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PHYTOSOCIOLOGICAL ANALYSIS OF HERBACEOUS PLANT DIVERSITY IN MANNARKKAD TALUK, KERALA

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Abstract:
The present study evaluates the phytosociological structure of herbaceous plant communities in a region of the Western Ghats using standard ecological methods. Field surveys were carried out across five locations employing randomly laid 1 m² quadrats. Phytosociological parameters including density, frequency, abundance, relative values, and Importance Value Index (IVI) were calculated to assess species composition, dominance, and community structure. Plant specimens were identified through morphological analysis and verified using standard taxonomic references. The results indicate clear dominance patterns within herbaceous communities. Alternanthera triandra emerged as a major dominant species, recording the highest IVI (158.47), while Synedrella nodiflora showed strong site-specific dominance with an IVI of 110.62. Co-dominance of Wedelia trilobata (IVI 69.54) and Mimosa pudica (IVI 62.24) was observed in certain locations. Several species with low IVI values were identified as ecologically minor components but contributed to overall floristic diversity. The study demonstrates that herbaceous community structure is strongly influenced by ecological adaptability and disturbance gradients. The dominance of a few resilient species alongside a diverse assemblage of less abundant taxa reflects typical vegetation dynamics of Western Ghats ecosystems. These findings provide baseline data useful for vegetation assessment, biodiversity monitoring, and conservation planning.

Keywords: Phytosociology; Herbaceous vegetation; Importance Value Index (IVI); Quadrat method; Western Ghats; Plant community structure.

INTRODUCTION

Phytosociology is a branch of ecology concerned with the structure, composition, and interrelationships of plant communities. It is a subset of vegetation science that deals with extant plant communities and places special emphasis on their classification (J. Dengler & J. Ewald, 2008). Phytosociology aims to empirically describe the vegetative environment of a given territory by distinguishing between concrete vegetation stands, represented by plot records, and abstract vegetation types (syntaxa), which group stands sharing common attributes.

The discipline focuses on current plant assemblages at the scale of vegetation stands. Its fundamental concepts, methods, and terminology were developed by the Swiss-French botanist Josias Braun-Blanquet in the 1920s, and the approach is therefore often referred to as the Braun-Blanquet approach or the Zurich–Montpellier school of vegetation science. Although methodological advances and computer-based analyses have modified phytosociological practices, the core principles established by Braun-Blanquet remain widely applied.

During the early development of plot-based vegetation classification, several regional schools emerged with differing methodologies; however, the Braun-Blanquet approach became dominant in central and southern Europe. At present, phytosociology is the mainstream vegetation classification method across Europe and is also widely applied in Northern Asia, Africa, and Latin America. Although its use in North America was initially limited, the US National Vegetation Classification system has recently adopted modified concepts derived from the Braun-Blanquet framework.

Major phytosociological attributes include species density, relative density, frequency, relative frequency, abundance, relative abundance, and Importance Value Index (IVI). Analysis of these attributes provides insights into the structure and dynamics of plant communities. In the present study, phytosociological data were collected using the quadrat method, in which standardized plots are laid within the study area to record species composition, population size, and percentage cover. This method facilitates the identification of dominant species and their ecological significance.

In addition, the line transect method was employed, wherein vegetation is sampled along a fixed line using a measuring tape or rope, and all plant species intersecting the line are recorded. Phytosociology is useful for describing the population dynamics of plant species within communities and understanding interspecific relationships (Mishra et al., 2012). A distinctive strength of phytosociology is its globally applicable system for consistent naming of vegetation units (Dengler, 2016).

Unlike approaches that focus only on dominant or woody species, phytosociology aims to compile a complete census of all visible plant species, including vascular plants, bryophytes, lichens, macro-algae, and epiphytes. Species are assigned to different vegetation layers, and those occurring in multiple layers are recorded accordingly. Phytosociological investigations thus help in understanding vegetation dynamics, particularly of riparian vegetation, and in assessing the ecological status of species across different study sites. A phytosociological and floristic study of Mannarkkad Taluk was conducted using the quadrat method. The objectives were to analyze plant community structure across different localities and to systematically invent the flora within sampled quadrats.

MATERIALS AND METHODS

The study was conducted in the biodiverse foothills of the Western Ghats within Mannarkkad Taluk, Palakkad, Kerala. Field surveys across five representative locations were followed by specimen collection and preservation using standard herbarium techniques. Phytosociological data were collected using randomly placed 1 m^2 quadrats to calculate key parameters, including Density, Frequency, Abundance, and the Importance Value Index (IVI). Specimens were identified in the laboratory using morphological study, taxonomic keys, and comparison with authenticated herbarium material. All nomenclature was verified and updated using authoritative botanical databases.

Phytosociological Analysis

Phytosociological Analysis is the ecological study of plant communities to understand their composition, structure, and organization. It uses quantitative measures, like density, frequency, abundance, and the Importance Value Index (IVI)to identify dominant species and interpret habitat conditions, such as disturbance or environmental health, based on the plant species present.

Structural Analysis

Phytosociology quantifies communities using parameters
like Density (individuals/area), Frequency (distribution), and Abundance (local crowding). Their relative values (RD, RF, RA) are summed into the Importance Value Index (IVI), a score (0-300) that ranks a species' overall ecological significance.

RESULTS

Phytosociological Result

Various phytosociological parameters were studied in the following forest areas of Mannarkkad Taluk. They are given below

SPOT 1: Payyanadam

Phytosociological parameters were quantitatively assessed across selected forest areas in Mannarkkad Taluk, beginning with an analysis of Spot 1 at Payyanadam.

Table 1 *Phytosociological Analysis of Herbaceous Species in Payyanadam (Spot 1).*

Si. No	Name of species	Total no	Density (D)	Relative Density (RD)	Abundance	Frequency (F)	Relative frequency (RF)	Relative abundance	IVI
1	*Alternathera triandra*, Lam	60	15	68.18	15	100	33.33	56.96	158.47
3	*Synedrella Nodiflora* (L.) Gaertn	16	4	18.31	5.33	75	25	20.24	63.55
4	*Tridax* procumbens	1	0.25	1.14	1	25	8.33	3.79	13.26
5	*Sida acuta* Burm. F.	7	1.75	8.04	3.5	50	16.6	13.29	37.93

Table 1 shows In Payyanadam, *Alternanthera triandra* is the clear dominant (IVI 158.47), with *Synedrella nodiflora* (IVI 63.55) as a secondary species. *Sida acuta* (IVI 37.93) is a common associate, while *Tridax procumbens* (IVI 13.26) is rare and ecologically minor.

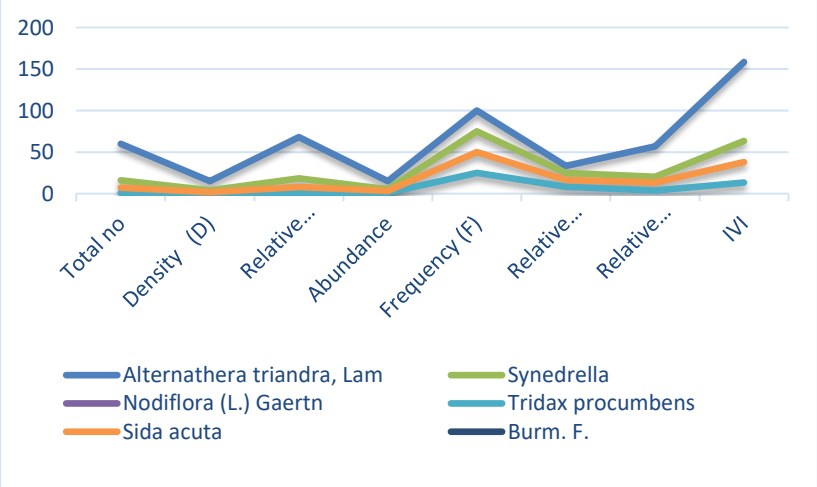

Figure 1 *Phytosociological Analysis of Herbaceous Species in Payyanadam (Spot 1).*

SPOT 2 : *Kunthipuzha*

Phytosociological analysis of Spot 2 in Kunthipuzha reveals a clear dominance hierarchy, with *Wedelia trilobata* (IVI 69.54) and *Mimosa pudica* (IVI 62.24) as the co-dominant species, followed by species of intermediate and minor ecological importance.

Table 2. *Phytosociological Analysis of Herbaceous Species in Kunthipuzha (Spot 2).*

Si. No	***Name of species***	***Total no:***	***Density (D)***	***Relative Density (RD)***	***Abundance***	***Frequency (F)***	***Relative frequency (RF)***	***Relative abundance***	***IVI***
1	*Alternanthera triandra* Lam.	*11*	*2.75*	*11.45*	*5.5*	*50*	*8.69*	*15.10*	*35.24*
2	*Pennisetum polystachyon* Schult.	*4*	*1*	*4.1*	*4*	*25*	*4.34*	*10.98*	*19.42*
3	*Mimosa pudica* L.	*26*	*6.5*	*27.0*	*6.5*	*100*	*17.39*	*17.85*	*62.24*
5	*Desmodium procumbens*(Mill.) Hitchc.	*6*	*1.5*	*6.25*	*1.5*	*100*	*17.39*	*4.12*	*27.76*
6	*Synedrella nodiflora*(L.) Gaertn	*1*	*.25*	*1.04*	*1*	*25*	*4.34*	*2.74*	*8.12*
7	*Wedelia* trilobata (C.) Hitchc.	*29*	*7.25*	*30.2*	*9.6*	*75*	*13.04*	*26.3*	*69.54*
8	*Ehrharta erecta*Lam.	*1*	*.25*	*1.04*	*1*	*25*	*4.34*	*2.74*	*8.12*
9	*Nerremia umbellata*(L.) Hallier f.	*6*	*1.5*	*6.25*	*2*	*75*	*13.04*	*5.49*	*24.78*
10	*Eragrostis nigra* Nees ex Steud.	*2*	*.5*	*2.08*	*2*	*25*	*4.34*	*5.49*	*11.91*

Table 2 indicates Spot 2 (Kunthipuzha), *Wedelia trilobata* (IVI=69.54) and *Mimosa pudica* (IVI=62.24) are the co-dominant species, with *M. pudica* exhibiting 100% frequency. *Alternanthera triandra* (IVI=35.24) and an unidentified species (IVI=32.51) show moderate dominance. Several species, including *Synedrella nodiflora* and *Ehrharta erecta* (both IVI=8.12), have a minor ecological role, indicating a community dominated by a few successful species.

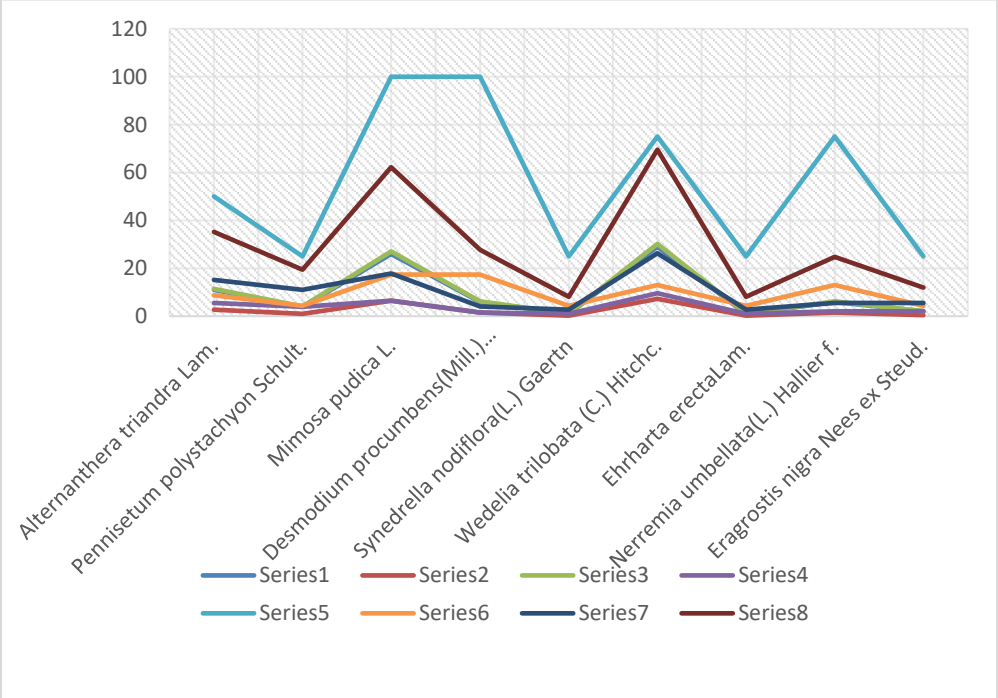

Figure 2. *Phytosociological Analysis of Herbaceous Species in Kunthipuzha (Spot 2).*

3.1.3. SPOT :3: Akkipadam, Mannarkkad

In Spot 3 (Akkipadam), *Synedrella nodiflora* (IVI 110.62) is the dominant species, with *Alternanthera triandra* (IVI 63.27) and *Ehrharta erecta* (IVI 43.87) as significant co-dominant species. Other species show moderate to minor ecological importance.

Table 3. *Phytosociological Analysis of Herbaceous Species in Akkipadam, Mannarkkad (Spot 3).*

Si. No	Name of species	Total. no	Density (D)	Relative Density (RD)	Abundance	Frequency (F)	Relative frequency (RF)	Relative abundance	IVI
1	*Synedrella nodiflora*(L.) Gaertn	68	17	50.74	17	100	23.52	36.36	110.62
2	*Alternanthera triandra*Lam.	31	7.75	23.13	7.75	100	23.52	16.57	63.27
3	*Ehrharta erecta*Lam.	18	4.5	13.43	6	75	17.64	12.8	43.87
4	*Digitarias anguinalis*(L.) Scop.	11	2.75	8.20	11	25	5.88	23.53	37.61
5	*Ageratum conyzoides*(L.) L.	2	0.5	1.49	1	50	11.76	2.14	15.39
6	*Tridax procumbens*(L.) L.	1	0.25	0.74	1	25	5.88	2.14	8.76
8	*Prunella vulgaris* L.	1	0.25	0.74	1	25	5.88	2.14	8.76

Table 3 shows in Akkipadam, *Synedrella nodiflora* is the unequivocal dominant species (IVI 110.62), supported by the highest density and universal frequency. *Alternanthera triandra* (IVI 63.27) is a co-dominant species also found in every quadrat. *Ehrharta erecta* (IVI 43.87) is a significant associate, while *Digitaria anguinalis* (IVI 37.61) shows a patchy distribution. The remaining species, including *Ageratum conyzoides* (IVI 15.39), *Tridax procumbens*, and *Prunella vulgaris* (both IVI 8.76), have minor ecological roles.

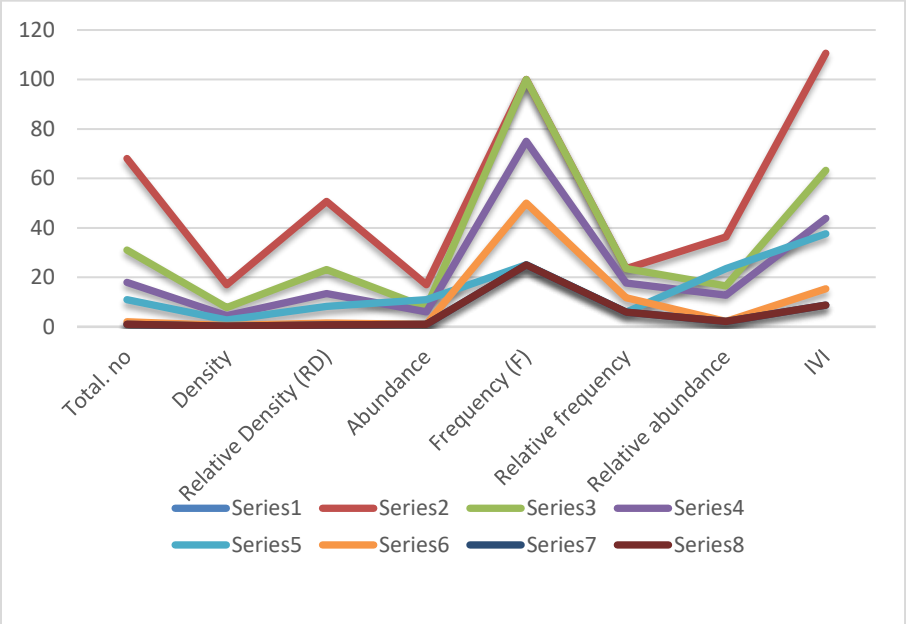

Figure 3. *Phytosociological Analysis of Herbaceous Species in Akkipadam, Mannarkkad (Spot 3).*

3.1.4. SPOT 4: Punjakodu

The phytosociological analysis for Spot 4 (Punjakodu) reveals a herbaceous community dominated by *Mimosa pudica* (IVI 86.80) and *Alternanthera triandra* (IVI 79.88), with *Ehrharta erecta* (IVI 60.85) as a significant co-dominant species.

Table 4. Phytosociological Analysis of Herbaceous Species in Punjakodu.(Spot 4)

Si. No	Name of species	Total no	Density (D)	Relative Density (RD)	Abundance	Frequency (F)	Relative frequency (RF)	Relative abundance	IVI
1	*Sida acuta*Burm. F.	6	1.5	5.50	1.5	100	21.05	4.87	31.43
2	*Microstegium Vimineum* (Trin.) A. Camus	3	0.75	2.75	3	25	5.26	9.75	17.77
3	*Ehrharta erecta*Lam.	23	5.75	21.10	5.75	100	21.05	18.69	60.85
4	*Alternathera triandra*, Lam.	34	8.5	31.19	8.5	100	21.05	27.64	79.88
5	*Mimosa pudica* L.	38	9.5	34.86	9.5	100	21.05	30.89	86.80
6	*Synedrella nodiflora* (L.) Gaertn.	5	1.25	4.58	2.5	50	10.52	8.13	23.24

Table 4 indicates the Herbaceous Species in Punjakodu.(Spot 4) community is strongly dominated by *Mimosa pudica* and *Alternanthera triandra*, both of which were present in all sampled quadrats. *Ehrharta erecta* is a well-established associate. *Sida acuta* (IVI 31.43) and *Synedrella nodiflora* (IVI 23.24) are common but non-dominant components, while *Microstegium vimineum* (IVI 17.77) has a minor ecological role. The universal frequency (100%) of the top three species indicates a homogeneously distributed core community.

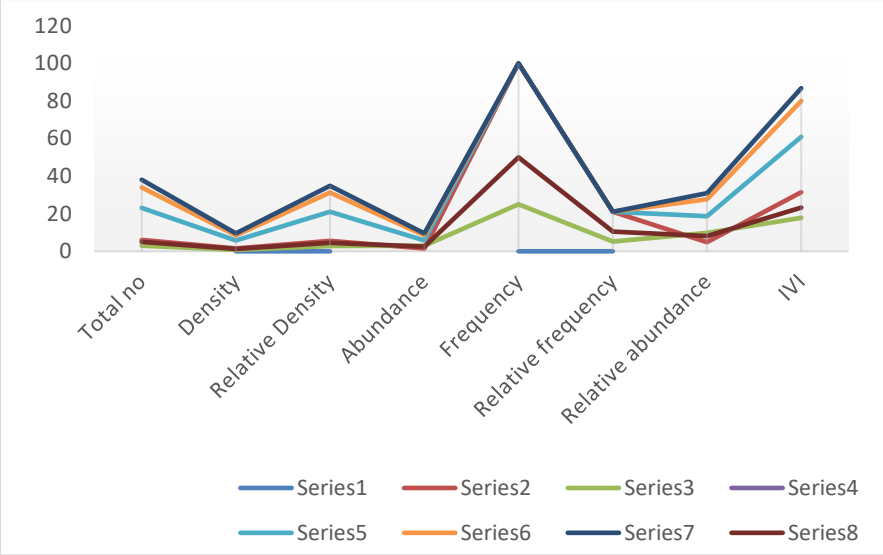

Figure 4. Phytosociological Analysis of Herbaceous Species in Punjakodu.(Spot 4)

3.1.5. SPOT:5 Vattaparambu, Thengara

The phytosociological analysis for Spot 5 (Vattaparambu, Thengara) identifies *Alternanthera triandra* (IVI 85.2) and *Wedelia trilobata* (IVI 65.51) as the dominant species, with *Ehrharta erecta* (IVI 48.94) as a co-dominant associate. Several other species are present as rare, minor components.

Table 5. *Phytosociological Analysis of Herbaceous Species in Vattaparambu, Thengara.*

Si. No	Name of species	Total no	Density (D)	Relative Density (RD)	Abundance	Frequency (F)	Relative frequency (RF)	Relative abundance	IVI
1	*Alternanthera triandra*, Lam	18	4.5	37.5	6	75	20	27.70	85.2
2	*Ehrharta erecta Lam.*	8	2	16.66	2.66	75	20	12.28	48.94
3	*Synedrella Nodiflora* (L.) Gaertn	1	0.25	2.08	1	25	6.66	4.61	13.35
4	*Wedelia trilobata(L.) Hitchc.*	12	3	25	3	100	26.66	13.85	65.51
5	*Amaranthus viridis L.*	1	0.25	2.08	1	25	6.66	4.61	13.35
6	*Pueraria montana (Lour.) Merr.*	1	0.25	2.08	1	25	6.66	4.61	13.35
8	*Phyllanthus tenellusRoxb.*	1	0.25	2.08	1	25	6.66	4.61	13.35

Table 5 indicates Alternanthera triandra is the most dominant species, supported by the highest relative density (37.5%). *Wedelia trilobata*, found in every quadrat (100% frequency), is a strong secondary dominant. *Ehrharta erecta* is a well-established associate. Four species—*Synedrella nodiflora*, *Amaranthus viridis*, *Pueraria montana*, and *Phyllanthus tenellus*—share identical, low IVI values (13.35 each), indicating they are rare and ecologically insignificant components of this community.

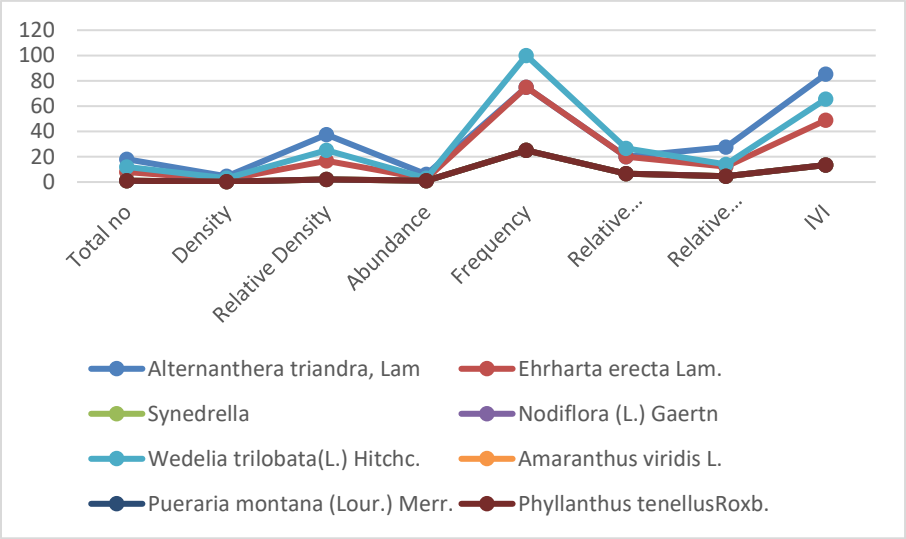

Figure 5. *Phytosociological Analysis of Herbaceous Species in Vattaparambu, Thengara..*

DISCUSSION FINDINGS

The phytosociological analysis of herbaceous vegetation in Mannarkkad Taluk reveals clear dominance patterns across the five study sites, as reflected by the Importance Value Index (IVI). In Payyanadam (Spot 1), *Alternanthera triandra* recorded a very high IVI (158.47), indicating strong dominance and ecological adaptability, while *Synedrella nodiflora* (IVI 63.55) and *Sida acuta* (IVI 37.93) functioned as associated species. Similar dominance of *Alternanthera* species in disturbed and semi-natural habitats of Kerala has been reported by Raveendran and Mohanan (2022) in forest margin ecosystems of northern Kerala.

In Kunthipuzha (Spot 2), the herbaceous layer was co-dominated by *Wedelia trilobata* (IVI 69.54) and *Mimosa pudica* (IVI 62.24), both showing high frequency values. Comparable dominance of these species in riparian and anthropogenically influenced habitats of the Western Ghats has been documented by Joseph and Thomas (2021) and Nair et al. (2024), who associated their success with rapid growth and competitive colonization ability.

A distinct pattern was observed in Akkipadam (Spot 3), where *Synedrella nodiflora* emerged as the dominant species with a high IVI of 110.62, followed by *Alternanthera triandra* (IVI 63.27) and *Ehrharta erecta* (IVI 43.87). Similar site-specific dominance of *Synedrella nodiflora* has been reported from the Palakkad Gap region by Anitha and Balakrishnan (2022), emphasizing its role as a successful early successional herb.

In Punjakodu (Spot 4), *Mimosa pudica* (IVI 86.80) and *Alternanthera triandra* (IVI 79.88) dominated the community, with *Ehrharta erecta* also showing substantial ecological importance (IVI 60.85). The uniform dominance and 100% frequency of these species indicate a relatively homogeneous herbaceous assemblage, a trend consistent with observations from midland forest ecosystems of Kerala (Sasidharan et al., 2023).

At Vattaparambu, Thengara (Spot 5), *Alternanthera triandra* again emerged as the dominant species (IVI 85.20), followed by *Wedelia trilobata* (IVI 65.51) and *Ehrharta erecta* (IVI 48.94). Species with low IVI values (13.35) were ecologically minor but contribute to overall diversity. Recent reviews on herbal flora of the Western Ghats highlight that such low-abundance herbs often possess significant ethnomedicinal value despite limited ecological dominance (Sreekumari et al., 2025).
Overall, the dominance of a few adaptable herbaceous species with high IVI values across all sites reflects the influence of disturbance, microhabitat variation, and ecological flexibility, a pattern widely reported in recent phytosociological studies from Kerala and the Western Ghats.

CONCLUSIONS

The present study provides a detailed phytosociological account of herbaceous plant communities across five locations in Mannarkkad Taluk, revealing clear dominance hierarchies and spatial variation in species composition. High IVI values of species such as *Alternanthera triandra*, *Synedrella nodiflora*, *Mimosa pudica*, *Wedelia trilobata*, and *Ehrharta erecta* indicate their strong ecological adaptability and central role in structuring herbaceous vegetation in the foothills of the Western Ghats.

The variation in community composition among sites reflects the influence of microenvironmental conditions, disturbance regimes, and habitat heterogeneity. While dominant species contribute significantly to ecosystem stability and ground cover, the presence of several low-IVI species enhances overall biodiversity and underscores the ecological and ethnomedicinal value of the region's herbaceous flora.

By integrating phytosociological analysis with insights from recent studies on Kerala's herbal diversity, this research contributes baseline data essential for biodiversity monitoring, conservation planning, and sustainable utilization of plant resources. The findings highlight the need for further long-term and multidisciplinary studies combining ecology, ethnobotany, and conservation biology to ensure the protection of herbaceous plant diversity in the Western Ghats.

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