CHANGES IN THE SCENARIO OF DOMINANCE AND DIVERSITY IN *SHOREA ROBUSTA* GAERTN. F. (SAL) FORESTS OF LACHCHHIWALA, DOON VALLEY, INDIA

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Introduction

Change is the law of nature. It may be positive in the form of evolution or negative as destruction of ecosystems and extinction of flora and fauna. *Shorea robusta* Gaertn.f. (Sal) forests are no exception to these changes. Urbanization, a new symbol of prosperity, and reduction in forest cover are altering the temperature and reducing the rainfall of Doon valley (Negi *et al*., 2003). These factors coupled with infestation of deadly beetle *Hoplocerambyx spinicoris* and subsequent Sal mortality has created wide openings reducing the soil moisture of the forest floor and the Sal regeneration.

Lachchhiwala is a famous picnic spot of Dehra Dun. It owns one of most beautiful Sal forest of Doon valley. In recent years, especially after the inception of Uttaranchal in year 2000, Dehra Dun city is expanding exponentially. Other sources of disturbances in the region are the National Highway connecting Dehra Dun and the holy cities of Haridwar and Rishikesh, frequent forest fires, collection of fodder and fuelwood, grazing of cattle etc. Reduction in rainfall and rise in temperature due to these disturbances (Negi *et al*., 2003) has forced the locals to go for cooler places like Lachchhiwala, putting extra pressure on the picnic spot and its nearby forest (personal observation since year 1999).

All these perturbations must have put some impact on the dominance and diversity of plant species in Lachchhiwala forests and may have changed its structure. This paper attempts to analyse these changes by comparing the previous studies of Bisht and Sharma (1987) and Chauhan (2001) with the present work.

Material and Methods

The present study was carried out in Lachchhiwala Sal forest, lying between 30° 10' to 30° 13' N longitude and 78° 05' to 78° 06' E latitudes with average of 577m above sea level. The study site lies in Doon valley, which runs parallel to the Shiwaliks. This area is characterized by deep alluvial soil intersected by several streams and marshy places.

Vegetation surveys and other measurements were conducted during March-April, 2005. Vascular plants were assigned to one or more layers based upon the height: (i) tree layer, including woody spjecies>3m height (ii) shrub layer, including woody species from 1m to 3m height, and (iii) herb layer, including all

species< 1m height. Saplings of trees were included in the shrub layer and seedlings of trees and shrubs in herb layer. All the three layers were quantified using the nested quadrat method (Khan, 1961) in a transact line from North to South direction. A total of 75 quadrats of 10m x 10m, 3m x 3m and 1m x 1m sizes were laid for tree, shrub and herb layers respectively. The adequate sampling size was determined by the species area curve method given by Cain (1938).

In each quadrat, tree, shrub and herb species along with their number and diameter [diameter at breast height (DBH) for trees and collar diameter for shrubs and herbs)] were recorded to analyze the dominance of species and plant diversity of the three sites. Nomenclature of Kanjilal (1901) was followed for all the plant species.

Dominance of the plant species was determined by the Importance Value Index (IVI) species and Concentration of dominance (C_d). The importance value index of each species was calculated by the summation by the summation of relative values of frequency, density and dominance (Curtis and McIntosh, 1950, 1951; Mishra, 1968) for all three layers to compare the structure and dominance of various species. Data of 25 quadrats each was used to calculate the IVI of tree, shrub and herb layers of a site.

Concentration of dominance (C_d) was calculated for the observation of strongest control of species over space in different communities within the forest (Simpson, 1949).

$$C_d = \sum_{i=1}^{s} (pi)^2$$

where pi is the proportion of *i*th species and s is the number of individuals of all the species.

Diversity was measured using species richness (NO) calculated as the total number of species present in a site, and Shannon-Wiener diversity index (Shannon and Wiener, 1963) calculated from the importance values using the formula as given in Magurran (1988) :

$$H' = -\sum_{i=1}^{s} pi \ln pi$$

where H' is Shannon-Wiener Index of species diversity, and pi and s are same as in C_d.

Results are expressed as average of values. Data was analyzed for single factor by analysis of variance (ANOVA). SPSS and Microsoft Excel software of Windows was used for all the statistical analysis.

Results and Discussion

(i) *Dominance* : Sal was the most dominant species in the tree layer (IVI, 134.7), having the highest importance values index (IVI) (Table 1). *M. philippensis* and *Syzygium cumuni* were the co-dominant species. Lowest importance values were reported for *Holarrhena antidysentrica.* In the shrub layer *M. philippensis,* with 45.8 importance value, was the most dominant species. *Millettia auriculata, Clerodendrum viscosum, Flacourtia indica* etc. were the other important species present in the shrub layer. *Jasminum multiflorum* (IVI, 39.2) was the most dominant species in herbaceous layer, closely followed by *Millettia auriculata* (IVI, 39.1) and *Urena lobata* (IVI, 34.6).

Importance values of Sal in tree layer are well within the limits of earlier studies

Table 1

Importance Value Index (IVI) of plant species present in the tree, shrub & herb layers.

Species	Layer		
	Tree	Shrub	Herb
1	2	3	4
Acacia pennata Willd.	-	2.1	-
Achyranthes aspera Linn.	-	-	3.9
Adhatoda vasica Nees.	-	0.4	-
Ageratum conyzoides Linn.	-	-	2.2
Ailanthes excelsa Roxb.	2.1	-	-
Anogeissus latifolia Wall.	3.0	1.2	-
Ardisia solanacea Roxb.	8.1	7.8	5.7
Bauhinia variegata Linn.	15.9	5.8	-
Bauhinia vehlii W. and A.	-	4.5	-
Boehmeria macrophylla Don.	-	-	16.0
Bombax cieba Linn.	-	-	-
Callicarpa macrophylla Vahl.	-	3.7	-
Carissa opaca Stapf.	-	1.1	4.2
Caseaeria tomentosa Roxb.	2.0	2.8	-
Cassia fistula Linn.	23.5	4.2	-
Cheilanthes farinose Bl.	-	-	3.9
Cissampelos pareira Linn.	-	-	4.1
Clematis gouriana Roxb.	-	-	-
Clerodendrum viscosum Vent.	-	23.1	5.7
Coffea bengalensis Linn.	-	8.7	5.4
Colebrookia oppositifolia Smith.	-	1.8	-
Commelina benghalensis Linn.	-	-	4.3
Cordia dichotoma Forest. F.	-	-	-
Corida myxa Linn.	-	6.3	-
Cudrania javanensis Trecul.	-	-	-
Curculigo orchioides Gaertn.	-	-	6.8
Cynodon dactylon (Linn.) P. Beauv.	-	-	-
Cynoglossum zeylanicum Thunb.	-	-	-
Cyperus iria Linn.	-	-	12.1
Cyperus rotundus Linn.	-	-	-
Desmodium gangeticum DC.	-	-	3.4
Desmodium pulchellum Benth.	-	4.2	0.9

Contd...

1	2	3	4
Dioscorea deltoidea Wall.	-	1.1	5.5
Diospyros malabaricum (Gtn.) Gurke.	-	0.9	-
Ehretia laevis Roxb.	5.6	5.6	-
Emillia sonchifolia (Linn.) DC.	-	-	2.0
Eragrostis nigra Nees ex Steudl.	-	-	1.1
Ficus palmata Forsk.	-	0.3	-
Ficus religiosa Linn.	-	4.1	-
Flacourtia indica (Burm. f.) Merr.	1.8	28.8	-
Flemingia bracteata Wight.	-	2.3	-
Flemingia chappar Ham.	-	5.1	13.8
Grewia glabra Linn.	-	3.1	-
Hesperethusa crenulata Roxb.	-	-	3.5
Holarrhena antidysenterica Wall	1.6	2.2	-
Ichnocarpus frutescens Br.	-	-	16.2
Inula cuspidate Clarke	-	3.2	-
Jasminum multiflorum (Burm.f.) Andr.	-	22.1	39.2
Justicia japonica Thumb.	-	-	2.8
Lantana camara Linn.	-	1.5	-
Lindernia anagalis (Burm.f.) Penn	-	-	-
Litesa glutinosa (Lour.) C.B. Robinson	5.4	3.2	2.1
Mallotus philippensis Muell. Arg.	51.5	56.0	2.0
Millettia auriculata Baker.	-	32.7	39.1
Mimosa spp.	-	3.9	-
Murraya koenigii Spreng.	-	9.1	3.3
Oplismenus compositus (Linn.) P. Beauv	-	-	6.3
Ougeinia oojeinensis (Roxb.) Hocht.	-	0.4	-
Phyllanthus simplex Retz.	-	-	7.9
Phgastemon plectranthoides Desf.	-	-	0.8
Randia uliginosa DC.	-	2.9	5.1
Rungia pectinata (Linn.) Nees.	-	-	5.0
Saussurea albescens (DC.) Hook. f. and Thomas.	-	-	2.3
Shorea robusta Gaertn.	134.7	7.7	7.0
Sida cordifolia Linn.	-	-	2.7
Syzygium cumini (Linn.) Skeels.	39.9	10.3	6.5
Terminalia alata Heyne.	4.9	-	1.0
Terminalia belerica Roxb.	-	0.4	-
Terminalia chebula Retz.	-	6.4	5.2
Toona ciliate Roem.	-	0.6	-
Urena labota Linn.	-	7.5	34.6
Zingiber roseum Rosc.	-	0.8	6.2

of Bisht and Sharma (1987), Rawat and Bhaisora (1999), Pande (1999), Agni *et al*. (2000), Chauhan (2001) and Chauhan *et al*. (2001). The dominance of Sal is assured due to various silvicultural practices adopted in colonial times in the early twentieth century to have its monoculture. In these processes the natural associates of Sal and the outer corridor of forest were removed (Negi *et al*., 2003).

Dominance of Sal saplings and seedlings in the present study was lower than the previous studies (Bisht, 1989; Pande, 1999; Agni *et al*., 2000; Chauhan, 2001). This may be ascribed to the fact that forests of Lachchhiwala are very easy to access as they lie a few feet from national highway connecting Dehra Dun and the holy cites of Haridwar and Rishikesh. Other reasons, as stated earlier, may be that they are situated next to one of the most famous and busy picnic spots (Lachchhiwala canal) of Dehra Dun, forest fires, collection of fuel-wood and fodder, grazing of cattle etc.

The second index used for measuring the dominance was concentration of dominance (Cd) or Simpson's index (Simpson, 1949). The values of Cd (Table 2) for tree, shrub and herb layers, reveals that the site was heterogeneous as far as distribution of species is concerned. Sal forests of Doon valley are characteristically homogeneous in distribution due to various silvicultural operations carried out in the past (Negi *et al*., 2003), but the values of Cd in the present study are much less than the previous studies (Fig. 1). This means that the Sal forests of the Lachchhiwala are moving towards heterogeneity.

(ii) *Structural Diversity* : Values of species richness (NO) and species diversity index (H') are tabulated in Table 2. Species richness for the tree and shrub layers was 14 and 43 species respectively. In herb layer, the value of richness was 39. The value of H' of tree layer was 1.70, for shrub layer 2.94 and for herb layer 2.79.

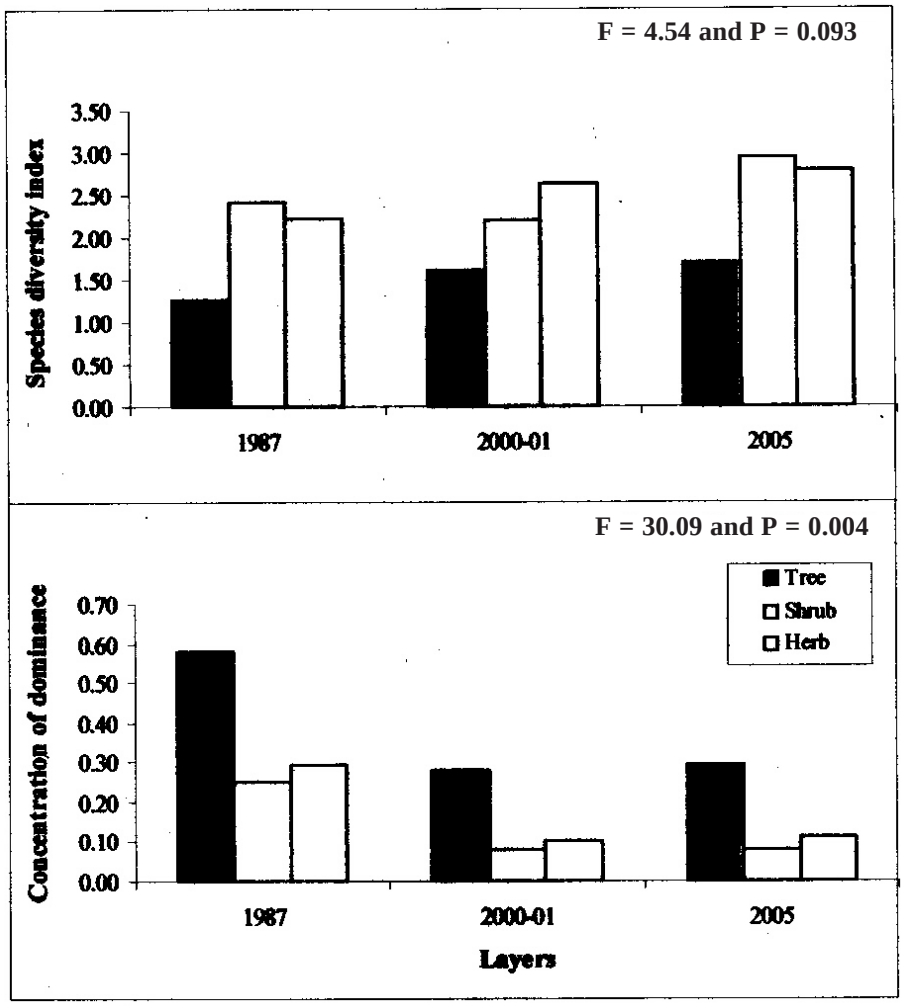
Species richness of species in Sal forests of Doon Valley is generally low. This may be due to false management practices adopted during the British rule to get the monoculture of Sal trees (Negi *et al.*, 2003). In tropical forests, values of species diversity (H') are generally high, between 5.06 and 5.40, (Knight, 1975) as compared to Indian forests, between 0.00 and 4.21 (Singh *et al*., 1984; Bisht and Sharma, 1987; Parthasarathy *et al*., 1992; Visalakshi, 1995; Pande, 1999; Agni *et al*.,

Table 2

Richness (NO), species diversity index (H') and Concentration of dominance (Cd) of tree, shrub and herb layers of Lacchiwala.

Layers	Richness	Species Diversity Index	Concentration of Dominance
Tree	14	1.70	1.29
Shrub	43	2.94	0.08
Herb	39	2.79	0.11

Fig. 1



Comparative state of species diversity and concentration of dominance in Lachchhiwala (Bisht and Sharma, 1987; Chauhan, 2001; Present study)

2000; Chauhan, 2001; Chauhan *et al*., 2001). The values of H' reported in the present study are well within these limits.

It has also been found that the values of H' have increased from 1.29 to 1.70 for tree layer, from 2.42 to 2.94 for shrub layer and from 2.22 to 2.79 for herb layer against the homogeneity (values of Cd), which has decreased in all the three layers (Fig. 1). As mentioned earlier, the reasons for this may be anthropogenic disturbances and infestation of *Hoplocerambyx spinicornis*. These disturbances have caused Sal mortality in patches, which has facilitated the canopy openings, promoted the invasion of species and finally increased the heterogeneity of these forests.

SUMMARY

Changes in an ecosystem are inevitable. Recording of these changes can prove to be fruitful for the management of forests, particularly the moist Sal forest. Present study was carried out in Sal Forests of Lachchhiwala, a famous pcinic spot, to assess the changes in dominanace and diversity of plant species since 1987. After critically analyzing the results it was found that Sal is still the most dominant tree species. In shrub and herb layers the species richness has increased significantly and so is the species diversity. It was also found that homogeneous Sal forests, managed as monocultures, are slowly but steady becoming heterogeneous.

लच्छीवाला, दून उपत्यका, भारत के *शोरिया रोबस्टा* गार्टन० वत्स (शाल) वनों की अधिरोहिता और विविधता परिदृश्य में हुए परिवर्तन

मुकेश कुमार गौतम, ए०के० त्रिपाठी व आर०के० मन्हास

सारांष

परिस्थिति–संहति में परिवर्तन होना अनिवार्यता है। इन परिवर्तनों को आलेखित करना वनों का, विशेषतः आर्द्र शाल वनों का प्रबन्ध करने में फलदायी सिद्ध हो सकता है। प्रस्तुत अध्ययन प्रसिद्ध वन विहार स्थली, लच्छीवाला के शाल वनों की अधिरोहिता और पादप जातियों की विविधता में 1987 के उपरान्त हुए परिवर्तनों का पता लगाने के लिए किया गया। इससे मिले परिणामों का समालोचनापूर्वक विश्लेषण करने पर हमें पता लगा कि शाल अभी भी अधिरोही वृक्ष जाति बना हुआ है। क्षुप और शाक स्तरों पर जातिगत सम्पन्नता में काफी वृद्धि हुई है और यही स्थिति जातिगत विविधता की है। हमने यह भी देखा कि एक जाति शाल वन, जिनका प्रबन्ध एकजाति संवर्धन की तरह किया जा रहा है, धीरे–धीरे परन्तु निश्चित रूप से विषम जातीय वन बनते जा रहे हैं।

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