Communications in Plant Sciences (July-December 2013) 3(3-4): 37-45
ISSN 2237-4027
www.complantsci.wordpress.com
Manuscript accepted on November 01, 2013 / Manuscript published online on November 18, 2013

Phytosociology and pedological characteristics of selected beats of Durgapur Forest Range, West Bengal, India

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ABSTRACT

The aim of the investigation was to analyze phytosociological characteristics and diversity pattern of five selected beats of tropical dry deciduous forest of Durgapur Forest Range, Burdwan, West Bengal, India. The present investigation was carried out through quadrat method for analysis of phytosociological aspect of vegetation. The soil of the different study sites were analyzed by following standard methodology. The results reflect dominancy of dicotyledons over monocotyledons in the five studied sites. Basudha (61) and Shibpur (58) beats represents higher number of species among the five studied sites. Maximum IVI value was recorded by *Shorea robusta* followed by *Madhuka longifolia* among all the beats except Shibpur. The study represents overall dominance of Sal forest over the entire region. Therefore Basudha and Shibpur beat needs prior conservative measure for protection of bioresources in those two forest region. The soil characteristics of the four study sites revealed acidic nature of soil in all the studied sites of Durgapur Forest Division. The range of organic carbon % was found to be higher in amount in comparison to conventional soil samples reflecting higher soil fertility of the studied sites. Therefore, proper management and conservative measures needs to be implemented for conservation of bioresources in different sites of Durgapur Forest Division, West Bengal, India.

Keywords: Soils, phyto-diversity, community structure, forest.

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INTRODUCTION

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 (Palit and Banerjee 2010).

The patterns and role of species richness in ecosystem function are important in terms of land-use and climate change concerns (Chapin and Korner 1995, Reynolds and Tenhunen 1996, Oechel et al. 1997). While there is still debate on the role of species diversity and ecosystem function (Hooper and 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 and 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 1991). 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.

Distribution of plant communities mostly depends upon the edaphic factors, like, soil texture, structure, pH, moisture and mineral composition. The varied physiography, soil and climatic conditions of the region are responsible for the luxuriant growth of various types of forest. Soil factors include all the physical, chemical and biological properties of the soil. The nature of the soil profile, soil pH and the nutrient cycle between the soil and the trees are some of the important dimensions in determining the site quality. In dry tropical forest ecosystems, soil nutrients play an important role in the formation of plant communities, their species and structural diversity, thus soil conservation has fundamental significance for biodiversity conservation and sustainable land use (Wang et al. 2004).

This paper deals with the plant species diversity, structure and composition across various strata within natural forests within the DFD. The main objective of this present investigation includes assessment of phytodiversity, distribution pattern of vegetation and associated phytosociological attributes in Durgapur forest division.

MATERIAL AND METHODS

Study sites. The present work is primarily based on thorough field survey in the study sites located in and around Durgapur Forest Range of Burdwan district of West Bengal. Durgapur is located with an average elevation of 65 meters (213 ft) in the Burdwan District (from 22^o 56' to 23^o 53' North latitudes and from 86^o 48' to 88^o 25' East longitudes) of West Bengal. The soil is lateritic in nature and the temperature ranges from 37.8 ^{0}C to 46.1 ^{0}C during summer and from 20.4 ^{0}C to 32.2 ^{0}C during winter. Annual rainfall is more or less 1,500 mm. Durgapur Forest Range is situated close to the bank of the river Ajay which sets the natural boundary between Burdwan and Birbhum districts. The topography is undulating. The coal-bearing area of the Raniganj coalfields lies just beyond Durgapur, although some parts intrude in to the area. The area was deeply forested till recent times, and some streaks of the original forests are still there, standing to witness its rich-natural past.

In the Blocks (administrative units) of Kanksa and Aushgram large tracts of land are still covered with sal trees. The Ajay River flows past unhindered forming the border in the north The Durgapur forests are continued in the Birbhum district beyond the Ajay while the forest area in the Asansol subdivision forms a part of the forest area of Dumka District of Jharkhand. Two rivulets, Kunur and Tumuni flow through the area and join the Ajay river. In case of Burdwan district, the State Forest report of FSI (2011) shows that the district has only 225 sq km i.e. 3.2% of forest coverage of the total geographic area which includes very dense, moderately dense and open forest cover.

Durgapur Forest Range consists of total 5 beat namely Shibpur, Gopalpur, Molandighi, Basudha and Arrah. These 5 beat have an area of protected forest of 1792.404 (Shibpur), 1319.55 (Gopalpur), 1209.634 (Molandighi), 1672.51 (Basudha) and 546.59 (Arrah) hectares.

Quadrat and phytosociological studies. A total of 5 sites representing various categories of natural forests and plantations were selected for vegetation sampling.

At each site 10 quadrats (20 ft x 20 ft) 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. Voucher specimens of plant species were collected and processed for herbarium preservation. Some of the specimens were worked out taxonomically for identification. During the field survey utmost care was taken to avoid disturbance to the flora and fauna. 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).

Soil sampling and analysis. Soil samples were collected from upper surface layers (top 15 cm). The samples were properly packed, air-dried, cleaned, crushed and then strained through 2 mm mesh sieves and analyzed. The soil pH was estimated by standard paste technique using pH meter (Rhodes 1982). The organic carbon percentage was measured using potassium dichromate method (Black 1965). Specific conductance was measured by following the method of Black (1965). Total nitrogen was measured by the standard Kjeldahl procedure (Bremner and Mulvaney 1982).Extractable phosphorus was determined by using sodium bicarbonate extracts (Olsen et al. 1954).

Statistical analysis. The phytosociological and soil characteristic data were treated with Statistical package *XLSTAT-software,* version 10, Addinsoft, Paris, France, for descriptive statistical analysis. In order to judge the observed pattern of soil characteristics of different study sites, a cluster analysis (CA) based on Ward's method was carried out. It allowed interpreting the levels of similarity of the study sites in terms of their soil characteristics. To predict the pattern of dependency of soil characteristics over plant sociological data Canonical Correlation Analysis (CCor) was carried out.

RESULTS

Phytosociology. The predominant forest types in five selected sites of Durgapur Forest Division are tropical dry deciduous type. 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 (Ter Baak 1987).

A summary of phytosociological data of Arrah beat is summarized in (Table 1). The plant community represents 20 species belonging to 17 genera in Arrah beat. *Shorea robusta* was found to be the most frequent, dominant and important species among the plant community of Arrah beat. The decreasing trend of IVI value was in the order *Madhuca longifolia, Syzygium cumini, Diospyros melanoxylon, Acacia auriculiformis, Buchanania lanzan, and Semecarpus anacardium.* The highest IVI score of *Shorea robusta* deserves special mention for its luxuriant occurrence in the study area. The lowest IVI scores were in the following order *Dalbergia sissoo, Cassia fistula, Alangium salvifolium*. The dominance and relative dominance value of plants species (n = 20) reveals the highest value for *Shorea robusta and Madhuca longifolia* followed by *Acacia auriculiformis*. *Shorea robusta* is the most dominant species of the area.

Table 1. Phytosociological characteristics of tree species in the Arrah beat of Durgapur Forest Range, West Bengal, India, during March – June 2010.

Name of the Plant	RF (%)	RD (%)	DOM (m^2)	RDOM (%)	IVI
Syzygium cumini	9.52	6.84	32.35	1.97	18.33
Shorea robusta	12.69	45.10	720.69	43.89	101.68
Diospyros melanoxylon	11.11	5.43	7.78	0.47	17.01
Acacia catechu	1.58	0.35	0.59	0.03	1.96
Madhuca longifolia	11.11	13.34	578.52	35.23	59.68
Cassia fistula	1.58	0.11	2.49	0.15	1.84
Alangium salvifolium	1.58	0.11	1.84	0.11	1.8
Semecarpus anacardium	3.17	0.35	11.07	0.67	4.19
Morinda citrifolia	3.17	0.23	0.62	0.03	3.43
Buchanania lanzan	7.93	1.41	7.46	0.45	9.79
Borassus flabellifer	1.58	0.11	4.14	0.25	1.94
Terminalia bellirica	1.58	0.23	8.28	0.5	2.33
Acacia auriculiformis	6.34	3.89	38.04	2.31	12.54
Acacia suma	7.93	1.88	3.19	0.19	10.00
Dalbergia sissoo	1.58	0.35	1.06	0.06	1.99
Pterocarpus marsupium	1.58	0.11	1.03	0.06	1.75
Azadirachta indica	1.58	0.23	5.92	0.36	2.17
Artocarpus lakoocha	1.58	0.23	10.23	0.62	2.43
Lannea coromandelica	1.58	0.11	3.26	0.19	1.88
Holarrhena pubescens	11.11	19.48	203.27	12.38	42.97

Phytosociological analysis of the plant community of Basudha beat of Durgapur Forest Range reflects diverse nature of plant species. A summary of phytosociological data is summarized in (Table 2). Basudha beat seems to harboring the most diverse type of plant species (61) in comparison to other studied sites. The plant community represents 61 species belonging to 57 genera in Basudha beat. Among all the listed sixty one plant species *Shorea robusta* was found leading dominant in most of the stands. *Gliricidia sepium, Emblica officinalis, Pterocarpus marsupium* were found in scarce. The IVI values revealed that the highest value belongs to the species *Shorea robusta* as in Arrah beat. The decreasing trend of IVI value was in the order of *Azadirachta indica*. The highest IVI value of *Shorea robusta* reveals that the species was most dominant in that community and the lowest IVI values of *Buchanania lanzan*, *Bridelia retusa, Gliricidia sepium, Emblica officinalis, and Pterocarpus marsupium* represent they are the rare species of that community.

The plant community of Gopalpur Beat was represented by 34 species belonging to 31 genera (Table 3). *Shorea robusta* was found to be the most frequent, dominant and important species in the community. In the forest the ground vegetation was very thick and the forest floor was moist in nature. The decreasing trend of IVI value was in the order of *Holarrhena pubescens, Diospyros melanoxylon, Acacia catechu, Syzygium cumini and Morinda citrifolia.* The highest IVI value of *Shorea robusta* reveals that the species was most dominant in that community and the lowest IVI values of *Pterocarpus marsupium, Bauhinia purpurea, Semecarpus anacardium, T. tomentosa, Haldina cordifolia, Garuga pinnata, Holoptelea integrifolia, Grewia asiatica, Croton roxborghii.* It represents that they are the rare species of that community. Thus, *Shorea robusta* is the most dominant species of the study area.

The plant community of Molandighi beat was represented by 34 species (Table 4). Among the different species in the present study site *S. robusta, Madhuca longifolia, Buchanania lanzan*, *Syzygium cumini* were found to be the most frequent, dominant and important species in the community. In the forest the ground vegetation was very thick and the forest floor was moist in nature. On the basis of IVI scores, which give an idea regarding the relative importance of species and sociobiological structure of the community, *S. robusta* appears to be the dominant species. The decreasing trend of IVI score was in the order of *Alstonia scholaris, Gelonium multiflorum*, *Azadirachta indica Phoenix sylvestre, Bambusa arundinacea, Gmelina arborea*. The highest IVI score of *Shorea robusta* deserves special mention for its luxuriant occurrence in the study area. The low IVI scores of *Pterocarpus marsupium, Lannea coromandelica, Emblica officinalis, Gmelina arborea, Croton roxburghii* indicate that these are rare species in the study area. Thus, *S. robusta* was the most dominant species in the study area and reveals its extensive distribution.

Table 2. Phytosociological characteristics of tree species in the Basudha beat of Durgapur Forest Range, West Bengal, India, during March – June 2010.

Name of the Plant	RF (%)	RD (%)	DOM (m^2)	RDOM (%)	IVI
Syzygium cumini	3.0	4.23	23.47	0.87	8.10
Shorea robusta	5.0	27.60	714.01	26.58	59.18
Trewia nudiflora	2.0	1.10	8.21	0.30	3.40
Holoptelea integrifolia	2.5	1.10	6.18	0.23	3.83
Terminalia bellirica	2.5	1.55	71.83	2.67	6.72
Semecarpus anacardium	1.5	0.84	44.29	1.64	3.98
Croton roxburghii	1.5	0.56	2.85	0.10	2.16
Symplocos racemosa	1.0	0.28	1.82	0.06	1.34
Zizyphus mauritiana	1.5	0.70	1.11	0.04	2.24
Diospyros melanoxylon	3.0	4.79	12.71	0.47	8.26
Holarrhena pubescens	1.5	0.84	14.95	0.55	2.89
Madhuca longifolia	3.5	12.68	921.54	34.41	50.49
Annona squamosa	1.0	0.56	1.007	0.03	1.59
Morinda citrifolia	3.5	1.33	8.67	0.32	5.15
Buchanania lanzan	0.5	0.28	0.79	0.02	0.80
Grewia asiatica	1.0	0.56	5.53	0.20	1.76
Cinnamomum tamala	0.5	0.21	0.33	0.01	0.72
Phoenix sylvestris	1.5	1.05	15.52	0.57	3.12
Borassus flabellifer	2.0	2.11	65.06	2.42	6.53
Bridelia retusa	0.5	0.28	1.32	0.04	0.82
Gliricidia sepium	0.5	0.14	0.83	0.03	0.67
Emblica officinalis	0.5	0.14	0.15	0.005	0.64
Pterocarpus marsupium	0.5	0.14	1.63	0.06	0.70
Bauhinia purpurea	1.5	0.84	11.9	0.44	2.78
Terminalia tomentosa	1.0	0.28	5.11	0.19	1.47
Careya arborea	0.5	0.21	5.53	0.20	0.91
Mallotus phillippinensis	0.5	0.56	0.89	0.03	1.09
Butea monosperma	1.0	0.84	9.48	0.35	2.19
Bombax ceiba	2.0	0.84	49.69	1.85	4.69
Naringi crenulata	1.0	0.56	4.72	0.17	1.73
Limonia acidissima	1.0	0.42	11.19	0.41	1.83
Alangium salvifolium	2.0	0.28	7.38	0.27	2.55
Mitragyna parvifolia	2.5	0.84	29.93	1.11	4.45
Gelonium multiflorum	2.5	1.26	23.01	0.85	4.61
Haldina cordifolia	1.0	0.42	6.47	0.24	1.66
Grevillea robusta	1.0	1.97	20.72	0.77	3.74
Garuga pinnata	0.5	0.70	7.77	0.28	1.48
Ehretia laevis	1.0	0.70	22.31	0.83	2.53
Acacia auriculiformis	3.0	2.25	14.60	0.54	5.79
Acacia holocerica	1.0	1.26	6.55	0.24	2.50
Albizia lebbeck	2.0	0.56	45.44	1.69	4.25
Artocarpus heterophyllus	1.0	0.56	33.12	1.23	2.79
Azadirachta indica	3.0	1.55	112.63	4.19	8.74
Ailanthus excelsa	3.0	0.70	18.46	0.68	4.38
Lannea coromandelica	1.0	0.28	13.05	0.48	1.76
Acacia nilotica	1.5	0.72	6.72	0.25	2.47
Acacia catechu	2.5	1.26	20.75	0.77	4.53
Bambusa arundinacea	3.5	2.25	7.01	0.26	6.01
Aegle marmelos	2.0	0.98	7.22	0.26	3.24
Tamarindus indica	1.5	0.42	25.36	0.94	2.86
Psidium guava	1.0	0.42	1.31	0.04	1.46
Ficus hispida	1.5	1.19	33.38	1.24	3.93
Pongamia pinnata	1.5	0.90	22.22	0.82	3.22
Cassia fistula	2.5	1.83	56.38	2.09	6.42
Terminalia arjuna	1.0	0.42	11.07	0.41	1.83
Alstonia scholaris	3.0	1.40	65.30	2.43	6.83
Strychnos potatorum	0.5	0.14	3.69	0.13	0.77
Trema orientalis	1.0	0.35	13.98	0.52	1.87
Anthocephalus chinensis	1.0	0.20	12.50	0.46	1.66
Gmelina arborea	0.5	0.07	0.81	0.01	0.50
Dillenia pentagyna	2.0	1.12	14.31	0.53	3.65

Table 3. Phytosociological characteristics of tree species in the Gopalpur beat of Durgapur Forest Range, West Bengal, India, during March – June 2010.

Name of the Plant	RF (%)	RD (%)	DOM (m^2)	RDOM (%)	IVI
Shorea robusta	8.26	29.36	508.17	34.96	72.58
Holarrhena pubescens	6.61	9.39	113.86	7.83	23.83
Syzygium cumini	4.95	3.23	13.02	0.89	9.07
Diospyros melanoxylon	5.78	6.02	11.39	0.78	12.58
Acacia suma	1.65	2.49	5.41	0.37	4.51
Madhuca longifolia	8.26	16.74	538.23	37.03	62.03
Bauhinia purpurea	0.82	0.29	0.40	0.02	1.13
Phoenix sylvestris	4.13	1.76	15.76	1.08	6.97
Semecarpus anacardium	0.82	0.29	10.32	0.71	1.71
Gelonium multiflorum	2.47	2.64	34.00	2.33	7.45
Azadirachta indica	3.30	0.88	21.84	1.5	5.68
Terminalia bellirica	1.65	0.58	14.8	1.01	3.24
T. tomentosa	0.82	0.14	2.50	0.17	1.13
Symplocos racemosa	1.65	1.02	8.63	0.59	3.26
Zizyphus rugosa	4.13	1.76	3.82	0.26	6.15
Alangium salvifolium	2.47	0.88	8.93	0.61	3.96
Cassia fistula	1.65	0.58	10.02	0.68	2.91
Pterocarpus marsupium	0.82	0.14	1.87	0.12	1.08
Aegle marmelos	2.47	0.73	4.23	0.29	3.49
Buchanania lanzan	1.65	0.88	3.95	0.27	2.80
T. chebula	3.30	1.76	22.91	1.57	6.63
Mitragyna parvifolia	4.13	1.17	11.99	0.82	6.12
Acacia catechu	5.78	5.13	11.14	0.76	11.67
Careya arborea	0.82	0.58	10.92	0.75	2.15
Haldina cordifolia	0.82	0.29	1.79	0.12	1.23
Z. mauritiana	4.13	1.46	2.03	0.13	5.72
Garuga pinnata	0.82	0.44	1.20	0.08	1.34
Nyctanthes arbortristis	4.13	2.34	1.81	0.12	6.59
Pongamia pinnata	3.30	2.34	8.16	0.56	6.20
Holoptelea integrifolia	0.82	0.44	7.31	0.50	1.26
Morinda citrifolia	4.13	2.49	11.01	0.75	7.37
Grewia asiatica	0.82	0.29	5.01	0.34	1.45
Samanea saman	1.65	0.73	26.08	1.79	4.17
Croton roxborghii	0.82	0.58	0.80	0.05	1.45

The plant community of Shibpur beat was represented by 50 species (Table 5). Among the different observed species in the present study site *Shorea robusta, Buchanania lanzan, Syzygium cumini, Diospyros melanoxylon, Holarrhena pubescens* were found to be the most frequent, dominant and important species in the community. In the forest the ground vegetation was very thick and the forest floor was moist in nature. On the basis of IVI scores, which give an idea regarding the relative importance of species and sociobiological structure of the community, *Shorea robusta* appears to be the dominant species. The decreasing trend of IVI score was in the order of *Shorea robusta*, *Buchanania lanzan, Syzygium cumini, Holarrhena pubescens, Diospyros melanoxylon, Madhuca longifolia*. The highest IVI score of *Shorea robusta* deserves special mention for its luxuriant occurrence in the study area. The low IVI scores of *Grewia asiatica, Strychnos potatorum, Mallotus phillippinensis, A. heterophyllus, and Trema orientalis* indicate that these are rare species in the study area. *Shorea robusta* was the most dominant species in the study area and reveals its extensive distribution.

Table 4. Phytosociological characteristics of tree species in the Molandighi beat of Durgapur Forest Range, West Bengal, India, during March – June 2010.

Name of the Plant	RF (%)	RD (%)	DOM (m^2)	RDOM (%)	IVI
Artocarpus heterophyllus	2.87	0.43	26.31	0.74	4.04
Ficus racemosa	2.87	0.87	13.46	0.38	4.12
Shorea robusta	5.74	35.88	1390.1	39.49	81.11
Crateva religiosa	1.14	0.52	6.77	0.19	1.85
Madhuca longifolia	4.59	15.67	1254.5	35.64	55.90
Diospyros melanoxylon	4.02	1.82	19.80	0.56	6.40
Cassia fistula	4.02	1.04	22.17	0.63	5.69
Pterocarpus marsupium	0.57	0.17	3.97	0.11	0.85
Dalbergia sissoo	2.29	1.04	9.08	0.25	3.58
Albizia lebbeck	2.87	1.65	22.35	0.63	5.15
Lannea coromandelica	0.57	0.17	6.64	0.18	0.92
Syzygium cumini	4.02	5.40	36.71	1.04	10.46
Terminalia arjuna	1.72	0.52	15.52	0.44	2.68
Terminalia chebula	0.57	0.17	154.01	4.37	5.11
Terminalia bellirica	1.14	0.69	33.2	0.94	2.77
Emblica officinalis	0.57	0.17	6.39	0.18	0.92
Garuga pinnata	1.14	0.69	3.44	0.09	1.92
Buchanania lanzan	5.74	10.10	139.70	3.96	19.80
Lagerstroemia speciosa	2.87	2.09	13.40	0.38	5.34
Azadirachta indica	3.44	1.04	38.64	1.09	5.57
Aegle marmelos	3.44	1.56	41.42	1.17	6.17
Alstonia scholaris	4.02	1.82	62.48	1.77	7.61
Holarrhena pubescens	1.72	0.69	11.91	0.33	2.74
Gmelina arborea	0.57	0.08	0.89	0.02	0.67
Tectona grandis	1.72	1.04	8.89	0.25	3.01
Anthocephalus chinensis	1.14	0.43	16.78	0.47	2.04
Pongamia pinnata	2.29	1.13	10.34	0.29	3.71
Gelonium multiflorum	3.44	2.09	38.15	1.08	6.61
Nyctanthes arbortristis	3.44	1.74	4.46	0.12	5.30
Phoenix sylvestre	3.44	0.95	18.29	0.51	4.90
Semecarpus anacardium	1.72	0.43	21.65	0.61	2.76
Catunaregam uliginosa	1.14	0.34	1.91	0.05	1.53
Holoptelea integrifolia	0.57	0.26	7.97	0.22	1.05
Morinda citrifolia	2.87	1.48	9.17	0.26	4.61
Croton roxburghii	0.57	0.17	1.34	0.01	0.75
Acacia catechu	2.87	1.04	14.11	0.40	4.31
Careya arborea	0.57	0.17	4.22	0.12	0.86
Zizyphus mauritiana	4.02	2.09	11.75	0.33	6.44
Kydia calycina	0.57	0.08	0.74	0.02	0.67
Limonia acidissima	1.14	0.43	2.79	0.07	1.64
Ficus religiosa	2.29	0.52	12.19	0.34	3.15
Bambusa arundinacea	2.87	0.95	2.36	0.06	3.88
Naringi crenulata	0.57	0.17	0.36	0.01	0.75

Table 5. Phytosociological characteristics of tree species in the Shibpur beat of Durgapur Forest Range, West Bengal, India, during March – June 2010.

Name of the Plant	RF (%)	RD (%)	DOM (m^2)	RDOM (%)	IVI
Shorea robusta	4.20	27.82	1624.85	46.49	78.51
Buchanania lanzan	3.36	12.17	317.88	9.09	24.62
Pterocarpus marsupium	2.94	4.34	89.33	2.55	9.83
Semecarpus anacardium	2.52	3.04	155.42	4.44	10.00
Albizia lebbeck	2.10	2.60	41.79	1.19	5.89
Catunaregam uliginosa	1.26	0.57	3.91	0.11	1.94
Madhuca longifolia	2.52	2.02	194.61	5.56	10.10
Gelonium multiflorum	0.84	0.36	8.60	0.24	1.44
Symplocos racemosa	1.26	1.01	4.11	0.11	2.38
Syzygium cumini	2.52	8.11	62.57	1.79	12.42
Croton roxburghii	1.68	0.43	1.34	0.03	2.14
Acacia catechu	2.52	2.10	10.73	0.30	4.92
Diospyros melanoxylon	4.20	5.65	67.03	1.19	11.76
Zizyphus mauritiana	1.26	1.08	4.99	0.14	2.48
Azadirachta indica	2.10	0.79	32.72	0.93	3.82
Borassus flabellifer	2.52	1.30	74.71	2.13	5.95
Haldina cordifolia	2.52	1.52	11.73	0.33	3.37

Annona squamosa	2.10	1.01	17.94	0.51	3.62
Aegle marmelos	2.52	1.30	35.45	1.01	4.83
Derris indica	1.26	0.57	4.46	0.12	1.95
Holarrhena pubescens	2.52	1.44	276.7	7.91	11.87
Memecylon umbellatum	0.84	0.21	1.07	0.03	1.08
Phoenix sylvestris	2.10	1.08	16.93	0.48	3.66
Alangium salvifolium	2.10	1.30	33.26	0.95	4.35
Bridelia retusa	0.84	0.21	3.38	0.09	1.14
Mitragyna parvifolia	2.52	0.86	22.17	0.63	4.01
Schleichera oleosa	2.10	1.01	60.64	1.73	4.84
Tectona grandis	2.10	2.31	23.72	0.67	5.08
Nyctanthes arbortristis	1.26	0.57	1.98	0.05	1.88
Terminalia bellirica	1.26	0.43	21.69	0.62	2.31
Garuga pinnata	1.26	0.43	2.58	0.07	1.76
Holoptelea integrifolia	2.94	0.86	23.63	0.67	4.47
Morinda citrifolia	2.10	0.86	10.31	0.29	3.25
Cassia fistula	2.10	0.57	20.04	0.57	3.24
Grewia asiatica	0.42	0.28	0.31	0.01	0.70
Limonia acidissima	2.94	0.86	7.10	0.20	4.00
Naringi crenulata	0.84	0.21	0.60	0.01	1.06
Chloroxylon swietenia	1.68	0.86	9.55	0.27	2.81
Anthocephalus chinensis	1.68	0.72	28.04	0.80	3.20
Strychnos potatorum	0.42	0.07	2.16	0.06	0.55
Alstonia scholaris	2.52	0.86	35.06	1.00	4.38
Tamarindus indica	1.26	0.28	5.67	0.16	1.70
Gmelina arborea	0.84	0.14	2.56	0.07	1.05
Emblica officinalis	0.84	0.28	10.02	0.28	1.40
Anacardium occidentalis	1.26	0.72	33.56	0.96	2.94
Dillenia pentagyna	1.26	0.43	5.40	0.15	1.84
Dalbergia sissoo	1.26	0.57	4.06	0.11	1.94
Bambusa arundinacea	1.68	0.86	2.33	0.06	2.60
Mallotus phillippinensis	0.42	0.14	0.25	0.01	0.56
Murraya paniculata	1.26	0.57	2.35	0.06	1.89
Ficus benghalensis	0.84	0.28	12.47	0.35	1.47
F. religiosa	1.26	0.36	7.06	0.20	1.82
Artocarpus lakoocha	0.84	0.21	15.05	0.43	1.48
A. heterophyllus	0.42	0.14	9.63	0.27	0.83
Trema orientalis	0.42	0.14	2.35	0.06	0.62
Ehretia laevis	1.26	0.57	5.93	0.16	1.99
Barringtonia acutangula	0.84	0.28	7.87	0.22	1.34
Streblus asper	1.26	0.28	3.34	0.09	1.63

Pedological characteristics. Soil factors include all the physical, chemical and biological properties of the soil. The nature of the soil profile, soil pH and the nutrient cycle between the soil and the trees are some of the important dimensions in determining the site quality. The pH of the soil ranged from 2.11 to 6.93 for all the studied sites clearly indicating that the soil is acidic in nature and there is significant level of variation in the pH values of different soil samples (Table 6). The conductivity value of pedons of five studied beat ranged between 0.025 to 0.140 µ mho cm^{-1}. The minimum and maximum organic carbon percentage were 2.740 and 1.410 respectively. The soil of Basudha and Gopalpur is highly enriched with organic carbon in comparison to the other studied sites. Higher level of conductivity of soil reflected in case of Basudha and Shibpur. The pH value varied significantly among the five studied beats.

On the basis of soil characteristics, CA (Cluster Analysis) allowed classification of the five forest beats under three central classes, as shown in Figure 1. While Gopalpur and Basudha were are same class and differed from Molandighi and Arrah. Shibpur was grouped under class number three.

Figure 2 depicts the CCor (Canonical Correlation Analysis) derived ordination biplot based on Phytosociolgical (Y1) and Soil (Y2) charecteristcs data. The first and second canonical axes together explained 66.67% of variations in the Phyto-environmental relation. It was revealed that pH and Conductivity have strong relationship with the Dominace of plant species studied in the study site. Whereas Relarive dominance, Relative density and IVI values are prone to depend on Organic carbon of soil.

Table 6. Variation of soil quality in Arrah, Basudha, Gopalpur, Molandighi and Shibpur beats of Durgapur Forest Range, West Bengal, India.

Statistic	Organic Carbon	pH	Conductivity (µ mho cm^{-1})
Minimum	1.410	2.110	0.025
Maximum	2.740	6.930	0.140
Mean	1.946	5.414	0.084
Standard deviation (n-1)	0.422	1.173	0.034

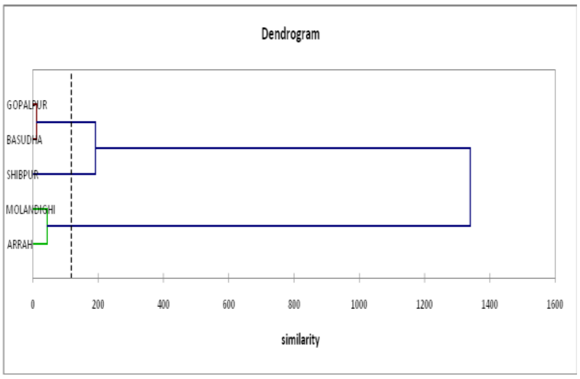

Figure 1. Dendrogram derived from AHC analysis using phytosociological and soil characteristics data for similarity analysis among Arrah, Basudha, Gopalpur, Molandighi and Shibpur beats of Durgapur Forest Range, West Bengal, India.

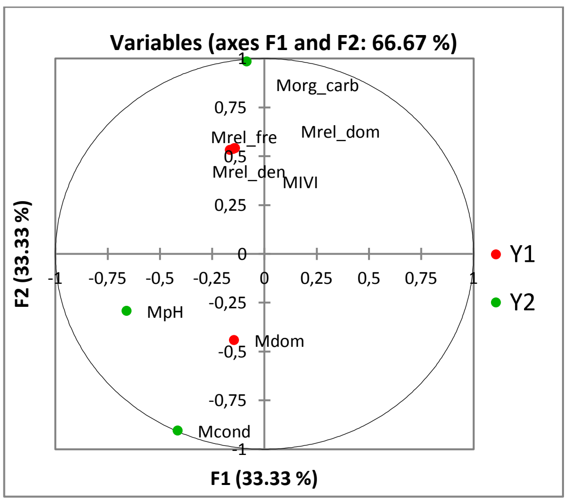

Figure 2. Biplot derived from CCor (Canonical Correlation Analysis) analysis using phytosociological and soil characteristics data for relating the Arrah, Basudha, Gopalpur, Molandighi and Shibpur beats of Durgapur Forest Range, West Bengal, India.

DISCUSSION

In order to assess ecological knowledge of the native flora in Durgapur Forest Division in particular, a quantitative phytosociological study in different was carried out. Importance value index (IVI) 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 trees for fuel and for fodder, overgrazing, removal of economically important trees, defective forest management 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 five studied sites was considerably different. Vegetation analysis gives the information necessary to determine the name of community and provide data that can be used to compare it with other communities. Four to five plant communities: *Shorea robusta*, *Madhuca longifolia,* 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. *Dalbergia sissoo, Cassia fistula, Alangium salvifolium* in Arrah beat; *Azadirachta indica in Basudha beat*, *Pterocarpus marsupium, Bauhinia purpurea, Semecarpus anacardium, T. tomentosa, Haldina cordifolia, Garuga pinnata, Holoptelea integrifolia, Grewia asiatica, Croton roxborghii in Gopalpur beat, Pterocarpus marsupium, Lannea coromandelica, Emblica officinalis, Gmelina arborea, Croton roxburghii in Molandighi beat, Grewia asiatica, Strychnos potatorum, Mallotus phillippinensis, A. heterophyllus, Trema orientalis* in Shibpur beat. The communities in the study area were heterogeneous.

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. The ecology of different plant communities from different sites of Durgapur Forest Division showed variation in nature, structure, composition of vegetation and soil characteristics. Most of the species were dry deciduous in nature. The majority of individuals of plant population were seen in danger. Various types of activities have modified the plant cover over wide areas. There is a need to develop plant-protected areas. Scientific information relating to the composition of vegetation can be helpful for proper rehabilitation of the affected area because this forms the basic element for the conservation of important and endangered flora and fauna of any region. 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. 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 five studied sites of Durgapur Forest Division 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, preempts that fraction. The second species then preempts a similar fraction of the remaining resource and so on with further colonists.

Soil pH gives some measure of general level of fertility (Wilde 1954). Grubb (1963) noted low pH (4.2) with poor exchangeable potassium in Montane Forest soil. Acidic nature of different studied sites of Durgapur Forest Division may be attributed towards the acidifying effect of intense decomposition products of organic residues accumulated on the forest floor since remote past. Higher level of conductivity of different beat maybe attributed towards higher decomposition rate of leaf litter along with higher mineralization rate of the pedons of respective study sites.

The present study indicate significantly higher organic-C in Basudha and Gopalpur beats than remaining sites, and it may result due to towards low vegetation demand for the nutrients and increase in supply due to microbial cell death (Jaramillo and

Sanford 1985). The differential responses of the different pedons of the forest areas under study to different parameters are possibly an outcome of their unique abiotic composition, the interactions between biotic and abiotic components and between themselves and the prevailing climatic condition. This information can be used in future for laying out schemes optimization of forest ecosystems. The high organic carbon content in basudha beat and higher conductivity value of Basudha and Shibpur reflects higher fertility of the soil of these two beats in comparison to other studied sites. Our data was further supported by higher occurrences of plant species in these two beats.

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 trees for fuel and for fodder, overgrazing, removal of economically important trees, defective forest management and some other biotic interferences affecting the nature, structure and composition of plant communities. Periodical ecological survey, knowledge of vegetation and their relationship with soil characteristic can be helpful for future development project Plant ecological surveys of all the disturbed and threatened areas on permanent basis are required to know their current biodiversity situation and future continuity status. The impact of anthropogenic alteration of habitats in Senchal forest has to be taken into account. The policymakers should focus their conservation efforts in the fragile ecosystem. 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.

The association of the study sites based on soil characteristics may be attributed to geographical and environmental similarities of the five beats. Earlier studies on soil pedological properties from this zone revealed similar pattern (Gupta et al. 1982, Banerjee et al. 1985, Chanda and Palit 2009). Ecological process, floral assemblage or light period, humidity and temperature prevailing in this eco-region may also attribute to form the soil quality of varying gradient (Nath 1983, Rannie 1986, Chakraborty et al. 2002). More over spatial distribution along with plant-soil interaction of this study sites i.e the forest beats are the key factors determining the prevailing soil physic chemical profile (Host 1992, Hooper 1997).

Organic carbon is a key influential factor determining the major phyto-sociological parameters studied in the five forest beats which was also recorded earlier in other studies. In contrast our study finds more relationship pattern which may be new from this eco-region. Dominance of plant species have strong relationship with pH and Conductivity. This may be attributed the strong interdependence of Plant species with this two parameters. Further studies on difference of plant species association depending on the soil edaphic features thus can be more effective and demanding for ecological research from this part of Bengal.

CONCLUSION

From the results of the present investigation it can be concluded that Basudha and Shibpur beats of Durgapur forest division needs prior conservation to sustain its diverse flora. The results also further conclude that higher level of soil fertility promotes higher species diversity and richness for an area. Therefore pedological features of a particular habitat should be an important criteria for its species distribution.

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