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Floristics diversity composition along an altitudinal gradient in Himalayan chir pine forest of the western Himalayas

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Abstract

In the present study, we examined the species composition of Himalayan Chir Pine forest (*Pinus roxburghii* Sargent) at different altitudes between 1000-1600m asl, considering three altitudinal gradients viz., A1(Lower altitude: 1000-1200m); A2(Middle altitude: 1200-1400m); A3(Higher altitude: 1400-1600m) in the Western Himalayas. In this study, a total of 50 species were recorded, of which 9 were trees, 15 shrubs, 26 herbs. Herb plant richness (in number) showed a diminishing trend with altitude whereas shrub species remain same for low and mid altitudes with slight drop in high altitudes and the tree species richness remain constant for all the altitudes. Many types of environmental changes (altitudes, slopes, aspect, temperature, precipitation etc.) influence the processes that can both augment or erode diversity. The study suggests that species distribution, presence of the particular species (species composition) and number of species present (species richness) are largely regulated by altitudes and other climatic + topographic factors.

Keywords: Chir pine, altitude, species richness and composition.

Introduction

Pines clearly form the most ecologically and economically significant tree group in the world. The chir pine (*Pinus roxburghii* Sargent), native to the Himalayas belonging to family pinaceae is found in Hindu Kush Himalayas from Afghanistan to Bhutan, forms extensive forests up to 2,700 meters and does best on north facing slopes on good soils (Kaushik *et al.*, 2010) [2]. It generally occurs at lower altitudes than other pines in the Himalaya. Chir pine is one of the most dominant forest plants and it contributes for a huge proportion of the total forest cover of Himachal Pradesh. Various studies have been done in the past to assess the effect of environmental factors like temperature, altitude, slope on floristic composition and growth patterns of temperate forests.

Floral composition, their distribution and abundance in a community is the measure of plant diversity, indicated by simple and easily interpretable indicator called species richness (Peet, 1974) [6]. The community always experience fluctuations driven by season and long-term changes that lead to expansion of dominant species and further decline in species richness. These dominant species exert controlling effects on the phytosociology of vegetation. Presence of plants of different growth forms having different growing requirements in a community on the same unit of land, maximizes the efficacy of utilization of total environmental resources, creates a variety of riches of organism and imparts a layered vegetation structure. The vegetation of an area is regarded as a product of two factors: the fluctuating and fortuitous immigration of plants and an equally fluctuating and variable enrolment resulting in the gradual and continuous change in species composition along an environmental gradient. Diversity of life-forms usually decreases with increasing altitude and one or two life-forms remain at extreme altitudes (Pavón *et al.*, 2000) [5].

Material and Method

The present investigation was carried out in Himalayan Chir pine forest of Kullu Himalaya 31.8246°N, 77.4702°E, to reveal species composition and the impact of altitude on species

richness. Species richness was simply taken as a count of number of species present in each altitude. Three different altitudinal gradients were marked first and 3 quadrats of $31.62\text{m} \times 31.62\text{m}$ (1000m^2 or 0.1ha) size were randomly laid in each altitude to study tree species. The tree species includes all the saplings, poles and trees present in the study area. The shrub and herbaceous species were studied by laying 9 quadrats of size $5\text{m} \times 5\text{m}$ and $1\text{m} \times 1\text{m}$, respectively randomly in each altitude. Indices of similarity and dissimilarity were calculated (Mishra, 1989) ^[4].

Results

In this study, a total of 50 species were recorded, of which 9 were trees, 15 shrubs, 26 herbs. The total species richness (in number) was recorded from 30 to 28 to 23 along increasing altitudinal gradient. Maximum with a total number of 30 species (4Tree + 10Shrub + 16Herb) were found at lower altitude (A1), slight less of 28 species (4T + 10S + 14H) at middle altitude (A2) and least number of 23 species (4T + 8S + 11H) at higher altitude (A3) as shown in table 1.

Table 1: Inventory of trees, shrubs and herbs under different altitudes in Chir Pine forest

Category	Altitude (A)			
	A1 (1000-1200m)	A2 (1200-1400m)	A3 (1400-1600m)	Total
Trees (T)	4	4	4	12
Shrubs (S)	10	10	8	28
Herbs (H)	16	14	11	41
Total	30	28	23	81

Table 2: Tree species under different altitudes in Chir Pine forest

Sr. No.	Tree Species	Family	A1	A2	A3
1.	Bauhinia variegata	Caesalpiniaceae	+	-	-
2.	Cedrus deodara	Pinaceae	-	-	+
3.	Lyonia ovalifolia	Ericaceae	+	-	-
4.	Myrica esculenta	Myricaceae	-	+	-
5.	Pinus roxburghii	Pinaceae	+	+	+
6.	Pinus wallichiana	Pinaceae	-	-	+
7.	Pyrus pashia	Rosaceae	+	-	-
8.	Quercus leucotrichophora	Fagaceae	-	+	-
9.	Rhododendron arboreum	Ericaceae	-	+	+
	Total		4	4	4

Table 3: Shrub species under different altitudes in Chir Pine forest

Sr. No.	Shrub Species	Family	A1	A2	A3
1.	Berberis aristata	Berberidaceae	+	+	-
2.	Carissa carandus	Apocynaceae	+	-	-
3.	Coraria nepalensis	Coriariaceae	+	+	+
4.	Daphne papyracea	Thymelaeaceae	-	-	+
5.	Debregeasia salicifolia	Urticaceae	-	+	+
6.	Lantana camara	Verbenaceae	+	-	-
7.	Lonicera quinquelocularis	Caprifoliaceae	-	+	+
8.	Myrsine africana	Myrsinaceae	+	+	+
9.	Prinsepia utilis	Rosaceae	+	+	+
10.	Rosa moschata	Rosaceae	+	-	-
11.	Rubus ellipticus	Rosaceae	+	+	-
12.	Wikstroemia canescens	Thymelaeaceae	-	+	-
13.	Woodfordia fruticosa	Lythraceae	+	-	-
14.	Zanthoxylum alatum	Rutaceae	+	+	+
15.	Ziziphus mauritiana	Rhamnaceae		+	+
	Total		10	10	8

Table 4: Herb species under different altitudes in Chir Pine forest

Sr. No.	Herb Species	Family	A1	A2	A3
1.	Achyranthes aspera	Amaranthaceae	-	+	-
2.	Agrimonia pilosa	Rosaceae	+	-	-
3.	Ajuga bracteosa	Lamiaceae	+	+	+
4.	Anaphalis busua	Asteraceae	+	-	-
5.	Apluda mutica	Poaceae	+	+	+
6.	Artemisia roxburghiana	Asteraceae	+	+	-
7.	Barleria cristata	Acanthaceae	+	-	-
8.	Bidens pilosa	Asteraceae	+	+	-
9.	Chenopodium album	Chenopodiaceae	+	+	+
10.	Cynodon dactylon	Poaceae	+	-	-
11.	Dactylis glomerata	Poaceae	-	-	+
12.	Dichanthium annulatum	Poaceae	+	+	
13.	Digitaria stricta	Poaceae	+	-	-

14.	Fimbristylis complanata	Cyperaceae	-	+	-
15.	Heteropogon contortus	Poaceae	+	+	+
16.	Leucas lanata	Lamiaceae	-	+	-
17.	Origanum vulgare	Lamiaceae	-	+	+
18.	Oxalis corniculata	Oxalidaceae	-	+	+
19.	Parthenium hysterophorus	Asteraceae	+	-	-
20.	Rubia cordifolia	Rubiaceae	-	-	+
21.	Rumex nepalensis	Polygonaceae	+	-	+
22.	Setaria glauca	Poaceae	-	+	-
23.	Solanum indicum	Solanaceae	+	-	+
24.	Tagetes minuta	Asteraceae	-	+	-
25.	Themeda anathera	Poaceae	+	-	-
26.	Viola serpens	Violaceae	-	-	+
	Total		16	14	11

Table 5: Index of similarity and dissimilarity of shrubs under different altitudes in Chir Pine forest

Tree				Shrub				Herb			
(D) \ (S)	A1	A2	A3	(D) \ (S)	A1	A2	A3	(D) \ (S)	A1	A2	A3
A1	-	0.25	0.25	A1	-	0.60	0.44	A1	-	0.46	0.44
A2	0.75	-	0.50	A2	0.40	-	0.78	A2	0.54	-	0.48
A3	0.75	0.50	-	A3	0.56	0.22	-	A3	0.56	0.52	-

Discussion

Forest composition, community structure and diversity patterns are important ecological attributes correlated with prevailing environmental as well anthropogenic variables. Slobodkin and Sanders (1969) [9] opined that species richness of any community is a function of severity, variability and predictability of the environment in which it develops. Therefore, diversity tends to increase as the environment becomes more favourable and more predictable (Putman, 1994) [7]. Tree species diversity varied greatly from place to place mainly due to variation in biogeography, habitat and disturbance. (Sagar *et al.*, 2003) [8]. Ellu & Obua (2005) [1] have suggested that different altitudes and slopes influence the species richness and dispersion behaviour of species. Moreover, Kharakwal *et al.* (2005) [3] have pointed out that altitude and climatic variables like temperature and rainfall are the determinants of species richness.

Conclusion

The altitudinal factor evaluated in this study has an effect on the observed pattern of floral composition and its richness. So, for a long-term management of natural resources, the researcher needs to take altitudinal and other climatic + topographical factors variation into consideration for the study of floral diversity in the mountainous region, as it shows the greatest effect in limiting plant species and community types.

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