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Full Length Research Paper

Qualitative analysis of tree species in evergreen forests of Kumaun Himalaya, Uttarakhand, India

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Current study provides information on the characteristics of tree species in five forests types in the Kumaun Himalaya. On the basis of importance value index, it was observed that *Pinus roxburghii* is the common tree species at site 1 and 2, *Quercus leucotricophora* is common at site 3, 4 and 5 is dominated by *Quercus floribunda* and *Quercus semecarpifolia,* respectively. Tree density (individual/100 m^2) varied from 5.3 to 9.4 in different forest sites. Diversity and dominance indices showed a range of 0.1 to 1.6 and 0.6 to 1.0, respectively. Equitability index in different sites varied from 1.1 to 4.4. It was noticed that with an increase in species richness, diversity and equitability increases. Dominance value decreases with an increase in equitability and diversity indicating inverse relationship between diversity and dominance.

Key words: Diversity index, dominance index, equitability, Kumaun Himalaya.

INTRODUCTION

A number of qualitative and quantitative indices of spe-cies diversity have been proposed by several workers (Simpson 1949; Margalef 1972; Shannon and Wiener 1963; Pielou 1975; Whittaker 1972) which provided infor-mation on compositional change at different analytical levels, includes species diversity in relation to size of area, relationship between local and regional species diversity and diversity along gradients across space or environmental factors (Busing and White, 1997; Gaston, 2000). Kumaun region of the Central Himalaya harbors rich biodiversity because of its unique and diverse cli-mate. The high altitudinal belt of Central Himalaya can be divided into two sub- groups, that is, dry alpine zone (about 2750 to 4000 m a.s.l.), with very low annual precipitation, comprising dry alpine scrub and dwarf juniper scrub; and the wet alpine zone (about 2500 to 4000 m a.s.l.) characterized by high annual precipitation, with characteristic vegetation of birch-rhododendron scrub, deciduous alpine scrub and dwarf rhododendron scrub. Mountain meadow and glacial soils characterize the high altitude belt.

At about 2700 m a.s.l., the forests comprise higher level oaks such as tilonj and kharsu, giving way to rhododendron and grassy slopes at 3000 m a.s.l. The middle belt (1500 to 2750 m a.s.l.), is the temperate zone, consisting of two climatic zones: the dry temperate characterized by pine forests and the wet temperate region, dominated by mixed broad-leafed and coniferous species. The soils of the mid altitude belt varies from brown forest soils to brown deciduous and grey and coniferous forest soils. The lower altitude belt (600 to 1500 m a.s.l.) is characterized by a mix of alluvial and brown forest soils, sal and chir pine forests (Champion and Seth, 1968; Singh and Singh, 1992). The present work provides detailed information, qualitative analysis on the characteristics of different forest sites in the study region.

MATERIALS AND METHODS

The study-sites are located between 1500 - 2600 m a.s.l. in Kumaun Himalaya around Nainital area (29°22' N lat. and 79°26' E long). Each forest site was divided into stands, that is, hill base (HB), hill slope (HS) and hill top (HT). The climate is monsoon temperate, and annual rainfall of the area is 2668 mm/year. The average monthly temperature ranges from 11.5°C in winter and 18.5°C during summer. Soil moisture (0 – 30 cm) varied from 42 to 57% in the rainy season. Soil pH was in the range of 5 to 6 indi-cating the acidic nature of the soil. Percentage of sand, silt and clay varied from 50 to 65%, 17 to 30% and 11 to 28% respectively. Organic matter and water holding capacity ranged from 3 to 5% and 55 to 80% respectively.

The rocks of Nainital belong to Krol series (Valdia, 1983). Phyto-sociological analysis of the study area was carried out by using 10 numbers, 10 × 10 m quadrants placed randomly for tree layer cir-cumference at breast height (cbh), that is, 1.37 m from ground;

Table 1. Importance value index (IVI) of different species in the study-sites.

Species	Site 1	Site 2	Site 3	Site 4	Site 5
Pinus roxburghii	200	200	-	-	-
Rhododendron arboretum	8.9	27.4	-	-	-
Ilex dipyrena	-	-	7.2	13.6	13.00
Cornus oblonga	-	-	7.2	-	7.1
Quercus leucotricophora	-	-	180	9.4	28.4
Quercus floribunda	-	-	-	171.8	40.2
Quercus semecarpifolia	-	-	-	-	200
Acer oblongum	-	-	8.2	-	7.1
Myrica esculenta	27.4	-	16.0	-	-
Lyonia ovalifolia	-	-	7.2	-	-
Fraxinus micrantha	-	-	14.4	-	-
Litsea umbrosa	-	-	8.6	-	-
Biota orientalis	-	-	17.1	-	-
Aesculus indica	-	-	17.1	-	-
Cupressus torulosa	-	-	-	36.6	14.4

trees with cbh ≥ 31.5 cm were considered) . Vegetation analysis was quantitatively analysed for abundance, density and frequency following Curtis and McIntosh (1950) and the relative values were summed up to represent Importance Value Index (IVI) as per Curtis (1959). Species richness was calculated by the number of species per unit area (Whittaker, 1960). Equitability or Evenness value represent the distribution of individuals among the species and calculated following Whittaker (1972) as:

$$E = S / (\log Ni - \log Ns)$$

Where, S is the total number of species, Ni is the number of individuals of most important species, Ns is the number of individuals of least important species and E is the evenness index. Species diversity (H') was calculated by following Shannon and Wiener (1963) as:

$$H = -\sum_{n=1}^{i} (Ni/N) \log2 (Ni/N)$$

Where, Ni is the total number of species i and N is the number of individuals of all species in that site. Concentration of dominance (Cd) was calculated by following Simpson (1949) as:

$$Cd = \Sigma (Ni/N)^2$$

Where, Ni and N are the same as for the Shannon-Weiner information function.

RESULTS

Analysis of tree vegetation and their Importance Value Index (IVI) are depicted in Table 1. From the table, it is evident that total number of species ranged from 2 to 11 with maximum number in site 3 and minimum in site 2. *Pinus roxburghii* was common at site 1 and 2, and *Quercus leucotricophora* was common at site 3. 4 and 5 are dominated by *Quercus floribunda* and *Quercus semecarpifolia*, respectively. At site 1, *P. roxburghii* was found to be most dominant species (IVI, 200) followed by *Rhododendron arboretum* (8.1). At site 2, *P. roxburghii* was found to be most dominant species (IVI, 200) and *R. arboretum* exhibited lowest IVI (27.4). *Q. leucotricophora* was observed to be dominant species (IVI, 180) at site 3. The next two dominant species on that site were *Biota orientalis* and *Asculus indica.* Analysis of vegetation at site 4 revealed that *Q. floribunda* was observed to be the most dominant species (171.8) followed by *Cupressus torulosa* (36.6). At site 5, *Q. semecarpifolia* exhibited the maximum IVI value (200) followed by *Q. floribunda* and *Q. leucotricophora.*

Table 2, represents vegetational parameters in different forest sites. From the table it is evident that density (individual/100 m^2) of tree species ranged from 6.6 to 8.5 at site 1. Species richness (per m^2) varied from 1.0 to 1.3 and diversity value varied from 0 to 0.3. Equitability and concentration of dominance value ranged from 0.4 to 2.7 and 0.9 to 1.0 respectively. At site 2, density (individual/100 m^2) of tree species varied from 4.7 to 7.8 and species richness (per m^2) ranged from 1.0 to 1.3. Diversity and equitability value ranged from 0 to 0.3 and 0.4 to 2.5. Concentration of dominance value varied between 0.9 and 1.0 on the basis of density values. Tree density (individual/100 m^2) at site 3 ranged from 6.7 to 11.4 per 100 m^2. Species richness (per m^2) ranged from 1.2 to 1.6. Diversity value ranged from 0.2 to 6.2.

Equitability and concentration of dominance value ranged from 3.1 to 3.8 and 1.0 to 2.4, respectively. At site 4, tree density (individual/100 m^2) varied from 5.0 to 6.7 and species richness (per m^2) ranged from 1.3 to 2.2. Diversity and equitability values varied from 0.3 to 0.8

Table 2. Vegetation parameters in different forest stands.

Site	Aspect	Stand	S	D	H´	E	Cd
S1	E	HB	1.3	6.6	0.3	2.5	0.9
		HS	1.3	6.7	0.3	2.6	0.9
		HT	1.0	7.2	0	0.4	1.0
	SW	HB	1.3	8.2	0.3	2.3	0.9
		HS	1.3	8.5	0.3	2.7	0.9
		HT	1.0	6.6	0	0.4	1.0
S2	NE	HB	1.0	7.8	0	0.4	1.0
		HS	1.3	7.0	0.3	2.5	0.9
		HT	1.0	4.7	0	0.4	1.0
S3	E	HB	1.5	11.4	0.4	3.8	0.9
		HS	1.6	10.5	0.4	3.8	1.0
		HT	1.2	6.7	0.2	2.4	0.8
	W	HB	1.4	9.8	6.2	3.1	0.9
		HS	1.3	10.6	0.4	3.1	0.9
		HT	1.4	7.2	0.4	3.1	0.9
S4	E	HB	2.2	6.7	0.6	3.6	0.8
		HS	1.9	6.6	0.8	3.9	0.9
		HT	1.3	5.9	0.3	2.4	0.9
	SW	HB	1.4	6.1	0.5	3.1	0.9
		HS	1.7	5.8	0.5	4.2	0.8
		HT	1.4	5.0	0.4	3.1	0.9
S5	NE	HB	2.9	5.5	2.0	7.7	0.3
		HS	2.3	3.7	1.6	5.1	0.5
		HT	2.1	5.8	3.6	4.4	0.5
	NW	HB	1.9	4.0	1.2	5.1	0.5
		HS	1.9	6.5	0.9	4.0	0.7
		HT	1.0	6.4	0	0.4	1.0

E, east; SW, southwest; NE, northeast; W, west; NW, northwest; HB, hill base; HS, hill slope; HT, hill top; S, species richness (per m^2); D, density (individual/100m^2); H', diversity; E, Equitability; Cd, concentration of dominance.

and 2.4 to 4.2 respectively. Concentration of dominance value varied from 0.8 to 0.9. Tree density (individual/100 m^2) at site 5 varied from 3.7 to 5.8. Species richness (per m^2) ranged from 1.0 to 2.9 and diversity value varied from 0 to 3.6. Equitability and concentration of dominance values ranged from 0.4 to 7.7 and 0.3 to 1.0, respectively (Table 2).

DISCUSSION

From the above results, it is evident that species number is found to be maximum at site 3 and minimum at site 2 (Table 1). Species diversity in different sites indicated maximum diversity at site 5 and minimum at site 2. (Table 2) may be due to relatively more moisture level which considered as some of the factors for higher diversity in that site. Maximum concentration of dominance value at site 2 and minimum at site 5 indicate the trend of inverse relationship between diversity and dominance (Figure 1).

Analysis of variance (ANOVA) was applied following Snedecor and Cochran (1967) to test for significant differences among different parameters of diversity. Analysis of variance in the tree species (between species richness and diversity), the F-value (5.54) with 1 and 52 df, were significant at the 5% level.

In temperate forests, highest values for diversity index were recorded 2 to 3 (Risser and Rice, 1971). Braun (1950) reported tree diversity between 1.7 and 3.4 in an eastern forest of North America. For tropical rain forests, higher diversity (5.40) was calculated by Knight (1975). In certain forests of the Kumaun Himalaya the value ranged from 0.8 to 2.3 (Garkoti, 1992; Srivastava, 2002). These results are consistent with the present study.

Whittaker (1972) stated that the dominance of one stratum might affect the diversity of another stratum. For temperate forests, the value of concentration of dominance in the range of 0.10 to 0.99 has been reported by Risser and Rice (1971). For tropical rain forests, an average value of 0.06 was reported by Knight (1975) and 0.06 to 0.14 by Singh and Krishnamurthy (1981). Adhikari (1992), Arvind (2000) and Srivastava (2002) reported the value from 0.2 to 0.9 in the central Himalayan forests. The value in the present study was in the range of 0.6 to 3.4.

The Shannon-Wiener index is used as a diversity index because it combines the variety and equitability components. However, this may obscure the individual behavior of two components since an increase in the equitability may counteract a decrease in number of species. This index increased with an increase in number of species. Present study indicates that diversity and equitability (Ec) were positively correlated ($P < 0.01$) with species richness (S) and inversely correlated ($P < 0.01$) with concentration of dominance (Cd) (Figure 1). Similar trend was obtained by Kumar and Bhatt (2006). Significant relation was found between Altitude and equitability ($P < 0.01$). With increasing elevations, diversity increases across aspects ($P < 0.01$).

The higher diversity at higher elevations across these sites may be due to interaction of different species on these sites. Higher number of species with generally overlapping niches may coexist and it may be concluded that higher diversity always give higher stability. Various climatic factors are influences by the altitude. Aspect also plays an important role at the development of forest particularly in high altitudes. In the temperate regions, most of the soil belongs to the group of pod sol soils which is found on the northern aspect carry in coniferous vegetation. In addition, from the above results it may be concluded that, particularly in a forest type contribution is shared by one or more species.

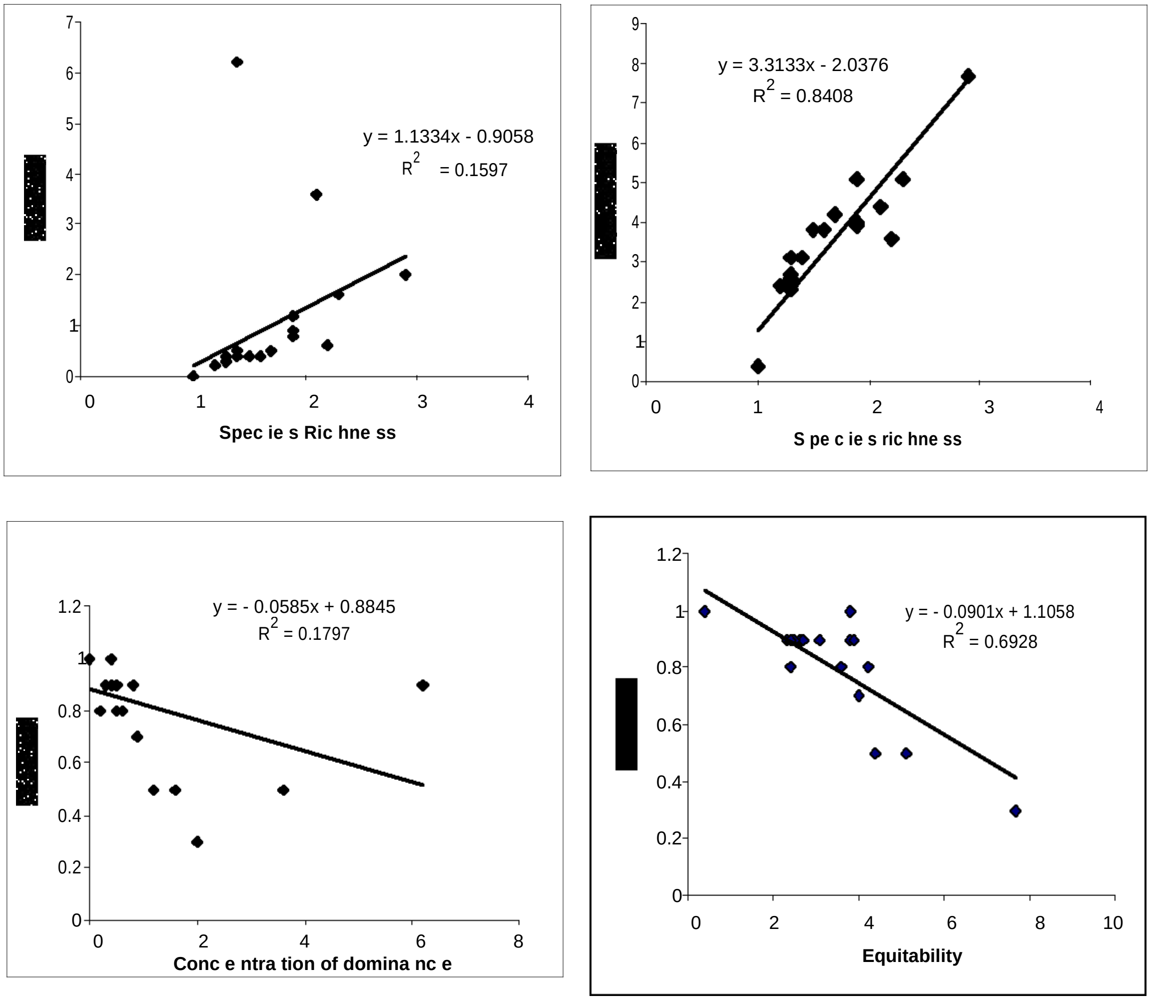

Figure 1. Correlation between different parameters.

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REFERENCES

Braun EL (1950). The ecology of the forest of Eastern North America, their development, composition & distribution. Deciduous forest of Eastern North America. Mc Graw Hill (New York: Blakiston).

Busing RT, White PS (1997). Species diversity and small-scale disturbance in an old-growth temperate forest: a consideration of gap partitioning concepts. Oikos, 78: 562-568.

Champion HG, Seth SK (1968). A revised survey of the forest types of India. Govt. India Publ. Division, New Delhi, p. 404.

Curtis JT (1959). The Vegetation of Wisconsin. An Ordination of plant communities, University Wisconsin press, Madison Wisconsin, p. 657.

Curtis JT, McIntosh RP (1950). The interrelations of certain analytic and synthetic phytosociological characters. Ecol., 31: 438-455.

Garkoti SC (1992). High altitude forest of Central Himalaya: Productivity and nutrient cycling. Ph.D. Thesis, Kumaun University, Naini Tal.

Gaston KJ (2000). Global pattern in biodiversity. Nature, 405: 220-227.

Knight DH (1975). A phytosociological analysis of species rich tropical forest on Barro Colorado Island, Panama. Ecol. Mono. 45: 259-284.

Margalef DR (1972). Homage to Evelyn Hutchinson, or why is there an upper limit to diversity. Trans. Connect. Acad. Arts Sci., 44: 211-235.

Kumar M, Bhatt V (2006). Plant Biodiversity and Conservation of Forests in Foot Hills of Garhwal Himalaya. Lyonia, 11(2): 43-59.

Pielou EC (1975). Ecological diversity. Wiley-Interscience New York, p. 165.

Risser PG, Rice EL (1971). Diversity in tree species in Oklahoma Upland forests. Ecology 52: 786-800.

Shannon CE, Wienner W (1963). The mathematical theory of communication. University Illionis Press, Urbana.

Simpson EH (1949). Measurement of Diversity. Nature 163: 688.

Singh JS, Krishnamurty L (1981). Analysis of structure and function of tropical grassland vegetation of India. Ind. Rev. Life Sci., 1: 225-270.

Singh JS, Singh SP (1992). Forest if Himalaya: Structure, Functioning and Impact of man. Gynodaya Prakashan, Nainital, India.

Snedecor GW, Cochran WG (1967). Statistical methods, Oxford and IBH Publishing Co., New Delhi. p. 503.

Srivastava AK (2002). Forest vegetation and tree regeneration in a species-rich sub montane transect of central Himalaya. Ph.D. Thesis, Kumaun University, Nainital.

Valdia KS (1983). Simla slates: The precambian flysch of the lesser Himalaya, its tributes, sedimentary structures and paleocurrems. Bull. Geol. Soc. Amer. 81: 451-467.

Whittaker RH (1972). Evolution and measurements of species diversity. Taxon, 21: 213-251.