Original Research Article

<https://doi.org/10.20546/ijcmas.2021.1002.054>

Assessment of Plant Diversity of Selected Forest Sites of Aurangabad District of Bihar

A. Chandra*, H. B. Naithani, P. K. Verma, J. Saxena, R. Saini and S. Kishwan

Forest Botany Division, Forest Research Institute, Dehradun- 248006, India

*Corresponding author

ABSTRACT

Keywords

Important Value
Index, Diversity
Index, Species
Richness, Evenness

Article Info

Accepted:
07 January 2021
Available Online:
10 February 2021

Plant diversity of natural forest selected sites of Aurangabad district of Bihar was assessed. Study was carried out in twelve sites. A total of 126 species belonging to 49 families and 104 genera were reported from all twelve sites. Different indices such as Important Value Index (IVI), Species richness, Shannon Wiener index, Concentration of dominance and Evenness were estimated. For different sites highest IVI for tree was reported (*Ficus mollis* (2 sites), *Acacia catechu*, *Diospyros melanoxylon* var. *tupra*, *Azadirachta indica*, *Lagerstroemia parviflora* (2 sites), *Strychnos potatorum*, *Butea monosperma*, *Lannea coromandelica* and *Diopsyros melanoxylon*). Study reveals that Mahulan and pathra forest sites are more diverse forest sites in the Aurangabad district. Study also reveals that *Lantana camara* var. *aculeata* an invasive showed its presence in the area, it can adversely impact the indigenous species in future.

Introduction

Vegetation is primary source for energy which transfer to other trophic levels. Environment of an area effects the vegetation of an ecosystem (Billings, 1952). Structure and function of plant community can be understood by phyto-sociological study of the area. It explains and predicts pattern in a meaningful manner (Braun Blanquet, 1932, Odum, 1971). Therefore, for proper understanding of plant diversity of any area, phyto-sociology aspects should be thoroughly studied. Biodiversity in wild state has its far reaching importance as species have diverse genotypes which can further be exploited.

Forest are storehouse of the biodiversity, therefore, it is need of the hour to assess and conserve the forest biodiversity. However, owing to burgeoning population coupled with rapid industrialization plant resources are under tremendous pressure. It has resulted decline of plant diversity in forest ecosystem. Convention of Biological Diversity also asserted the need of regular inventorization and monitoring of biodiversity for sustainable utilization. The state of Bihar has recorded forest area of 6877 km², which is 7.3% of its geographical area. The Reserve, Protected and Unclassified Forests are 693 km², 6183 km² and 1 km² respectively. The forest cover in the state is 7306 km² which is 7.76% of the

total geographical area of the state. On the basis of density classes, 333.13 km² is under very dense forest, 3280.32 km² under moderately dense forests and 3692.54 km² under open forest. Aurangabad is one of the 38 districts of Bihar. The district has geographical area of 3305 km². The district has two sub-divisions namely Aurangabad and Daudnagar and 11 blocks namely, Madanpur, Kutumbba, Daudnagar, Aurangabad, Barun, Obra, Deo, Nabinagar, Haspura, Goh and Rafiganj. The forest cover in the Aurangabad district is 156.76 km² which is 4.74 % of the total geographical area of the state. On the basis of density classes, 62.26 km² under moderately dense forests and 94.50 km² under open forest. There is no very dense forest in the Aurangabad district (FSI, 2019).

Bihar state has been extensively surveyed for its floral wealth by various workers in the past (Anderson, 1863; Hooker, 1872-1897; Wood, 1903; Haines, 1921-1925; Mukhrjee, 1947; Mooney, 1950; Paul, 1973; Biswas and Maheshswari, 1980; Bhattacharya and Sarkar, 1998; Singh *et al.*, 2001 etc.). Qualitative status cannot provide the dynamics of vegetation of the area, therefore, quantitative status should be worked out. Diversity indices for various forests have been reported by several workers (Whittaker, 1965; Risser and Rice, 1971; Ralhan *et al.*, 1982; Knight, 1963). However, till date no work has been reported on different diversity indices of different sites of the region. Therefore, in the present study efforts have been made to assess the different sites for comparison of different sites.

Materials and Methods

Study site, survey and vegetative data

Study was conducted at the Aurangabad district of Bihar. The district with a

geographical area of 3305 km² between the longitudes of 84°00' - 84°45' E and latitudes of 24° 30' -25°15' N is located in the South Bihar Plains (SBP) and constitute a part of the marginal alluvial plains of Ganga Basin.

Fig.1 Location map of study area

Twelve random forest sites were selected for the vegetation analysis. Random coordinating points were provided by the GIS cell of the Forest Research Institute, Dehradun for collection of vegetative data. Details of sites is given in Table 1. Quantitative analysis of vegetation for frequency, density and dominance was calculated following Mishra (1968). 10 quadrats were randomly laid in each site. Quadrant size of 10 x 10m, 3x3m and 1x1m was kept for trees, shrubs and herbs respectively. In each quadrat, g.b.h. (girth at breast height at 1.37m above ground level) of each tree was measured and recorded individually. In case of herb and shrub, diameter was measured 2.5 cm above ground level. Species were identified with the help of concerned floras and matched with DD Herbarium specimens. Plant nomenclature was updated as per the plant list website (www.theplantlist.com). Values of Relative frequency, density and dominance were summed to get Importance Value Index (IVI). Different biodiversity indices were estimated as given below:

S= Species Richness

Total number of species

Shannon-Wiener information function (Shannon & Wiener, 1963) was calculated using the formula:

$$H = - \sum p_i \ln p_i$$

Where p_i is (N_i/N) , N_i = Number of individuals of species i and N = Total number of individuals of all the species.

Concentration of dominance (cd) was measured by Simpson Index (Simpson, 1949).

$$Cd = \sum (p_i)^2$$

Pielou's evenness index (Pielou, 1966) was calculated using formula:

$$J = H' / \ln(S)$$

Where H' is Shannon Weiner diversity and S is the total number of species

Results and Discussion

In the present study, a total of 126 species belonging to 49 families and 104 genera were reported from all twelve sites. Biggest family was Fabaceae (12 spp.) followed by Rubiaceae and Poaceae (6 spp. each), Asteraceae, Rhamnaceae, Malvaceae and Acanthaceae (5 spp. each), Moraceae (4 spp.) etc. Plant species vary in their responses to environmental factors. A given species will have a unique set of tolerances to environmental variables, such as light, temperature, moisture, and nutrients. The status of a species is an important indicator for its conservation and sustainable utilization. Importance Value Index (IVI) is a measure of how dominant a species is in a given forest area. IVI was estimated for tree, shrubby and herbaceous layers. In tree layer,

on the basis of IVI most dominant species in different sites is shown in Fig.2. Among different sites, highest IVI was reported for *Azadirachta indica* (229.58, Site-IV) followed by *Lagerstroemia parviflora* (211.18, site-XI), *Acacia catechu* (186.57, Site II), *Diospyros melanoxylon* (153.72, Site-XII) *Strychnos potatorum* (128.26, Site-VIII), etc. In case of shrubby layer, highest IVI was estimated for *Casuarina tomentosa* (-119.7, site-I) and lowest for *Holarrhena pubescens* (42.16, site-X) In herbaceous layer, highest IVI reported for *Hyptis suaveolens* (129.33, Site-VIII) and lowest for *Tridax procumbens* (55.58, Site- II).

Diversity indices aim to describe general properties of communities that allow us to compare different regions and taxa. Diversity indices viz., Shannon-Wiener Diversity Index (H), Concentration of Dominance (cd), Evenness (E) and Species Richness (SR) for different growth forms at different sites of Aurangabad district is presented in Table 1. Higher value of species richness indicates higher diversity of species. In the tree layer, Mahulan site showed highest Species Richness (SR) of 23 species followed by Pathra Beat (18 spp.), Bheli Bandh (17 spp.) etc. and lowest was recorded for Salaya Forest (2 spp.) while Unga Forest lacks tree growth in the area. In case of shrubby layer, highest Species Richness (SR) value was found in Pathra Beat (20 spp.), followed by Mahulan (18 spp.), Eroura (14 spp.) etc. and lowest was in Nima Forest and Pirthu Forest (6 spp. each). Herbaceous layer had highest Species Richness (SR) in Mahulan (29 spp.), followed by Pathra Beat (24 spp.), Badam Forest (19 spp.), Nima Forest and Peeghliya Forest (Each with 16 spp.) etc. and lowest value was found in Unga Forest (5 spp.). The higher value of Diversity Index (H) indicates the variability in the type of species and heterogeneity in communities whereas lesser value points to homogeneity in the community (Fig. 3 and 4).

Table.1 Diversity indices for different growth forms at different sites of Aurangabad District of Bihar

Site no.	Sites Name	Tree Layer				Shrubby Layer				Herbaceous Layer			
		SR	H	cd	E	SR	H	cd	E	SR	H	cd	E
I.	Badam, Madanpur Range	7	1.781	0.186	1.107	9	1.669	0.257	0.760	19	2.111	0.216	0.216
II.	Nima Forest, Madanpur Range	5	0.910	0.567	0.566	6	1.696	0.199	0.947	16	2.454	0.110	0.885
III.	Pirthu Forest, Range Madanpur	3	1.040	0.375	0.947	6	1.606	0.221	0.897	14	1.541	0.319	0.584
IV.	Salaya Forest, Madanpur Range	2	0.501	0.681	0.723	8	1.638	0.228	0.788	14	1.684	0.298	0.638
V.	Unga Forest, Madanpur Range	-	-	-	-	11	1.812	0.222	0.756	5	1.511	0.247	0.939
VI.	Pathra Beat, Aurangabad Range	18	2.687	0.084	0.930	20	2.696	0.088	0.899	24	1.955	0.290	0.616
VII.	Mahulan, Pathra Beat, Aurangabad Range	23	2.717	0.098	0.867	18	2.432	0.123	0.842	29	2.442	0.167	0.726
VIII.	Bheli Bandh, Aurangabad Range	17	1.945	0.273	0.687	10	1.918	0.189	0.833	11	1.585	0.285	0.661
IX.	Bhedani, Aurangabad Range	8	1.742	0.223	0.838	11	2.062	0.166	0.860	9	1.963	0.165	0.894
X.	Eroura, Aurangabad Range	8	1.667	0.256	0.802	14	2.485	0.095	0.943	10	1.789	0.229	0.777
XI.	Bhalwadi Khard, Maharaj Ganj Range	5	0.921	0.566	0.573	10	2.103	0.138	0.914	10	1.822	0.206	0.792
XII.	Peeghliya Forest, Maharaj Ganj Range	3	0.956	0.429	0.870	11	2.039	0.166	0.851	16	1.831	0.233	0.661
(SR= Species Richness; H=Diversity Index; cd=Concentration of Dominance; E= Evenness)													

Fig.2 Highest Important Value Index (IVI) of tree species in different sites(I: Badam site, II- Nima Forest III- Pirthu Forest, V: Salaya Forest, V: Unga Forest,VI: Pathra Beat, VII: Mahulan, Pathra Beat, VIII: Bheli Bandh, IX: Bhedani X: Eroura, XI: Bhalwadi Khard, XII: Peeghliya Forest)

Fig.3 Highest Important Value Index (IVI) of shrubby layer species in different sites

Fig.4 Highest Important Value Index (IVI) of herbaceous layer species in different sites

The higher value of Concentration of Dominance (cd), the greater is the homogenous nature of community and vice-versa. In other words, such communities are dominant by single species. The lower value of concentration of dominance indicates that dominance of plant is shared by many species. In the tree layer, Concentration of Dominance (cd) was highest in case of Salaya Forest (0.681), followed by Nima Forest (0.567), Bhalwadi Khard (0.566) etc. and lowest in case of Pathra Beat (0.084). Shrubby layer had highest value of Concentration of Dominance (cd) in Badam Forest (0.257), followed by Salaya Forest (0.228), Unga Forest (0.222) etc. and lowest in Eroura (0.095). In the herbaceous layer, highest value of Concentration of Dominance (cd) was estimated for Pirthu Forest (0.319), followed by Salaya Forest (0.298), Pathra Beat (0.290) etc. and lowest in Nima Forest (0.110).

Higher value of Evenness (E) indicates that species are evenly distributed and vice-versa. In case of tree layer, highest Evenness (E) value was estimated for Badam Forest site (1.107), followed by Pirthu Forest (0.947), Pathra Beat (0.930) etc. and lowest in Nima

Forest (0.566). In case of shrubby layer, highest Evenness (E) value was recorded for Nima Forest (0.947), followed by Eroura (0.943), Bhalwadi Khard (0.914) etc. and lowest in Unga Forest (0.756). In the herbaceous layer, highest value of Evenness (E) was estimated for Unga Forest (0.939), followed by Bhedani (0.894), Nima Forest (0.885) etc. and lowest in Badam (0.216).

It reveals from the study that Mahulan and pathra forest sites are more diverse site in the Aurangabad forest division. Study also reveals that *Lantana camara* var. *aculeata* an invasive is showing its presence in the area, it can adversely impact the indigenous species in future. Both quantitative and quantitative assessment of vegetation is essential for developing conservation and management strategies. Hence, presence study will be immense use for the field staff of the forest department for making future working plans. Regular inventorization and monitoring of plant diversity is the need of the hour. Therefore, similar kind of studies should be carried out in different forest sites to assess the present status of plant diversity for conservation and sustainable management.

Acknowledgement

Authors are thankful to the Director, Forest Research Institute, Dehradun for constant encouragement and support. Authors are also thankful to the PCCF and other Forest officials of Bihar Forest Department for funding and proving necessary support for carrying out the study.

References

- Anderson, T. 1863. On the Flora of Bihar and the mountains of Parasnath with a list of species collected by Messrs Hooer, *J. Asiat. Soc., Bengal*. 32:187-218.
- Bhattacharya P. K. and Sarkar K. 1998. Flora of West-Champaran District, Bihar. *Botanical Survey of India, Calcutta*.
- Billings, W.D. 1952. The environment complex in relation to plant growth and distribution *Quarterly Review of Biology*. 27; 251-265.
- Biswas, D. K. and Maheshwari, J. K. 1980. A contribution to the vegetation of Chaibasa, Singhbhum District in South Bihar. *Bull. Bot. Soc. Bengal* 25 (1 & 2): 43-51.
- Braun Blanquet, J. 1932. Plant Sociology :the study of plant communities. *McGraw-Hill, New York*.
- Forest Survey of India. 2019. State of Forest Report. *Forest Survey of India, Dehradun*
- Haines, H.H. 1921-24. The Botany of Bihar and Orissa. *Adlard and Sons, London*.
- Hooker, J.D. 1875-1897. The Flora of British India (7 Vols.). *L. Reeve and Co., London*.
- Knight, D.H. 1963. A distance method for constructing forest profile diagrams and obtaining structural data. *Tro. Ecology*. 89-94.
- Misra, R. 1968. Ecological Workbook. *Oxford Press, New Delhi*.
- Mooney, H.F. 1950. Supplement to the Botany of Bihar and Orissa. *Catholic Press, Ranchi*.
- Mukherjee, S.K. 1947. A Botanical Tour in Chhotanagpur. *Bull. Bot. Soc. Bengal* 1:27-28.
- Odum, E.P. 1971. Fundamentals of Ecology (Third Ed). *W.B. Saunders, Philadelphia*
- Paul, S.R. 1973. On the aquatic and Marsh Flora of Monghyr, Bihar. *Botanique* : 143-152.
- Pielou, E.C. 1966. The measurement of diversity in different types of biological collections. *Journal of Theoretical Biology*, 13, 131-144.
- Ralhan, P.K., Saxena, A. K. and Singh, J. S. 1982. Analysis of forest vegetation at and around Nainital in Kumaun Himalaya. *Proc. Indian National Sciences*.19:307-324.
- Resser, P.G. and Rice, E.L. 1971. Diversity in tree species in Oklahoma upland forests. *Ecology*. 52:876-880.
- Shannon, C. E. and Wiener, W. 1963. The Mathematical Theory of Communities. *University of Illinois press, Urbana*, 117.
- Simpson, E. M. 1949. Measurement of diversity. *Nature*, 163: 688.
- Singh, N.P., Mudgal V., Khanna K.K, Srivastava S.C., Sahoo A. K., Bandhopadhyay S., Aziz N., Das M., Bhattacharya R.P. and Hajra P.K.. 2001. Flora of Bihar-Analysis. *Botanical Survey of India, Calcutta*
- Whittaker, R.H. 1965. Dominance and diversity inland plant communities: numerical relations of species express in importance of competition in community function and evolution. *Science*, 147 (3655), 250-260.
- Wood, J. J. 1903. Plants of Chotanagpur including Jaspur and Surguza. *Rec. Bot. Sur. India*. 2:1-170.

How to cite this article:

Chandra, A., H. B. Naithani, P. K. Verma, J. Saxena, R. Saini and Kishwan, S. 2021. Assessment of Plant Diversity of Selected Forest Sites of Aurangabad District of Bihar. *Int.J.Curr.Microbiol.App.Sci*. 10(02): 462-468. doi: <https://doi.org/10.20546/ijcmas.2021.1002.054>