The changes in topography, altitude, precipitation, temperature and soil conditions contribute to the diverse bioclimate that results in a mosaic of biotic communities at various spatial and organizational levels.

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Abstract: This study showed that perennials gained dominance over annuals in oak forest as well as pine forest (Figure 1). Perennial have ability to conserve soil and with their extensive root systems of perennial grasses they also add more organic matter to the soil than annuals which can be more favorable for plant growth. Singh and Singh (1987) observed that annuals colonize and dominate the early stages of succession. Annuals to perennials species ratio are higher at primary successional site than climax stage. Species richness generally increases during secondary succession when environmental and edaphic conditions are favorable with low fluctuations.
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1. Introduction

Among the both forest site, species richness value was maximum in pine forest at HB (10.5) and minimum in oak forest at HB (7.4). Beta diversity showed pronounced effect at both sites. The value for oak forest varied marginally from 4.5 (HB) to 4.6 (HS), respectively. While for pine forest, it remained approximately same at all sub-sites. Our study showed that perennials gained dominance over annuals in oak forest as well as pine forest (Figure 1). Perennial have ability to conserve soil and with their extensive root systems of perennial grasses they also add more organic matter to the soil than annuals which can be more favorable for plant growth. Singh and Singh (1987) observed that annuals colonize and dominate the early stages of succession. Annuals to perennials species ratio are higher at primary successional site than climax stage. Species richness generally increases during secondary succession when environmental and edaphic conditions are favorable with low fluctuations.

2. Results

Among the both forest site, species richness value was maximum in pine forest at HB (10.5) and minimum in oak forest at HB (7.4). Beta diversity showed pronounced effect at both sites. The value for oak forest varied marginally from 4.5 (HB) to 4.6 (HS), respectively. While for pine forest, it remained approximately same at all sub-sites. Between the forests, the value was higher in oak forest than pine forest. The lowest value of beta-diversity in oak forest was observed at HB (4.5) and for pine forest at HS (2.8). Equitability/evenness value ranged from 17.0 (HT) to 31.7 (HB) in the oak forest. A reverse pattern was observed in the pine forest (31.4 at HT and 27.3 at HB) (Table 1).

Table 1. Comparison of diversity indices (Sp, species number; Sr, speceis richness; Bd, beta-diversity; H', diversity; Cd, concentration of dominance; E, evenness/equitability)

Indices	Oak forest			Pine forest		
	HB	HS	HT	HB	HS	HT
Sp	30	23	15	23	17	12
Sr	7.4	6.9	5.0	10.5	6.5	4.7
Bd	4.5	4.6	4.6	2.8	2.9	2.8
H'	4.2	4.2	3.5	4.4	4.0	3.4
Cd	1.4	0.1	0.1	0.1	0.2	0.1
E	31.7	27.1	17	27.3	27.4	31.4

Table 2. Forest wise ratio of species, genera and family (F, Family; G, Genus; S, Species)

Forest	F:G	F: S	G: S
Oak	1.2	1.3	1.0
Pine	1.4	1.5	1.1

The concentration of dominance fluctuated from 0.1 to 1.4 in oak and from 0.1 to 0.2 in pine forest (Table 2). It was comparatively higher in the oak forest. The low value of concentration of dominance indicates that the dominance is shared by many species. The ratio of family to species, family to genera and genera to species for the both forests indicated higher taxonomic diversity in pine forest than that in the oak forest (Table 4). Species richness generally increases during secondary succession when environmental and edaphic conditions are favorable with low fluctuations. Percent contribution of perennial herbs is maximum in oak forest than the pine forest (Figure 1).

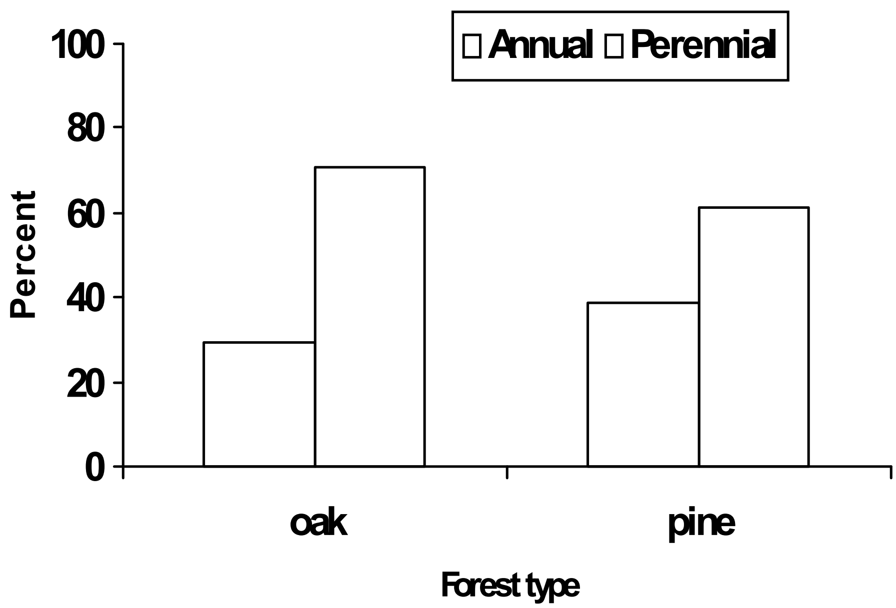

Figure 1. Percent contribution by life forms in oak and pine forests

4. Discussions

The changes in topography, altitude, precipitation, temperature and soil conditions contribute to the diverse bioclimate that results in a mosaic of biotic communities at various spatial and organizational levels. Diversity represents the number of species, their relative abundance, composition, interaction among species and temporal and spatial variation in their properties. Where richness and evenness coincide, i.e., a high proportion of plant species in the vegetation are restricted, community of that area is supposed to have evolved through a long period of environmental stability.

The observation in the present study showed that the oak forest was typically moister than the pine forest which is consistent with the study of Saxena and Singh (1982). Pine forest was about 25% more diverse (40 spp.) in comparison to the oak forest (32 spp.).

Asteraceae was the dominant family in pine forest because most of the species of the family are primary successionals and have different types of growth forms. This family showed basal as well as erect forms in which basal forms emerged near the ground-level with well-developed petioles and formed a short-umbrella (Mehrotra, 1998). They can tolerate cool temperatures to high irradiances with low density of herb cover. However, erect forms are less able to capitalize on the spring window of light than any other form. This showed that the different growth forms reflect a mixed type of forest response (harsh dry to mesic). Moreover, basal forms of Violaceae showed affinity to mesic and cold conditions under the oak forest. Few species are able to tolerate the entire spectrum of environment and range throughout the gradient (Brown, 2001).

Our study showed that perennials gained dominance over annuals in oak forest as well as pine forest (Figure 1). Perennial have ability to conserve soil and with their extensive root systems of perennial grasses they also add more organic matter to the soil than annuals which can be more favorable for plant growth. Singh and Singh (1987) observed that annuals colonize and dominate the early stages of succession. Annuals to perennials species ratio are higher at primary successional site than climax stage. Species richness generally increases during secondary succession when environmental and edaphic conditions are favorable with low fluctuations.

The above results indicate that the oak forest makes climax stage for succession. The evenness and β-diversity showed similar values in sub-sites of oak as well as pine forests. The high values of beta-diversity indicate that the species composition varied from one stand to another.

Equitability/evenness varied in pine forest with respect to sub-site from 27.3 (HB) to 31.4 (HT) (Table 3). This was because of the conditional presence or absence of functional relationship of species. Comparatively higher value of equitability in pine forest with respect to oak forest indicated that the individual herb species distribution is higher. This may perhaps due to intermediate level of disturbance.

The allocation of species in the Kumaun Central Himalaya is mainly governed by moisture and temperature gradients that incorporate the effect of many physical factors. Moustafa (1990) found that the association of community types is the result of the performance of the species in response to the environmental conditions that prevail in a particular forest type. Tewari (1982) assumed that the temperature gradient is the net product of elevation and aspect; while moisture gradient is a function of slope degree, soil texture and nature of soil surface.

In addition to that, hierarchical diversity concerns taxonomic differences at other than the species level. Pielou (1975) and Magurran (1998) suggested that hierarchical (taxonomic) diversity would be higher in an area in which the species are divided amongst many genera as opposed to one in which most species belong to the same genus, and still higher as these genera are divided amongst many families as opposed to few. The families, genera and species ratio was observed maximum in the pine forest as compared to the oak forest in the present study (Table 4), indicating diverse taxonomic vegetation in the pine forest.

Species richness (per m^2) was higher in the pine forest than the oak forest. A high value of beta-diversity in the oak forest point out that the species composition varied from one stand to another. However, low concentration of dominance value in the pine forest with compare to the oak forest point towards the dominance, which is shared by many species.

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