STUDY OF PLANT DIVERSITY IN RED SANDERS PARK IN CHITTOOR DISTRICT OF ANDHRA PRADESH

Comment [A1]: Add study country to the title

Abstract

The study deals with the assessment ~~STUDY~~ of plant diversity in R~~r~~ed S~~s~~anders park in C~~c~~hittoor district of A~~a~~ndhra P~~p~~radesh, India~~that was carried out in four sites~~. A total of nine~~9~~ species of trees belonging to six~~6~~ families with 1625individuals, 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~~e~~ size of 400 m^2 were established for trees, 100 m^2 for shrubs, 20 m^2 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~~s~~ 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 aShannon-Weiner Diversity Index (H') of~~(~~2.62~~)~~. The ~~need of~~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.

Comment [A2]: Write the full meaning of the abbreviation IVI

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 particularecosystem, 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 **(Raven *et. al.*, 2005).**Plant diversity is ~~the~~ ofutmost value to basic research because the data generated through these studies are highly useful in ecological, biogeographic, taxonomic and evolutionary studies **(Gaston, 2000)**. 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 ~~abroad~~ other parts of the world**(Gupta and Chaudhary, 2016)**.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 **(Patil *et. al.*, 2020)**. 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 typess 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)**.

MATERIALS AND METHODS

STUDYAREAANDSITES:

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).

Comment [A3]: Cite a source for this statement

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 ~~understanding~~ the assessment of ~~the~~ plant diversity and the ecological dynamics of the Eastern Ghats mountain range in southern India.

Methods

Sample Plot Establishment and Field vegetation measurement

Comment [A4]: Report method for data collection in the past tense. Change all "is" to "was"

Random sampling method wa~~i~~s employed for data collection. The sampling wa~~i~~s 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 wa~~i~~s collected using quadrate counts (numbers of trees occurring in the quadrates is recorded and tree diameter at breast-height (DBH) is measured.

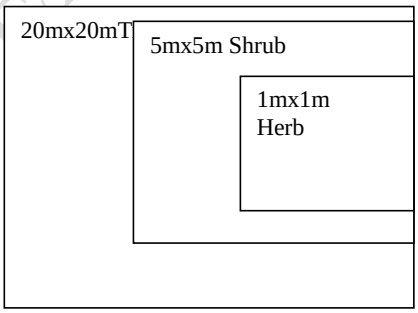

Fig: 1 Pattern of sampling method

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.

$$\textbf{Frequency Percentage \%} = \frac{\text{Number of quadrats in which a species occurs}}{\text{Total number of quadrats sampled}} \times 100$$

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

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

The Important Vegetation Index (Curtis 1959),

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

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

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

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

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.

Importance Value Index = Relative Dominance + Relative Density + 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).

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

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).

$$SR=(S-1)/(\log N)$$

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

RESULTS AND DISCUSSION

Comment [A5]: Organize this section and cut down the tables or figures. Currently, it is a lot of information and it is hard for readers to follow well. Discuss results according to the wider literature on the topic. This is currently missing.

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, were the study area was divided into four sites and the species founded in the redsanders park are listed below:

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

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

A total number of 09 species from 06 familes 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 m^2 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.	*Pterocarpus santalinus*	Fabaceae	Yerra Chandanam	Red sandalwood
2.	*Tamarindus indicus*	Fabaceae	Chinthakayi	Tamarind
3.	*Azadirachta indica*	Meliaceae	Vepa chettu	Neem tree
4.	*Citrus limon*	Rutaceae	Nimma Chettu	Lemon
5.	*Annona reticulata*	Annonaceae	Seetha phal	Custard apple
6.	*Millettia pinnata*	Fabaceae	Kanuga Chettu	Seashore Mempoari

Table no 2. Tree species recorded in 20x20 quadrate in Site 1

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

Table no 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 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.	*Pterocarpus santalinus*	4.13	12.1	100.0	12.1	50.3	26.8	50.3	127.3

2.	*Tamarindus indicus*	30.59	1.1	60.0	1.1	4.7	16.1	4.7	25.5
3.	*Azadirachta indica*	3.26	3.8	60.0	3.8	15.7	16.1	15.7	47.6
4.	*Citrus limon*	1.83	1.9	46.7	1.9	7.7	12.5	7.7	28.0
5.	*Annona reticulata*	1.21	1.7	53.3	1.7	6.9	14.3	6.9	28.1
6.	*Millettia pinnata*	0.82	3.5	53.3	3.5	14.6	14.3	14.6	43.6
	Total	41.84	24.1	373.3	24.1	100.0	100.0	100.0	300.0

Table no 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 no 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 frequeancy was ***Citrus limon (46.7), Annona reticulata* (53.3)**, ***Millettia pinnata (*53.3)**

Table no 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 no 3 showed tree species having highest IVI amongst the species included ***Pterocarpussantalinus* (127.3)** followed by ***Azadirachta indica* (47.6)**.while the lowest IVI shown by the species was ***Tamarindusindicus* (25.5),*Citrus limon* (28.0).**

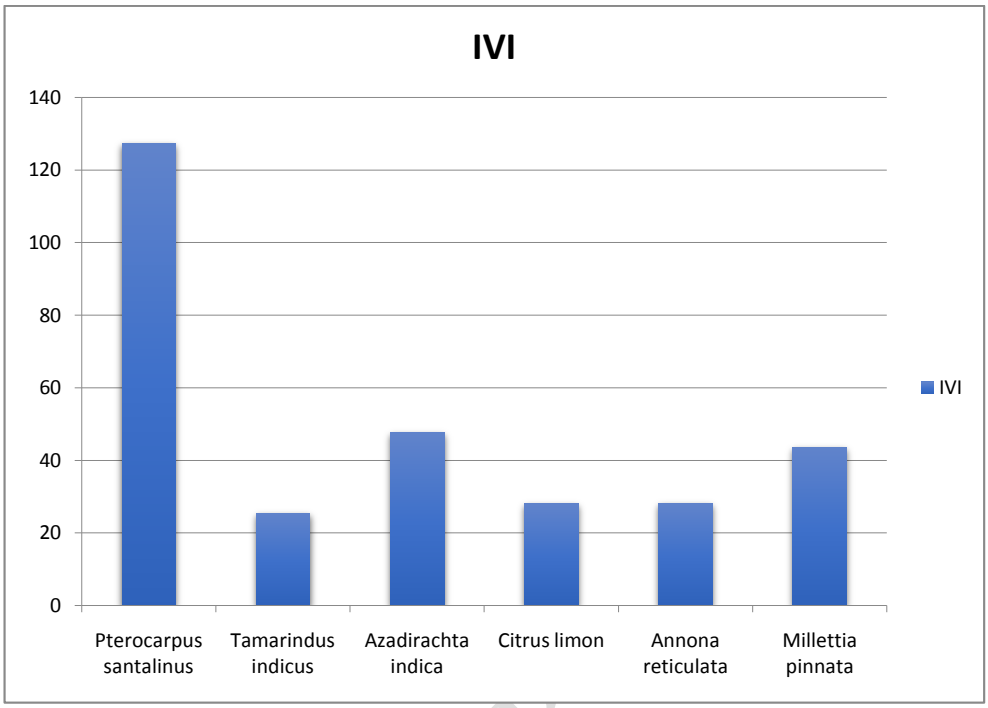

Fig.2: IVI Index of tree species in Site-1

Tree species in Site-2

Table no 4. Tree species recorded in Site-2

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

Table no 5. Tree species recorded in 20x20 quadrate in Site 2

S.no.	Botanical name	Total individuals	No of quadrate species occured
1.	*Pterocarpus santalinus*	209	15

2.	*Tamarindus indicus*	19	10
3.	*Azadirachta indica*	10	8
4.	*Annona reticulata*	48	12
5.	*Borassus flabellifer*	14	8
	Total	**300**	**53**

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 no 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.	*Pterocarpus santalinus*	1.03	13.93	100.00	13.93	69.67	28.30	69.67	167.64
2.	*Tamarindus indicus*	12.84	1.27	66.67	1.27	6.33	18.87	6.33	31.53
3.	*Azadirachta indica*	1.83	0.67	53.33	0.67	3.33	15.09	3.33	21.76
4.	*Annona reticulata*	0.46	3.20	80.00	3.20	16.00	22.64	16.00	54.64
5.	*Borassus flabellifer*	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 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 no 6 showed tree species having highest frequency amongst the species include ***Pterocarpus santalinus*** **(100),*Annonareticulata*** **(80),*Azadirachta indica*** **(53.33)**.While thetree species showing the lowest frequeancy was ***Tamarindus indicus*** **(66.67)**

Table no 6 showed tree species showing the highest abundance among the species include ***Pterocarpussantalinus*** **(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 no 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).**

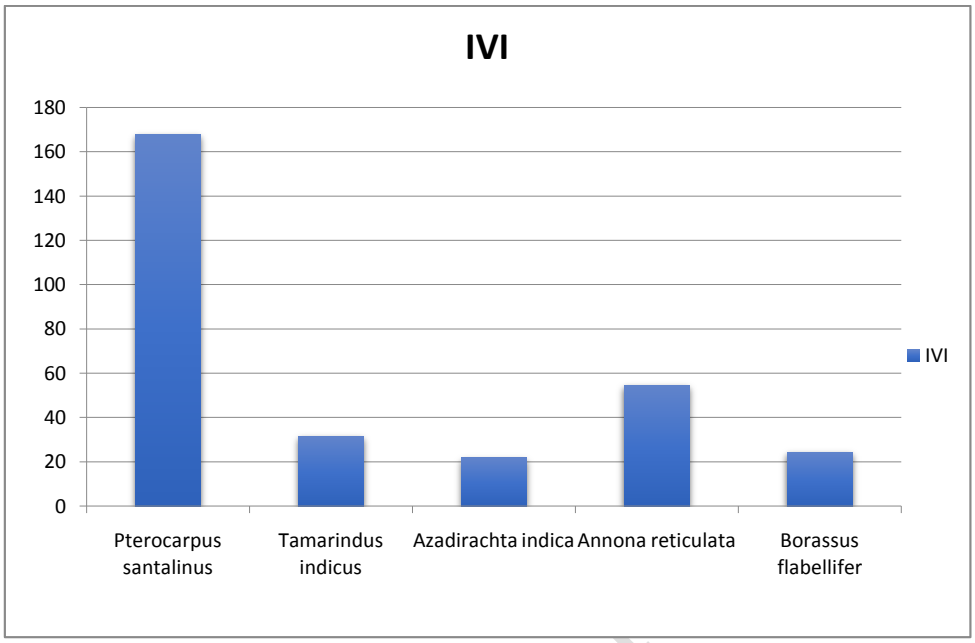

Fig.3: IVI Index of tree species in Site-2

Tree species in Site-3

Table no 7. Tree species recorded in Site-3

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

Table no 8. Tree species recorded in 20x20 quadrate in Site 3

S.no.	Botanical name	Total individuals	No. of quadrate species occured

1.	*Pterocarpus santalinus*	192	15
2.	*Tamarindus indicus*	62	14
3.	*Azadirachta indica*	109	13
4.	*Citrus limon*	14	5
5.	*Annona reticulata*	34	10
6.	*Millettia pinnata*	15	6
7.	*Ficus religiosa*	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)** ,***Citruslimon*** **(14) , *Millettia pinnata* (15).**

Table no 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.	*Pterocarpus santalinus*	6.45	12.8	100.0	12.8	43.8	21.4	204.6	269.8
2.	*Tamarindus indicus*	21.68	4.1	93.3	4.4	14.2	20.0	70.8	104.9
3.	*Azadirachta indica*	11.85	7.3	86.7	8.4	24.9	18.6	134.0	177.5
4.	*Citrus limon*	3.57	0.9	33.3	2.8	3.2	7.1	44.7	55.1
5.	*Annona reticulata*	1.83	2.3	66.7	3.4	7.8	14.3	54.3	76.4
6.	*Millettia pinnata*	1.61	1.0	40.0	2.5	3.4	8.6	40.0	52.0
7.	*Ficus religiosa*	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 no 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 no 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 frequeancy was***Citrus limon* (33.3), *Millettia pinnata* (40.0), *Ficus religiosa* (46.7).**

Table no 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 no 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).**

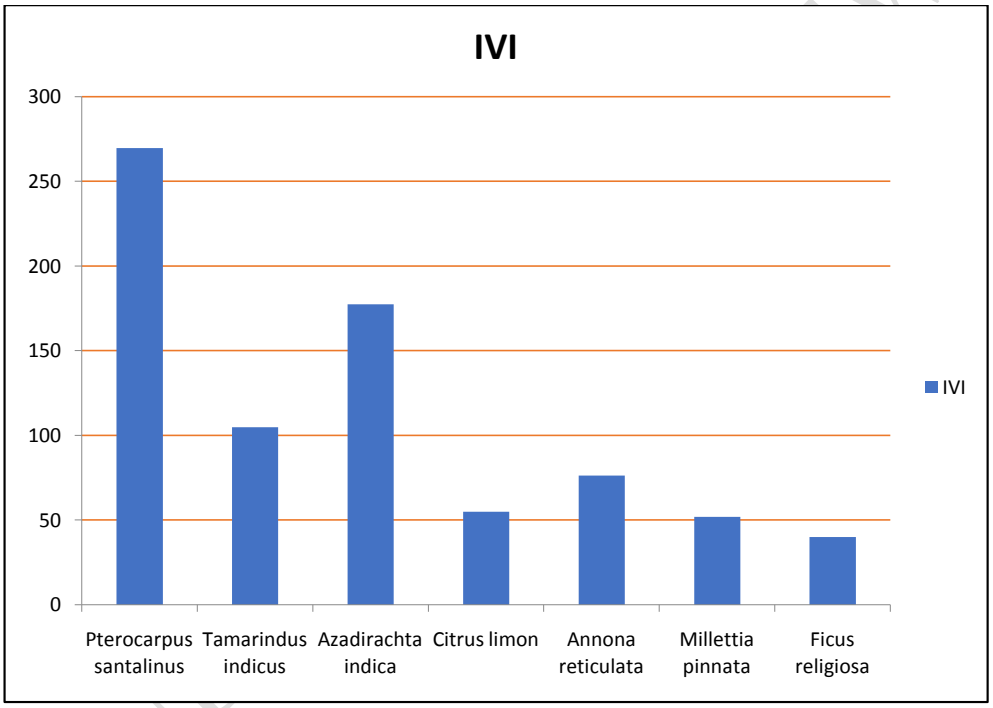

Fig.4: IVI Index of tree species in Site-3

Tree species in Site-4

Table no 10. Tree species recorded in Site-4

S.no.	Botanical name	Family name	Local name	Common name
1.	*Pterocarpus santalinus*	Fabaceae	Yerrachandhanam	Red sandal
2.	*Tamarindus indicus*	Fabaceae	Chintha chettu	Tamarind

3.	*Azadirachta indica*	Meliaceae	Vepa chettu	Neem tree
4.	*Citrus limon*	Rutaceae	Nimma chettu	Lemon
5.	*Annona reticulata*	Annonaceae	Seetha phal	Custard apple
6.	*Ficus religiosa*	Moraceae	Bodhi Tree	Sacred fig
7.	*Borassus flabellifer*	Aracaceae	Thati chettu	Palm
8.	*Phoenix dactylifera*	Aracaceae	Khajura	Date palm

Table no 11. Tree species recorded in 20x20 quadrate in Site 4

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

Table no 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 no 12. quantative 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.	*Pterocarpus santalinus*	17.44	8.1	73.3	11.0	23.0	13.4	171.8	208.3

2.	*Tamarindus indicus*	60.65	5.1	93.3	5.5	14.7	17.1	85.9	117.7
3.	*Azadirachta indica*	2.59	10.1	100.0	10.1	29.0	18.3	158.3	205.5
4.	*Citrus limon*	1.09	3.7	80.0	4.6	10.5	14.6	71.6	96.7
5.	*Annona reticulata*	1.83	6.1	73.3	8.4	17.5	13.4	130.6	161.6
6.	*Ficus religiosa*	55.49	0.7	46.7	1.4	1.9	8.5	22.3	32.8
7.	*Borassus flabellifer*	6.74	0.7	40.0	1.8	2.1	7.3	28.6	38.0
8.	*Phoenix dactylifera*	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 no 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 no 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 frequeancy was***Phoenix dactylifera*** **(40.0),*Borassus flabellifer*** **(40.0),** ***Ficus religiosa*** **(46.7).**

Table no 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 no 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).**

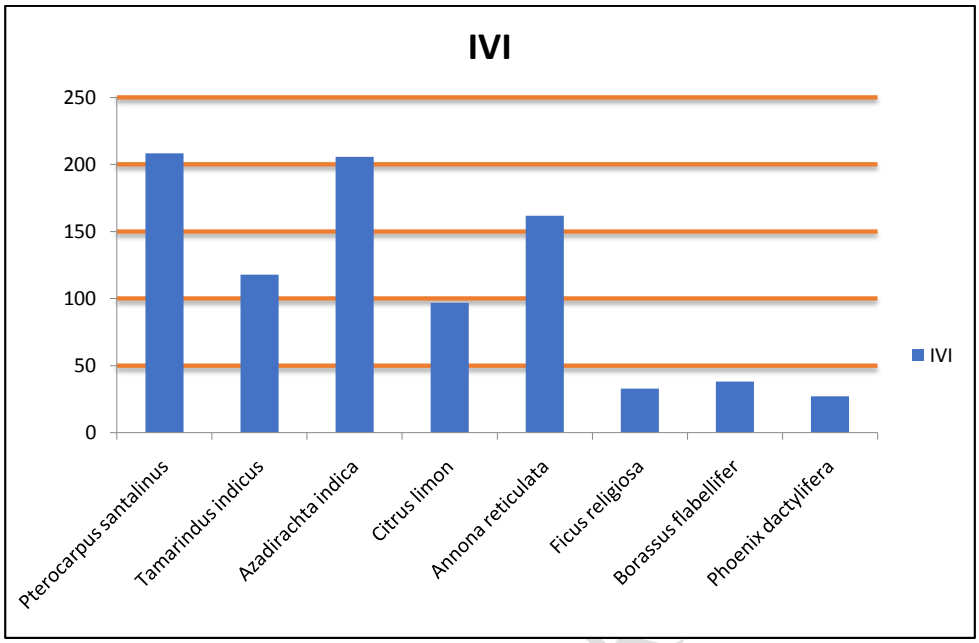

Fig.5: IVI Index of tree species in Site-4

5.0). Shrub

5.1 list of the entire Shrub species found in all four sites

S no.	Botanical name	Family	Local name	Common name
1.	Alvaradoa amorphoides	Picramniaceae		Mexican alvaradoa
2.	Barleria prionitis			
3.	chromolaena odorata	Asteraceae	Siam weed	Butterfly weed
4.	Cyprus turpentine	Anacardiaceae	Terebinth	
5.	Dalbergia horrida	Dalbergiaceae		Dalbergia
6.	Diplopterys cabrerana	Malphigiaceae		Cagrofunga
7.	Flueggea	Phyllantheaceae		White berry bush
8.	Flueggea leucopyrus-wild	Euphorbiaceae	Poolie pulanji	Spinos flugea
9.	Ehretia microphylla	Boraginaceae		Fukein tea tree
10.	Pachira aquatica	Malvaceae	Monguba	French peanut, Gift tree
11.	Indian sarsaparilla	Ehretia Microphylla	Nannadi	Smilax ornate
12.	Lantana camera	Verbeneveae	Kongini	Spinach Flag

13.	Leonotis leonurus	Lamiaceae		Lion's tail
14.	Millettia pinnata	Fabaceae	Malapari	Kalanja tree
15.	Oplismenus hirtellus sub.spp	Poaceae		Basket grass
16.	Randia aculeata	Rubiaceae		White indigo berry
17.	Salix purpurea	Salicaceae		Basket willow
18.	Sanna spectabilis	Fabaceae		Popcrorn tree
19.	Senegalia alaxacantha			
20.	Mimosa pudica	Fabaceae		Shame plant
21.	Calotropis procera	Apocynaceae		Soddom apple
22.	Stryechnos psilosperma	Loganiaceae		Poison fruit
23	Tephrosa purpurea	Fabaceae		Wild indigo
24	Vachellia schalfueri	Fabaceae		Thorn trees
25	Ziziphus mauritiana	Rhamnaceae		Wild jujube

Site 1

The vegetation compostion in site 1 recorded in 15 quadrates of 5 x 5m^2 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.	*chromolaena odorata*	Asteraceae	Siam weed	Butterfly weed
2.	*Indian sarsaparilla*	Asclepidiaceae	Nannari	Smilax ornate
3.	*Randia aculeata*	Rubiaceae		White indigo berry
4.	*Leonotis leonurus*	Lamiaceae		Lion's tail
5.	*Flueggea leucopyrus-wild*	Euphorbiaceae	Poolie pulanji	Spinos fluggea
6.	*Cyprus turpentine*	Anacardiaceae	Terebinth	
7.	*Diplopterys cabrerana*	Malphigiaceae		Cagrofunga
8.	*Millettia pinnata*	Fabaceae	Malapari	Kalanja tree
9.	*Salix purpurea*	Salicaceae		Basket willow

10.	*Tephrosa purpurea*	Fabaceae		Wild indigo
11.	*Barleria prionitis*			
12.	*Flueggea*	Phyllantheaceae		White berry bush
13.	*Lantana camera*	Verbeneveae	Kongini	Spinach flag

Table no 14. Shrub species recorded in 5 x5m quadrate in Site 1

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

Table no 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. Quantative analysis for Shrub species of site 1 is categorized as below:

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

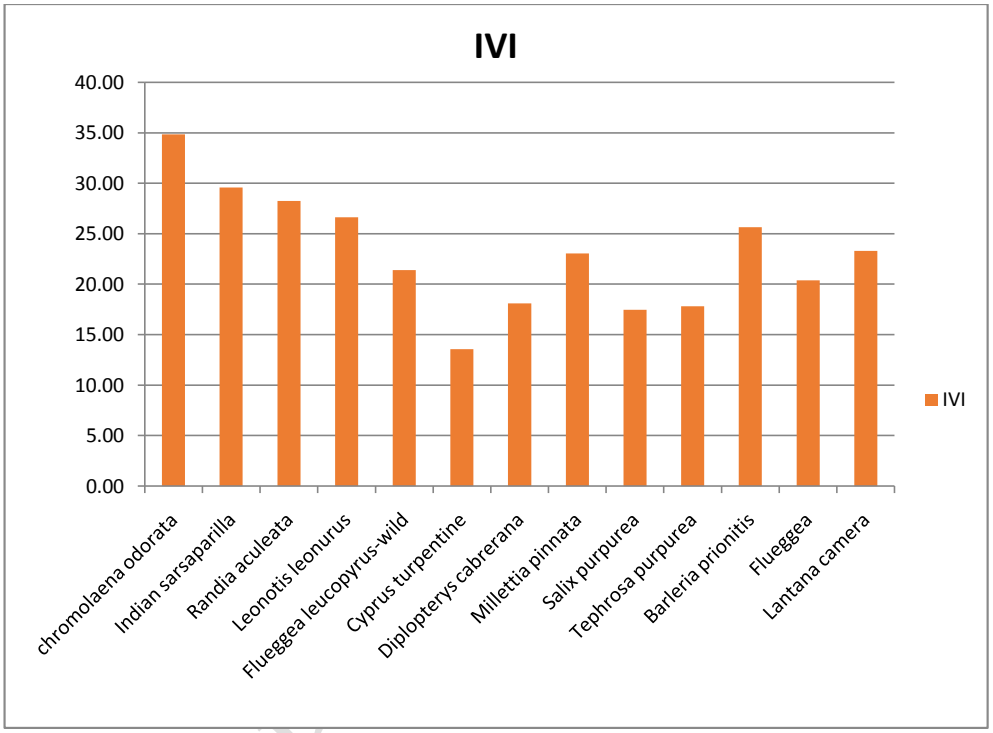

Fig.6: IVI Index of Shrub species in Site-1

Site-2
Table 16. list of Shrub found in site 2

S no.	Botanical name	family	Local name	Common name
1.	*chromolaena odorata*	Astaraceae	Siam weed	Butterfly weed
2.	*Indian sarsaparilla*	Asclepidiaceae	Nannari	Smilax ornate
3.	*Diplopterys cabrerana*	Malphigiaceae		Cagrofunga
4.	*Barleria prionitis*			
5.	*Oplismenus hirtellus sub.spp*	Poaceae		Basket grass

6.	*Lantana camera*	Verbenaveae	Kongini	Spinach flag
7.	*Ehretia microphylla*	Boraginaceae		Fukein tea tree
8.	*Calotropis procera*	Apocynaceae		Soddom apple
9.	*Alvaradoa amorphoides*	Picramniaceae		Mexican Alvaradoa
10	*Mimosa pudica*	Fabaceae		Shame palnt

Table no 17. Shrub species recorded in 5 x5m quadrate in Site 2

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

Table no 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. Quantative analyses for Shrub species of site 2 is categorized as below:

S.no.	**Species**	**D.**	**F.**	**A.**	**RD.**	**RF.**	**R Do.**	**IVI**
1.	*chromolaena odorata*	5.93	86.67	0.87	14.44	14.44	14.44	43.33
2.	*Indian sarsaparilla*	8.07	80.00	0.80	13.33	13.33	13.33	40.00

3.	*Diplopterys cabrerana*	6.73	73.33	0.73	12.22	12.22	12.22	36.67
4.	*Barleria prionitis*	1.47	40.00	0.40	6.67	6.67	6.67	20.00
5.	*Oplismenus hirtellus sub.spp*	5.40	80.00	0.80	13.33	13.33	13.33	40.00
6.	*Lantana camera*	6.87	100.00	1.00	16.67	16.67	16.67	50.00
7.	*Ehretia microphylla*	2.47	40.00	0.40	6.67	6.67	6.67	20.00
8.	*Calotropis procera*	0.93	46.67	0.47	7.78	7.78	7.78	23.33
9.	*Alvaradoa amorphoides*	0.27	20.00	0.20	3.33	3.33	3.33	10.00
10.	*Mimosa pudica*	1.33	33.33	0.33	5.56	5.56	5.56	16.67
	Total	**39.47**	**600**	**6**	**100**	**100**	**100**	**300**

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 frequeancy 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).**

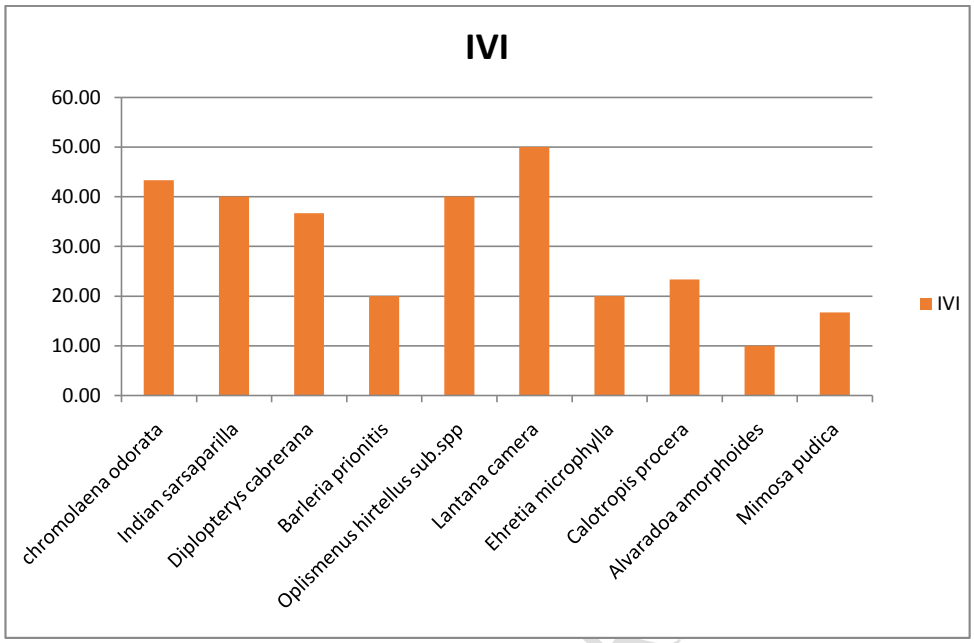

Fig.7: IVI Index of Shrub species in Site-2

Site-3

Table 19. list of shrub found in site 3

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

Table no 20. Tree species recorded in 5x5 quadrate in Site 3

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

Table no 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 no 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.	*chromolaena odorata*	3.47	86.67	86.67	13.61	16.67	16.67	46.95
2.	*Indian sarsaparilla*	5.33	66.67	66.67	20.94	12.82	12.82	46.58
3.	*Dalbergia horrida*	0.67	26.67	26.67	2.62	5.13	5.13	12.87
4.	*Lantana camera*	7.07	100.00	100.00	27.75	19.23	19.23	66.21
5.	*Leonotis leonurus*	0.47	40.00	40.00	1.83	7.69	7.69	17.22
6.	*Ziziphus mauritiana*	0.53	33.33	33.33	2.09	6.41	6.41	14.91
7.	*Senegalia alaxacantha*	0.87	40.00	40.00	3.40	7.69	7.69	18.79
8.	*Diplopterys cabrerana*	0.87	20.00	20.00	3.40	3.85	3.85	11.10

9.	*Mimosa pudica*	4.93	80.00	80.00	19.37	15.38	15.38	50.14
10.	*Vachellia schalfueri*	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 no 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 no 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 frequeancy was ***Diplopterys cabrerana* (20.00), *Dalbergia horrida* (26.67), *Vachellia schalfueri* (26.67) .**

Table no 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).**

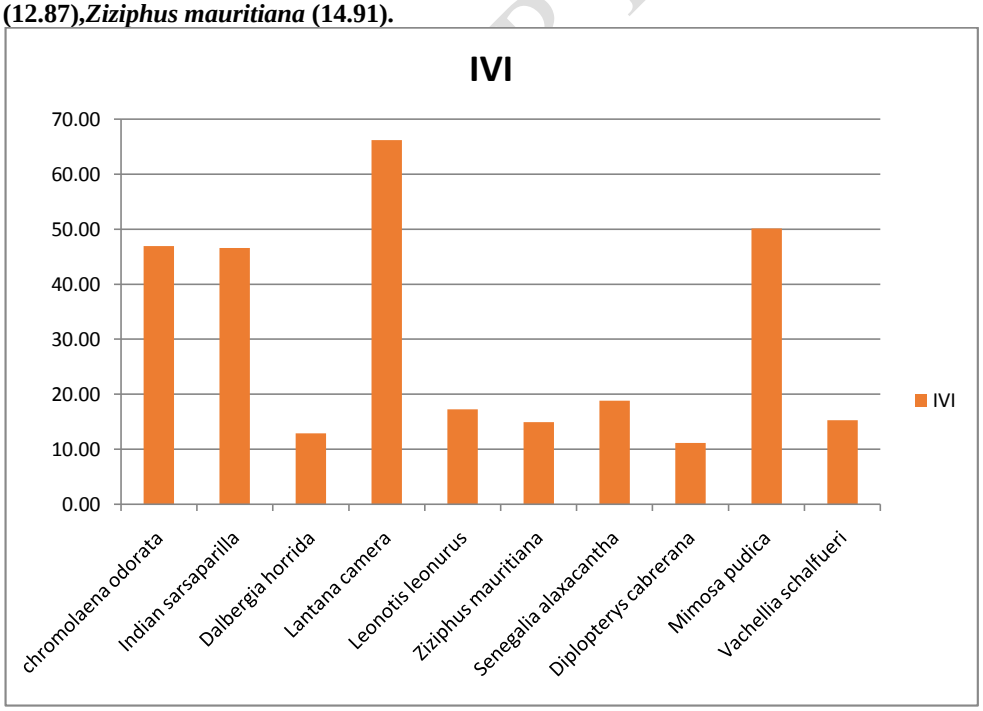

Fig.8: IVI Index of Shrub species in Site-3

Site-4

Table 22. list of shrub found in site 4

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

Table no 23. Shrub species recorded in 5x5 quadrate in Site 4

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

Table no 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 no 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.	*chromolaena odorata*	*2.00*	*33.33*	*2.00*	*6.61*	*6.17*	*6.61*	*19.39*
2.	*Indian sarsaparilla*	*5.53*	*80.00*	*5.53*	*18.28*	*14.81*	*18.28*	*51.38*
3.	*Leonotis leonurus*	*3.20*	*46.67*	*3.20*	*10.57*	*8.64*	*10.57*	*29.79*
4.	*Oplismenus hirtellus sub.spp*	*4.33*	*53.33*	*4.33*	*14.32*	*9.88*	*14.32*	*38.51*
5.	*Lantana camera*	*4.20*	*66.67*	*4.20*	*13.88*	*12.35*	*13.88*	*40.10*
6.	*Mimosa pudica*	*3.27*	*53.33*	*3.27*	*10.79*	*9.88*	*10.79*	*31.46*
7.	*Sanna spectabilis*	*2.07*	*40.00*	*2.07*	*6.83*	*7.41*	*6.83*	*21.06*
8.	*Dalbergia horrida*	*2.73*	*73.33*	*2.73*	*9.03*	*13.58*	*9.03*	*31.64*
9.	*Stryechnos psilosperma*	*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 no 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 no 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 frequeancy was ***Gift tree* (26.67), *chromolaena odorata* (33.33) , *Sanna spectabilis* (40.00).**

Table no 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 no 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),*Stryechnos psilosperma* (26.44).**

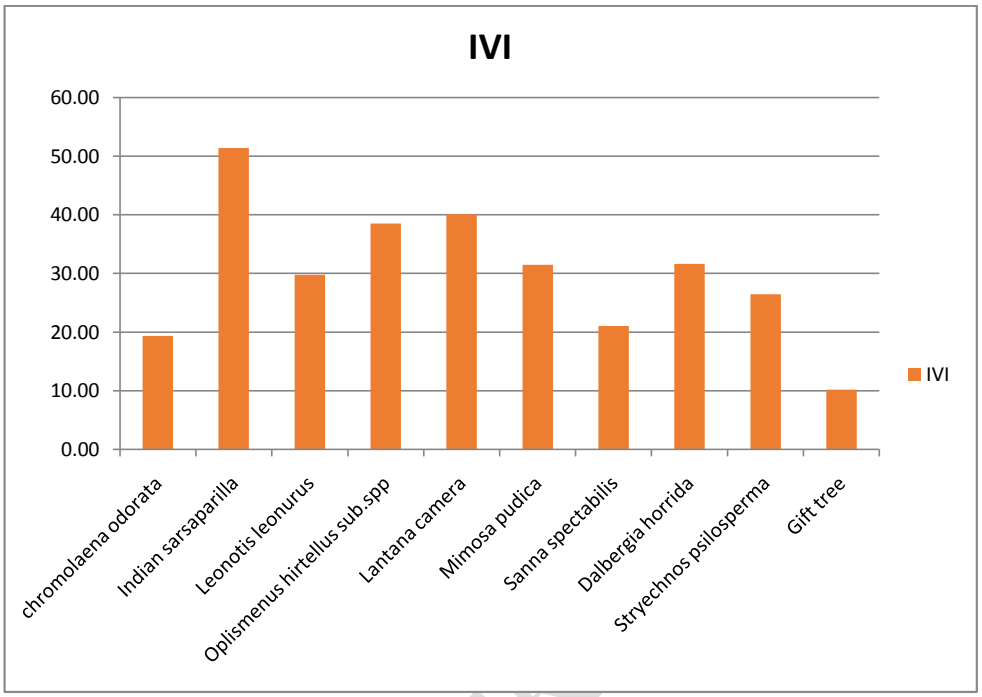

Fig.9: IVI Index of Shrub species in Site-4

6.0).HERB

6.1 list of the entire Herb Species found in all four sites:

S no.	Botanical name	family	Common name
1.	*Abrus precatorius*	Fabaceae	Rosary Pea
2.	*Ageratum conyzoides*	Asteraceae	
3.	*Allamanda cathartica*	Apocynaceae	Yellow allamanda
4.	*Alternanthera ficoidea*	Amaranthaceae	Brazillian Snow flower
5.	*Alternanthera sessils*	Amaranthaceae	Stalkless joyweed
6.	*Ambrosia artemisiifolia*	Amaranthaceae	Annual rag weed
7.	*Aristida purpurea*	Poaceae	Purple three awn
8.	*Bigelovia verticillata*		

9.	*Bistorta officinalis*	Poligonaceae	Bistort
10.	*Bothriochloa ischaemum*	Poaceae	Yellow blue stem
11.	*Opuntia macrorhiza*	Cactaceae	Pricklypear cactus
12.	*Celtica gigantea*	Poaceae	Golden Oats
13.	*Ceropegia bulbosa roxb*	Apocynaceae	Lantern flower
14.	*Chenopodium album*	Amarantheaceae	Bacon weed
15.	*Cuscuta approximata*	Convolvolaceae	Alfaalfa Dodder
16.	*Dichanthelium clandestinum*	Poaceae	Deer tongue
17.	*Dioscorea bulbifera*	Dioscoreaceae	Air yam
18.	*Eachinochola*	Paniceae	Deccan grass
19.	*Elephantopus scaber*	Astaraceae	Elephant's foot
20.	*Galinsoga ciliata*	Astaraceae	Hairy galinsoga
21.	*Grona triflora*	Fabaceae	Trefoil
22.	*Harrisia martinii*	Cactaeace	Harrisia cactus
23.	*Herbarium pacificum*		
24.	*Lithocarpus femestratus*	Fagaceae	Stone oak
25.	*lternanthera caracasana*	Amarantheaceae	Washerman women
26.	*Merrennia hedoracea*	Convolvulaceae	Ivy woodrose
27.	*Mesophaerum suavelens*	Lamiaceae	Pignut
28.	*Oplismenus burmannii*	Poaceae	Running mountaingrass
29.	*Pandiaka augustifolia*		
30.	*Panicum repens*	Poaceae	Bullet grass
31.	*Paspalum vaginatum*	Poaceae	Sword grass

32.	*Scrophularia nodosa*	Schrophuliaceae	Fig wort
33.	*Semecarpus kathalekamensis*	Anacardiaceae	Kathalekan marsh nut
34.	*Stylo santhes fruticose*	Fabaceae	African stylo
35.	*Synedrella nodiflora*	Astaraceae	Cynderella weed
36.	*Tortoise preserve*		
37.	*Treebine*	Vitaceae	Veldt grape
38.	*Tridax procumbeus*	Aataraceae	Tridax daisy
39.	*Trifolium repens*	Fabaceae	White clover
40.	*Verbena officinalis*	Verbaceae	Vervain

Site 1

The vegetation compostion in site 1 recorded in 20 quadrates of 1 x 1m^2 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 25. list of herbs found in site 1

S no.	Botanical name	family	Common name
1.	Scrophularia nodosa	Schrophuliaceae	Fig wort
2.	Mesophaerum suavelens	Lamiaceae	Pignut
3.	Ceropegia bulbosa roxb	Apocynaceae	Lantern flower
4.	Panicum repens	Poaceae	Bullet grass
5.	Verbena officinalis	Verbaceae	Vervain
6.	Cuscuta approximata	Convolvolaceae	Alfaalfa Dodder
7.	Lithocarpus femestratus	Fagaceae	Stone oak
8.	Alternanthera sessils	Amaranthaceae	Stalkless joyweed
9.	Paspalum vaginatum	Poaceae	Sword grass

10.	Pandiaka augustifolia		
11.	Stylo santhes fruticose	Fabaceae	African stylo
12.	Tridax procumbeus	Aataraceae	Tridax daisy
13.	Synedrella nodiflora	Astaraceae	Cynderella weed
14.	Semecarpus kathalekamensis	Anacardiaceae	Kathalekan marsh nut

Table no 26. Herb species recorded in 1x1 quadrate in Site-1

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

Table no. 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 sessils (25)*** whereas, the herb species having *minimum* number of individuals ***Panicum repens* (8), *Lithocarpus femestratus* (10), *Tridax procumbeus* (11).**

Table no 27. Quantative analyses for Herb species of site 1 is categorized as below:

S.no.	Species	D.	F.	A.	RD.	RF.	R Do.	IVI
1.	*Scrophularia nodosa*	1.20	40.00	3.00	7.03	8.11	86.72	101.86
2.	*Mesophaerum suavelens*	2.53	53.33	4.75	14.84	10.81	137.30	162.96
3.	*Ceropegia bulbosa roxb*	0.87	33.33	2.60	5.08	6.76	75.16	86.99
4.	*Panicum repens*	0.53	33.33	1.60	3.12	6.76	46.25	56.13
5.	*Verbena officinalis*	1.47	53.33	2.75	8.59	10.81	79.49	98.90
6.	*Cuscuta approximata*	1.93	33.33	5.80	11.33	6.76	167.66	185.74
7.	*Lithocarpus femestratus*	0.67	20.00	3.33	3.91	4.05	96.35	104.31
8.	*Alternanthera sessils*	1.67	46.67	3.57	9.77	9.46	103.24	122.46
9.	*Paspalum vaginatum*	0.87	26.67	3.25	5.08	5.41	93.95	104.43
10.	*Pandiaka augustifolia*	1.07	26.67	4.00	6.25	5.41	115.63	127.28
11.	*Stylo santhes fruticose*	1.20	26.67	4.50	7.03	5.41	130.08	142.51
12.	*Tridax procumbeus*	0.73	33.33	2.20	4.30	6.76	63.59	74.65
13.	*Synedrella nodiflora*	1.27	26.67	4.75	7.42	5.41	137.30	150.13
14.	*Semecarpus kathalekamensis*	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 density amongst the ***Mesophaerum suavelens* (2.53), *Cuscuta approximata* (1.93), *Alternanthera sessils* (1.67)**, While the Herb species showing lowest density included***Panicum repens* (0.53), *Lithocarpus femestratus* (0.67), *Tridax procumbeus* (0.73).**
Table no 27 showed Herb species having highest frequency amongst the species include***Mesophaerum suavelens* (53.33). *Verbena officinalis* (53.33), *Alternanthera sessils* (46.67).** While the Herb species showing the lowest frequeancy 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).**

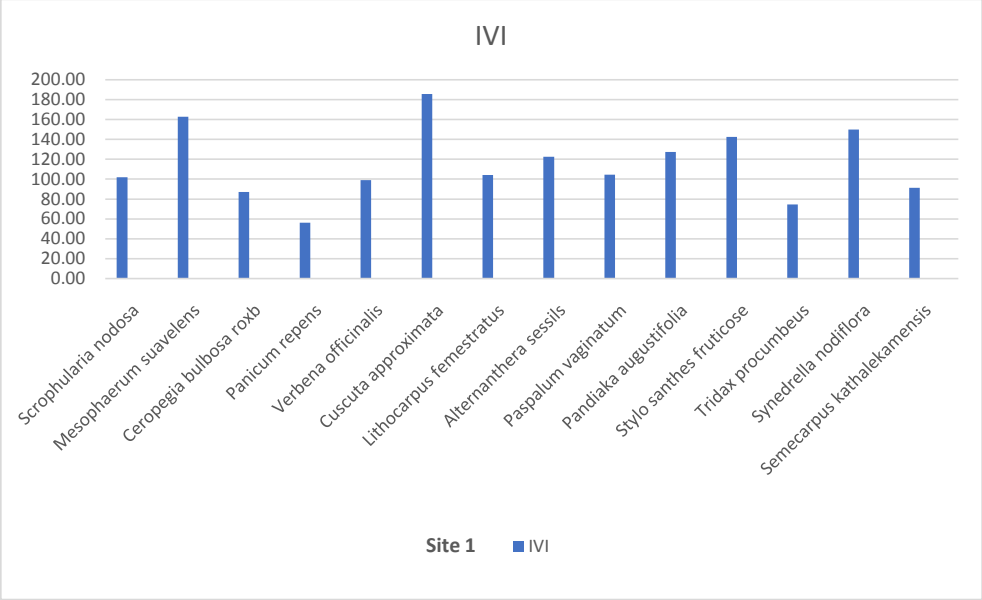

Fig.10: IVI Index of Herb species in Site-1

Site-2

Table 28. list of Herb found in site 2

S. No.	Botanical name	Family	Common name
1.	*Mesophaerum suavelens*	Lamiaceae	Pignut
2.	*Tridax procumbeus*	Aataraceae	Tridax daisy
3.	*Synedrella nodiflora*	Astaraceae	Cynderella weed
4.	*Galinsoga ciliata*	Astaraceae	Hairy galinsoga
5.	*Trifolium repens*	Fabaceae	White clover
6.	*Abrus precatorius*	Fabaceae	Rosary Pea

7.	*Grona triflora*	Fabaceae	Trefoil
8.	*Merrennia hedoracea*	Convolvulaceae	Ivy woodrose
9.	*Aristida purpurea*	Poaceae	Purple three awn
10.	*Dioscorea bulbifera*	Dioscoreaceae	Air yam

Table no 29. Herb species recorded in 1x1 quadrate in Site 2

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

Table no. 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 no 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.	*Mesophaerum suavelens*	1.13	60.00	1.13	6.64	13.64	6.64	26.92
2.	*Tridax procumbeus*	0.53	26.67	0.53	3.12	6.06	3.12	12.31
3.	*Synedrella nodiflora*	1.33	33.33	1.33	7.81	7.58	7.81	23.20

4.	*Galinsoga ciliata*	1.73	53.33	1.73	10.16	12.12	10.16	32.43
5.	*Trifolium repens*	2.07	40.00	2.07	12.11	9.09	12.11	33.31
6.	*Abrus precatorius*	2.53	60.00	2.53	14.84	13.64	14.84	43.32
7.	*Grona triflora*	1.47	33.33	1.47	8.59	7.58	8.59	24.76
8.	*Merrennia hedoracea*	0.67	40.00	0.67	3.91	9.09	3.91	16.90
9.	*Aristida purpurea*	2.60	46.67	2.60	15.23	10.61	15.23	41.07
10.	*Dioscorea bulbifera*	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 no 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 no 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 frequeancy was ***Tridax procumbeus*** **(26.67),*****Synedrella nodiflora*** **(33.33),*****Grona triflora*** **(33.33).**

Table no 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 no 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).**

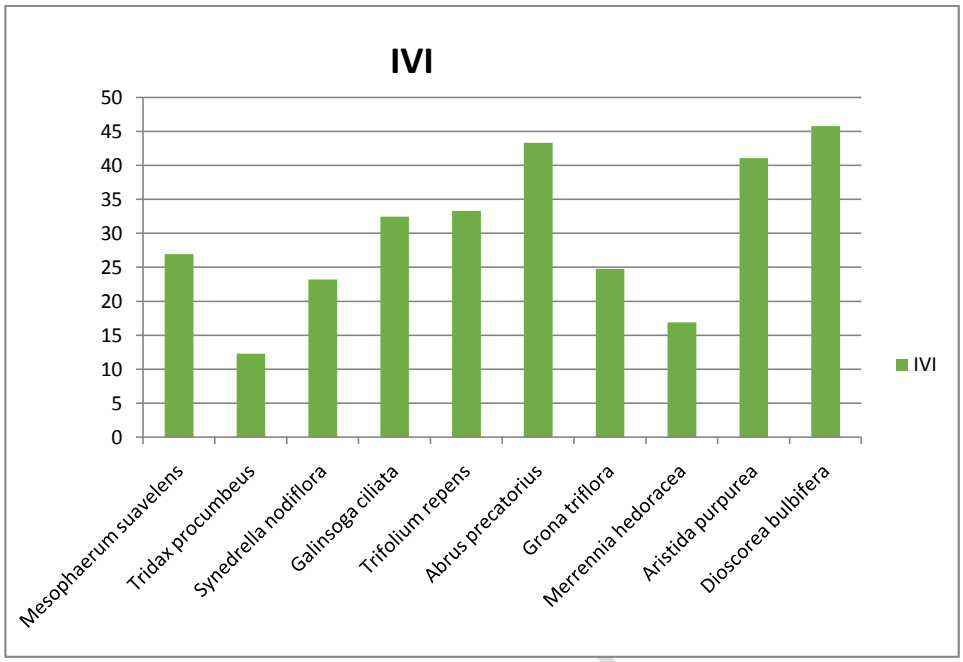

Fig.11: IVI Index of Herb species in Site-2

Site-3

Table 31. list of Herb found in site 3

S no.	Botanical name	family	Common name
1.	*Tridax procumbeus*	Aataraceae	Tridax daisy
2.	*Synedrella nodiflora*	Astaraceae	Cynderella weed
3.	*Abrus precatorius*	Fabaceae	Rosary Pea
4.	*Celtica gigantea*	Poaceae	Golden Oats
5.	*Bothriochloa ischaemum*	Poaceae	Yellow blue stem
6.	*Tortoise preserve*		
7.	*Treebine*	Vitaceae	Veldt grape
8.	*Bistorta officinalis*	Poligonaceae	Bistort
9.	*Alternanthera ficoidea*	Amaranthaceae	Brazillian Snow flower
10.	*Eachinochola*	Paniceae	Deccan grass

11.	*Allamanda cathartica*	Apocynaceae	Yellow allamanda
12.	*Chenopodium album*	Amarantheaceae	Bacon weed
13.	*Ageratum conyzoides*	Asteraceae	
14.	*Bigelovia verticillata*		
15.	*Herbarium pacificum*		
16.	***Harrisia martinii***	Cactaeace	Harrisia cactus

Table no 32. Herb species recorded in 1x1 quadrate in Site-3

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

16.	*Harrisia martinii*	9	5
	Total	**311**	**93**

Table no. 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 havingminimum number of individuas ***Abrus precatorius* (7), *Harrisia martinii* (9),*Chenopodium album* (11).**

Table no 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.	*Tridax procumbeus*	0.93	40.00	0.93	4.50	6.45	4.50	15.45
2.	*Synedrella nodiflora*	2.67	40.00	2.67	12.86	6.45	12.86	32.18
3.	*Abrus precatorius*	0.47	33.33	0.47	2.25	5.38	2.25	9.88
4.	*Celtica gigantea*	1.00	53.33	1.00	4.82	8.60	4.82	18.25
5.	*Bothriochloa ischaemum*	3.27	66.67	3.27	15.76	10.75	15.76	42.26
6.	*Tortoise preserve*	2.47	33.33	2.47	11.90	5.38	11.90	29.17
7.	*Treebine*	0.80	46.67	0.80	3.86	7.53	3.86	15.24
8.	*Bistorta officinalis*	0.93	46.67	0.93	4.50	7.53	4.50	16.53
9.	*Alternanthera ficoidea*	1.27	40.00	1.27	6.11	6.45	6.11	18.67
10.	*Eachinochola*	1.33	46.67	1.33	6.43	7.53	6.43	20.39
11.	*Allamanda cathartica*	0.80	33.33	0.80	3.86	5.38	3.86	13.09
12.	*Chenopodium album*	0.73	40.00	0.73	3.54	6.45	3.54	13.53
13.	*Ageratum conyzoides*	1.13	20.00	1.13	5.47	3.23	5.47	14.16
14.	*Bigelovia verticillata*	1.07	26.67	1.07	5.14	4.30	5.14	14.59
15.	*Herbarium pacificum*	1.27	20.00	1.27	6.11	3.23	6.11	15.44
16.	*Harrisia martinii*	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 no 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 no 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 frequeancy was***Ageratum conyzoides* (20.00),*Herbarium pacificum* (20.00), *Bigelovia verticillata.* (26.67).**

Table no 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 no 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).**

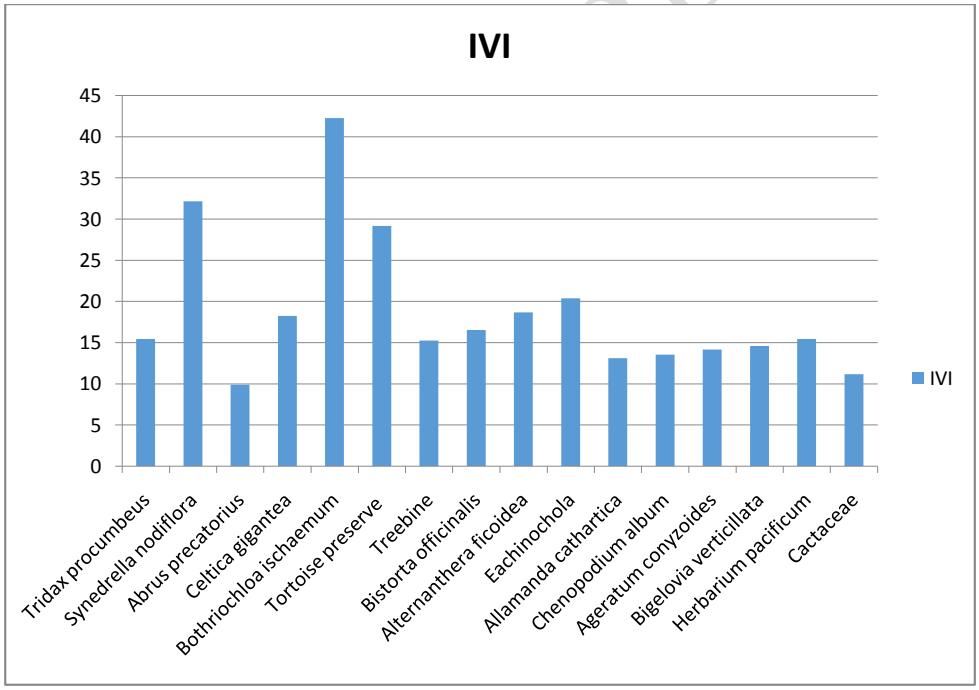

Fig.12: IVI Index of Herb species in Site-3

Site - 4

Table 34. list of Herb found in site 4

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

Table no 35. Herb species recorded in 1x1 quadrate in Site 4

S.no.	Botanical name	Total individuals	No.of quadrate species occured
1.	Synedrella nodiflora	32	7
2.	Ageratum conyzoides	25	5
3.	Harrisia martinii	12	8
4.	Elephantopus scaber	22	6
5.	Oplismenus burmannii	28	6
6.	Dichanthelium clandestinum	27	5
7.	lternanthera caracasana	19	5
8.	Ambrosia artemisiifolia	28	8
	Total	**193**	**50**

Table no. 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), *lternanthera caracasana* (19).**

Table no 36. Quantative analysis for herb species of site 4 is categorized as below:

S.No.	Species	D.	F.	A.	RD.	RF.	R Do.	IVI
1.	Synedrella nodiflora	2.13	46.67	4.57	16.58	14.00	118.43	149.01
2.	Ageratum conyzoides	1.67	33.33	5.00	12.95	10.00	129.53	152.49
3.	Harrisia martinii	0.80	53.33	1.50	6.22	16.00	38.86	61.08
4.	Elephantopus scaber	1.47	40.00	3.67	11.40	12.00	94.99	118.39
5.	Oplismenus burmannii	1.87	40.00	4.67	14.51	12.00	120.90	147.41
6.	Dichanthelium clandestinum	1.80	33.33	5.40	13.99	10.00	139.90	163.89
7.	lternanthera caracasana	1.27	33.33	3.80	9.84	10.00	98.45	118.29
8.	Ambrosia artemisiifolia	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 no 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) , lternanthera caracasana (1.27), Elephantopus scaber (1.47)***

Table no 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 frequeancy was***Ageratum conyzoides (33.33),Dichanthelium clandestinum (33.33), lternanthera caracasana (33.33).***

Table no 36 showed Herb species showing the highest abundance among the species include***Dichanthelium clandestinum (5.40), Ageratum conyzoides (5.00), Oplismenus burmannii (4.67).*** While, the lowest abundance was shown by the species***Harrisia martinii (1.50), Ambrosia artemisiifolia (3.50), Elephantopus scaber (3.67).***

Table no 36 showed Herb species having highest IVI amongst the species included***Dichanthelium clandestinum (163.89), Ageratum conyzoides (152.49), Synedrella nodiflora (149.01).***While the lowest IVI shown by the species was***Harrisia martinii (61.08), lternanthera caracasana (118.29), Elephantopus scaber (118.39).***

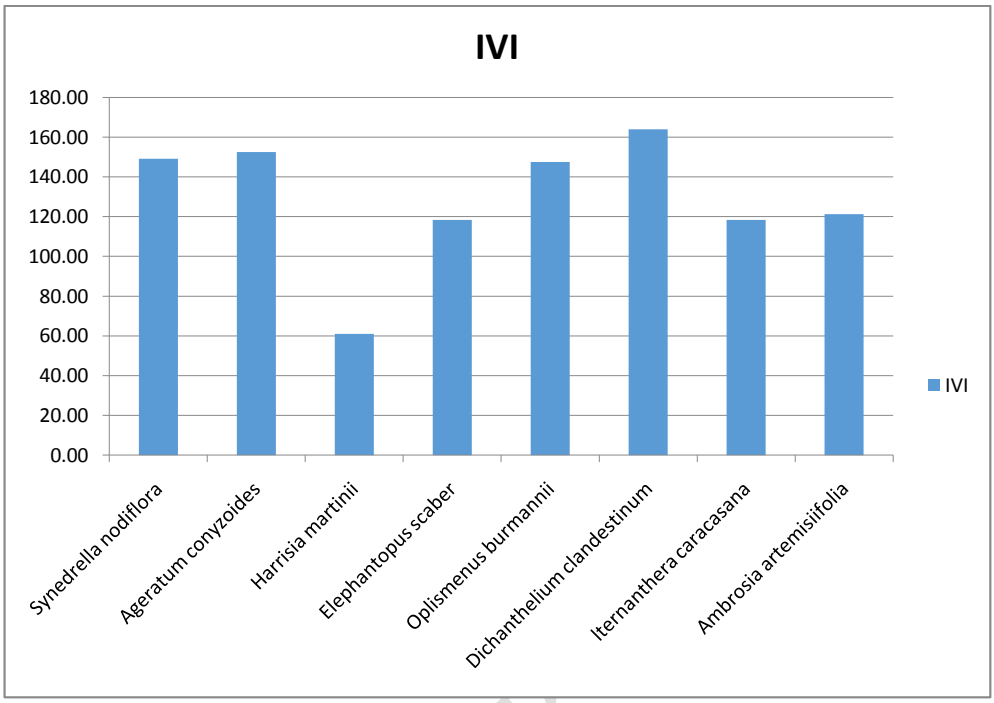

Fig.13: IVI Index of Herb species in Site-4

7.0 Diveristy of species in Redsanders Park Chittoor

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

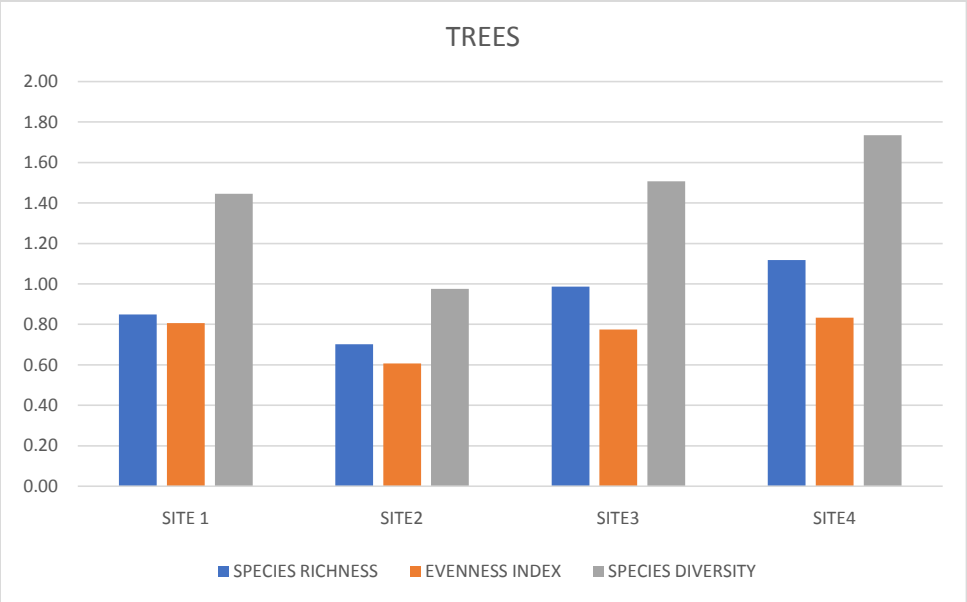

Fig 14: Diversity parameter of tree species in different sites.

	SPECIES RICHNESS	EVENNESS INDEX	SPECIES DIVERSITY
SITE 1	0.85	0.81	1.44
SITE2	0.70	0.61	0.98
SITE3	0.99	0.77	1.51
SITE4	1.12	0.83	1.73

7.2 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).

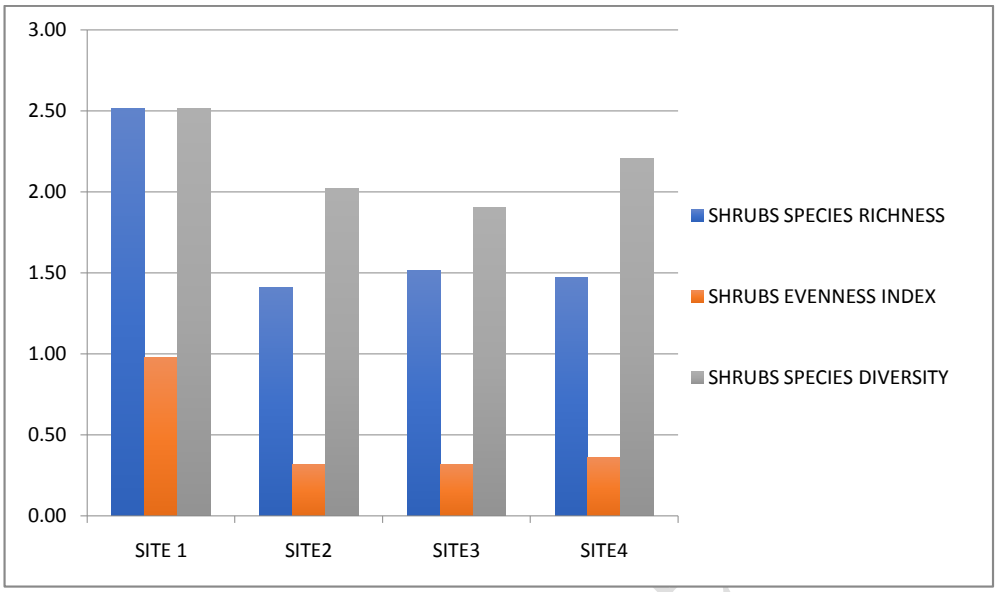

Fig 15: Diversity parameter of Shrub species in different sites.

	SPECIES RICHNESS	EVENNESS INDEX	SPECIES DIVERSITY
SITE 1	2.52	0.98	2.52
SITE2	1.41	0.32	2.02
SITE3	1.51	0.32	1.90
SITE4	1.47	0.36	2.20

7.3 Herb 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).

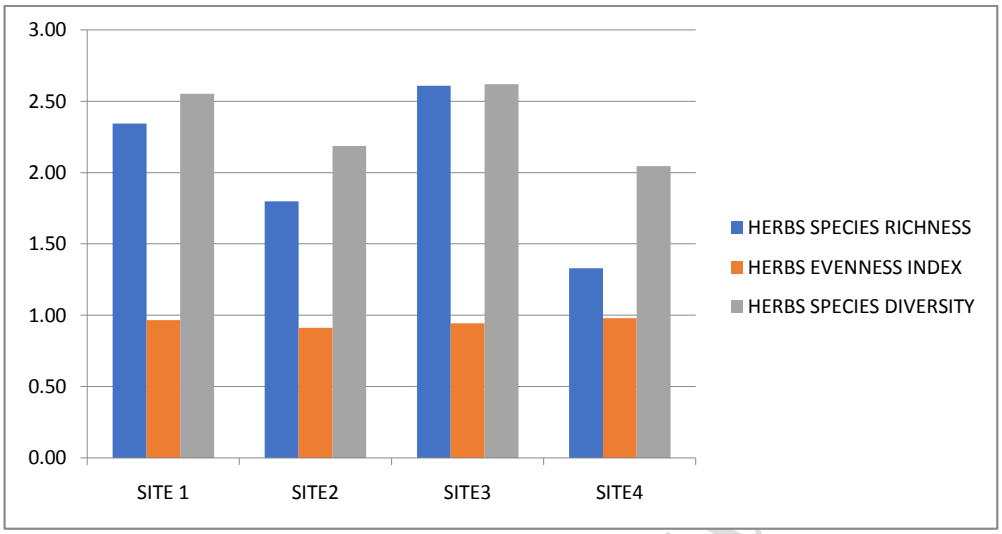

Fig 16: Diversity parameter of Herb species in different sites.

	SPECIES RICHNESS	EVENNESS INDEX	SPECIES DIVERSITY
SITE 1	2.34	0.97	2.55
SITE2	1.80	0.91	2.19
SITE3	2.61	0.95	2.62
SITE4	1.33	0.98	2.05

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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