RESEARCH PAPER

Tree Species Diversity, Community Structure and Population Status of Sarampeta Sacred Grove, Addateegala Mandal, Alluri Sitaramaraju District, Andhra Pradesh, India

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Abstract

Sacred groves are forest fragments that local communities have safeguarded for generations through religious belief and customary taboo, and they often persist as the last remnants of climax vegetation in otherwise altered landscapes. The present study assessed the tree species diversity, community structure and population status of the Sarampeta Sacred Grove (locally known as Veerabhadrudu Konda), a roughly one-hectare patch of dry deciduous forest in Addateegala Mandal, Alluri Sitaramaraju District, Andhra Pradesh, situated in the Eastern Ghats. All trees with a girth at breast height of 30 cm or more were enumerated in two sample plots, identified to species, and analysed using standard phytosociological parameters (density, frequency, basal area, relative density, relative frequency, relative dominance and Importance Value Index) together with five diversity indices (Shannon–Wiener, Simpson, Margalef, Menhinick and Pielou). A total of 407 individuals belonging to 56 species, 45 genera and 26 families were recorded. Euphorbiaceae was the most species-rich family. The Shannon–Wiener index (3.79), Simpson's index of diversity (0.97) and Pielou's evenness (0.94) indicated a highly diverse and even community, with *Anogeissus latifolia*, *Lannea coromandelica*, *Dalbergia paniculata* and *Xylia xylocarpa* as the leading dominants. Girth-class analysis showed that 56% of individuals were below 60 cm GBH, suggesting an actively regenerating stand, although the comparatively low representation of the smallest (<30 cm) class points to possible constraints on seedling and sapling recruitment. These findings underscore the conservation value of Sarampeta Sacred Grove and provide baseline data for its long-term monitoring and management.

Keywords Sacred grove · Importance Value Index · Shannon–Wiener index · Population structure · Eastern Ghats · Dry deciduous forest · Andhra Pradesh

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1 Introduction

Forest ecosystems harbour the bulk of terrestrial biological diversity, yet they continue to shrink and degrade under the combined pressures of land-use change, fuelwood extraction, livestock grazing and unregulated harvesting. Against this backdrop of widespread habitat loss, sacred groves represent a distinctive and often-overlooked category of community-conserved area. These are patches of relatively undisturbed, climax-type vegetation that village communities have protected for generations because of their association with deities, ancestral spirits, or significant local events, with access and resource extraction governed by customary taboos rather than formal forest law. Because such taboos have often persisted for centuries with little active management intervention, sacred groves frequently retain tree species assemblages, structural complexity and regeneration patterns that have been lost from the surrounding, more heavily used forest matrix, and they are increasingly recognised as informal but ecologically significant components of regional conservation networks.

The Eastern Ghats of peninsular India, though less studied than the Western Ghats, support a network of such groves embedded within tropical dry and moist deciduous forest types. In Andhra Pradesh in particular, a series of recent phytosociological surveys from the Visakhapatnam and Alluri Sitaramaraju districts have documented tree species richness ranging from about 30 to over 60 species per grove (Koda et al. 2020, 2021; Mudadla et al. 2023; Ramalakshmana et al. 2023), consistent with broader assessments of tree diversity and population structure across the Eastern Ghats of northern Andhra Pradesh (Naidu and Kumar 2015; Premavani et al. 2014), with *Anogeissus latifolia*, *Lannea coromandelica*, *Xylia xylocarpa* and *Mangifera indica* recurring as dominant

or co-dominant trees. These studies have highlighted not only the floristic value of the groves but also their role as refugia for economically and medicinally important timber species, several of which are increasingly scarce in unprotected forest. However, quantitative, plot-based assessments of community structure, dominance hierarchy and population (girth-class) status remain available for only a limited number of groves in this landscape, which constrains comparative and conservation planning at a regional scale.

Sarampeta Sacred Grove, locally venerated as Veerabhadrudu Konda, is one such grove in Addateegala Mandal of Alluri Sitaramaraju District. The site is associated with local oral tradition linking it to the freedom fighter Alluri Sitarama Raju, and it continues to be a focus of community worship, with an annual festival observed on the occasion of Maha Shivaratri. Despite this strong cultural association and its location within a biogeographically important stretch of the Eastern Ghats, no quantitative phytosociological account of its tree flora has so far been published. The present study was therefore undertaken with the objectives of (i) enumerating the tree species composition of the grove and quantifying the density, frequency and dominance of each species through standard phytosociological parameters and the Importance Value Index (IVI); (ii) characterising overall community diversity using a suite of complementary diversity indices; and (iii) examining the population (girth-class) structure of the stand as an indicator of its regeneration status. The resulting dataset is intended to serve as a baseline against which future changes in this culturally protected forest patch can be assessed.

2 Materials and methods

2.1 Study area

Sarampeta Sacred Grove (Veerabhadrudu Konda) is located near Sarampeta village in Addateegala Mandal, Alluri Sitaramaraju District, Andhra Pradesh (approximately 17.413812°N, 82.053825°E), within the Eastern Ghats hill range. According to local tradition, a cave situated on the hill once provided shelter to the freedom fighter Alluri Sitarama Raju and his associates; over time the cave became a site of worship of Lord Veerabhadra, after whom the hill is now named, and an annual festival is held there on Maha Shivaratri, drawing devotees from the surrounding villages. The grove covers an area of approximately one hectare and supports dry deciduous forest vegetation, consistent with the broader vegetation type of this part of the Eastern Ghats.

2.2 Vegetation sampling

Tree vegetation was sampled in two plots (designated T1 and T2) laid out within the grove. All woody individuals attaining a girth at breast height (GBH, measured at 1.3 m) of 30 cm or more were enumerated, identified to species, and assigned to their respective families. For each species, the number of individuals recorded in each plot, the combined total number of individuals, and the basal area (computed from GBH measurements) were recorded.

2.3 Data analysis

Standard phytosociological parameters were calculated for each species following Curtis and McIntosh (1950): density (D, mean number of individuals per plot), frequency (F, percentage of plots in which a species occurred), relative density (RD), relative frequency (RF) and relative dominance (RDo, based on basal area). The Importance Value Index (IVI) was obtained as the sum of RD, RF and RDo (maximum possible value = 300, summed across all species).

Community-level diversity was characterised using five complementary indices computed from species abundance data: the Shannon–Wiener diversity index, $H' = -\Sigma\ pi\ \ln(pi)$, where pi is the proportional abundance of the ith species (ni/N) (Shannon and Weaver 1949); Simpson's index, expressed both as the dominance index $\lambda = \Sigma(pi)^2$ and its complement, the index of diversity $(1 - \lambda)$ (Simpson 1949); Margalef's richness index, $R1 = (S-1)/\ln N$, and Menhinick's richness index, $R2 = S/\sqrt{N}$, where S is the total number of species and N is the total number of individuals (Margalef 1958; Menhinick 1964); and Pielou's evenness index, $J' = H'/\ln S$, which expresses the observed Shannon diversity as a proportion of the maximum possible diversity for the recorded number of species (Pielou 1966).

To examine population structure, all enumerated individuals were grouped into six girth classes (<30, 31–60, 61–90, 91–120, 121–150 and >150 cm GBH), and the number of individuals and total basal area within each class were summarised to assess the size-class distribution of the stand.

3 Results

3.1 Floristic composition and family-wise distribution

A total of 407 individual trees belonging to 56 species, 45 genera and distributed across 26 families were recorded from the two sample plots in Sarampeta Sacred Grove (Table 1). Euphorbiaceae was the most species-rich family, represented by seven species

(12.8% of all stems, 52 individuals), followed by Combretaceae, Fabaceae, Rubiaceae and Verbenaceae, each with four species. Anacardiaceae and Ebenaceae were each represented by three species, while eleven families were monospecific, indicating a community in which a relatively small number of families contribute disproportionately to overall species richness.

Of the two sample plots, T2 contributed slightly more individuals (227) than T1 (180). Sixteen species (28.6% of the total) occurred in both plots (frequency = 100%), twelve species occurred only in T1, and twenty-eight species occurred only in T2 (frequency = 50% in each case), reflecting a degree of within-site spatial heterogeneity in species distribution typical of structurally complex forest stands.

3.2 Density, frequency, dominance and Importance Value Index

Phytosociological parameters for all 56 species are presented in Table 1. *Anogeissus latifolia* recorded the highest IVI (16.99), driven primarily by its high relative dominance (10.03%), reflecting large-girth individuals, despite a moderate relative density (4.18%). *Lannea coromandelica* (IVI = 14.89), *Dalbergia paniculata* (IVI = 12.62), *Xylia xylocarpa* (IVI = 12.58), *Chloroxylon swietenia* (IVI = 11.53), *Bridelia airy-shawii* (IVI = 11.28) and *Wrightia tinctoria* (IVI = 10.96) constituted the remaining members of the seven leading dominants. Collectively, the ten species with the highest IVI accounted for 120.2 of the total possible IVI of 300 (40.1%), while the remaining 46 species together contributed the balance, indicating that dominance, although concentrated in a relatively small set of species, is not extreme.

In terms of stem density, *Wrightia tinctoria* (21 individuals), *Chloroxylon swietenia* (20), *Polyalthia cerasoides* (18), *Anogeissus latifolia* (17) and *Lannea coromandelica* (16) were the most numerous species. At the other end of the spectrum, *Ficus tinctoria*, *Stereospermum colais*, *Sterculia urens*, *Semecarpus anacardium* and *Pterocarpus marsupium* were each represented by only one or two individuals, underlining the presence of a substantial tail of low-frequency, low-density species that nonetheless contribute to overall richness.

Table 1 Phytosociological parameters – density (D), frequency (F), basal area (BA), relative density (RD), relative frequency (RF), relative dominance (RDo) and Importance Value Index (IVI) – of tree species recorded in Sarampeta Sacred Grove

S. No.	Botanical name	Family	D	F (%)	BA (m²)	RD (%)	RF (%)	RDo (%)	IVI
1	*Alangium salvifolium*	Alangiaceae	1.5	50	0.0550	0.74	1.39	0.34	2.47
2	*Albizia procera*	Mimosaceae	1.5	50	0.0518	0.74	1.39	0.32	2.45
3	*Anogeissus latifolia*	Combretaceae	8.5	100	1.6242	4.18	2.78	10.03	16.99
4	*Barringtonia acutangula*	Lecythidaceae	5	50	0.0791	2.46	1.39	0.49	4.33
5	*Bombax ceiba*	Bombacaceae	2	50	0.1159	0.98	1.39	0.72	3.09
6	*Bridelia airy-shawii*	Euphorbiaceae	5	100	0.9789	2.46	2.78	6.05	11.28
7	*Bridelia monoica*	Euphorbiaceae	3.5	50	0.1371	1.72	1.39	0.85	3.96
8	*Butea monosperma*	Fabaceae	3.5	50	0.0570	1.72	1.39	0.35	3.46
9	*Callicarpa arborea*	Verbenaceae	2.5	50	0.1385	1.23	1.39	0.86	3.47
10	*Callicarpa tomentosa*	Verbenaceae	2	50	0.0681	0.98	1.39	0.42	2.79
11	*Careya arborea*	Lecythidaceae	2	50	0.1681	0.98	1.39	1.04	3.41
12	*Cassia fistula*	Caesalpiniaceae	6	100	0.2497	2.95	2.78	1.54	7.27
13	*Ceiba pentandra*	Bombacaceae	4	50	0.9652	1.97	1.39	5.96	9.32
14	*Chloroxylon swietenia*	Flindersiaceae	10	100	0.6221	4.91	2.78	3.84	11.53
15	*Cleistanthus collinus*	Euphorbiaceae	4	50	0.3155	1.97	1.39	1.95	5.30
16	*Dalbergia latifolia*	Fabaceae	2	50	0.0942	0.98	1.39	0.58	2.95
17	*Dalbergia paniculata*	Fabaceae	7.5	100	0.9966	3.69	2.78	6.15	12.62
18	*Diospyros malabarica*	Ebenaceae	3.5	50	0.2464	1.72	1.39	1.52	4.63

S. No.	Botanical name	Family	D	F (%)	BA (m²)	RD (%)	RF (%)	RDo (%)	IVI
19	*Diospyros montana*	Ebenaceae	3	50	0.0991	1.47	1.39	0.61	3.48
20	*Diospyros sylvatica*	Ebenaceae	1.5	50	0.0662	0.74	1.39	0.41	2.53
21	*Ficus auriculata*	Moraceae	1	50	0.0556	0.49	1.39	0.34	2.22
22	*Ficus tinctoria*	Moraceae	0.5	50	0.0054	0.25	1.39	0.03	1.67
23	*Gardenia gummifera*	Rubiaceae	5	50	0.0993	2.46	1.39	0.61	4.46
24	*Gardenia latifolia*	Rubiaceae	1.5	50	0.0367	0.74	1.39	0.23	2.35
25	*Garuga pinnata*	Burseraceae	2.5	100	0.2482	1.23	2.78	1.53	5.54
26	*Glochidion velutinum*	Euphorbiaceae	4.5	50	0.1752	2.21	1.39	1.08	4.68
27	*Gmelina arborea*	Verbenaceae	1.5	50	0.0864	0.74	1.39	0.53	2.66
28	*Grewia damine*	Tiliaceae	5	50	0.1298	2.46	1.39	0.80	4.65
29	*Haldinia cordifolia*	Rubiaceae	7	100	0.6168	3.44	2.78	3.81	10.03
30	*Kydia calycina*	Malvaceae	4.5	50	0.2847	2.21	1.39	1.76	5.36
31	*Lagerstroemia parviflora*	Lythraceae	4.5	100	0.5005	2.21	2.78	3.09	8.08
32	*Lannea coromandelica*	Anacardiaceae	8	100	1.3254	3.93	2.78	8.19	14.89
33	*Limonia acidissima*	Rutaceae	1	50	0.0424	0.49	1.39	0.26	2.14
34	*Macaranga peltata*	Euphorbiaceae	1.5	50	0.0880	0.74	1.39	0.54	2.67
35	*Mallotus philippensis*	Euphorbiaceae	6	50	0.2878	2.95	1.39	1.78	6.11
36	*Mangifera indica*	Anacardiaceae	5.5	50	0.4707	2.70	1.39	2.91	7.00

S. No.	Botanical name	Family	D	F (%)	BA (m²)	RD (%)	RF (%)	RDo (%)	IVI
37	*Mitragyna parvifolia*	Rubiaceae	2	100	0.1163	0.98	2.78	0.72	4.48
38	*Phyllanthus emblica*	Euphorbiaceae	1.5	50	0.0759	0.74	1.39	0.47	2.59
39	*Polyalthia cerasoides*	Annonaceae	9	100	0.3258	4.42	2.78	2.01	9.21
40	*Polyalthia suberosa*	Annonaceae	2.5	50	0.0227	1.23	1.39	0.14	2.76
41	*Premna tomentosa*	Verbenaceae	2.5	100	0.0509	1.23	2.78	0.31	4.32
42	*Protium serratum*	Burseraceae	6.5	100	0.6358	3.19	2.78	3.93	9.90
43	*Pterocarpus marsupium*	Fabaceae	1	50	0.0368	0.49	1.39	0.23	2.11
44	*Pterospermum xylocarpum*	Sterculiaceae	4	50	0.2676	1.97	1.39	1.65	5.01
45	*Schleichera oleosa*	Sapindaceae	1.5	50	0.0584	0.74	1.39	0.36	2.49
46	*Semecarpus anacardium*	Anacardiaceae	0.5	50	0.0748	0.25	1.39	0.46	2.10
47	*Sterculia urens*	Sterculiaceae	0.5	50	0.0521	0.25	1.39	0.32	1.96
48	*Stereospermum colais*	Bignoniaceae	0.5	50	0.0097	0.25	1.39	0.06	1.69
49	*Stereospermum personatum*	Bignoniaceae	1.5	50	0.0468	0.74	1.39	0.29	2.41
50	*Strychnos nuxvomica*	Loganiaceae	4	50	0.2428	1.97	1.39	1.50	4.85
51	*Syzygium cumini*	Myrtaceae	1.5	50	0.1288	0.74	1.39	0.80	2.92
52	*Terminalia alata*	Combretaceae	6.5	100	0.5662	3.19	2.78	3.50	9.47
53	*Terminalia bellirica*	Combretaceae	0.5	50	0.1164	0.25	1.39	0.72	2.35
54	*Terminalia chebula*	Combretaceae	3.5	50	0.1454	1.72	1.39	0.90	4.01

S. No.	Botanical name	Family	D	F (%)	BA (m²)	RD (%)	RF (%)	RDo (%)	IVI
55	*Wrightia tinctoria*	Apocynaceae	10.5	100	0.4889	5.16	2.78	3.02	10.96
56	*Xylia xylocarpa*	Mimosaceae	5.5	100	1.1489	2.70	2.78	7.10	12.58

D density (mean individuals per plot); F frequency; BA basal area; RD relative density; RF relative frequency; RDo relative dominance; IVI Importance Value Index (RD + RF + RDo)

3.3 Diversity indices

The diversity indices computed for the Sarampeta Sacred Grove tree community are summarised in Table 2. The Shannon–Wiener index (H′ = 3.785) was close to the theoretical maximum for 56 species (Hmax = ln 56 = 4.025), yielding a Pielou's evenness value of 0.940. Simpson's dominance index (λ) was correspondingly low (0.027), giving a Simpson's index of diversity of 0.973 and a Simpson's reciprocal index of 37.5, meaning that, on average, an individual would need to be compared with roughly 37–38 randomly drawn individuals before encountering one of the same species. Margalef's richness index (9.15) and Menhinick's richness index (2.78) both reflect the high number of species relative to the number of individuals sampled. Collectively, these indices point to a tree community that is not only species-rich but also structurally even, without strong numerical or basal-area dominance by any single taxon.

Table 2 : Diversity indices of the tree community of Sarampeta Sacred Grove

Parameter	Value
Total number of species (S)	56
Total number of genera	45
Total number of families	26
Total number of individuals (N)	407
Shannon–Wiener diversity index (H′)	3.785
Simpson’s dominance index (λ)	0.027
Simpson’s index of diversity (1−λ)	0.973
Simpson’s reciprocal index (1/λ)	37.50
Margalef’s richness index (R1)	9.15
Menhinick’s richness index (R2)	2.78
Pielou’s evenness index (J′)	0.940

3.4 Population (girth-class) structure

The girth-class distribution of the 407 enumerated individuals is presented in Table 3 and Figure 1. The 31–60 cm class contained the largest number of individuals (167; 41.0%), followed by the 61–90 cm class (125; 30.7%) and the smallest class, <30 cm (61; 15.0%). The three highest girth classes (91–120, 121–150 and >150 cm) together accounted for only 54 individuals (13.3%) but contributed disproportionately to total basal area: the >150 cm class alone, comprising just 11 individuals (2.7% of stems), accounted for 17.8% of total basal area, and the 121–150 cm class (22 individuals, 5.4%) contributed a further 18.8%. Overall, individuals below 60 cm GBH made up 56.0% of the population, while those above 120 cm GBH made up only 8.1%, giving the stand a broadly descending (reverse-J-like) size-class distribution from the 31–60 cm class onward. Notably, however, the smallest (<30 cm) class held fewer individuals than the 31–60 cm class, a pattern that is examined further in the Discussion.

Table 3 Girth-class distribution of tree density and basal area in Sarampeta Sacred Grove

Girth class (cm)	No. of individuals	Individuals (%)	Basal area (m²)	Basal area (%)
<30	61	14.99	0.2946	1.82
31–60	167	41.03	2.7667	17.09

Girth class (cm)	No. of individuals	Individuals (%)	Basal area (m²)	Basal area (%)
61–90	125	30.71	5.4411	33.60
91–120	21	5.16	1.7572	10.85
121–150	22	5.41	3.0462	18.81
>150	11	2.70	2.8866	17.83
Total	**407**	**100.00**	**16.1925**	**100.00**

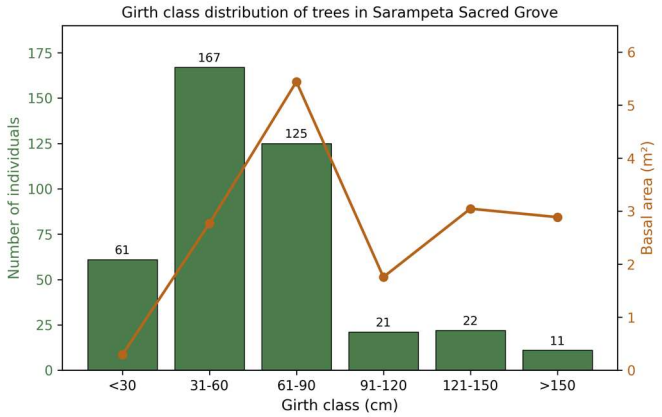

Fig. 1 Girth-class distribution of tree density (bars, left axis) and basal area (line, right axis) in Sarampeta Sacred Grove

4 Discussion

The species richness recorded for Sarampeta Sacred Grove (56 species, 26 families, 407 individuals in two plots) is comparable to, and in some respects exceeds, values reported for other sacred groves of the Eastern Ghats of Andhra Pradesh. In a study of two sacred groves in the same district, the Daralamma Sacred Grove was found to harbour 55 species across 26 families (Ramalakshmana et al. 2023), an almost identical richness to that recorded here, while the Borra Sacred Grove of Anathagiri in neighbouring Visakhapatnam District supported 31 species in 20 families (Koda et al. 2021), and the Pamuleru Sacred Grove, also in Alluri Sitaramaraju District, recorded 64 species across 31 families when herbs, shrubs and climbers were included alongside trees (Mudadla et al. 2023). Taken together, these figures suggest that Sarampeta Sacred Grove ranks among the more species-rich groves so far documented in this part of the Eastern Ghats.

The dominance hierarchy at Sarampeta also mirrors patterns reported elsewhere in the region. *Anogeissus latifolia*, the leading dominant in the present study, was similarly reported as the most common tree of the Gudem Sacred Groves in Alluri Sitaramaraju District, where it occurred alongside *Lannea coromandelica* and *Xylia xylocarpa* among the dominant species (Ramalakshmana et al. 2023), and the same three species – together with *Mangifera indica* – were identified as the principal dominants in a phytosociological assessment of sacred groves in Visakhapatnam District (Koda et al. 2020). Several other co-dominants at Sarampeta, including *Garuga pinnata*, *Protium serratum*, *Bridelia airy-shawii* and *Mallotus philippensis*, were likewise reported as dominant trees of the Daralamma Sacred Grove (Ramalakshmana et al. 2023). This recurrence of the same suite of dry-deciduous species across independently surveyed groves suggests that they represent a characteristic, regionally consistent climax assemblage of sacred-grove vegetation in this part of the Eastern Ghats, rather than site-specific anomalies.

The diversity indices obtained for Sarampeta Sacred Grove are also broadly consistent with, and at the upper end of, values reported for comparable Eastern Ghats sites. Koda et al. (2020), working across eight transects in sacred groves of Visakhapatnam District, reported Shannon–Wiener values of 3.09–3.40 and Simpson's index values of 0.95–0.96; the

corresponding values obtained here (H′ = 3.79; Simpson's index of diversity = 0.97) fall just above this range, indicating that the Sarampeta community is at least as diverse, and marginally more even, than the groves studied previously. By contrast, Shannon–Wiener values reported for sacred groves of Central India ranged much more widely, from 0.77 to 2.53, with evenness values of 0.28–0.90 (Dar et al. 2019); the Sarampeta values lie at or above the upper end of even this broader range, reinforcing the impression of a particularly diverse and even tree community at this site. Such high evenness, combined with a moderate concentration of IVI in the ten leading species (40.1% of the total), suggests a community structure typical of relatively undisturbed climax dry-deciduous forest, in which no single species has been able to achieve strong numerical or basal-area dominance at the expense of associated species.

The girth-class distribution of Sarampeta Sacred Grove, with peak stem density in the 31–60 cm class and a progressive decline through the higher girth classes, parallels the density–diameter pattern reported for sacred groves of Manipur, where the highest stand density and species richness likewise occurred in the lowest girth classes (30–60 cm), declining in the succeeding classes (Khumbongmayum et al. 2006). Such a pattern is generally interpreted as indicative of an actively regenerating population, in which a broad base of younger, smaller-girth individuals is available to replace larger trees as they are lost through natural mortality. The relatively small proportion of individuals in the highest girth classes (8.1% above 120 cm), despite their disproportionate contribution to basal area (36.6% combined for the 121–150 and >150 cm classes), is consistent with a stand in which large, mature individuals are present but not numerically dominant – a structure compatible with long-term protection rather than recent, intensive exploitation.

One feature of the Sarampeta data that merits attention is the comparatively low representation of the smallest (<30 cm GBH) class relative to the 31–60 cm class. While part of this difference may simply reflect natural variation in recruitment and early mortality, a similar shortfall in the smallest size classes has elsewhere been linked to disturbances such as livestock grazing, trampling, and removal of leaf litter and ground vegetation associated with frequent human visitation – factors that can be expected to operate at Sarampeta given its role as an active site of worship and the annual Maha Shivaratri festival, which draws visitors from the surrounding region. If sustained, such pressure on the smallest size classes could, over time, translate into reduced recruitment into larger girth classes, even where the overall stand currently appears species-rich and structurally diverse. This points to the value of periodic re-assessment of the seedling and sapling component of the population, alongside the tree-level data presented here, as part of any long-term monitoring programme for the grove.

More broadly, the persistence of a tree community of this richness and structural complexity within a one-hectare patch embedded in a working agricultural and forest landscape underscores the continuing contribution of community-based, faith-driven conservation to regional biodiversity outcomes in the Eastern Ghats. Comparative work on sacred groves of the southern Eastern Ghats has suggested that such groves can be at least as effectively protected, in floristic terms, as formally designated forest reserves (Rao et al. 2011), and the present results from Sarampeta Sacred Grove are consistent with that broader conclusion.

5 Conclusion

The present study provides a quantitative phytosociological assessment of Sarampeta Sacred Grove (Veerabhadrudu Konda), documenting 56 tree species belonging to 45 genera and 26 families, with 407 individuals across two sample plots. High values of the Shannon–Wiener index (3.79), Simpson's index of diversity (0.97) and Pielou's evenness (0.94), together with a dominance hierarchy led by *Anogeissus latifolia*, *Lannea coromandelica*, *Dalbergia paniculata* and *Xylia xylocarpa*, indicate a species-rich, structurally even tree community broadly consistent with – and in places exceeding – other sacred groves documented in the Eastern Ghats of Andhra Pradesh. The girth-class distribution, with more than half of all individuals below 60 cm GBH, suggests an actively regenerating stand, although the relatively low representation of the smallest (<30 cm) size class warrants continued monitoring of seedling and sapling recruitment, particularly in light of the disturbance associated with the grove's role as an active pilgrimage site. These findings reaffirm the conservation value of Sarampeta Sacred Grove and provide a quantitative baseline against which future changes in its species composition, dominance structure and population status can be evaluated, in support of continued community-based protection of this culturally significant forest patch.

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Declarations

Conflict of interest the authors declare that they have no conflict of interest.

Data availability

the datasets generated and analysed during the current study are included in this article.

References

Curtis JT, McIntosh RP (1950) The interrelations of certain analytic and synthetic phytosociological characters. Ecology 31:434–455

Dar JA, Sundarapandian S, Subashree K, Saikia P, Sahu N, Kumar A, Khan ML (2019) Tree diversity, biomass and carbon storage in sacred groves of Central India. Environ Sci Pollut Res 26:37212–37227

Khumbongmayum AD, Khan ML, Tripathi RS (2006) Biodiversity conservation in sacred groves of Manipur, northeast India: population structure and regeneration status of woody species. Biodivers Conserv 15:2439–2456

Koda S, Padal SB, Devara SD (2020) Tree diversity assessment in sacred groves of Eastern Ghats, Visakhapatnam District, Andhra Pradesh, India. In: Khasim SM, Long C, Thammasiri K, Lutken H (eds) Medicinal Plants: Biodiversity, Sustainable Utilization and Conservation. Springer, Singapore, pp 109–121

Koda S, Shyamal T, Murali Krishna Ch, Padal SB (2021) Tree diversity in the Borra Sacred Groves of Anathagiri in Visakhapatnam District, Andhra Pradesh, India. Sch Acad J Biosci 9(8):205–208

Margalef R (1958) Information theory in ecology. Gen Syst 3:36–71

Menhinick EF (1964) A comparison of some species-individuals diversity indices applied to samples of field insects. Ecology 45:859–861

Mudadla SR, Krishna PH, Kedareswari NSSN, Kumar BS, Gnanojwala V, Aravinda T, Kalyani Bai K (2023) Phytodiversity and its significance of the Pamuleru Sacred Grove in Alluri Sitharamaraju district of Andhra Pradesh, India. Nelumbo 65(1):239–244

Naidu MT, Kumar OA (2015) Tree species diversity in the Eastern Ghats of northern Andhra Pradesh, India. J Threat Taxa 7(8):7443–7459

Pielou EC (1966) The measurement of diversity in different types of biological collections. J Theor Biol 13:131–144

Premavani D, Naidu MT, Venkaiah M (2014) Tree species diversity and population structure in the tropical forests of north central Eastern Ghats, India. Notulae Sci Biol 6(4):448–453

Ramalakshmana J, Kumari ME, Murali Krishna Ch, Padal SB (2023) Tree diversity, composition and structure of two sacred groves forest of Alluri Sitaramaraju District, Andhra Pradesh, India. Eco Env Cons 29(2):829–834

Rao BRP, Babu MVS, Reddy MS, Reddy AM, Rao VS, Sunitha S, Ganeshaiah KN (2011) Sacred groves in southern Eastern Ghats, India: are they better managed than forest reserves? Trop Ecol 52:79–90

Shannon CE, Weaver W (1949) The mathematical theory of communication. University of Illinois Press, Urbana

Simpson EH (1949) Measurement of diversity. Nature 163:688