Environment Conservation Journal 13(3) 141-145, 2012
ISSN 0972-3099 (Print) 2278-5124 (Online)
Abstracted and Indexed

Phytosociology and species diversity in the catchment of Ratle hydro-electric project, District Kishtwar –J&K (India)

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Received: 10.4.2012 **Accepted: 12.07.2012**

Abstract

This study deals with the phytosociology and plant diversity in the 10 km radius influence zone of Ratle hydro-electric catchment area in district Kishtwar (J&K). Quadrats of varying sizes were laid to record the parameters like frequency, density, abundance and IVI for trees, shrubs and herbs. The data obtained was further computed to analyse the species diversity using Shannon- Wiener's index. The results revealed the dominance of *Quercus baloot, Vitex negundo and Viola pilosa* for trees, shrubs and herbs, respectively. The computation of diversity index showed that species richness and evenness remained relatively lower for trees and shrubby flora whereas relatively higher in case of herbaceous vegetation.

Keywords*: IVI, Phytosociology, Ratle H.E. project, species diversity, species richness, species evenness*

Introduction

Phytosociology, the study of aspects of communal relations of plant, is important for understanding the functioning of community. The study of plant community implies knowledge of structure and composition of the component species. Phytosociological investigations cover all life forms and involve measurement of analytic characters like frequency, density, basal area and Importance Value Index (IVI) as well as Diversity indices in order to compare different sites and identify richer locations. Differences in data of species distribution and richness collected reveals changes and shifts in population structure, the appearance and disappearance of species and changes in habitat factors. Species richness is a simple and easily interpretable indicator of biological diversity (Peet, 1974). Many types of environmental changes influence the processes that can both augment or erode diversity (Sagar *et al*., 2003). The catchment area of Ratle Hydro Electric Power Project, a run-of-river scheme proposed to be constructed in the district Kishtwar of J&K, is going to be exposed to various anthropogenic activities that might disturb the species structure and composition of the area. The area is mountainous and falls mostly between sub-tropical to temperate zone. The catchment area of Ratle Hydro Electric-Power Project, a run-of-theriver scheme proposed to be constructed in the district Kishtwar of J&K, is going to be exposed to various anthropogenic activities that might disturb the species structure and composition of the area. The area is mountainous and falls mostly between sub-tropical to temperate zone. Though, several workers (Kumar, 1987; Kumar, 1997; Kour 2001; Singh, 2002; Kesar, 2002; Sharma, 2003; Jhangir, 2004; Dutt, 2005; Rai, 2007 and Sharma, 2009) have studied the phytosociology and species diversity of different nearby areas yet the work on this aspect in the present area of district Kishtwar has not been done so far. Therefore, the present work has been carried out to document the species diversity and dominance in the catchment of Ratle H. E. Power Project.

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Material and Methods

The study area is spread over 314 sq km which includes 10 kms radius influence zone with its centre point at proposed dam site (Latitude 32°06' N to 34°12.5'N and longitude 75°23'E to 77°48'E) located at village Drabshalla. The area falls between 75^0 41' 49.43" E to 75^0 54' 38.62" E longitude and 33^0 05' 19.21" N to 33^0 16' 06.54" N latitude and exhibit altitudinal variation from 900 m asl to 3800 m asl. Regular visits from October

2007 to March 2010 during different seasons have been conducted for identification and enlisting of the floral diversity by using "Flowers of the Himalaya" (Polunin and Stainton, 1984) and "Flowers of the Himalaya- A Supplement" (Stainton, 1988) and also through consultation of the local herbaria of department of Botany, University of Jammu. Random sampling method was adopted for recording the phytosociological parameters and quadrats of 400 (10 X 10m), 200 (5 X 5m) and 100 (1 X 1m) were placed for trees, shrubs and herbs, respectively in the study area. Parameters like frequency, density, basal area has been recorded as per methods given by Misra (1969) to compute the secondary data in the form of relative frequency, relative density, relative dominance and IVI. Species Diversity was also computed by using Shannon- Wiener's index (1949).

Results and Discussion

The data recorded for the different phytosociological parameters have been computed and represented in Tables 1, 2 and 3. Similarly, data computed for Shannon- Wiener's index has been represented in Table 4. The perusal of tables 1, 2 and 3 reveals that among the arboreal elements, highest values for both relative frequency and relative density was exhibited by *Quercus baloot* with percent values of 7.27 and 13.82, respectively whereas highest value for relative dominance was exhibited by *Cedrus deodara* (8.34%).

Table 1: Phytosociological parameters of different tree species of the study area (quadrats=100)

S. No.	Trees Name	Basal area	Freq.	Density	Abundance	R.F.	R.D.	R. Dom.	I.V.I.
1.	***Quercus baloot***	312.5	76	6.57	8.64	7.27	13.82	6.08	27.17
2.	***Cedrus deodara***	428.5	67	5.9	8.81	6.41	12.41	8.34	27.16
3.	***Quercus semicarpifolia***	328.9	71	5.23	7.37	6.79	11.00	6.4	24.19
4.	***Pinus wallichiana***	189.1	48	5.32	11.08	4.59	11.19	3.68	19.46
5.	***Dalbergia sissoo***	306.4	41	3.2	7.80	3.92	6.73	5.96	16.61
6.	***Pinus roxburghii***	183.3	41	4.09	9.98	3.92	8.60	3.57	16.09
7.	***Robinia pseudoacacia***	168.5	39	3	7.69	3.73	6.31	3.28	13.32
8.	***Prunus domestica***	189.6	36	1.79	4.97	3.44	3.77	3.69	10.90
9.	***Ficus palmata***	308.5	38	0.37	0.97	3.63	0.78	6	10.41
10.	***Populus ciliata***	150.6	31	1.81	5.84	2.96	3.81	2.93	9.70
11.	***Olea ferruginea***	109.6	61	0.78	1.28	5.83	1.64	2.13	9.60
12.	***Alnus nitida***	197.6	38	0.68	1.79	3.63	1.43	3.85	8.91
13.	***Salix alba***	210.2	38	0.56	1.47	3.63	1.18	4.09	8.90
14.	***Ulmus wallichiana***	268.1	26	0.55	2.12	2.49	1.16	5.22	8.86
15.	***Prunus persica***	130.4	38	1.25	3.29	3.63	2.63	2.54	8.80
16.	***Juglans regia***	143.6	47	0.67	1.43	4.49	1.41	2.79	8.69
17.	***Pyrus pashia***	139.3	40	1.02	2.55	3.82	2.15	2.71	8.68
18.	***Zizyphus mauritiana***	150.2	34	0.89	2.62	3.25	1.87	2.92	8.04
19.	***Toona ciliata***	167.2	35	0.67	1.91	3.35	1.41	3.25	8.01
20.	***Celtis australis***	178.1	29	0.78	2.69	2.77	1.64	3.47	7.88
21.	***Melia azaderach***	168.4	29	0.6	2.07	2.77	1.26	3.28	7.31
22.	***Aesculus indica***	154.5	32	0.52	1.63	3.06	1.09	3.01	7.16
23.	***Lannea coromandelica***	180.4	25	0.45	1.80	2.39	0.95	3.51	6.85
24.	***Morus alba***	125.6	32	0.47	1.47	3.06	0.99	2.44	6.49
25.	***Grewia optiva***	120.3	35	0.17	0.49	3.35	0.36	2.34	6.04
26.	***Pistasia integerrima***	129.5	19	0.2	1.05	1.82	0.42	2.52	4.76

Table 2: Phytosociological parameters of different shrubs of the study area (quadrats=200)

S. No	Shrubs Name	Basal area	Freq.	Density	Abundance	R.F.	R.D.	R. Dom.	IVI
1.	***Vitex negundo***	13.4	92	3.5	3.8	13.86	25.93	8.3	45.53
2.	***Dodonaea viscosa***	15.5	88	2.03	2.31	13.25	15.04	9.6	35.45
3.	***Lantana camara***	6.4	76	2	2.63	11.45	14.81	3.97	28.12
4.	***Justicia adhatoda***	20.3	33	0.49	1.48	4.97	3.63	12.58	20.26
5.	***Berberis lycium***	10.6	35	0.9	2.57	5.27	6.67	6.57	17.53
6.	***Viburnum grandiflorum***	8.4	58	0.69	1.19	8.73	5.11	5.2	17.44
7.	***Indigofera heterantha***	11.4	38	0.57	1.5	5.72	4.22	7.06	15.95
8.	***Indigofera tinctoria***	10.2	31	0.43	1.39	4.67	3.19	6.32	13.31
9.	***Rubus hoffmeisterianus***	9.3	35	0.37	1.06	5.27	2.74	5.76	12.8
10	***Buddleja asiatica***	7.5	33	0.49	1.48	4.97	3.63	4.65	12.33
11	***Sarcococca saligna***	7.3	32	0.46	1.44	4.82	3.41	4.52	11.86
12	***Nerium indicum***	8.1	28	0.35	1.25	4.22	2.59	5.02	11.05
13	***Rosa brunonii***	10.7	20	0.25	1.25	3.01	1.85	6.63	10.94
14	***Desmodium gyrans***	8.4	25	0.33	1.32	3.77	2.44	5.2	10.72
15	***Desmodium elegans***	5.8	28	0.37	1.32	4.22	2.74	3.59	9.77
16	***Rhabdosia rugosus***	8.1	12	0.27	2.25	1.81	2	5.02	8.49

In case of shrubby elements, highest relative frequency (13.86%) and relative density (25.93%) has been exhibited by *Vitex negundo.* However, *Justicia adhatoda* has been observed to have the highest value of relative dominance (12.58%). The highest values of relative frequency and relative density for herbaceous flora have been represented by *Cynodon dactylon* with respective percent values of 5.64 and 4.53, whereas *Duchesnea indica* represented the highest relative dominance (12.58%).In case of IVI, *Quercus baloot* (27.17%) followed by *Cedrus deodara* (27.16%), *Quercus semicarpifolia* (24.19%), *Pinus wallichiana* (19.46%), *Dalbergia sissoo* (16.61%) and *Pinus roxburghii* (16.09%) have been found to be dominant among the arboreal elements. However, studies conducted in adjoinings revealed *Pinus roxburghii* to exhibit highest IVI in Trikuta hills (Kour, 2001), Jammu (Sharma, 2003), Kathua (Jhangir, 2004) and Mansar-Surinsar wildlife sanctuary (Rai, 2007) in sub-tropical forest areas whereas in case of temperate vegetation, the highest IVI values have been reported for species like *Quercus floribunda* in Kathua (Jhangir, 2004) and *Quercus dilatata* and *Quercus leucotrichophora* in Bhaderwah (Dutt, 2005). For shrubby elements, the highest IVI has been represented by *Vitex negundo* (45.53%) followed by *Dodonaea viscosa* (35.45%), *Lantana camara* (28.12%) and *Justicia adhatoda* (20.26%). Similar findings have also been presented by Kumar (1997), Kour (2001), Kesar (2002), Sharma (2003), Jhangir (2004), Rai (2007) and Sagar and Singh (2005). The herbaceous flora has indicated the highest IVI for *Viola pilosa* (18.32%) followed by *Verbascum thapsus* (16.47%), *Solanum nigrum* (13.55%), *Duchesnea indica* (13.26%) and *Geranium ocellatum* (12.32%).

Table 3: Phytosociological parameters of herbs of the study area (quadrats=400)

S.No	Herbs Name	Basal area	Freq.	Density	Abun-dance	R.F.	R.D.	R. Dom	I.V.I
1.	***Viola pilosa***	0.98	53	0.65	1.23	5.16	4.53	8.63	18.32
2.	***Verbascum thapsus***	1.109	36	0.46	1.28	3.5	3.21	9.76	16.47
3.	***Solanum nigrum***	1.025	31	0.37	1.19	3.02	2.58	9.02	14.62
4.	***Duchesnea indica***	1.13	17	0.28	1.65	1.65	1.95	9.95	13.55
5.	***Geranium ocellatum***	1.04	20	0.31	1.55	1.95	2.16	9.15	13.26
6.	***Datura stramonium***	1.001	16	0.28	1.75	1.56	1.95	8.81	12.32
7.	***Cynodon dactylon***	0.003	58	0.65	1.12	5.64	4.53	0.03	10.2
8.	***Ipomoea purpurea***	0.021	43	0.59	1.37	4.18	4.11	0.18	8.48
9.	***Artemisia cina***	0.041	38	0.6	1.58	3.7	4.18	0.36	8.24
10.	***Solanum surratense***	0.502	15	0.32	2.13	1.46	2.23	4.42	8.11
11.	***Bergenia ligulata***	0.061	38	0.47	1.24	3.7	3.28	0.54	7.51
12.	***Achillea millefolium***	0.032	35	0.46	1.31	3.4	3.21	0.28	6.89
13.	***Taraxacum officinale***	0.28	22	0.3	1.36	2.14	2.09	2.46	6.7
14.	***Arisaema jacquemontii***	0.1	31	0.39	1.26	3.02	2.72	0.88	6.62
15.	***Anagallis arvense***	0.095	30	0.39	1.3	2.92	2.72	0.84	6.47
16.	***Androsace rotundifolia***	0.121	25	0.4	1.6	2.43	2.79	1.07	6.29
17.	***Aquilegia pubiflora***	0.011	34	0.41	1.21	3.31	2.86	0.1	6.26
18.	***Tridax procumbens***	0.012	32	0.4	1.25	3.11	2.79	0.11	6.01
19.	***Cirsium arvense***	0.024	32	0.38	1.19	3.11	2.65	0.21	5.97
20.	***Aster pseudamellus***	0.023	30	0.39	1.3	2.92	2.72	0.2	5.84
21.	***Poa aunua***	0.006	31	0.38	1.23	3.02	2.65	0.05	5.72
22.	***Sonchus arvensis***	0.13	18	0.35	1.94	1.75	2.44	1.14	5.34
23.	***Bistorta amplexicaulis***	0.013	23	0.42	1.83	2.24	2.93	0.11	5.28
24.	***Euphorbia hirta***	0.069	20	0.28	1.4	1.95	1.95	0.61	4.51
25.	***Cannabis sativa***	0.078	19	0.24	1.26	1.85	1.67	0.69	4.21
26.	***Sassurea heteromalla***	0.045	17	0.26	1.53	1.65	1.81	0.4	3.86
27.	***Stellaria media***	0.17	13	0.15	1.15	1.26	1.05	1.5	3.81
28.	***Oenothera lamarckiana***	0.091	17	0.19	1.12	1.65	1.32	0.8	3.78
29.	***Euphorbia heliscopia***	0.052	17	0.22	1.29	1.65	1.53	0.46	3.65
30.	***Rumex hastatus***	0.025	14	0.26	1.86	1.36	1.81	0.22	3.4
31.	***Duchesnea indica***	0.065	13	0.21	1.62	1.26	1.46	0.57	3.3
32.	***Silene conoidea***	0.081	12	0.19	1.58	1.17	1.32	0.71	3.21
33.	***Galium elegans***	0.081	13	0.17	1.31	1.26	1.19	0.71	3.16
34.	***Valeriana wallichii***	0.036	12	0.21	1.75	1.17	1.46	0.32	2.95
35.	***Urtica dioica***	0.051	12	0.19	1.58	1.17	1.32	0.45	2.94
36.	***Galium asperifolium***	0.062	10	0.18	1.8	0.97	1.26	0.55	2.77
37.	***Micromeria biflora***	0.011	11	0.18	1.64	1.07	1.26	0.1	2.42
38.	***Ranunculus arvensis***	0.019	9	0.19	2.11	0.88	1.32	0.17	2.37
39.	***Plantago lanceolata***	0.011	10	0.11	1.1	0.97	0.77	0.1	1.84
40.	***Tagetus minuta***	0.076	5	0.09	1.8	0.49	0.63	0.67	1.78
41.	***Thymus serphyllum***	0.018	1	0.04	4	0.1	0.28	0.16	0.53

Table-4: Diversity index of vegetation in the study area

Type	Trees	Shrubs	Herbs
Shannon-Wiener's Index	2.78	2.38	3.61

Species diversity is an index that incorporates the number of species in an area and also their relative abundance. It has been calculated on the basis of total number of individuals of species and total number of species. Typically the value of the index ranges from 1.5 (low species richness and evenness) to 3.5 (high species evenness and richness), though values beyond these limits may also be encountered.The perusal of the Table-4 revealed that value of Shannon Wienner's index to be 2.78 for trees, 2.38 for shrubs and 3.61 for herbs. This interprets that species richness and evenness in the study area is high with respect to its tree and shrubby vegetation whereas it is sufficiently low in terms of herbaceous flora. Comparison of the diversity indices of the present study revealed that values of Shannon Wienner's index were higher than the values calculated by Rai (2009) for Mansar-Surinsar area (sub-tropical area) and lower than that calculated by Dutt (2005) for Bhaderwah region (temperate area) in Jammu province.

Conclusions

The phytosociology studies conducted in the study area revealed the predominance of tree species like *Quercus baloot, Q. semicarpifolia, Cedrus deodara, Pinus wallichiana, P. roxburghii* along with under storey species of shrubby vegetation like *Justicia adhatoda, Dodonaea viscoa* and herbaceous species like *Viola pilosa, Verbascum thapsus, Solanum nigrum* etc. The results of the secondary data analysis revealed that species diversity exhibited relatively higher values for herbs.

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