

WOODY VEGETATION OF THE DIFFERENT FOREST AREAS IN THE ALWAR DISTRICT OF RAJASTHAN

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Density and frequency of woody species of 24 reserve forest areas were estimated in Alwar district of Rajasthan (27°4' to 28°4' north latitude and 76°7' to 76°13' east longitude). Forty five woody species consisting of 25 tree and 20 shrub species were recorded in the study samples. *Anogeissus pendula* is the dominant tree with highest density varying from 17.4 per 100m² in the Rajgarh to 7.9 per 100m² in the Laxmangarh forest range. It is uniformly distributed with 100 per cent frequency in 5 out of 6 forest ranges. Among the shrubs, *Capparis sepiaria*, *C. decidua* and *Grewia flavescens* grow in almost all the forest ranges. *Acacia catechu*, *Commiphora wightii*, *Mimosa hamata*, *Sterculia urens* and *Tecomella undulata* are the rare species of these forests. A gymnosperm, *Ephedra foliata* grows in the Jakharana forest of the Behror range. The alien invasive species, *Prosopis juliflora* has invaded with density varying from 6.9 to 2.0 per 100m² almost all forest areas in Alwar district.

Keywords: Density; Forest range; Frequency.

Introduction

Tropical dry deciduous forests occupy 54 percent of the 86 percent of the tropical forest area in India¹. However, Dixit² have reported that the tropical dry deciduous forest occupy 38 percent of the total forest area in India. These forests are commonly found in the plains of Rajasthan and Madhya Pradesh. In Rajasthan, the hilly topography provides a wide variety of micro-habitats in the Aravalli mountain ranges which support rich biodiversity of plant species. However, the forests of Jakhrana in Behror range and Methna in Laxmangarh range are example of torpical dry deciduous thorn forest in plain areas in Rajasthan.

The preliminary floristic study of the Alwar district was initiated by Vyas³. The systematic description of most of the plant species of this region is presented in the Flora of North-East Rajasthan⁴. The first serious attempt to enumerate the plant species of the Sariska Tiger Project was made by Parmar⁵ who reported 403 plant species belonging to 86 families of vascular plants. Yadav⁶ studied the flora of permanent sandy pathways of Alwar district which may represent the relics of the past vegetation of the region. Yadav⁷ discovered the new habitat of *Tephrosia collina* var. *lanuginocarpa* in the Bala-fort forest in Alwar which was earlier reported to be confined to hills within a small area at Todgarh in Ajmer⁸. Twenty species of Angiosperms have been added to the flora of North-East Rajasthan⁹. Yadav and Yadav¹⁰ have

investigated the vasuclar flora of the Bala-fort forest in which they have reported 190 plant speices belonging to 47 families from an area of about 2 km² of this forest.

Besides floristic studies, the distribution and natural regeneration of *Holoptelea integrifolia* has been evaluated¹¹. The effect of micro-environment and human disturbance on the plant diversity of the Sariska Tiger Projected was evaluated^{12,13}. They observed that the spatial heterogeneity created by the Aravalli mountain range supports high species diversity of the plants; and once the vegetation is disturbed by human interference it is almost impossible to restore original vegetation structure even if the disturbing factor has been removed. Yadav and Yadav¹⁴ analysed the vegetation composition and species diversity of the Bala-fort reserve forest. The population structure of the tree species of the Sariska reserve forest and the Bala fort reserve forest have been evaluated^{14,15}. The phenology of the selected woody species of the Bala fort forest and the Sariska reserve forest have been evaluated^{16,17}. The natural regeneration of tree species in the Sariska Tiger Project is very poor becuase of the lengthy dry period, frequent droughts which occur in this region and grazing by wild animals¹⁸. Hence, it was suggested that these forest ecocystems should be preserved as such without any anthropogenic disturbance. Although considerable work has been done to analyse the composition and plant species diversity of the Sariska

reserve forest and the Bala-forest reserve forest, further investigation is required to understand the vegetation composition of other kinds of forest habitats present in this region. Hence, the survey of the different forest regions was carried out to understand the distribution of woody vegetation of the forest areas of Alwar district of Rajasthan.

Material and Methods

Study site: The Alwar district covers an area of about 8400 km², is situated between 27°4' to 28°4' north latitude and 76°7' to 76°13' east longitude in the north eastern part of Rajasthan state. The characteristic feature of the district is the Aravalli mountain range which runs for about 81 km from south to north. The Aravalli hills cover the whole of the Thanagazi and Rajgarh tehsils and about one third of Alwar tehsil and form important features in Bansur, Kishangarh and Tijara tehsils¹⁹. The valleys and plateaus are at a height of 377-380 m and the peaks of the world's oldest Aravalli mountain range are as high as 640m above sea level. The remarkable characteristics of the hills are their homogeneity of height, level summits and uniform appearance, stretching out from north-east to south-west in more or less parallel lines²⁰. The largest and most conspicuous rock groups of the district are named as Delhi system as these belong to the famous ridge at Delhi, which is composed of quartzite belonging to this formation. Geologically the Aravalli formations are less observable features throughout the district. They consist of mica, schists, granite, schistos, quartzite and marble or crystalline limestone. The rocks of Aravalli formations are much older than the Delhi system. Indeed, they appear to have been subjected to an enormous amount of erosion¹⁹.

There is great spatial heterogeneity due to the presence of Aravalli mountain range in the Alwar district. The forest areas can be divided in three chief kind of habitats :

(i) The hilly terrain areas which include the forest regions of Behror, Thanagazi, Rajgarh, Laxmangarh and Tijara forest ranges. (ii) The sandy plain area is represented by the Jakhrana forest area is the Behror and Indore in Tijara forest range. (iii) The sandy loam plain area in Methna in Laxmangarh forest range. These habitats have many specific species adapted to various edaphic factors.

The climate is hot and dry with three distinct seasons in a year. The summer season is from mid March to June is extremely hot with temperature soaring to 47°C, the hot westerly winds blow during the month of May and June known as 'loo' during this season. The rainy season is from July to mid September with 90 percent of

average annual rainfall (620mm) occurring during this period. The dry cold winter season is from October to February with temperature dropping to 0°C in December and January months and the light showers of rainfall also occurs in these months.

Methods : The survey of forest areas in Alwar district was carried out in six forest ranges, *i.e.* Behror, Kishangarh Bas, Rajgarh, Thanagazi, Laxmangarh and Alwar. The behror forest range includes Banhar, Tasing, Jakharana, Renanagar, Beroje, Hamirpur and Nangal singhalka forest areas. Similarly the Kishangarh Bas forest range includes Jajorbas, Nimali, Indore, Tijara, Ismilepur; the Rajgarh forest range includes Rajpura, Bighota, Kundla. Machari, Bhulari; the Thanagazi forest range includes Malutana, Narayanpur, Garhbasai: the Laxmangarh forest range includes Methna, Kirori kund, Mojpur: the Alwar forest range includes the Bala-fort forest. Thus the botanical survey was carried out in 24 forest areas of the Alwar district. In each forest area 10 quadrats of 10m x 10m were laid down at random to evaluate the density and frequency of the woody plant species in 2011-2012.

Results and Discussion

The vegetation of the Alwar district is mainly tropical dry deciduous thorn forest type according to Champion and Seth²¹, however, the species composition varies depending upon the type of habitat.

(i) **The hilly terrain:** The vegetation of these forest areas is dominated by *Zizyphus nummularia*, *Butea monosperma*, *Acacia leucophloea* and *Prosopis juliflora* at the base of the slopes and *Anogeissus pendula*, *Boswellia serrata*, *Acacia senegal* and *Euphorbia caducifolia* on the hill slopes. The common shrubs are *Capparis sepiaria*, *Grewia flavescens* and *Grewia tenax* throughout the region.

(ii) **The sandy plain forest area:** There two habitats, one at Jakhrana covering an area 35.6 hectares and the other at Indore in Tijara covering an area of 2290 hectares. The dominant tree species at Jakhrana forest are *Salvadora oleoides*, *Prosopis cineraria*, *Acacia nilotica* and *Capparis decidua*. The shrubs are *Lycium barbarum*, *Mimosa hamata* and *Zizyphus nummularia*. A gymnosperm, *Ephedra foliata* grows among the shrubs in this forest. The sandy base of hills at Indore and Tijara in the Kishangarh forest range are dominated by *Zizyphus nummularia* whereas on the hill slopes *Anogeissus pendula* is more common.

(iii) **The sandy loam plain forest area :** This habitat is situated at Methna forest on the border of Bharatpur district. The dominant tree and tree like species are *Salvadora oleoides* and *Capparis decidua*. The other

Table 1. Density (100m²) of woody species in different forest ranges of Alwar district, Rajasthan.

Plant species	Forest ranges					
	Behror	Kishangarh Bas	Rajgarh	Thanagazi	Laxmangarh	Alwar
<i>Acacia catechu</i>				1.33		
<i>Acacia leucophloea</i>	2.47	0.8	0.8	0.83	0.83	0.03
<i>Acacia nilotica</i>	0.28	0.4	1.6	0.33	2	
<i>Acacia senegal</i>	2.12	0.8	2.2	0.73	2	1.77
<i>Acacia tortilis</i>	0.88	0.56		0.33	0.33	
<i>Anogeissus acuminata</i>						0.83
<i>Anogeissus pendula</i>	10.56	13.36	17.38	12.43	7.9	8.9
<i>Balanites aegyptiaca</i>	0.48	1.2		1	1.33	
<i>Boswellia serrata</i>	1	1	4.3	8.96		0.67
<i>Butea monosperma</i>	0.66	1.3	2	0.66	6.6	0.2
<i>Capparis decidua</i>	1.54	0.58	0.6	0.33	3.6	0.1
<i>Capparis sepiaria</i>	1.75	2.12	0.8	3.16	2.5	0.76
<i>Clerodendrum phlomidis</i>	0.28	0.2			0.03	0.65
<i>Commiphora wightii</i>	0.03		0.02	0.4		0.08
<i>Cordia Dichotoma</i>						0.19
<i>Dendrocalamus strictus</i>	4.28					
<i>Dichrostachys cinerea</i>	1.16		1	0.33		0.14
<i>Diospyros kanjilali</i>		0.6				
<i>Ehretia laevis</i>	0.86					0.06
<i>Ephedra foliata</i>	0.18					
<i>Euphorbia caducifolia</i>	0.01		0.8	1.93		
<i>Feronia limonia</i>					0.03	
<i>Ficus mollis</i>	0.01	0.02				0.01
<i>Flacourtia indica</i>	0.63	0.02		3.3		0.01
<i>Grewia flavescens</i>	1.28	1.9	0.9	3.66		5.56
<i>Grewia tenax</i>	0.72	1	1	0.83		1.87
<i>Grewia tilifolia</i>	0.47					
<i>Hamamelis integrifolia</i>	0.21	0.52	0.22	0.1		0.29
<i>Hamamelis mandelica</i>	0.18	0.02	0.2	1	3.4	0.21
<i>Hamamelis arbarum</i>	2.18	2.2	1	2.16	0.66	
<i>Hamamelis emarginatus</i>	0.31			0.76		
<i>Melia azadirachta</i>	0.03		0.4		0.33	0.01
<i>Mimosa hamata</i>	0.36	0.2				
<i>Mitragyna parviflora</i>	0.01				0.7	
<i>Moringa oleifera</i>					0.03	0.01
<i>Nyctanthes arbor-tritis</i>		1.5				
<i>Phoenix sylvestris</i>		0.2	0.2			
<i>Prosopis cineraria</i>	0.86	0.2			0.76	
<i>Prosopis juliflora</i>	5.8	5.3	2	3.43	6.86	
<i>Rhus mysurensis</i>	5.04		0.8	9.43		
<i>Salvadora oleoides</i>	0.17	0.2			1.03	
<i>Sterculia urens</i>	0.03			0.33		0.02
<i>Tecomella undulata</i>					0.03	
<i>Wrightia tinctoria</i>	0.14	0.2	1.4		0.33	0.13
<i>Zizyphus nummularia</i>	11.18	16.5	25.16	2.06	13.86	0.38

Table 2. The frequency (%) of woody species in various forest areas in Alwar district of Rajasthan.

Plant species	Forest ranges					
	Behror	Kishangarh Bas	Rajgarh	Thanagazi	Laxmangarh	Alwar
<i>Acacia catechu</i>				33.3		75
<i>Acacia leucophloea</i>	28.6	80	60	66.6	33.3	100
<i>Acacia nilotica</i>	28.6	20	60	33.3	100	
<i>Acacia senegal</i>	85.71	60	60	33.3	100	100
<i>Acacia tortilis</i>	28.6	20		33.3	33.3	
<i>Anogeissus acuminata</i>						25
<i>Anogeissus pendula</i>	100	100	100	100	66.6	100
<i>Balanites aegyptiaca</i>	42.9	100		33.3	66.6	
<i>Boswellia serata</i>	14.3	40	80	100		75
<i>Butea monosperma</i>	28.6	60	60	66.6	33.3	75
<i>Capparis decidua</i>	85.71	20	60	33.3	100	25
<i>Capparis sepiaria</i>	85.71	80	60	66.6	100	75
<i>Clerodendrum phlomidis</i>		20			33.3	25
<i>Commiphora wightii</i>	14.3		20	33.3		75
<i>Cordia dichotoma</i>						100
<i>Dendrocalamus strictus</i>	14.3					
<i>Dichrostachys cinerea</i>	14.3		60	33.3		50
<i>Diospyros kanjilali</i>		20				
<i>Ehretia laevis</i>	14.3					75
<i>Ephedra foliata</i>	14.3					
<i>Euphorbia caducifolia</i>	14.3		60	100		
<i>Feronia limonia</i>					33.3	
<i>Ficus mollis</i>	14.3	20				25
<i>Flacourtia indica</i>	42.9	20		33.3		25
<i>Grewia flavescens</i>	14.3	80	40	100		100
<i>Grewia tenax</i>	28.6	40	60	33.3		100
<i>Grewia tilifolia</i>	14.3					
<i>Holoptelea integrifolia</i>	42.9	40	40	33.3		100
<i>Lannea coromandelica</i>	14.3	20	20	66.6	66.6	75
<i>Lycium barbarum</i>	85.7	60	20	66.6	66.6	
<i>Maytenus emarginatus</i>	28.6			33.3		
<i>Melia azadirachta</i>	28.6		20		33.3	25
<i>Mimosa hamata</i>	14.3	20				
<i>Mitragyna parviflora</i>	14.3				66.6	
<i>Moringa oleifera</i>					33.3	25
<i>Nyctanthes arbor-tritis</i>		20				
<i>Phoenix sylvestris</i>		20	20			
<i>Prosopis cineraria</i>	14.3	20			66.6	
<i>Prosopis juliflora</i>	57.1	60	60	100	100	
<i>Rhus mysurensis</i>	28.6		40	100		
<i>Salvadora oleoides</i>	42.9	20			66.6	
<i>Sterculia urens</i>	14.3			33.3		50
<i>Tecomela undulata</i>					33.3	
<i>Wrightia tinctoria</i>	14.3	20	40		33.3	75
<i>Zizyphus nummularia</i>	100	100	100	100	100	75

associated tree species are *Acacia nilotica*, *Prosopis juliflora*, *Prosopis cineraria* and *Acacia senegal*. The shrubs include *Zizyphus nummularia* and *Dichrostachys cinerea*.

Density: Forty five woody species which includes 25 tree and 20 shrub species were recorded in the study samples in various forest areas of Alwar district. The density of dominant tree, *Anogeissus pendula* was highest in the Rajarh (17.4 per 100m²) and lowest in the laxamangarh forest range (7.9 per 100m²). This is followed by *Boswellia serrata* from 8.9 per 100m² in the Thanagazi to 0.7 per 100m² in Alwar range and *Acacia leucophloea* density varying from 2.5 per to 0.03 per 100m² in different forest ranges. *Acacia nilotica*, *A. senegal*, *Lannea coromandelica*, *Holoptelea integrifolia*, *Prosopis cineraria*, *Salvadora oleoides* and *Wrightia tinctoria* is less than 2 per 100m². The rare tree species are *Cordia dichotoma*, *Ficus mollis*, *Feronia limonia*, *Sterculia urens* and *Tecomella undulata* are represented by one or a few individuals. Among the shrubs, the dominant species is *Zizyphus nummularia* with density varying from 25 to 0.38 per 100m² followed by *Capparis sepiaria* with density varying from 3.2 to 0.8 per 100m² and *Grewia flavescens* from 5.6 to 0.9 per 100m² in different forest ranges (Table 1). The other common shrubs are *Lycium barbarum*, *Capparis decidua*, *Clerodendrum phlomidis*, *Flacourtia indica* and *Dichrostachys cineria*. The rare shrubs are *Commiphora wightii*, *Maytenus emarginatus* and *Mimosa hamata*. The alien invasive tree species, *Prosopis juliflora* has density varying from 6.9 to 2 per 100m² in different forest areas in this district.

Frequency: *Anogeissus pendula* is uniformly distributed in all the forest ranges with frequency 100 per cent except Laxmangarh range where its frequency is 66.6 per cent (Table 2). It is followed by *Boswellia serrata*, *Acacia leucophloea*, *A. senegal*, *Butea monosperma*, *Lannea coromandelica* and *Holoptelea integrifolia*. The alien species, *Prosopis juliflora* is also commonly distributed in all the forest ranges with frequency varying from 100 to 57 per cent. The shrub *Zizyphus nummularia* is most uniformly distributed with frequency ranging from 100 to 75 per cent followed by *Capparis sepiaria*, *C. decidua* and *Grewia flavescens* with frequency varying from 100 to 25 per cent in different forest ranges (Table 2). The other shrubs have irregular distribution such as *Flacourtia indica*, *Balanites aegyptiaca* and *Dichrostachys cinerea* occur in four forest ranges whereas *Clerodendrum phlomidis*, *Maytenus emarginatus* and *Mimosa hamata* grow only in two forest ranges.

Economically important plant species: Biodiversity is a

very valuable resource. Besides providing various forest ecosystem services, the plants are used daily by man to meet food, energy, medicine, timber and other requirements. Several woody species of tropical dry deciduous thorn forests of Alwar district are used as source of food, for example, fruits of *Zizyphus nummularia*, *Rhus mysurensis*, *Flacourtia indica*, *Phoenix sylvestris* and *Salvadora oleoides* are eaten by man and other animals. The leaves of *Anogeissus pendula*, *Boswellia serrata*, *Prosopis cineraria* and *Zizyphus nummularia* are highly nutritious and used as fodder. *Acacia nilotica*, *Prosopis juliflora*, *Anogeissus pendula* and *Prosopis cineraria* are also used as fire wood by the local population. The dried leaves of *Salvadora oleoides* are used for baking bricks. The timber is obtained from *Tecomella undulata*, *Melia azadirachta*, *Acacia nilotica*. The local people also use wood of *Prosopis cineraria* and *Holoptelea integrifolia* as a low quality timber. The forests of Alwar district have several plants which are used as source of medicine, such as *Commiphora wightii*.

It may be concluded that the forest areas of Alwar district are rich in diversity of woody species with about 25 tree and 20 shrub species. The dominant tree species is *Anogeissus pendula* followed by *Boswellia serrata* and *Acacia* spp. The dominant shrubs includes *Zizyphus nummularia*, *Capparis* spp. and *Grewia flavescens*. There are many rare species represented by only a few individuals. Many of these woody species are of immense economic value.

Acknowledgements

The author is grateful to Shri B P Pareek, the then Deputy Conservator of Forest, Alwar for providing inspiration and all facilities in accomplishing this task. The financial assistance received from the Department of Forest, Government of Rajasthan is gratefully acknowledged.

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