

Study of biodiversity of Giridih District Jharkhand

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Abstract: The forests of Giridih are mostly over hills and undulating lands. Sal is the pioneer species in Giridih Division. These are found everywhere in tract but are not so good and suffers from over exploitation. Due to repeated cutting the crop is severely destroyed and reached to sapling and rooted waste stage. The associates of Sal are *Diospyros melanoxylon*, *Buchananian alazan*, *Anogeissus latifolia*, *Adina cordifolia*, *Albizia sps*, *Aegle marmelos*, *Emblica officinalis*, *Terminalia sps* etc. The common shrubs are *Woodfordia fruticosa*, *Phoenix sps*, *Helicteres isora*, *Nyctanthes arborescens* etc. Phytosociological parameters such as frequency (70 to 130), Density (1.0 to 6.20), Abundance (1.43 to 5.64) varies between 13 different blocks of the district studied. Average value of richness for the trees present in the district was 1.63. Average value of evenness 8.46. The Shannon-Weiner biodiversity Index (H) is very realistic and popular among varied Bio diversity indices. The H' value for district for tree is (4.13) and Simpson's Index (D) 0.0172. Among the mega fauna in district Elephants are prominent and it has not been a regular event of crop raiding and attacks on human. Stray incidences of crop raiding have been reported in some of the villages between 2015 to 2021. Total number of crop raiding has been 7 across the last six year in the Giridih Forest Division but attack on human life has not been reported. Creating waterholes in the forests will help in reducing incidences of animals moving to the non-forest area during summer seasons especially. Planting of bamboos in and around elephant corridors will help in reducing elephant menace in the farmers field.

(Keywords : Biodiversity, Giridih, Biodiversity Index, Richness, Evenness)

Introduction

Giridih is an administrative district of Jharkhand, situated at $24.18^{\circ}15'N$ latitude,

$86.30^{\circ}12'E$ longitude and an average altitude of 289 meters. It was carved out from Hazaribag district in 1972 lying almost in the central part of the North Chotanagpur Division (16) with an area of 4853.56 sq. km. The plateau maintains the height of 1300 ft. Giridih is one of the fastest emerging hub of mineral extraction in the state of Jharkhand. It has coal and mica mines of best quality.

The city is also having several small medium scale enterprises that are contributing to the economy. The blocks Tisri and Gawan are rich in ores and minerals of many metals that are used by GOI.

There are several popular tourist attraction in the district like Usri fall, Khandoli, Parasnath etc.

The climatic condition in the region is generally dry with temperature rising upto $47^{\circ}C$ in May month of summer season and experiences monsoon during the month of June. The average annual rainfall is about 1300 mm.

Two types of soil are found in Giridih:-

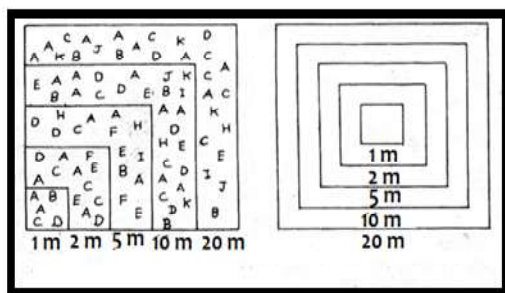
- Red loamy soil- Small patches in north eastern sector near Chauki, Panitarn villages in Deori block
- Red and Yellow soil- central part over a large chunk of area in Jaunia Birni and Dhanwar blocks.

Barakar and Sakri rivers flows through Giridih and contributes immensely in the biodiversity of the region.

The region is covered by dense forest vegetation and Species are Simul, Bamboo, Palas, Mahua, Kusum, Asan, Bhelwa etc. The dense forest is inhabited by several tribal communities. This has resulted into unsustainable harvest of natural resources and have been a key factor for degradation of biodiversity vegetation in the area have been under constant threat because of the exploitation due to mining, industrialisation, illicit felling, firewood, fodder collection etc.

Besides, depletion in faunal biodiversity has also been observed mainly due to excessive hunting, climate change and invasive species.

Methodology



study was conducted between March 2022 to February 2023. Sampling was done during Pre monsoon (March to May) and post monsoon (October to December).

Random quadrat (size-20mx20m) sampling method was adopted. The district Giridih contains 13 blocks viz. Bagodar (south –west), Bengabad (East), Birni (North-west), Deori (North East), Dhanwar (North west), Dumri (South), Gande (South East), Gawan (North), Giridih (South East), Jamua (North-East), Pirtand (South), Suriya (South West), Tisri (North). Altogether 13 samples (3 replicate each) one in each block were collected. For quantitative estimation their average value was calculated. Each value represented one block and thus, 13 values were obtained for the calculation of the entire scenario of biodiversity of Giridih district.

How to select a representative sample

1. Species area curve method (1) was used to determine minimal size of quadrat. This gave us the quadrat size of 20 m x 20 m (0.4 Ha) where with minimum size of sampling efficiency is maximum.

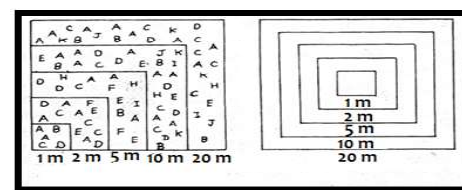
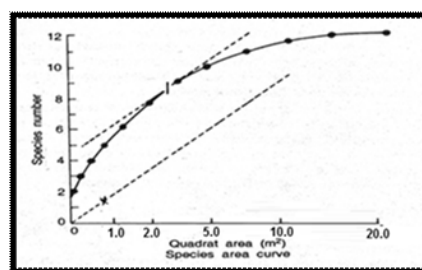


Fig. Species-area curve showing an initial rapid increase in number of species with increase in area of the quadrat. Gradually the rate of increase in number of species declines. A tangent is drawn on this curve parallel to a line joining the axis extending upwards.

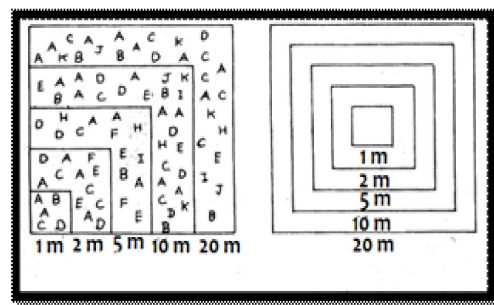


Fig. Diagrammatic representation of increasing size of quadrats and the numbers of species (represented by letters) in determination of the minimal requisite size of a quadrat by species area curve method.

Following methods have been used for real time qualitative and quantitative characterisation of biodiversity in the area.

Qualitative characterisation

Terrestrial flora

This has been studied in terms of floristic enumeration, sociability, dispersion, habit and habitat using standard floral sampling techniques such as:

The random sampling approach was followed for phyto-sociological survey in the study area. Placing of quadrat is based on accessibility and vegetation cover present study site and distributed uniformly as far as possible. Sampling was done for all the life-forms *i.e.*, trees, shrubs and herbs.

A total of 13 numbers of quadrats have been studied in the district split over 2 forest division namely Giridih east and Giridih west (19) of the district.

Quantitative characterisation

Flora has been quantified using Phyto sociological techniques such as Frequency, density and Abundance (FDA) described by (Ambasht 1990). These are as below-

Frequency

This describes degree of dispersion of individual species in an area. Usually expressed in terms of percentage (%) of occurrence. It is probability of an individual of a given species to be present in a randomly placed quadrat. For instance if a species occurs in two quadrats out of a total 13 quadrats studied, then its frequency is 20%.

$$F = \frac{\text{Number of quadrats in which a species occurs}}{\text{Total number of quadrats sampled}} \times 100$$

Abundance

This is the study of number of individual of different species in the community per quadrat.

Here samplings are made random at several places and the number of individuals of each species is summed for all the quadrats. The total number of individuals of different species is divided by the number of quadrats where that species occurs.

Abundance =

$$\frac{\text{Total no. of individuals of a species in all quadrats}}{\text{Total no. of quadrats in which the species occurred}}$$

Density

Density is an expression of the numerical strength of a species where the total number of individuals of each species is divided by the total number of quadrats studied and expressed in numbers per sq. m

Density =

$$\frac{\text{Total no. of individuals of a species in all quadrats}}{\text{Total no. of quadrats sampled}}$$

The above formula would give the density value per quadrat.

Biodiversity Indices

Biodiversity indices are essentially a measure of the number of species in a defined sampling unit like quadrats. It is a statistical abstraction with 2 components including RICHNESS and EVENNESS. The diversity is principally a mechanism which generates community stability. Greater diversity provides a number of alternative pathways in the ecosystem functioning that give stability to the ecosystem whereas single species crops are least productive.

I. Species Richness (s)

Species richness represents a measure of the variety of species in per unit area. It can be calculated by counting total number of species in a given sampling unit. It has very good discriminant ability. It is highly sensitive to

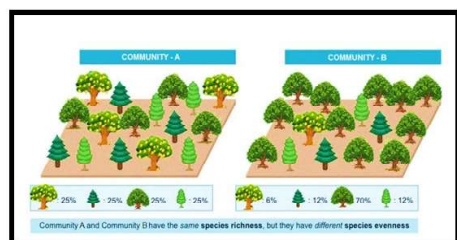
sample size. Due to these characteristics it is widely used. As species richness increases the diversity increases.

Species richness = number of species

II. **Evenness** : Describes the relative abundance of the different **species** in an area

(Similar abundance = more **evenness**)

$E = H / \ln(S)$ Richness



Types of Biodiversity Indices-

1. A numbers of biodiversity indices have been given by ecologists from time to time, out of which 2 types of biodiversity indices(10) have been calculated:-

I. Shannon -Weiner Index ($\bar{H}$)

II. Simpson's Index (D)

I. **Shannon-wiener Index ($\bar{H}$)**

Shannon-wiener diversity index is widely used for comparing diversity between various habitats and represented by **or**. It is sensitive to sample size and calculated by the following formula:-

$$\bar{H} = - \sum P_i \ln P_i$$

Where, ($P_i = \frac{n_i}{N}$) (n_i = the number of individuals in the i th species and N = the total number of individuals.)

Diversity of species in a particular community is directly proportional to the value of $\bar{H}$. Its value can range from 0 to infinity, but in practice, it usually ranges from 0 to 5. Species will be needed to produce a value of

Shannon diversity index more than 5. $\bar{H} = 0$ indicates a community with only one species while a value of 5 indicates a community with maximum diversity.

II. **Simpson's Index (D)**

The Simpson's index is a measure of diversity which takes into account the number of species present, as well as the relative abundance of each species. This index is heavily weighted towards the most abundant species in the sample and is less sensitive to species richness. It is represented by the alphabet D and the value ranges between 0 to 1. It is calculated by the formulae

$$D = \sum \left(\frac{n_i(n_i - 1)}{N(N - 1)} \right)$$

The D value which is standing for the dominance index is used in pollution monitoring studies. As D increases, diversity decreases. That way it is effectively used in Environmental Impact Assessment to identify perturbation. The value of D ranges between 0 and 1. Where, High scores (close to 1) indicate high diversity.

Results and Discussion

1. The forests of Giridih are mostly over hills and undulating lands. This unproductive nature of the soil coupled with low rainfall and high drainage reflects itself in the poor condition of the growing stocks(8). This has been accentuated by heavy tree felling over grazing and fire. In some cases, the proposed rotation has been transformed into a scrub due to human interference.

2. The dominant trees in these forests are Shorearobusta, Anogeissuslatifolia, Buchananialanzan, Terminaliabellirica, Boswelliaserrata, Sterculiaurens, Lagerstroemia parviflora, Acacia catechu, Buteamonosperma, Mitragynaparviflora, Soymidafebrifuga, Gmelinaarborea, Aegelemarmelos, Phyllanthusemblica, Bauhinia purpurea, Bauhinia racemosa, Semecarpusanacardium, Diospyrosmelanoxylon, and Ficussp.

3. Sal is the pioneer species in Giridih Division. These are found everywhere in tract but bad suffers of over exploitation. Due to repeated cutting the crop is severely destroyed and reached to sapling and rooted waste stage. The associates (9) of Sal are *Diospyrosmelanoxylon*, *Buchananialanzan*, *Anogeissuslatifolia*, *Adina cordifolia*, *Albiziasps*, *Aeglemarmelos*, *Emblicaofficinalis*, *Terminaliasps* etc. The common shrubs are *woodfordiafruticosa*, *oenixsps*, *Helicteresisora*, *Nytanthesarbostritis* etc. amongst the climbers the following are prominent *Bauhinia vahli* etc.

4. **Climbers:** Common climbers of the area are *Bauhinia vahli*, *Combretumde can drum*, *Buteasuperba*, *Smilax spp.* etc.

5. **Grasses:** Main grasses of the area are *Heteropogoncontortus*, *Chrysopogon spp.*, *Dicanthium spp.* etc. that occur in open patches (blanks) and abandoned cultivated lands. Some of these grass spp. Are important sources of food for herbivores.

6. Phytosociological parameters such as frequency (70 to 130), Density (1.0 to 6.20), Abundance (1.43 to 5.64) varies between 13 different blocks of the district studied. Average value of richness for the entire vegetation was 1.63. Average value of evenness for the entire vegetation is 8.46. The Shannon-Weiner biodiversity Index is very realistic and popular among varied Bio diversity indices. The H' value for division is for tree (4.13) and Simpson's Index (D) 0.0172

7. **Sub terrestrial vegetation:** The species having roots, rhizomes, bulbs tubers etc. find a mention in this category. These are important sources of food for Wild boars, Porcupine, Rodents, Monkeys etc. The *Salmaliamalabarica*, *Asperagusrecemosa*, *Dendrocalamusstrictus* and a few other species having tuberous roots, come under this category

8. Tree species present in the tract belong to several families. The prominent families are Dipterocarpaceae, Ebenaceae, Fabaceae, Anacardiaceae, Flacourtiaceae, Lytheraceae, Mimosaceae, Rubiaceae, Sapindaceae, Tiliaceae,

Arecaceae, Bombacaceae, Combretaceae, Moraceae, Meliaceae and Euphorbiaceae.

9. Sal & Palash are predominant species with its associates. Some areas have miscellaneous forests with species like Kend, Arjun, Sidha, Mahua, etc. Sal is generally confined to plains, narrow valleys and foothills of hills. Because of severe problem of grazing and hot climate, moisture retaining capacity of soil is very low. Soils have become impoverished.

10. As a result, xerophytic plants like Salai, Bamboo, Khair, Harsingar out number other species. Type of forest is the resultant reconciliation of the floristic inheritance of the locality with the habitant.

11. At the onset of summer all the trees shed their leaves, remaining leafless for about 6 months in a year. The fallen leaves increase the fire hazard and before adding nutrients to the soil, are burnt every year. The ashes are washed out of the forests by next monsoon.

12. **Movement of mega fauna in last 3 years** Among the mega fauna in both the divisions Elephants are prominent and it has not been a regular event of crop raiding and attacks on human. Stray incidences of crop raiding have been reported in some of the project villages between 2015 to 2021. Total number of crop raiding has been 7 across the last six year in the Giridih Forest Division. Similarly in Giridih Division also crop raiding has been reported but attack on human life has not been reported.

13. Plantation in the areas which has been mapped as elephant corridors or areas worth high incidences of man wild conflicts. Creating waterholes in the forests will help in reducing incidences of animals moving to the non forest area during summer seasons especially. Planting of bamboos in and around elephant corridors will help in reducing elephant menace in the farmers field.

14. A total of 14 elephant corridors has already been identified in India. Jharkhand has two distinct elephant populations, viz. Palamau and Singhbhum elephants, which constitutes half of the population of elephants in Jharkhand. The

Quantitative estimation of Giridih blocks and circles (Trees)

Sl. No.	Botanical name	Sampling location @ 13 Blocks of the District													Total No. (n)	Total No. (DFT)	P (%) (N)	Shannon Index (H')	1/Species No. of Quadrats (No. of Quadrats sampled x 100)	Abundance (Total No. of individuals of a given species/Total No. of Quadrats sampled)	Density (Total No. of individuals of a given species/Total No. of Quadrats sampled)	H4-H3	H4-H2	Simpson's Index (D)	H4-H1
		1	2	3	4	5	6	7	8	9	10	11	12	13											
1	Acacia auriculiformis	2	3	4	2	2	2	4	3	2	2	1	2	2	31	13	0.02	-0.07	130	2.38	3.10	930	3E+06	0.0003	
2	Acacia catechu	4	2	2	3	2	0	2	3	4	1	2	2	1	28	12	0.02	-0.06	120	2.33	2.80	756	3E+06	0.0002	
3	Adina cordifolia	2	2	2	2	2	2	2	5	2	4	0	4	2	31	12	0.02	-0.07	120	2.58	3.10	930	3E+06	0.0003	
4	Accia arabica	2	2	2	4	2	2	2	4	3	2	2	2	1	2	30	13	0.02	-0.07	130	2.31	3.00	870	3E+06	0.0003
5	Aegale marmelos	0	3	2	3	2	3	2	2	2	2	2	1	3	27	12	0.02	-0.06	120	2.25	2.70	702	3E+06	0.0002	
6	Ailanthus excelsa	1	1	2	2	2	3	2	2	2	1	2	2	5	27	13	0.02	-0.06	130	2.08	2.70	702	3E+06	0.0002	
7	Albizia lebbek	4	2	4	3	2	2	2	2	3	2	3	1	2	32	13	0.02	-0.07	130	2.46	3.20	992	3E+06	0.0003	
8	Albizia procera	0	2	2	2	2	0	0	1	4	1	2	2	2	20	10	0.01	-0.05	100	2.00	2.00	380	3E+06	0.0001	
9	Alstonia scholaris	3	4	2	4	3	3	4	4	2	4	2	4	1	40	13	0.02	-0.08	130	3.08	4.00	1560	3E+06	0.0005	
10	Anogeissus latifolia	0	0	2	1	2	1	2	1	0	1	1	0	2	13	9	0.01	-0.04	90	1.44	1.30	156	3E+06	0.0000	
11	Arocarpus integrifolia	1	2	1	1	2	2	0	1	3	4	2	5	1	25	12	0.01	-0.06	120	2.08	2.50	600	3E+06	0.0002	
12	Asadirachta indica	1	2	4	2	2	2	1	4	2	4	2	2	2	30	13	0.02	-0.07	130	2.31	3.00	870	3E+06	0.0003	
13	Bauhinia retusa	4	6	4	6	8	6	8	5	8	10	1	2	4	72	13	0.04	-0.13	130	5.54	7.20	5112	3E+06	0.0016	
14	Bauhinia variegata	2	1	3	2	1	2	4	4	2	2	2	1	2	28	13	0.02	-0.06	130	2.15	2.80	756	3E+06	0.0002	
15	Bauhinia purpurea	1	1	0	1	4	1	2	1	2	1	0	2	2	18	11	0.01	-0.05	110	1.64	1.80	306	3E+06	0.0001	
16	Bischofia javanica	1	4	2	1	1	2	1	1	2	1	3	2	2	23	13	0.01	-0.06	130	1.77	2.20	342	3E+06	0.0002	
17	Bombax ceiba	2	4	2	2	2	6	0	2	0	6	2	2	2	32	11	0.02	-0.07	110	2.91	3.20	992	3E+06	0.0003	
18	Boswellia serrata	2	5	1	1	1	2	2	2	3	2	2	6	1	30	13	0.02	-0.07	130	2.31	3.00	870	3E+06	0.0003	
19	Bridelia retusa	0	2	0	4	1	0	3	1	2	2	0	1	1	17	9	0.01	-0.04	90	1.89	1.70	272	3E+06	0.0001	
20	Buchanania purpurea	0	1	6	2	2	1	2	1	2	3	2	2	1	25	12	0.01	-0.06	120	2.08	2.50	600	3E+06	0.0002	
21	Butea monosperma	2	2	3	2	4	3	2	8	2	4	1	1	2	36	13	0.02	-0.08	130	2.77	3.60	1260	3E+06	0.0004	
22	Butea superba	1	0	1	1	0	2	1	0	2	2	1	1	1	13	10	0.01	-0.04	100	1.30	1.30	156	3E+06	0.0000	
23	Careya arborea	3	2	1	0	0	0	5	1	1	0	2	2	2	19	9	0.01	-0.05	90	2.11	1.90	342	3E+06	0.0001	
24	Casuarina tomentosa	0	1	8	0	1	0	2	2	2	2	3	2	2	25	10	0.01	-0.06	100	2.50	2.50	600	3E+06	0.0002	
25	Cassia fistula	2	2	2	2	3	4	4	3	4	5	2	2	4	39	13	0.02	-0.08	130	3.00	3.90	1482	3E+06	0.0005	
26	Cedrela toona	0	0	2	2	0	2	2	3	2	2	1	2	1	19	10	0.01	-0.05	100	1.90	1.90	342	3E+06	0.0001	
27	Chloroxylon swietenia	1	1	1	2	2	2	1	2	3	2	1	1	1	20	13	0.01	-0.05	130	1.54	2.00	380	3E+06	0.0001	
28	Cochlospermum gossypium	1	1	1	1	1	0	1	1	0	1	2	2	3	15	11	0.01	-0.04	110	1.36	1.50	210	3E+06	0.0001	
29	Dalbergia sissoo	4	5	4	8	3	6	4	3	4	6	2	2	2	53	13	0.03	-0.10	130	4.08	5.30	2756	3E+06	0.0009	
30	Dendrocalamus strictus	2	0	1	3	1	1	0	0	4	4	4	2	1	23	10	0.01	-0.06	100	2.30	2.30	506	3E+06	0.0002	
31	Diospyros malabarica	0	2	1	2	2	1	1	0	0	1	2	2	2	16	10	0.01	-0.04	100	1.60	1.60	240	3E+06	0.0001	
32	Diospyros melanoxylon	2	4	5	2	3	2	10	4	4	6	3	6	1	52	13	0.03	-0.10	130	4.00	5.20	2652	3E+06	0.0008	
33	Emblica officinalis	0	0	2	4	0	0	0	3	1	3	2	2	2	19	8	0.01	-0.05	80	2.38	1.90	342	3E+06	0.0001	
34	Ficus benghalensis	2	2	2	2	3	2	2	4	2	4	1	1	1	28	13	0.02	-0.06	130	2.15	2.80	756	3E+06	0.0002	
35	Ficus glomerata	0	0	0	3	0	2	4	0	0	2	1	1	1	14	7	0.01	-0.04	70	2.00	1.40	182	3E+06	0.0001	
36	Ficus religiosa	1	2	3	2	3	2	3	4	4	6	2	1	3	36	13	0.02	-0.08	130	2.77	3.60	1260	3E+06	0.0004	
37	Ficus tomentosa	0	0	2	1	1	0	2	0	2	2	1	1	1	13	9	0.01	-0.04	90	1.44	1.30	156	3E+06	0.0000	
38	Gardenia latifolia	0	0	3	1	2	0	5	1	0	1	2	1	1	17	9	0.01	-0.04	90	1.89	1.70	272	3E+06	0.0001	
39	Garuga pinnata	0	0	2	0	0	1	3	0	1	1	2	2	2	14	8	0.01	-0.04	80	1.75	1.40	182	3E+06	0.0001	
40	Gmelina arborea	5	2	2	2	2	2	3	4	6	6	3	1	2	40	13	0.02	-0.08	130	3.08	4.00	1560	3E+06	0.0005	
41	Gardenia gummifera	2	0	0	4	0	2	0	0	2	2	4	2	1	19	8	0.01	-0.05	80	2.38	1.90	342	3E+06	0.0001	
42	Grewia tilloefolia	2	0	2	0	0	2	2	2	0	0	2	2	2	16	8	0.01	-0.04	80	2.00	1.60	240	3E+06	0.0001	
43	Helecteres isara	1	0	2	3	2	0	0	1	2	2	3	6	1	23	10	0.01	-0.06	100	2.30	2.30	506	3E+06	0.0002	
44	Holarrhena antisysepticaria	1	0	2	0	2	2	0	0	3	2	2	2	2	18	9	0.01	-0.05	90	2.00	1.80	306	3E+06	0.0001	
45	Hymenodictyon excelsum	1	0	0	1	2	2	1	0	2	1	1	1	1	13	10	0.01	-0.04	100	1.30	1.30	156	3E+06	0.0000	
46	Ixora arborea	2	0	0	0	2	4	1	2	1	1	1	1	1	16	10	0.01	-0.04	100	1.60	1.60	240	3E+06	0.0001	
47	Jasminum grandiflorum	1	2	1	5	2	2	2	3	2	2	2	1	3	28	13	0.02	-0.06	130	2.15	2.80	756	3E+06	0.0002	
48	Lagerstromia parviflora	0	2	2	2	1	0	1	0	1	1	1	1	1	13	10	0.01	-0.04	100	1.30	1.30	156	3E+06	0.0000	
49	Lannea coromandelica	2	4	5	2	3	4	4	6	4	4	2	1	1	42	13	0.02	-0.09	130	3.23	4.20	1722	3E+06	0.0005	
50	Madhuca indica	10	0	0	0	2	1	5	1	1	1	2	2	2	28	10	0.02	-0.06	100	2.80	2.80	756	3E+06	0.0002	
51	Mangifera indica	2	3	4	2	3	4	2	4	2	4	3	1	2	36	13	0.02	-0.08	130	2.77	3.60	1260	3E+06	0.0004	
52	Melia azadirach	0	0	1	2	1	2	0	4	2	3	4	2	1	22	10	0.01	-0.05	100	2.20	2.20	462	3E+06	0.0001	
53	Phoenix aculeis	3	4	4	2	2	6	8	4	4	6	2	2	2	49	13	0.03	-0.10	130	3.77	4.90	2352	3E+06	0.0007	
54	Pongamia glabra	2	1	1	1	2	2	4	2	2	2	3	6	1	29	13	0.02	-0.07	130	2.23	2.90	812	3E+06	0.0001	
55	Pterocarpus marsupium	1	2	0	0	2	1	2	2	1	3	2	2	2	20	11	0.01	-0.05	110	1.82	2.00	380	3E+06	0.0001	
56	Saraca indica	0	2	2	0	3	0	0	5	1	0	1	1	1	16	8	0.01	-0.04	80	2.00	1.60	240	3E+06	0.0001	
57	Scheuchzeria oleosa	2	2	2	0	2	3	2	4	2	4	1	1	1	26	12	0.01	-0.06	120	2.17	2.60	650	3E+06	0.0002	
58	Semecarpus anacardium	0	0	3	2	1	0	1	2	2	2	2	1	3	19	10	0.01	-0.05	100	1.90	1.90	342	3E+06	0.0001	
59	Shorea robusta	6	8	8	6	0	6	10	0	6	9	1	1	1	62	11	0.03	-0.12	110	5.64	6.20	3782	3E+06	0.0012	
60	Spondias pinnata	0																							

Palamau population occupies about 1306 km² of the Betla National Park, Palamau Tiger Reserve and adjoining areas. The Singhbhum population occupies about 2570 km² of the available forest area of Dalma Wildlife Sanctuary and the forest of Saranda, Porhat, Kolhan, Saraikala (formerly North Chaibasa) and Dhalbhum Forest Divisions. (The Right of Passage, Wildlife Trust of India). In recent past wandering Elephants movements have been

reported in the Giridih forests as they move from Dumka to Gumla and beyond. In the process they sometime reported to wander into Giridih Forest areas. Below is given movement pattern of wandering elephants in Giridih forest division. Movement of elephants in group is from 2 points namely Jamtara and Tundi and exit from Tundi only. Solo movements of elephants are reported from areas Bagodar, to Parasnath to Bokaro.

References

1. RS Ambasht Conservation of soil through plant cover of certain slopes in India Proc. IX Tech. Meeting IUCN pp. 44 (1970)
2. RS Ambasht Environment and Pollution-An Ecological Approach. Students Friends & Co. Varanasi (1990)
3. N.L.Bor Manual of Indian Forest Botany. Oxford University Press, Bombay (1953) .
4. H.G. Seth and S.K.Seth. A revised survey of the forest types of India. Manager of Publications, New Delhi (1968).
5. J.T. Curtis. The vegetation of Wisconsin: an ordination of plant communities. University of Wisconsin Press, Madison (1959).
6. J.T. and McIntosh, R.P. Curtis., The interrelations of certain analytic and synthetic phytosociological characters. *Ecol.* **31**: 434 (1950)
7. F.S.I. State of Forest Report , Forest Survey of India, Kaulagarh Road, Dehradun (2011).
8. O.P. Shukla, R.P. Gupta. The composition and dynamics of associated plant communities of sal plantations. *Trop. Ecol.* **32**: 296 (1991)
9. H.H. Haines , The Botany of Bihar and Orissa. Adlard & Son & West Newman Ltd London (1925).
10. S.P.S. and Nandy, S. Kushwaha, Species diversity and community structure in sal (Shorearobusta) forests of two different rainfall regimes in West Bengal, *India. Biodivers. Conserv.* **21**:1215 (2012)
11. A.E.Magurran. Ecological Diversity and Its Measurement. Croom Helm. London (1988).
12. P.K.Pande Comparative vegetation analysis and sal (Shorearobusta) regeneration in relation to their disturbance magnitude in some sal forests. *Trop. Ecol.* **40**:51 (1999)
13. SK Pandey and RP Shukla Plant diversity and community patterns along the disturbance gradient in plantation forests of sal (Shorearobusta Gaertn). *Curr. Sci.* **77**:814 (1999)
14. SK Pandey, and RP Shukla.Plant diversity in managed Sal(ShorearobustaGaertn.) forests of Gorakhpur, India: species composition, regeneration and conservation. *Biodivers. Conserv.* **12**: 2295 (2003)
15. <https://www.environment.gov.au/biodiversity/publications/australias-biodiversity-conservation-strategy-summary>
16. <https://giridih.nic.in/>
17. http://participate.melbourne.vic.gov.au/application/files/4214/6524/9371/Draft_Urban_Ecology_and_Biodiversity_Strategy.pdf
18. Strategies and Action Plans". Available at [http://www.cbd.int/nbsap/Convention on Biological Diversity. "Principles for an ecosystem approach"](http://www.cbd.int/nbsap/Convention on Biological Diversity.). Available at <http://www.cbd.int/ecosystem/principles.shtml>
19. <https://egreenwatch.nic.in/Masters/Public/RangesViewList.aspx?ID=NjYyfDE2fDIxNA==>

