

Impact of different type of plantations on the diversity of asteraceae in Doddabetta, Nilgiri district, Tamil Nadu

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Abstract

Doddabetta is the highest peak in Nilgiri Biosphere Reserve located at Nilgiri District (11°25'19.48"N, 76°43' 42.20" E and 2516 m above msl). The present study deals with four types of plantations *viz*, Tea plantation, Pinus plantation, Acacia plantation, Eucalyptus plantation and the Sholas. The present investigation was carried out to compare the diversity of Asteraceae in Sholas and the different types of plantations. Details about a total of 102 species belonging to 53 genera of Asteraceae plants were recorded during the present study. Quantitative analysis such as density, frequency, and abundance of Tree Species, Shrubs and Herbs species were determined as per Curtis and McIntosh (1950). A total of 500 quadrates were studied during the present investigation. Tea plantation (34.99%) has the highest relative density of Asteraceae followed by Pinus plantation (33.64%), Acacia plantation (16%), Eucalyptus plantation (12.21%), and Sholas (6.5%). Difference in the distribution pattern in different plantations and Shola in the same altitude is well expressed. The canopy shape of different plantations, light availability to herbs and allelopathic interaction of plantation trees form and influence the diversity of Asteraceae in the Study area.

Keywords: asteraceae, density, Doddabetta, sholas, plantations, the Nilgiri biosphere reserve

Introduction

India is one of the 17 mega biodiversity centers on the earth due to the presence of highly varied edaphic and climatic region ^[1]. 'Sholas' are the places of high biodiversity, which includes many endemic, endangered and rare species of both flora and fauna. The climatic and ecological diversity create a foundation for very rich diversity ^[2]. The Nilgiris comprise the second highest peak in India situated in the south of Western Ghats. Low population size is the characteristic of the shola forests of the Nilgiris ^[3].

The name Asteraceae is derived from the term Aster means *composite* and refers to the characteristic inflorescence – have flower heads composed of many small flowers, called florets, and are surrounded by bracts ^[4]. The Asteraceae (Compositae) is the richest vascular plant family in the world, with 1600–1700 genera and 24,000–30,000 species. They are easily distinguished by the florets grouped in capitula, and the fruit a cypsela often with a pappus. Asteraceae comprises almost every life-form: herbs, succulents, lianas, epiphytes, shrubs, trees, and they reach every environment and continent, except Antarctica ^[5].

Asteraceae seeds are readily dispersed to natural areas by wind, water and wildlife, sometimes far from the original plantings. Wild plants found growing in unwanted agricultural lands, gardens, roadsides and mainly distributed areas where they do not depend on human intervention for their reproduction and survival ^{[6][7]}. Which leads to the unsustainable exploitation many endemic plant species found only in particular ecological niche, due to human action such as deforestation, habitat destruction through urbanization and industrialization. As a result some of the plant species are endangered and some of the plants have been reached verge of extinction. The present investigation was carried out to compare the diversity of Asteraceae in

Sholas with different types of plantations. A total of 102 species of Asteraceae plants were recorded belonging to 53 genera during the present study.

Materials and Methods

Doddabetta is the highest peak in Nilgiri biosphere reserve located in Nilgiri District (11°25'19.48"N, 76°43' 42.20" E and 2516 m above msl). The present study deals with four types of plantations *viz*, Tea plantation, Pinus plantation, Acacia plantation, and Eucalyptus plantation. Field trips were made every month to study, throughout the year (September 2019-August 2020).

The Plantation was enumerated from the 10 x 10 meter plots. Herbs and shrub seedling were enumerated from the nested subplots of 1x1 established at each corner of the plots (4 sub plots per plot). All the collected plant specimens were pressed, poisoned and mounted on herbarium sheets. Herbarium specimens are prepared by standard methodology ^[8]. Plant species are identified with the help regional Floras like, Flora of the Presidency of Madras ^[9], The Flora of the South Indian Hill Station ^[10], Flora of Tamil Nadu ^[11], The Flora of Tamil Nadu and Carnatic ^[12], The Flora of Nilgiris Tamil Nadu ^[13] and Manual of cultivated plants ^[14]. Western Ghats portal was also used for easy identification and confirmation. Plant specimens are kept in Government Arts College Herbarium, Udhagamandalam.

Quantitative analysis

The important quantitative analysis such as density, frequency, and abundance of tree species, shrubs and herbs species were determined as per ^[15].

a. Density

Density is an expression of the numerical strength of a species where the total number of Individuals of each species in all the quadrats is divided by the total number of quadrats studied. Density is calculated by the equation:

$$\text{Density} = \frac{\text{Total number of individuals of a species in all quadrats}}{\text{Total number of quadrates studied}}$$

b. Frequency (%)

This term refers to the degree of dispersion of individual species in an area and usually expressed in terms of percentage occurrence. It was studied by sampling the study area at several places at random and recording the name of the species that occurs in each sampling unit. It is calculated by the equation:

$$\text{Frequency (\%)} = \frac{\text{Number of quadrats in which the species occurred}}{\text{Total number of quadrats studied}} \times 100$$

c. Abundance

It is the study of the number of individuals of different species in the community per unit area. By quadrates method, samplings are made at random at several places and the number of individuals of each species was summed up for all the quadrates divided by the total number of quadrats in which the species occurred. It is represented by the equation:

$$\text{Abundance} = \frac{\text{Total number of individuals of a species in all quadrats}}{\text{Total number of quadrats in which the species occurred}}$$

d. Relative density

Relative density is the study of numerical strength of a species in relation to the total Number of individuals of all the species and can be calculated as:

$$\text{Relative density} = \frac{\text{Number of individual of the species}}{\text{Number of individual of all the species}} \times 100$$

Result and Discussion

A total of 102 species of Asteraceae plants belonging to 53 genera were recorded during the present study. In the study habit wise distribution recorded in Doddabetta there are 2 Trees, 8 Shrubs, 89 Herbs, and 3 Climbers of Asteraceae. Quantitative analysis such as density, frequency, and abundance of tree Species, shrubs and herbs species were determined as per Curtis and McIntosh. A total of 500 quadrats were studied during the present investigation.

Herbs found in different plantations, the composition of different Relative Density from Acacia plantation and its percentage composition are presented in (Table 1). The result shows that the *Poa annua* L. (Grass) is the highest density group in the Acacia plantation. *Poa annua* (53.14%), *Oxalis pubescens* (20.98%), *Cyanotis pilosa* (9.8%), *Erigeron mucronatus* (9%). The composition of different Relative Density from Eucalyptus plantation and its percentage composition are presented in (Table 2). The result shows that the *Digitaria wallichiana* (Grass) is the highest density group in the Eucalyptus plantation. *Digitaria wallichiana* (36.6%), *Cyanotis pilosa* (20.30%), *Oxalis pubescens* (12.91%), *Calceolaria maxicana* (7.04%),

Fragaria nilgerrensis (4.02%), *Helichrysum buddleioides* (3.35%), *Myriactis wightii* (3.18%), *Bidens pilosa* (2.18%), *Anaphalis lawii* (1.84%), *Hypochaeris glabra* (1.84%), *Erigeron mucronatus* (1.84%), *Oxalis corniculata* (1.34%), *Clinopodium umbrosum* (1.0%), *Thalictrum javanicum* (0.83%), *Dichrocephala latifolia* (0.83%), *Lactuca hastata* (0.83%). The composition of different Relative Density from Pinus plantation and its percentage composition are presented in (Table 3). The result shows that the *Eragrostis nigra* (Grass) is the highest density group in the Pinus plantation. *Eragrostis nigra* (66.13%), *Oxalis pubescens* (9%), *Erigeron mucronatus* (6.34%), *Dichrocephala latifolia* (5.3%), *Taraxacum officinale* (4.8%), *Erigeron linifolius* (4.8%), *Gnaphalium luteo-album* (3.7%). The composition of different Relative Density from Shola and its percentage composition are presented in (Table 4). The result shows that the *Oxalis pubescens* is the highest density group in the Shola plantation. *Oxalis pubescens* (29.11%), *Poa annua* (28.23%), *Viola serpens* (18.52%), *Conyza japonica* (5%), *Peperomia reflexa* (4.7%), *Cyanotis pilosa* (3.82%), *Scutellaria violaceae* (3.52%), *Fragaria nilgerrensis* (2.05%), *Sphenomeris chinensis* (2.4%), *Myriactis wightii* (1.5%), *Clinopodium umbrosum* (0.88%), *Malaxis densiflora* (0.2%). The composition of different Relative Density from Tea plantation and its percentage composition are presented in (Table 5). The result shows that the *Isachne kunthiana* (Grass) is the highest density group in the Tea plantation. *Isachne kunthiana* (17.6%), *Oxalis pubescens* (12.9%), *Centella asiatica* (11.04%), *Fragaria nilgerrensis* (6.64%), *Cotula australis* (6%), *Polycarpon tetraphyllum* (4%), *Galinsoga parviflora* (3.7%), *Gnaphalium coarctatum* (3.4%), *Bidens pilosa* (3.08%), *Anaphalis elliptica* (2.7%), *Conyza bonariensis* (2.47%), *Emilia sonchifolia* (2.47%), *Clinopodium umbrosum* (2.47%), *Helichrysum bracteatum* (2.2%), *Gnaphalium luteo-album* (1.9%), *Viola serpens* (1.9%), *Oxalis corniculata* (1.9%), *Dichrocephala latifolia* (1.7%), *Trifolium repens* (1.23%), *Conyza japonica* (1.23%), *Brassica juncea* (1.2%), *Bidens tripartite* (1.1%), *Bidens humilis* (0.5%), *Stellaria media* (0.5%), *Crassocephalum crepidioides* (0.5%), *Hypochaeris glabra* (0.5%), *Taraxacum officinale* (0.5%), *Capsella bursa-pastoris* (0.3%), *Knoxia sumatrensis* (0.3%).

Habit of plants divided in to Herbs and Shrubs. Density, percentage and relative density of Regeneration (Herbs) in the above five plantations were found out. The highest relative density group in the Acacia plantation is *Poa annua* (Grasse). The density and relative density of herbs found in Acacia plantation is 53.14%. Asteraceae was found to be only 16%. Figure 1, shows Asteraceae distribution in various plantations. The highest relative density group in the Eucalyptus plantation is *Digitaria wallichiana* (Grasse). The density and relative density of herbs found in this plantation is 36.6%. Asteraceae found to be only 12.21 %. The highest relative density group in the Pinus plantation is *Eragrostis nigra* (Grasse). The density and relative density of herbs found Pinus plantation is 66.13%. Asteraceae found to be only 33.64%. The highest relative density group in the Shola is *Oxalis pubescens*. The density and relative density of herbs found in Shola is 29.11%. Asteraceae found to be only 6.5%. The highest relative density group in the Tea plantation is *Isachne kunthiana* (Grasse). The density and relative density of herbs found in Tea plantation is 17.6%.

Asteraceae is a dominate species in Tea plantation 34.99%. The results of the present study reveal that the altitudinal gradient is well expressed in the distribution of Asteraceae in Nilgiris.

Figure 2 showing Quadrates studies found in study plots. Global warming has changed the species composition of the ecosystem. Soil has become sterile and unsuitable for vegetation. Acid rain is the result of contamination of rainwater by acidic discharge from mechanical motor vehicles, factories and industries. Some susceptible species on the earth could not live on the adverse atmosphere. Some of the species had modified, adapting to the changing environmental condition by natural selection. Most exotic

tropical plant species survive well in disturbed environmental conditions. These disturb the natural ecosystem by their vigorous distribution more than the other species. Alien vegetation affects the structure of plant communities [16]. Further the difference in the distribution pattern in different plantations and Shola in the same altitude is well expressed. This may be due to the allelopathic interaction between the trees found in the habitat and plants of Asteraceae in the same elevation. The canopy shape of different plantations, light availability to herbs and allelopathic interaction of plantation trees were found to influence the diversity of Asteraceae in the Study area.

Table 1: Density and percentage of Regeneration (Herbs) species recorded in *Acacia* plantation at Doddabetta.

S. No	Name of the plant species.	Number of individuals	Density no./ha	Relative density (%)
1.	<i>Erigeron mucronatus</i> DC.	52	5.200	9
2.	<i>Poa annua</i> L.	304	30.400	53.14
3.	<i>Oxalis pubescens</i> H.B.K.	120	12.000	21
4.	<i>Cyanotis pilosa</i> Schult. & Schult.f.	56	5.600	9.8
5.	<i>Helichrysum bracteatum</i> (Venten.) Willd.	40	4.000	7

Table 2: Density and percentage of Regenerations (Herbs) species recorded in *Eucalyptus* plantation at Doddabetta.

S. No	Name of the plant species.	Number of individuals	Density no./ha	Relative density (%)
1.	<i>Helichrysum buddleioides</i> DC.	80	8.000	3.35
2.	<i>Digitaria wallichiana</i> (Steud.) Stapf	872	87.200	36.6
3.	<i>Anaphalis lawii</i> (Hook.f.) Gamble	44	4.400	1.84
4.	<i>Calceolaria maxicana</i> Benth. – Ham.ex D.Don.	168	16.800	7.04
5.	<i>Dichrocephala latifolia</i> (Lam.) L'Her. Ex DC.	20	2.000	0.83
6.	<i>Fragaria nilgerrensis</i> Schltdl.ex J.Gay	96	9.600	4.02
7.	<i>Hypochaeris glabra</i> , L.	44	4.400	1.84
8.	<i>Clinopodium umbrosum</i> (Fisch. & Mey.)O.Kuntze.	24	2.400	1.00
9.	<i>Myriactis wightii</i> , DC.	76	7.600	3.18
10.	<i>Erigeron mucronatus</i> DC.	44	4.400	1.84
11.	<i>Thalictrum javanicum</i> Blume	20	2.000	0.83
12.	<i>Lactuca hastate</i> , DC.	20	2.000	0.83
13.	<i>Oxalis corniculata</i> L.	32	3.200	1.34
14.	<i>Bidens pilosa</i> , L.	52	5.200	2.18
15.	<i>Cyanotis pilosa</i> Schult. & Schult.f.	48	48.400	20.30
16.	<i>Oxalis pubescens</i> H.B.K.	308	30.800	12.91

Table 3: Density and percentage of Regeneration (Herbs) species recorded in *Pinus* plantation at Doddabetta.

S. No	Name of the plant species.	Number of individuals	Density no./ha	Relative density (%)
1.	<i>Eragrostis nigra</i> Nees ex Steud.	500	50.000	66.13
2.	<i>Oxalis stricta</i> L.	6.8	6.800	9
3.	<i>Dichrocephala latifolia</i> , DC.	40	4.000	5.3
4.	<i>Taraxacum officinale</i> , Wigg.	36	3.600	4.8
5.	<i>Erigeron linifolius</i> , Wild.	36	3.600	4.8
6.	<i>Gnaphalium luteo-album</i> , L.	28	2.800	3.7
7.	<i>Erigeron mucronatus</i> DC.	48	4.800	6.34

Table 4: Density and percentage of Regeneration (Herbs) species recorded in Shola at Doddabetta.

S. No	Name of the plant species.	Number of individuals	Density no./ha	Relative density (%)
1.	<i>Viola serpens</i> Wall. Ex Ging.	252	25.200	18.52
2.	<i>Myriactis wightii</i> , DC.	20	2.000	1.5
3.	<i>Oxalis pubescens</i> H.B.K.	396	39.600	29.11
4.	<i>Scutellaria violaceae</i> B.Heyne ex Benth.	48	4.800	3.52
5.	<i>Poa annua</i> L.	384	38.400	28.23
6.	<i>Fragaria nilgerrensis</i> Schltdl.ex J.Gay	28	2.800	2.05
7.	<i>Oxalis corniculata</i> L.	68	6.800	5
8.	<i>Cyanotis pilosa</i> Schult. & Schult.f.	52	5.200	3.82
9.	<i>Clinopodium umbrosum</i> (Fisch. & Mey.)O.Kuntze.	12	1.200	0.9
10.	<i>Peperomia reflexa</i> Kunth	64	6.400	4.7
11.	<i>Sphenomeris chinensis</i> (L.) J.Sm.	32	3.200	2.4
12.	<i>Malaxis densiflora</i> (A.Rich.) Kuntze	4	400	0.2

Table 5: Density and percentage of Regeneration (Herbs) species recorded in Tea plantation at Doddabetta.

S. No	Name of the plant species.	Number of individuals	Density no./ha	Relative density (%)
1.	<i>Centella asiatica</i>	572	57.200	11.04
2.	<i>Gnaphalium luteo-album</i> L.	96	9.600	1.9
3.	<i>Oxalis pubescens</i> H.B.K.	668	66.800	12.9
4.	<i>Anaphalis elliptica</i> DC.	140	14.000	2.73
5.	<i>Bidens pilosa</i> L.	160	16.000	3.08
6.	<i>Conyza japonica</i> , Less.	64	6.400	1.23
7.	<i>Fragaria nilgerrensis</i> Schltdl.ex J.Gay	344	34.400	6.64
8.	<i>Isachne kunthiana</i> (Wight & Arn. Ex Steud.) Miq.	912	91.200	17.6
9.	<i>Conyza bonariensis</i> (L.) Cronquist.	128	12.800	2.47
10.	<i>Polycarpon tetraphyllum</i> (L.) L.	156	15.600	3.01
11.	<i>Trifolium repens</i> L.	64	6.400	1.23
12.	<i>Clinopodium umbrosum</i> (Fisch. & Mey.)O.Kuntze.	128	12.800	2.5
13.	<i>Cotula australis</i> Hk. F	312	31.200	6.02
14.	<i>Galinsoga parviflora</i> Cav.	192	19.200	3.7
15.	<i>Helichrysum bracteatum</i> (Venten) Willd.	112	11.200	2.2
16.	<i>Emilia sonchifolia</i> DC.	128	12.800	2.5
17.	<i>Gnaphalium coactratum</i> Wild.	176	17.600	3.4
18.	<i>Dichrocephala latifolia</i> DC.	88	8.800	1.7
19.	<i>Bidens tripartite</i> L.	56	5.600	1.1
20.	<i>Polygonum chinense</i> L.	208	20.800	4.01
21.	<i>Viola serpens</i> Wall. ex Ging.	100	10.000	1.9
22.	<i>Taraxacum officinnale</i> Wigg.	28	2.800	0.50
23.	<i>Hypochoeris glabra</i> L.	28	2.800	0.50
24.	<i>Senecio vulgaris</i> L.	52	5.200	1
25.	<i>Capsella bursa-pastoris</i> (L.) Medik.	16	1.600	0.3
26.	<i>Brassica juncea</i> (L.) Czern.	64	6.400	1.2
27.	<i>Stellaria media</i> (L.) Vill.	28	2.800	0.5
28.	<i>Bidens humilis</i> H.B.K.	24	2.400	0.46
29.	<i>Oxalis corniculata</i> L.	96	9.600	1.9
30.	<i>Knoxia sumatrensis</i> (Retz.) DC.	16	1.600	0.3
31.	<i>Crassocephalum crepidioides</i> (Benth.) S. Moore	24	2.400	0.5

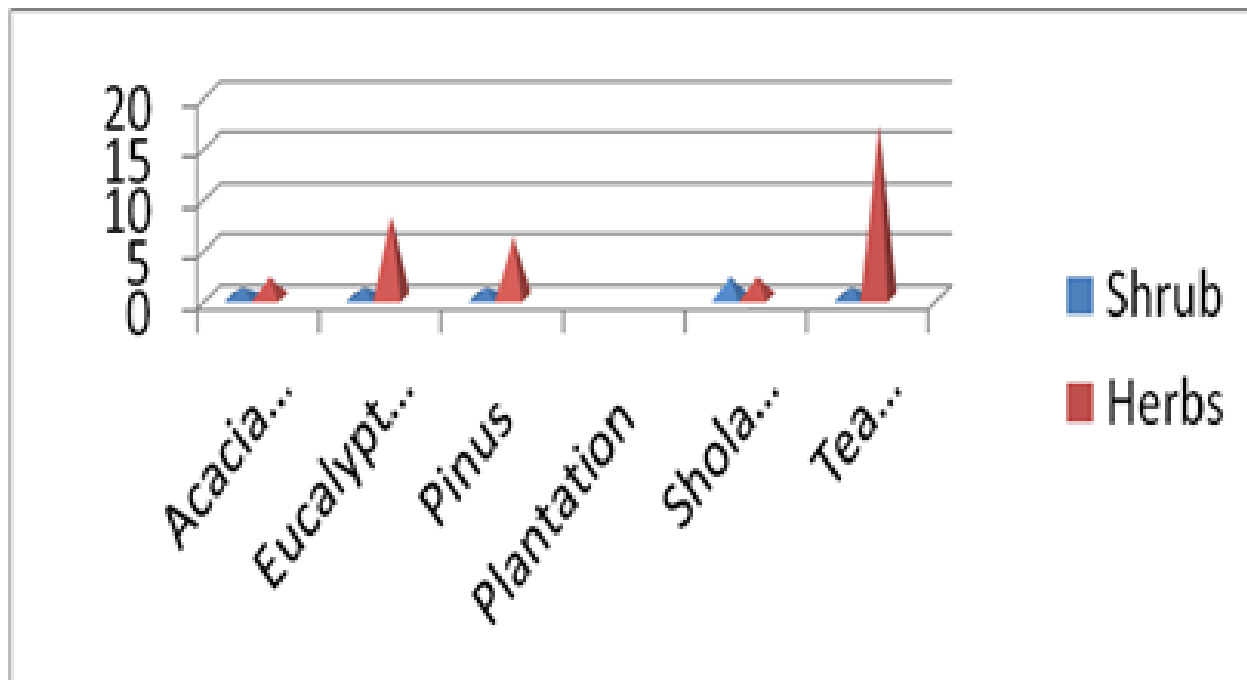


Fig 1: Graph showing Asteraceae distribution in various plantations

Quadrates studies on various plantations



Acacia Plantation



Herbs found in acacia plantation



Eucalyptus plantation



Herbs found in eucalyptus plantation



Pinus plantation



Herbs found in Pinus plantation



Sholas



Herbs found in sholas



Fig 2: Showing Quadrates studies found in study plots

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