Original Research Article

Assessment of Floristic Diversity of Udaipur Wildlife Sanctuary, West Champaran, Bihar, Eastern India

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A B S T R A C T

Aim of the study was to assess the quantitative status of plant diversity of the Udaupur Wildlife Santuary, West Champaran, Bihar. Five random sites were selected for the collection of vegetative data. Different phyto-diversity indices were such as species richness, concentration of dominance, Evenness and Shannon and Wiener index were used for assessment. On the basis of IVI, top five dominant tree species for different sites were estimated. Study reveals that Near Permanent Nursery study was most diverse site followed Majharia Jungle-I, Jal Bharia, Majharia Jungle –II and Balwa Rampura.

Introduction

Biological diversity means the variety and variability of all life forms from all sources on earth. It involves diversity within species and of ecosystem (McNeely *et al.,* 1990). Environment is an important factor which determines pattern of vegetation in an ecosystem (Billings, 1952). Change in species diversity and composition in an area is a long dynamic process. Forests are store house of wild plant diversity with diverse genotypes which can be exploited in future. However, owing to rapid population explosion and industrialization, pressure on forests has been increased manifolds resulting decline in plant diversity. Changes in pattern of vegetation can properly be understood through phyto-sociological studies. Therefore, for conservation and sustainable utilization of plant resources, regular monitoring of forest biodiversity is need of the hour.

Udaipur Wild Life Sanctuary (UWLS) is one of the smallest wildlife sanctuaries in India. It is situated in the Bariya Anchal of West Champaran district of Bihar state. It is located within the coordinates 26^0 48' 47.1" and 26^0 47' 16.2" N latitude and 84^0 25' 8.8" and 84^0 24' 24" E longitude. It is a forested wetland with total area of 548.75 ha. There exists an ox-bow shaped lake named Sareyaman.

Earlier work on qualitative estimation of different species of the West Champaran district was carried out by workers like Haines (1921-24); Mooney (1950); Bhatacharya and Sarkar (1998); Singh *et al.,* (2001). However, to date no research has been done to evaluate the quantitative status of the various plant species of the area. Hence, in the present work was carried out to quantify the status of phyto-diversity of the forest area of Udaipur Wildlife Sanctuary.

Materials and Methods

Location map of the study is shown in fig. 1. Climate of the area is hot during summer and pleasant in winter. The hot weather begins from the middle of March and is at its height in May when westerly winds prevail.

The cold weather prevails in November and persists till January. The average annual temperature is 26^0C. The area receives annual 168 cm rainfall. Extensive floristic survey was conducted in forest sites and outside forest and all species were recorded.

For phyto-sociology, GIS Cell of Forest Research Institute, Dehradun provided the random coordinate points for the collection of vegetative data. Data was collected from five random sites viz., Balwa Rampura, Jal Bharia, Near Permanent Nursery, Majharia Jungle –I and Majharia Jungle –II. A survey for vegetative study of forest area was carried out during 2015. Quadrat number and size were determined by the running mean method (Kershaw, 1973) and species-area curve method (Misra, 1968), respectively.

Figure.1 Location of map

Fig.1. Location map of study area
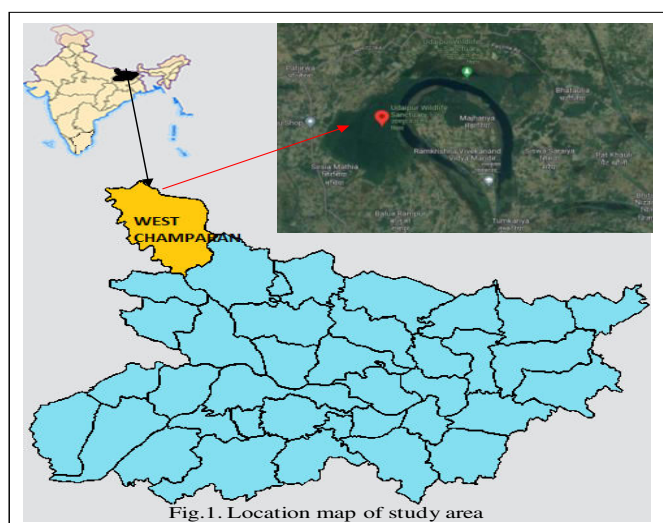
Quantitative analysis of vegetation for frequency, density and dominance was calculated following Misra (1968). Ten quadrats were randomly laid on each site. Quadrat size of 10m x 10m, 3m x 3m, and 1m x 1m was kept for trees, shrubs and herbs respectively. In each quadrat, the GBH (girth at breast height at 1.37m above ground level) of each tree was measured and recorded individually. In the case of herb and shrub, the collar diameter was measured at 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 Plant of the World Online (POWO, 2023). Values of Relative frequency, density and dominance were summed to get Importance Value Index (IVI). Species richness was calculated by counting total number of species. The diversity index (H') , concentration of dominance (Cd) and Evenness (E) were estimated using the Shannon and Wiener equation

(Shannon and Wiener, 1963), Simpson's index (Simpson, 1949) and Pielou evenness index (Pielou, 1966) respectively.

Results and Discussion

Study reveals that there are a total of 257 species (70 families, 204 genera) in the forest area of the Udaipur Wildlife Sanctuary. It includes 57 dicotyledons families (157 genera, 200 species), 11 monocotyledons families (45 genera, 57 species), 1 gymnosperm family (1 genus, 1 species) and 1 pteridophyte family (1 genus, 1 species). Largest family reported from the area is Poaceae (27 genera, 30 species) followed by Fabaceae (13 genera, 17 species), Caesalpiniaceae (7 genera, 12 species), Mimosaceae (5 genera, 10 species), Moraceae (4 genera, 9 species), Lamiaceae (7 genera, 8 species), Combretaceae (3 genera, 8 species), Apocynaceae (7

genera, 7 species), Euphorbiaceae (5 genera, 7 species), Cyperaceae (3 genera, 7 species) etc. Five genera viz. *Acacia, Bauhinia, Terminalia, Ficus* and *Cyperus* are dominant with 5 species each in the area.

These are followed by *Ipomoea* and *Solanum* with 4 species each. On the basis of habit, there are 115 tree, 27 shrub, 30 climber and 85 herb species in the area. Some of the important species of the area are *Putranjiva roxburghii, Syzygium cumini, Streblus asper, Holoptelea integrifolia, Miliusa velutina, Adina cordifolia, Albizia lebbeck, Barringtonia acutangula, Terminalia arjuna, Dalbergia sissoo etc.* Sahu *et al.,* (2012), reported a total of 57 plant species from the dry deciduous forests of Eastern Ghats. Thakur (2015) reported 36 species of tree, 8 of shrub and 34 of herb from the Sagar district of Madhya Pradesh.

A total of 14 tree species under 10 families was found from tropical dry deciduous forest of West Bengal (Kumar *et al.,* 2020). Recently, Chandra *et al.,* (2021a, b, c; 2022a, b; 2023) reported 126 and 174 156, 129 and 190 plant species from the forest of Nalanda, Aurangabad, Gaya, Banka, Jamui and Kaimur districts of Bihar, respectively. Climatic and edaphic factors and area covered under the study may be the reason for variation in the number of species in the present work.

Current status of species in an area is a crucial sign for both sustainable use and conservation. Species dominance in a community can be determined by Importance Value Index (IVI). A high value of IVI of a species reflects its good representation in the area. Top five tree species at different sites is presented in table 1. *Syzygium cumini* was the most dominant tree species in sites III and V whereas *Dryptes roxburghii, Holoptelea integrifolia* and *Wendlndia heynei* were occupied top position in sites I, II and IV respectively. Diversity indices are used to describe general characteristic of communities and are employed to compare different sites 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 Udaipur Wildlife Sanctuary is given in Table No.4.6. In the tree layer, highest Species Richness (SR) was reported for Near Permanent Nursery and Majharia Jungle-I sites (21 spp. each), followed by Jal Bharia (12 spp.), Majharia Jungle-II (11 spp.) and Balwa Rampurwa (07 spp.). In shrubby layer, highest Species Richness (SR) was observed for Near Permanent Nursery (21spp.), followed by Majharia

Jungle- II (18 spp.), Majharia Jungle-I (14 spp.), Balwa Rampurwa (11 spp.) and Jal Bharia (08 spp.). Herbaceous layer had high Species Richness (SR) in Near Permanent Nursery (23 spp.), followed by Majharia Jungle-II (15 spp.), Balwa Rampurwa and Jal Bharia (14 spp. each) and Majharia Jungle-I (10 spp.).

High value of diversity index reflects heterogeneity in the community and low value indicate homogeneity. In the tree layer, highest Diversity Index (H) was estimated for Near Permanent Nursery site (2.57), followed by Majharia Jungle-I (1.95), Jal Bharia (1.91), Majharia Jungle-II (1.47) and Balwa Rampurwa (1.13). In the shrubby layer, highest Diversity Index (H) value was estimated for Near Permanent Nursery (2.43), followed by Majharia Jungle-I (1.73), Balwa Rampurwa (1.71), Jal Bharia (1.44) and Majharia Jungle-II (1.34).

In the herbaceous layer, highest Diversity Index (H) was estimated for Jal Bharia (2.48), followed by Majharia Jungle-II (1.96), Near Permanent Nursery (1.94), Majharia Jungle-I (1.59) and Balwa Rampurwa (0.94). Various researchers (Sundarapandian and Swamy, 2000; Himanshi *et al.,* 2020; Chandra *et al.,* 2021a, b, c; 2022a, b; 2023) reported diversity index of tropical forests of Indian Sub-continental. They reported diversity index value ranges from 0.10 to 3.24. In the present study, diversity index values are also within the above range.

The higher value of Concentration of Dominance (CD) reflects that community is dominant by single species. The lower value indicates that community is equally shared by many species. In the tree layer, Concentration of Dominance (CD) was highest in case of Balwa Rampurwa site (0.49) followed by Majharia Jungle-II (0.38), Jal Bharia (0.23), Majharia Jungle-I (0.17) and Near Permanent Nursery (0.11). In shrubby layer, highest value of Concentration of Dominance was estimated for Majharia Jungle-II (0.50) site, followed by Jal Bharia (0.33), Majharia Jungle-I (0.32), Balwa Rampurwa (0.23) and Near Permanent Nursery (0.12). In the herbaceous layer, highest value was reported for Balwa Rampurwa (0.65), followed by Near Permanent Nursery (0.26), Majharia Jungle-I (0.24), Majharia Jungle-II (0.20) and Jal Bharia (0.09).

High value of Evenness (E) is the indication of uniformly distribution of species. In case of tree layer, highest Evenness (E) value was estimated for Majharia Jungle-I site (0.89), followed by Near Permanent Nursery (0.84), Jal Bharia (0.77), Majharia Jungle-II (0.61) and Balwa

Rampurwa (0.58). In case of shrubby layer, highest Evenness (E) value was observed for Near Permanent Nursery (0.80), followed by Balwa Rampurwa (0.71), Jal Bharia (0.69), Majharia Jungle-I (0.66) and Majharia Jungle-II (0.61).

In the herbaceous layer, highest value of Evenness (E) was estimated for Jal Bharia (0.94) followed by Majharia Jungle-II (0.72), Majharia Jungle–I (0.69), Near Permanent Nursery (0.62) and Balwa Rampurwa (0.36). In our study, Pielou's Evenness Index (E) for the tree, shrubby and herbaceous layers showed similar pattern as reported by other tropical Indian forests such as Udaipur, Rajasthan (Kumar *et al.,* 2010), Western Ghats (Sundarapandian and Swamy, 2000), Bundelkhand region of Uttar Pradesh (Verma *et al.,* 2013), South West Haryana (Himanshi and Jakhar, 2020), Nalanda, Aurangabad, Gaya, Banka, Jamui and Kaimur districts of

Bihar (Chandra *et al.,* 2021a, b, c; 2022 a, b; 2023). Regular inventorization and monitoring of bio-diversity is the need of the hour for conservation and sustainable utilization. Earlier no work was carried out for the assessment of quantitative status of different species in the region. In the present study, both quantitative and qualitative status of plant diversity was done in the forest area of Udaipur Wildlife Sanctuary.

Study reveals that Near Permanent Nursery study was most diverse site followed Majharia Jungle-I, Jal Bharia, Majharia Jungle –II and Balwa Rampura. There are number of biotic and abiotic factors which are posing threat to the biodiversity. These factors need to be identified and suitable management strategies to be developed for reversal of the original status of the vegetation.

Table.1 Top five dominant tree species with IVI values at different sites

S.No.	Site-I	Site-II	Site-III	Site-IV	Site-V
1.	*Drypetes roxburghii* (123.15)	*Holoptelea integrifolia* (98.11)	*Syzygium cumini* (111.90)	*Wendlandia heynei* (65.53)	*Syzygium cumini* (155.17)
2.	*Syzygium cumini* (114.18)	*Miliusa velutina* (73.43)	*Mallotus philippensis* (39.36)	*Syzygium cumini* (57.53)	*Dalbergia sissoo* (42.25)
3.	*Streblus asper* (26.92)	*Mallotus philippensis* (33.71)	*Pongamia pinnata* (21.32)	*Terminalia arjuna* (54.12)	*Terminalia arjuna* (37.64)
4.	*Trewia nudiflora* (14.12)	*Streblus asper* (25.44)	*Miliusa velutina* (16.42)	*Dalbergia sissoo* (32.08)	*Celtis tetrandra* (15.32)
5.	*Gmelina arborea* (7.85)	*Adina cordifolia* (12.39)	*Albizia lebbeck* (13.59)	*Mallotus philippensis* (32.03)	*Mallotus repandus* (9.43)

Table.2 Diversity indices for different growth forms at different sites

S.N.	Sites	Tree Layer				Shrubby Layer				Herbaceous Layer			
		SR	H	CD	E	SR	H	CD	E	SR	H	CD	E
1.	Balwa Rampurwa	07	1.13	0.49	0.58	11	1.71	0.23	0.71	14	0.94	0.65	0.36
2.	Jal Bharia	12	1.91	0.23	0.77	08	1.44	0.33	0.69	14	2.48	0.09	0.94
3.	Near Permanent Nursery	21	2.57	0.11	0.84	21	2.43	0.12	0.80	23	1.94	0.26	0.62
4.	Majharia Jungle– I	21	1.95	0.17	0.89	14	1.73	0.32	0.66	10	1.59	0.24	0.69
5.	Majharia Jungle-II	11	1.47	0.38	0.61	18	1.34	0.50	0.02	15	1.96	0.20	0.72

(SR=Species richness; H=Diversity index; CD=Concentration of dominance; E=Evenness)

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Author Contribution

A. Chandra: Investigation, formal analysis, writing—original draft. H. B. Naithani: Validation, methodology, writing—reviewing. P. K. Verma:—Formal analysis, writing—review and editing.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

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Consent to Publish: Not applicable.

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