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Tree diversity status in dry deciduous forest of Haliyal taluk, Uttar Kannada district

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#### Abstract

The present study was conducted in dry deciduous forests of Haliyal taluk, Uttar Kannada district to assess the status of tree diversity in the region. In the study area, Point Centred Quarter (PCQ) technique was adopted for sampling in which tree ( $\geq$ 30 cm girth) parameters like species, girth (m) and height (m) were recorded. The results indicated that the number of plants per ha of forest was 647. The average volume of trees was 1.7008 cubic meters. The total volume of the trees from sample units was 644.2147 cubic meters. Margoloff's species richness was 13.245, Species Richness (S) was 13.585, Shannon-Wiener Diversity index (H') was 1.80, and Simpson's diversity index (D) was 0.66. These values indicate high tree diversity in the study area. *Tectona grandis* estimated to have highest IVI of 111.976 followed by *Terminalia* paniculate with 40.876 and *Lagerstroemia lanceolata* with 40.289.

Keywords: Dry deciduous, forest, tree diversity, tree-species, diversity index

## Introduction

Tropical forests accounts for 52% of the total forests of the world. They are known to be the most important areas in terms of biodiversity as they constitute 50% of the world life form that includes 96% of tree species richness nourishes 65% of global biodiversity, thus considered as the richest and complex biomes on the earth. These forests have established their significance through the roles they play in sustainable development, climate change, and floristic biodiversity (Djuikouo *et al.* 2010)<sup>[6]</sup>.

Indian tropical forests are classified as dry (54%) and moist deciduous forests (37%) (Krishnamurthy *et al.* 2010) <sup>[11]</sup>. Dry deciduous forests are more susceptible to fire, that accounts more than 40% of all the forest types in India (Krishna and Reddy, 2012; Naveenkumar *et al.* 2017) <sup>[15]</sup>. The increasing biotic infestation such as anthropogenic perturbations and cattle grazing (Sundarapandian and Swamy 2000 and Saha 2003) <sup>[20, 19]</sup> are also the other reasons for the decline of these forests. Tropical forest of Asia, mainly those of Western and Eastern Ghats of southern India are declining at an alarming rate because of pertaining anthropogenic pressure which is either being replaced by inferior species or change in land use pattern (Parthasarathy 1999) <sup>[18]</sup>.

The lack of information about the structure and dynamics of these forests adds to the disappearance of these forest ecosystem (Hubbell and Foster 1992) <sup>[8]</sup>. Inadequate quantitative information is making the documentation and impacts on genetic tree diversity difficult (Ledig, 1992) <sup>[13]</sup>. For the conservation of forest, the inventory of tree species is a vital aspect as they are the essential structural characteristics of the forest (Aye *et al.* 2014) <sup>[1]</sup>. Understanding tree composition and structure of forest is a vital instrument in assessing the sustainability of the forest, species conservation, and management of forest ecosystems (Kacholi 2014) <sup>[9]</sup>. It is further stressed that there is an urgent need for quantitative inventory in the deciduous forest ecosystem. Therefore, a study was conducted in dry deciduous forest of Haliyal taluk, Uttar Kannada district, Karnataka, India, to assess the status of tree diversity in the region.

#### **Materials and Methods**

The present study was carried out in Haliyal taluk having dry deciduous forest type in Uttar Kannada district of Karnataka Karnataka having total geographical area 38,724 ha with 26,332.32 ha of forest area. The study area is shown in fig 1.



Fig 1: Study area

The volume and diversity of trees of the study area was estimated by Point centered quarter (PCQ) technique. The PCQs within the grids were laid according to the topography. In flat area, PCQ is put diagonally to the grid and in slopes, it is put along the slope. In PCQ technique of forest survey, transect of 100 m was laid in forests. At every 20 m, a point is marked and that site is divided into four quarters. In each of quarter, the distance is measured from the point/stake to the nearest tree of  $\geq$ 30 cm. Only one tree of  $\geq$ 30 cm is measured in a quarter and parameters like species, girth (m) and height (m) were taken. Such points are laid at every 20 m and thus at the end of 100 m, five points were recorded with 20 trees. The tree height was measured using Ravi altimeter and girth of tree using measuring tape Calculations:

- Mean point to tree distance for the entire sample of trees, regardless of species is calculated. This gives mean area per tree.
- Density (all species) = 1/ Mean point to plant distance (This gives individuals per square metre)
- Density (D) = 100 / Mean point to plant distance (This gives individuals per hactre)
- Relative density = (No. of individuals of a species / Total no. of individuals of all species) × 100
- Density = (Relative density of a species/ 100) × Density of all species
- Dominance = Density of a species × Average Basal area for species
- Relative Dominance = (Dominance/ Total Dominance of all species) × 100 (Kumarathunge, 2011)<sup>[12]</sup> The girth and height details of trees are used to calculate volume of the trees using volume equations (FSI, 2006).
- Simpson diversity index = 1-D
- $D = 1 [\Sigma n(n-1)/N(N-1)]$ where n = Number of individual species and N = Total number of all the species.
- Species Richness (S): Species richness is the number of different species represented in an ecological community, landscape or region. Species richness is simply a count of species and it does not take into account the abundance of the species or their relative abundance distributions (Chao *et al.* 2009) <sup>[2]</sup>.
- Margalef's diversity index (DMg) = (S -1)/In N Where, N = the total number of individuals in the sample and S = the number of species recorded Importance Value Index (IVI): IVI was calculated to know the dominant species in a community. The maximum value of IVI can take 300 since three different percentages are added and each can attain a maximum value of 100 (Curtis and McIntosh 1950) <sup>[3]</sup>. IVI was computed by

using the formulae as mentioned below. IVI = Relative frequency (Rf) + Relative density (RD) + Relative dominance (Rd)

## **Results and Discussion**

In the study area, the total of 44 sample units were laid during field sample survey, in which 880 trees of 40 different species were recorded. The average distance of the tree from centre point to tree in PCQ from all the PCQs was 3.93 metre. The different parameters were estimated in the dry deciduous forests of Haliyal taluk and the results indicated that the number of plants per ha of forest was 647. The tree parameters like average height, girth, basal area, volume was also enumerated. The average height of trees was 10.56 metre and average girth 0.84 metre. The average basal area of the trees was 0.07 square meters and average volume was 1.7008 cubic meters. The total volume of the trees from sample units was 644.2147 cubic meters

 
 Table 1: Species having highest Importance Value Index (IVI) in the dry deciduous forests of Haliyal taluk

SL No.	Sl. No. Species		Average
5	Species	Volume	Volume/tree
1	Acacia auraculiformis	11.3174	2.8293
2	Adina cordifolia	0.47769	0.0531
3	Anogeissus latifolia	16.67005	0.3145
4	Bauhinia racemosa	0.67375	0.2246
5	Butea monosperma	11.7609	1.9602
6	Buchanania lanzan	10.84	5.4200
7	C. timorentis	13.61	13.6100
8	Canthium dicocum	3.647	3.6470
9	Careya arborea	52.9194	4.8109
10	Carissa carandas	0.54	0.5400
11	Cassia fistula	0.09	0.0900
12	Cassia species	1.2938	0.2588
13	Ceiba pentandra	0.165	0.1650
14	Cordia diaddotoma	4.5087	4.5087
15	Dalbergia latifolia	23.2309	0.6637
16	Dillenia pentagyna	0.2846	0.1423
17	Diospyros melanoxylon	0.6558	0.0937
18	Dysoxymum melanoxylon	0.135	0.1350
19	Grewia teliaefolia	2.0805	0.5201
20	Holigarna arnottiana	0.4852	0.4852
21	Lagerstroemia lanceolata	47.7194	0.6537
22	Lannea coromandelica	0.4915	0.4915
23	Madhuca indica	0.9143	0.4572
24	Mallotus philippensis	0.038	0.0380
25	Mitragyna parvifolia	0.2043	0.2043
26	Morinda pubescens	0.6430	0.6430
27	Peltophorum pterocarpum	4.534	1.5113
28	Pongamia pinnata	1.3538	1.3538
29	Pterocarpus marsupium	5.2715	0.8786
30	Randia dumetorum	6.8618	1.3724
31	Semicarpus species	0.606	0.6060
32	Sesbania grandiflora	6.3547	1.588675
33	Strychnos nux-yomica	11.9373	5.96865
34	Tectona grandis	298,9584	0.6064
35	Terminalia bellirica	0.0790	0.0790
36	Terminalia paniculata	36.3394	0.3950
37	Terminalia tomentosa	30.4727	0.8706
38	Udav tree	2.8181	1.4091
39	Xylia xylocarpa	31.7161	7.9290
40	Zizinhus rugosa	1.5157	0.5052
		644 2146	0.0002

The total of 40 different species were found in the dry deciduous forests of Haliyal taluk (table 1). The dominant species in terms of density was *Tectona grandis* (56.023)

followed by *Terminalia paniculata* (10.455) and *Lagerstroemia lanceolata* (8.295) in the study area, which

agrees with the observations made by Naveenkumar and Sundarapandian in 2018.

<b>Table 2:</b> Different tree spec	cies in dry deciduous	forests of Haliyal taluk v	with highest Importance	Value Index (IVI)
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Sl. No.	Species	<b>Relative Density</b>	<b>Relative Dominance</b>	<b>Relative Frequency</b>	IVI
1	Tectona grandis	56.023	17.200	38.752	111.976
2	Terminalia paniculata	10.455	17.189	13.233	40.876
3	Lagerstroemia lanceolata	8.295	22.541	9.452	40.289
4	Anogeissus latifolia	6.023	7.811	9.641	23.475
5	Terminalia tomentosa	3.977	12.268	6.238	22.484
6	Dalbergia latifolia	3.977	9.621	5.860	19.458
7	Careya arborea	1.250	1.438	1.134	3.823
8	Pterocarpus marsupium	0.682	1.712	1.134	3.528
9	Adina cordifolia	1.023	0.384	1.512	2.919
10	Diospyros melanoxylon	0.795	0.272	1.323	2.390

The Importance Value index (IVI) was estimated for the sampled dry deciduous forests of Haliyal taluk and among all the species the top ten species with highest IVI were selected. *Tectona grandis* estimated to have highest IVI of 111.976 followed by *Terminalia paniculata* with 40.876 and *Lagerstroemia lanceolata* with 40.289. The IVI index of other species among the top ten are as follows: *Anogeissus latifolia*-23.475, *Terminalia tomentosa*-22.484, *Dalbergia latifolia*-19.458, *Careya arborea*-3.823, *Pterocarpus marsupium*-3.528, *Adina cordifolia*-2.919 and *Diospyros melanoxylon*-2.390 (table 2).

species and can be used to recognise the pattern of association of dominant species in a community (Parthasarathy and Karthikeyan 1997)<sup>[17]</sup>. In the forest, the dominant species association was formed by *Tectona grandis*, *Terminalia paniculata* and *Lagerstroemia lanceolata* along with other species *Anogeissus latifolia*, *Terminalia tomentosa*, *Dalbergia latifolia*, *Careya arborea*, *Pterocarpus marsupium*, *Adina cordifolia* and *Diospyros melanoxylon* which agrees with the observations of Dani *et al.*, 1991<sup>[4]</sup> and Devi and Behera (1999)<sup>[5]</sup>. Climatic and edaphic suitability makes *Tectona grandis* the dominant species in the forest of the region (Meher-Homji 1977)<sup>[14]</sup>.

Analysis of IVI provides information about social status of a

**Table 3:** Average volume, average basal area and number of trees of the species with highest IVI.

Sl. No.	Species	Average volume (m <sup>3</sup> )	Average Basal area (m <sup>2</sup> )	No. of trees
1	Tectona grandis	0.606	1.07	493
2	Terminalia paniculata	0.395	5.73	92
3	Lagerstroemia lanceolata	0.654	9.47	73
4	Anogeissus latifolia	0.315	4.52	53
5	Terminalia tomentosa	0.871	10.75	35
6	Dalbergia latifolia	0.664	8.43	35
7	Careya arborea	4.811	4.01	11
8	Pterocarpus marsupium	0.879	8.75	6
9	Adina cordifolia	0.053	1.31	9
10	Diospyros melanoxylon	0.094	1.19	7

The tree parameters of the top ten species with highest IVI was estimated. *Tectona grandis* consisted of 493 individuals and has average volume of 0.606 m<sup>3</sup>, average volume of 1.07 m<sup>2</sup>. *Terminalia paniculate* had 92 individuals with 0.395 m<sup>3</sup> of average volume, 5.73 m<sup>2</sup> of average basal area. *Lagerstroemia lanceolata* had 73 individuals with 0.654 m<sup>3</sup> of average volume, 9.47 m<sup>2</sup> of average basal area. *Anogeissus latifolia* had 53 individuals with 0.315 m<sup>3</sup> volume and basal area 4.52 m<sup>2</sup>, *Terminalia tomentosa* had 35 individuals with

volume 0.871 m<sup>3</sup> and basal area 10.75 m<sup>2</sup>, *Dalbergia latifolia* had 35 individuals, volume 0.664 m<sup>3</sup> and basal area 8.43 m<sup>2</sup>, *Careya arborea* had 11 trees, volume- 4.811 m<sup>3</sup>, basal area 4.01 m<sup>2</sup>, *Pterocarpus marsupium* had 6 individuals, volume 0.879 m<sup>3</sup>, basal area 8.75 m<sup>2</sup>, *Adina cordifolia* had 9 trees with volume 0.053 m<sup>3</sup>, basal area 1.31 m<sup>2</sup> and *Diospyros melanoxylon* had 7 individuals with volume 0.094 m<sup>3</sup> and basal area 1.19 m<sup>2</sup> (table 3).

Table 4: Diversity indices in the forest area of Haliyal taluk

Sl. No.	Diversity index	Value
1	Species Richness Margoloffs	13.245
2	Species Richness (S)	13.585
3	Shannon-Wiener Diversity index (H')	1.80
4	Simpson's Reciprocal index (D)	2.96
5	Simpson's Diversity index (D)	0.66

The different diversity indices were also calculated for the sampled dry deciduous forest and it was found that Species Richness Margoloffs was 13.245, Species Richness (S) was 13.585, Shannon-Wiener Diversity index (H') was 1.80,

Simpson's Reciprocal index (D) was 2.96 and Simpson's Reciprocal index (D) was 0.66. These values indicate high tree diversity in the study area (table 4). Higher tree species richness indicates a more stable ecosystem and may

## Conclusion

The study was conducted in dry deciduous forest of Haliyal taluk, Uttar Kannada district to assess the status of tree diversity in the region. Total of 40 species were found during the sampling. The forest was dominated by *Tectona grandis*, *Terminalia paniculata* and *Lagerstroemia lanceolata* with the highest IVI value among the total species present in the sampled area. The forest had considerably good tree diversity for the deciduous nature, indicating a more stable ecosystem and demonstrating a better ecosystem/carbon service. It was found that there were 647.463 trees per hectare. The average volume was 1.7008 cubic meters and total volume of the trees from sample units was 644.2147 cubic meters showing the potential of the trees in the dry deciduous forests of the Haliyal taluk to sequester carbon.

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