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Inventory of Plant Species, Phytosociology, Species Diversity and Pedological characteristics of Rambhi Beat, Senchal East Zone Forest Range, Darjeeling, West Bengal, India

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Abstract

The present study is an attempt to give an account of the inventory of plant species, phytosociological characteristics of vegetation and pedological characteristics of Rambi Beat Forest under Senchal East Forest Zone, Darjeeling, West Bengal, India. Its plant community were analyzed quantitatively and synthetically. The results reflect dominancy of dicotyledons over monocotyledons in the four studied sites The plant community comprising of 50 plant species belonging to 40 genera of 27 families. Ramhi beat reflected higher diversity of species. Maximum IVI value was recorded by *Viola surpense* (47.17) in Rambhi forest beat. The Berger parker index and evenness index were found to be highest for *Viola surpense*, *Fragaria nubicola*, *Pilea umbrosa* in Rambhi beat. The soil characteristics of the different pedons revealed alkaline nature of soil in Rambhi beat. Higher levels of soil organic carbon content reflect higher fertility of the soil of Rambhi beat. The response towards soil available nitrogen and phosphate were different among the ten pedons of Rambhi beat. Therefore, proper management and conservative measures needs to be implemented for conservation of bioresources in Senchel wildlife Sanctuary of West Bengal, India.

Key Words: plant diversity, IVI, organic carbon

Introduction

Darjeeling Sikkim Himalayas is a part of the Himalayas Biodiversity Hotspot. The hill town of Darjeeling and adjoining areas host a variety of habitats including subtropical to montane forests as well as temporary shrub land. The dynamic nature of the soil along with the climatic conditions regulates the diversity of vegetations that in turn accounts for the biological diversity. Darjeeling hill appear as the matrix encompassing some features of boreal and temperate flora of the eastern and western hemispheres together with certain unique features of Asia and her own.

The patterns and role of species richness in ecosystem function are important in terms of land-use and climate change concerns (Chapin et al. 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

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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), canopy coverage, i.e., light availability (Kull and Zobel 1991) etc. 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. However, diversity of trees in the Darjeeling foot hill region of Eastern Himalaya was recently studied by (Rai and Das 2008; Chanda and Palit 2009). Studies on soils in the Himalayan region are rather scanty (Dhir 1967; Pal et al. 1984). Available studies on the physical and chemical characteristics and nutrient status of soils under different vegetation in different altitudes of the eastern and north-eastern Himalayas is mainly with reference to Darjeeling Himalayan region (Nath et al. 1983; Banerjee et al. 1985; Das et al. 1986; Chandran et al. 1987). A noteworthy contribution in the field of phytosociology was received from Das and Lahiri (1997) which dealt with the ground covering flora in different types of vegetation in Tiger Hill, Darjeeling District. The main objective of this present investigation was i) to prepare a checklist of different plant species of Rambi Beat Forest, Darjeeling that contribute towards taxonomy of forests of Darjeeling-Sikkim Himalayas and ii) assessment of pedological characteristics that can be used as a measurement tools of the ecosystem health of Rambi Beat Forest, Darjeeling.

Materials and Methods

Study area

Darjeeling Himalaya forms a part of the Eastern Himalayan Ranges and is bounded by Sikkim, Nepal and Bhutan on the north, west and east respectively. The study sites are located in the district of Darjeeling. Rambi Beat is under the jurisdiction of Senchal Wildlife Sanctuary, Darjeeling, West Bengal. It lies between 26°N and 27°N and 88°E and 88°20´E longitude. The forest has the status of reserve forests and under the supervision of The Forest Department, Government of West Bengal.

Inventory of plant species

A rapid survey of the concerned study sites were done and the plant species were identified through preparation of herbarium specimens following Rai et al. (2000) and identified at Dept. of Botany, The University of Burdwan.

Quadrat and phytosociological studies

A total of 4 sites representing various categories of natural forests and plantations were selected for vegetation sampling. At each site 20 quadrats (1x1 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 ($H'=\sum pi \ln pi$; 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) and Shannon and Weaver (1949) respectively. 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. Next, each species were given a number. We then grouped the species in abundance classes of $\log_{10}$.

Soil sampling and analysis

Soil samples were collected from upper surface layers (top 15 cm).The samples were properly packed, air-dried,

Table 1. Inventory of plant species of Rambhi Forest Beat

Sl. No.	Plant Species	Family	Habit (Herb/Shrub/Tree)
1	*Nasturtium montanum*	Brassicaceae	Herb
2	*Stellaria skkimensis*	Caryophyllaceae	Herb
3	*Stellaria media*	Caryophyllaceae	Herb
4	*Cardamine hirsuta*	Brassicaceae	Herb
5	*Viola betonicifolia*	Violaceae	Herb
6	*Viola serpens*	Violaceae	Herb
7	*Fragaria nubicola*	Rosaceae	Herb
8	*Geranium nepalense*	Geraneaceae	Herb
9	*Dichroa febrifuga*	Hydrangiaceae	Herb
10	*Rubus ellipticus*	Rosaceae	Herb
11	*Gallium mollugo*	Rubiaceae	Herb
12	*Rubia manjith*	Rubiaceae	Herb
13	*Rubia cordifolia*	Rubiaceae	Herb
14	*Gnaphalium luetoalbum*	Asteraceae	Herb
15	*Ageratum conyzoides*	Asteraceae	Herb
16	*Artemisia vulgaris*	Asteraceae	Herb
17	*Senecio scandens*	Asteraceae	Herb
18	*Senecio diversifolius*	Asteraceae	Herb
19	*Vitex negundo*	Vitaceae	Herb
20	*Eupatorium adenophrum*	Asteraceae	Herb
21	*Hemipharagma heterophylla*	Scorpulariaceae	Herb
22	*Leucoseptum cannum*	lamiaceae	Herb
23	*Calamintha wallichiana*	Lamiaceae	Herb
24	*Polygonum runcinatum*	Polygonaceae	Herb
25	*Polygonum capitatum*	Polygonaceae	Herb
26	*Cinomonum imperssinervium*	Laurineae	Herb
27	*Pilea umbrosa*	Urticaceae	Herb
28	*Pilea microflora*	Urticaceae	Herb
29	*Urtica dioica*	Urticaceae	Herb
30	*Trifolium repens*	Fabaceae	Herb
31	*Viola placiola*	Violoaceae	Herb
32	*Hydrocotyle asiatica*	Apiaceae	Herb
33	*Hydrocotyle nepalense*	Apiaceae	Herb
34	*Primula malacoides*	Primulaceae	Herb
35	*Acer campbali*	Aceraceae	Herb
36	*Berberis insignis*	Berbaridaceae	Herb
37	*Hypericum hookerianum*	Hypericaceae	Herb
38	*Parachetus communis*	Leguminosae	Herb
39	*Asperagus racemosus*	Asperagaceae	Herb
40	*Commelina sikkimensis*	Commelinaceae	Herb
41	*Commelina benghalensis*	Commelinaceae	Herb
42	*Plantago major*	Plantagenaceae	Herb
43	*Pouzolzia hirta*	Articaceae	Herb
44	*Ophiorrhiza nutans*	Rubiaceae	Herb
45	*Linaria cordata*	Scrophulariaceae	Herb
46	*Paris polyphylla*	Liliaceae	Herb
47	*Cynodon dactylon*	Poaceae	Herb
48	*Poa annua*	Poaceae	Herb
49	*Calceolaria mexicana*	Scrophulariaceae	Herb
50	*Oxalis corniculata*	Oxaladaceae	Herb

cleaned, crushed and then strained through 2 mm mesh sieves and analyzed. The soil pH were 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 were determined by using sodium bicarbonate extracts (Olsen et al. 1954).

Statistical analysis

The statistical analysis like single linkage Euclidian distance of different variables and principal component analysis were done by using STATISTICA 5.0 and PAST software respectively.

Results

The present work is the outcome of careful study of the plants of Senchal East Zone Forest Range, Darjeeling. The study site deserves special mention for its floristic composition. Since, the presence of all life forms of plants is one of the characteristic features of forest and may form the bulk of the forest flora and have immense functional values, the present work keeps confined into taxonomic account of them. The community was composed of as many as 50 species of 40 genera from 27 families. In the forest the ground vegetation was very thick and the forest floor was moist in nature. The data in table 1 represents the different genera along with their families of Rambhi beat. The results reflect maximum representatives belonging to families Asteraceae (5) and Rubiaceae (4). The least representatives belonging to families Geraneaceae, Oxaladaceae, Liliaceae, Articaceae and Hydrangiaceae, each containing single representatives.

The predominant forest types in Rambhi beat of Senchal Wildlife sanctuary are subalpine evergreen 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).

Table 2. A general synoptic account of forest flora of four selected sites of Senchal Wildlife Sanctuary, Darjeeling, West Bengal, India

	Rambhi			
	D	%	M	%
Families	24	86.52	3	14.32
Genera	35	85.5	5	14.5
Species	44	85	6	14

D=Dicotyledones; M=Monocotyledons.

Taxonomic survey of the ground cover flora reflects the dominance of dicotyledonous plants over monocots (Table 2).

A summary of phytosociological data is summarized in Table 3. The plant community represents 50 species belonging to 40 genera from 27 families in Rambhi beat. *Viola surpense* was found to be the most frequent, dominant and important species among the plant community of Rambhi beat. The decreasing trend of IVI value was in the order of *Hydrocotyle nepalensis*, *Calamintha wallichiana*, *Fragaria nubicola*, *Hydrocotyle japonica*, *Hydrocotyle asiatica*, *Stellaria media*. The highest IVI score of *Viola surpense* deserves special mention for its luxuriant occurrence in the study area. The lowest IVI scores were in the following order of *Calceolaria mexicana*, *Senecio diversifolius*, *Paris polyphylla, Rubia cordifolia*, *Cinnamonum imperssineryium*.

Diversity is the index of the ratio between the number of species and the important value of an individual. Shanon index value is highest in *Viola surpense* followed by *Calamintha wallichiana* and *Fragaria nubicola* and being lowest in *Cinnomonum imperssineryium*, *Rubia cordifolia* and *Berberis insignis* etc. (Table 4). *Viola surpense* is the most dominant species of the study area. 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 maximum in case of *Viola surpense followed* by *Hydrocotyle nepalense*, and *Fragaria nubicola*. The minimum

Table 3. Phyto-sociological attributes of different species of Rambhi beat of Senchal Wildlife sanctuary

Plant Name	D	A	F	FC	A:F	RF	RD	RA	IVI
Nasturtium montanum	0.36	2.50	11.40	A	0.13	1.48	0.46	0.78	2.65
Stellaria sikkimensis	2.40	14.28	10.35	A	1.20	1.54	3.70	6.45	11.62
Stellaria media	1.53	8.79	10.30	A	0.70	1.35	2.26	4.10	7.85
Cardamine hirsuta	0.60	7.50	11.00	A	0.60	1.10	1.25	2.65	4.85
Viola betonicifolia	0.31	2.50	14.46	A	0.15	1.61	0.44	0.78	3.10
Viola surpense	16.45	20.85	66.46	D	0.30	9.48	30.15	8.90	47.27
Fragaria nubicola	3.23	11.3	15.00	A	3.25	1.10	5.28	11.45	11.96
Geranium nepalense	2.45	4.38	51.32	C	0.06	5.75	3.60	1.65	11.26
Dichroa febrifuga	0.10	5.50	2.30	B	1.3	0.32	0.28	1.80	2.44
Rubus ellipticus	0.26	2.9	14.64	A	0.17	1.61	0.66	1.14	3.65
Gallium mollugo	1.60	6.54	28.82	B	0.15	3.32	2.25	2.26	8.42
Rubia manjith	0.63	2.54	32.50	B	0.10	3.35	1.25	0.95	5.31
Rubia cordifolia	0.02	1.50	1.43	A	0.35	0.26	0.08	0.36	0.76
Gnaphalium luetoalbum	1.10	8.57	14.30	A	0.65	1.55	2.25	3.62	7.24
Ageratum conyzoides	0.25	2.50	8.68	A	0.38	0.70	0.30	1.15	2.12
Artemisia vulgaris	0.34	1.85	12.42	A	0.25	1.85	0.49	1.10	3.41
Senecio scandens	0.03	1.50	1.30	A	0.35	0.39	0.25	0.35	2.16
Senecio diversifolius	0.18	4.35	5.60	A	0.65	0.68	0.10	1.45	1.61
Vitex negundo	0.25	1.55	10.23	A	0.15	1.48	0.61	0.61	3.33
Eupatorium adenophrum	0.41	2.45	41.50	B	0.10	4.42	2.30	1.25	7.60
Hemiphragma heterophylla	1.31	3.74	11.43	A	0.22	1.40	0.35	1.28	2.28
Leucoseptum cannum	0.66	1.62	25.53	B	0.14	2.57	0.90	0.70	4.26
Calamintha wallichiana	3.18	8.7	31.43	B	0.28	3.58	5.35	3.65	12.48
Polygonum runcinatum	1.25	2.60	42.56	C	0.04	5.10	1.88	0.94	8.12
Polygonum capitatum	1.14	3.6	31.16	B	0.15	3.60	2.10	1.45	7.22
Cinnamonum imperssineryium	0.02	1.50	1.58	A	0.32	0.32	0.06	0.38	0.71
Pilea umbrosa	0.50	5.00	12.00	A	0.3	1.10	0.72	1.80	3.70
Pilea microflora	0.30	9.00	1.30	A	1.7	0.26	0.59	3.36	4.25
Urtica dioica	0.96	7.25	12.45	A	0.55	1.65	1.48	2.72	5.71
Trifolium repens	0.23	1.40	15.64	A	0.10	1.71	0.28	0.50	2.75
Viola ploaciola	2.30	5.75	42.50	B	0.18	4.26	3.65	2.24	10.5
Hydrocotyle asiatica	1.70	4.25	41.63	B	0.15	4.26	2.71	1.56	8.65
Hydrocotyle nepalense	4.23	11.54	32.56	B	0.35	4.15	7.10	4.21	15.22
Primula malacoides	1.20	12.00	13.25	A	1.1	1.10	1.88	4.42	7.56
Acer campbeli	0.40	3.00	10.32	A	0.25	1.48	0.68	1.15	3.26
Berberis insignis	0.06	1.00	5.76	A	0.25	0.74	0.95	0.32	2.10
Hypericum hookerianum	0.16	1.25	10.31	A	0.10	1.55	0.16	0.49	2.27
Parachetus communis	0.13	5	11.43	A	0.28	1.65	1.10	1.76	4.20
Asperagus racemosus	0.20	1.33	12.25	A	0.15	1.10	0.26	0.59	1.89
Commelina sikkimensis	0.23	1.75	14.33	A	0.12	1.55	0.48	0.55	2.58
Commelina benghalensis	0.13	1.33	14.00	A	0.15	1.10	0.41	0.45	1.76
Plantago major	1.00	3.33	31.62	B	0.15	3.22	1.60	1.26	6.26
Pouzolzia hirta	0.20	3.00	5.70	A	0.46	0.74	0.31	1.15	2.26
Ophiorrhiza nutans	0.66	4.00	14.86	A	0.28	1.85	1.10	1.42	4.41
Linaria cordata	0.16	5.00	2.33	A	1.55	0.32	0.36	1.76	2.58
Paris polyphylla	0.13	1.33	12.25	A	0.12	1.10	0.25	0.46	1.76
Cynodon dactylon	1.13	6.80	14.26	A	0.45	1.71	1.82	2.51	6.25
Poa annua	0.16	1.25	11.53	A	0.10	1.55	0.25	0.44	2.16
Calceolaria mexicana	0.16	2.50	7.76	A	0.40	0.70	0.25	0.92	1.95
Oxalis corniculata	1.53	6.57	20.31	B	0.30	2.58	2.51	0.95	6.25

D=Density, A=Abundance, F=Frequency, FC=Frequency Class, RF=Relative Frequency, RD=Relative Density, RA=Relative Abundance, IVI=Important Value Index.

Table 4. Diversity Indices of different species of Rambhi beat of Senchal Wildlife sanctuary

Sl. No.	Name of the Plants	Shanon Index	Barger Parker	Evenness
1.	*Nasturtium montanum*	-0.024	0.005	7.32
2.	*Stellaria sikkimensis*	-0.124	0.039	41
3.	*Stellaria media*	-0.085	0.026	26.14
4.	*Cardamine hirsuta*	-0.048	0.015	18.33
5.	*Viola betonicifolia*	-0.024	0.004	6.66
6.	*Viola surpense*	-0.364	0.290	125
7.	*Fragaria nubicola*	-0.154	0.055	55
8.	*Geranium nepalense*	-0.125	0.038	45
9.	*Dichroa febrifuga*	-0.020	0.0028	3
10	*Rubus ellipticus*	-0.034	0.009	15
11	*Galium mollugo*	-0.102	0.031	30.32
12	*Rubia manjith*	-0.055	0.018	15.46
13	*Rubia cordifolia*	-0.002	0.0003	5
14	*Gnaphalium luetoalbum*	-0.061	0.025	22
15.	*Ageratum conyzoides*	-0.015	0.001	3.23
16.	*Artemisia vulgaris*	-0.025	0.004	15
17.	*Senecio scandens*	-0.015	0.004	2
18.	*Senecio diversifolius*	-0.003	0.002	4
19.	*Vitex negundo*	-0.040	0.0055	10.60
20.	*Eupatorium adenophrum*	-0.025	0.021	22.46
21.	*Hemiphragma heterophylla*	-0.024	0.0048	9
22.	*Leucoseptum cannum*	-0.045	0.0083	12
23.	*Calamintha wallichiana*	-0.150	0.063	50.64
24.	*Polygonum runcinatum*	-0.085	0.021	20
25.	*Polygonum capitatum*	-0.088	0.022	25
26.	*Cinnamonum imperssineryium*	-0.001	0.0004	2
27.	*Pilea umbrosa*	-0.018	0.006	10.56
28.	*Pilea microflora*	-0.016	0.0051	8.56
29.	*Urtica dioica*	-0.072	0.014	10.66
30.	*Trifolium repens*	-0.041	0.0028	12
31.	*Viola ploaciola*	-0.140	0.057	20
32.	*Hydrocotyle asiatica*	-0.150	0.017	30.13
33.	*Hydrocotyle nepalensis*	-0.160	0.059	65
34.	*Primula malacoides*	-0.050	0.021	20.34
35.	*Acer campbeli*	-0.025	0.0056	15
36.	*Berberis insignis*	-0.005	0.0015	1.53
37.	*Hypericum hookerianum*	-0.018	0.0017	7
38.	*Parachetus communis*	-0.042	0.015	14.53
39.	*Asperagus racemosus*	-0.015	0.0021	2.38
40.	*Commelina sikkimensis*	-0.024	0.005	6.38
41.	*Commelina benghalensis*	-0.015	0.001	6
42.	*Plantago major*	-0.060	0.014	25
43.	*Pouzolzia hirta*	-0.015	0.002	4.69
44.	*Ophiorrhiza nutans*	-0.059	0.015	14.53
45.	*Linaria cordata*	-0.014	0.002	4.66
46.	*Paris polyphylla*	-0.015	0.0021	2.33
47.	*Cynodon dactylon*	-0.062	0.016	28
48.	*Poa annua*	-0.015	0.004	4.66
49.	*Calceolaria mexicana*	-0.019	0.001	4.66
50.	*Oxalis corniculata*	-0.082	0.024	28.86

value was observed in *Cinomonum imperssineryium*, *Rubia cordifolia* and *Berberis insignis* etc.

Rank diagrams give amore a complete description of a community could be obtained by plotting the proportional abundance of every species against its rank of abundance. It was evident (Fig. 1) that single species with few individuals was in the highest abundance class of 2.1-2.5 and 2.6-3.0 respectively, a twelve species were in abundance class of 1.1-1.5 but most with an intermediate number and sixteen species were found to occur in the lowest abundance class of 0.6-1.0.

The obtained frequency of 50 plant species has been compared with that of Raunkier's normal frequency distribution curve (Fig. 2) and it was evident that the frequency class-A was greater than that of other frequency classes. One of the significant observations was that the frequency class-E has no representation in the present study. This indicates that the species with low frequency value are higher in number than the species with higher frequency value in most natural communities.

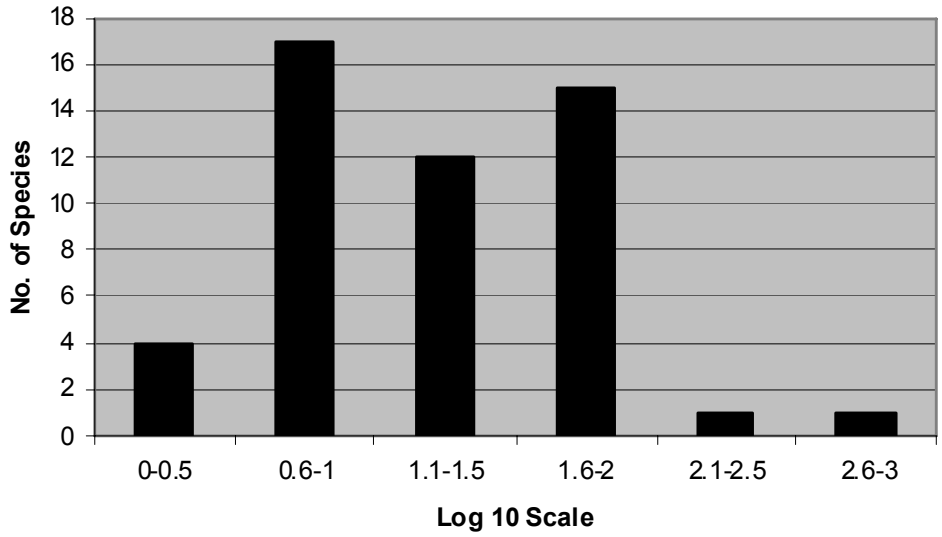

Fig. 1. Log-rank abundance of plant species of Rambhi Forest.

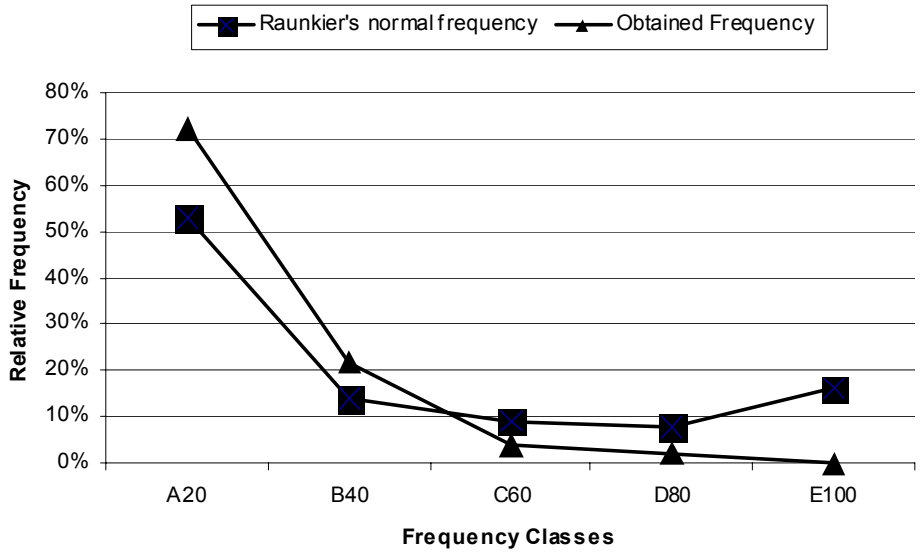

Fig. 2. Comparison between Raunkier's normal frequency distribution (Out of 800 species) and frequency distribution (Out of 50 species).

Table 5. Physico-chemical characteristics of ten different pedons of Rambhi Beat

Pedon	pH	Specific Conductance (umhos/cm)	Phosphorus (g/kg)	Nitrate Nitrogen (g/kg)	Organic C (%)	C/N
PEDON I	7.03	232.05	2.82	0.11	2.28	20.7
PEDON II	7.42	136.5	1.8	0.12	2.04	17
PEDON III	8.24	156.25	1.72	0.11	2.28	20.7
PEDON IV	7.15	241.5	2.31	0.1	2.51	25.1
PEDON V	7.33	96.6	2.38	0.12	2.37	19.75
PEDON VI	6.76	181.65	2.01	0.08	2.03	25.37
PEDON VII	7.23	180.6	1.97	0.24	2.85	11.87
PEDON VIII	6.74	120.75	1.88	0.11	2.37	21.54
PEDON IX	7.07	225.75	1.36	0.06	2.51	41.83
PEDON X	6.67	284.55	1.42	0.1	2.28	22.8

Table 6. Extraction Method: Principal Component Analysis (Component Matrix of soil parameters)

	1	2	3
pH	7.831E-02	0.770	0.433
Specific conductance	-0.412	0.531	-4.495E-02
Phosphorus	0.468	-0.133	0.807
Nitrogen	0.923	0.152	-0.317
Organic C	0.481	0.786	-0.214
C/N	-0.861	0.347	3.999E-02

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 7.03 to 8.24 for Rambhi beat clearly indicating that the soil is alkaline in nature and there is not much variation in the pH values of different soil samples (Table 6). The soil analyzed for percentage organic carbon revealed higher level of organic carbon (%) in Rambhi beat. Soil conductivity value (96.6-284.55 umhos/cm) reflected much wider variation among the ten different pedons of Rambhi beat. Pedon-V reflecting the lowest conductivity value and pedon-X reflecting the highest value. Available Phosphorous content varied significantly from 1.36 g/kg to 2.82 g/kg.The nitrate nitrogen content varied between 0.06-0.24 g/kg among the ten different pedons of Rambhi beat. (Table 5) Higher level of C: N ratio values were obtained for pedon VI, IX and pedon X.

The Principal Component Analysis (PCA) with varimax rotation and Kaiser Normalization were made for data reduction to focus the most important components to influence the physicochemical features of the study sites. Table 6 depicts the factor loadings (FL) in different components and three components for the study site. Highest factor loadings for 1st, 2nd and 3rd components were considered and these were for nitrogen (FL=0.923) in the 1st component, organic carbon (FL=0.786) in the 2nd component and phosphorus (FL=0.807) in the 3rd. The highest factor among all the soil parameters were recorded as FL=0.923 for nitrogen, this reveals that soil nitrogen is an important component to determine the plant species diversity in the forested area.

The differential responses of soil parameters and plant species diversity in the study area are possibly an outcome of the interactions between biotic and abiotic components. This information can be used in further for ecological optimization of biotic and abiotic interaction in the framework of the concern forest.

Discussion

A quantitative phytosociological study in Rambhi beat were carried out which reflected evergreen nature of the vegetation. This evergreen vegetation is under severe threat of loss due to the extensive cutting of tress 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. 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: *Viola surpense*, *Fragaria nubicola*, *Viola betonicifolia* and *Pilea umbrosa* were observed as a leading dominant. The communities with strong single species dominance has been attributed to grazing, species competition, seed predation, disease, stability and niche diversification (Whittaker and Levin 1977; Harper 1977). 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.

A common biological explanation for the pattern of rank distribution of species during present investigation was that the 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.

The idea of displacement of one species through competition with other is net prime importance. The ecology of different plant communities from Rambhi beat of Senchel wildlife sanctuary showed variation in nature, structure, composition of vegetation and soil characteristics. Most of the species were evergreen 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 (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 Rambhi beat of Senchel wildlife sanctuary 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). Higher level of conductivity of different pedons of Rambhi beat maybe attributed towards higher decomposition rate of leaf litter along with higher mineralization rate of the pedons of respective study sites. Higher level of organic carbon in ten different pedons of Rambhi beat reflects the fertile nature of the forest floor which may be due to rapid addition of organic matter through proper leaf litter decomposition. The variable rate of soil phos phate content among the ten different pedons might be attributed towards differential release of inorganic and organic phosphorous by organic acids through the action of lower molecular weight organic anions such as oxalate which can replace phosphorous sorbed at metal hydroxide surfaces through ligand exchange reactions and dissolved metal oxide surfaces that sorb phosphorous (Fox et al. 1990) under higher decomposition rate of litter of different species. Higher level of C:N ratio value of pedon VI, IX and X may be attributed towards optimum supply due to microbial cell death (Jaramillo and Sanford 1985) and indicates the fertile nature of the soil.

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 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, 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 Ranbhi 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 community is heterogeneous, so it has the potentiality to receive high degree of diversity if prevailing environmental conditions are most advantageous. But at present it stands in a disturbed state. Various stress factors like extensive cutting of tress for fuel and fodder and other plants, overgrazing, removal of economically important trees, defective forest management and other biotic interferences, declining the trend of species density. This added precision allows policymakers to more accurately focus their conservation efforts in that fragile ecosystem. Since species diversity is important to maintain heterogeneity and functional redundancy of a stable ecosystem, the diversity is to preserve through adequate measures. Since this forest is likely to have generous impact on socio-economics of local stakeholders, its ecorestoration and protection is of utmost importance.

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