Studies on Tree Species Richness and Diversity of Dandeli Wildlife Sanctuary, Karnataka, India

Nandagopal P[1] Sathyanarayana Bhat P[2]
[1]Department of Environmental Science [2]Department of Forests, Environment & Ecology
[1]Bangalore University, Jnanabharathi Campus, Bengaluru, India [2]Karnataka Biodiversity Board, Government of Karnataka, Bengaluru, India

Abstract — Dandeli Wildlife Sanctuary, a key segment of the Western Ghats landscape in Karnataka, supports a rich assemblage of arboreal flora due to its varied topography and microclimatic gradients. To evaluate tree diversity and species richness, a structured belt transect method was applied across major vegetation types, including semi-evergreen, moist deciduous and riparian forest zones. A total of 36 belt transects (10 m × 100 m) were laid to enumerate all trees ≥15 cm DBH, along with measurements of basal area, density and frequency. The assessment recorded 50 tree species belonging to 25 families and 44 genera, dominated by typical Western Ghats taxa such as *Tectona grandis, Xylia xylocarpa, Terminalia paniculata, Syzygium cumini and Dalbergia latifolia.* Species richness and diversity indices (Shannon–Wiener and Simpson) revealed significant spatial variation, with riparian forests exhibiting the highest tree diversity, while moist deciduous patches showed greater dominance due to canopy-forming species. The overall stand structure indicated a healthy regeneration profile, with a balanced distribution of saplings, poles and mature trees. The findings reinforce the ecological importance of Dandeli Wildlife Sanctuary as a stronghold for native and endemic tree species, emphasizing the need for sustained management interventions to safeguard tree diversity against anthropogenic disturbance.

Keywords: Species Richness, Species Diversity, Wildlife Sanctuary, Western Ghats, Biodiversity Hotspot

I. INTRODUCTION

Dandeli Wildlife Sanctuary (now part of the larger Kali Tiger Reserve) lies in the northern reaches of the Western Ghats, Uttara Kannada district, from 14º 52’ to 15º 12’ N latitude and 74º 16’ to 74º 44’ E longitude, Karnataka, India — a recognized global biodiversity hotspot characterized by steep topographic gradients and a mosaic of moist deciduous, semi-evergreen and riparian forest types. These forests form an important ecological corridor connecting adjacent protected areas and support a high diversity of plant and animal taxa, including numerous endemic and conservation-concern species. Recent floristic treatments for the region emphasize the exceptionally rich vascular-plant assemblage in the Anshi–Dandeli landscape and provide a baseline for systematic ecological studies.

Tree communities in the Dandeli tract exhibit marked spatial heterogeneity in species composition and structure due to gradients in rainfall, soil type, elevation and historical land use (e.g., natural teak stands and plantation patches). Phyto-sociological surveys and targeted studies within Dandeli Wildlife Sanctuary have documented the dominance of several canopy taxa (e.g., *Terminalia paniculata, Syzygium spp., Tectona grandis* in managed/plantation areas) while also recording pockets of rare or endemic trees important for ecosystem functioning and foraging by frugivores such as hornbills. These earlier inventories and status assessments provide useful comparative data for evaluating species richness, relative abundance and stand structure in new field surveys (Punekar *et al*.,2012).

Quantitative assessments of tree species richness and diversity are essential for understanding forest resilience, regeneration dynamics and conservation priorities in the sanctuary. Transect-based and plot-based phytosociological methods have been widely applied across the Western Ghats to estimate diversity metrics (species richness, Shannon–Wiener and Simpson indices), importance value indices (IVI), basal area, and size-class distributions; such metrics permit comparisons across habitat types (semi-evergreen, moist deciduous, riparian and lateritic scrub) and land-use gradients (core versus tourism/buffer zones). In the Dandeli–Kali landscape, focused ethnobotanical and floristic inventories have additionally highlighted the conservation value of rock-crevice and riparian microhabitats that harbour medicinal and rare tree taxa, underscoring the need to integrate floristic data with management actions (Radhadevi, 2003).

II. GENERAL EXPLANATION

This study uses systematic belt-transect sampling to quantify tree species richness, composition and structural attributes across representative habitat types within Dandeli Wildlife Sanctuary. By comparing diversity indices, IVI rankings and size-class distributions with published inventories and regional assessments, the study aims to (i) document the current status of arboreal diversity, (ii) identify habitat sectors of high conservation value (including concentrations of endemic or IUCN-listed tree species), and (iii) provide baseline data to inform long-term monitoring and management in Dandeli Wildlife Sanctuary landscape. The results will complement the growing body of work on Western Ghats tree ecology and contribute directly to conservation planning for the Dandeli protected area complex.

III. MATERIALS AND METHODS

A. Study Area:

Dandeli (475.02 km^2) was declared a wildlife sanctuary on 10th May 1956, but at that time covered only 204.33 km^2. This was enlarged to 5725.07 km^2 on 10th May 1975. Realizing that this was too big to manage with the industrial and mining pressures, it was reduced to 831.16 km^2 0n 31st August 1988, and further to its present size on 29th April 1994. A relatively undistributed area of 250 km^2 in the southern part of the sanctuary became the Anshi National Park (Nandagopal,

2007). The Dandeli Wildlife Sanctuary study area, now part of the Kali Tiger Reserve (formerly Anshi-Dandeli Tiger Reserve), is a significant research focus due to its location in the Central Western Ghats, a global biodiversity hotspot.
Here is an overview of the sanctuary's study area and key research themes:

1) Geographic and Ecological Context:

- Location: Uttara Kannada District, Karnataka, India.
- Area: The sanctuary's area has changed over time but currently covers approximately 834.16 sq. km (often combined with the adjacent Anshi National Park to form the Kali Tiger Reserve).
- Terrain and Temperature: Undulating terrain with steep slopes, deep river valleys, and hilly forest. Altitude varies from 100 to 970 m, the highest point being Hegada Temba in the southwest. Temperatures range from 16 to 36º c, and annual rainfall varies between 1250 and 5000 mm, with an average of 2500 mm.
- River: It is the catchment area for the Kali River basin, which is vital to the region's hydrology and is a major component of the study area.
- Forest Types:

The sanctuary has a mosaic of forests, primarily-

- Moist Deciduous
- Semi-Evergreen
- Evergreen (in deeper valleys and western parts)
- The forests include areas of teak and bamboo plantations.

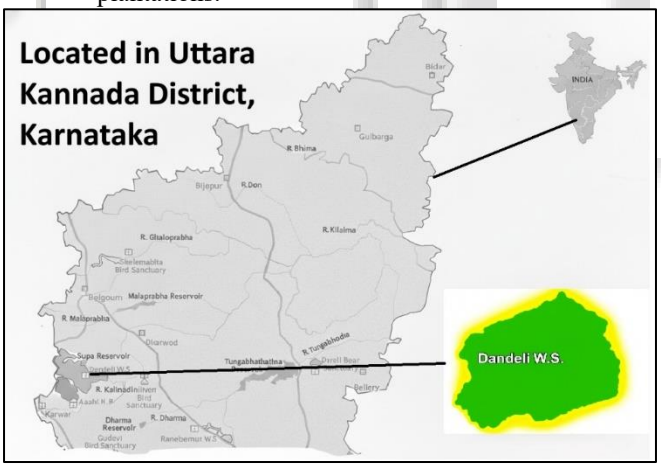

Fig. 1: Location of study area

B. Methodology:

The following two methods was followed to get the better results,

1) GPS and Toposheets- Locating the area using GPS using Toposheet as a basic data and to mark the transect line. GPS provides precise geographic coordinates for each sampling plot or transect. Toposheets offer detailed spatial information such as contour lines (elevation, slope, aspect), drainage systems (rivers, streams), forest blocks, roads, settlements, landscape features affecting vegetation patterns. This helps in selecting representative sampling sites across different habitats and terrain types.
2) Belt transect line- The belt transect method is a quantitative ecological survey technique used to assess species composition, abundance, diversity, and distribution along an environmental gradient. It involves laying a straight transect line across a study area and sampling organisms within a defined belt (strip) of fixed width along the line. Belt transects are particularly valuable for studying forest vegetation, tree communities, regeneration patterns, and habitat gradients, because they provide detailed spatial data and minimize sampling bias. The method is repeatable, efficient, and suitable for long-term monitoring of changing ecological patterns. A total of 36 belt transects (10 m × 100 m) were laid to enumerate all trees ≥15 cm DBH, along with measurements of basal area, density and frequency.

IV. Field Survey Work

Species richness within the study area was assessed using a series of belt transects systematically laid across representative habitat types. The alignment of each transect was first delineated and interpreted on the toposheet to ensure precise spatial coverage and to minimize sampling bias. Field surveys along these transects were conducted predominantly during the early morning hours using GPS, a period known for heightened faunal activity and optimal visibility, thereby increasing the probability of detecting both flora and fauna. In total, 36 belt transect lines were established, providing adequate sampling intensity to capture variations in species composition, distribution patterns, and habitat associations across the landscape. Data collected along these transects formed the basis for evaluating species richness and understanding ecological heterogeneity within the study area.

A. Tree species list:

Based on the ecological inventory. Dataset represents a biodiversity survey with a significant sample size.

1) Total Abundance: 1,084 individual trees were surveyed.
2) Species Richness: The population consists of 50 distinct tree species.
3) Taxonomic Diversity: These species fall under 26 different plant families.

B. Diversity indices:

1) Species richness.
2) Shannon–Wiener Index (H').
3) Simpson's Diversity Index (1–D).

C. Results and Discussion:

The floristic assessment conducted across the belt transects in Dandeli Wildlife Sanctuary revealed a high level of tree species richness and structural heterogeneity, characteristic of Western Ghats moist deciduous and semi-evergreen forest ecosystems. A total of 50 tree species belonging to 26 families were recorded from the sampled transects, comprising 1,084 individual trees.

SL.No	Species name	Family name	Genera
1	*Tectona grandis*	*Lamiaceae*	*Tectona*
2	*Lagerstroemia microcarpa*	*Lythraceae*	*Lagerstroemia*

3	*Terminalia paniculata*	*Combretaceae*	*Terminalia*
4	*Bambusa arundinacea*	*Poaceae*	*Bambusa*
5	*Acacia ferruginea*	*Fabaceae*	*Acacia*
6	*Acacia nilotica*	*Fabaceae*	*Acacia*
7	*Cassia fistula*	*Fabaceae*	*Cassia*
8	*Xylia xylocarpa*	*Fabaceae*	*Xylia*
9	*Terminalia alata*	*Combretaceae*	*Terminalia*
10	*Albizia lebbeck*	*Fabaceae*	*Albizia*
11	*Terminalia arjuna*	*Combretaceae*	*Terminalia*
12	*Samanea saman*	*Fabaceae*	*Samanea*
13	*Cocos nucifera*	*Arecaceae*	*Cocos*
14	*Dalbergia latifolia*	*Fabaceae*	*Dalbergia*
15	*Royal poinciana*	*Fabaceae*	*Delonix*
16	*Santalum alba*	*Santalaceae*	*Santalum*
17	*Phyllantus emblica*	*Phyllanthaceae*	*Phyllantus*
18	*Kydia calcina*	*Malvaceae*	*Kydia*
19	*Terminalia bellirica*	*Combretaceae*	*Terminalia*
20	*Artocarpus integrifolia*	*Moraceae*	*Artocarpus*
21	*Archidendron bigeminum*	*Fabaceae*	*Archidendron*
22	*Anogeissus latifolia*	*Combretaceae*	*Anogeissus*
23	*Arenga wightii*	*Arecaceae*	*Arenga*
24	*Calophyllum polyanthum*	*Calophyllaceae*	*Calophyllum*
25	*Madhuca neriifolia*	*Sapotaceae*	*Madhuca*
26	*Caryota urens*	*Arecaceae*	*Caryota*
27	*Chrysophyllum roxburghii*	*Sapotaceae*	*Chrysophyllum*
28	*Dimorphocalyx lawianus*	*Euphorbiaceae*	*Dimorphocalyx*
29	*Dillenia pentagyna*	*Dilleniaceae*	*Dillenia*
30	*Drypetes confertiflora*	*Euphorbiaceae*	*Drypetes*
31	*Elaeocarpus serratus*	*Elaeocarpaceae*	*Elaeocarpus*
32	*Euonymus indicus*	*Celastraceae*	*Euonymus*
33	*Ficus microcarpa*	*Moraceae*	*Ficus*
34	*Flacourtia montana*	*Salicaceae*	*Flacourtia*
35	*Garcinia gummigutta*	*Clusiaceae*	*Garcinia*
36	*Gymnacranthera canarica*	*Myristicaceae*	*Gymnacranthera*
37	*Harpullia arborea*	*Sapindaceae*	*Harpullia*
38	*Hopea ponga*	*Dipterocarpaceae*	*Hopea*
39	*Hydnocarpus laurifolia*	*Achariaceae*	*Hydnocarpus*
40	*Knema attenuata*	*Myristicaceae*	*Knema*
41	*Lannea coromandelica*	*Anacardiaceae*	*Lannea*
42	*Madhuca longifolia*	*Sapotaceae*	*Madhuca*
43	*Nephelium longana*	*Sapindaceae*	*Nephelium*
44	*Ochrocarpus longifolius*	*Clusiaceae*	*Ochrocarpus*
45	*Pterospermum diversifolium*	*Malvaceae*	*Pterospermum*
46	*Reinwardtiodendron anamalaiense*	*Meliaceae*	*Reinwardtiodendron*
47	*Pterygota alata*	*Malvaceae*	*Pterygota*
48	*Vateria indica*	*Dipterocarpaceae*	*Vateria*
49	*Syzygium laetum*	*Myrtaceae*	*Syzygium*
50	*Syzygium cumini*	*Myrtaceae*	*Syzygium*

Table. 1: Recorded full tree species list of the study area

The survey of 1,084 individual trees revealed a diverse community structure characterized by high species evenness and low dominance.

Diversity Metric	Value
Species Richness (S)	50 species
Shannon–Wiener Index (H')	2.83
Simpson's Diversity Index (1–D)	0.866

Table. 2: Diversity Indices (Calculated)

1) H' = 2.83 → Indicates high species diversity, typical of moist/semi-evergreen forests of the Western Ghats.
2) Simpson = 0.866 → A highly diverse community with no extreme dominance by a single species.
3) Richness = 50 species → Indicates strong floristic heterogeneity along the transects.

Rank	Family	Individuals
1	*Lamiaceae (Tectona grandis)*	348
2	*Fabaceae*	216

3	*Combretaceae*	109
4	*Poaceae (Bamboo)*	84
5	*Sapotaceae*	66
6	*Arecaceae*	38

These six families alone account for ~76% of total individuals.

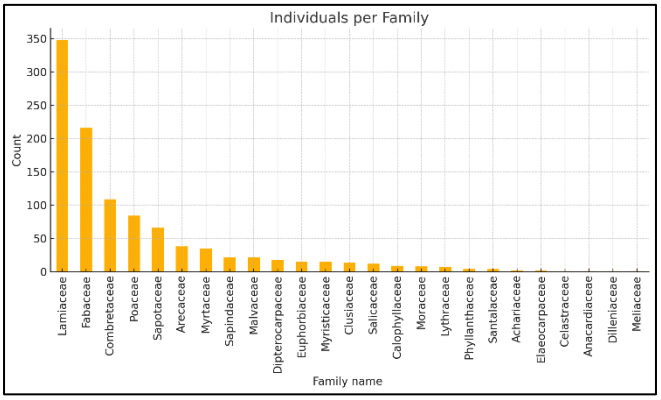

Fig. 2: Graph of Individuals per Family

This graph visually shows:

- *Tectona grandis (Lamiaceae)* has the highest dominance.
- Good family-level diversity with long-tailed distribution, typical of natural forest systems.

V. Conclusion

The floristic assessment conducted across the belt transects in Dandeli Wildlife Sanctuary revealed a high level of tree species richness and structural heterogeneity, characteristic of Western Ghats moist deciduous and semi-evergreen forest ecosystems. A total of 50 tree species belonging to 26 families were recorded from the sampled transects, comprising 1,084 individual trees.

Diversity analysis indicated a Shannon–Wiener Index (H') of 2.83 and a Simpson Diversity Index (1–D) of 0.866, reflecting a well-balanced community with substantial species evenness and minimal dominance. The observed indices confirm that the study area supports a highly diverse arboreal community, consistent with earlier studies on Western Ghats forests. Also it confirms that the 50 species recorded are well-balanced. The site does not suffer from "monodominance" (where one species takes over), which is a positive indicator of ecological resilience and complexity.

Family-wise distribution showed clear patterns of dominance, with *Lamiaceae, Fabaceae, Combretaceae, Poaceae (Bambusoideae), and Sapotaceae* contributing the highest proportion of individuals. *Tectona grandis* alone accounted for 32% of the total individuals, indicating its strong representation in the moist deciduous forest patches. The presence of ecologically important families such as *Dipterocarpaceae, Myristicaceae, Clusiaceae, and Euphorbiaceae* further highlights the transitional nature of vegetation between moist deciduous and semi-evergreen forest types.

The high species richness, combined with the presence of multiple life forms and forest types, reflects the ecological complexity of Dandeli Wildlife Sanctuary. These results underscore the conservation importance of the landscape and support the need for long-term monitoring of floral communities, particularly under increasing anthropogenic pressures and climate variability.

References

[1] Chapman ASA, Tunnicliffe V, Bates AE, 2018. Both rare and common species make unique contributions to functional diversity in an ecosystem unaffected by human activities. Divers Distrib 24:568–578.

[2] Li S, Lang X, Liu W, Ou G, Xu H, Su J, 2018. The relationship between species richness and aboveground biomass in a primary Pinus kesiya forest of Yunnan, southwestern China. PLoS ONE 13(1):0191140.

[3] Nandagopal P, Venkataramana GV, 2017. Ecotourism opportunities in brahmagiri wildlife sanctuary of Kodagu District, Karnataka, India. International Journal of Current Research 9(11): 61182-61184.

[4] Portela R, Pires A, Braz M, Mattos EA, 2017. Species richness and density evaluation for plants with aggregated distributions: fixed vs. variable area methods. Journal of Plant Ecology 10(5): 765–770.

[5] Punekar SA, P Lakshminarasimhan, 2011. Flora of Anshi National Park, Western Ghats, Karnataka. Biospheres Publications, Pune: 672.

[6] Radhadevi A, 2003. Forest Management plan of Anshi National Park, Karnataka, India. Karnataka Forest Department, Dandeli: 45.

[7] Ricardo A, Scrosati, Amanda S, Knox, Nelson Valdivia, Markus Molis, 2011. Species richness and diversity across rocky intertidal elevation gradients in Helgoland: testing predictions from an environmental stress model. Helgol Mar Res: 65:91–102.

[8] Saldanha CJ, 1984 and 1996. Flora of Karnataka. Vol. 1 and 2. Oxford and IBH Publishing Co., New Delhi.

[9] Sarkar AK, Dey M, Mazumder M, 2017. A Comparative Study of Tree Species Composition of Panjhora Forest Beat and Sipchu Forest Beat of Chalsa Forest Range,West Bengal,India. J App Biol Biotech 5(02): 045-052.

[10] Sasaki T, Lauenroth WK, 2011. Dominant species, rather than diversity, regulates temporal stability of plant Communities. Oecologia 166:761-768.

[11] Wohlgemuth D, Solan M, Godbold J, 2016. Specific arrangements of species dominance can be more influential than evenness in maintaining ecosystem process and function. Sci. Rep 6-39325.

