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A comparative study of tree species composition of Jaisinghnagar forest and Beohari forest of Shahdol forest range, Madhya Pradesh, India

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Abstract
The present paper deals the ecological diversity of tree vegetation in Jaisinghnagar and Beohari forest Shahdol district (M.P.) India. Both the forest are very well known for their characteristics as dense forest. To screen the ecological status of these forests a stratified random quadrate method was employed in the study. A total of 20 tree species were recorded from Jaisinghnagar forest and 22 tree species were recorded from Beohari Forest. The work conclude that though both the forest belong to same forest range, they differ in pattern of diversity in tree vegetation and specially in regard to the pattern of dominance.

Keywords: comparative, tree, species, composition, Jaisinghnagar, Beohari, forest, ecology, diversity

1. Introduction
Forests are the principal bio-resources and repositories of natural wealth that support human well-being and ecological sustainability. The forest ecosystems provide unequal share to the world's biodiversity (Battles *et al.* 2001) [1]. Thus, for the maintenance of biodiversity it is essential to attain forest sustainability (Osorio *et al.* 2009) [2]. It is undoubtedly justified that the long-term sustainability of forest ecosystems is greatly concerned with plant diversity and their phytosociological attributes. Plant diversity is widely acknowledged to support many other communities of forests as well as human community. Much of the overall diversity depends on plant diversity, because plants provide both food and habitat for other organisms (Hunter, 1990) [3]. The ecological security of any country depends on the health of its forests (Khosla, 1992) [4]. Thus, management and maintenance of any forest is obligatory. As the over al condition of forest depends on its plant composition, the information on composition, diversity and ecological aspects of plant species is of primary importance in the planning and implementation of forest biodiversity conservation efforts. In a typical forest knowledge of vascular plant diversity and changes that occur with disturbance may provide planning information to Biologists (Sarkar, 2015) [5]. Among the vascular plants tree species are much important as they are controlling the keystone factor, i.e., entry of light in to forest bed. Analysis and estimation of Tree diversity, in which a combination of physical habitat, vegetation, physiognomy, species composition and community relationship are useful in formulating forest management programme (Sarkar, 2016) [6]. The inherent variation within communities and ecosystems must be documented and used for base-line data to effectively predict the outcome of disturbances, such as regeneration harvest methods, on floristic diversity and richness (Sarkar, 2016) [6].

2. Methodology
2.1 Description of the study site
The present study has been carried out in two Jaisinghnagar and Beohari forests of Shahdol Division (M.P.) India. Both the forest is located on the undulating plain of Satpura foothill, which create a great floral and faunal diversity. It is located in close Bandhavgarh National Park. The forest is situated very close to the bank of the Son River

Study of tree vegetation composition and structure
For phytosociological studies of tree vegetation in the selected forest of Shahdol forest range, the quadrate methods were used. In each forest, a total of 20 sampling sites representing various categories of natural forests and plantations were selected for vegetation sampling. At each sampling site four quadrates (20 m x 20 m) were laid to quantify various tree vegetation. In order to analyze the diversity of tree vegetation Frequency, Relative frequency, density and Relative density were calculated. Importance Value Index was calculated by adding Relative frequency Relative density and Relative Basal Area (Chaubey *et al.* 1988 and Phillips, 1959) [7, 8].

a) Frequency (%)
This term refers to the degree of dispersion of individual species in an area and usually expressed in terms of percentage. It is calculated by the equation:

$$Frequency\ (\%) = \frac{No.of\ sampling\ plots\ in\ which\ the\ species\ is\ present}{Total\ no.of\ plots\ sampled} \times 100$$

b) Relative Frequency (%)
The degree of dispersion of individual species in an area in relation to the number of all the species occurred.

$$Relative\ frequency = \frac{Frequency\ of\ the\ species}{Frequency\ of\ the\ all\ species} \times 100$$

c) Density

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

$$Density\ (Ha^{-1}) = \frac{No.of\ individuals\ of\ the\ species}{Total\ area\ sampled\ (ha)}$$

d) Relative Density (%)

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

$$Relative\ Density\ = \frac{Density\ of\ the\ species}{Density\ of\ all\ the\ species} \times 100$$

e) Relative Dominance (%)

Dominance of a species is determined by the value of the basal area. Relative dominance is the coverage value of a species with respect to the sum of coverage of the rest of the species in the area.

$$Basal\ area = \frac{(Circumference\ at\ breast\ height)^2}{12.56}$$

f) Abundance

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

$$Abundance = \frac{No.of\ individuals\ of\ the\ species}{No.of\ sampling\ plots\ in\ which\ the\ species\ is\ present}$$

g) Importance Value Index

This index is used to determine the overall importance of each species in the community structure. In calculating this index, the percentage values of the relative frequency, relative density and relative dominance (Relative Basal Area) are summed up together and this value is designated as the Importance Value Index or IVI of the species.

IVI (of trees) = Relative basal area + Relative frequency + Relative density

Importance value Index (IVI) was calculated by adding the values of Relative Frequency, Relative Density and Relative Basal area.

Data processing and phytosociological analysis

All the data both spatial and especial collected from different sources has been tabulated and analyzed separately. The data collected were used to compute community indices like.

a) Species diversity (H')

Species diversity of different tree species; it was calculated using the Shannon- Weiner Index: (Shannon and Weiner, 1963) [9].

$$(H') = -\Sigma [(ni / N). \ln (ni / N)]$$

Where 'ni' is the IVI of individual species and N is the total IVI of all the species (Shannon and Weiner, 1963) [9].

b) Species dominance (Cd)

Species dominance was calculated following Simpson:

$$Cd = \Sigma (ni/N)^2,$$

where, ni and N are the same as those for Shannon Weiner information function (Simpson, 1949) [10].

c) Equitability of evenness (e)

Equitability of evenness (Pielou, 1966) [11] refers to the degree of relative dominance of each species in that area. It was calculated as:

$$Evenness\ (e) = H'/\log S$$

where,

H'= Shannon index, S = number of species.

d) Species richness (D)

Species richness was determined by Margalef index (1968) [12] as:

$$D=(S-1)/\ln N.$$

where,

S = number of species.

N= total number of individuals.

e) Menhinick's index (Dmm)

Menhinick's index (Whittaker, 1977) [13]. is expressed as Dmm=S/ N, where N is the number of individuals in the sample and S is the species number.

f) Equitability Index

The Shannon's equitability Index (Lloyd and Ghelard, 1964) [14] is expressed as:

$$(EH) = H/Hmax = H/\ln S.$$

Where, H is the Shannon index and S is the species number.

g) Berger-Parker Dominance Index

The Berger-Parker Dominance Index is a simple measure of the numerical importance of the most abundant species and is expressed a d = Nmax/N.

N max is the number of individuals in the most abundant species and N is the total number of individuals in the sample. The increase in the value of reciprocal of Berger-Parker Dominance Index reflects the increase in diversity and a reduction in dominance (Berger & Parker, 1970) [15].

3. Results and discussion

The present study showed that both the forest are rich in tree diversity. A total 20 tree species were recorded from Jaisinghnagar forest. Among them highest IVI was recorded for *Diospyros melanoxylong* (62.90). IVI was also good for *Dendrocalamus strictus* (50.57) and *Tectona grandis* (35.42). The lowest IVI was recorded for *Pithecellobium dulce* (1.34). IVI was also poor for *Shorea robusta, Terminalia arjuna* and *Terminalia tomentosa* (Table 1). From *Beohari forest* 22 tree species were recorded. Among the tree species highest IVI was recorded *Diospyros melasioxylon* (82.71). The *Dendrocalamus strictus, Tectona grandis, Madhuca indica* and *Shorea robusta* had quite good IVI (Table 2). The lowest IVI was recorded *Holoptelra integrifolia* (1.71).

Table 1: Different Phytosociological values of tree vegetation of Jaisinghnagar forest.

S. No.	Name of species	Fre	Density/Ha	B.A.	R. F.	R. D.	R. Dom.	I.V.I.
1.	*Acacia nilotica*	40	70	121.4	4.08	1.71	0.21	6.00
2.	*Aegle mermelos*	10	20	49.74	1.02	0.49	1.16	2.67
3.	*Alangium salvifolium*	10	10	402.42	1.02	0.24	0.13	1.40
4.	*Anogeissus latifolia*	20	20	443.48	2.04	0.49	1.53	4.06
5.	*Azadirachta indica*	30	40	81.44	3.06	0.98	0.50	4.54
6.	*Bauhinia racemosa*	60	140	697.48	6.12	3.41	1.72	11.25
7.	*Boswellia serrata*	60	100	3663.30	6.12	2.44	9.01	17.57
8.	*Butea monosperma*	80	240	29.73	8.16	5.85	3.55	17.57
9.	*Cassia fistula*	20	30	201.41	2.04	0.73	1.74	4.51
10.	*Dendrocalmus strictus*	90	250	14345.46	9.18	6.10	35.29	50.57
11.	*Diospyros melanoxylon*	100	1490	9292.30	10.20	36.34	16.35	62.90
12.	*Lagerstroemia parviflora*	70	230	2373.57	7.14	5.61	3.38	16.13
13.	*Madhuca indica*	20	30	1033.39	2.04	0.73	2.54	5.31
14.	*Miliusa tomentosa*	20	20	160.27	2.04	0.49	1.53	4.06
15.	*Pithecellobium dulce*	10	10	103.33	1.02	0.24	0.08	1.34
16.	*Shorea robusta*	10	10	15391.4	1.02	0.24	0.20	1.46
17.	*Syzygium cumuni*	10	10	509.25	1.02	0.24	0.10	1.37
18.	*Tectona grandis*	80	390	7213.95	8.16	9.51	17.75	35.42
19.	*Terminalia arjuna*	10	10	418.903	1.02	0.24	0.59	1.86
20.	*Terminalia tomentosa*	10	20	623.95	1.02	0.49	0.32	1.82

B.A. = Basal Area
R.F. = Relative Frequency
R.D. = Relative Density
R.Dom. = Relative Dominance
I.V.I. = Importance Value Index

Table 2: Different Phytosociological values of tree vegetation of Beohari forest.

S. No.	Species	Fre.	Den/ Ha.	B.A.	R. F.	R. D.	R. Dom.	I.V.I.
1.	*Albizzia lebbeck*	10	10	630.33	1.14	0.25	1.64	3.03
2.	*Bauhinia racemosa*	20	280	1197.08	2.27	7.12	3.11	12.51
3.	*Boswellia serrata*	20	20	572.88	2.27	0.51	1.49	4.27
4.	*Buchanania lanzan*	20	30	1883.07	2.27	0.76	4.89	7.93
5.	*Butea monosperma*	30	50	71.44	3.41	1.27	0.19	4.87
6.	*Cassia fistula*	30	40	165.18	3.41	1.02	0.43	4.86
7.	*Cordia dichotoma*	10	10	240.72	1.14	0.25	0.63	2.02
8.	*Dendrocalmus strictus*	60	190	12764.78	6.82	4.83	33.16	44.81
9.	*Diospyros melanoxylon*	100	1820	9635.22	11.36	46.31	25.03	82.71
10.	*Flacourtia indica*	10	10	128.73	1.14	0.25	0.33	1.73
11.	*Gardenia latifolia*	10	10	140.37	1.14	0.25	0.36	1.76
12.	*Garuga pinnata*	10	20	123.27	1.14	0.51	0.32	1.97
13.	*Holoptelea integrifolia*	10	10	121.04	1.14	0.25	0.31	1.71
14.	*Madhuca indica*	60	60	2807.15	6.82	1.53	7.29	15.64
15.	*Pithecellobium dulce*	10	10	343.77	1.14	0.25	0.89	2.28
16.	*Pongamia pinnata*	20	30	705.37	2.27	0.76	1.83	4.87
17.	*Salmalia malabarica*	10	20	921.92	1.14	0.51	2.40	4.04
18.	*Shorea robusta*	30	40	89.52	3.41	1.02	0.23	4.66
19.	*Sterculia urens*	10	10	623.95	1.14	0.25	1.62	3.01
20.	*Tectona grandis*	90	420	4030.26	10.23	10.69	10.47	31.38
21.	*Terminalia tomentosa*	20	30	201.41	2.27	0.76	0.52	3.56
22.	*Wrightia tomentosa*	20	30	66.30	2.27	0.76	0.17	3.21

B.A. = Basal Area
R.F. = Relative Frequency
R.D. = Relative Density
R.Dom. = Relative Dominance
I.V.I. = Importance Value Index

Table 3: Different community indices of tree vegetation of the forest.

S.No.	Community Indices Value	Jaisinghnagar forest	Beohari forest
1.	Species diversity ($H^{'}$)	2.8785	2.9575
2.	Species dominance (Cd)	0.0707	0.0684
3.	Equitability of evenness (e)	1.9893	1.9831
4.	Species richness (d)	5.5725	5.1980
5.	Menhinick's Index (D_{mm})	0.0828	0.0965
6.	Equitability Index	0.8734	0.8612
7.	Berger-Parker dominance Index	0.2668	0.1401

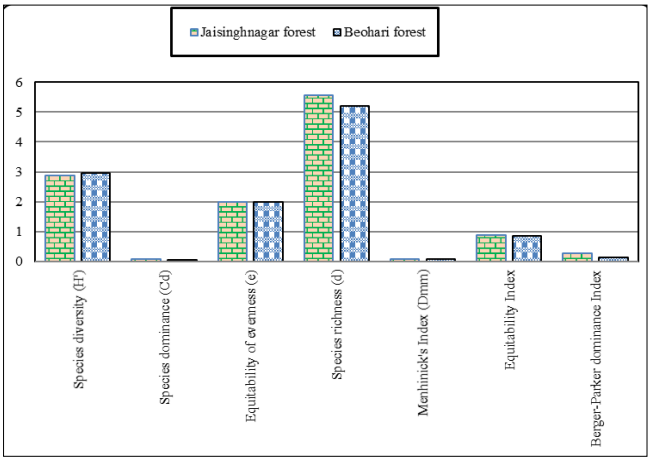

Fig 1: Graphics analysis of Different community indices of tree vegetation of the forest.

4. Conclusion

The paper reflects the phytosociological and ecological characters of tree vegetation in two forests namely Jaisinghnagar forest and Beohari forest. The structural composition of flora found in these forests were quite similar. The similarities were noticed that *Diospyros melanoxylon* was found as the dominant species in both forests. The *Dendrocalamus strictus* and *Tectona grandis* occupied third position for IVI in both forest ranges. Here the Species diversity index value of tree species at Jaisinghnagar forest was found as 2.8785 and Species richness was 5.5725. Where as the Species diversity index value of tree species at Beohari forest was found as 2.9575 and Species richness was 5.1980. Both the indices showed that slightly high tree species diversity was accounted in Beohari forest than Jaisinghnagar forest. It is important to note that high diversity status in terms of all the above indices was reflected in Beohari forest. The evenness indices showed that there was a very little difference in evenness in between the forest. The Margalef's and Menhinick's indices also revealed the similar trend like that of evenness index. There was also a significant difference in Berger-Parker Dominance Index. The indices revealed that Jaisinghnagar forest had comparatively low diversity in tree vegetation and high level of Dominance. On the contrary Beohari forest had high diversity and low level of dominance among tree species. More than one tree species of Beohari forest showed good IVI and thus it was concluded that the tree vegetation of Beohari forest support the concept of ecological codominance. The study suggested to the followers for the study of soil seed bank and allelopathic interactions among the tree species as well as other plants and microbes in both the forest beats. It is also suggested for the study of successive pattern of the plant communities in these forest.

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