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FLORISTIC COMPOSITION AND BIOLOGICAL SPECTRUM STUDY NEAR THE MINING CLUSTER AT KEONJHAR DISTRICT, ODISHA, INDIA

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ABSTRACT

A total of 192 numbers of species belonging to 68 families out of which 74 species of trees, 27 climbers, 23 shrubs, 62 herbs and 6 fern species were recorded. Highest number of species was found in Zone II (141 numbers) followed by Zone I (101 numbers), Zone III (93 numbers) and Zone IV (90 numbers). It was observed that, in all the four Zones *Shorea robusta* was the dominant tree species with an IVI value of 17.2 in Zone I, 10.63 in Zone II, 23.7 in Zone III and 19.43 in Zone IV. The Shannon-Weiner diversity index for the tree was recorded highest in Zone II (3.87) followed by Zone I (3.29), Zone III (3.23) and Zone IV (3.14). The species evenness index for tree species was found to be highest in Zone IV (0.32) followed by Zone III (0.28), Zone I (0.27) and Zone II (0.18). The Simpson's dominance index for tree species was found to be highest in Zone IV (0.047) followed by Zone III (0.046), Zone I (0.043) and Zone II (0.023). The species richness index has been found to be in the order of Trees>Shrubs>Herbs.

KEYWORDS: Floristic Composition; IVI; Species Richness Index; Shannon- Wiener Diversity Index; Simpson's Index; Species Richness Index.

INTRODUCTION

The structure of plant and animal communities in many natural ecosystems are largely influenced by the disturbances, frequently occurring in the system which may be due to natural or anthropogenic activities [1,2,3,4]. Anthropogenic activities such as overgrazing, deforestation, bush fires, shifting cultivation, developmental activities like mining, urbanization and road construction inside the protected areas are found to be the major causes of lose of biodiversity & forest. Apart from this, climatic factor, especially precipitation also play a significant role in species composition and structure [5,6,7]. Mining activities causes massive damage to the landscapes and biological communities of the area and impact of severity depends on whether the mine is working or abandoned, mining methods and the geological conditions [8]. Increase mining & allied activities have put tremendous negative impact on the forest [9]. The problems of overburden dumping & digging has affected the landscape of an area , as a result, natural plant communities get disturbed thus making the environment unsuitable for growth of plants.

Studies have emphasized to assess the vegetation structure and species diversity of an ecosystem [10,11]. Measures of vegetation structure provide information on habitat suitability, ecosystem productivity and successional pathways [12,13] while species diversity provide information on susceptibility to invasion and trophic structures [14]. Some of the researches worked in this area are [15,16,17,18].

STUDY AREA

Keonjhar district is one of the largest mineral bearing deposits not only in Odisha but also in the country. The study area is located between 21°37'09"-21°40'02"N and longitudes 85°29'20" - 85°31'30"E, near to Suakati town in Keonjhar district of Odisha **(Figure 1)**. A major iron ore deposit of state namely Gandhmardan hill is located at the center of study area, having a reserve of 4177 million tonne of iron ore [19]. The existing iron ore mines located at this hill is one of the oldest mines of Odisha being operated by Odisha Mining Corporation, a state government owned agency. Apart from this a number of private owned mining companies are also operating at Putulpani (Talajagar) and at Urumunda village. The study area can roughly be divided into hills, plain land and waste lands. The forest cover of the study area can be classified in to pure sal forest, mixed forest, degraded

forest, extensive plantation & open forest. A number of reserve forest like Nayagarh R.F, Gandhamardhan R.F , Raiguda R.F, Kumundi R.F , Khejurmundi R.F, Suakati R.F, Sanaghagara R.F & Siddhamatha R.F are located within 10 Km radius of the mines area which indicates the ecological richness of the area.

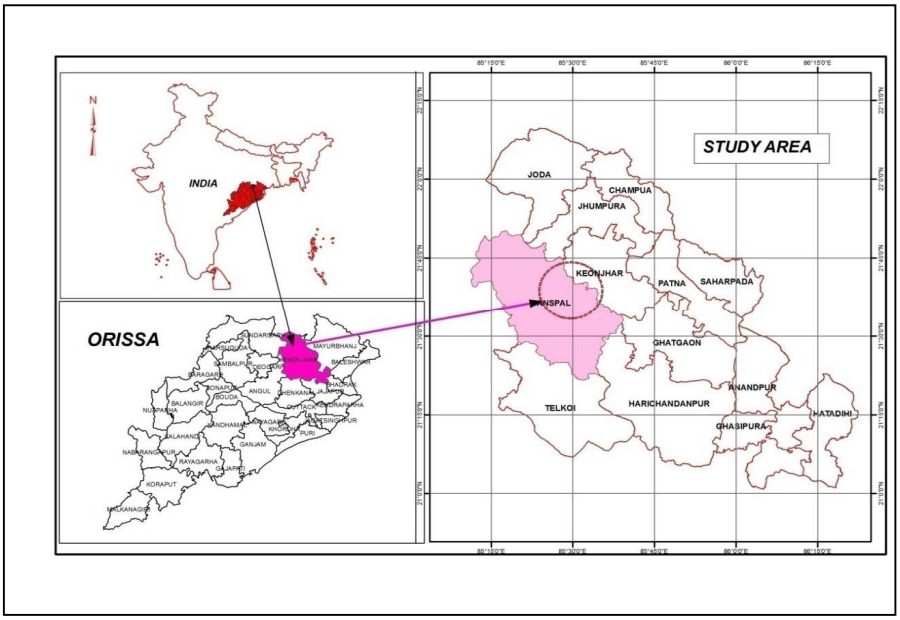

Figure 1: The study area

MATERIALS AND METHODS

To analyze the impact of iron ore mining on vegetation, distance gradient analysis was carried out. The structure and composition of vegetation was studied in mining affected and adjacent undisturbed forest area. The unaffected area is located far from mining area which is relatively unaffected by mining & allied activity. The mine affected area are open forest where the canopy covers ranges between 10-40% & lies relatively closer to the centers of mining activities. In total 16 sampling sites were identified (within 10km radius from the centre of study area). The location of the sampling station was selected by dividing the total sampling area in to grids. The location details are given in **Table 1**. Selection of sites for vegetation data was done by random sampling procedure. Accordingly, quadrates of size 10 m x 10 m for study of tree layer and sub-plots 5 m x 5 m for shrub layer and regeneration of tree species were laid out randomly. For information on ground layer including herbaceous species, quadrates of size 1 m x 1 m were laid out within the tree quadrate.

Table 1: Location details of the study area

Zone	Villages & Forest found in site
Zone I	Jamudihi village , Amor Reserve Forest , Kansari village ,Tentuli village, Suakati village
Zone II	Kumundi village, Kumundi Reserve Forest , Dumurdiha village , Khjerauna village , Rangadihi village
Zone III	Dumurdihi village , Jagar Protected Forest , Satpada village
Zone IV	Uperjagar village , Gandhmardan Reserve Forest , Talajagar village.

The species encountered in the quadrates were identified as per [20]. Quantitative community characteristics such as frequency, density, basal area and importance value index (IVI) of each species were determined [21]. Shannon-Wiener diversity index and Simpson's dominance index were also computed following [22].

Frequency: It exposes the distribution of species in a community.
Density and abundance: It represents the numerical strength of a species in a community. While density is the number of individuals per unit area, abundance when consider with frequency gives an idea of the distribution pattern of the species.

Basal area: It refers the ground actually penetrated by the stem. It is one of the chief character in determine the dominance or otherwise of a particular species in community or vegetation strand.

Important Value Index (IVI): This expresses the dominance or the ecological succession of a particular species in a community. This is the submission of relative frequency, relative density and relative dominance.

$$\text{Relative frequency} = \frac{No.\ of\ occurrence\ of\ species}{No.\ of\ occurrence\ of\ all\ species} \times 100$$

$$\text{Relative density} = \frac{No.\ of\ individuals\ of\ the\ species}{No.\ of\ individuals\ of\ all\ species} \times 100$$

$$\text{Relative dominance} = \frac{Total\ basal\ area\ of\ species}{Total\ basal\ area\ of\ all\ species} \times 100$$

$$\text{Relative frequency} = \frac{\text{No. of occurrence of species}}{\text{No. of occurrence of all species}} \times 100$$

$$\text{Relative density} = \frac{\text{No. of individuals of the species}}{\text{No. of individuals of all species}} \times 100$$

$$\text{Relative dominance} = \frac{\text{Total basal area of species}}{\text{Total basal area of all species}} \times 100$$

Now Impotent Value Index (IVI) = RF + RDen + RDom

Simpson's dominance index, c [23]:

$$c = \sum_{i=1}^{S}\left(\frac{n_i}{N}\right)^2$$

where ni = number of individuals in the 'ith' species
N = total number of individuals
S = total number of species

The Shannon diversity index (*H*) is another index that is commonly used to characterize species diversity in a community. this measurement takes into account species richness and proportion of each species within the local aquatic community.

$H = -\ P_i(\ln P_i)$ where P_i is the proportion of each species in the sample

Species Richness: The number of species per sample is a measure of richness. The more species present in a sample, the 'richer' the sample. Species richness as a measure on its own takes no account of the number of individuals of each species present.

Species Evenness: Evenness is a measure of the relative abundance of the different species making up the richness of an area. The more species present in a sample the 'richer' the area.

$$D = 1 - \text{sum}(p_i)^2$$

Where; D is the Diversity Index with values that vary from 0 (all of same species) to 1 (myriads of species, all equal in number);
sum over all species in community;
p_i is the proportion of species i in the community.

RESULTS AND DISCUSSION

A total of 192 numbers of species belonging to 68 families were recorded from the four study stands. Out of these, 74 species of trees, 27 climbers, 23 shrubs, 62 herbaceous species and 6 fern species were recorded.

Species found in the study zone:

Highest numbers of species were found in Zone II with a total of 141 species. This is followed by Zone I with 101 numbers of species, followed by Zone III 93 numbers of species and Zone IV with total of 90 numbers of species. The details number of species found in various zones is being presented in **Table 2.**

Table 2: Zone wise composition of plant species

Study Zones	Life forms	No. of species	No. of Families
Zone I	Herbs	36	25
	Shrubs & Climbers	32	19
	Trees	33	20
Zone II	Herbs	46	25
	Shrubs & Climbers	42	23
	Trees	53	29
Zone III	Herbs	33	20
	Shrubs & Climbers	28	21
	Trees	32	20
Zone IV	Herbs	32	27
	Shrubs & Climbers	31	22
	Trees	27	21

Importance value Index (IVI): IVI was calculated to find out the dominant species in the study region.

Zone I: It has been found that the dominant trees species with highest IVI values at Zone I was *Shorea robusta* (17.2) followed by *Madhuca longifolia* (16.78) and *Butea monosperma* (15.13). Among the shrubs the dominant species is *Lantana camara* (24.36) followed by *Calotropis gigantea* (18.01) and among the climber *Ziziphus oenoplia* is the dominant species (37.20) followed by *Cyanodon dactylon* (21.10).

Zone II: In zone II, the dominant tree species is *Shorea robusta* (10.63) followed by *Diospyros malabarica* and *Terminalia arjuna* with IVI of 9.83 and 9.39 respectively. The dominant shrub is *Lantena camara* followed by *Woodfordia fruticosa* with IVI of 14.74 and 13.78 respectively. Among the herbaceous vegetation the dominant species is *Ageratum conyzoides* with IVI of 30.12 followed by *Andrographis paniculata* with IVI of 14.73.

Zone III: In zone III, the dominant tree species is *Shorea robusta* (23.7) followed by *Madhuca longifolia* (17.99). Among the shrubs and climbers the dominant species are *Lantena camara* (34.84) followed by *Calotropis gigantea* (19.32).

Among herbaceous vegetation the dominant herb was *Ageratum conyzoides* (29.63) followed by *Andrographis paniculata* (26.98).

In Zone IV: In zone IV, the dominant tree species is *Shorea robusta*, (19.43) followed by *Butea monosperma* (18.45). Among the shrubs the dominant species is *Calotropis gigantea* (24.82) followed by *Clerodendrum viscosum* Vent (22.93) and the dominant herb is *Ageratum conyzoides (42.12)* followed by *Curculigo orchioides* Gaertn *(24.38)*.

The species richness index was found to be varying from zone to zone as well as among the tree, shrub and herb. Zone II has the highest tree species richness index 2.64 followed by Zone IV 2.52, Zone III 2.39 and Zone I with 1.77 respectively. For shrub the species richness index was found to be highest at Zone II followed by Zone III, Zone I & Zone IV. For herb the species richness index order was highest at Zone I followed by Zone II, III & IV. The detailed phyto-sociological characteristic of the study sites is being presented in **Table-3. Figure 2 and Figure 3** shows the species richness index distribution of the study area and Shannon-Wiener index of the study area respectively.

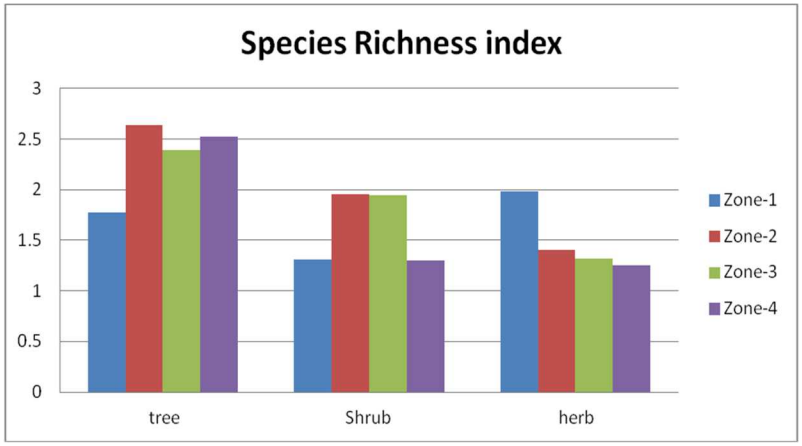

Figure 2: Species richness index distribution of the study area

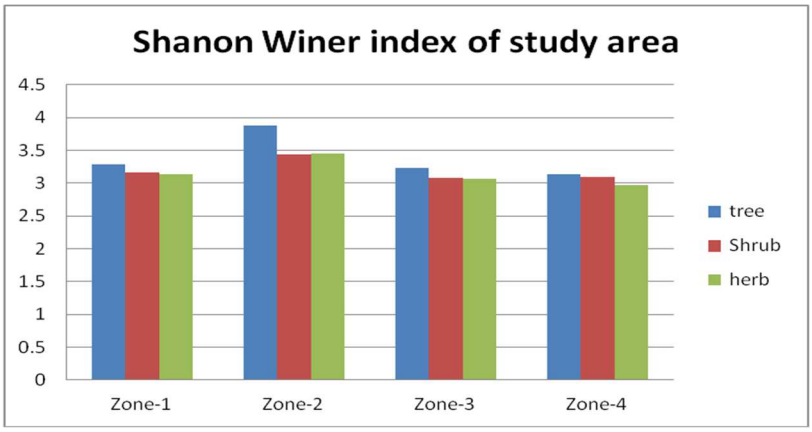

Figure 3: Shannon – Wiener index of the study area

Table 3: Phyto-sociological characteristic of the study sites

Index	Zone-I			Zone-II			Zone-III			Zone-IV		
	Herbs	**Shrubs**	**Trees**	**Herbs**	**Shrubs**	**Trees**	**Herbs**	**Shrubs**	**Trees**	**Herbs**	**Shrubs**	**Trees**
Species richness Index	1.98	1.31	1.77	1.40	1.954	2.64	1.32	1.94	2.39	1.25	1.30	2.52

Shannon and Wiener diversity index (H')	3.14	3.16	3.29	3.45	3.43	3.87	3.06	3.08	3.23	2.97	3.09	3.14
Simpson's Dominance index (D)	0.048	0.069	0.043	0.05	0.039	0.023	0.066	0.064	0.046	0.047	0.051	0.047
Species evenness index (E)	0.282	0.224	0.277	0.203	0.226	0.186	0.250	0.287	0.281	0.11	0.26	0.32

The Shannon-Weiner diversity index for the tree was recorded highest in Zone II (3.87) followed by Zone I (3.29), Zone III (3.23) and Zone IV (3.14). The species evenness index for tree species was highest in Zone IV (0.32) followed by Zone III (0.28), Zone I (0.27) and minimum in Zone II (0.18). The Simpson's dominance index for tree was found highest in Zone IV (0.047) followed by Zone III (0.046), Zone I (0.043) and Zone II (0.023).

From various phyto-sociological parameters it has been observed that the species richness of herbs, shrubs and trees varies from each other. The vegetation composition in the study areas is found to be heterogeneous. The species richness index of all the study sites has been found to be Trees>Shrubs>Herbs. Moreover, high diversity and low dominance index may be due to the different microclimatic & local factors observed in the study zone. In general, species diversity and dominance index showed inverse relationship and Simpson's index is heavily weighted towards the most abundant species in the sample and is less sensitive to species having only a few individuals. It has been found that Zone II is having highest species richness and with highest diversity index. The area comprises of highest species diversity. The tree diversity is much higher in this area as compare to other study sites. The diversity index of tree species is comparatively higher than that of shrubs and herbs. The species richness is also higher in case of tree species as compare to the shrubs and herbs. While Zone III is a forest fringe village area Zone IV is affected anthropogenic activity like open cast mining. The species richness and diversity of species is less as compare to the Zone II and Zone I area which are forest areas. However the dominance index for trees, herbs and shrubs is maximum in Zone III and Zone IV. In Zone I the species richness is minimum in case of tree species. This is because of rapid urbanization observed in these areas due to mines operating in this area resulting in deforestation and human interference in the forest. This may be result in less species richness and diversity as compare to other study sites.

CONCLUSION

In the present study, a total of 192 species belonging to 68 families were recorded from the four study stands out of which, 74 species of trees, 27 climbers, 23 shrubs, 62 herbaceous species and 6 fern species were recorded. Highest number of species was found in Zone II with a total of 141 numbers of species followed by Zone I with 101 numbers of species, Zone III with 93 numbers of species and Zone IV with total of 90 numbers of species. The vegetation composition in the study areas is found to be heterogeneous. Differences in the number of individual tree, climber, herb and shrub species and their indices in the study area may be due to differences in local environmental variables like disturbance gradients, vegetation characteristics and more over the mining and allied activities in the area. *Shorea robusta* was found to be the dominant tree species.

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