Tree layer vegetational analysis in temperate forest of Uttarakhand

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Abstract: In this study, we examined plant vegetation analysis at altitudes between 1900 and 2200m asl in the Uttarakhand Himalaya. The maximum species richness was recorded at moist habitat, while minimum at stream bank habitat and ridge habitat. *Lyonia ovalifolia*, *Quercus leucotricophora*, *Rhododendron arboreum* and *Myrica esculenta* was the dominant tree species. *Quercus floribunda* and *Cinnamomum tamala* were least species on the study area. Total tree density was maximum at stream bank habitat. Total basal area was maximum on dry habitat whereas minimum on ridge habitat. Species diversity was maximum on moist habitat. The present study concludes that the distribution and species richness pattern in this region largely depend on the altitude and climatic variables like rainfall, temperature.

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1. Introduction

The term phytosociology is frequently used to the study plant community structure. In order to understand the structure, composition and tropic set up of the community, we take into consideration the analytic and synthetic characters. Analytic characters are directly observed in the field and are quantitative (measure in quantities) and qualitative (usually described). Qualitative characters are physiognomy, life form, phenology, stratification, sociability and vitality, whereas quantitative characters are frequency, density, abundance, crown cover, basal area, covers percent and distribution pattern (analytic characters). Synthetic characters are based on the data recorded for the analytic characters. Quantitative data give the complete picture of a community.

The vegetation diversity of forest ecosystems of Himalaya is influenced by topography, soil, climate and geographical location of the region. There is a great diversity in the floristic pattern due to altitudinal variation, coupled with rainfall (Arora, 1993). The ecosystem function is warmly related to the components of community. The elements vary in quality and quantity and build a structure to the community. There is a complex relation between the structure and function within a community (Whittaker, 1975).

The phytosociological study incorporates mainly the description of the vegetation of the terrain because it provides detailed information about composition of trees, shrubs, herbs and climbers communities and also the functional aspect. It is assumed that the dominating plant species actually determine the structure of a community and not another characteristic (Odum, 1971). The structure of a vegetational unit depends upon the species composition and their relative number (Gleason, 1926).

Species diversity is an important concept and is distributed heterogeneously across the plants. A number of quantitative indices of diversity have been proposed (Simpson, 1949; Shannon Weaver 1963). The diversity is commonly considered as an important attribute of natural and organized community (Hairston, 1964). Diversity has been said to increase in a successional sequence, leading to climax stage. There is growing awareness that biodiversity is closely linked with long term health and vigour of the biosphere, as an indicator of global environment and also as a regulator of ecosystem functioning (Solbrig, 1991).

2. Material and Methods

The vegetation of different sites was analyzed for trees, shrubs, herbs and climbers. Trees were considered to be individuals >30 cm cbh circumference at breast height, saplings, 10-30 cm cbh and seedlings <10 cm circumference (Saxena *et al.* 1984). Tree layer was analyzed by sampling thirty quadrats of 10x10 m. The size and number of samples was determined following Saxena and Singh (1982). The vegetation data were quantitatively analyzed for density, frequency and abundance (Curtis and McIntosh, 1950). The distribution pattern of different species was studied using the ratio of abundance to frequency (Whitford, 1949). The ratio <0.025 indicates regular distribution, 0.025-0.050 random and >0.050 contagious distribution (Curtis and Cottam, 1956). Diversity is measured as the number of species occurring within an area of a given size (Huston, 1994). It therefore, measures the richness of a potentially interactive assemblage of

species. The diversity index was computed by using Shannon-Wiener information index (Shannon and Weaver, 1963 and Concentration of Dominance (CD) was calculated by Simpson's index (Simpson, 1949). T-test was determined (Snedecor and Cochran, 1967)

3. Results

A total of 12 species on stream bank habitat, 13 species on dry habitat, 12 species on ridge habitat and 17 tree species on moist habitat were recorded from the present study. The most dominant tree species was *Quercus leucotricophora* (IVI=96.80) on dry habitat (Table 1) followed *Lyonia ovalifolio* (IVI=62.99) on stream bank site (Table 1).

Myrica esculenta (IVI=50.26) was most dominant tree species on dry habitat followed by *Rhododendron arborerum* (IVI=49.43). *Quercus floribunda* (IVI=1.05) was the most dominant tree species on ridge habitat. *Cinnamamomum tamala* (IVI=0.91) was the most dominant tree species on moist habitat. The total tree density ranged from 1606 ind/ha (stream bank habitat) to 1089 ind/ha (moist habitat). The individual density was maximum for *Quercus leucotricophora* (516 ind/ha, Table 1) on stream bank habitat and minimum for *Quercus floribunda* on ridge habitat and *Cinnammomum tamala* on moist habitat (03 ind/ha each, Table 1). Total basal area was maximum on dry habitat (53.87±16.04 m^2/ha, Table 1) and minimum on ridge habitat (39.97±20.84 m^2/ha, Table 1). The mean individual basal area was maximum on stream bank habitat (24.95±11.66 m^2/ha) and minimum on ridge habitat (0.08±0.00 m^2/ha).

Table 1 Vegetational parameters for tree layer on Stream bank, Dry, Ridge and Moist habitat

S.No	Name of Species	Density (ind/ha)	A/F Ratio	Total Basal Area (m^2/ha)	IVI (%)
	Stream bank habitat				
1.	*Carpinus viminea*	30	0.05	0.07±0.2	7.29
2.	*Cornus capitata*	97	0.02	1.62±0.6	19.00
3.	*Lyonia ovalifolia*	367	0.04	13.25±5.4	62.99
4.	*Myrica esculenta*	163	0.02	5.33±0.9	33.09
5.	*Pyrus pashia*	47	0.03	1.08±0.2	11.22
6.	*Quercus floribunda*	60	0.02	0.80±0.1	12.56
7.	*Quercus glauca*	13	0.02	0.19±0.0	2.73
8.	*Quercus leucotrichophora*	516	0.06	24.95±11.6	93.35
9.	*Rhododendron arboreum*	157	0.02	3.98±0.89	30.23
10.	*Rhus wallichii*	10	0.01	0.08±0.00	2.33
11.	*Symplocos chinensis*	13	0.01	0.21±0.00	3.28
12.	*Symplocos crataegoides*	133	0.04	2.25±0.70	21.89
Total		**1606**		**53.81±8.80**	
	Dry habitat				
1.	*Carpinus viminea*	20	0.08	0.30±0.06	5.33
2.	*Cinnamomum tamala*	10	0.03	0.13±0.08	2.95
3.	*Cornus capitata*	46	0.01	0.79±0.00	8.97
4.	*Lyonia ovalifolia*	280	0.03	9.34±0.49	58.34
5.	*Meliosma pungens*	16	0.01	0.22±0.00	4.87
6.	*Myrica esculenta*	83	0.04	17.99±17.2	50.26
7.	*Pyrus pashia*	30	0.05	0.56±0.15	8.54
8.	*Quercus floribunda*	36	0.05	0.37±0.16	9.30
9.	*Quercus glauca*	16	0.01	0.22±0.00	4.23
10.	*Quercus leucotrichophora*	503	0.05	20.05±1.25	96.80
11.	*Rhododendron arboreum*	86	0.02	2.06±0.89	22.21
12.	*Symplocos chinensis*	20	0.03	0.21±0.12	5.82
13.	*Symplocos crataegoides*	96	0.03	1.64±0.55	22.22
Total		**1242**		**53.88±16.05**	
	Ridge habitat				
1.	*Alnus nepalensis*	13	0.03	0.46±0.00	3.67
2.	*Carpinus viminea*	06	0.03	0.08±0.00	2.15
3.	*Cornus capitata*	50	0.11	0.65±0.43	12.31
4.	*Lyonia ovalifolia*	250	0.04	8.85±4.39	61.19
5.	*Myrica esculenta*	170	0.04	4.80±2.40	39.28
6.	*Pinus roxburghii*	53	0.03	6.72±5.03	27.73
7.	*Pyrus pashia*	20	0.06	0.32±0.12	6.80
8.	*Quercus floribunda*	03	0.03	0.03±0.00	1.05
9.	*Quercus leucotrichophora*	283	0.05	10.70±5.79	67.13
10.	*Rhododendron arboreum*	223	0.03	5.69±1.79	49.43
11.	*Rhus wallichii*	20	0.01	0.22±0.00	5.82
12.	*Symplocos crataegoides*	96	0.06	1.50±0.43	23.35

Total		**1187**		**40.02±10.36**	
		Moist habitat			
1.	*Aesculus indica*	26	0.01	2.80±0.00	11.26
2.	*Betula alnoides*	6	0.02	0.09±0.00	1.91
3.	*Carpinus viminea*	50	0.05	3.63±2.89	18.12
4.	*Cinnamomum tamala*	3	0.03	0.03±0.00	0.91
5.	*Cornus capitata*	63	0.07	1.65±1.34	16.27
6.	*Cornus macrophylla*	36	0.03	0.74±0.38	8.95
7.	*Lyonia ovalifolia*	200	0.04	5.61±3.78	43.08
8.	*Machilus duthiei*	33	0.04	1.42±0.00	7.79
9.	*Meliosma pungens*	6	0.02	0.06±0.00	1.83
10.	*Myrica esculenta*	103	0.02	3.29±1.91	25.18
11.	*Osmanthus fragens*	40	0.02	1.52±1.08	12.71
12.	*Pyrus pashia*	20	0.02	0.45±0.25	6.28
13.	*Quercus glauca*	20	0.02	4.33±3.20	16.86
14.	*Quercus leucotrichophora*	190	0.02	11.61±5.13	57.26
15.	*Rhododendron arboreum*	230	0.03	8.78±2.69	54.33
16.	*Rhus wallichii*	50	0.05	0.78±0.32	13.22
17.	*Symplocos crataegoides*	13	0.08	0.19±0.04	3.91
Total		**1089**		**46.98±5.67**	

Species diversity was maximum on moist habitat (3.52) and minimum on ridge habitat (2.99). Concantration of dominance was maximum on ridge habitat (0.177) and minimum on moist habitat (0.120, Table 2).

Table 2 Species Diversity and Concentration of Dominance for Different habitat

Site	Species richness	Species Diversity	Concentration of Dominance
Stream bank	20	3.95	0.081
Dry	21	3.81	0.087
Ridge	23	3.92	0.087
Moist	19	3.53	0.118

Dominance diversity curves of the tree layer showed a geometric progression (Fig. 1).

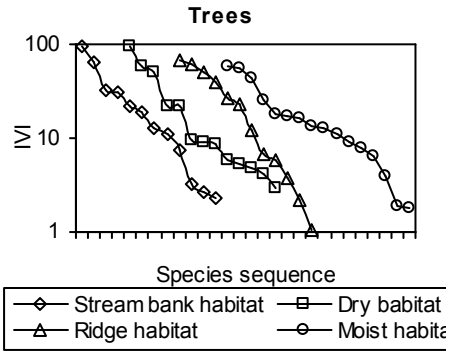

Fig 1. Dominance diversity curves of different habitats and vegetation layer

4. Discussions

The north-west Himalaya has long recognized as distinct floristic region in India (Mani, 1974). The middle(1800-3300m) in which present study located mainly consists of unfossiferous, Paleozoic and Mesozoic formation support the forest of coniferrous, oak, maple etc (Kaul, 1977).. The present study is located in the altitudinal range of 1900 to 2200m and divisible into four different habitat on the basis of various disturbances such as grazing, lopping, litter removal surface burning at a given time (Giri *et al* 2008). These disturbances are affecting the stability of the ecosystem and retarding the successional process in the area. Both natural and human caused disturbances are considered since vegetation responses do not distinguish between natural and human activities (Khera *et al.* 2001).In the present study, the trees density was reported 1089-1606 ind/ha. The total tree density was found highest in the stream bank habitat. The values are lower (1103 to 2460 ind/ha) than that reported for Panchayat forests of Kumaun Himalaya (Agarwal, 1996), and comparable with certain degraded forest types in Kumaun Himalaya (Singh and Singh, 1987, Semwal 2006, 350-2460 ind/ha). Total tree basal area was reported between 39.97±20.84 and 53.87±16.04 m^2/ha. Tewari and Singh (1981) reported 15.60 and 216.00 m^2/ha basal area for different Central Himalyan forests. Saxena and Singh (1982) reported this value from 35.02 to 83.77 m^2/ha for different oak forests of Kumaun Himalaya. The values of basal cover in different oak forests of Kumaun Himalaya ranged from 34.76 to 60.46 m^2 / ha (Upreti et al. 1985, Tewari, 1982, Giri *et al.* 2008b). Diversity values for the tree layer in the present study ranged from 2.99-3.52 are within the range reported for most similar Central Himalayan forests (0.000-3.065 by

Saxena and Singh 1982; Kumar 2000; Ram *et al.* 2004). Braun (1950) reported 1.69 - 3.40 diversity value for certain temperate forests. Concentration of dominance value of the present study ranged between 0.120-0.177. Adhikari (1992) and Srivastava (2002) reported the concentration of dominance value between 0.20 to 0.89 for central Himalayan forest. Dominance diversity curves of tree layer showed a geometric progression because species IVI was very contrast. Anthropogenic disturbances change the vegetational structure and regeneration status of a particular forest. Various levels of disturbances cause the increase in community species richness. This is because disturbances prevents dominance by a few competitive species and allows opportunistic species to invade.

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