TREE SPECIES COMPOSITION, REGENERATION AND DIVERSITY STATUS OF MISCELLANEOUS FOREST IN TARAI REGION OF KUMAON HIMALAYA

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Abstract: The study deals with the tree species composition, regeneration status and plant diversity of miscellaneous forest in tarai region of Kumaon Himalaya. The total tree basal area ranged from 2325.0 to 2974.7 cm^2 and density from 4.7 to 7.0 plants $100m^{-2}$ for tree layer, 8.0 to 18.4 individuals 100m-2 for saplings and 58.8 to 146.3 individuals 100m-2 for seedlings. Shannon-Wiener Index (diversity) values for tree layer ranged 2.408 to 2.862, concentration of dominance ranged 0.163 to 0.205 and equitability between 8.58 and 11.23. On the basis of data on population structure, a total of four patterns were recognized, *Mallotus philipinensis*, showed expanding population structure. Absence of lower girth classes of *Dalbergia sissoo* indicates that this early successional species is failing to regenerate with increasing density of forest cover. *Tectona grandis*, *Cassia fistula* were represented only by seedlings indicating they have invaded recently. Rest of the species exhibit accidental population structure.

INTRODUCTION

Forest vegetation of tarai is apparent from the foregoing that several destructive forces repeatedly obstructed and even reversed the natural course of species enrichment. The denudation of natural forests in the recent past and reforestation of fast growing species, which requires more water content results in drying up of natural springs and lowering the water level. The present paper reports on the natural pieces of forest vegetation, regeneration status and diversity patterns.

STUDY SITES AND METHODS

The study sites are located between 29°3'-29°12' N lat and 79°30'-79°40' E long in the tarai belt of lesser Himalaya. Tarai is the outlying level belt, corresponding with the deposition of finer materials. The climate of the tarai region is subtropical, monsoon type. The monthly rainfall ranges from 1.8mm in November to 421.4mm in July. The total rainfall is 1593mm. the mean annual temperature is 23.6°C, The January mean minimum is 14.4°C and the June mean maximum is 37.6°C.

The species composition of the relatively intact pieces of vegetation was accomplished by quadrat method (Misra, 1968). The size and number of quadrats were determined by running mean method (Kershaw, 1973). Diversity was computed by using Shannon-Wiener information index (Shannon-Wiener, 1963) concentration of dominance (cd) was measured by Simpson's index (Simpson, 1949) and equitability calculated by Whittaker's Species per log cycle. To determine population structure each tree species in addition to seedling and sapling classes, six more classes based on cbh (circumferance at breast height i.e. 1.37m). Were arbitrarily established (after Good and Good, 1972). Total number of individuals belonging to each size classes were calculatd for each species on each stand. The density of each girth class, for each species was divided by total density of that species on a stand. The resulting value was multiplied by 100 to yield per cent density for each size class for each species.

RESULTS AND DISCUSSION

In tarai forest, a clear-cut dominance by any single species was lacking and broadleaf species, like *Albizia procera* and *Kydia calycina* in canopy layer and *Mallotus philipinensis* in undercanopy layer were well represented. In this forest early succesioal species like *Bombax ceiba*, *Acacia catechu* and *Dalbergia sissoo* (Champion and Seth 1968) also occurred in substantial importance. Many species bore compound leaves (*A. procera*, *D. sissoo*, *K. calycina* etc.) with small leaflets which are especially adapted summer drought, which is relatively more severe at this site. The under canopy tree layer was fairly, continuous and *Mallotus philipinensis* the chief species (with an average important value index (IVI) of about 72) had the higher IVI value than the canopy species (Table.1). *Cedrela toona*, *Albizia procera*, *Kydia calycina* and *Dalbergia sissoo*, were common associates in the canopy layer with average IVI of 49.7, 45.0, 35.7 and 26.6, respectively. The total basal area ranged from 2325.0 to 2974.7cm^2 ha^{-1}, it is considerably lesser than the value reported (3600.0–7360.0cm^2 ha^{-1}) for tropical rain forests (Dawkins 1958, 1959, Burgess 1961, Kortawinata et al. 1981, Singh et al. 1984). As far as total density is concerned it was varied from 4.7 individuals $100m^{-2}$ to 7.0 individuals $100m^{-2}$ with highest proportion of *Mallotus philipinensis* in first stand (2.2 individuals $100m^{-2}$) and second stand (1.9 individuals $100m^{-2}$). While in third stand *Albizia procera* exhibited highest density (1.5 individuals $100m^{-2}$). Sapling layer density indicates that species which were predominant in the tree layer exhibit maximum density as *Mallotus philipinensis* possesses 11.0, 8.4 and 3.2 individuals $100m^{-2}$, respectively. Same pattern was

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also followed by seedlings layer having maximum density for *M. philipinensis* in all the stands (Table. 2). The total density of sapling layer was maximum in first stand (18.4 individuals $100m^{-2}$) and minimum (8.0 individual $100m^{-2}$) in third stand. Where as total seedling density varied from 58.8 individuals $100m^{-2}$ for second stand to 146.3 individuals $100m^{-2}$ for first stand.

Diversity is an important concept, and one of the major attributes of a natural community. It has often been related to various community attributes, such as productivity, structure, stability, niche structure and evolution. Of all the fundamental ecological variables, diversity is the one that best characterizes the biotic component of ecosystems. The first principle concerns the relationship between diversity and the stability of ecological factors. The greater the stability, the greater the diversity of the ecosystem. Diversity, as represented by Shannon-Wiener information index incorporates the highest value for second stand (2.862) and lowest for third stand (2.408). While in case of saplings maximum value (1.957) recorded for stand three, and minimum (1.678) for first stand. The diversity in sapling population was low than that of the trees in this forest. In case of shrubs diversity ranged 2.298 to 2.821. The concentration of dominance was low (0.163–0.205) for tree layer, (0.264–0.432) for sapling and 0.226–0.271) for shrubs. As compared with temperate forest, where a value as high as 0.99 is recorded (Whittaker, 1965, Risser and Rice, 1971). Species per log cycle index was positively correlated with species diversity in all the stages. Two of the mechanisms which seem likely to account for high diversity in tropical forests are : i) that of habitats are for less uniform then they appear, at least so far as seeds are concerned (Pielou, 1975) ii) that predation by insects and pathogens keeps population sizes regulated so that inter - tree competition is much less fierce than it seems (Janzen 1970).

The collection of data about age structure of individuals, particularly of the species which largely influence a community is of considerable significance, the data can be interpreted to show the future trend in tree composition. Relative stability in communities apparently results from the population function of individual species and small sets of interacting species, not from the richness in species of the whole community (May, 1971). An attempt was made to interpret certain trends of change in species composition on the basis of existing seeding, sapling and young populations.

Population structures of different tree species are given in Fig.1. In this forest *Mallotus philipinensis* showed an expanding population structure. However, in *Cedrela toona* and *Celtis tetrandra* indicates that disturbances in regeneration had occurred at past. *Tectona grandis* and *Cassia fistula* were represented only by seedlings, indicating that they have invaded only recently. *Dalbergia sissoo, Bombax ceiba, Engelhardtia indica* and *Broussonitia papyrifera* axhibited accidental population structure with absence of lower and higher girth classes. Many of these species are sun demanding and seem to regenerate in deeper shade. *Kydia calycina, Albizia procera* and *Eugenia frundosa* with absence of individuals in one or other of middle girth classes indicated interrupted population structure.

Table-1: Quantitative characters of trees, sapling & seedling layer of forest

Species	TREE LAYER								
	STAND 1			STAND 2			STAND 3		
	Density (tress-$100m^{-2}$)	Total basal area (cm^2 $100m^{-2}$)	IVI	Density (tress-$100m^{-2}$)	Total basal area (cm^2 $100m^{-2}$)	IVI	Density (tress-$100m^{-2}$)	Total basal area (cm^2 $100m^{-2}$)	IVI
Mallotus philipinensis	2.2	521.1	73.1	1.9	751.3	75.3	1.3	578.6	67.0
Cedrela toona	1.4	561.9	56.8	1.2	281.2	42.8	1.1	275.5	49.4
Albizia procera	0.2	131.9	13.0	1.1	416.9	33.1	1.5	1094.5	88.9
Kydia calycina	0.9	834.1	58.4	0.9	581.8	48.8	—	—	—
Dalbergia sissoo	0.6	564.1	39.2	0.7	521.3	40.6	—	—	—
Bombax ceiba	0.3	166.5	15.7	0.3	146.6	19.0	—	—	—
Acacia catechu	—	—	—	—	—	—	0.5	279.6	32.0
Engelhardtia indica	0.4	104.4	17.9	0.3	90.8	13.8	—	—	—
Celtis tetrandra	0.3	55.0	14.7	0.3	46.2	12.3	—	—	—
Callicarpa arborea	—	—	—	—	—	—	0.3	96.8	15.4
Eugenia frundosa	—	—	—	0.3	102.0	14.2	—	—	—
Broussonitia papyrifera	0.3	35.7	11.3	—	—	—	—	—	—

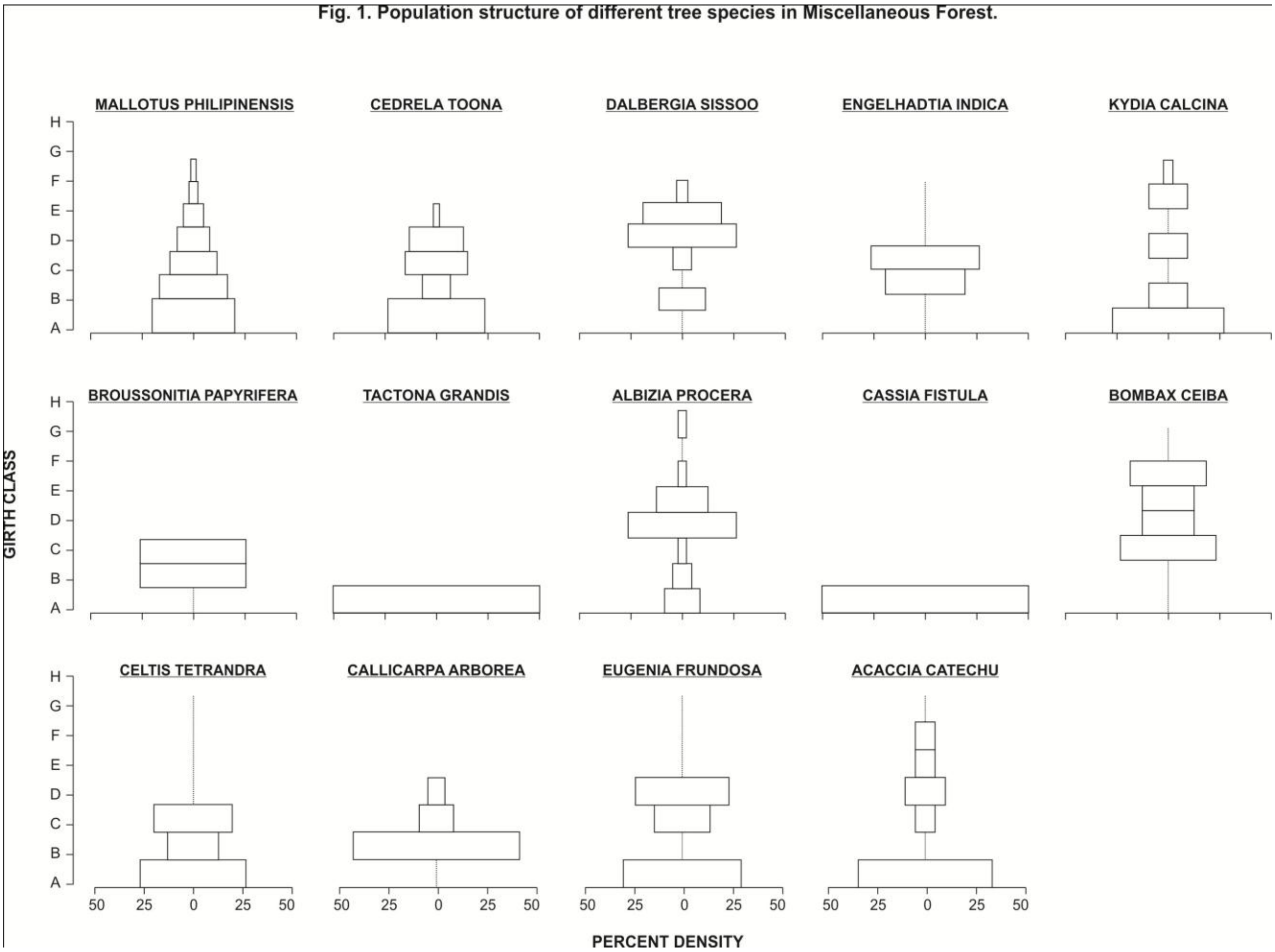
Table-2: Quantitative characters of trees, sapling & seedling layer of forests

Species	SAPLING LAYER						SEEDLING LAYER					
	STAND 1		STAND 2		STAND 3		STAND 1		STAND 2		STAND 3	
	Frequ-ncy (%)	Density (Ind. $100m^{-2}$)	Frequ-ncy (%)	Density (Ind. $100m^{-2}$)	Frequ-ncy (%)	Density (Ind. $100m^{-2}$)	Frequ-ncy (%)	Density (Ind. $100m^{-2}$)	Frequ-ncy (%)	Density (Ind. $100m^{-2}$)	Frequ-ncy (%)	Density (Ind. $100m^{-2}$)
Mallotus philipinensis	100	11.6	90	8.4	60	3.2	45	30.0	40	22.5	55	41.3
Kydia calycina	40	2.0	30	1.6	—	—	45	30.0	20	11.3	—	—
Cedrela toona	—	—	20	1.2	50	2.4	25	11.2	30	15.0	30	11.3
Callicarpa arborea	30	1.6	—	—	40	1.6	—	—	—	—	—	—
Albizia procera	—	—	—	—	50	2.8	—	—	—	—	40	15.0
Ficus mimuralis	30	2.0	—	—	—	—	—	—	—	—	—	—
Broussonetia papyrifera	30	1.2	—	—	—	—	—	—	—	—	—	—
Dalbergia sissoo	—	—	20	1.2	—	—	—	—	—	—	—	—
Celtis tetrandra	—	—	20	1.2	—	—	30	10.0	15	5.0	—	—
Cassia fistula	—	—	—	—	—	—	45	28.8	—	—	—	—
Erythrina arborescens	—	—	—	—	—	—	35	23.8	—	—	—	—
Tectona grandis	—	—	—	—	—	—	30	12.5	—	—	—	—
Acacia catechu	—	—	—	—	—	—	—	—	—	—	30.0	11.3
Eugenia frundosa	—	—	—	—	—	—	—	—	15	5.0	—	—

Table-3: Diversity and Related parameters

	Stands	Shannon-Wiener information index (Diversity)	Simpson's Index (Concentration of dominance)	Species per log cycle Index (Equitability)
	1	2.717	0.205	10.40
TREE LAYER	2	2.862	0.194	11.23
	3	2.408	0.163	8.58
	1	1.678	0.432	5.075
SAPLING	2	1.719	0.419	5.916
LAYER	3	1.957	0.264	13.28

Fig. 1. Population structure of different tree species in Miscellaneous Forest.



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