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Tree diversity in moist deciduous forests of Similipal biosphere reserve, Odisha, India

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ABSTRACT

The phytosociological study was conducted in moist deciduous forests of Similipal Biosphere Reserve of Mayurbhanj, Odisha to assess species structure, distribution, diversity and dominance of trees. Enumeration of all tree species ≥ 30 cm GBH yielded a total of 3214 individuals belonging to 141 species, under 105 genera and 41 families. The most dominant families were Euphorbiaceae, Rubiaceae, Moraceae, Caesalpiniaceae and Fabaceae. Shanon-Weiner Index (H') was calculated as 3.46 with Simpson Index of dominance of 0.90. Analysis of population density of trees across the girth class interval showed that nearly 31.83 % of individuals belong to 30-50 cm GBH. The result of the study renders a helping hand to the forest managers in preparing a conservation plan for the highly species diverse and threatened ecosystem of moist deciduous forests of Similipal Biosphere Reserve, Mayurbhanj, Odisha.

1. Introduction

The analysis of forest structure and composition is prerequisite for formulating appropriate conservation strategies and management of protected areas. Phytosociological study indicates species diversity and distribution of individuals in a plant community of a habitat (Kar *et al.,* 2009). The depletion of plant genetic resources is mainly due to loss and fragmentation of habitats. The conversion of forest land for agriculture, human settlement and over exploitation of forest resources for timber, fuel wood, non-timber forest products, etc. are some of the anthropogenic causes which threatens the loss of biodiversity.

Similipal Biosphere Reserve (SBR) is one of the seventeen biosphere reserves of India. Due to its rich biodiversity and cultural significance it has been included in World Network of Biosphere Reserve (WNBR) since 6th may, 2009. It lies between 20^0 17' to 22^0 34'N latitude and 85^0 40' to 87^0 10' E longitude, located in the central part of Mayurbhanj district, Odisha. It extends over an area of 5569.00 km^2 with a core area of *ca* 1194.75 km^2, buffer area *ca* 1335.88 km^2 and transition area *ca* 3038.39 km^2 Similipal is considered as Himalayas of Odisha, because of its enormous influence over the climate of the state and its neighbourhood and is a treasure house of floristic diversity of Odisha.

Moist deciduous forests are predominantly composed of taxa namely *Shorea robusta*, *Terminalia alata, Haldinia cordifolia, Anogeissus latifolia, Schleichera oleosa, Pterocarpus marsupium, Syzygium cumini, Dillenia pentagyna, Terminalia bellirica, Kydia calycina, Mitragyna parvifolia, Ardisia solanacea,* etc.The shrubby elements are mostly evergreen. *Bauhinia vahlii, Butea superba* and *Millettia extensa* are worth mentioning among the climbers.

Earlier few quantitative estimation of the vegetation of Similipal were carried out by some workers (Reddy *et al.,* 2000; Mishra *et al.,* 2000, 2003, 2006, 2008). But phytosociological studies on tree species of moist deciduous forest in Similipal Biosphere Reserve is scanty. Keeping in view the above fact the present study is an attempt to

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record structural composition of moist deciduous forest types in Similipal, Mayurbhanj, Odisha, India.

2. Materials and methods

2.1 Ground data

Phytosociological study was carried out in moist deciduous forest types of Similipal Biosphere Reserve using random quadrat (20 m × 20 m). Trees greater than or equal to 30 cm GBH were recorded from all the sample plots. The data were collected from randomly selected 140 sample plots (5.6 ha) from different forest ranges of Similipal Biosphere Reserve. The elevation, aspect, latitude, longitude and level of biotic interference etc. are given in Table 1. The size and number of quadrats needed were determined using the species area curve (Misra, 1968). Voucher specimens were collected for preparation of Herbarium adopting proper scientific methodology. The species were identified in consultation with taxonomic literature, viz., Flora of Presidency of Madras (Gamble, 1915-1935), Botany of Bihar and Orissa (Haines, 1921-1925), Supplement to the Botany of Bihar and Orissa (Mooney, 1950), Flora of Orissa (Saxena and Brahmam, 1994-1996), Flora of Bilaspur district (Murti and Panigrahi, 1989-1999), and Flora of Bihar b(Singh *et al.,* 2001). The information regarding latitude, longitude and altitude of each quadrat in sample area were collected using a Global Positioning System (GPS).

2.2 Data analysis

The main purpose of phytosociological analysis is carried out to understand vegetation characteristics and to estimate the species richness and species diversity existing in the study area. In order to express the dominance and ecological success of any species with a single value, the concept of important value index has been utilized. This index utilizes three characteristics, viz., relative frequency, relative density and relative dominance. The analysis was carried out for each vegetation type for computing important value index.

Relative density (RD) = (Density of sp. /Total density of all spp.) x 100.

Relative frequency (RF) = (Frequency of sp./Total frequency of all spp.) x 100.

Relative dominance (ReD) = (Basal area of sp./Total basal area for all spp.) x 100.

Importance Value Index (IVI) = RD + RF + ReD

Species diversity of this forest type was determined as explained by Shannon and Wiener (1963) (*H'*). Concentration of dominance was also measured as Simpson's index (C) (Simpson, 1949).

3. Results and discussion

3.1 Floristic composition

During the present study a total of 3214 trees belonging to 41 families from 140 sample plots were enumerated. Among the families, Euphorbiaceae (15 species), Rubiaceae (14 species) and Moraceae (8 species) were most diverse. Fabaceae and Caesalpiniaceae were represented by 7 species each.

The dominant tree elements are *Shorea robusta, Terminalia alata, Anogeissus latifolia, Syzygium cumini, Protium serratum, Xylia xylocarpa,* etc. The tree species with their IVI values are given in Table 2. The top most 20 species represented 73.55 % of individuals in the forests. The Shannon-Weiner Index (H') was 3.46 with Simpson index of 0.9.

3.2 Forest structure

Stem density was found decreased with increasing girth class of tree species from 50 cm girth (Fig. 2). The

Table 1
Characteristic features of the study area.

Forest Range of Similipal	Elevation (m)	Aspect	Latitude	Longitude	Level of biotic interference
Pithabata	200 - 830	East	21° 55' - 21° 59'	86° 32' - 86° 36'	HB
Nawana	650 - 810	North	21° 52' - 21° 56'	86° 18' - 86° 25'	MB
Chahala	780 - 850	North	21° 56' - 21° 59'	86° 17' - 86° 22'	NB
Jenabil	740 - 890	South	21° 25' - 21° 52'	86° 21' - 86° 52'	NB
Upper barakamuda	815 - 1165	South	21° 02' - 21° 50'	86° 16' - 86° 50'	NB
National Park	444 - 920	North-west	21° 09' - 21° 52'	86° 14' - 86° 54'	MB

Abbreviations: HB – High biotic interference; MB – Moderate biotic interference; NB – No biotic interference.

Table 2
The top twenty predominant species with their IVI values.

Sl. No.	Name	Relative Density	Relative Frequency	Relative Dominance	IVI
1	*Shorea robusta* Gaertn.f.	27.785	7.749	35.773	71.307
2	*Terminalia alata* Heyne ex Roth	8.525	7.159	8.247	23.931
3	*Anogeissus latifolia* (Roxb.ex DC) Wall.ex Guill.&Perr.	4.636	4.797	4.634	14.067
4	*Syzygium cumini* (L.) Skeels	4.449	4.502	3.642	12.593
5	*Protium serratum* (Wall.ex Colebr.) Engl.	3.205	3.247	3.574	10.026
6	*Xylia xylocarp*a (Roxb.) Taub.	2.862	2.435	3.716	9.014
7	*Dillenia pentagyna* Roxb.	2.302	3.173	2.674	8.150
8	*Haldinia cordifolia* (Roxb.) Ridsd.	2.085	3.100	2.646	7.831
9	*Scheleichera oleosa* (Lour.) Oken	1.836	2.657	3.003	7.495
10	*Madhuca indica* Gmel.	1.773	2.140	2.843	6.756
11	*Croton roxburghii* Balak.	2.427	2.583	0.785	5.795
12	*Pterocarpus marsupium* Roxb.	1.680	1.993	1.620	5.293
13	*Syzygium cerasoides* (Roxb.) Chatt.& Kanjilal	1.805	1.771	1.142	4.718
14	*Bridelia retusa* (L.) Spreng	0.965	1.476	1.435	3.876
15	*Mangifera indica* L.	0.498	0.664	2.708	3.870
16	*Bombax ceiba* L.	0.933	1.771	1.154	3.858
17	*Buchanania lanzan* Spreng.	1.369	1.919	0.555	3.843
18	*Nyctanthes arbor-tristis* L.	1.836	1.624	0.293	3.752
19	*Terminalia chebula* Retz.	1.089	1.697	0.936	3.722
20	*Cleistanthus collinus* (Roxb.) Benth.ex Hook.f.	1.493	1.697	0.465	3.656

Fig. 1. Location map of Study area.

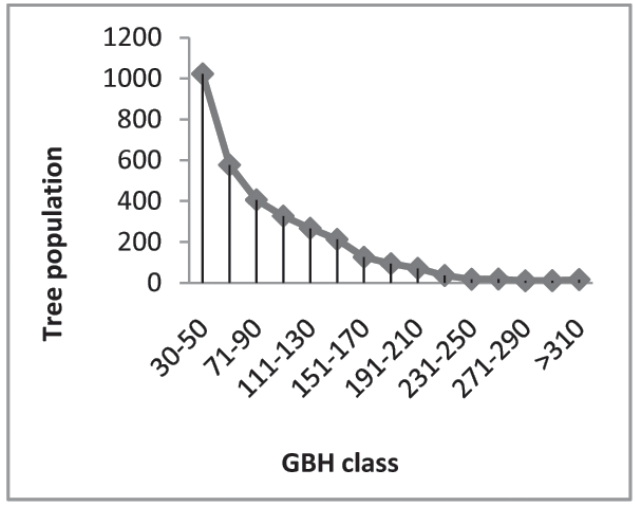

Fig. 2: Relation between girth class and tree population.

Table 3
Population density of tree elements across girth class intervals.

GBH class (cm)	No. of Species	% of Species	No. of individuals	% of individuals
30-50	122	86.52	1023	31.83
51-70	87	61.70	577	17.95
71-90	71	50.35	406	12.63
91-110	110	78.01	327	10.17
111-130	46	32.62	267	8.31
131-150	38	26.95	213	6.63
151-170	28	19.86	126	3.92
171-190	23	16.31	94	2.92
191-210	21	14.89	71	2.21
211-230	18	12.77	36	1.12
231-250	8	5.67	18	0.56
251-270	12	8.51	19	0.59
271-290	7	4.96	10	0.31
291-310	6	4.26	11	0.34
>310	10	7.09	16	0.50
Grand Total	141	100	3214	100

distribution of the basal area across different GBH interval showed that the GBH class having 30-50 cm contributed 86.52 % of species richness (Table 3). The highest GBH was measured case of *Ficus rumphii* (672 cm), *Mangifera indica* (455 cm), *Shorea robusta* (430 cm), *Terminalia chebula* (390 cm), etc. Among the tree species the relative density was highest in *Shorea robusta* (27.78) followed by *Terminalia alata* (8.52), *Anogeissus latifolia* (4.63), *Syzygium cumini* (4.44) and *Protium serratum* (3.20). Relative dominance was highest in *Shorea robusta* (35.77) followed by *Terminalia alata* (8.24), *Anogeissus latifolia* (4.63), *Xylia xylocarpa* (3.71) and *Syzygium cumini* (3.64).

The IVI of most dominant tree *i.e*. *Shorea robusta* is 71.307, which is comparable with the IVI value of Mishra *et al.* (2006, 2008) reported in Site 10 as 53.75 for the same species. The change in IVI of *Shorea robusta* is due to the change in species composition, disturbance and altitude. The tree species with higher IVI values indicate their good regeneration capacity and more adaptability.

Many researchers have reported the diversity value for Indian forests in the range of 0.8 to 4.1 (Parthasarathy *et al.,* 1992; Visalakshi, 1995).The diversity value of the tree species obtained in the present study is within the reported range of tropical forests which is significant. However, our value is lower than some other tropical forest (Knight, 1975) due to anthropogenic disturbances.

4. Conclusion

The quantitative characters with reference to density, diversity and frequency distribution could well act as indicators of anthropogenic disturbances that are affecting various forest types and such studies would help in understanding the threats that are being faced by the tropical forests and would help in deriving conservation policies. An understanding of the distribution of tree species and their assemblages must play an important role in elucidating the larger patterns of distribution of biodiversity.

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