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Population Structure of *Pinus roxburghii* and *Quercus leucotrichophora* Forests of Almora Hills in Kumaun Himalaya

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ABSTRACT

The present study deals with phytosociology and population structure (through density-diameter distribution curve) of 16 forest sites along an altitudinal gradient (1400-2000 m) on south, north and west aspects of Almora hills of Kumaun Himalaya. The maximum density ;was exhibited by *Pinus roxburghii* Sarg. at lower altitude and by *Quercus leucotrichophora* A. Camus at higher altitudes. The diameter-distribution curve for all species exhibited an overall convex appearence. Lower aged populations were dominant in all sites. There appeared a tendency towards increasing evenagedness and marked absence of older trees due to management practices and biotic pressures.

Key words: Phytosociology, population structure, altitude, density-diameter distribution curve

INTRODUCTION

The diameter-distribution of stems has been frequently used to represent the population structure of forests (UNESCO/UNEP/FAO 1978). Density-diameter distribution curves may differ for even and all aged stands and in the number of large and small stems. According to Goff and West (1975) early successional forests may be distinguished from mature forests by the distribution of stems in different diameter classes. Considerable literature has been reviewed for tropical region by UNESCO/ UNEP/FAO (1978) and for temperate regions by West et al. (1981).

In the present paper, an attempt has been made, on the basis of 16 forest sites, to understand the phytosociology and population structure through density-diameter distribution curve of Almora district in Kumaun Himalaya.

MATERIAL AND METHODS

Location: The study site is situated about 10 km north-west of Almora town (29° 36' to 29° 38' N latitude, 79° 39' to 79° 41' E longitude) along an altitudinal gradient of 1400 m to 2000 m. The study was conducted in an area of about 400 ha.

Climate: The climate is monsoon temperate with three distinct seasons, namely winter (October to March), summer (April to 15th of June), and rainy (June 15th to September). For further details regarding the climate, please see Pandey and Singh (1981). The minimum and maximum monthly average temperatures fluctuated from 2.3° C (January) to 21.5° C (May) and from 12.8° C (January) to 32° C (May), respectively. Average annual rainfall is 797 mm, August and September were the wettest months of the year receiving about 70 per cent of the total precipitation.

Methodology: Phytosociological study of the forest was conducted by using 10 m x 10 m quadrats (Misra 1968) at altitudes of 1400 m to 2000 m along south, north and west

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aspects. The density (stem ha^{-1}) of trees, saplings and seedlings was calculated for each altitudinal zone of the tree aspects separately following Curtis and McIntosh (1950). Plants with cbh more than 31.5 cm were considered trees and those that had 10.5 to 31.4. cm cbh were considered as saplings or shrubs as the case may be, and individuals with 10.5 cm cbh were considered as seedlings (Knight 1963).

The density-diameter curve for all species of chir pine was constructed by summing up the density values for each species, in each diameter class interval over all sites and then dividing by the total number of sites examined. On the basis of West et al. (1981), the average tree diameters for all sites were calculated and the sites were grouped in four different age classes (diameter class from the youngest to the oldest: 24-29 cm, 30-33 cm, 34-39 cm, 40-44 cm).

RESULTS AND DISCUSSION

Pinus roxburghii covers 69 per cent of the total forest area, is dominant on lower altitudes and the dominance decreases considerably towards higher altitudes on all aspects. *Quercus leucotrichophora*, which covers 16 per cent of total forest area, exhibited dominance on higher altitudes and declined towards lower altitudes on all aspects. *Rhododendron arboreum* Smith showed dominance only on the west aspects of 2000 m altitude. Other associates, apart from the dominants across the aspects, are *Myrica esculenta* Ham. ex D. Don., *R. arboreum*, *Lyonia ovalifolia* (Wall.) Drude. and *Cedrus deodara* Hook. f., which have lesser density value and are sparsely distributed.

The density-diameter curves for all the species of the site indicated that the number of individuals decreased with the increasing diameter (size) class, indicating increasing removal rates of higher diameter classes (Fig 1). The curve exhibited an overall convex form and is different from the rotated sigmoid curve of deciduous forests (Goff and West 1975, West et al. 1981). This is probably due to the management practices of mother trees of chir pine by forest department (Fig 1). The curve for *P. roxburghii* forest is from convex-to-linear, as reported for short leaf pine by West et al. (1981) and for chir pine forests by Saxena et al (1984) which reflects shade intolerance character of the species. The curve for *Q. leucotrichophora* (ban-oak) is linear-to-concave. This is attributed to its moderate shade tolerance capacity. When the forest sites are stratified on the basis of mean diameter, the younger sites show a rotated sigmoid curve. The older sites show partly bell shaped

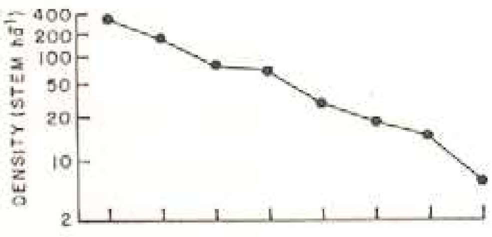

FIG.1

Fig 1: Density diameter distribution curves at all sites. (● -- ● for *Quercus leucotrichophora*)

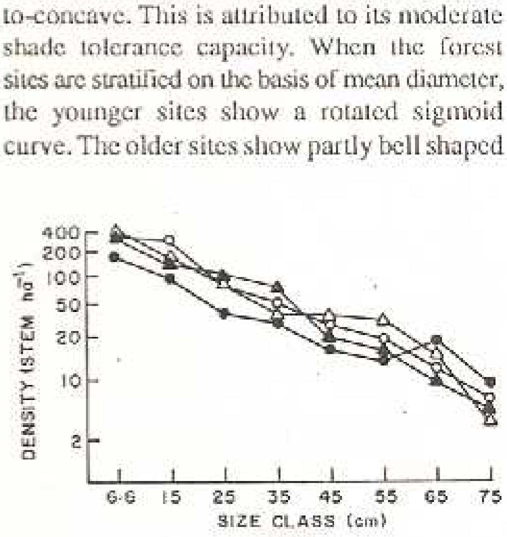

FIG. 2

Fig 2: Density-diameter distributions for all species at all sites across age sequence. Diameter strata are; 24-29 cm (△ -- △); 29-34 cm (▲ -- ▲); 34-39 cm (○ -- ○) ; 39-44 cm (●

curve at the extreme right side of the curve (Fig 2). Small diameter classes produce a steep negative slope on the left end of the curve. The curve again attains a steep negative slope in the large diameter classes at the far right side of the curve. Even-aged and all-aged stands also differ in the configuration of these curves. Much lower mortality and/or much faster growth rates in intermediate diameter classes resulting from trees emerging from the understorey in the forest canopy causes a laveling influence in the middle of the distribution curve.

The values for stem density of *P. roxburghii* and *Q. leucotrichophora* show that the largest number of small stems is found in the younger and middle aged sites and the lowest in the old-aged sites.

Thus, an overall convex appearence of density-diameter curves in both the forest sites has come up due to exploitation, which maximizes the even agedness and reflects predominance of early successional forests. The bell-shaped curve assumed by relatively-aged stand is typical of even-aged stands, regardless of species composition (Lee 1971). The exploitation of older trees of *Q. leucotrichophora* has encouraged shade intolerant species like *P. roxburghii* resulting in greater density of this species towards lower sized classes. It may be recalled that much of the area now occupied by pine was the result of conversion of original vegetation of oaks (Champion and Seth 1968).

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