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Phyto-Sociological Assessment of Vegetation of Durgapur Government College Campus, Durgapur, West Bengal, India

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ABSTRACT
The aim of the investigation was to analyze phyto-sociological characteristics and diversity pattern of the vegetation of Durgapur Government College campus, Durgapur, West Bengal, India. The results reflect dominancy of dicotyledons over monocotyledons in the four studied sites. Site II of college campus shows higher diversity of species among the three studied sites. Maximum IVI value was recorded by *Mangifera indica* (41.11) in site I, *Caesalpinea pulcherima* (40.39) in site II, *Eucalyptus paniculata*(62.12) in site III respectively. Plant diversity was maximum in site II. Therefore, proper management and conservative measures needs to be implemented for conservation of bioresources in Durgapur Government College campus in Durgapur of West Bengal, India. Distribution pattern of plant species in all sites were regular.
Keywords: Phytodiversity, Importance value index, Species distribution.

I. INTRODUCTION

The development of human societies often has caused an overexploitation of forests and a decrease in their area. Floristic diversity means floristic variety of plant forms rich diversity suggests a great many kinds of plants species and conversely poor diversity indicates flower types of living species. On this diversity hinges the future, health and beauty of the living planet habitat of floristic diversity contain wild species and genetic variation within, it is useful in the development of agriculture, medicines and industry. The present study aims to highlight the biodiversity of trees of Durgapur Government College Campus of Durgapur, Burdwan district, West Bengal.
The habitat is of immense value to mankind because the modern material civilization is entirely based on the exploitation and utilization of the existing resources drawn from the environment and created through human efforts. In mountain areas this is more pronounced; terrain inaccessibility, climate in hospitability, soil infertility, and transport availability, scarcity of basic amenities and facilities make life nature oriented. The controlling mechanisms of biodiversity in different ecosystems are mentioned by the theory of species richness which considers resource availability and disturbance as factors for structuring plant communities.

The patterns and role of species richness in ecosystem function are important in terms of land-use and climate change concerns (Chapin &Korner 1995; Reynolds &Tenhunen 1996; Oechel*et al.* 1997). While there is still debate on the role of species diversity and ecosystem function (Hooper &Vitousek 1997; Patrick 1997), species richness is a frequently measured ecosystem attributes (Magurran 1988) because it characterizes the biodiversity of an area at any scale. Species richness is controlled by a variety of biotic and abiotic parameters (Rannie 1986; Cornell & Lawton 1992; Huston 1994; Pollock *et al.* 1998).
The plant diversity at any site is influenced by species distribution and abundance patterns. A number of factors have been shown to affect the distribution and abundance of plant species, including site conditions, i.e., moisture and nutrient gradients (Day and Monk 1974, Whittaker and Niering 1975, Marks and Harcombe 1981, Host and Pregitzer 1992) and canopy coverage, i.e., light availability (Kull and Zobel l991). However the investigations concerning different types of forests or similar forests located in different areas have given no concrete conclusion for pinpointing the vegetation effect since site condition are changed and it is often impossible to separate the cause from the effect.

II. MATERIAL AND METHODS

2.1 Study Area

The study was carried out in three sites of Durgapur Government College campus located near at Durgapur, (23°30' N, 87°20' E). Site I (23°32'39.92"N, 87°19'43.36"E at an elevation of 96.01m); site II (23°32'36.64"N, 87°19'37.04"E at an elevation of 99.66m); site III (23°32'32.14"N, 87°19'41.86"E at an elevation of 92.04m). Site I is situated in behind of P.G. Department of Conservation Biology, site II is located adjustened area of main building, Geology

Department and staff quarters and site III situated at the playground area of the college campus.

2.2 Quadrat and Phyto-sociological Studies

A total of three sites representing various categories of natural forests and plantations were selected for vegetation sampling. At each site 20 quadrats (1 m x 1 m) were laid to quantify various layers. The size of the quadrat used in this study was decided based on the species area curve method following Misra (1968). Individuals of shrubs, climbers and tree seedlings were enumerated within each quadrat. The structure and composition of vegetation across vegetation types have been compared in terms of frequency, density, abundance, and basal area of major species. Importance Value Index (IVI =relative frequency + relative density + relative dominance) and species diversity index ($H^{'}$ = pi ln pi; where, pi= ni/N; and ni = abundance of each species, N= total abundance of all species) were derived from the primary data separately for each layer following Misra (1968). Berger and Parker Index (D_{BP} = Nmax / N Where Nmax = is the number of individuals in the most species and N= is the total number of all individuals in all species) were weighted toward the abundance of the commonest species. For any information-statistics index, the maximum diversity of a community is found when all species are equally abundant. Community's actual diversity is measured by the formula: Evenness (E) = H / Hmax. Rank Abundance diagrams visually describe the allocation of individuals to species in communities. We ranked and represented 34 species in that forest community in a standard rank abundance diagram.

III. RESULTS

3.1 Phytosociology and Species Diversity and Abundance

The number of species in a particular forest type varies markedly along the altitudinal range of its growth, which depends on the complex suit of factors that characterize the habitat of individual species. Ecological function of the species involves all kinds of processes, which are inevitably associated with some changes over space; composition and structure are affected at species level. The fundamental capability of ecosystems to evolve, change and recognize themselves is a prerequisite for the sustainability of viable system (Ashby, 1974). The species in a community grow together in a particular environment because they have a similar requirement for existence in terms of environmental factors (TerBaak, 1987).

Taxonomic survey of the ground cover flora reflects the dominance of dicotyledonous plants over monocots (Table 1). A summary of phytosociological data is summarized in (Table-2). The plant community represents 24 tree species which bearing 13 families in site I. *Azadirachta indica* belongs to Meliaceae family exhibit the highest density and frequency and *Mangifera indica* belongs to Anacardiaceae family bears the highest IVI score deserves special mention for its luxuriant occurrence in the study area. The minimum IVI value was in the order of *Butea monosperma*(5.43), *Eucalyptus paniculata*(5.57), *Terminalia arjuna*(5.75), *Dalbergia sissoo*(6.59), *Caesalpinia pulcherima*(6.65).

Diversity is the index of the ratio between the number of species and the important value of an individual. Shannon index value in site I is 2.56. All information-statistics indices are affected by both the number of species and their equitability or evenness. A higher number of species and a more even distribution both increase diversity. The evenness index value is 0.718.

Table 1: Recorded tree species presenting with density and important value index (IVI) from site I in Durgapur Government College Campus during my study period from March, 2010 to March 2011

Serial No.	Family	Species	TI	D (tree/ha)	RD	F (%)	FC	RF	BA ($m^2 \cdot ha^{-1}$)	R Do	IVI	A:F ratio
1	Anacardiaceae	*Mangifera indica*	6	1.5	14.63	75	D	9.67	8.85	16.81	41.11	0.016
2		*Anacardium occidentale*	0	0	0	0	0	0	0	0	0	0
3	Apocynaceae	*Alstonia scholaris*	0	0	0	0	0	0	0	0	0	0
4		*Holarrhena antidysentrica*	0	0	0	0	0	0	0	0	0	0
5	Rutaceae	*Aegle marmelos*	1	0.25	0.61	25	B	3.22	1.86	3.53	7.35	0.008
6	Meliaceae	*Azadirachta indica*	10	2.5	6.09	100	E	12.90	8.81	16.73	35.72	0.020
7		*Melia azadirachta*	2	0.5	1.21	50	C	6.45	1.87	3.55	11.21	0.008
8	Moraceae	*Artocarpus heterophylus*	2	0.5	1.21	50	C	6.45	6.17	11.72	19.38	0.008
9		*Ficus benghalensis*	1	0.25	0.61	25	B	3.22	3.75	7.12	10.94	0.008
10		*Ficus religiosa*	1	0.25	0.61	25	B	3.22	2.82	5.35	9.17	0.008
11	Leguminosae	*Caesalpinea pulcherima*	1	0.25	0.61	25	B	3.22	1.49	2.83	6.65	0.008
12		*Delonix regia*	1	0.25	0.61	25	B	3.22	1.82	3.45	7.27	0.008
13		*Cassia fistula*	3	0.75	1.82	50	C	6.45	2.63	4.99	13.26	0.012

14		*Albizzia lebbek*	0	0	0	0	0	0	0	0	0	0
15		*Dalbergia sissoo*	1	0.25	0.61	25	B	3.22	1.46	2.77	6.59	0.008
16		*Tamarindus indica*	3	0.75	1.82	75	D	9.67	2.49	4.73	16.22	0.008
17		*Acacia nilotica*	2	0.5	1.21	50	C	6.45	1.28	2.43	10.09	0.008
18	Dipterocarpaceae	*Shorea robusta*	2	0.5	1.21	50	C	6.45	2.75	5.22	12.88	0.008
19	Anonaceae	*Polyalthia longifolia*	2	0.5	1.21	50	C	6.45	1.82	3.45	11.11	0.008
20	Myrtaceae	*Eucalyptus paniculata*	1	0.25	0.61	25	B	3.22	0.89	1.69	5.51	0.008
21	Verbenaceae	*Tectona grandis*	0	0	0	0	0	0	0	0	0	0
22	Combretaceae	*Terminalia arjuna*	1	0.25	0.61	25	B	3.22	1.02	1.93	5.75	0.008
23	Aurocariaceae	*Aurocaria sp.*	0	0	0	0	0	0	0	0	0	0
24	Fabaceae	*Butea monosperma*	1	0.25	0.61	25	B	3.22	0.85	1.61	5.43	0.008

(TI- Total no. of individuals, D- Density, RD- Relative Density, F- Frequency, FC- Frequency Class, RF- Relative Frequency, BA- Basal Area, R Do- Relative Dominance, IVI- Important Value Index)

Table 1a: Calculated diversity indices of tree species from site I in Durgapur Government College Campus during my study period from March, 2010 to March, 2011

Diversity Indices	
Dominance_D	0.1089
Shannon_H	2.56
Evenness_e^H/S	0.7186
Margalef	4.578

In site II among 24 tree species, *Polyalthialongifolia*, belongs to Annonaceae family, exhibit highest density and frequency. The vegetation of studied areas showed the presence of evergreen plant species. A summary of phytosociological data is summarized in (Table-3). Among all the listed twenty four plant species *Caesalpinea pulcherima* belongs to Leguminosae family was found leading dominant in most of the stands. The IVI values (Table- 4) revealed that the highest value belongs to the species *Caesalpinea pulcherima*. The decreasing trend of IVI value was in the order of – *Butea monosperma*(6.52), *Azadirchta indica*(6.60), *Aurocaria sp.* (6.65), *Anacardium occidentale* (6.82). The highest IVI value of *Caesalpinea pulcherima* reveals that the species was most dominant in that community and the lowest IVI values of *Butea monosperma*, *Azadirchta indica*, *Aurocaria sp.*, *Anacardium occidentale* represent that they are the rare species of that community. Higher Shanon index value in this site is 2.78.

Table 2: Recorded tree species presenting with density and important value index (IVI) from site II in Durgapur Government College Campus during my study period from March, 2010 to March 2011

Serial No	**Family**	**Species**	**TI**	**D (tree/ha)**	**RD**	**F (%)**	**FC**	**RF**	**BA ($m^2 \cdot ha^{-1}$)**	**R Do**	**IVI**	**A:F ratio**
1	Anacardiaceae	*Mangifera indica*	1	0.25	2.22	25	B	2.85	1.8	3.00	8.07	0.008
2		*Anacardium occidentale*	1	0.25	2.22	25	B	2.85	1.05	1.75	6.82	0.008
3	Apocynaceae	*Alstonia scholaris*	5	1.25	11.11	75	D	8.57	4.66	7.77	27.45	0.013
4		*Holarhena antidysentrica*	3	0.75	6.66	50	C	5.71	1.83	3.05	15.42	0.012
5	Rutaceae	*Aegle marmelos*	3	0.75	6.66	50	C	5.71	3.42	5.70	18.07	0.012
6	Meliaceae	*Azadirachta indica*	1	0.25	2.22	25	B	2.85	0.92	1.53	6.60	0.008
7		*Melia azadirachta*	0	0	0	0	0	0	0	0	0	0
8	Moraceae	*Artocarpus heterophylus*	1	0.25	2.22	25	B	2.85	2.22	3.70	8.77	0.008
9		*Ficus benghalensis*	2	0.5	4.44	25	B	2.85	5.26	8.78	16.07	0.016
10		*Ficus religiosa*	1	0.25	2.22	25	B	2.85	2.50	4.17	9.24	0.008
11	Leguminosae	*Caesalpinea pulherima*	4	1	8.88	75	D	8.57	11.45	22.94	40.39	0.010
12		*Delonix regia*	2	0.5	4.44	50	C	5.71	2.20	3.62	13.77	0.008
13		*Cassia fistula*	0	0	0	0	0	0	0	0	0	0
14		*Albizzia lebbek*	1	0.25	2.22	25	B	2.85	1.22	2.03	7.10	0.008
15		*Dalbergia sissoo*	3	0.75	6.66	75	D	8.75	3.82	6.37	21.60	0.008
16		*Tamarindus indica*	0	0	0	0	0	0	0	0	0	0
17		*Acacia nilotica*	0	0	0	0	0	0	0	0	0	0
18	Dipterocarpaceae	*Shorea robusta*	1	0.25	2.22	25	B	2.85	1.55	2.58	7.65	0.008

19	Anonaceae	*Polyalthia longifolia*	6	1.40	13.33	100	E	11.42	5.35	8.93	33.68	0.012
20	Myrtaceae	*Eucalyptus paniculata*	4	1	2.22	75	D	8.57	4.01	6.69	17.48	0.010
21	Verbenaceae	*Tectona grandis*	3	0.75	6.66	50	C	5.71	3.57	5.95	18.32	0.012
22	Combretaceae	*Terminalia arjuna*	1	0.25	2.22	25	B	2.85	1.25	2.08	7.15	0.008
23	Aurocariaceae	*Aurocaria sp.*	1	0.25	2.22	25	B	2.85	0.95	1.58	6.65	0.008
24	Fabaceae	*Butea monosperma*	1	0.25	2.22	25	B	2.85	0.87	1.45	6.52	0.008

(TI- Total no. of individuals, D- Density, RD- Relative Density, F- Frequency, FC- Frequency Class, RF- Relative Frequency, BA- Basal Area, R Do- Relative Dominance, IVI- Important Value Index)

Table 2a: Calculated diversity indices of tree species from site II in Durgapur Government College Campus during my study period from March, 2010 to March, 2011

Diversity Indices	
Dominance_D	0.07259
Shannon_H	2.788
Evenness_e^H/S	0.8123
Margalef	4.991

*Eucalyptus paniculata*was found to be the most frequent, dominant and important species in the community in site III. The increasing trend of IVI

value was in the order of – *Tamarindus indica* (7.49), *Tectona grandis*(7.57), *Terminalia arjuna (8.24)* .The highest IVI value of *Eucalyptus paniculata* reveals that the species was most dominant in that community. Shannon index value is 2.435. On the other hand the evenness index value is 0.7613.

Table 3: Recorded tree species presenting with density and important value index (IVI) from site III in Durgapur Government College Campus during my study period from March, 2010 to March 2011

(TI- Total no. of individuals, D- Density, RD- Relative Density, F- Frequency, FC- Frequency Class, RF- Relative Frequency, BA- Basal Area, R Do- Relative Dominance, IVI- Important Value Index)

Table 3a: Calculated diversity indices of tree species from site II in Durgapur Government College Campus during my study period from March, 2010 to March, 2011

Diversity Indices	
Dominance_D	0.115
Shannon_H	2.435
Evenness_e^H/S	0.7613
Margalef	3.795

IV. DISCUSSIONS

Serial No	**Family**	**Species**	**TI**	**D (tree/ha)**	**RD**	**F (%)**	**FC**	**RF**	**BA ($m^2 \cdot ha^{-1}$)**	**R Do**	**IVI**	**A:F Ratio**
1	Anacardiaceae	*Mangifera indica*	0	0	0	0	0	0	0	0	0	0
2		*Anacardium occidentale*	0	0	0	0	0	0	0	0	0	0
3	Apocynaceae	*Alstonia scholaris*	2	0.5	5	50	C	6.45	1.77	3.57	15.02	0.008
4		*Holarrhena antidysentrica*	0	0	0	0	0	0	0	0	0	0
5	Rutaceae	*Aegle marmelos*	2	0.5	5	50	C	6.45	2.37	4.78	16.23	0.008
6	Meliaceae	*Azadirachta indica*	5	1.25	12.5	75	D	9.67	4.73	9.54	31.71	0.013
7		*Melia azadirachta*	3	0.75	7.5	75	D	9.67	3.45	6.95	24.12	0.008
8	Moraceae	*Artocarpus heterophylus*	1	0.25	2.5	25	B	3.22	3.20	6.45	12.17	0.008
9		*Ficus benghalensis*	0	0	0	0	0	0	0	0	0	0
10		*Ficus religiosa*	0	0	0	0	0	0	0	0	0	0
11	Leguminosae	*Caesalpinea pulcherima*	3	0.75	7.5	75	D	9.67	5.94	11.98	29.15	0.008
12		*Delonix regia*	1	0.25	2.5	25	B	3.22	1.32	2.66	8.38	0.008
13		*Cassia fistula*	2	0.5	5	50	C	6.45	1.59	3.20	14.65	0.008
14		*Albizzia lebbek*	0	0	0	0	O	0	0	0	0	0
15		*Dalbergia sissoo*	2	0.5	5	50	C	6.45	2.83	5.70	17.15	0.008
16		*Tamarindus indica*	1	0.25	2.5	25	B	3.22	0.88	1.77	7.49	0.008
17		*Acacia nilotica*	0	0	0	0	0	0	0	0	0	0
18	Dipterocarpaceae	*Shorea robusta*	2	0.5	5	50	C	6.45	3.52	7.10	18.55	0.008
19	Anonaceae	*Polyalthia longifolia*	4	1	10	75	D	9.67	3.79	7.64	27.31	0.010
20	Myrtaceae	*Eucalyptus paniculata*	10	2.5	25	100	E	12.90	12.01	24.22	62.12	0.020
21	Verbenaceae	*Tectona grandis*	1	0.25	2.5	25	B	3.22	0.92	1.85	7.57	0.008
22	Combretaceae	*Terminalia arjuna*	1	0.25	2.5	25	B	3.22	1.25	2.52	8.24	0.008
23	Aurocariaceae	*Aurocaria sp.*	0	0	0	0	O	0	0	0	0	0
24	Fabaceae	*Butea monosperma*	0	0	0	0	0	0	0	0	0	0

In order to assess ecological knowledge of the native flora in Durgapur College campus in general, a quantitative phytosociological study in different was carried out. Importance Value Index (I.V.I.) for each plant species was determined to quantify the importance of each species. The vegetation of the studied sites is composed of evergreen vegetation. The disturbance is mainly due to the extensive cutting of tress for fuel and for fodder, overgrazing, removal of economically important trees and some other biotic interference. These activities are responsible in converting natural vegetation to semi natural vegetation. An important component of any ecosystem is the species it contains. Species also serves as good indicators of the ecological condition of a system (Morgenthal, *et al.,* 2001). A list of all species collected during the study was compiled. The floristic composition of different area was also compared. The species composition of the three studied sites was considerably different. Vegetation analysis gives the information necessary to determine the name of the community and provide data that can be used to compare it with other communities. Four to five plant communities: *Azadirachta indica*, *Polyalthia longifolia*, *Eucalyptus paniculata* were observed as a leading dominant. The communities with strong single species dominance have been attributed to grazing, species competition, seed predation, disease, stability and niche diversification (Whittaker and Levin 1977, Harper 1977). The rarer plant species with poor representation in our samples need proper attention from plant biologists to determine their conservation status and key functions. *Butea monosperma, Eucalyptus paniculata, Terminalia arjuna, Dalbergia sissoo, Caesalpinia pulcherima* in site I; *Butea monosperma, Azadirchta indica, Aurocaria sp., Anacardium occidentale* in site II and *Tamarindus indica*, *Tectona grandis*, *Terminalia arjuna* in site III. The communities in the study area were heterogeneous. The absence of certain frequencies classes in the communities reflected the heterogeneity of the vegetation, which is either due to biotic disturbance or the floral poverty. The result obtained by Raunkiaer (1934) may be regarded only as possibilities to be confirmed by other alternative approaches. The ratio of abundance to frequency for different species was calculated to elicit the distributional patterns. This ratio indicates regular (<0.025), random (0.025-0.05) and contagious (>0.05) distributions (Curtis and Cottam 1956). In our present investigation all of the studied plant species were regular in distribution. The concept of species diversity relates simply to "richness" of a community or geographical area in species. At the simplest level of examination, species diversity corresponds to the number of species present. Species diversity is considered to be an important attribute of community organization and allowed comparison of the structural characteristics of the communities. It is often related to community dynamics stability, productivity, integration, evolution, structure and competition. The idea of displacement of one species through competition with other is net prime importance. Protection of the natural flora from overgrazing is necessary, especially during the time when the desirable plants set their seeds. Protection is essential to maintain the desirable forage plant species in a good proportion, to avoid invader plant species and to rehabilitate the destroyed natural flora (Arshad, *et al.,* 2002). We must carry out our efforts to make a list of the plant species, which can be lost from the natural environment, otherwise it will leads to desertification. Desertification associated with human activities has been recognized over the past two decades as one of the important facets of ongoing global environmental change (Verstraete and Schwartz, 1991; UNEP,1997; Huenneke, *et al.,* 2002) and Species loss can alter the goods and services provided by ecosystems (Hooper, *et al.,* 2005).

The variable rate of frequency class distribution at three studied sites of Durgapur Government College campus may be explained by a common biological explanation pattern which implies most dominant species appeared to colonize a new area appropriates a fraction of the available resources and by competitive interaction, pre-empts that fraction. The second species then preempts a similar fraction of the remaining resource and so on with further colonists.

The reconstruction of plant communities on disturbed sites with a species composition similar to that of the natural area will require allocation of more financial inputs. The saving and establishment of plant communities one of the major tasks facing by ecologist. Extensive work on the development of vegetation depends upon good indigenous vegetation recovery. Preservation of these communities especially within disturbed sites is more generally, demands a unique and pressing conservation challenge. Extensive cutting of tress for fuel and for fodder, overgrazing, removal of economically important trees and some other biotic interference affecting the nature, structure and composition of plant communities. Since species diversity is important to maintain heterogeneity of a stable ecosystem, the diversity is to be preserved through appropriate measures. Since this forest is likely to have generous impact on socio-economic conditions of local stakeholders, its ecorestoration and protection is of utmost importance.

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