Seasonal Plant Diversity of Gautala Reserve Forest, District Aurangabad

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Seasonal Plant Diversity of Gautala Reserve Forest, District Aurangabad

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Abstract   The Gautala Reserve forest is a Tropical dry deciduous forest. The area has been declared as a Gautala Autramghat Wildlife Sanctuary for the conservation of the flora, fauna and environs of that zone. A comprehensive survey has been carried out during the year 2017-2018. The fifteen sites were selected for the identification of plant species and their existence at Gautala Sanctuary Area. Quantitative characters of plant species were recorded and identified. Total 91 species were found during the survey. Out of it 41 species of trees, 24 species of shrubs, 12 species of herbs and 6 species of climbers belonging to 85 genera in 44 families have been recorded. The Fabaceae family has a maximum number of species (26 species). Based on this data morphological identification of plants was carried out. Based on present study, It is recommended that the botanical collection and documentation of ethnobotanical knowledge be carried out before such rich habitats are lost due to various anthropogenic and other natural causes. Therefore the proper data of plant diversity could play a significant role in planning for the preservation and sustainable use of existing resources in the forest areas.

Keywords: Plants, Morphology, Species, Gautala, Reserve Forest

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1. Introduction

Plant diversity is ecological assets to human life and livelihood. Mostly, local people depend on products, services, or even land from nearby natural areas to meet their livelihood needs. The Reserved forests have played an important role in preserving plant diversity although providing substantial advantages to households in rural areas [1,2,3].

Quantitative analysis on plant species diversity gives the morphological status and distribution pattern which may help in biodiversity preservation. Quantitative data are frequently obtained through ecological inventories that are used to determine the nature and distribution of biotic assets of the region to be managed [4]. Evaluation of plant species distribution and abundance is a significant aspect as they contribute to the structural characteristics of the forest and provide assets and habitat for various species [5,6]. Plant diversity varies significantly from location to location due to variety in biogeography territory and disturbance [7]. The details on plant composition and forest structure helps in protecting threatened and economic species, and to understand the forest ecology dynamics for nature preservation [8]. All human societies showed a profound interest in utilization as well as conservation of biodiversity in a sustainable manner to which India has no exception. India has two mega biodiversity centers especially in plant species viz., North eastern Himalayan region and the Western Ghats. Indian forests are rich in medicinal plant species with a wide spectrum of healing characteristics [9]. The sanctuary is suitable for a large number of birds, mammalian, and invertebrate species [10]. It is of utmost importance to assess the actual herbal wealth of Gautala sanctuary [11]. The present study has been carried out of baseline information about the status of different plant species occupying the Gautala reserve forest.

2. Material and Methods

2.1. Study Area

Gautala reserve forest is also renowned as "Gautala Autramghat Wildlife Sanctuary" is situated in the west-north direction of the Aurangabad District, Marathwada region. It has a region of about 261 sq. km. It covered 64 sq. km area of Jalgaon District and 197 sq. km. area of Aurangabad District. Its geographical position is longitude E 740, 55', latitude N 190, 54', and altitude 1904 ft. [12]. The annual rainfall is near about 550-600 mm. It goes high up to 45°C in summer and falls down to 8°C in winter. The Gautala sanctuary is very much famous for its well-known flora of medicinal plants, some of the woody shrubs and herbs etc. which are grown in natural conditions [13].
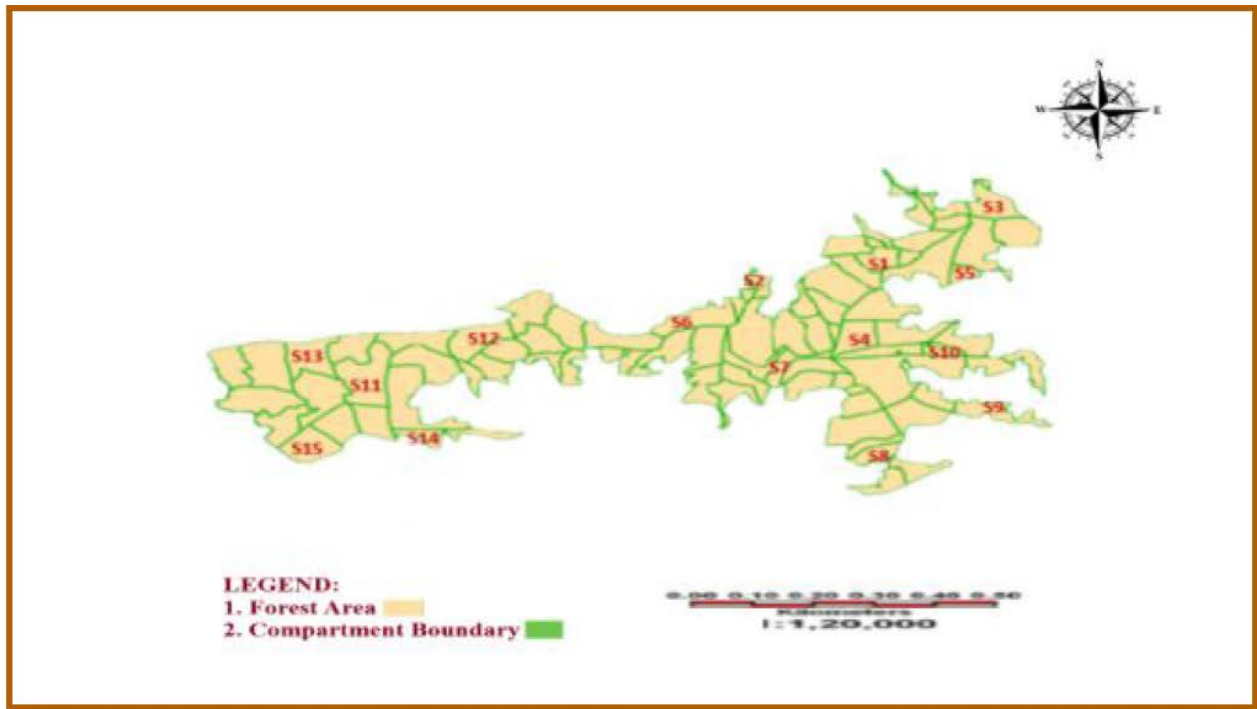
Figure 1. Showing fifteen spots selected from Gautala Reserve Forest

The frequently visited various 15 spots were selected for the identification of plants at Gautala sanctuary (Figure 1). Different types of plant species were observed during the survey. Their qualitative characters were noted at site and photographed by using high-quality digital cameras. Photographs were identified at the Department of Environmental Science, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, India. Based on the data, morphological identification of plants was done.

Flora of the entire study zone was divided into five quadrats of 1.2 km x 1.2 km each having the area of 100m x 100m. In each of these a 5m x 5m quadrats were marked for sampling of shrubs and herbs etc. The total numbers of trees, shrubs, herbs, climbers etc. were counted in each respective quadrats. The present study demonstrates the average of plant diversity observed in the Gautala forest. Botanical families were grouped by using reference material, recent scientific publications, and morphological studies. The sanctuary areas were surveyed using a systematic sampling technique. The size and number of quadrats were determined using the species area-curve [14].

2.2. Statistical Analysis

To identify plant species with similar diversity based on the diversity of species in rainy, winter and summer season by using K means Clustering method. Analyses were done using statistical and qualitative data analysis software i.e. R Studio.

2.3.1. Clustering Methodology (K)

K-means is one of the simplest unverified learning algorithms. The procedure involves classifying a given plant species into a certain number of clusters (assume K clusters) fixed a prior with similar characteristics. The main knowledge is to describe K centers, one for each cluster. The better choice is to place centers as much as possible far away from each other. The next step is to take each point belonging to a given all Plant Species and associate it to the nearest center. When no point is awaiting, the first step is finished and an early group age is completed. At this point, it is essential to re-calculate k new centroids as the barycenter of the clusters resulting from the earlier step. Afterward, these k new centroids, a new binding, had to be done among the same statistics set points and the nearby new center. A loop had been produced. As a result of this loop, it is noticed that the k centers variation their position phase by phase until no extra variations were completed or in other words centers didn't change anymore. To conclude, algorithm aims at decreasing an objective function recognized as a squared error function given by:

$$J(V) = \sum_{i=1}^{c} \sum_{j=1}^{c_i} \left(\left\| x_i - v_j \right\| \right)^2 \qquad (1)$$

Where,

'$\|x_i - v_j\|$' is the Euclidean distance between x_i and v_j.
'c_i' is the number of data points in the ith cluster.
'c' is the number of cluster centers.

2.3.2. Algorithmic Steps for K-means Clustering

Let X = {$x_1, x_2, x_3, \ldots\ldots, x_n$} be the set of data points and V = {v1, v2, ..., vc} be the set of centers.

1) Randomly selected 'c' cluster centers.
2) Calculated the distance between each data point and cluster centers.
3) Assigned the data point to the cluster center whose distance from the cluster center is the minimum of all the cluster centers.
4) Recalculated the new cluster center using:

$$v_i = \left(1 / c_i \right) \sum_{j=1}^{c_i} x_i \qquad (2)$$

Where, 'c_i' represents the number of data points in i^{th} cluster.

5) Recalculated the distance between each data point and new obtained cluster centers.

6) If no data point is reassigned then stop, otherwise repeat from step 3.

3. Result and Discussion

The records of twelve months rigorous study (i.e. June-2017 to May-2018) were pooled for three seasons and evaluated for seasonal variations regarding rainy, winter, and summer. The outcomes of present study showed a significant variance in plant diversity properties with different seasons. The ecological factors indicated some of most common plant species which occurred in study area is *Azadirachta indica, Ficus benghalensis, F. religiosa, F. racemosa, Syzygium cumini* (*Myrtaceae*), *Butea monosperma* (*Fabaceae*), *Dalbergia sissoo* (*Fabaceae*), *Acacia leucophloea* (*Fabaceae*), *Gliricidia* varieties in various seasons in the exploration area depending upon the topography. Average of plant diversity of seasonal variations in forest areas of study spots are given in (Figure 2). In the present investigation, 91 plant species belonging to 85 genera in 44 families have been recorded, and the results of the study placed in Table 1. A total of 41 species of trees, 24 shrubs, 12 herbs and 6 climbers species have been included (Table 2). The Different families in the present study are *Fabaceae* (26), *Malvaceae* (4), *Poaceae* (3), *Apocynaceae* (3), *Combretaceae* (3), *Lamiaceae* (3), *Rutaceae* (3) etc. (Table 2). The Fabaceae family has the maximum number of species found at the Gautala sanctuary. In the present study, A total 44 plant families recorded that 4 species are monocotyledons and remaining 40 families have been dicotyledons (Table 2). The present investigation gives baseline and detailed information about the plant diversity of Gautala reserve forest. The whole causes of diversity loss are the similar as those responsible for land use and surface of land change. The existing natural forests protected our living environment [15]. Enormous regions of diverse forest are degraded or lost every year with considerable outcomes for biodiversity. Overexploitation, and invasive species, Fragmentation, Deforestation and climate change are the main factors of forest biodiversity loss [16,17,18,19].

Fabaceae, Poaceae, Rubiaceae, Euphorbiaceae, *Acanthaceae, Asteraceae, Lamiaceae,* etc as the different families of Indian forest [20,21]. A great similarity is evident at the family level and It's clear that across various tropical forests. Chauhan *et al.,* [22] reported dominant families are *Fabaceae* (14 species), *Euphorbiaceae, Moraceae,* and *Mimosaceae* (7 species each) followed by *Caesalpiniaceae* and *Verbenaceae*. These dominant families were found in the Terai-Bhabhar of Sohagibarwa Wildlife Sanctuary, India. *Combretaceae, Meliaceae, Mimosaceae, Celastraceae* and *Rubiaceae* were the predominant families of Bannerghatta National Park in Eastern Ghats of southern India [23]. Bokhary and Awad [3], Detailed that the most dominant families were Fabaceae (33.8%) followed by Combretaceae (10.8%), Capparaceae (9.5%), and Malvaceae (9.5%) respectively found in El Reserved forest, Sudan. Shukla and Singh [24], observed that the family *Fabaceae* signifies maximum quantity i.e., seventeen species, followed through *Moraceae* (07), *Combretaceae* (06), *Myrtaceae* (05) *Rutaceae* (04), *Anacardiaceae, Euphorbiaceae* and *Rubiaceae* with 3 species, respectively. Also, the families *Annonaceae, Apocynaceae, Burseraceae, Embenaceae, Lamiaceae and Meliaceae* originate with two species of each in the surveyed zone. Fabaceae found the predominant family with 26 species, onward the gradients in the dry deciduous forests of Godavari valley, Telangana State [25].

3.1. Statistical Relationship

K means clustering method is used for clustering the 91 Species into Clusters having the similar diversity and for the current study using the k=5. Therefore, Total 5 Clusters are derived with K means method. Each cluster contains the Plant Species with similar diversity. (Table 3). The clustering analysis in this examination proposed the presence of indicator species. Indicator species are species that are used as a biological indicator community, territory type or Natural changes [26,27].

1. There are only five Plant Species in the cluster 4 having the higher average biodiversity among all other Plant Species.
2. Plant Species in the cluster 3 have 141 average diversity which is lowest among all other Clusters.
3. Cluster 3 contains the highest number of Plant Species with similar diversity.

Following plant species were observed during the survey:

Table 1 Average of Floral Diversity in Gautala Forest (Herbs 1-58; Shrubs 59-81; Climber 82-85; Grass-86-88; Woody climber 89-90; Climbing shrub 91)

Sr No.	Scientific Name	Rainy Season	Winter Season	Summer Season	Total	Average
1	*Tectona grandis L. f.*	1602	1558	1507	4667	1555.66
2	*Boswellia serrata*	1019	988	937	2944	981.33
3	*Butea monosperma*	1054	1022	969	3045	1015
4	*Semecarpus anacardium L.f.*	992	962	917	2871	957
5	*Santalum album L.*	1017	980	929	2926	975.33
6	*Sterculia urens Roxb*	552	517	474	1543	514.33
7	*Diospyros melanoxylon Roxb*	586	557	509	1652	550.66
8	*Hardwickia Roxb.*	744	718	681	2143	714.33
9	*Terminalia elliptica (Roxb.)*	711	681	646	2038	679.33
10	*Senegalia catechu (L.f.)*	763	731	693	2187	729
11	*Syzygium cumini (L.)*	192	162	137	491	163.66
12	*Ficus racemosa L.*	509	476	430	1415	471.66

Sr No.	Scientific Name	Rainy Season	Winter Season	Summer Season	Total	Average
13	*Ficus benghalensis L.*	397	373	337	1107	369
14	*Tamarindus indica*	259	235	199	693	231
15	*Azadirachta indica*	364	323	279	966	322
16	*Haldina cordifolia Roxb.*	369	321	282	972	324
17	*Bauhinia variegata L.*	295	255	217	767	255.66
18	*Buchanania lanzan*	647	610	566	1823	607.66
19	*Cassia fistula L.*	535	504	466	1505	501.66
20	*Madhuca longifolia*	695	659	615	1969	656.33
21	Acacia leucophloea	169	139	108	416	138.66
22	*Indigofera tinctoria L.*	591	560	509	1660	553.33
23	*Limonia acidissima L.*	213	188	159	560	186.66
24	*Terminalia bellirica (Gaertn.) Roxb.*	239	207	182	628	209.33
25	*Anogeissus latifolia (Roxb.)*	323	286	238	847	282.33
26	Cinnamomum verum	494	461	421	1376	458.66
27	*Mitragyna parvifolia (Roxb.)*	303	262	225	790	263.33
28	*Senna auriculata (L.) Roxb.*	371	332	290	993	331
29	*Grewia tiliifolia*	311	268	180	759	253
30	*Dolichandrone falcata*	221	190	139	550	183.33
31	*Aegle marmelos (L.)*	186	164	121	471	157
32	*Bauhinia racemosa Lam.*	326	292	244	862	287.33
33	Citrus aurantium L.	141	125	109	375	125
34	*Cochlospermum religiosum*	73	68	62	203	67.66
35	*Erythrina variegata L.*	156	142	125	423	141
36	*Dalbergia sissoo Roxb.*	404	367	331	1102	367.33
37	*Gmelina arborea Roxb.*	433	391	355	1179	393
38	*Albizia lebbeck (L.)*	357	324	287	968	322.66
39	*Ficus religiosa*	261	228	194	683	227.66
40	*Lagerstroemia speciosa (L.)*	213	188	154	555	185
41	*Schleichera Oleosa (Lour.)*	321	289	253	863	287.66
42	*Vachellia nilotica (L.)*	226	192	151	569	189.66
43	*Prosopis juliflora*	149	126	99	374	124.66
44	*Millingtonia Hortensis L.f.*	270	248	215	733	244.33
45	*Lannea coromandelica*	491	445	413	1349	449.66
46	*Emblica officinalis*	325	269	239	833	277.66
47	*Gliricidia maculata*	400	365	327	1092	364
48	*dalbergia latifolia*	456	415	376	1247	415.66
49	*Pongamia pinnata*	349	312	275	936	312
50	*Boerhavia diffusa L.*	396	353	0	749	249.66
51	*Tribulus terrestris L.*	301	263	0	564	188
52	*Oxalis corniculata L.*	427	373	0	800	266.66
53	*Papaver somniferum L.*	252	215	0	467	155.66
54	*Senna tora (L.) Roxb.*	419	373	0	792	264
55	*Martynia annua L.*	229	193	0	422	140.66
56	*Curculigo orchioides*	322	269	0	591	197
57	*Parthenium hysterophorus L.*	663	623	0	1286	428.66
58	*Stylosanthes hamata*	452	403	0	855	285
59	*Dendrocalamus strictus (Roxb.)*	845	778	0	1623	541
60	*Carissa spinarum L.*	300	261	0	561	187
61	*Hyptis suaveolens*	430	390	0	820	273.33
62	*Ziziphus mauritiana Lam.*	347	268	0	615	205
63	*Annona squamosa L.*	260	236	0	496	165.33
64	*Drimia indica (Roxb.)*	214	196	0	410	136.66
65	*Senegalia pennata (L.)*	188	153	65	406	135.33
66	*Nerium oleander L.*	131	106	0	237	79
67	*Guilandina bonduc L.*	272	235	0	507	169
68	*Calotropis gigantea (L.)*	203	185	0	388	129.33
69	*Justicia adhatoda L.*	120	106	0	226	75.33
70	*Withania somnifera (L.)*	109	96	0	205	68.33
71	*Woodfordia fruticosa (L.)*	256	225	0	481	160.33
72	*Abutilon indicum L.*	324	289	0	613	204.33
73	*Helicteres isora L.*	235	199	33	467	155.66
74	*Ricinus communis L.*	213	192	0	405	135
75	*Mimosa pudica*	343	301	0	644	214.66
76	*Ehretia laevis Roxb.*	343	293	0	636	212
77	*Cassia auriculata*	530	484	0	1014	338

Sr No.	Scientific Name	Rainy Season	Winter Season	Summer Season	Total	Average
78	*Acacia pennata*	478	435	0	913	304.33
79	*Cestrum nocturnum L.*	332	303	0	635	211.66
80	*Lantana Camara*	429	391	0	820	273.33
81	*Vitex negundo Linn.*	347	308	0	655	218.33
82	*Tinospora cordifolia (Thunb).*	391	343	0	734	244.66
83	*Dioscorea bulbifera*	224	171	0	395	131.66
84	Abrus precatorius	363	322	0	685	228.33
85	*Cuscuta reflexa L.*	349	302	0	651	217
86	*Dichanthium annulatum*	401	359	0	760	253.33
87	*Heteropogon contortus (L.)*	338	287	0	625	208.33
88	*Schima nervosum*	209	179	0	388	129.33
89	*Celastrus paniculatus*	310	289	128	727	242.33
90	*Asparagus racemosus*	216	189	0	405	135
91	*Mucuna pruriens (L.) DC.*	202	156	0	358	119.33

Table 2. Arrangement of Taxa of Gautala Reserve Forest

Name of family	No. of Genera	No. of Species	Name of Family	No. of Genera	No. of Species
			Dicotyledons		
Acanthaceae	1	1	*Myrtaceae*	1	1
Anacardiaceae	2	2	*Nyctaginaceae*	1	1
Annonaceae	1	1	*Oxalidaceae*	1	1
Apocynaceae	3	3	*Phyllanthaceae*	1	1
Asteraceae	1	1	*Ranunculales*	1	1
Bignoniaceae	2	2	*Rhamnaceae*	1	1
Bixaceae	1	1	*Rubiaceae*	2	2
Boraginaceae	1	1	*Rutaceae*	3	3
Burseraceae	1	1	*Santalaceae*	1	1
Celastraceae	1	1	*Sapindaceae*	1	1
Combretaceae	3	3	*Sapotaceae*	1	1
Convolvulaceae	1	1	*Solanaceae*	2	2
Ebenaceae	1	1	*Theaceae*	1	1
Euphorbiaceae	1	1	*Verbenaceae*	2	2
Fabaceae	22	26	*Zygophyllaceae*	1	1
Lamiaceae	3	3	**Monocotyledons**		
Lauraceae	1	1	*Asparagaceae*	2	2
Leguminaceae	1	1	*Dioscoreaceae*	1	1
Lythraceae	2	2	*Hypoxidaceae*	1	1
Malvaceae	4	4	*Poaceae*	3	3
Martyniaceae	1	1			
Meliaceae	1	1			
Menispermaceae	1	1			
Mimosaceae	1	1			
Moraceae	1	3			

Table 3. Represents The Five Clusters of Plant Species Having Similar Plant Diversity Among Each Cluster

Plant Species		Cluster
Ficus benghalensis L. *Tamarindus indica* *Azadirachta indica* *Haldina cordifolia (Roxb.)* *Bauhinia variegata (L.)* *Anogeissus latifolia (Roxb.)* *Mitragyna parvifolia (Roxb.)* *Senna auriculata (L.) Roxb.* *Grewia tiliifolia* *Bauhinia racemosa Lam.*	*Dalbergia sissoo Roxb.* *Gmelina arborea Roxb.* *Albizia lebbeck (L.)* *Ficus religiosa* *Schleichera Oleosa (Lour.)* *Millingtonia Hortensis L.f.* *Emblica officinalis* *Gliricidia maculata* *dalbergia latifolia* *Pongamia pinnata*	1
Tinospora Cordifolia (Thunb.) *Boerhavia diffusa L.* *Carissa spinarum L.* *Hyptis suaveolens* *Tribulus terrestris L.* *Ziziphus mauritiana Lam.* *Oxalis corniculata L.* *Abutilon indicum L.* *Senna tora (L.) Roxb.* *Dichanthium annulatum* *Heteropogon contortus (L.)* *Vitex negundo Linn.*	*Celastrus paniculatus* *Mimosa pudica* *Ehretia laevis Roxb.* *Abrus precatorius* *Curculigo orchioides* *Cassia auriculata* *Acacia pennata* *Cuscuta reflexa L.* *Stylosanthes hamata* *Cestrum nocturnum L.* *Lantana Camara*	2

Syzygium cumini (L.) Acacia leucophloea Mucuna pruriens (L.) DC. Limonia Acidissima L. Annona squamosa L. Drimia indica (Roxb.) Terminalia bellirica (Gaertn.) Roxb. Senegalia pennata (L.) Nerium oleander L. Dioscorea bulbifera Guilandina bonduc L. Calotropis gigantea (L.) Dolichandrone falcata Aegle marmelos (L.) Justicia adhatoda L.	Withania somnifera (L.) Woodfordia fruticosa (L.) Citrus aurantium L. Papaver somniferum L. Cochlospermum religiosum Helicteres isora L. Erythrina variegata L. Lagerstroemia speciosa (L.) Schima nervosum Vachellia nilotica (L.) Ricinus communis L. Martynia annua L. Prosopis juliflora Asparagus racemosus	3
Tectona grandis L.f Boswellia serrata Butea monosperma	Semecarpus anacardium L.f. Santalum album L.	4
Sterculia urens Roxb Diospyros melanoxylon Roxb Hardwickia Roxb. Terminalia elliptica (Roxb.) Senegalia catechu (L.f.) Dendrocalamus strictus (Roxb.) Ficus racemosa L.	Buchanania lanzan Cassia fistula L. Madhuca longifolia Indigofera tinctoria L. Cinnamomum verum Lannea coromandelica Parthenium hysterophorus L.	5

*The above table represents the 5 Clusters of Plant Species having similar biodiversity among the each cluster.

Table 4. Clusters and Respective Plant Species Count

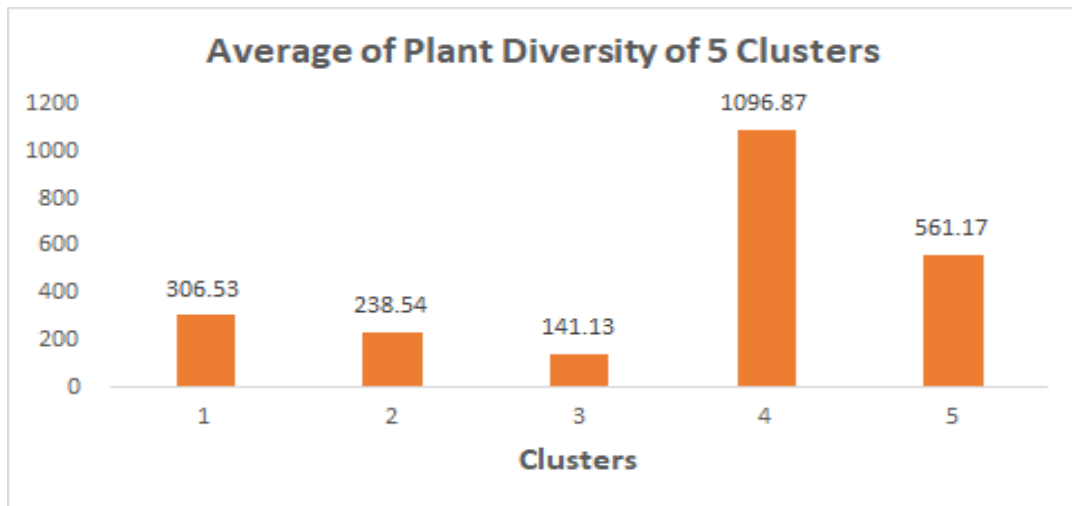| Cluster	Total Plant Species
1	20
2	23
3	29
4	5
5	14
Grand Total	91

Figure 2. Showing Average of plant diversity of five clusters

Table 5. Seasonal Analysis of Different Types of Plant

| Type	Rainy season	Winter Season	Summer Season	Total
Climber	1327	1138	0	2465
Climbing shrub	202	156	0	358
Grass (herb)	948	825	0	1773
Herb	3461	3065	0	6526
Shrub	7249	6430	98	13777
Tree	22074	20475	18571	61120
Woody climber	526	478	128	1132
Grand Total	35787	32567	18797	87151

Season wise diversity of different Plant types
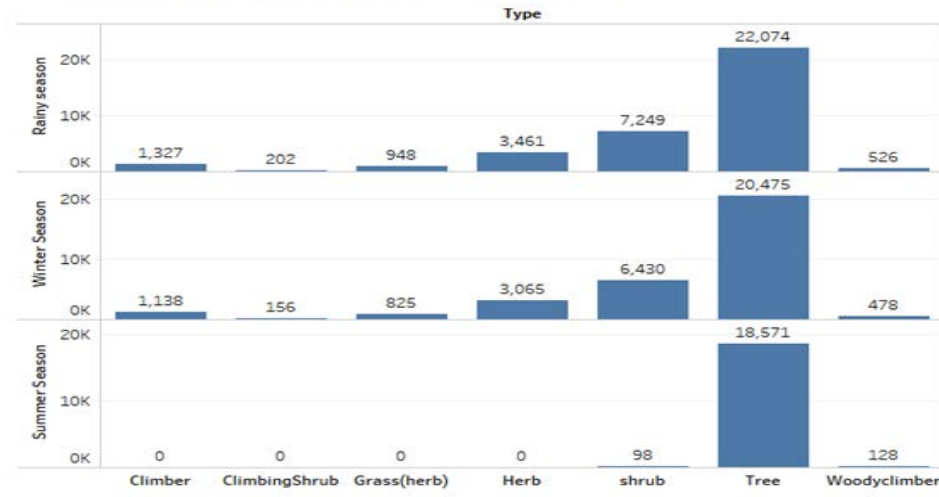
*Total Plant diversity for the Summer season is less as compared to the Rainy and Winter season.
**Total Plant Diversity for the Rainy and Winter season is approximately similar.

Figure 3. Showing season wise diversity of different Plant types

Total diversity of different Plant types
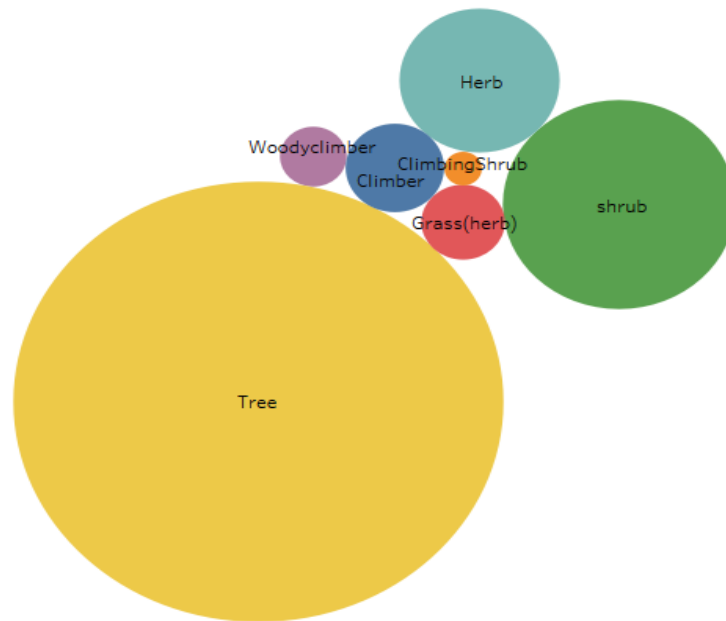
*Total Plant diversity for trees is highest among the all Different types.
**Climbing Shrub has the lowest diversity.

Figure 4. Showing total diversity of different plant types

Table 6. Seasonal Analysis of Plant Diversity of Different Families

Family	Rainy season	Winter Season	Summer Season	Total
Acanthaceae	120	106	0	226
Anacardiaceae	1639	1572	1483	4694
Annonaceae	260	236	0	496
Apocynaceae	634	552	0	1186
Asparagaceae	430	385	0	815
Asteraceae	663	623	0	1286
Bignoniaceae	491	438	354	1283
Bixaceae	73	68	62	203
Boraginaceae	343	293	0	636
Burseraceae	1019	988	937	2944
Celastraceae	310	289	128	727
Combretaceae	1273	1174	1066	3513
Convolvulaceae	349	302	0	651
Dioscoreaceae	224	171	0	395

Family	Rainy season	Winter Season	Summer Season	Total
Ebenaceae	586	557	509	1652
Euphorbiaceae	213	192	0	405
Fabaceae	10515	9591	6550	26656
Hypoxidaceae	322	269	0	591
Lamiaceae	2465	2339	1862	6666
Lauraceae	494	461	421	1376
Leguminaceae	349	312	275	936
Lythraceae	469	413	154	1036
Malvaceae	1422	1273	687	3382
Martyniaceae	229	193	0	422
Meliaceae	364	323	279	966
Menispermaceae	391	343	0	734
Mimosaceae	478	435	0	913
Moraceae	1167	1077	961	3205
Myrtaceae	192	162	137	491
Nyctaginaceae	396	353	0	749
Oxalidaceae	427	373	0	800
Papaveraceae	252	215	0	467
Phyllanthaceae	325	269	239	833
Poaceae	1584	1424	0	3008
Rhamnaceae	347	268	0	615
Rubiaceae	672	583	507	1762
Rutaceae	540	477	389	1406
Santalaceae	1017	980	929	2926
Sapindaceae	321	289	253	863
Sapotaceae	695	659	615	1969
Solanaceae	441	399	0	840
Theaceae	209	179	0	388
Verbenaceae	776	699	0	1475
Zygophyllaceae	301	263	0	564
Grand Total	35787	32567	18797	87151
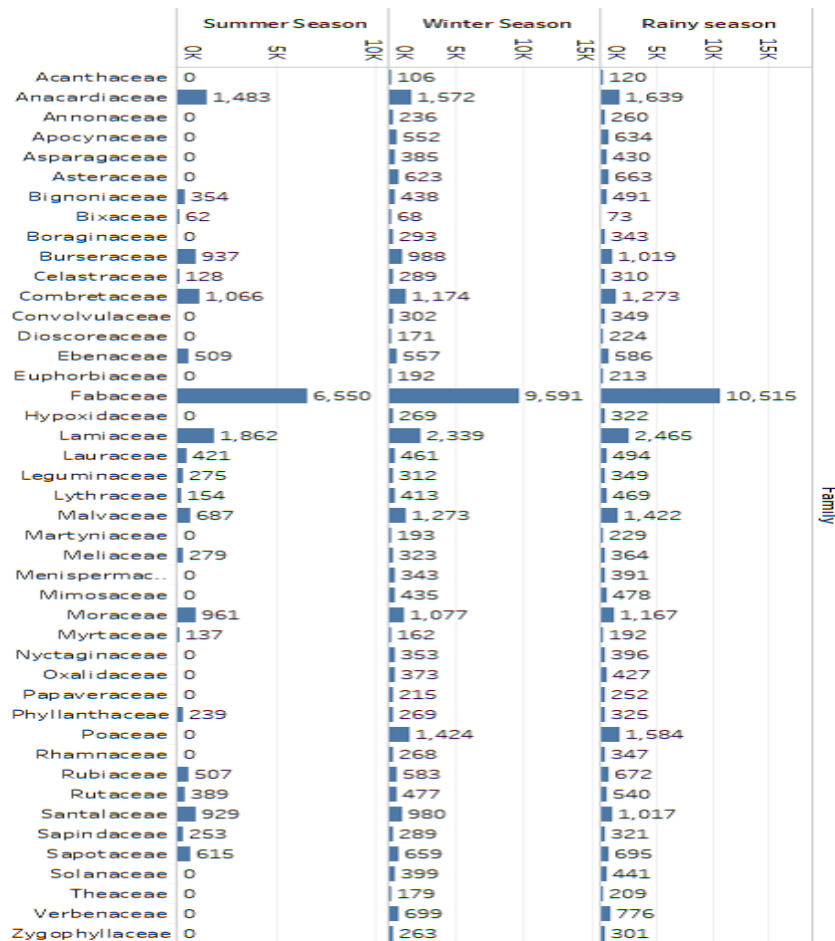
*Total Plant Diversity for the summer season is less as compared to Rainy and Winter season.
**Total Plant Diversity for the Rainy and Winter season is approximately similar
***For all the seasons family *Fabaceae* has the higher Plant Diversity.

Figure 5. Showing seasonal wise variations in plants families

Total Plant Diversity of different family
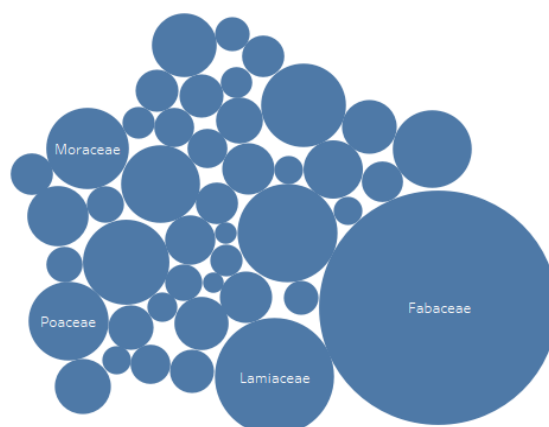
*Total Plant Diversity varies with different families.
** Families *Fabaceae, Lamiaceae, Moraceae* and *Poaceae* have the most diversity
as compared to other families.
****Fabaceae* Family has the highest Plant Diversity among all families.

Figure 6. Showing total plant diversity of different family

4. Conclusion

A total of 91 higher plant species in 84 genera and 44 families were recorded. In the present study, Gautala reserve forest Dist. Aurangabad, Observed 91 plant species with different families as: *Acanthaceae, Anacardiaceae, Annonaceae, Apocynaceae, Asteraceae, Bignoniaceae, Bixaceae, Boraginaceae, Burseraceae, Celastraceae, Combretaceae, Convolvulaceae, Ebenaceae, Euphorbiaceae, Fabaceae, Lamiaceae, Lauraceae, Leguminaceae, Lythraceae, Malvaceae, Martyniaceae, Meliaceae, Menispermaceae, Mimosaceae, Moraceae, Myrtaceae, Nyctaginaceae, Oxalidaceae, Phyllanthaceae, Ranunculales, Rhamnaceae,* etc. (Table 2). In the present study, the *Fabeceae* family found the maximum number of species (Figure 5). The Different varieties of plants in Gautala sanctuary constituted about 50-100 plant species. It is highly probable that the medicinal properties of the remaining plant species have not yet been discovered or documented. It is recommended that the botanical collection and documentation of ethno-botanical knowledge be carried out before such rich habitats are lost due to various anthropogenic and other natural causes [11]. The so far unexplored Gautala sanctuary was surveyed for its plant diversity.

The present study provides basic information about the different plant species, which are presently found in the Gautala Sanctuary. Such a list could play a crucial role in the local and regional structure involved in the conservation of valuable plant diversity for superior and well protected future, use of well-being for upcoming generations and sustainable development of the zone.

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Conflict of Interest

The authors do not have any conflict of interest.

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