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Phytodiversity Characterization of Dry Deciduous Forest of Baran Forest Division

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Abstract The present study was carried out for vegetation diversity of dry deciduous forest in seven micro-sites. Phytodiversity revealed 39 tree species, 16 shrub species and 36 herbaceous species. Highest tree density and basal area were found in Site-VI, 1040 ind/ha and Site-I, 8.44 m^2/ha respectively, whereas in shrubs Site-I, 208 ind/ha and Site-VII, 0.0470 m^2/ha represented as a maximum density and basal area. In case of herbaceous highest density and basal area were recorded in Site-VII, 3776 ind/ha and Site-I, 152.42 cm^2/ha. Similarity index ranged for tree, shrub and herbaceous species from 10.98 to 69.62, 12.80 to 66.55 and 16.03 to 64.44. Species diversity for tree, shrub and herbaceous ranged from 1.31 to 3.08, 1.28 to 1.71 and 1.32 to 2.72. Simpson's dominance ranged from 0.05 to 0.40, 0.20 to 0.31 and 0.07 to 0.35 for tree, shrub and herbaceous species. Three types of dominance diversity curves were also found in this present study in various vegetation stratums.

Keywords Vegetation, Density, Basal area, IVI, D-D curve.

Introduction

Forest is considered as a complex ecosystem which is predominantly composed of trees, shrubs and climbers and has closed canopy of plants and are the natural storehouse of large variety of various life forms including plants, animals, birds, insects, reptiles and micro-organisms [1]. Biodiversity is the totality of genes, species and ecosystem in a region. It is essential for human survival and economic well-being and for the ecosystem function and stability [2]. Phytosociology is the study of the characteristics, classification, relationship, spatial and temporal distribution of plant communities and it is useful to collect such as data to describe the population dynamics of each species studied and how they related to each other species in the same communities [3]. In India, habitat destruction, over exploitation, pollution and species introduction are identified as per major causes of

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Table 1. General characteristics of the study sites.

Site No.	Site name	GPS readings Starting	GPS readings Ending	Total density/ha Tree	Shrub	Herb	Total basal area (m^2) Tree (m^2)	Shrub (m^2)	Herb (cm^2)	Soil texture class
I	Around Naka	25°12′ 13.06′′N 77°07′ 51.21′′E	25°12′ 22.20′′N 77°07′ 46.57′′E	868	208	2256	8.44	0.0442	152.42	Sandy loam
II	Bansthooni	25°04′ 47.60′′N 76°42′ 27.74′′E	25°04′ 51.92′′N 76°42′ 38.79′′E	828	104	3416	0.90	0.0054	135.21	Clay
III	Butea Valley	25°14′ 30.54′′N 77°09′ 31.00′′E	25°14′ 28.45′′N 77°09′ 27.89′′E	872	88	2824	6.15	0.0237	164.42	Sandy
IV	Kunda Kho	25°13′ 18.45′′N 77°07′ 48.27′′E	25°13′ 21.68′′N 77°07′ 50.09′′E	724	132	1396	5.25	0.0285	91.00	Clay
V	Shahbad Upland	25°14′ 24.71′′N 77°09′ 31.72′′E	25°14′ 27.87′′N 77°09′ 33.05′′E	980	104	1568	4.43	0.0185	59.43	Sandy loam
VI	Toll Left	25°12′ 56.30′′N 77°08′ 20.01′′E	25°12′ 58.62′′N 77°08′ 18.90′′E	1040	140	3084	4.52	0.0417	120.15	Sandy loam
VII	Toll Right	25°12′ 24.62′′N 77°08′ 25.31′′E	25°12′ 51.58′′N 77°08′ 30.60′′E	968	188	3776	4.65	0.0470	70.59	Clay

biodiversity loss [4]. In Rajasthan, the hilly topography in Aravalli mountain ranges provides a wide variety of micro-habitats which support rich biodiversity of plant species. However, many tropical forests are under great anthropogenic pressure and require management intervention to maintain the overall biodiversity, productivity and sustainability. Understanding species diversity and distribution pattern is important for helping managers evaluate the complexity and resources of these forests [5].

Topography, climate and study area

Baran district is known as tribal area specially Sehariya tribe. Around 283 villages of Kishanganj, Shahbad,

Table 2. Importance value index (IVI) of tree species in various sites.

Sl. No.	Name of species	Sites I	II	III	IV	V	VI	VII
1	*Acacia catechu*	15.75	65.43	5.18	7.61	1.86	9.12	5.59
2	*Acacia leucophloea*	1.56	10.31	1.71	–	6.02	4.02	–
3	*Acacia senegal*	11.24	–	–	6.13	3.09	15.88	1.86
4	*Aegle marmelos*	1.30	–	–	4.94	–	2.47	4.91
5	*Ailenthes excellsa*	–	–	–	1.53	–	–	–
6	*Alangium salvifolium*	–	–	11.54	–	15.50	3.06	8.50
7	*Albizia lebbeck*	–	–	–	–	–	5.83	–
8	*Annona reticulate*	–	–	14.54	–	–	–	–
9	*Anogeissus latifolia*	3.39	4.35	32.98	6.60	6.91	19.94	41.79
10	*Anogeissus pendula*	–	129.44	9.00	14.80	1.38	–	–
11	*Azadirachta indica*	7.59	13.76	7.09	1.78	1.27	1.29	–
12	*Bauhinia variegata*	–	2.24	–	4.27	–	–	–
13	*Boswellia serrata*	–	–	–	11.37	–	18.02	–
14	*Buchanania lanzan*	–	–	–	15.87	–	1.40	23.67
15	*Butea monosperma*	35.87	13.17	128.62	8.45	20.51	23.71	9.44
16	*Caesearia tomentosa*	3.65	–	–	6.68	–	5.77	3.33
17	*Cassia fistula*	4.97	3.32	2.56	9.12	18.89	6.46	11.38
18	*Cassine glauca*	–	–	–	1.62	–	–	–
19	*Dalbergia sissoo*	–	–	–	–	–	3.17	–
20	*Diospyros melanoxylon*	10.87	–	5.75	27.35	23.41	20.36	20.97

Table 2. Continued.

Sl. No.	Name of species	Sites I	II	III	IV	V	VI	VII
21	*Euphorbia neriifolia*	–	–	–	7.89	–	–	–
22	*Ficus benghalensis*	14.88	–	–	–	–	12.05	
23	*Ficus racemosa*	–	–	–	3.68	–	–	–
24	*Ficus virens*	–	–	–	7.45	–	–	–
25	*Flacourtia indica*	1.34	–	6.76	6.60	7.49	5.07	11.96
26	*Holoptelea integrifolia*	5.74	–	20.81	2.01	4.95	13.79	11.74
27	*Lagerstroemia indica*	5.76	–	–	18.86	–	5.77	13.39
28	*Lannea coromandelica*	23.88	–	–	25.03	103.58	13.75	27.82
29	*Limonia crenulata*	41.22	–	–	6.54	–	18.55	4.97
30	*Madhuca indica*	37.96	–	–	1.81	–	20.70	9.21
31	*Miliusa tomentosa*	7.24	–	–	15.30	4.55	14.60	29.79
32	*Mitragyna parviflora*	26.57	5.44	44.09	18.75	17.14	22.54	
33	*Emblica officinalis*	–	43.69	–	5.54	–	–	1.42
34	*Sterculia urens*	–	–	–	31.23	9.07	–	
35	*Syzygium jambolanum*	–	–	–	2.56	–	–	–
36	*Tamarindus indica*	5.63	–	3.08	3.30	–	–	–
37	*Terminalia bellerica*	6.16	–	–	–	1.85	6.02	22.55
38	*Wrightia tinctoria*	23.62	8.82	6.24	15.18	52.44	26.31	35.64
39	*Ziziphus jujuba*	*3.26*	–	–	–	–	–	–

Atru and Mangrol Tehsils are known as Sehariya Basti, where about 90% population belongs to Sehariya. According to a study there are about 80,000 Sehariya. It is situated at 265 meter hight from mean sea level. Kalisindh, Parwati, Andheri, Banganga, Parwan Rivers passes through South to North in the district. The temperature ranges between maximum 48.6°C and minimum 10.6°C. Average rainfall is 873.80 mm. The rainfall pattern is typically monsoon type with rainfall concentrated from July to September. Drought like conditions occurs during April, May and June just before the start of monsoon [6].

The present study was carried out in Baran for-

Table 3. Importance value index (IVI) of shrub species in various sites.

Sl. No.	Name of species	Sites I	II	III	IV	V	VI	VII
1	*Acacia catechu*	–	86.16	–	–	–	–	–
2	*Anogeissus latifolia*	–	–	–	–	–	–	47.56
3	*Anogeissus pendula*	–	86.07	–	–	–	–	–
4	*Butea monosperma*	–	–	115.97	–	–	–	–
5	*Calotropis procera*	–	–	–	–	37.89	–	–
6	*Capparis sepiaria*	61.67	38.39	51.79	49.12	36.55	44.20	50.76
7	*Carissa carandas*	–	–	–	–	10.96	–	12.43
8	*Flacourtia indica*	40.26	–	68.67	103.58	119.85	132.12	71.29
9	*Lannea coromandelica*	–	–	–	–	56.48	–	–
10	*Limonia crenulata*	76.45	–	–	–	–	–	–
11	*Mitragyna parviflora*	–		–	–	–	–	–
12	*Nerium olender*	–	–	–	25.73	–	–	–
13	*Sterculia urens*	–	–	–	42.35	–	–	–
14	Wrightia tinctoria	–	–	–	–	–	53.33	–
15	*Ziziphus jujuba*	10.99	89.38	–	57.68	38.27	–	71.31
16	*Ziziphus oenoplia*	110.62	–	–	21.53	–	70.35	46.65

Table 4. Importance value index (IVI) of herbaceous species in various sites.

Sl. No.	Name of species	Sites I	II	III	IV	V	VI	VII
1	*Achyranthus aspera*	45.35	2.25	18.28	34.76	24.64	30.69	27.09
2	*Aristida adscensionis*	4.63	19.99	3.01	5.12	–	9.08	5.59
3	*Boechera stricta*	–	16.55	–	–	–	–	–
4	*Borreria sticta*	–	–	–	1.86	1.52	–	–
5	*Barleria prionitis*	–	–	–	18.04	1.53	–	–
6	*Cassia tora*	73.33	11.12	104.07	28.56	77.35	59.15	55.02
7	*Celosia argentea*	–	2.70	–	–	–	–	–
8	*Centratherum anthelmintictum*	–	–	–	5.52	–	3.09	–
9	*Chloris barbata*	–	18.91	–	10.03	3.07	–	10.69
10	*Chrysopogon fulvus*	–	–	–	6.90	–	3.04	14.13
11	*Commelina benghalensis*	–	13.37	–	–	3.72	–	–
12	*Cynodon dactylon*	–	–	–	–	1.89	–	–
13	*Cyperus compressus*	2.14	_	_	_	_	28.37	–
14	*Cyperus rotundus*	–	–	–	–	–	–	20.47
15	*Dactyloctenium aegypticum*	3.35	3.35	–	–	–	–	–
16	*Dichanthium annulatum*	1.40	10.94	–	8.27	–	–	–
17	*Dimeria lawsonii*	33.07	39.10	–	–	–	–	4.03
18	*Echinchloa colona*	2.10	1.25	–	–	–	–	–
19	*Eragrostis pilosa*	3.32	–	98.04	–	21.57	39.10	36.59
20	*Eragrostis unioloides*	–	6.71	–	–	–	–	8.90
21	*Euphorbia hirta*	1.38	1.06	–	2.16	5.69	10.98	4.87
22	*Launaea procumbens*	21.56	–	8.43	–	16.75	14.92	13.03
23	*Melanocenchris jacquemontii*	–	–	–	–	3.23	–	7.60
24	*Merremia emerginata*	3.34	–	–	–	–	–	–
25	*Ocimun basilicum*	14.76	29.43	–	40.31	39.40	13.52	44.66
26	*Oplismenus burmannii*	7.78	19.31	–	11.47	11.88	9.11	22.42
27	*Pedalium murex*	40.14	–	–	–	–	–	1.70
28	*Penicum maximum*	–	17.13	–	–	–	–	–
29	*Rumex critus*	21.39	7.05	21.69	13.48	50.83	–	8.87
30	*Sonchus asper*	3.53	2.52	–	–	–	–	–
31	*Sporobolus diander*	–	31.16	–	–	–	–	–
32	*Themeda guadrivalus*	–	–	–	–	–	13.04	–
33	*Tridex procumbens*	–	2.95	–	6.84	1.97	–	–
34	*Triumfetta rhomboidea*	7.12	11.36	–	–	–	–	–
35	*Verninia cineria*	2.74	–	12.66	43.80	7.69	17.73	14.26
36	*Xanthium strumarium*	7.46	31.72	33.80	62.80	27.16	48.12	–

est division in Rajasthan. The Baran district lies between 24°25´ to 25°25´ N latitude and from 72°12´ to 76°26´ E longitude of Rajasthan state. Madhya Pradesh state is adjoining in North East of Baran District. Jhalawar in South and Kota District in North West. The total geographical area of district is 6992 sq km in which 6909.82 sq km in rural and 82.18 sq km in urban areas. The present forest cover is 2239.31 sq km which constitute 32.20% of district geographic area. The distict is the second highest in terms of forest cover [6]. According to Champion and Seth 1962 the Baran forest division is representing in group 4 - dry tropical forest [7].

Materials and Methods

To study the status of plant diversity, the forest area was divided into seven forest micro-sites based on dominance of forest species and their association with other forest species and site factors. In every forest site 25 quadrats of 10 m × 10 m (100 sq m) size were randomly laid to studied tree species (Fig. 1). The tree species includes all the trees which have 16 cm or its

Fig. 1. Map of the study site.

above girth at breast height, appeared in quadrats. The shrub and herbaceous species were studied by laying 25 quadrats randomly in each forest site. In each quadrat, a nested-quadrat of 3 m × 3 m (9 sq m) size for shrubs and 1 m × 1 m for herbaceous vegetation were selected. Field data were analyzed for abundance, dersity and frequency. The IVI was calculated follow standard method. Indexes of similarity and dissimilarity were calculated by using formulae given earlier. D-D curves have been used to approach the distribution of relative dominance of species and to interpret the community organization in terms of re-

Table 5. Similarity and dissimilarity index for tree species for different sites.

DS S	Site-I	Site-II	Site-III	Site-IV	Site-V	Site-VI	Site-VII
Site-I	–	19.70	34.82	41.89	41.66	69.62	42.94
Site-II	80.29	–	18.25	20.79	15.21	16.58	10.98
Site-III	65.17	81.74	–	25.34	29.54	36.96	29.72
Site-IV	58.10	79.20	74.65	–	44.94	53.83	54.16
Site-V	58.33	84.78	70.45	55.05	–	47.08	47.75
Site-VI	30.37	83.41	63.03	46.16	52.91	–	56.93
Site-VII	57.05	89.01	70.27	45.83	52.24	43.06	–

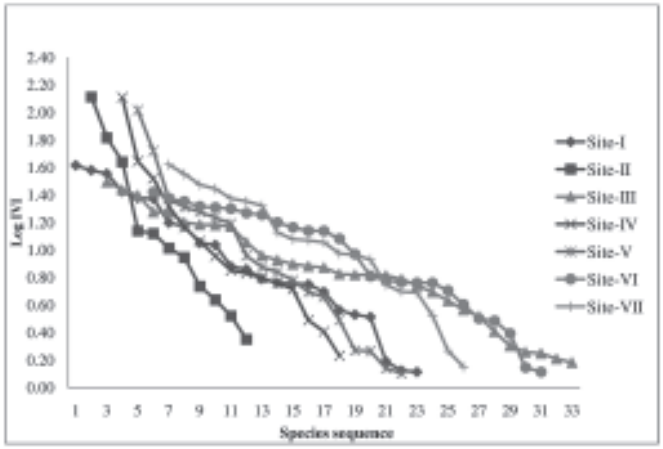

Fig. 2. Dominance diversity curves of tree species in various sites.

source share and niche space. Species diversity and dominance were evaluated by using the following methods- Shannon's diversity index and Simpson's index of dominance was calculated using importance value index (IVI) of species.

Results and Discussion

It was inferred from the data that in tree community, two species i.e. *Butea monosperma* and *Wrightia tinctoria* immerzed as a dominant species thereby occurred commonly in three out of seven microsites (Fig. 2). Further four species i.e. *Mitragyna parviflora, Anogeissus latifolia, Diospyros melanoxylon* and *Lannea coromandelica* immerzed as co-dominant species. Remaining seven species *Limonia crenulata, Madhuca indica, Anogeissus pendula, Acacia catechu, Embelica officinalis, Sterculia urens* and *Miliusa tomentosa* immerzed as individual species in the community. In case of herbaceous species *Cassia tora* and *Xanthium strumarium* immerzed as a dominant herbs. *Eragrostis pilosa* and *Ocimum basilicum* immerzed as a co-dominant herbaceous species. Remaining five species i.e. *Achyranthus aspera, Pedalium murex, Dimeria lawsonii, Sporobolus diander* and *Vernonia cineria* immerzed as a individual species in the community.

Among seven micro site, maximum and minimum density was found in Site-VI (1040 ind/ha) and Site-IV (724 ind/ha). The results of present finding are supported by Adhikari et al. [8]. However, recorded basal area was highest in Site-I (8.44 sq m/ha) and lowest in Site-II (0.90 sq m/ha). The results are in agreement with Mir et al. [9] that had shown the basal area

Table 6. Similarity and dissimilarity index for shrubs species for different sites.

DS	Site-I	Site-II	Site-III	Site-IV	Site-V	Site-VI	Site-VII
Site-I	–	16.46	33.98	40.64	29.27	51.60	49.55
Site-II	83.54	–	12.80	32.03	24.94	12.80	36.57
Site-III	66.02	87.20	–	39.27	35.07	37.62	39.81
Site-IV	59.36	67.97	60.73	–	59.47	56.44	66.55
Site-V	70.73	75.06	64.93	40.53	–	52.58	52.36
Site-VI	48.40	87.20	62.38	43.56	47.42	–	54.05
Site-VII	50.45	63.43	60.19	33.45	47.64	45.95	–

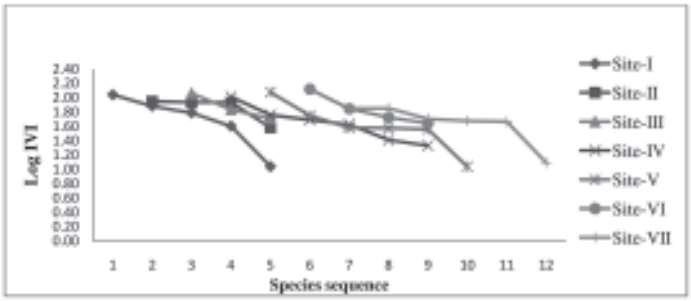

Fig. 3. Dominance diversity curves of shrub species in various sites.

0.84-8.74 in Chaupal Forest Division in Himachal Pradesh. This clearly revealed the IVI determination was justified to study. Shrub density ranged from 88-208 ind/ha that was maximum in Site-I (208 ind/ha) and minimum in Site-III (88 ind/ha) (Fig. 3). On the other hand, the basal area ranged from 0.0054–0.0470 sq m/ha with maximum in Site-VII (0.0420 sq m/ha) and minimum in Site-II (0.0054 sq m/ha). Highest herbaceous density was recorded in Site-VII (3776 ind/ha) and lowest in Site-IV (1396 ind/ha). The basal area was recorded maximum in Site-III (164.42 cm sq/ha) and minimum in Site-V (59.43 cm sq/ha). The results of present investigation are supported by the finding of Bachulkar and Awale [10] (Tables 1, 2, 3, 4).

Similarity index for trees was maximum for Site-I and Site-VI i.e. 69.62 and minimum in Site-II and Site-VII i.e. 10.98. In case of shrubs similarity index was found maximum in Site-VII and Site-IV i.e. 66.55 and minimum similarity index was found for Site-VI and Site-II, Site-III and Site-II i.e. 12.80. In case of herbs maximum similarity was found in Site-V and Site-VII i.e. 64.44 and minimum was found in Site-II and Site-III i.e. 16.03 which is in conformity with Gairola et al. [11] (Tables 5, 6, 7).

Maximum species evenness was 0.89 Site-IV, 0.87 Site-VI, 0.84 Site-VII, 0.83 Site-I in descending order. The range of species evenness of trees ranges from 0.54 to 0.89 with maximum in Site-IV and minimum in Site-II. However shrub species evenness ranges from 0.87 to 0.97 with maximum in Site-II and minimum in Site-I, the herbaceous species evenness ranges from 0.63 to 0.88 with maximum in Site-II and minimum in Site-III. This similarity between different micro Sites may be due to similar resources acquisition conditions. Less difference in the value if similarity index indicate that growth forms in the stand responded in a similar fashion as per Bhadra et al. [12] and Sharma et al. [13] (Table 8).

In case of trees the diversity index ranges from

Table 7. Similarity and dissimilarity index for herbaceous species for different sites.

DS S	Site-I	Site-II	Site-III	Site-IV	Site-V	Site-VI	Site-VII
Site-I	–	34.95	46.00	39.00	57.87	49.26	48.13
Site-II	65.04	–	16.03	40.78	33.42	25.95	32.42
Site-III	53.99	83.96	–	36.60	60.73	58.14	47.62
Site-IV	60.99	59.21	63.39	–	54.24	53.72	51.60
Site-V	42.12	66.57	39.26	45.75	–	61.16	64.44
Site-VI	50.73	74.04	41.85	46.27	38.83	–	60.71
Site-VII	51.86	67.57	52.37	48.39	35.55	39.28	–

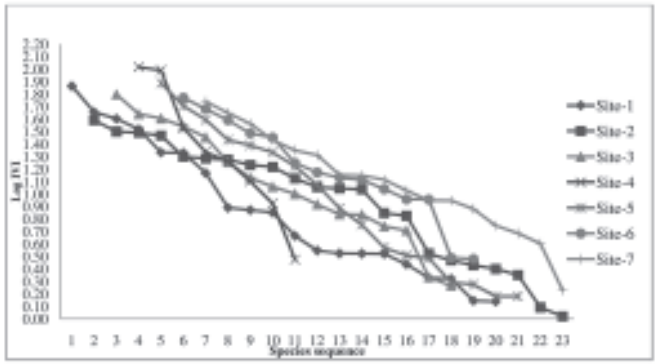

Fig. 4. Dominance diversity curves of herbaceous species in various sites.

0.59 to 0.94 with maximum in Site-IV and minimum in Site-II and Site-I and Site-VII show the similar diversity index i.e. 0.90 however in case of shrubs diversity index ranges from 0.69 to 0.80 with maximum in Site-IV and minimum in Site-VI and in case of herbs diversity index ranges from 0.71 to 0.92 with maximum in Site-II and minimum in Site-III. Shannon-Wiener Index for trees ranges from 1.31 to 3.08 with maximum in Site-IV and minimum in Site-II, however in case of shrubs Shannon-Wiener Index ranges from 1.28 to 1.71 with maximum in Site-IV and minimum in Site-VI and in case of herbs Shannon-Wiener Index ranges from 1.32 to 2.72 with maximum in Site-II and minimum in Site-III. In case of tree stratum, range of Simpson's dominance is from 0.05 to 0.40 with maximum in Site-II and minimum in Site-IV, however in case of shrubs Simpson's dominance ranges from 0.20 to 0.31 with maximum in Site-VI and minimum in Site-VII and in case of herbs Simpson's dominance ranges from 0.07 to 0.35 with maximum in Site-III and minimum in Site-II and Site-VI. The herbaceous vegetation diversity ranged from 1.32 to 2.73 with maximum in Site-II and minimum in Site-III (Fig. 4). Which is well supported by species diversity index reported between 0.78 to 3.45 for forest communities of Garhwal Himalayan by Raturi [14] (Table 8).

In case of tree stratum Site-II, Site-V have geometric and broken stick distribution curve and all remaining sites have log normal distribution curve. In

Table 8. Shannon-Wiener Index (SW ind), Simpson's dominance (Sim dom), Diversity index (Div ind) ans Species evenness (Sp eve) of different plant categories in different sites.

	Tree				Shrub				Herb			
Site	SW ind	Sim dom	Div ind	Sp eve	S-W ind	Sim dom	Div ind	Sp eve	S-W ind	Sim dom	Div ind	Sp eve
I	2.61	0.09	0.90	0.83	1.41	0.27	0.73	0.87	2.28	0.14	0.85	0.76
II	1.31	0.40	0.59	0.54	1.34	0.27	0.73	0.97	2.72	0.07	0.92	0.88
III	1.83	0.35	0.64	0.67	1.33	0.28	0.72	0.96	1.32	0.35	0.71	0.63
IV	3.08	0;05	0.94	0.89	1.71	0.20	0.80	0.96	2.32	0.12	0.87	0.83
V	2.26	0.14	0.85	0.78	1.58	0.24	0.76	0.88	1.98	0.21	0.78	0.70
VI	2.84	0.14	0.92	0.87	1.28	0.31	0.69	0.93	2.19	0.07	0.85	0.83
VII	2.63	0.10	0.90	0.84	1.66	0.21	0.79	0.93	2.43	0.09	0.89	0.87

case of shrub stratum all seven sites exhibiting geometric distribution pattern due to poor species richness. In herbaceous stratum all the sites have log normal distribution except Site-III which has geometric type of distribution pattern which is well supported by Devilal and Sharma [15].

Conclusion

In the present study microsite mosaics representing in various sites was evidently established for both stratum of tree and herbaceous except for shrub due to poor species richness. Further results obtained as per the objectives are in conformity with established phyto-sociological and ecological attributes. The further finding study showed the microsite mosaic in a better and clear-cut insightment in terms of dry deciduous forest ecosystems rather than major site study (holistic site), which was also in conformity with mosaic cycle concepts proposed by rammert [15]. The community species need conservation and scientific management of locally rare and endangered species for establishment of healthy sites and also for forest ecosystem management. The voluminous data generated in the present investigation will be used as a baseline information for spatial and temporal studies of forest structure, composition and community dynamics for further researches.

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