



Study of Plant Diversity in Red Sanders Park in Chittoor District of Andhra Pradesh, India

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The study deals with the assessment of plant diversity in Red Sanders park in Chittoor district of Andhra Pradesh, India. A total of nine species of trees belonging to six families with 1625 individuals, 25 species of shrubs belonging to 18 families with 2,042 individuals and 40 species of grasses and herbs belonging to 14 families with a total of 1,016 individuals were encountered. Quadrat size of 400 m² were established for trees, 100 m² for shrubs, 20 m² for grasses and herbs. In terms of IVI, *Pterocarpus santalinus* was found to be the most dominant tree species, *chromolaena odorata* was found to be the most dominant shrub species and *Bothriochloa ischaemum* was found to be the most dominant grasses and herb species. The result of the phytosociological aspects in all four sites concluded that for trees, Site-IV showed the highest value for Shannon-Weiner Diversity Index (H) (1.73). For shrubs, Site-I showed the highest value for Shannon-Weiner Diversity Index (H') (2.52). For grasses and herb, Site-III had a Shannon-Weiner Diversity Index (H') of 2.62. The quantitative analysis of diversity and phytosociological attributes of tree species recorded from the present study may provide baseline information for formulating a working plan for conservation and management strategies for the forest.

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1. INTRODUCTION

Plant diversity deals with the enumeration of plant species growing in a particular region at a particular time. Its assessments are considered as the basic requirement to understand the current status of plant diversity. The structure, composition, and vegetative functions are most significant ecological attributes of a particular ecosystem, which show variations in response to environmental as well as anthropogenic variables (Chaudhary and Bhatt, 2017). Major threats to ecosystems and biodiversity are loss of habitat, fragmentation, overexploitation, pollution, invasions of alien species, and global climate change (Pereira et al. 2010). The study of plant diversity provides required knowledge about the various plant species regarding their nomenclature, distribution, utility and ecology. Such studies also help to understand the basic aspects of biology such as speciation, isolation, endemism and evolution [1]. Plant diversity is of utmost value to basic research because the data generated through these studies are highly useful in ecological, biogeographic, taxonomic and evolutionary studies [2]. Knowledge generated by these studies are utilized by a breadth of applied research fields including land management, forestry, conservation biology, ecology, and range science. It forms the basis for regional floras and systematic monographs. Though, a number of studies have been undertaken in different parts of the India as well as in other parts of the world [3]. Red Sanders tree, which is endemic to the southern parts of India, is one of the most valuable timber species in the world due to its rich red colour and medicinal properties [4]. Red sanders forests are a type of tropical dry deciduous forest that are home to a wide variety of tree species [5]. Red Sanders forest had a wide variety of tree, shrub, and herb species, exhibiting significant floristic diversity [6]. An important step in the preservation of red sanders trees was the creation of the Red Sanders Park. These trees will find refuge in the park, which will help to secure their long-term existence [7]. Red Sanders forest of Andhra Pradesh harbors a rich and diverse flora, highlighting its ecological significance [8]. Red sanders forests in Chittoor district are rich in plant diversity, with a high number of rare and endangered species [9]. Population in Chittoor district is declining, due to illegal logging and overexploitation [10]. Forests in the Seshachalam hills possess rich floristic

diversity, emphasizing the need for conservation and sustainable management of these forests [11]. Red Sanders forests play a crucial role in carbon sequestration and emphasized the importance of preserving and managing these forests for their environmental benefits [12]. A total of 73 plant species belonging to 63 genera and 45 families within the Red Sanders forest fragments. The dominant families identified were Fabaceae, Rubiaceae, Euphorbiaceae, and Meliaceae [13]. Use of herbal plants for primary health care and the treatment of various health disorders through the personal contact and personal interview of rural old people [14]. Unfortunately, the illegal trade of Red Sanders timber has led to its exploitation, and the species has become critically endangered. In response to this, the Indian government has taken several measures to protect and conserve the Red Sanders tree, and Red Sanders Park is one of the conservation sites that has been established to protect this species. The park is situated in a region that is characterized by a tropical dry deciduous forest ecosystem. The forest types found in the park include dry mixed deciduous forest, southern thorn forest, and scrub forest. The park is home to a diverse range of plant species, including trees, shrubs, herbs, and grasses. The park is also home to a variety of animal species, including birds, mammals, reptiles, and amphibians (WWF-India, 2016).

2. MATERIALS AND METHODS

2.1 Study Area and Sites

Red Sanders Park is located in the Chittoor district of Andhra Pradesh in southern India. The park is situated in the Seshachalam Biosphere Reserve, which is part of the Eastern Ghats mountain range. The park covers an area of approximately 156.61 hectares and is known for its rich biodiversity, including the rare and endangered Red Sanders tree (*Pterocarpus santalinus*).

The park is located between 13° 39' and 13° 41' N latitude and 79° 19' and 79° 21' E longitude. The park is characterized by hilly terrain with an elevation ranging from 500 to 1,500 meters above sea level. The climate of the area is tropical with a hot and humid summer season and a cooler winter season. The park is home to a diverse range of flora, including several endemic and threatened species. In addition to

the Red Sanders tree, other important tree species found in the park include teak, anogeissus, and terminalia. Overall, Red Sanders Park is an important study area for the assessment of plant diversity and the ecological dynamics of the Eastern Ghats mountain range in southern India.

2.2 Methods

2.2.1 Sample plot establishment and field vegetation measurement

Random sampling method was employed for data collection. The sampling was performed after selecting five sites of the total area and 10% area cover of all the site with quadrates (20m× 20m) for trees, (5m×5m) for shrubs and (1m×1m) for herbs. The data was collected using quadrat counts (numbers of trees occurring in the quadrates is recorded and tree diameter at breast-height (DBH) is measured.

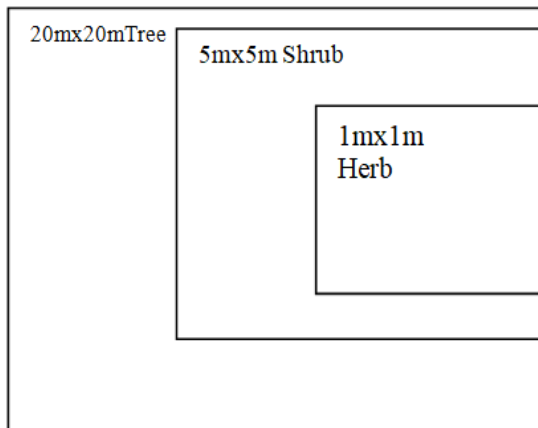


Fig. 1. Pattern of sampling method

Important Value Index (IVI): The Importance Value Index (IVI) is used to express dominance and ecological succession of plants species. The method implies quantitative parameters such as abundance, frequency and basal area of trees determined by relative frequency, relative density and relative dominance. The important quantitative analysis such as: density, frequency, and abundance of tree species is determined as mentioned by Curtis & McIntosh (1950). The following formulas are employed for assessment of IVI.

Frequency Percentage %=

$$\frac{\text{Number of quadrats in which a species occurs}}{\text{Total number of quadrats sampled}} \times 100$$

Density=

$$\frac{\text{Total number of individuals of a species in all quadrats}}{\text{Total number of quadrats sampled}}$$

Abundance=

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

The Important Vegetation Index (Curtis 1959),

$$\text{Relative Density} = \frac{\text{Density of a species}}{\text{Total density of all species}} \times 100$$

$$\text{Relative Frequency} = \frac{\text{Frequency of a species}}{\text{Total frequency of all species}} \times 100$$

$$\text{Relative Dominance} = \frac{\text{Basal area of a species}}{\text{Basal area of all species}} \times 100$$

$$\text{Basal area} = \frac{\pi (\text{circumference at breast height})^2}{4}$$

2.2.2 Importance value index

Importance value index (IVI) was used to determine the overall importance of each species in the community structure. While calculating IVI, the percentage values of the relative frequency, relative density and relative dominance are summed up together for individual species (Curtis 1959) like.

$$\text{Importance Value Index} = \text{Relative Dominance} + \text{Relative Density} + \text{Relative Frequency}$$

Species Diversity:

It is defined as the number of species and abundance of each species that live in a particular location.

It is calculated using the formula (Shannon Wiener, 1963).

$$\text{Diversity Index (H)} = -\sum \text{Pi} (\log \text{Pi})$$

Where,

Pi= n/N (Proportion of species in the community).

n= No. of individual species

N= Total no. of individuals

Species Richness:

The species richness is based solely on the number of species found in the given area (Margalef's Index).

$$\text{SR} = (S-1)/(\text{Log}N)$$

Where,

S is the Number of species and
N is the total no. of individuals in the sample.

Species Evenness Index:

Species evenness describes the relative abundance of each species.

Evenness index (E) (Pielou, 1975):

$$E = H' / \ln S$$

Where,

H' = Shannon's index value

S = Total no. of species

3. RESULTS AND DISCUSSION

The result of investigation entitled “Study of Plant Diversity in Red Sanders Park in Chittoor District of Andhra Pradesh” were carried out during 2022-2023. Details on the results of study and survey during the course of investigation are given below under different tables and graphs.

As mentioned earlier the survey was conducted upon plant diversity and medicinal importance of plants, where the study area was divided into four sites and the species founded in the redsanders park are listed below:

List of the entire Tree species found in all four Sites:

S no.	Botanical name	family	Local name	Common name
1.	<i>Pterocarpus santalinus</i>	Fabaceae	Yerra Chandanam	Red sandalwood
2.	<i>Tamarindus indicus</i>	Fabaceae	Chinthachettu	tamarind
3.	<i>Azadirachta indica</i>	Meliaceae	Vepachettu	Neem tree
4.	<i>Citrus limon</i>	Rutaceae	Nimmachettu	lemon
5.	<i>Annona reticulata</i>	Annonaceae	Seetha Phal	Custard Apple
6.	<i>Ficus religiosa</i>	Moraceae	Bodhi Tree	Sacred fig
7.	<i>Borassus flabellifer</i>	Aracaceae	Thati chettu	Palm
8.	<i>Phoenix dactylifera</i>	Aracaceae	Kharjura	Date Palm
9.	<i>Millettia pinnata</i>	Fabaceae	Kanuga Chettu	Seashore Mempoari

A total number of 09 species from 06 families were found in all five sites where the study was conducted.

Site 1:

The vegetation composition in site I recorded in 15 quadrates of 20 x 20 m² in size shows that a total 6 species of trees were found. The species along with their recorded attributes and other recorded parameters are shown below in the different tables:

Table 1. list of trees found in site 1

S. no.	Botanical name	Family name	Local name	Common name
1.	<i>Pterocarpus santalinus</i>	Fabaceae	Yerra Chandanam	Red sandalwood
2.	<i>Tamarindus indicus</i>	Fabaceae	Chinthakayi	Tamarind
3.	<i>Azadirachta indica</i>	Meliaceae	Vepa chettu	Neem tree
4.	<i>Citrus limon</i>	Rutaceae	Nimma Chettu	Lemon
5.	<i>Annona reticulata</i>	Annonaceae	Seetha phal	Custard apple
6.	<i>Millettia pinnata</i>	Fabaceae	Kanuga Chettu	Seashore Mempoari

Table 2. Tree species recorded in 20x20 quadrate in Site 1

S. no.	Botanical name	Total individuals	No of quadrate species occurred
1.	<i>Pterocarpus santalinus</i>	182	15
2.	<i>Tamarindus indicus</i>	17	9
3.	<i>Azadirachta indica</i>	57	9
4.	<i>Citrus limon</i>	28	7
5.	<i>Annona reticulata</i>	25	8
6.	<i>Millettia pinnata</i>	53	8
	Total	362	56

Table 2 shows a total of 362 individuals and 56 species were found during the study. The tree species having maximum number of individuals included *Pterocarpus santalinus* (182), *Azadirachta indica* (57), *Millettia pinnata* (53), whereas, the tree species having minimum number of individuals includes *Tamarindus indicus* (17), *Annona reticulata* (25), *Citrus limon* (28).

Table 3 showed tree species having highest density amongst the species include *Pterocarpus santalinus* (12.1), *Azadirachta indica* (3.8), *Millettia pinnata* (3.5).while the tree species showing lowest density included *Tamarindus indicus* (1.1), *Annona reticulata* (1.7), *Citrus limon* (1.9).

Table 3 showed tree species having highest frequency amongst the species include

Pterocarpus santalinus (100.0), *Tamarindus indicus* (60.0) followed by *Azadirachta indica* (60.0). While the tree species showing the lowest frequency was *Citrus limon* (46.7), *Annona reticulata* (53.3), *Millettia pinnata* (53.3).

Table 3 showed tree species showing the highest abundance among the species include *Pterocarpus santalinus* (12.1) followed by *Azadirachta indica* (3.8). while, the lowest abundance was shown by the species *Tamarindus indicus* (1.1), *Annona reticulata* (1.7).

Table 3 showed tree species having highest IVI amongst the species included *Pterocarpus santalinus* (127.3) followed by *Azadirachta indica* (47.6). while the lowest IVI shown by the species was *Tamarindus indicus* (25.5), *Citrus limon* (28.0).

Table 3. Quantative analysis for tree species of Site 1 is categorized as below:

S. no.	Species	Basal area cm ²	D.	F.	A.	RD.	RF.	R Do.	IVI
1.	<i>Pterocarpus santalinus</i>	4.13	12.1	100.0	12.1	50.3	26.8	50.3	127.3
2.	<i>Tamarindus indicus</i>	30.59	1.1	60.0	1.1	4.7	16.1	4.7	25.5
3.	<i>Azadirachta indica</i>	3.26	3.8	60.0	3.8	15.7	16.1	15.7	47.6
4.	<i>Citrus limon</i>	1.83	1.9	46.7	1.9	7.7	12.5	7.7	28.0
5.	<i>Annona reticulata</i>	1.21	1.7	53.3	1.7	6.9	14.3	6.9	28.1
6.	<i>Millettia pinnata</i>	0.82	3.5	53.3	3.5	14.6	14.3	14.6	43.6
	<i>Total</i>	41.84	24.1	373.3	24.1	100.0	100.0	100.0	300.0

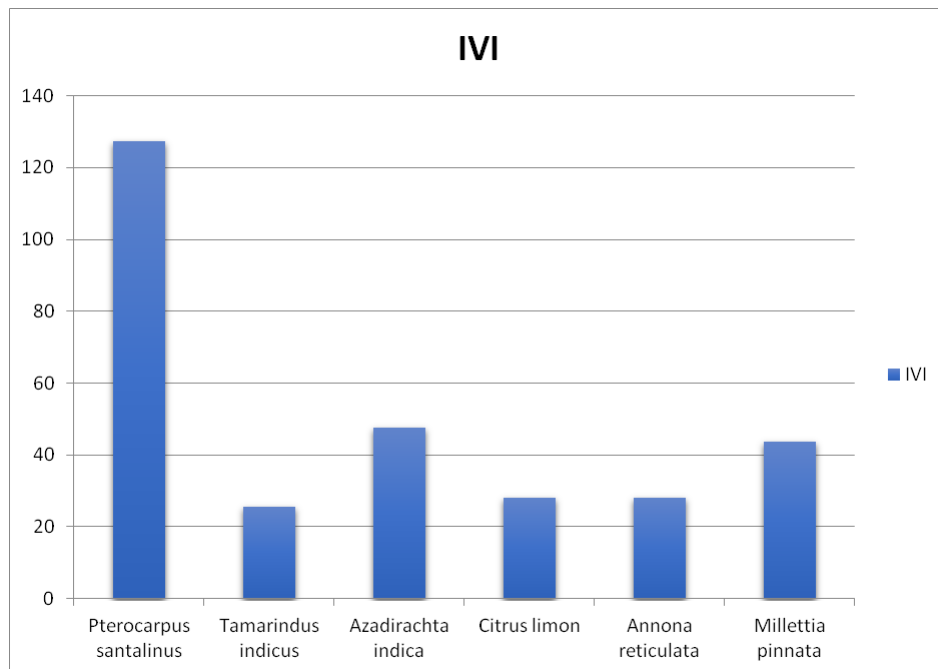


Fig. 2. IVI Index of tree species in Site-1

Tree species in Site-2

Table 4. Tree species recorded in Site-2

S. No.	Botanical name	Family name	Local name	Common name
1.	<i>Pterocarpus santalinus</i>	Fabaceae	Errachandhanam	Red sandal
2.	<i>Tamarindus indicus</i>	Fabaceae	Chinthachettu	Tamarind
3.	<i>Azadirachta indica</i>	Meliaceae	Vepa chettu	Neem tree
4.	<i>Annona reticulata</i>	Annonaceae	Seetha phal	Custard apple
5.	<i>Borassus flabellifer</i>	Aracaceae	Thati chettu	Palm

Table 5. Tree species recorded in 20x20 quadrat in Site 2

S. no.	Botanical name	Total individuals	No of quadrat species occurred
1.	<i>Pterocarpus santalinus</i>	209	15
2.	<i>Tamarindus indicus</i>	19	10
3.	<i>Azadirachta indica</i>	10	8
4.	<i>Annona reticulata</i>	48	12
5.	<i>Borassus flabellifer</i>	14	8
Total		300	53

Table 6. Quantitative analysis for tree species of site 2 is categorized as below

S. No.	Species	Basal area cm ²	D.	F.	A.	RD.	RF.	R Do.	IVI
1.	<i>Pterocarpus santalinus</i>	1.03	13.93	100.00	13.93	69.67	28.30	69.67	167.64
2.	<i>Tamarindus indicus</i>	12.84	1.27	66.67	1.27	6.33	18.87	6.33	31.53
3.	<i>Azadirachta indica</i>	1.83	0.67	53.33	0.67	3.33	15.09	3.33	21.76
4.	<i>Annona reticulata</i>	0.46	3.20	80.00	3.20	16.00	22.64	16.00	54.64
5.	<i>Borassus flabellifer</i>	7.34	0.93	53.33	0.93	4.67	15.09	4.67	24.43
Total		23.50	20.00	353.33	20.00	100.00	100.00	100.00	300.00

Table no 5 shows a total of 300 individuals and 05 species were found during the study. The tree species having maximum number of individuals included *Pterocarpus santalinus* (209), *Annona reticulata* (48), *Tamarindus indicus* (19). Whereas, the tree species having minimum number of individuals includes *Azadirachta indica* (10), *Borassus flabellifer* (14).

Table 6 showed tree species having highest density amongst the species include *Pterocarpus santalinus* (13.93), *Annona reticulata* (3.20) *Tamarindus indicus*(1.27) while the tree species showing lowest density included *Azadirachta indica* (0.67), *Borassus flabellifer* (0.93).

Table 6 showed tree species having highest frequency amongst the species include *Pterocarpus santalinus* (100), *Annona reticulata* (80), *Azadirachta indica* (53.33).While the tree

species showing the lowest frequency was *Tamarindus indicus* (66.67).

Table 6 showed tree species showing the highest abundance among the species include *Pterocarpus santalinus* (13.93), *Annona reticulata* (3.20), *Tamarindus indicus* (1.27).while, the lowest abundance was shown by the species *Azadirachta indica* (0.67), *Borassus flabellifer* (0.93), *Tamarindus indicus* (1.27).

Table 6 showed tree species having highest IVI amongst the species included *Pterocarpus santalinus* (167.64), *Annona reticulata* (54.64), *Azardicta indica* (25.30).while the lowest IVI shown by the species was *Tamarindus indicus* (31.53), *Azadirachta indica* (21.76), *Borassus flabellifer* (24.43).

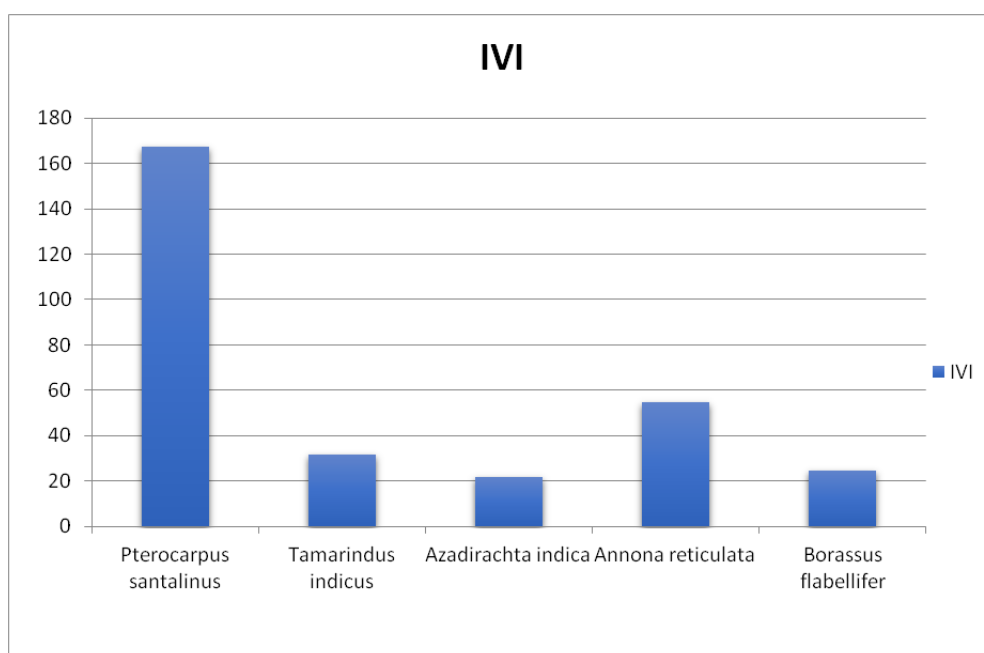


Fig. 3. IVI Index of tree species in Site-2

Tree species in Site-3

Table 7. Tree species recorded in Site-3

S. no.	Botanical name	Family name	Local name	Common name
1.	<i>Pterocarpus santalinus</i>	Fabaceae	Yerrachandhanam	Red sandal
2.	<i>Tamarindus indicus</i>	Fabaceae	Chinthachettu	Tamarind
3.	<i>Azadirachta indica</i>	Meliaceae	Vepa chettu	Neem Tree
4.	<i>Citrus limon</i>	Rutaceae	Nimma chettu	Lemon
5.	<i>Annona reticulata</i>	Annonaceae	Seetha phal	Custard apple
6.	<i>Millettia pinnata</i>	Fabaceae	Kanuga	Seashore mempoari
7.	<i>Ficus religiosa</i>	Moraceae	Bodhi Tree	Sacred fig

Table 8. Tree species recorded in 20x20 quadrate in Site 3

S. no.	Botanical name	Total individuals	No. of quadrate species occurred
1.	<i>Pterocarpus santalinus</i>	192	15
2.	<i>Tamarindus indicus</i>	62	14
3.	<i>Azadirachta indica</i>	109	13
4.	<i>Citrus limon</i>	14	5
5.	<i>Annona reticulata</i>	34	10
6.	<i>Millettia pinnata</i>	15	6
7.	<i>Ficus religiosa</i>	12	7
	Total	438	70

Table no 8 shows a total of 438 individuals and 07 species were found during the study. The tree species having maximum number of individuals included *Pterocarpus santalinus* (192), *Azadirachta indica* (109), *Tamarindus indicus* (62). Whereas, the tree species having minimum number of individuals *Ficus religiosa* (12), *Citrus limon* (14), *Millettia pinnata* (15).

Table 9 showed tree species having highest density amongst the species include *Pterocarpus santalinus* (12.8), *Azadirachta indica* (7.3), *Tamarindus indicus* (4.1). while the tree species showing lowest density included *Ficus religiosa* (0.8), *Citrus limon* (0.9), *Millettia pinnata* (1.0).

Table 9. Quantative analysis for tree species of site 3 is categorized as below :

S. No.	Species	Basal area cm ²	D.	F.	A.	RD.	RF.	R Do.	IVI
1.	<i>Pterocarpus santalinus</i>	6.45	12.8	100.0	12.8	43.8	21.4	204.6	269.8
2.	<i>Tamarindus indicus</i>	21.68	4.1	93.3	4.4	14.2	20.0	70.8	104.9
3.	<i>Azadirachta indica</i>	11.85	7.3	86.7	8.4	24.9	18.6	134.0	177.5
4.	<i>Citrus limon</i>	3.57	0.9	33.3	2.8	3.2	7.1	44.7	55.1
5.	<i>Annona reticulata</i>	1.83	2.3	66.7	3.4	7.8	14.3	54.3	76.4
6.	<i>Millettia pinnata</i>	1.61	1.0	40.0	2.5	3.4	8.6	40.0	52.0
7.	<i>Ficus religiosa</i>	38.89	0.8	46.7	1.7	2.7	10.0	27.4	40.1
8.	Total	85.88	29.2	466.7	36.0\	100.0	100.0	100.0	300.0

Table 9 showed tree species having highest frequency amongst the species include *Pterocarpus santalinus* (100.0), *Tamarindus indica* (93.3), *Azadirachta indica* (86.7). While the tree species showing the lowest frequency was *Citrus limon* (33.3), *Millettia pinnata* (40.0), *Ficus religiosa* (46.7).

Table 9 showed tree species showing the highest abundance among the species include *Pterocarpus santalinus* (12.8), *Azadirachta indica*

(8.4), *Tamarindus indicus* (4.4). while, the lowest abundance was shown by the species *Ficus religiosa* (1.7), *Millettia pinnata* (2.5), *Citrus limon* (2.8).

Table 9 showed tree species having highest IVI amongst the species included *Pterocarpus santalinus* (269.8), *Azadirachta indica* (177.5), *Tamarindus indicus* (104.9) while the lowest IVI shown by the species *Ficus religiosa* (40.1), *Millettia pinnata* (52.0), *Citrus limon* (55.1).

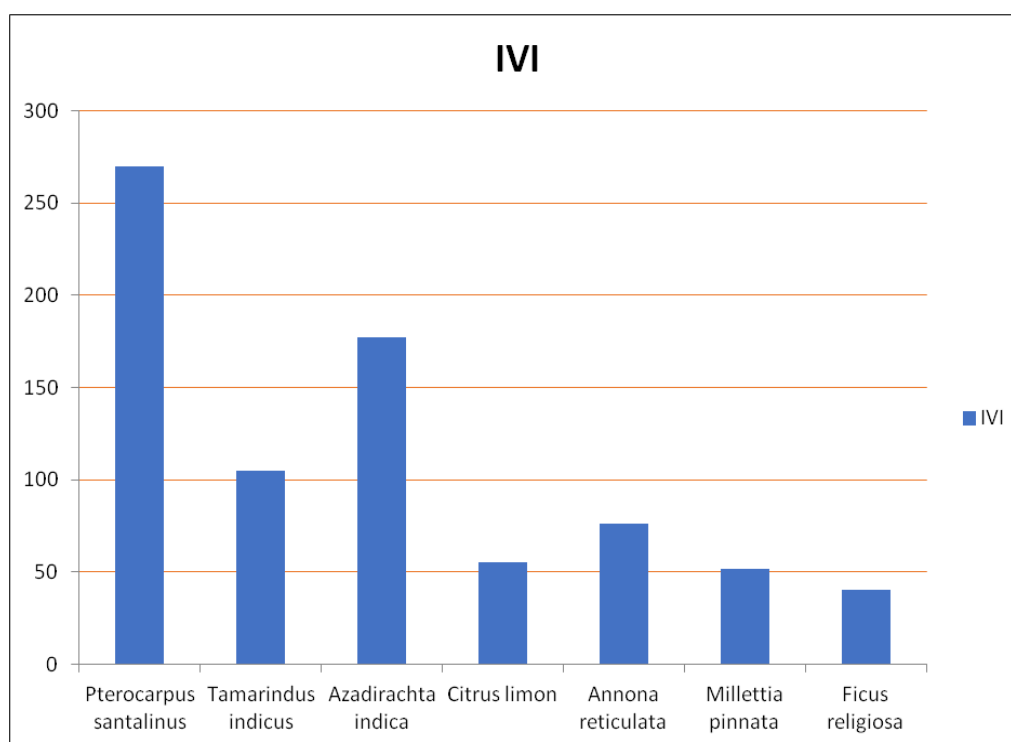


Fig. 4. IVI Index of tree species in Site-3

Tree species in Site-4

Table 10. Tree species recorded in Site-4

S. no.	Botanical name	Family name	Local name	Common name
1.	<i>Pterocarpus santalinus</i>	Fabaceae	Yerrachandhanam	Red sandal
2.	<i>Tamarindus indicus</i>	Fabaceae	Chintha chettu	Tamarind
3.	<i>Azadirachta indica</i>	Meliaceae	Vepa chettu	Neem tree
4.	<i>Citrus limon</i>	Rutaceae	Nimma chettu	Lemon
5.	<i>Annona reticulata</i>	Annonaceae	Seetha phal	Custard apple
6.	<i>Ficus religiosa</i>	Moraceae	Bodhi Tree	Sacred fig
7.	<i>Borassus flabellifer</i>	Aracaceae	Thati chettu	Palm
8.	<i>Phoenix dactylifera</i>	Aracaceae	Khajura	Date palm

Table 11. Tree species recorded in 20x20 quadrat in Site 4

S. no.	Botanical name	Total individuals	No. of quadrat species occurred
1.	<i>Pterocarpus santalinus</i>	121	11
2.	<i>Tamarindus indicus</i>	77	14
3.	<i>Azadirachta indica</i>	152	15
4.	<i>Citrus limon</i>	55	12
5.	<i>Annona reticulata</i>	92	11
6.	<i>Ficus religiosa</i>	10	7
7.	<i>Borassus flabellifer</i>	11	6
8.	<i>Phoenix dactylifera</i>	7	6
Total		525	82

Table 12. quantitative analysis for tree species of site 4 is categorized as below :

S. no.	Species	Basal area cm ²	D.	F.	A.	RD.	RF.	R Do.	IVI
1.	<i>Pterocarpus santalinus</i>	17.44	8.1	73.3	11.0	23.0	13.4	171.8	208.3
2.	<i>Tamarindus indicus</i>	60.65	5.1	93.3	5.5	14.7	17.1	85.9	117.7
3.	<i>Azadirachta indica</i>	2.59	10.1	100.0	10.1	29.0	18.3	158.3	205.5
4.	<i>Citrus limon</i>	1.09	3.7	80.0	4.6	10.5	14.6	71.6	96.7
5.	<i>Annona reticulata</i>	1.83	6.1	73.3	8.4	17.5	13.4	130.6	161.6
6.	<i>Ficus religiosa</i>	55.49	0.7	46.7	1.4	1.9	8.5	22.3	32.8
7.	<i>Borassus flabellifer</i>	6.74	0.7	40.0	1.8	2.1	7.3	28.6	38.0
8.	<i>Phoenix dactylifera</i>	13.66	0.5	40.0	1.2	1.3	7.3	18.2	26.9
Total		159.49	35.0	546.7	6.4	100.0	100.0	100.0	300.0

Table 11 shows a total of 525 individuals and 82 species were found during the study. The tree species having maximum number of individuals included *Azadirachta indica* (152), *Pterocarpus santalinus* (121), *Annona reticulata* (92). Whereas, the tree species having minimum number of individuals includes *Phoenix dactylifera* (07), *Ficus religiosa* (10), *Borassus flabellifer* (11).

Table 12 showed tree species having highest density amongst the species include *Azadirachta indica* (10.1), *Pterocarpus santalinus* (8.1), *Tamarindus indicus* (5.1) .while the tree species

showing lowest density included *Phoenix dactylifera* (0.5), *Borassus flabellifer* (0.7), *Ficus religiosa* (0.7).

Table 12 showed tree species having highest frequency amongst the species include *Azadirachta indica* (100.0), *Tamarindus indicus* (93.3), *Citrus limon* (80.0).While the tree species showing the lowest frequency was *Phoenix dactylifera* (40.0), *Borassus flabellifer* (40.0), *Ficus religiosa* (46.7).

Table 12 showed tree species showing the highest abundance among the

species include *Pterocarpus santalinus* (11.0), *Azadirachta indica* (10.1), *Annona reticulata* (8.4). While, the lowest abundance was shown by the species, *Phoenix dactylifera* (1.2), *Ficus religiosa* (1.4), *Borassus flabellifer* (1.8).

Table 12 showed tree species having highest IVI amongst the species *Pterocarpus santalinus*, (208.3), *Azadirachta indica* (205.5), *Annona reticulata*, (161.6).while the lowest IVI shown by the species *Phoenix dactylifera* (26.9), *Ficus religiosa* (32.8), *Borassus flabellifer* (38.0).

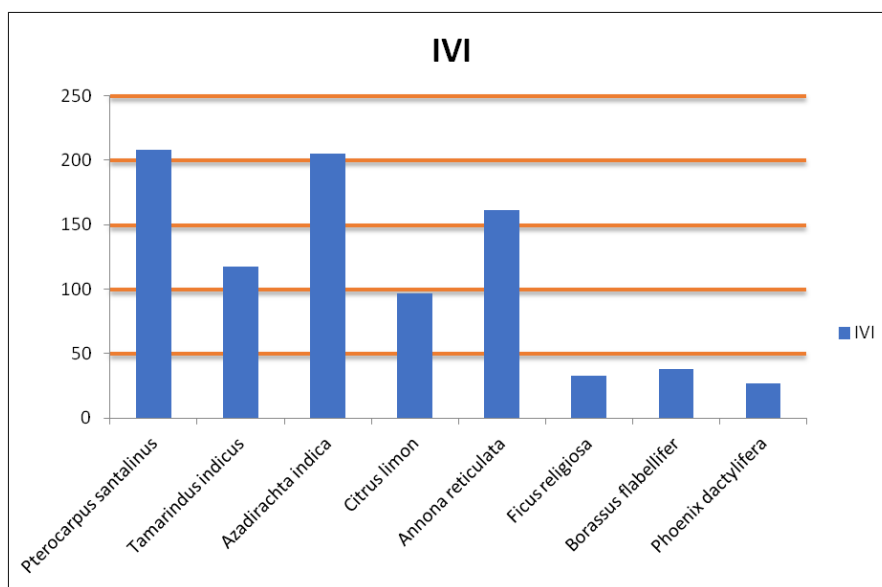


Fig. 5. IVI Index of tree species in Site-4

Shrub

List of the entire Shrub species found in all four sites

S no.	Botanical name	Family	Local name	Common name
1.	<i>Alvaradoa amorphoides</i>	Picramniaceae		Mexican alvaradoa
2.	<i>Barleria prionitis</i>			
3.	<i>chromolaena odorata</i>	Asteraceae	Siam weed	Butterfly weed
4.	<i>Cyprus turpentine</i>	Anacardiaceae	Terebinth	
5.	<i>Dalbergia horrida</i>	Dalbergiaceae		Dalbergia
6.	<i>Diplopterys cabrerana</i>	Malphigiaceae		Cagrofunga
7.	<i>Flueggea</i>	Phyllanthaceae		White berry bush
8.	<i>Flueggea leucopyrus-wild</i>	Euphorbiaceae	Poolie pulanji	Spinos flugea
9.	<i>Ehretia microphylla</i>	Boraginaceae		Fukein tea tree
10.	<i>Pachira aquatica</i>	Malvaceae	Monguba	French peanut, Gift tree
11.	<i>Indian sarsaparilla</i>	Ehretia Microphylla	Nannadi	Smilax ornate
12.	<i>Lantana camera</i>	Verbeneveae	Kongini	Spinach Flag
13.	<i>Leonotis leonurus</i>	Lamiaceae		Lion's tail
14.	<i>Millettia pinnata</i>	Fabaceae	Malapari	Kalanja tree
15.	<i>Oplismenus hirtellus sub.spp</i>	Poaceae		Basket grass
16.	<i>Randia aculeata</i>	Rubiaceae		White indigo berry
17.	<i>Salix purpurea</i>	Salicaceae		Basket willow
18.	<i>Sanna spectabilis</i>	Fabaceae		Popcorn tree
19.	<i>Senegalia alaxacantha</i>			
20.	<i>Mimosa pudica</i>	Fabaceae		Shame plant
21.	<i>Calotropis procera</i>	Apocynaceae		Sodom apple
22.	<i>Strychnos psilosperma</i>	Loganiaceae		Poison fruit
23.	<i>Tephrosia purpurea</i>	Fabaceae		Wild indigo
24.	<i>Vachellia schalfueri</i>	Fabaceae		Thorn trees
25.	<i>Ziziphus mauritiana</i>	Rhamnaceae		Wild jujube

Site 1:

The vegetation composition in site 1 recorded in 15 quadrates of 5 x 5m² in size shows that a total 12 species of Shrub were found. The species along with their recorded attributes and other recorded parameters are shown below in the different tables:

Table 13. list of shrub found in Site 1

S no.	Botanical name	Family	Local name	Common name
1.	<i>chromolaena odorata</i>	Asteraceae	Siam weed	Butterfly weed
2.	<i>Indian sarsaparilla</i>	Asclepiaceae	Nannari	Smilax ornate
3.	<i>Randia aculeata</i>	Rubiaceae		White indigo berry
4.	<i>Leonotis leonurus</i>	Lamiaceae		Lion's tail
5.	<i>Flueggea leucopyrus-wild</i>	Euphorbiaceae	Poolie pulanji	Spinosa fluggea
6.	<i>Cyprus turpentine</i>	Anacardiaceae	Terebinth	
7.	<i>Diplopterys cabrerana</i>	Malpigiaceae		Cagrofunga
8.	<i>Millettia pinnata</i>	Fabaceae	Malapari	Kalanja tree
9.	<i>Salix purpurea</i>	Salicaceae		Basket willow
10.	<i>Tephrosia purpurea</i>	Fabaceae		Wild indigo
11.	<i>Barleria prionitis</i>			
12.	<i>Flueggea</i>	Phyllanthaceae		White berry bush
13.	<i>Lantana camera</i>	Verbeneveae	Kongini	Spinach flag

Table 14. Shrub species recorded in 5 x5m quadrate in Site 1

S. no.	Botanical name	Total individuals	No of quadrate species occurred
1.	<i>chromolaena odorata</i>	76	15
2.	<i>Indian sarsaparilla</i>	64	13
3.	<i>Randia aculeata</i>	62	12
4.	<i>Leonotis leonurus</i>	55	13
5.	<i>Flueggea leucopyrus-wild</i>	41	12
6.	<i>Cyprus turpentine</i>	21	10
7.	<i>Diplopterys cabrerana</i>	35	10
8.	<i>Millettia pinnata</i>	46	12
9.	<i>Salix purpurea</i>	33	10
10.	<i>Tephrosia purpurea</i>	32	11
11.	<i>Barleria prionitis</i>	54	12
12.	<i>Flueggea</i>	42	10
13.	<i>Lantana camera</i>	53	9
Total		614	149

Table 15. Quantative analysis for Shrub species of site 1 is categorized as below

S. no.	Species	D.	F.	A.	RD.	RF.	R Do.	IVI
1.	<i>chromolaena odorata</i>	5.07	100.00	5.07	12.38	10.07	12.38	34.82
2.	<i>Indian sarsaparilla</i>	4.27	86.67	4.27	10.42	8.72	10.42	29.57
3.	<i>Randia aculeata</i>	4.13	80.00	4.13	10.10	8.05	10.10	28.25
4.	<i>Leonotis leonurus</i>	3.67	86.67	3.67	8.96	8.72	8.96	26.64
5.	<i>Flueggea leucopyrus-wild</i>	2.73	80.00	2.73	6.68	8.05	6.68	21.41
6.	<i>Cyprus turpentine</i>	1.40	66.67	1.40	3.42	6.71	3.42	13.55
7.	<i>Diplopterys cabrerana</i>	2.33	66.67	2.33	5.70	6.71	5.70	18.11
8.	<i>Millettia pinnata</i>	3.07	80.00	3.07	7.49	8.05	7.49	23.04
9.	<i>Salix purpurea</i>	2.20	66.67	2.20	5.37	6.71	5.37	17.46
10.	<i>Tephrosia purpurea</i>	2.13	73.33	2.13	5.21	7.38	5.21	17.81
11.	<i>Barleria prionitis</i>	3.60	80.00	3.60	8.79	8.05	8.79	25.64
12.	<i>Flueggea</i>	2.80	66.67	2.80	6.84	6.71	6.84	20.39
13.	<i>Lantana camera</i>	3.53	60.00	3.53	8.63	6.04	8.63	23.30
Total		40.93	993.33	40.93	100.00	100.00	100.00	300.00

Table 14 shows a total of 614 individuals and 149 species were found during the study. The Shrub species having maximum number of individuals included *chromolaena odorata* (76), *Indian sarsaparilla* (64), *Randia aculeata* (62). Whereas, the Shrub species having minimum number of individuals includes *Cyprus turpentine* (21), *Tephrosa purpurea* (32), *Salix purpurea* (33).

Table no 15 showed Shrub species having highest density amongst the species include *chromolaena odorata* (5.07) , *Indian sarsaparilla* (4.27), *Randia aculeata* (4.13). While the shrub species showing lowest density included *Cyprus turpentine* (1.40), *Tephrosa purpurea* (2.13), *Salix purpurea* (2.20).

Table no 15 showed Shrub species having highest frequency amongst the species include *chromolaena odorata* (100.0), *Indian sarsaparilla*

(86.67), *Leonotis leonurus* (86.67). While the Shrub species showing the lowest frequency *Lantana camera* (60.00), *Salix purpurea* (66.67), *Diplopterys cabrerana* (66.67).

Table no 15 showed Shrub species showing the highest abundance among the species include *chromolaena odorata* (5.07), *Indian sarsaparilla* (4.27), *Randia aculeata* (4.13) while, the lowest abundance was shown by the species *Cyprus turpentine* (1.40), *Tephrosa purpurea* (2.13), *Salix purpurea* (2.20).

Table no 15 showed Shrub species having highest IVI amongst the species included *chromolaena odorata* (34.82), *Indian sarsaparilla* (29.57), *Randia aculeata* (28.25). While the lowest IVI shown by the species was *Cyprus turpentine* (13.55), *Salix purpurea* (17.46) *Tephrosa purpurea* (17.81).

Site-2

Table 16. List of Shrub found in site 2

S no.	Botanical name	Family	Local name	Common name
1.	<i>chromolaena odorata</i>	Astaraceae	Siam weed	Butterfly weed
2.	<i>Indian sarsaparilla</i>	Asclepiadiaceae	Nannari	Smilax ornate
3.	<i>Diplopterys cabrerana</i>	Malphigiaceae		Cagrofunga
4.	<i>Barleria prionitis</i>			
5.	<i>Oplismenus hirtellus sub.spp</i>	Poaceae		Basket grass
6.	<i>Lantana camera</i>	Verbenaveae	Kongini	Spinach flag
7.	<i>Ehretia microphylla</i>	Boraginaceae		Fukein tea tree
8.	<i>Calotropis procera</i>	Apocynaceae		Sodom apple
9.	<i>Alvaradoa amorphoides</i>	Picramniaceae		Mexican Alvaradoa
10	<i>Mimosa pudica</i>	Fabaceae		Shame palnt

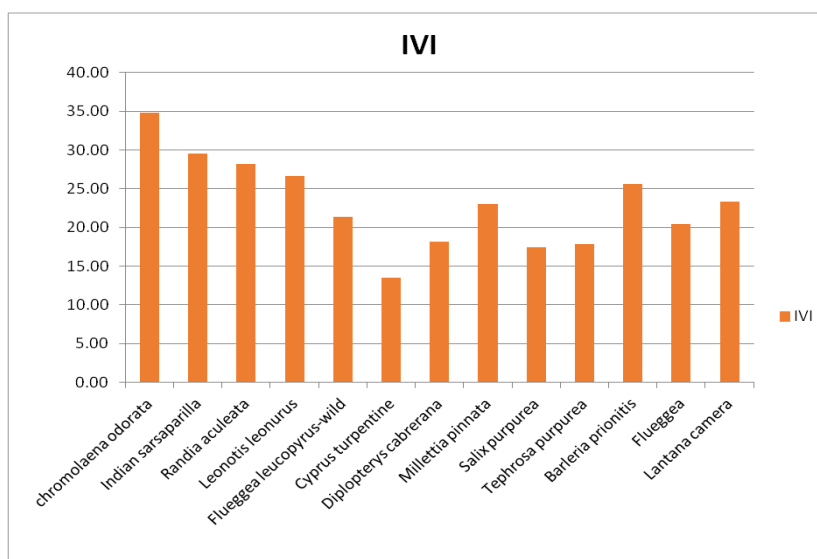


Fig. 6. IVI Index of Shrub species in Site-1

Table 17. Shrub species recorded in 5 x5m quadrat in Site 2

S. no.	Botanical name	Total individuals	No. of quadrat species occurred
1.	<i>chromolaena odorata</i>	89	13
2.	<i>Indian sarsaparilla</i>	121	12
3.	<i>Diplopterys cabrerana</i>	101	11
4.	<i>Barleria prionitis</i>	22	6
5.	<i>Oplismenus hirtellus sub.spp</i>	81	12
6.	<i>Lantana camera</i>	103	15
7.	<i>Ehretia microphylla</i>	37	6
8.	<i>Calotropis procera</i>	14	7
9.	<i>Alvaradoa amorphoides</i>	4	3
10.	<i>Mimosa pudica</i>	20	5
Total		592	90

Table 18. Quantitative analyses for Shrub species of site 2 is categorized as below:

S. no.	Species	D.	F.	A.	RD.	RF.	R Do.	IVI
1.	<i>chromolaena odorata</i>	5.93	86.67	0.87	14.44	14.44	14.44	43.33
2.	<i>Indian sarsaparilla</i>	8.07	80.00	0.80	13.33	13.33	13.33	40.00
3.	<i>Diplopterys cabrerana</i>	6.73	73.33	0.73	12.22	12.22	12.22	36.67
4.	<i>Barleria prionitis</i>	1.47	40.00	0.40	6.67	6.67	6.67	20.00
5.	<i>Oplismenus hirtellus sub.spp</i>	5.40	80.00	0.80	13.33	13.33	13.33	40.00
6.	<i>Lantana camera</i>	6.87	100.00	1.00	16.67	16.67	16.67	50.00
7.	<i>Ehretia microphylla</i>	2.47	40.00	0.40	6.67	6.67	6.67	20.00
8.	<i>Calotropis procera</i>	0.93	46.67	0.47	7.78	7.78	7.78	23.33
9.	<i>Alvaradoa amorphoides</i>	0.27	20.00	0.20	3.33	3.33	3.33	10.00
10.	<i>Mimosa pudica</i>	1.33	33.33	0.33	5.56	5.56	5.56	16.67
Total		39.47	600	6	100	100	100	300

Table 17 shows a total of 592 individuals and 90 species were found during the study. The Shrub species having maximum number of individuals included *Indian sarsaparilla* (121), *Lantana camera* (103), and *Diplopterys cabrerana* (101). Whereas, the Shrub species having minimum number of individuals includes *Alvaradoa amorphoides* (4), *Calotropis procera* (14), *Mimosa pudica* (20).

Table no 18. showed Shrub species having highest density amongst the species include *Indian sarsaparilla* (8.07), *Lantana camera* (6.87), *Diplopterys cabrerana* (6.73) .while the Shrub species showing lowest density included *Alvaradoa amorphoides*(0.27), *Calotropis procera* (0.93), *Mimosa pudica* (1.33).

Table no 18 showed Shrub species having highest frequency amongst the species include *Lantana camera* (100.00), *chromolaena odorata*

(86.67), *Indian sarsaparilla* (80.00).While the Shrub species showing the lowest frequency was *Alvaradoa amorphoides* (20.00), *Mimosa pudica* (33.33), *Ehretia microphylla* (40.00).

Table no 18 showed Shrub species showing the highest abundance among the species include *Lantana camera* (1.00), *chromolaena odorata* (0.87), *Indian sarsaparilla* (0.80) while, the lowest abundance was shown by the species *Alvaradoa amorphoides* (0.20), *Mimosa pudica* (0.33), *Ehretia microphylla* (0.40).

Table no 18 showed Shrub species having highest IVI amongst the species included *Lantana camera* (50.00), *chromolaena odorata* (43.33), *Indian sarsaparilla* (40.00) .while the lowest IVI shown by the species was *Alvaradoa amorphoides* (10.00), *Mimosa pudica* (16.67), *Ehretia microphylla* (20.00).

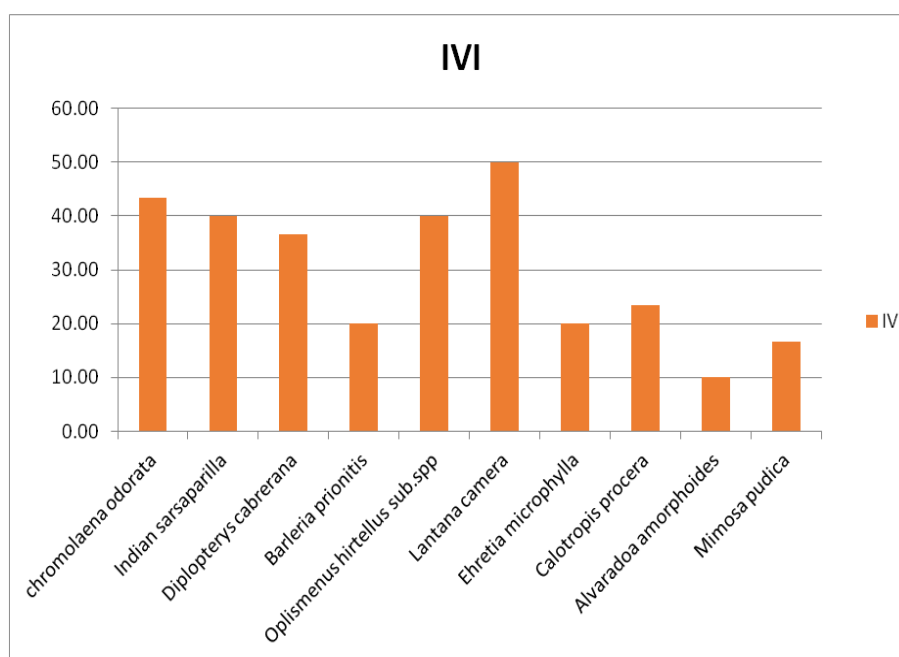


Fig. 7. IVI Index of Shrub species in Site-2

Site-3

Table 19. List of shrub found in site 3

S no.	Botanical name	Family	Local name	Common name
1.	<i>chromolaena odorata</i>	Astaraceae	Siam weed	Butterfly weed
2.	<i>Indian sarsaparilla</i>	Asclepiadiaceae	Nannari	Smilax ornate
3.	<i>Dalbergia horrida</i>	Dalbergiaceae		Dalbergia
4.	<i>Lantana camera</i>	Verbeneveae	Kongini	Spinach Flag
5.	<i>Leonotis leonurus</i>	Lamiaceae		Lion's tail
6.	<i>Ziziphus mauritiana</i>	Rhamnaceae		Wild jujube
7.	<i>Senegalia alaxacantha</i>			
8.	<i>Diplopterys cabrerana</i>	Malphigiaceae		Cagrofunga
9.	<i>Mimosa pudica</i>	Fabaceae		Shame plant
10.	<i>Vachellia schalfueri</i>	Fabaceae		Thorn trees

Table 20. Tree species recorded in 5x5 quadrate in Site 3

S. no.	Botanical name	Total individuals	No. of quadrate species occurred
1.	<i>chromolaena odorata</i>	52	13
2.	<i>Indian sarsaparilla</i>	80	10
3.	<i>Dalbergia horrida</i>	10	4
4.	<i>Lantana camera</i>	106	15
5.	<i>Leonotis leonurus</i>	7	6
6.	<i>Ziziphus mauritiana</i>	8	5
7.	<i>Senegalia alaxacantha</i>	13	6
8.	<i>Diplopterys cabrerana</i>	13	3
9.	<i>Mimosa pudica</i>	74	12
10.	<i>Vachellia schalfueri</i>	19	4
	Total	382	78

Table 21. Quantative analyses for Shrub species of site 3 is categorized as below

S. no.	Species	D.	F.	A.	RD.	RF.	R Do.	IVI
1.	<i>chromolaena odorata</i>	3.47	86.67	86.67	13.61	16.67	16.67	46.95
2.	<i>Indian sarsaparilla</i>	5.33	66.67	66.67	20.94	12.82	12.82	46.58
3.	<i>Dalbergia horrida</i>	0.67	26.67	26.67	2.62	5.13	5.13	12.87
4.	<i>Lantana camera</i>	7.07	100.00	100.00	27.75	19.23	19.23	66.21
5.	<i>Leonotis leonurus</i>	0.47	40.00	40.00	1.83	7.69	7.69	17.22
6.	<i>Ziziphus mauritiana</i>	0.53	33.33	33.33	2.09	6.41	6.41	14.91
7.	<i>Senegalia alaxacantha</i>	0.87	40.00	40.00	3.40	7.69	7.69	18.79
8.	<i>Diplopterys cabrerana</i>	0.87	20.00	20.00	3.40	3.85	3.85	11.10
9.	<i>Mimosa pudica</i>	4.93	80.00	80.00	19.37	15.38	15.38	50.14
10.	<i>Vachellia schalfueri</i>	1.27	26.67	26.67	4.97	5.13	5.13	15.23
	Total	25.47	520.00	520.00	100.00	100.00	100.00	300.00

Table 20 shows a total of 382 individuals and 78 species were found during the study. The Shrub species having maximum number of individuals included *Lantana camera* (106), *Indian sarsaparilla* (80), *Mimosa pudica* (74).Whereas, the Shrub species having minimum number of individuals includes *Leonotis leonurus* (7), *Ziziphus mauritiana* (8), *Dalbergia horrida* (10).

Table 21 showed Shrub species having highest density amongst the species include *Lantana camera* (7.07), *Indian sarsaparilla* (5.33), *Mimosa pudica* (4.93) .while the Shrub species showing lowest density included *Leonotis leonurus* (0.47), *Ziziphus mauritiana* (0.53), *Dalbergia horrida* (0.67).

Table 21 showed Shrub species having highest frequency amongst the species include *Lantana camera* (100.00), *chromolaena odorata* (86.67),

Mimosa pudica (80.00). While the tree species showing the lowest frequency was *Diplopterys cabrerana* (20.00), *Dalbergia horrida* (26.67), *Vachellia schalfueri* (26.67) .

Table 21 showed tree species showing the highest abundance among the species include *Lantana camera* (100.00), *chromolaena odorata* (86.67), *Mimosa pudica* (80.00).while, the lowest abundance was shown by the species *Diplopterys cabrerana* (20.00), *Dalbergia horrida* (26.67), *Vachellia schalfueri* (26.67).

Table no 21 showed tree species having highest IVI amongst the species included *Lantana camera* (66.21), *Mimosa pudica* (50.14), *chromolaena odorata* (46.95). while the lowest IVI shown by the species was *Diplopterys cabrerana* (11.10), *Dalbergia horrida* (12.87), *Ziziphus mauritiana* (14.91).

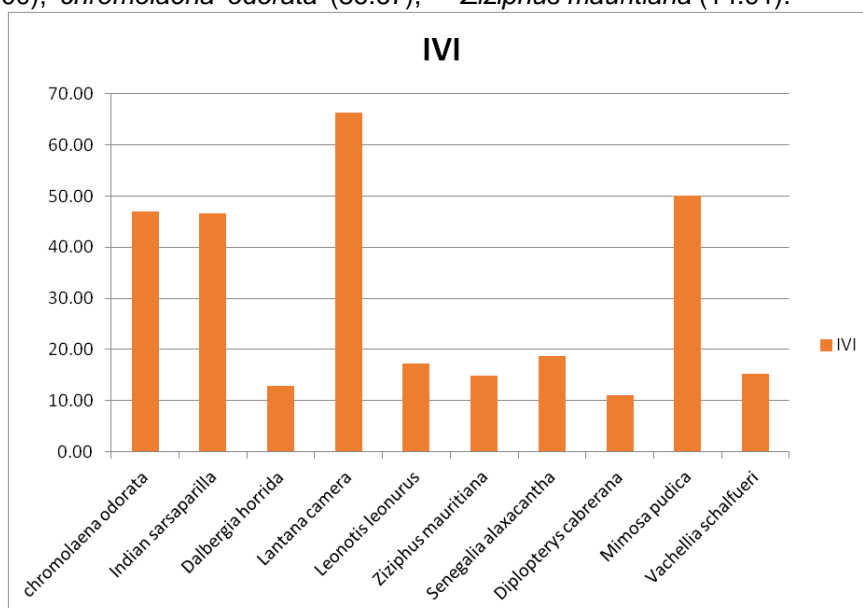


Fig. 8. IVI Index of Shrub species in Site-3

Site-4

Table 22. List of shrub found in site 4

S no.	Botanical name	Family	Local name	Common name
1.	<i>chromolaena odorata</i>	Astaraceae	Siam weed	Butterfly weed
2.	Indian sarsaparilla	Asclepiaceae	Nannari	Smilax ornate
3.	<i>Leonotis leonurus</i>	Lamiaceae		Lion's tail
4.	<i>Oplismenus hirtellus</i> sub.spp	Poaceae		Basket grass
5.	<i>Lantana camera</i>	Verbeneveae	Kongini	Spinach Flag
6.	<i>Mimosa pudica</i>	Fabaceae		Shame plant
7.	<i>Sanna spectabilis</i>	Fabaceae		Popcrom tree
8.	<i>Dalbergia horrida</i>	Dalbergiaceae		Dalbergia
9.	<i>Strychnos psilosperma</i>	Loganiaceae		Poison fruit
10.	Gift tree			

Table 23. Shrub species recorded in 5x5 quadrat in Site 4

S. no.	Botanical name	Total individuals	No. of quadrat species occurred
1.	<i>Chromolaena odorata</i>	30	5
2.	<i>Indian sarsaparilla</i>	83	12
3.	<i>Leonotis leonurus</i>	48	7
4.	<i>Oplismenus hirtellus</i> sub.spp	65	8
5.	<i>Lantana camera</i>	63	10
6.	<i>Mimosa pudica</i>	49	8
7.	<i>Sanna spectabilis</i>	31	6
8.	<i>Dalbergia horrida</i>	41	11
9.	<i>Strychnos psilosperma</i>	32	10
10.	Gift tree	12	4
Total		454	81

Table 24. Quantative analyses for Shrub species of site 4 is categorized as below:

S. no.	Species	D.	F.	A.	RD.	RF.	R Do.	IVI
1.	<i>chromolaena odorata</i>	2.00	33.33	2.00	6.61	6.17	6.61	19.39
2.	<i>Indian sarsaparilla</i>	5.53	80.00	5.53	18.28	14.81	18.28	51.38
3.	<i>Leonotis leonurus</i>	3.20	46.67	3.20	10.57	8.64	10.57	29.79
4.	<i>Oplismenus hirtellus</i> sub.spp	4.33	53.33	4.33	14.32	9.88	14.32	38.51
5.	<i>Lantana camera</i>	4.20	66.67	4.20	13.88	12.35	13.88	40.10
6.	<i>Mimosa pudica</i>	3.27	53.33	3.27	10.79	9.88	10.79	31.46
7.	<i>Sanna spectabilis</i>	2.07	40.00	2.07	6.83	7.41	6.83	21.06
8.	<i>Dalbergia horrida</i>	2.73	73.33	2.73	9.03	13.58	9.03	31.64
9.	<i>Strychnos psilosperma</i>	2.13	66.67	2.13	7.05	12.35	7.05	26.44
10.	Gift tree	0.80	26.67	0.80	2.64	4.94	2.64	10.22
Total		30.27	540.00	30.27	100.00	100.00	100.00	300.00

Table 23 shows a total of 454 individuals and 81 species were found during the study. The Shrub species having maximum number of individuals included *Indian sarsaparilla* (83), *Oplismenus hirtellus sub.spp* (65), *Lantana camera* (63) Whereas, the Shrub species having minimum number of individuals includes *Gift tree* (12), *Sanna spectabilis* (30), *chromolaena odorata* (31).

Table 24 showed Shrub species having highest density amongst the species *Indian sarsaparilla* (5.53), *Oplismenus hirtellus sub.spp* (4.33),

Lantana camera (4.20) while the Shrub species showing lowest density included *Gift tree* (0.80), *chromolaena odorata* (2.00), *Sanna spectabilis* (2.07).

Table 24 showed Shrub species having highest frequency amongst the species include *Indian sarsaparilla* (80.00), *Dalbergia horrida* (73), *Lantana camera* (66.67). While the Shrub species showing the lowest frequency was *Gift tree* (26.67), *chromolaena odorata* (33.33), *Sanna spectabilis* (40.00).

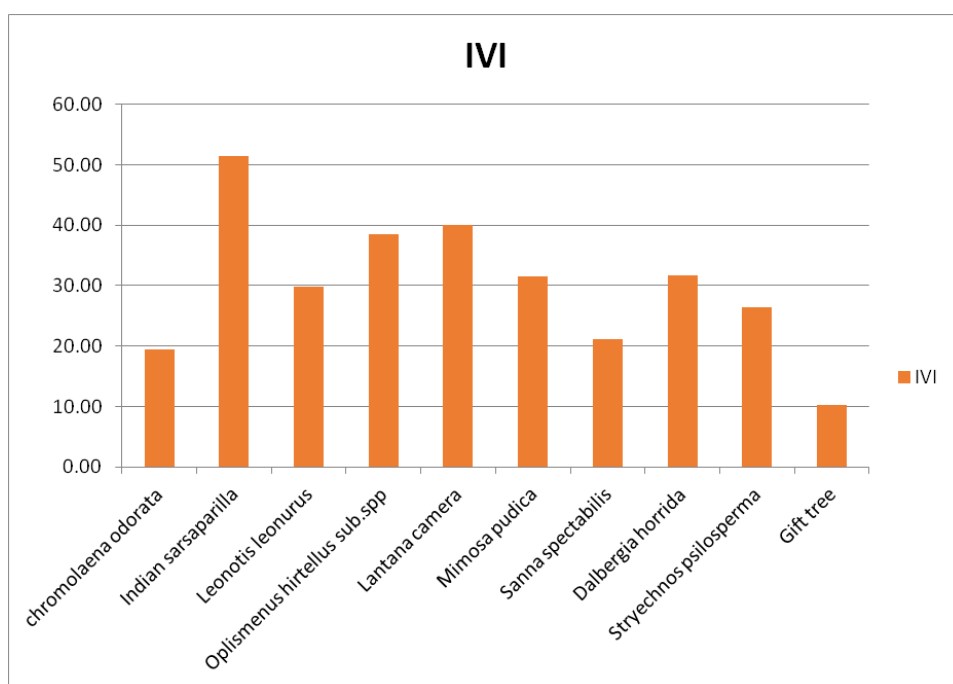


Fig. 9. IVI Index of Shrub species in Site-4

Table 24 showed Shrub species showing the highest abundance among the species include *Indian sarsaparilla* (5.53), *Oplismenus hirtellus sub.spp* (4.33), *Lantana camera* (4.20). While, the lowest abundance was shown by the species *Gift tree* (0.80), *chromolaena odorata* (2.00), *Sanna spectabilis* (2.07).

Table 24 showed Shrub species having highest IVI amongst the species included *Indian sarsaparilla* (51.38), *Lantana camera* (40.10), *Oplismenus hirtellus sub.spp* (38.51). While the lowest IVI shown by the species was *Gift tree* (10.22), *chromolaena odorata* (19.39), *Strychnos psilosperma* (26.44).

HERB

List of the entire Herb Species found in all four sites

S no.	Botanical name	Family	Common name
1.	<i>Abrus precatorius</i>	Fabaceae	Rosary Pea
2.	<i>Ageratum conyzoides</i>	Asteraceae	
3.	<i>Allamanda cathartica</i>	Apocynaceae	Yellow allamanda
4.	<i>Alternanthera ficoidea</i>	Amaranthaceae	Brazilian Snow flower
5.	<i>Alternanthera sessilis</i>	Amaranthaceae	Stalkless joyweed
6.	<i>Ambrosia artemisiifolia</i>	Amaranthaceae	Annual rag weed
7.	<i>Aristida purpurea</i>	Poaceae	Purple three awn
8.	<i>Bigelovia verticillata</i>		
9.	<i>Bistorta officinalis</i>	Poligonaceae	Bistort
10.	<i>Bothriochloa ischaemum</i>	Poaceae	Yellow blue stem
11.	<i>Opuntia macrorhiza</i>	Cactaceae	Pricklypear cactus
12.	<i>Celtica gigantea</i>	Poaceae	Golden Oats
13.	<i>Ceropegia bulbosa roxb</i>	Apocynaceae	Lantern flower
14.	<i>Chenopodium album</i>	Amaranthaceae	Bacon weed
15.	<i>Cuscuta approximata</i>	Convolvulaceae	Alfaalfa Dodder
16.	<i>Dichanthelium clandestinum</i>	Poaceae	Deer tongue
17.	<i>Dioscorea bulbifera</i>	Dioscoreaceae	Air yam
18.	<i>Eachinochola</i>	Paniceae	Deccan grass
19.	<i>Elephantopus scaber</i>	Astaraceae	Elephant's foot

S no.	Botanical name	Family	Common name
20.	<i>Galinsoga ciliata</i>	Astaraceae	Hairy galinsoga
21.	<i>Grona triflora</i>	Fabaceae	Trefoil
22.	<i>Harrisia martinii</i>	Cactaceae	Harrisia cactus
23.	<i>Herbarium pacificum</i>		
24.	<i>Lithocarpus femestratus</i>	Fagaceae	Stone oak
25.	<i>Alternanthera caracasana</i>	Amaranthaceae	Washerman women
26.	<i>Merrennia hedoracea</i>	Convolvulaceae	Ivy woodrose
27.	<i>Mesophaerum suavelens</i>	Lamiaceae	Pignut
28.	<i>Oplismenus burmannii</i>	Poaceae	Running mountaingrass
29.	<i>Pandiaka augustifolia</i>		
30.	<i>Panicum repens</i>	Poaceae	Bullet grass
31.	<i>Paspalum vaginatum</i>	Poaceae	Sword grass
32.	<i>Scrophularia nodosa</i>	Schrophuliaceae	Fig wort
33.	<i>Semecarpus kathalekamensis</i>	Anacardiaceae	Kathalekan marsh nut
34.	<i>Stylo santhes fruticose</i>	Fabaceae	African stylo
35.	<i>Synedrella nodiflora</i>	Astaraceae	Cynderella weed
36.	<i>Tortoise preserve</i>		
37.	<i>Treebine</i>	Vitaceae	Veldt grape
38.	<i>Tridax procumbeus</i>	Aataraceae	Tridax daisy
39.	<i>Trifolium repens</i>	Fabaceae	White clover
40.	<i>Verbena officinalis</i>	Verbaceae	Vervain

Site 1

The vegetation composition in site 1 recorded in 20 quadrates of 1 x 1m² in size shows that a total 11 species of herbs were found. The species along with their recorded attributes and other recorded parameters are shown below in the different tables:

Table 26 shows a total of 256 individuals and 14 species were found during the study. The herb species having maximum number of individuals included *Mesophaerum suavelens* (38), *Cuscuta*

approximata (29), *Alternanthera sessilis* (25) whereas, the herb species having minimum number of individuals *Panicum repens* (8), *Lithocarpus femestratus* (10), *Tridax procumbeus* (11).

Table no 27 showed Herb species having highest density amongst the *Mesophaerum suavelens* (2.53), *Cuscuta approximata* (1.93), *Alternanthera sessilis* (1.67), While the Herb species showing lowest density included *Panicum repens* (0.53), *Lithocarpus femestratus* (0.67), *Tridax procumbeus* (0.73).

Table 25. List of herbs found in site 1

S no.	Botanical name	family	Common name
1.	<i>Scrophularia nodosa</i>	Schrophuliaceae	Fig wort
2.	<i>Mesophaerum suavelens</i>	Lamiaceae	Pignut
3.	<i>Ceropegia bulbosa roxb</i>	Apocynaceae	Lantern flower
4.	<i>Panicum repens</i>	Poaceae	Bullet grass
5.	<i>Verbena officinalis</i>	Verbaceae	Vervain
6.	<i>Cuscuta approximata</i>	Convolvulaceae	Alfaalfa Dodder
7.	<i>Lithocarpus femestratus</i>	Fagaceae	Stone oak
8.	<i>Alternanthera sessilis</i>	Amaranthaceae	Stalkless joyweed
9.	<i>Paspalum vaginatum</i>	Poaceae	Sword grass
10.	<i>Pandiaka augustifolia</i>		
11.	<i>Stylo santhes fruticose</i>	Fabaceae	African stylo
12.	<i>Tridax procumbeus</i>	Aataraceae	Tridax daisy
13.	<i>Synedrella nodiflora</i>	Astaraceae	Cynderella weed
14.	<i>Semecarpus kathalekamensis</i>	Anacardiaceae	Kathalekan marsh nut

Table 26. Herb species recorded in 1x1 quadrat in Site-1

S no.	Botanical name	Total individuals	No. of quadrat species occurred
1.	<i>Scrophularia nodosa</i>	18	6
2.	<i>Mesophaerum suavelens</i>	38	8
3.	<i>Ceropegia bulbosa roxb</i>	13	5
4.	<i>Panicum repens</i>	8	5
5.	<i>Verbena officinalis</i>	22	8
6.	<i>Cuscuta approximata</i>	29	5
7.	<i>Lithocarpus femestratus</i>	10	3
8.	<i>Alternanthera sessilis</i>	25	7
9.	<i>Paspalum vaginatum</i>	13	4
10.	<i>Pandiaka augustifolia</i>	16	4
11.	<i>Stylo santhes fruticose</i>	18	4
12.	<i>Tridax procumbeus</i>	11	5
13.	<i>Synedrella nodiflora</i>	19	4
14.	<i>Semecarpus kathalekamensis</i>	16	6
Total		256	74

Table 27. Quantitative analyses for Herb species of site 1 is categorized as below:

S. no.	Species	D.	F.	A.	RD.	RF.	R Do.	IVI
1.	<i>Scrophularia nodosa</i>	1.20	40.00	3.00	7.03	8.11	86.72	101.86
2.	<i>Mesophaerum suavelens</i>	2.53	53.33	4.75	14.84	10.81	137.30	162.96
3.	<i>Ceropegia bulbosa roxb</i>	0.87	33.33	2.60	5.08	6.76	75.16	86.99
4.	<i>Panicum repens</i>	0.53	33.33	1.60	3.12	6.76	46.25	56.13
5.	<i>Verbena officinalis</i>	1.47	53.33	2.75	8.59	10.81	79.49	98.90
6.	<i>Cuscuta approximata</i>	1.93	33.33	5.80	11.33	6.76	167.66	185.74
7.	<i>Lithocarpus femestratus</i>	0.67	20.00	3.33	3.91	4.05	96.35	104.31
8.	<i>Alternanthera sessilis</i>	1.67	46.67	3.57	9.77	9.46	103.24	122.46
9.	<i>Paspalum vaginatum</i>	0.87	26.67	3.25	5.08	5.41	93.95	104.43
10.	<i>Pandiaka augustifolia</i>	1.07	26.67	4.00	6.25	5.41	115.63	127.28
11.	<i>Stylo santhes fruticose</i>	1.20	26.67	4.50	7.03	5.41	130.08	142.51
12.	<i>Tridax procumbeus</i>	0.73	33.33	2.20	4.30	6.76	63.59	74.65
13.	<i>Synedrella nodiflora</i>	1.27	26.67	4.75	7.42	5.41	137.30	150.13
14.	<i>Semecarpus kathalekamensis</i>	1.07	40.00	2.67	6.25	8.11	77.08	91.44
Total		17.07	493.33	3.46	100	100	100	300

Table no 27 showed Herb species having highest frequency amongst the species include *Mesophaerum suavelens* (53.33). *Verbena officinalis* (53.33), *Alternanthera sessilis* (46.67). While the Herb species showing the lowest frequency was *Lithocarpus femestratus* (20.00), *Paspalum vaginatum* (26.67), and *Pandiaka augustifolia* (26.67).

Table no 27 showed Herb species showing the highest abundance among the species include *Cuscuta approximata* (5.80), *Mesophaerum suavelens* (4.75), *Synedrella nodiflora* (4.75)

While, the lowest abundance was shown by the species *Panicum repens* (1.60), *Tridax procumbeus* (2.20), *Ceropegia bulbosa roxb* (2.60).

Table no 27 showed Herb species having highest IVI amongst the species included *Cuscuta approximata* (185.74), *Mesophaerum suavelens* (162.96), *Synedrella nodiflora* (150.13). While the lowest IVI shown by the species was *Panicum repens* (56.13), *Tridax procumbeus* (74.65), *Ceropegia bulbosa roxb* (86.99).

Site-2

Table 28. List of Herb found in site 2

S. No.	Botanical name	Family	Common name
1.	<i>Mesophaerum suavelens</i>	Lamiaceae	Pignut
2.	<i>Tridax procumbeus</i>	Aataraceae	Tridax daisy
3.	<i>Synedrella nodiflora</i>	Astaraceae	Cynderella weed
4.	<i>Galinsoga ciliata</i>	Astaraceae	Hairy galinsoga
5.	<i>Trifolium repens</i>	Fabaceae	White clover
6.	<i>Abrus precatorius</i>	Fabaceae	Rosary Pea
7.	<i>Grona triflora</i>	Fabaceae	Trefoil
8.	<i>Merrennia hedoracea</i>	Convolvulaceae	Ivy woodrose
9.	<i>Aristida purpurea</i>	Poaceae	Purple three awn
10.	<i>Dioscorea bulbifera</i>	Dioscoreaceae	Air yam

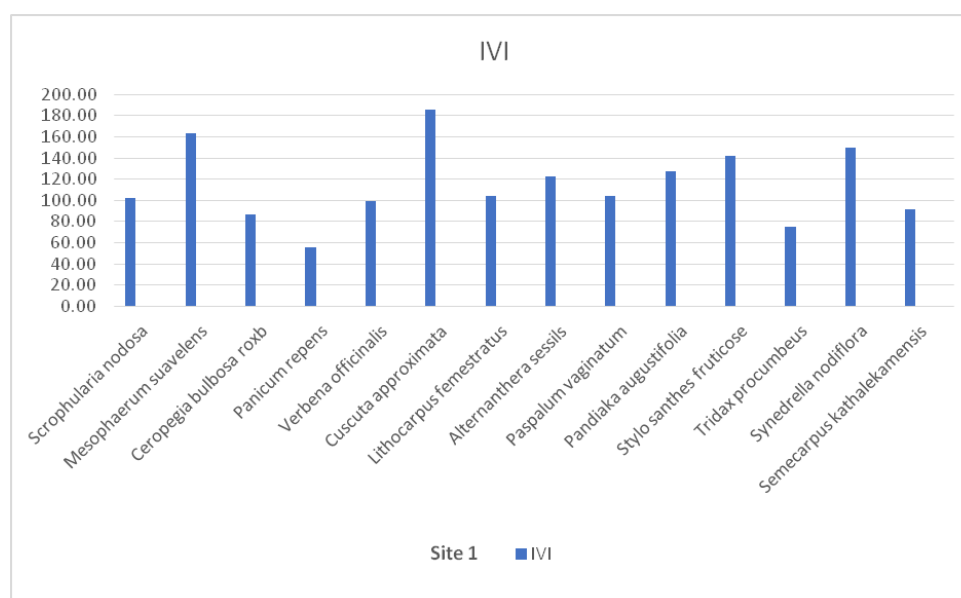


Fig. 10. IVI Index of Herb species in Site-1

Table 29. Herb species recorded in 1x1 quadrate in Site 2

S. no.	Botanical name	Total individuals	No.of quadrate species ocured
1.	<i>Mesophaerum suavelens</i>	17	9
2.	<i>Tridax procumbeus</i>	8	4
3.	<i>Synedrella nodiflora</i>	20	5
4.	<i>Galinsoga ciliata</i>	26	8
5.	<i>Trifolium repens</i>	31	6
6.	<i>Abrus precatorius</i>	38	9
7.	<i>Grona triflora</i>	22	5
8.	<i>Merrennia hedoracea</i>	10	6
9.	<i>Aristida purpurea</i>	39	7
10.	<i>Dioscorea bulbifera</i>	45	7
Total		256	66

Table 30. Quantative analysis for Herb species of site 2 is categorized as below:

S. No.	Species	D.	F.	A.	RD.	RF.	R Do.	IVI
1.	<i>Mesophaerum suavelens</i>	1.13	60.00	1.13	6.64	13.64	6.64	26.92
2.	<i>Tridax procumbeus</i>	0.53	26.67	0.53	3.12	6.06	3.12	12.31
3.	<i>Synedrella nodiflora</i>	1.33	33.33	1.33	7.81	7.58	7.81	23.20
4.	<i>Galinsoga ciliata</i>	1.73	53.33	1.73	10.16	12.12	10.16	32.43
5.	<i>Trifolium repens</i>	2.07	40.00	2.07	12.11	9.09	12.11	33.31
6.	<i>Abrus precatorius</i>	2.53	60.00	2.53	14.84	13.64	14.84	43.32
7.	<i>Grona triflora</i>	1.47	33.33	1.47	8.59	7.58	8.59	24.76
8.	<i>Merrennia hedoracea</i>	0.67	40.00	0.67	3.91	9.09	3.91	16.90
9.	<i>Aristida purpurea</i>	2.60	46.67	2.60	15.23	10.61	15.23	41.07
10.	<i>Dioscorea bulbifera</i>	3.00	46.67	3.00	17.58	10.61	17.58	45.76
Total		17.07	440.00	17.07	100.00	100.00	100.00	300.00

Table 29 shows a total of 256 individuals and 10 species were found during the study. The Herb species having maximum number of individuals included *Dioscorea bulbifera* (45), *Aristida purpurea* (39), and *Abrus precatorius* (38). Whereas, the Herb species having minimum number of individuals *Tridax procumbeus* (8), *Merrennia hedoracea* (10), *Mesophaerum suavelens* (17).

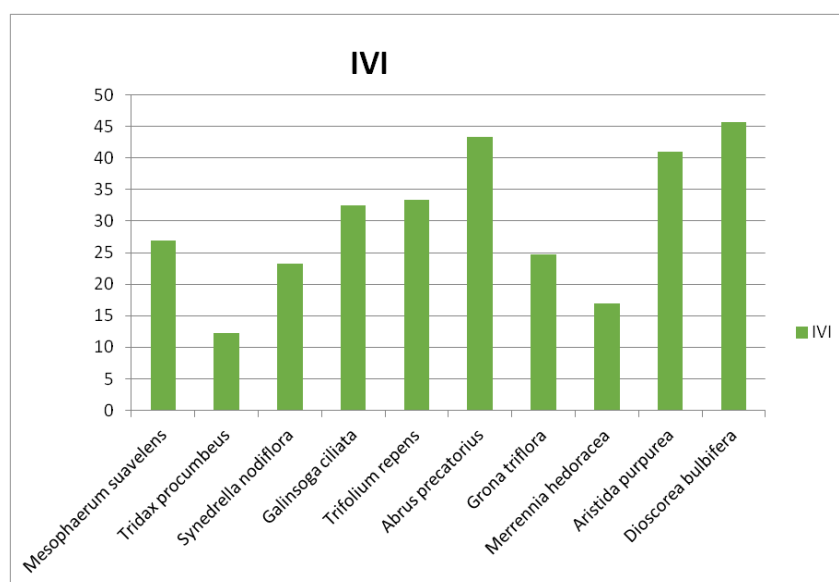
Table 30 showed Herb species having highest density amongst the species *Aristida purpurea* (2.60), *Abrus precatorius* (2.53), and *Trifolium repens* (2.07). While the Herb species showing lowest density included *Tridax procumbeus* (0.53), *Merrennia hedoracea* (0.67), and *Grona triflora* (1.47).

Table 30 showed Herb species having highest frequency amongst the species include *Mesophaerum suavelens* (60.00), *Abrus*

precatorius (60.00), *Galinsoga ciliata* (53.33). While the Herb species showing the lowest frequency was *Tridax procumbeus* (26.67), *Synedrella nodiflora* (33.33), *Grona triflora* (33.33).

Table 30 showed Herb species showing the highest abundance among the species include *Dioscorea bulbifera* (3.00), *Aristida purpurea* (2.60), *Abrus precatorius* (2.53). While, the lowest abundance was shown by the species *Tridax procumbeus* (0.53), *Merrennia hedoracea* (0.67), *Mesophaerum suavelens* (1.13).

Table 30 showed Herb species having highest IVI amongst the species included *Dioscorea bulbifera* (45.76), *Abrus precatorius* (43.32), *Aristida purpurea* (41.07). While the lowest IVI shown by the species was *Tridax procumbeus*, (12.31), *Synedrella nodiflora*, (23.20), *Merrennia hedoracea* (16.90).

**Fig. 11. IVI Index of Herb species in Site-2**

Site-3

Table 31. list of Herb found in site 3

S no.	Botanical name	family	Common name
1.	<i>Tridax procumbeus</i>	Aataraceae	Tridax daisy
2.	<i>Synedrella nodiflora</i>	Astaraceae	Cynderella weed
3.	<i>Abrus precatorius</i>	Fabaceae	Rosary Pea
4.	<i>Celtica gigantea</i>	Poaceae	Golden Oats
5.	<i>Bothriochloa ischaemum</i>	Poaceae	Yellow blue stem
6.	<i>Tortoise preserve</i>		
7.	<i>Treebine</i>	Vitaceae	Veldt grape
8.	<i>Bistorta officinalis</i>	Poligonaceae	Bistort
9.	<i>Alternanthera ficoidea</i>	Amaranthaceae	Brazillian Snow flower
10.	<i>Eachinochola</i>	Paniceae	Deccan grass
11.	<i>Allamanda cathartica</i>	Apocynaceae	Yellow allamanda
12.	<i>Chenopodium album</i>	Amarantheaceae	Bacon weed
13.	<i>Ageratum conyzoides</i>	Asteraceae	
14.	<i>Bigelovia verticillata</i>		
15.	<i>Herbarium pacificum</i>		
16.	<i>Harrisia martinii</i>	Cactaeace	Harrisia cactus

Table 32. Herb species recorded in 1x1 quadrate in Site-3

S no.	Botanical name	Total individuals	No.of quadrate species ocured
1.	<i>Tridax procumbeus</i>	14	6
2.	<i>Synedrella nodiflora</i>	40	6
3.	<i>Abrus precatorius</i>	7	5
4.	<i>Celtica gigantea</i>	15	8
5.	<i>Bothriochloa ischaemum</i>	49	10
6.	<i>Tortoise preserve</i>	37	5
7.	<i>Treebine</i>	12	7
8.	<i>Bistorta officinalis</i>	14	7
9.	<i>Alternanthera ficoidea</i>	19	6
10.	<i>Eachinochola</i>	20	7
11.	<i>Allamanda cathartica</i>	12	5
12.	<i>Chenopodium album</i>	11	6
13.	<i>Ageratum conyzoides</i>	17	3
14.	<i>Bigelovia verticillata</i>	16	4
15.	<i>Herbarium pacificum</i>	19	3
16.	<i>Harrisia martinii</i>	9	5
Total		311	93

Table 33. Quantative analysis for herb species of site 3 is categorized as below:

S. no.	Species	D.	F.	A.	RD.	RF.	R Do.	IVI
1.	<i>Tridax procumbeus</i>	0.93	40.00	0.93	4.50	6.45	4.50	15.45
2.	<i>Synedrella nodiflora</i>	2.67	40.00	2.67	12.86	6.45	12.86	32.18
3.	<i>Abrus precatorius</i>	0.47	33.33	0.47	2.25	5.38	2.25	9.88
4.	<i>Celtica gigantea</i>	1.00	53.33	1.00	4.82	8.60	4.82	18.25
5.	<i>Bothriochloa ischaemum</i>	3.27	66.67	3.27	15.76	10.75	15.76	42.26
6.	<i>Tortoise preserve</i>	2.47	33.33	2.47	11.90	5.38	11.90	29.17
7.	<i>Treebine</i>	0.80	46.67	0.80	3.86	7.53	3.86	15.24
8.	<i>Bistorta officinalis</i>	0.93	46.67	0.93	4.50	7.53	4.50	16.53
9.	<i>Alternanthera ficoidea</i>	1.27	40.00	1.27	6.11	6.45	6.11	18.67
10.	<i>Eachinochola</i>	1.33	46.67	1.33	6.43	7.53	6.43	20.39
11.	<i>Allamanda cathartica</i>	0.80	33.33	0.80	3.86	5.38	3.86	13.09
12.	<i>Chenopodium album</i>	0.73	40.00	0.73	3.54	6.45	3.54	13.53
13.	<i>Ageratum conyzoides</i>	1.13	20.00	1.13	5.47	3.23	5.47	14.16
14.	<i>Bigelovia verticillata</i>	1.07	26.67	1.07	5.14	4.30	5.14	14.59
15.	<i>Herbarium pacificum</i>	1.27	20.00	1.27	6.11	3.23	6.11	15.44
16.	<i>Harrisia martinii</i>	0.60	33.33	0.60	2.89	5.38	2.89	11.16
Total		20.73	620.00	20.73	100.00	100.00	100.00	300.00

Table 32. shows a total of 311 individuals and 16 species were found during the study. The herb species having maximum number of individuals included *Bothriochloa ischaemum* (49), *Synedrella nodiflora* (40), *Tortoise preserve* (37). Whereas, the herb species having minimum number of individuals *Abrus precatorius* (7), *Harrisia martinii* (9), *Chenopodium album* (11).

Table 33 showed Herb species having highest density amongst the species *Bothriochloa ischaemum* (3.27), *Synedrella nodiflora* (2.67), *Tortoise preserve* (2.47). While the Herb species showing lowest density included *Abrus precatorius* (0.47), *Harrisia martinii* (0.60), and *Chenopodium album* (0.73).

Table 33 showed Herb species having highest frequency amongst the species include *Bothriochloa ischaemum* (66.67), *Celtica*

gigantea (53.33), *Treebine.* (46.67), While the Herb species showing the lowest frequency was *Ageratum conyzoides* (20.00), *Herbarium pacificum* (20.00), *Bigelovia verticillata.* (26.67).

Table 33 showed Herb species showing the highest abundance among the species include *Bothriochloa ischaemum* (3.27), *Synedrella nodiflora* (2.67), *Tortoise preserve* (2.47) While, the lowest abundance was shown by the species *Abrus precatorius* (0.47), *Harrisia martinii*(0.60), *Treebine* (0.80).

Table 33 showed Herb species having highest IVI amongst the species included *Bothriochloa ischaemum* (42.26), *Synedrella nodiflora* (32.18), *Tortoise preserve* (29.17).While the lowest IVI shown by the species was *Abrus precatorius* (9.88), *Harrisia martinii*(11.16), *Allamanda cathartica* (13.09).

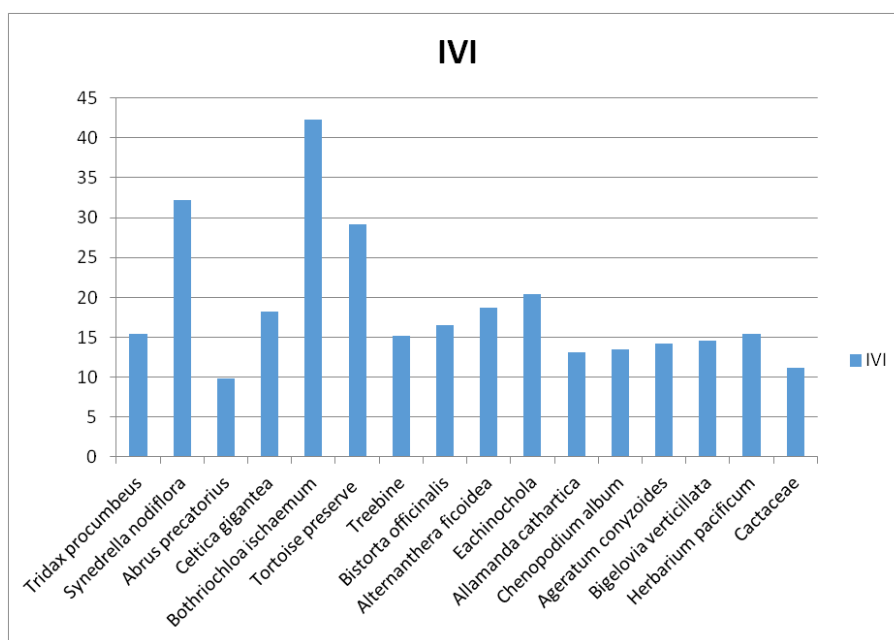


Fig. 12. IVI Index of Herb species in Site-3

Site – 4

Table 34. list of Herb found in site 4

S. no.	Botanical name	family	Common name
1.	<i>Synedrella nodiflora</i>	Astaraceae	Cynderella weed
2.	<i>Ageratum conyzoides</i>		
3.	<i>Harrisia martinii</i>	Cactaeace	Harrisia cactus
4.	<i>Elephantopus scaber</i>	Astaraceae	Elephant's foot
5.	<i>Oplismenus burmannii</i>	Poaceae	Running mountaingrass
6.	<i>Dichanthelium clandestinum</i>	Poaceae	Deer tongue
7.	<i>lternanthera caracasana</i>	Amarantheaceae	Washerman women
8.	<i>Ambrosia artemisiifolia</i>	Asteraceae	Annual rag weed

Table 35. Herb species recorded in 1x1 quadrat in Site 4

S. no.	Botanical name	Total individuals	No. of quadrat species occurred
1.	<i>Synedrella nodiflora</i>	32	7
2.	<i>Ageratum conyzoides</i>	25	5
3.	<i>Harrisia martinii</i>	12	8
4.	<i>Elephantopus scaber</i>	22	6
5.	<i>Oplismenus burmannii</i>	28	6
6.	<i>Dichantherium clandestinum</i>	27	5
7.	<i>Iternanthera caracasana</i>	19	5
8.	<i>Ambrosia artemisiifolia</i>	28	8
Total		193	50

Table 36. Quantitative analysis for herb species of site 4 is categorized as below

S. No.	Species	D.	F.	A.	RD.	RF.	R Do.	IVI
1.	<i>Synedrella nodiflora</i>	2.13	46.67	4.57	16.58	14.00	118.43	149.01
2.	<i>Ageratum conyzoides</i>	1.67	33.33	5.00	12.95	10.00	129.53	152.49
3.	<i>Harrisia martinii</i>	0.80	53.33	1.50	6.22	16.00	38.86	61.08
4.	<i>Elephantopus scaber</i>	1.47	40.00	3.67	11.40	12.00	94.99	118.39
5.	<i>Oplismenus burmannii</i>	1.87	40.00	4.67	14.51	12.00	120.90	147.41
6.	<i>Dichantherium clandestinum</i>	1.80	33.33	5.40	13.99	10.00	139.90	163.89
7.	<i>Iternanthera caracasana</i>	1.27	33.33	3.80	9.84	10.00	98.45	118.29
8.	<i>Ambrosia artemisiifolia</i>	1.87	53.33	3.50	14.51	16.00	90.67	121.18
Total		12.87	333.33	32.10	100.00	100.00	100.00	300.00

Table 35 shows a total of 193 individuals and 8 species were found during the study. The herb species having maximum number of individuals included *Synedrella nodiflora* (32), *Oplismenus burmannii* (28), *Ambrosia artemisiifolia* (28) whereas, the herb species having minimum number of individuals *Harrisia martinii* (12), *Iternanthera caracasana* (19).

Table 36 showed Herb species having highest density amongst the species *Synedrella nodiflora* (2.13), *Oplismenus burmannii* (1.87), *Ambrosia artemisiifolia* (1.87) While the Herb species showing lowest density included *Harrisia martinii* (0.80), *Iternanthera caracasana* (1.27), *Elephantopus scaber* (1.47).

Table 36 showed Herb species having highest frequency amongst the species include *Harrisia martinii* (53.33), *Ambrosia artemisiifolia* (53.33), *Synedrella nodiflora* (46.67). While the Herb species showing the lowest frequency was *Ageratum conyzoides* (33.33), *Dichantherium*

clandestinum (33.33), *Iternanthera caracasana* (33.33).

Table 36 showed Herb species showing the highest abundance among the species include *Dichantherium clandestinum* (5.40), *Ageratum conyzoides* (5.00), *Oplismenus burmannii* (4.67). While, the lowest abund uses of herbal plants for primary health care and the treatment of various health disorders through the personal contact and personal interview of rural old people ance was shown by the species *Harrisia martinii* (1.50), *Ambrosia artemisiifolia* (3.50), *Elephantopus scaber* (3.67).

Table 36 showed Herb species having highest IVI amongst the species included *Dichantherium clandestinum* (163.89), *Ageratum conyzoides* (152.49), *Synedrella nodiflora* (149.01). While the lowest IVI shown by the species was *Harrisia martinii* (61.08), *Iternanthera caracasana* (118.29), *Elephantopus scaber* (118.39).

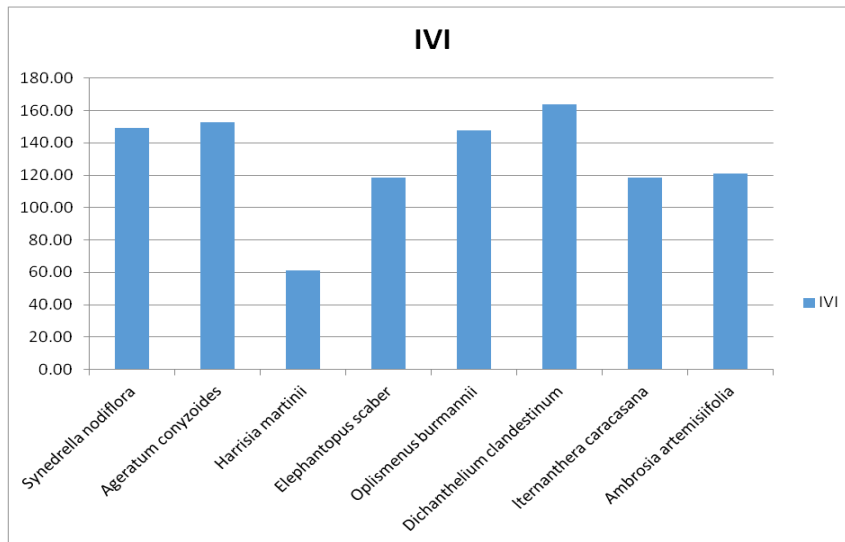


Fig. 13. IVI Index of Herb species in Site-4

4. DIVERSITY OF SPECIES IN REDSANDERS PARK CHITTOOR

index of richness(D mg) ,pielou index of evenness(E).

4.1 Tree Diversity of Redsanders Park

Upon studying the four sites of the park viz,site I, II, III, & IV Determination of the diversity of the sites based on various aspects were calculated which include species richness, Shannon and wiener index of species diversity (H'),Margalef's

4.2 Shrub Diversity of Redsanders Park

Upon studying the five sites of the sanctuary viz, site I, II, III, & IV. Determination of the diversity of the sites based on various aspects were calculated which include species richness, Shannon and wiener index of species diversity (H'), Margalef's index of richness(Dmg), pielou index of evenness(E).

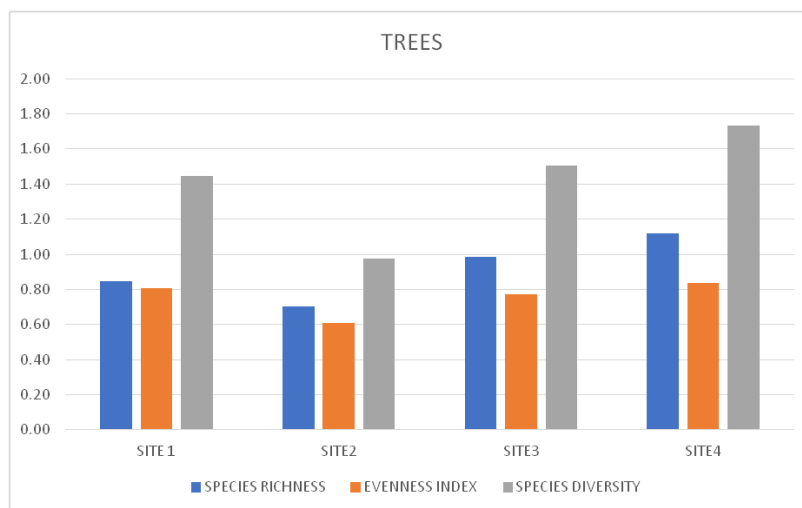


Fig. 14. Diversity parameter of tree species in different sites

	Species richness	Evenness index	Species diversity
SITE 1	0.85	0.81	1.44
SITE 2	0.70	0.61	0.98
SITE 3	0.99	0.77	1.51
SITE 4	1.12	0.83	1.73

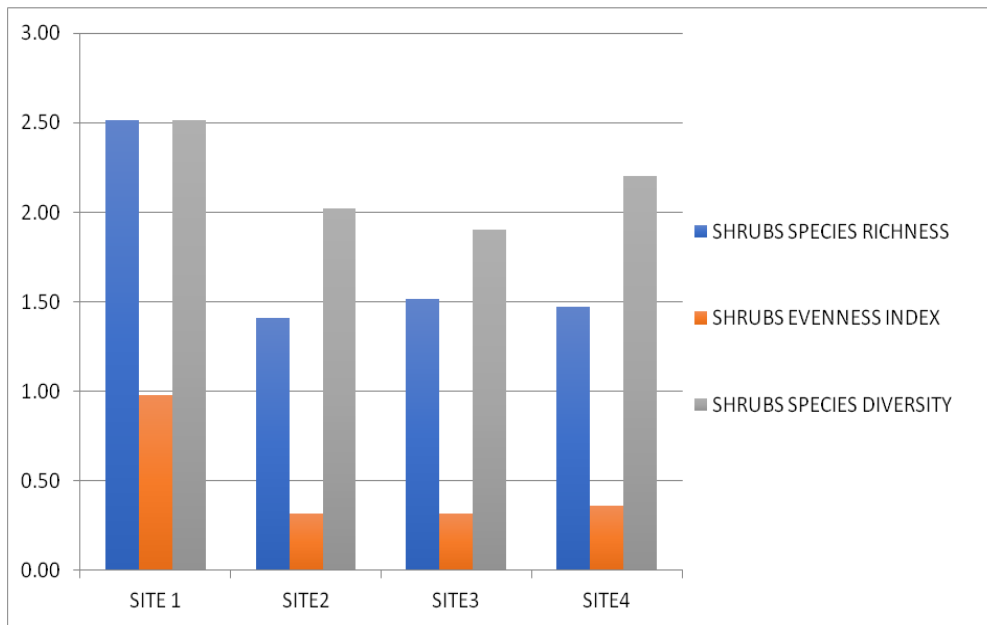


Fig 15. Diversity parameter of Shrub species in different sites

	Species richness	Evenness index	Species diversity
SITE 1	2.52	0.98	2.52
SITE 2	1.41	0.32	2.02
SITE 3	1.51	0.32	1.90
SITE 4	1.47	0.36	2.20

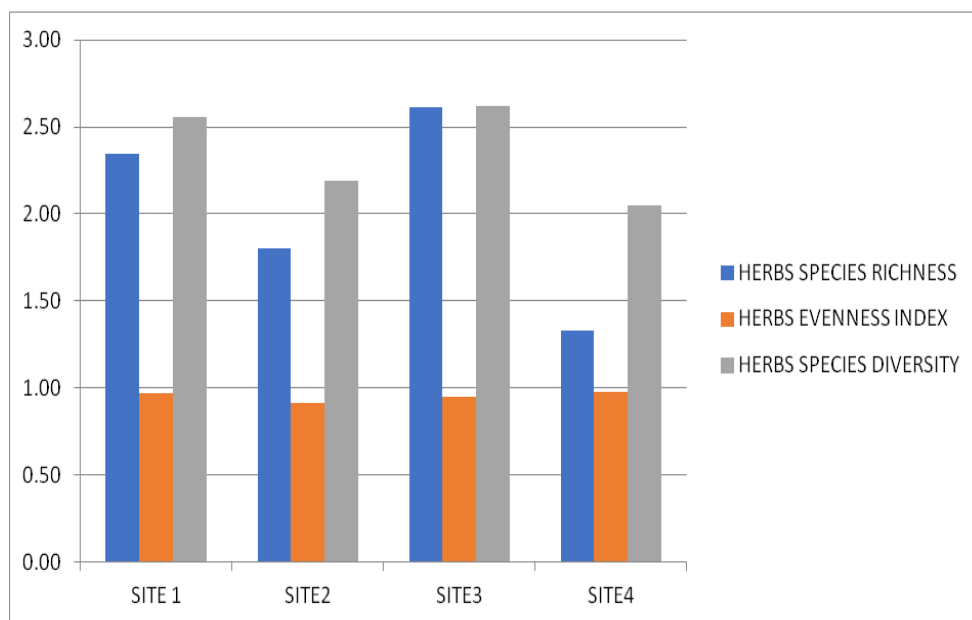


Fig. 16. Diversity parameter of Herb species in different sites

	Species richness	Evenness index	Species Diversity
SITE 1	2.34	0.97	2.55
SITE 2	1.80	0.91	2.19
SITE 3	2.61	0.95	2.62
SITE 4	1.33	0.98	2.05

4.3 Herb Diversity of Red Sanders Park

Upon studying the five sites of the sanctuary viz, site I, II, III, & IV. Determination of the diversity of the sites based on various aspects were calculated which include species richness, Shannon and Wiener index of species diversity (H'), Margalef's index of richness (D_{mg}), Pielou index of evenness (E).

5. CONCLUSION

From the present research work it can be concluded that tree species in Site-I of the forest comprised of 06 species of trees, 13 species of shrub and 14 species of grass & herb species, Site-II comprised of 05 species of trees, 10 species of shrub and 10 species of grass & herb species, Site-III comprised of 07 species of trees, 10 species of shrub and 16 species of grass & herb species, Site-IV comprised of 08 species of trees, 10 species of shrub and 08 species of grass & herb species.

Based on the results, it can be concluded that the forest is abundantly populated by *Pterocarpus santalinus*. Overall, Site-III showed the highest IVI parameter of dominant tree species for included *Pterocarpus santalinus* (269.8) Site-III showed the highest IVI parameter of dominant shrub species for *Lantana camera* (66.21) and Site-III showed the highest IVI parameter of dominant grass & herb species for *Cuscuta approximata* (185.74)..

The result of the phytosociological aspects in all four sites concluded that for trees, Site-IV shows the highest value for Shannon-Weiner Diversity Index (H') (1.73). For shrubs, Site-I showed the highest value for Shannon-Weiner Diversity Index (H') (2.52). For grasses and herb, Site-III Shannon-Weiner Diversity Index (H') (2.62).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Raven PH, Evert RF, Eichhorn SE. Biology of plants. W.H. Freeman and Company; 2005.
2. Gaston KJ. Global patterns in biodiversity. Nature. 2000;405(6783):220-227.
3. Gupta AK, Chaudhary LB. (Eds.). Plant Biodiversity: Monitoring, Assessment and Conservation. CABI; 2016.
4. Patil VK, Shimpale VB, Khan NA. Assessment of floristic composition, diversity, and regeneration status of Red Sanders (*Pterocarpus santalinus* L.f.) in the Seshachalam Hills, Eastern Ghats, Andhra Pradesh. Journal of Tropical Forest Science. 2020;32(2):159-172.
5. Raju M, Reddy M, Reddy V, Reddy G, Reddy G. Diversity and distribution of tree species in Red Sanders (*Pterocarpus santalinus* Linn.f.) forests of Eastern Ghats, India. Journal of Forestry Research. 2012;23(3):445-452.
6. Das AK, Mishra AK. Floristic diversity and structure of a Red Sanders (*Pterocarpus santalinus* L.f.) forest in the Eastern Ghats, Andhra Pradesh, India. Indian Forester. 2020;146(4):381-388.
7. Ganesan V, Parthasarathy N, Devi P, Babu RVS, Kumar JS. Red Sanders Park: A new protected area in Andhra Pradesh. Current Science. 2011;101(11):1425-1427.
8. Chakraborty S, Mukherjee A, Mishra AK. Evaluation of floristic diversity in the Red Sanders (*Pterocarpus santalinus* L.f.) forest of Andhra Pradesh, India. Journal of Forest Science. 2019;35(2):89-96.
9. Thulsi K, Sadasivam P, Reddy KM. Plant diversity and vegetation analysis of Red Sanders (*Pterocarpus santalinus* L.f.) forest patches in Chittoor district, Andhra Pradesh, India. International Journal of Scientific Research. 2014;3(10):434-437.
10. Sankar M, Singh D. Quantitative assessment of the tree diversity and population structure of Red Sanders (*Pterocarpus santalinus* L.f.) in Chittoor district, Andhra Pradesh. Journal of Forestry Research. 2019;30(6):2079-2091.
11. Anitha P, Nallathambi MS, Kumar S, Reddy SG. Floristic diversity and composition of woody species in Red Sanders (*Pterocarpus santalinus* L.f.)

- forests of Seshachalam hills, Andhra Pradesh, India. Journal of Forestry Research. 2016;27(2):445-452.
12. Sowmya K, Padmavathy M, Reddy VR. Tree diversity and carbon sequestration potential of Red Sanders (*Pterocarpus santalinus* L.f.) forest of Andhra Pradesh, India. Indian Journal of Forestry. 2017; 40(2):163-169.
 13. Sudhakar GR, Rao PVS. Floristic diversity and structure of Red Sanders (*Pterocarpus santalinus* L.f.) forest fragments in Seshachalam hills of Andhra Pradesh, India. Indian Journal of Forestry. 2018; 41(2):125-131.
 14. RAM P, Reddy KG, Kumar RN. Ethnobotanical survey of medicinal plants used by tribal people in the remote areas of Nallamala forest, Andhra Pradesh, India. Journal of Ethnobiology and Ethnomedicine. 2016;12(1):1-14.

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