<i>Semecarpus travancorica</i> Bedd.	Anacardiaceae	1.78
<i>Sterculia foetida</i> Linn.	Sterculiaceae	1.78
<i>Sterculia guttata</i> Roxb.	Sterculiaceae	1.76
<i>Strychnos nux-vomica</i> Linn.	Loganiaceae	3.80
<i>Swietenia mahagoni</i> Linn.	Meliaceae	2.20
<i>Syzygium arnottianum</i>	Myrtaceae	1.89
<i>Tamarindus indica</i> Linn.	Caesalpiniaceae	12.92
<i>Thespesia populnea</i>	Malvaceae	1.78
<i>Vitex negundo</i>	Verbenaceae	1.76

Shrubs		
<i>Barleria prionitis</i> Linn.	Acanthaceae	17.08
<i>Breynia patens</i> Rolfe.	Euphorbiaceae	11.18
<i>Bryophyllum pinnatum</i> Kurz.	Crassulaceae	9.40
<i>Calotropis gigantea</i> R.Br.	Asclepiadaceae	11.50
<i>Carissa spinarum</i> Linn.	Apocynaceae	8.36
<i>Citrus aurantifolia</i> Linn.	Rutaceae	11.62
<i>Ebretia microphylla</i> Lam.	Boraginaceae	17.00
<i>Euphorbia antiquorum</i> Linn.	Euphorbiaceae	10.64
<i>Gardenia lucida</i> Roxb.	Rubiaceae	16.94
<i>Hibiscus rosa-sinensis</i>	Malvaceae	17.44
<i>Ixora brachiata</i> Roxb.	Rubiaceae	18.30
<i>Lantana camara</i> Linn.	Verbenaceae	25.88
<i>Nerium odoratum</i> Soland.	Apocynaceae	7.17
<i>Ochna obtusa</i>	Ochnaceae	32.67
<i>Ophiorrhiza mungos</i> Linn.	Rubiaceae	30.67
<i>Opuntia dillenii</i> Haw.	Cactaceae	14.52

Table 1 (Continued)

Botanical Name	Family	IVI
<i>Pavetta zeylanica</i> Gamble.	Rubiaceae	24.54
<i>Tabernaemontana alternifolia</i> Linn.	Apocynaceae	15.10
Climbers (including Lianas)		
<i>Abrus precatorius</i> Linn.	Fabaceae	9.41
<i>Bridelia scandens</i> Gehrm.	Euphorbiaceae	12.69
<i>Cadamba latifolia</i>	Capparidaceae	1.53
<i>Cansjera rheedi</i>	Opliacae	4.53
<i>Capparis sepiaria</i> Linn.	Capparidaceae	8.36
<i>Capparis stylosa</i> D.S.	Capparidaceae	4.79
<i>Capparis zeylanica</i> Linn.	Capparidaceae	0.68
<i>Carrisa inermis</i> Vahl.	Apocynaceae	1.73
<i>Cayratia japonica</i> Gagnep.	Vitaceae	4.90
<i>Cissampelos pariera</i> Linn.	Menispermaceae	34.84
<i>Cissus vitiginea</i> Linn.	Vitaceae	3.53
<i>Grewia disperma</i> Rottl.	Tiliaceae	7.94
<i>Hugonia mystax</i> Linn.	Lianaceae	18.38

<i>Jasminum angustifolium</i> Vahl.	Oleaceae	11.62
<i>Morinda umbellata</i>	Rubiaceae	0.84
<i>Pueraria trilobata</i> (Lam) N.C Nair	Vitaceae	3.79
<i>Pyrenacantha volabilis</i> Hook.	Icapinaceae	8.05
<i>Strychnos colubrine</i> Linn.	Loganiaceae	26.32
<i>Tetracera akara</i>	Dilleniaceae	11.83
<i>Tetrastigma canarense</i> Gamble.	Vitaceae	6.15
<i>Uvaria narum</i> Wall.	Annonaceae	10.57
<i>Zizyphus oenoplia</i> Mill.	Rhamniaceae	7.52

Table (Continued)

Botanical Name	Family	IVI
Herbs		
<i>Aerva lanata</i> Juss.	Amaranthaceae	1.41
<i>Andrographis paniculata</i> Nees.	Acanthaceae	6.43
<i>Apluda mutica</i> Linn.	Poaceae	11.05
<i>Blepharis boerhavifolia</i> Pers.	Acanthaceae	9.04
<i>Boerhavia diffusa</i> Linn.	Nyctaginaceae	4.69
<i>Ceropegia</i> sp.	Asclepiadiaceae	2.88
<i>Commelina bengalensis</i> Linn.	Commelinaceae	2.54
<i>Commelina erecta</i> Linn.	Commelinaceae	4.22
<i>Dendrobium</i> sp.	Orchidaceae	4.22
<i>Eragrostis tenella</i> Roem.	Poaceae	15.94
<i>Eragrostis tenuifolia</i> Hochst.	Poaceae	10.46
<i>Gloriosa superba</i> Linn.	Liliaceae	4.29
<i>Hemidesmus indicus</i> R.Br.	Asclepiadiaceae	5.49
<i>Justicia simplex</i> D.Don.	Acanthaceae	5.02
<i>Justicia travencoria</i>	Acanthaceae	1.41
<i>Knoxia heyneana</i> DC.	Rubiaceae	1.14
<i>Mimosa pudica</i> Linn.	Mimosaceae	2.01
<i>Oplismenus compositus</i> Beauv.	Poaceae	7.91
<i>Ocimum sanctum</i>	Labiatae	2.28
<i>Perotis indica</i> R&S.	Poaceae	23.33
<i>Plumbago zeylanica</i> Linn.	Plumbaginaceae	1.74
<i>Sansevieria roxburghiana</i> Schult.	Liliaceae	64.61
<i>Sebastiana chamalea</i> M.Arg	Euphorbiaceae	4.62
<i>Sida acuta</i>	Malvaceae	1.41
<i>Sida cordifolia</i> Linn.	Malvaceae	0.87
<i>Walteria indica</i> Linn.	Sterculiaceae	1.00

3.2 Family Dominance

In the analyzed sacred forest, the plant family Rubiaceae was the most diverse, with 8 species, followed by Euphorbiaceae and Verbenaceae, each with 6 species. The families Acanthaceae and Poaceae each contained 5 species, while Anacardiaceae, Apocynaceae, Capparidaceae, Malvaceae, and Moraceae each had 4 species. Additionally, Asclepiadaceae, Mimosaceae, and Sterculiaceae each had 3 species, and nine families were represented by 2 species each, with 25 families being monospecific (Table 2; Figure 2). The dominance of Rubiaceae in this study mirrors findings from Basha et al. (2012) in the Eastern Ghats and Akhil et al. (2023) in the Western Ghats, indicating a consistent pattern of family dominance across different sacred groves. In contrast, Rubiaceae was codominant in the sacred groves of East Khasi Hills (Mishra et al., 2004) and Jaintia Hills (Jamir and Pandey, 2003), while Euphorbiaceae was predominant in the sacred groves of the Coromandel coast (Sambandan and Dhatchanaoorthy, 2012) and in Poyyur Ayyanaar sacred grove, Tamil Nadu (Anuradha and Muruganandam, 2016).

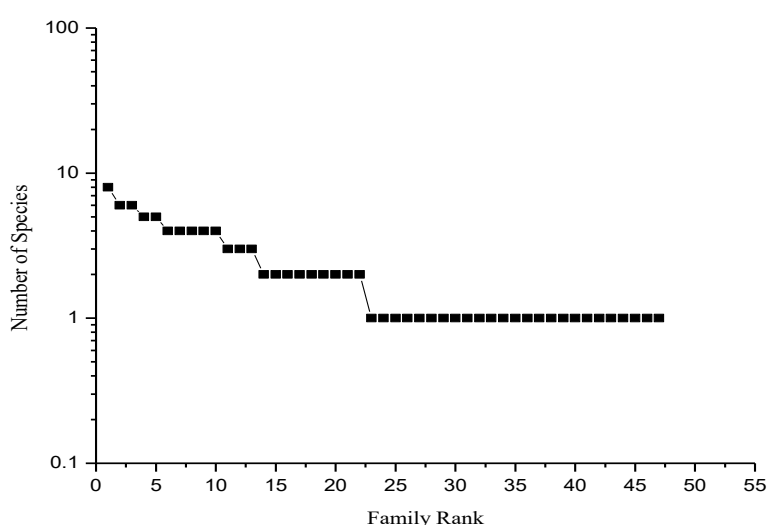


Figure 2 Dominance – distribution pattern of families in the study area

Table 2 Distribution of plant families in the study area.

Rank	Family	Genus	Species
1	Rubiaceae	7	8
2	Euphorbiaceae	6	6
3	Verbenaceae	6	6
4	Acanthaceae	4	5
5	Poaceae	4	5
6	Anacardiaceae	4	4
7	Apocynaceae	3	4
8	Capparidaceae	2	4
9	Malvaceae	3	4
10	Moraceae	2	4
11	Asclepiadaceae	3	3
12	Mimosaceae	3	3
13	Sterculiaceae	2	3

14	Annonaceae	1	2
15	Arecaceae	2	2
16	Bixaceae	2	2
17	Commelinaceae	1	2
18	Fabaceae	2	2
19	Liliaceae	2	2
20	Loganiaceae	1	2
21	Mrytaceae	2	2
22	Rutaceae	2	2
23	Amaranthaceae	1	1
24	Boraginaceae	1	1
25	Cactaceae	1	1
26	Caesalpiniaceae	1	1
27	Caricaceae	1	1
28	Crassulaceae	1	1

Table 2 (Continued)

Rank	Family	Genus	Species
29	Dilleniaceae	1	1
30	Icapinaceae	1	1
31	Labiatae	1	1
32	Lauraceae	1	1
33	Lianaceae	1	1
34	Magnoliaceae	1	1
35	Meliaceae	1	1
36	Menispermaceae	1	1
37	Nyctaginaceae	1	1
38	Ochnaceae	1	1
39	Oleaceae	1	1
40	Opliaceae	1	1
41	Orchidaceae	1	1
42	Plumbagenaceae	1	1
43	Rhaminaceae	1	1
44	Santalaceae	1	1
45	Sapindaceae	1	1
46	Sapotaceae	1	1
47	Tiliaceae	1	1

The significant presence of monospecific families, approximately 50%, aligns with Vieira et al. (2019), who suggested that the prevalence of these families could reflect ecological pressures from expanding monocultures impacting the flora of sacred groves. This trend indicates that early lineages adapting from surrounding forests might struggle in these altered environments, leading to a higher proportion of families represented by a single species.

3.3 Density and Dominance

In the present study, the majority of species (17sp. 20 - 40 cm dbh; 13sp. 40 – 60 cm dbh and 15 sp. 60 – 80 cm dbh) were represented by young individuals and species richness decreased with increase in dbh class, except in the case of mature trees beyond > 180 cm dbh (Figure 3) which is in agreement with the findings of Upadhaya et al. (2003) reported the number of species as well as stem density were greater for the trees of lower dbh (5–15 cm) class compared to the higher (> 66cm) dbh class in the sacred groves of Jaintia Hills, Meghalaya. The decline in stem density with increasing DBH classes has been reported by Ganesh et al. (1996) for evergreen forests of Kalakad–Mundanthurai Tiger Reserve of Western Ghats of India. Sahoo et al. (2020) reported that Both species richness and stem density of trees decreased with increasing girth class except for the larger girth classes (121–150 cm and > 150 cm) in the tropical moist deciduous forests of the Eastern Ghats of Odisha. Similar trend was also reported by Ao et al. (2024) in along an altitudinal gradient of Eastern Himalayas and Tamhane et al. (2024) in the northern Western Ghats, whilst Onyekwelu et al. (2024) in the sacred groves of southwestern Nigeria.

In natural forests, clumped or contagious distribution is commonly observed, reflecting the aggregation of individuals, whereas random distribution is typical of even-aged forests, and regular distribution occurs where high competition is present (Odum, 1971). In the current study, most species exhibited a clumped distribution pattern (*ca.* 80%), with only 6-10% showing a random distribution (Figure 4). This pattern aligns with findings from Kaushal et al. (2021) in the Indian Central Himalayas and Buragohain et al. (2023) in the lowland tropical rainforests of Assam. Clumped distribution suggests spatial clustering of individuals, indicative of habitat heterogeneity or resource availability. In contrast, random distribution occurs in stable, homogeneous environments, and regular distribution signals intense competition (Hill and Gauch, 1980). Additionally, anthropogenic factors such as population density, human activities, and land use changes can significantly alter species distribution patterns, influencing species dispersion on a broader scale (Xu et al., 2019; Ao et al., 2024). The predominance of clumped distribution in this study suggests that the forest may represent a climax community, characterized by a stable, mature ecosystem.

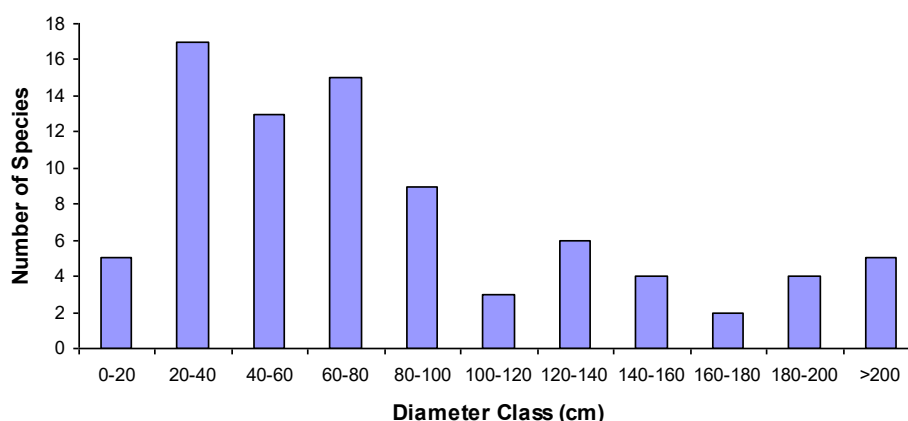


Figure 3 Distribution of species in different diameter classes the study area

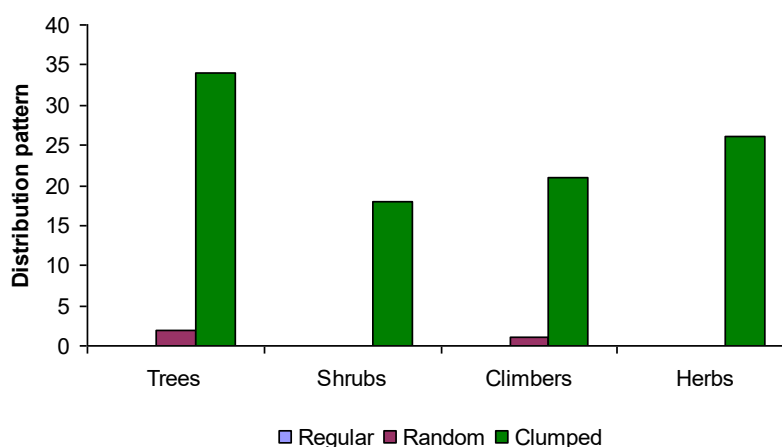


Figure 4 Distribution of pattern of plant species in the study area

3.4 Density and basal cover

Figure 5 illustrates the distribution of tree density across different girth classes in the sacred forest. The majority of stems (65.24%) fall within the 20-60 cm diameter at breast height (dbh) class, while only 2.67% are in the 140-160 cm dbh class, 1.07% in the 160-180 cm dbh class, 2.14% in the 180-200 cm dbh class, and 3.74% in the >200 cm dbh class. Tree density ranged from 5 to 155 trees per hectare, with a total of 935 trees per hectare representing 36 species (Table 3). Notably, nearly 50% of the species were represented by only one or two stems. Dominant species include *Hemicylea sepiaria* (135 stems), *Manilkara hexandra* (95 stems), *Morinda tinctoria* (80 stems), *Randia uliginosa* (75 stems), *Adenanthera pavonia* (50 stems), and *Tamarindus indica* (40 stems) per hectare (Figure 6). The density of young trees (20-40 cm dbh) was significantly higher compared to mature trees (>160 cm dbh). The mean stem density of 925 trees per hectare aligns with findings from other sacred forests in the Southern Eastern Ghats, such as Rao et al. (2011) who reported 971.6 trees per hectare. Similar trends were observed by Bharathi and Prasad (2017) in the sacred groves of Kushalnagar, Karnataka. However, the basal cover of young trees (0.07 m² ha⁻¹) was markedly lower than that of mature trees (31.05 m² ha⁻¹). This contrasts with Maru et al. (2023), who found higher above-ground biomass in young trees compared to old trees in the sacred forests of the Gedeo community, Southern Ethiopia.

Table 3 Density, basal area, dominance, diversity and evenness indices of plant species in the study area.

Variable	Trees	Shrubs	Climbers	Herbs
Density (ha ⁻¹)	925	1845	78750	931250
Basal area (m ² ha ⁻¹)	132.52	0.34	-	-
Shannon's diversity index	2.92	2.72	2.72	2.54
Pielou's evenness index	0.81	0.94	0.88	0.78
Simpson's dominance index	0.08	0.08	0.09	0.13
Whittaker index	6.88	3.05	3.41	3.93

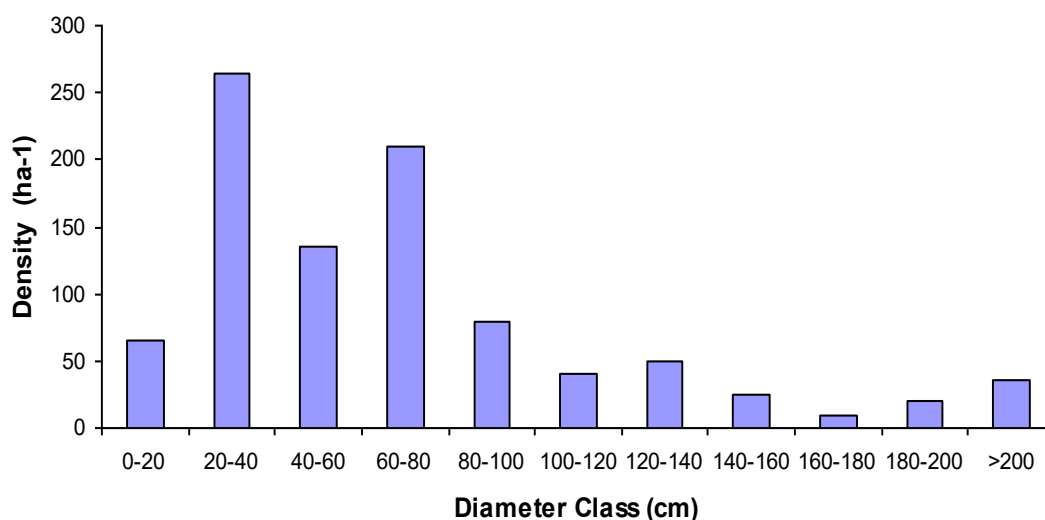


Figure 5 Distribution of density in different diameter classes in the study area.

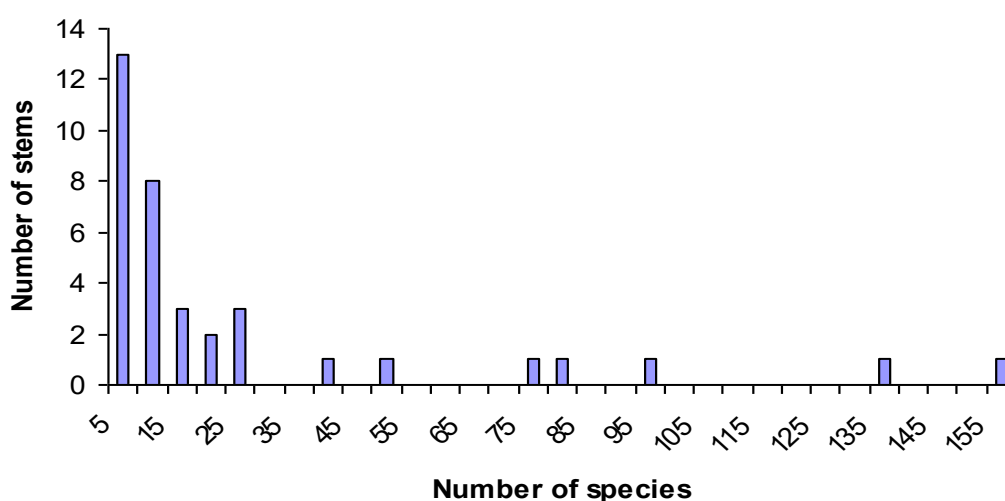


Figure 6 Species stem relationship in a hectare area of the sacred grove

3.5 Dominance distribution pattern of Tree species

The dominance distribution of tree species in the sacred forest fragments exhibited log-normal curves, indicating high equitability and low dominance (Figure 7). *Hemicylea sepiaria*, an evergreen native species, emerged as the most dominant with an Importance Value Index (IVI) of 40.50, while *Manikara hexandra*, a large, slow-growing evergreen, was the co-dominant species with an IVI of 25.19. In contrast, *Psidium guajava* exhibited the lowest dominance with an IVI of 1.73 (Table 1). Comparatively, the dominant species and their IVI values differ from those reported in other sacred groves. For instance, Dar et al. (2019) identified *Tectona grandis* as the predominant species with an IVI of 47.1 across 41 sacred groves in Central India. Mani and Parthasarathy (2005) found *Memecylon umbellatum* to have the highest IVI values in several sites, such as Shanmuganathapuram (107.6) and Maramadakki (73.8), and it also contributed significantly to the IVI in other locations. Other

notable species included *Chloroxylon swietenia* (IVI = 96) at Rayapatti, *Pterospermum canescens* (IVI = 67.65 and 71.74) at SP and RP sites respectively, and *Drypetes sepiaria* (IVI = 108.03) at Karisakkadu. Additionally, *Strychnos nux-vomica* was dominant at Araiypatti with an IVI of 61.6. These variations in dominant species across different forest types underscore the ecological diversity of sacred groves and highlight the site-specific nature of species dominance, with *Hemicylea sepiaria* and *Manikara hexandra* prevailing in the study area, in contrast to the dominant species identified in other tropical dry evergreen forests.

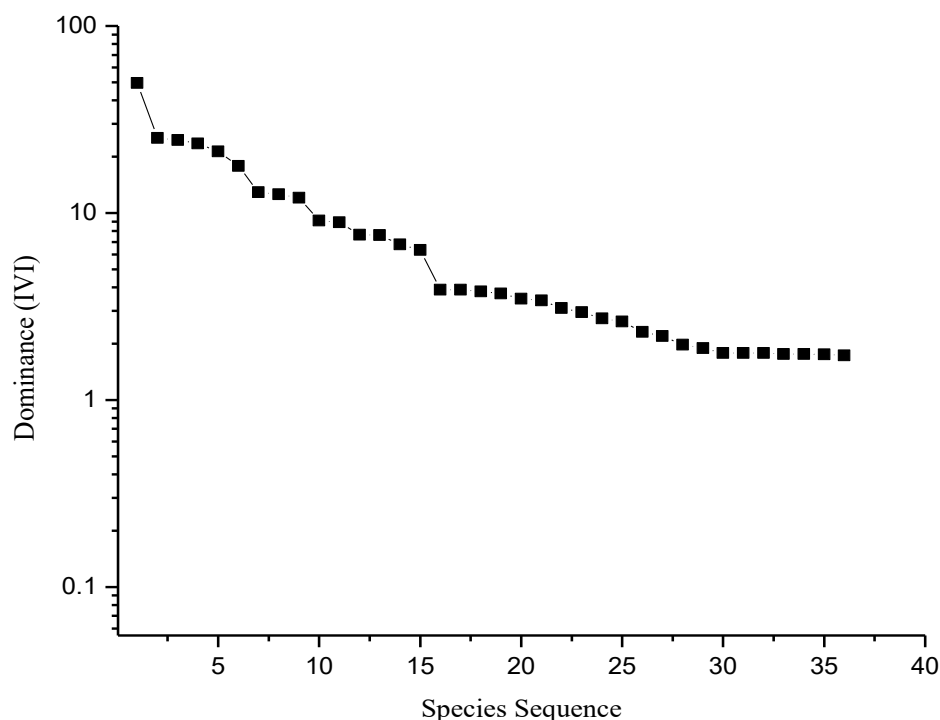


Figure 7 Dominance – diversity curves of trees in the study area

4.CONCLUSION

In conclusion, the study of the 0.2 ha sacred forest on the southwest coast of Kanniyakumari district reveals significant insights into its floristic composition and ecological dynamics. The forest, representing a West Coast tropical semi-evergreen fragment, houses a diverse array of 102 plant species, with a predominance of clumped distribution patterns reflecting the natural clustering of species. The tree density and girth class distribution indicate a predominance of mid-sized forest trees, with a noticeable gap in mature tree sizes. Despite its fragmented nature and anthropogenic influences, the forest maintains substantial biodiversity and demonstrates high species richness comparable to other sacred groves in India. The dominance distribution, characterized by log-normal curves, highlights *Hemicylea sepiaria* and *Manikara hexandra* emerge as dominant species, reflecting the forest's unique ecological dynamics. Despite fragmentation and human influence, the sacred groves retain significant biodiversity, comparable to other sacred forests in India. This underscores the ecological importance of West Coast tropical semi-evergreen forests in preserving native species and maintaining complex forest structures.

DECLARATIONS

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

CONSENT FOR PUBLICATION

All the authors expressly consent to the publication of the work

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

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