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Broad Community Identification of High Altitude Forest Vegetation in Pindari Region of Kumaun (Central Himalaya)

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Forest vegetation occurring between 2000-3300m altitudes in the Pindari region of Central Himalaya was analysed. Forty four forest stands were studied and eight forest communities were identified by constructing a dendrogram.

Key Words: High altitude, Cluster-analysis, Succession, Forest vegetation

Introduction

Singh and Singh (1987) reviewed the available information (both qualitative and quantitative) on the forest vegetation of Himalaya. Most of the literature reviewed by them pertaining to Central Himalaya, however, deals exclusively with the forests lying between 300-2500m altitudes. More recently from similar altitudinal ranges, some additional information on the patterns of forest vegetation of Kumaun has been added (Tewari et al. 1989, Rikhari et al. 1989). The only report for high altitude vegetation (2000-4000m) of Kumaun was of Kalakoti et al. (1986).

The present study is an attempt to identify different forest communities within the Pindari region of Kumaun Himalaya between 2000-3300m elevational range.

Description of the Study Area

The study area lies between 30°5′ -30°10′ N and 79°48′ -79°52′ E in close proximity of Pindari glacial ranges of Kumaun Himalayan (Himandri) range (elevational range of 2000-3300m) and is made up of high grade metamorphics of Vaikrita group (Valdiya 1979).

The area (Munsiari) has three seasons: winter (mid Oct. - April); summer (May-June) and rainy (July-Sept.). Mean monthly maximum and minimum temperatures range from 12°C (January) to 26°C (June) and -1°C (Dec.-Jan.) to 12°C (June) respectively. The mean annual total rainfall is 1959mm (more than half being during the rainy seasons - about 400mm in the month of August itself).

Materials and Methods

The study was undertaken during 1987-1989. Forty-four forest stands were studied following Misra (1968) at varying elevations and aspects by using 10 randomly placed 10 x 10 quadrats in each stand. Circumference at breast height (cbh, 1.37m from ground) for all the individuals was recorded. Individuals with cbh 31.5cm and also were considered as trees, 10.5-31.4cm as saplings and up to 10.5cm as seedlings.

The vegetation data were quantitatively analysed for frequency, density and basal area (Misra 1968). The importance value index (IVI) for the tree species was determined as the sum of the relative values of frequency, density and basal area (Curtis 1959). Species richness is the number of species per unit area (Whittaker 1975). The diversity (H') was calculated by using Shannon and Wiener (1963) information index. The community coefficient of the stands was calculated on IVI basis following Sorenson (1948). The percent similarity obtained for various stand pairs have been used for the construction of dendrograms following Mueller-Dombois and Ellenberg (1974).

Result and Discussion

The dendrogram constructed on the basis of detailed quantitative analysis is plotted in figure 1. Eight forest communities could be identified, as briefed below:

The Birch-Silver-fir Community (with *Betula utilis* and *Abies pindrow* as the dominant species) occupied the highest elevational limits of forest growth (3000-3300m). Champion and Seth (1968) have categorised this association under sub-alpine forest type of Western Himalaya and considered it as climatic climax of this region.

The Chuk (*Hippophae salicifolia*) Community formed more or less pure thickets (altitudinal range 2300-2800m) and usually occurred along the river banks. In the inner valleys of Himalaya, *Hippophae* replaced the *Alnus* (alder) of the outer hills, coming up on new gravel deposits, earth slides etc. and appears to be the seral stage before the local climax stage of conifers or broad leaved species (Champion & Seth 1968). Thickets of *Hippophae salicifolia* were more prominent on western part (Sundardhunga valley) of the study area, but occurred also on newer sites in the eastern part (Pindar-Kaphini valleys).

The Oak-mixed Deciduous Forest Community (altitudinal range 2200-2800m.) was characterized by (*Quercus semecarpifolia, Q. floribunda*) and other broad-leaved species (*Aesculus indica, Acer* spp., *Rhododendron* spp.). Both evergreen and deciduous elements were equally dominant. Following Singh and Singh (1987), this community must be at mid successional stage more probably nearer the oak climax of this region.

The Alder Community occurred along streams towards lower elevational extremity (2000-2200m). Alder (*Alnus nepalensis*) generally form almost pure patches. This community

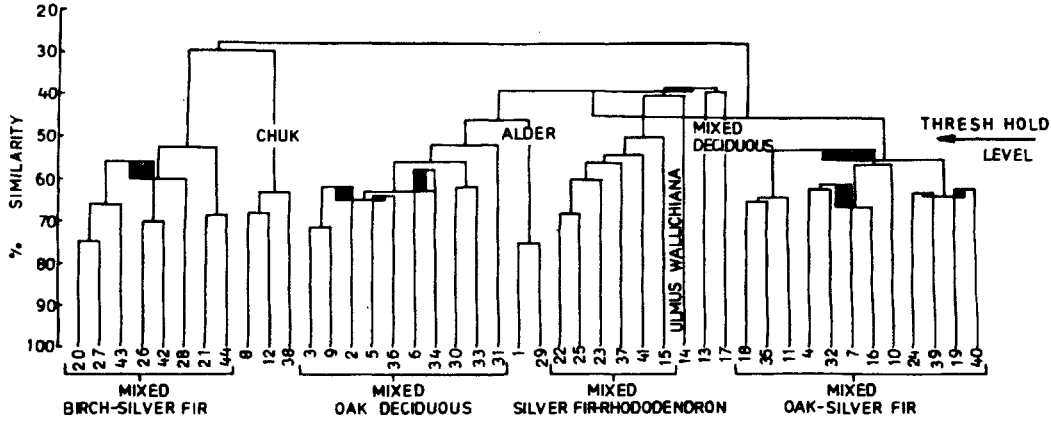

Figure 1 Dendrogram derived from cluster analysis applied to the vegetation data

is an early successional community. However, at some localities alder was mixed with the late successional communities (Sundardhunga valley).

The Mixed Silver-Fir *Rhododendron* Community (2600-3000m) all was characterized by *Abies pindrow, Acer cappadocicum* and *Rhododendron barbatum*. However on north slopes, A. pindrow was conspicuously significant whereas *R. barbatum* formed a thick undergrowth. Similar pure pockets of silver-fir (*Abies* spp.) have also been reported elsewhere in Western Himalaya (Champion & Seth 1968, Puri et al. 1989). The altitudinal occupance and the relative dominance of *A. pindrow* in fact parallels that of the high altitude oak (*Quercus semecarpifolia*) climax of this region.

The *Ulmus* Community represented one stand around 2200m, where *Ulmus wallichiana* dominated the vegetation. Usually this species has been reported as a companion of mixed deciduous or silver-fir forests of inner Himalayan ranges (Osmaston 1927). Present results indicated that the species has the potentiality to attain local dominance.

The Mixed-Deciduous Forest Community (2000-2500m) occurred in relatively more moist and cold pockets and was characteristically devoid of oaks. The major constituents were horse chestnut (*Aesculus indica*), maples (*Acer* spp.) and *Ulmus wallichiana*. Singh and Singh (1987) have classified such formation under mid-montane winter deciduous forests of Himalaya.

The Mixed Oak-Silver-Fir Community occurring at higher altitudes (2500-3000m) was characterized by the high altitude Oak (*Quercus semecarpifolia*) and Silver-fir (*Abies pindrow*). However, in some stands *Q. semecarpifolia* exhibited dominance. This species has been considered climax for this region (Champion & Seth 1968, Singh & Singh 1987). Towards the higher limits of this community, *A. pindrow* and other characteristic high altitude species like *Betula utilis, Rhododendron campanulatum* etc. shared the dominance with *Quercus semecarpifolia*.

The major phytosociological parameters of the identified communities are summarised in table 1. The mean values of total forest basal area and tree density varied between 6.9 and 78.7m^2

Table 1 *Certain quantitative characteristics of forest communities in Pindari region of Central Himalya (Values, except species richness, are averaged across all stands in respective community type)*

Community type	Tree layer				Shruv layer		
	TBA	D	R	H'	D	R	H'
Birch-Silver-fir community	10.7	353	12	2.41	1808	18	24.2
Chuk community	6.9	703	5	1.16	1624	11	0.88
Oak-mixed deciduous community	78.7	445	24	3.20	14773	16	0.53
Alder community	22.1	435	14	2.50	24882	13	0.17
Mixed-Silver-fir *Rhododendron community*	36.1	355	28	3.18	24441	24	0.49
Ulmus community	56.3	590	12	2.49	21326	9	0.32
Mixed deciduous community	42.5	450	23	3.17	14344	25	0.39
Mixed Oak-Silver-fir community	40.0	320	24	3.10	28789	19	0.39

TBA, Total basal area (m^2ha^{-1}); *D*, Density (individual ha-1); *R*, Total species richness; *H'*, Diveristy

ha^{-1} and 320-703 trees ha^{-1}, respectively. The values, for most of the forest communities reported here, thus fell within a comparable range of values (basal area: 26.9-83.8 m^2 ha^{-1}; tree density: 390-1670 trees ha^{-1}) reported for the moist temperate forests of Kumaun Himalaya (Ralhan et al. 1982, Saxena & Singh 1982). However, the lower values of basal area in Chuk and Birch-silver-fir communities are due to relatively small tree size of the dominant species, i.e. Chuk (*Hippophae salicifolia*) and Birch (*Betula utilis*) in their respective communities. The diversity (1.16-3.18 tree layer) values were also within the range of values (0.8-3.4) reported for different forests of the Himalaya (Upreti et al. 1985, Ralhan et al. 1982, Saxena & Singh 1982).

In the shrub layer, though the species richness ranged between 9 and 24, the diversity indexed for most of the communities was low indicating strong dominance by one or few species. Tewari and Singh (1985) reported a diversity range of 0.74-3.10 for the shrub layers in Kumaun Himalayan forests.

Thus, within a short elevational range of 1300m (2000 - 3300m), communities changed rather rapidly. Except for a few early successional communities, most of the communities are at mid or late successional stage. The study also suggests that the vegetation types overlap along the elevational gradient.

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