DOMINANCE OF PROSOPIS JULIFLORA (SW.) D.C IN THE DELHI RIDGE FOREST OF THE SEMI-ARID REGION, INDIA

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ABSTRACT

Prosopis juliflora was introduced in the arid and semi-arid region to increase the vegetation cover and stabilize the inhospitable terrain. The dominance of *P. juliflora* on the natural plant communities were assessed in Delhi ridge forest. Four ridges were selected subjectively and 40 sites were studied. Sites were selected randomly within each ridge to cover density variation. Density, frequency, richness and evenness of the different tree species were studied in the quadrates distributed in the sites. The results indicated that the effect of *P. juliflora* on the associated flora was significantly high and it was found to be the dominant species. It effected the growth of other native species. Its density was 14.75 trees/ha, which was highest among the all species. The total Basal Area covered by *P. juliflora* was 24.72 m^2 per ha. Its frequency was 85% and other species frequencies were < 30%. IVI of *P. juliflora* was found to be very high i.e., 117.73 compared to the next co-dominant species i.e., *Albizzia lebbeck*, whose IVI was 26.83. The phytograph showed that their population was dependent on the Relative Dominance. The Evenness index of species was 0.41 which indicated that there was less variation in the ridge. The Simpson's Diversity index (D) was 0.166, which showed very less diversity.The proliferative growth of *P. juliflora has* reduced the growth of other native trees of the forest. Hence, plant diversity might be enhanced following eradication or control of the growth of *P. juliflora*.

Key words: *Prosopis juliflora, Delhi ridge forest,* Simpson's Diversity index,.

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Introduction

Prosopis juliflora (Sw.) DC. is a noxious invasive species that is native to America ranging from Peru to Mexico (GISP, 2004). It was introduced to several arid and semi-arid regions including parts of Rajasthan and Delhi, for greening of landscapes and for sand and desertification control; increase the vegetation cover and stabilize the inhospitable terrain. It *is* also known for providing various socioeconomic and ecological benefits as it is able to grow well on arid lands where other plants fail to survive. It is a highly drought tolerant, fast growing and has outstanding coppicing power which gave it competitive advantages over native species. *P. juliflora* are now naturalized in many introduced regions where they have become invasive (Zimmerman, 1991; Pasiecznik *et al*., 2001; Shiferaw *et al*., 2004; van Klinken *et al*., 2006; Mwangi and Swallow, 2008). The success of *P. juliflora* is largely attributed to the high number of seeds produced and their efficient dispersal mechanisms (Shiferaw *et al*., 2004). In addition, its fast growing ability, dormant seeds, attractive and rewarding pods, seeds maintaining viability in the droppings of livestock and wild animals, resistance to browsing, incredible ability

of re-sprouting and fast coppice growth (Shiferaw *et al*., 2004), and high water use efficiency (Felker *et al*., 1983) contribute to its invasion. No other tree *Prosopis* is now developing into a serious threat to biodiversity (Pines, 2009; Prosopis Technical Working Group, 2009). No other desert tree has as pervasive an influence upon soil physical, chemical, biological and moisture properties, sub canopy micro-climate, neighbouring vegetation and wildlife (Peters, 1991).

Study Site

Delhi, the capital city of India is located between the 28º 24' 17" and 28º 53' 00" N latitudes and 76° 45' 30" and 77 º 21' 30" E longitudes and it spreads over an area of 1,463 km². It is situated on Aravali quartzite rage of Rajasthan. The climate is semi-arid with maximum rainfall is in the month of July (296 mm), October to December are dry. While the hottest months are May and June with maximum temperature upto 48°C, whereas, the lowest falls to 4°C at the end of December and early January. Soil present here has sandy loam texture with slightly alkaline pH ranging between 7-8.
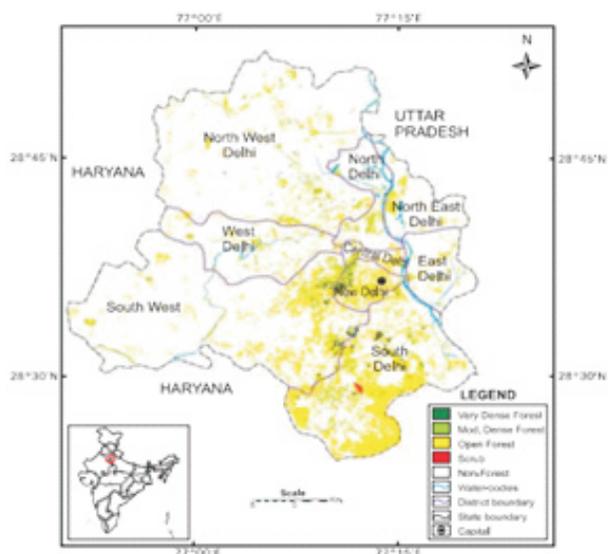

Figure 1. Forest cover of Delhi (Source : Forest deptt. of Delhi).

Delhi Ridge, a densely forested region within the Union Territory of Delhi is the lung of Delhi . The ridge comprises the tail end of the Aravallis. It is located towards the southern region of the city and heads northwest towards the west bank of Yamuna. The region is divided into four distinct zones. About 6,200 hectares of the Southern Ridge, which extends beyond the city limits, towards Haryana includes 1,900 hectare of the recently notified Asola Wildlife Sanctuary. The south central Ridge 626 hectare in extent includes the Kishangarh forest or Sanjay Van, one of the best preserved patches of forest in Delhi. Central Ridge lies within the heart of the city and is approximately 869 hectares. The smallest section, the 87 hectare northern Ridge lies like an emerald scimitar between Civil Lines and the University Campus in north Delhi.
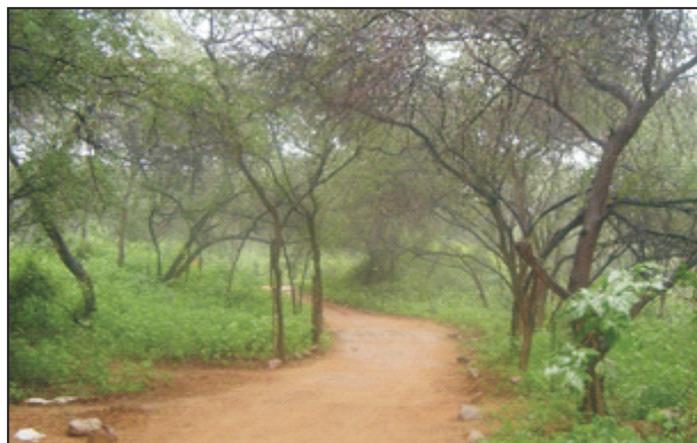
Figure 2. The ridge forest which is dominated by *P. juliflora.*

Materials and Methods

Field sampling

Forty sites of 10 x 10 m² area were selected randomly in each of the ridge to lay the quadrate to study the diversity of trees. Different varieties of trees were counted and the diameter was measured at breast height i.e. 1.37m above the ground.

Data analysis

The vegetational data were quantitatively analysed for dominance, density, frequency according to the formula given by Curtis and McIntosh (1950). The relative values of frequency, density and dominance were determined following Philips (1959). These three quantities were summed to represent IVI of individual species (Curtis, 1959).

The dominance was determined as Simpson's index (Cd = S pi²) and diversity as Shannon's index (H' = - S pi ln pi), where, pi represents the proportional abundance of ith species in the community. The degree of Evenness was calculated by Pielou's index (E = H'/ ln S), where, S is the total species richness of the community. These indices were determined by the help of software, Past.

Results and Discussion

P. juliflora was the most dominant species found in the ridge forest with IVI = 117.73 (Table 1). The co-dominant species was found to be *Albizzia lebbeck* (IVI =26.83). Lowest IVI (2.19) was recorded in *Haplophragma adenophyllum* and it was as rare species. Its basal area cover was 0.04m² per hectare. The phytograph shows the relative dominance is the main contributing factor in determining the IVI (Figure 3). This clearly indicates the invasive nature of *P. juliflora* by dominating in the ridge and suppressing the growth of the native species.

Highest density and frequency was also of *P. juliflora* i.e. 14.75 trees/ha and 0.85, respectively in the quadrat study. Maximum Basal area covered in the forest was by *P. juliflora* i.e. 24.72 m² per hectare because of the dominance of this tree. Simpson's diversity index (D) was found to be 0.1663 (Table 2). It shows that in the ridge forest there is dominance of only few species and rest of the species are less in number. Species richness was high but less evenness among the species. And IVI also indicates that *P. juliflora* dominated over other trees in the ridge. Shannon index was 2.376, which also indicated the high dominance of *P. juliflora*. Further, the species which were found most frequently had small leaves, thorny stems, woody branches as in *P. juliflora, Acacia catechu, Albizzia lebbeck, Murraya koengii,* etc. This clearly accounted for the prevalence of xeric conditions (Chauhan *et al.*, 2001).

Table 2. Diversity indices of the tree species of the Delhi ridge forest.

Dominance (D)	0.1663
Shannon index (H)	2.376
Simpson index (1-D)	0.8337
Evenness	0.4139

Table 1 . Phytosociological attributes of the tree species in the Delhi ridge forest.

| SPECIES	TOTAL B. AREA (per ha)	FREQUENCY	DENSITY (trees/ha)	DOMINANCE	RELATIVE FREQUENCY (%)	RELATIVE DENSITY (%)	RELATIVE DOMINANCE (%)	IVI
Prosopis juliflora	24.72	0.85	14.75	0.2472	25.373	35.329	57.030	117.732
Albizzia lebbeck	3.34	0.3	4.25	0.0334	8.955	10.180	7.696	26.831
Haplophragma adenophyllum	0.04	0.05	0.25	0.0004	1.493	0.599	0.094	2.185
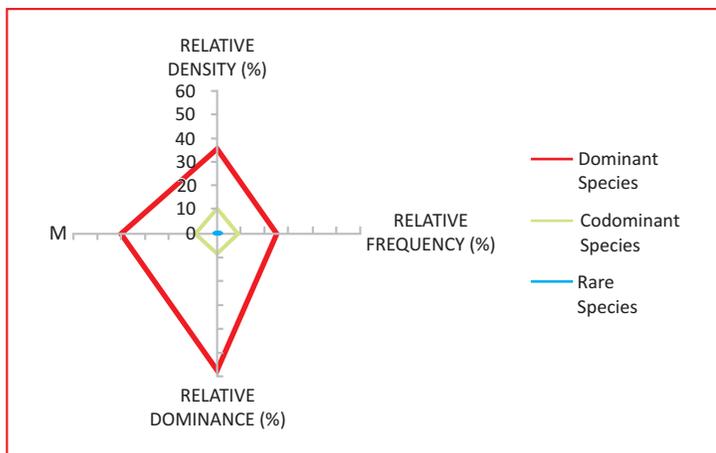
Figure 3. Phytograph showing dominant, codominant and rare species in the Delhi ridge forest. (Dominant spp.= *Prosopis juliflora*, Codominant spp.= *Albizzia lebbeck,* Rare spp.= *Haplophragma adenophyllum*).

Conclusion

Quantitative assessment of the tree community has been conducted for sustainable management and monitoring of species inside protected forest area. There was dominance of only *P. juliflora* throughout the ridge forest. The target for which *P. juliflora* was planted has been achieved but now the aim should be its strategic management so that it could benefit the society and environment.

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