

# Phytosociological studies on the vegetation of sand dunes and sandy plains of ajmer (Rajasthan)

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## Abstract

The phytosociological study of Ajmer sand dunes shows that three sites of the study i.e. Leela Sewri, Pushkar Valley Base & Pachkund, are dominated by *Acacia senegal* (Mimosaceae). *Acacia tortilis* (Mimosaceae) and *Eucalyptus camaldulensis* (Myrtaceae). All these three species are represented by highest frequency values in class-A. Species such as *Acacia leucophloea*, *Acacia senegal*, *Acacia tortilis* and *Maytenus emarginata* are present in all three localities and are different in respect of phytosociological parameters, height, girth and canopy width. In the present study shrubs and trees of sand dunes were differentiated on the basis of profile diagrams and scattering patterns of height and canopy width.

**Keywords:** Frequency, height, girth, canopy width, profile diagram, scattering, pattern.

## INTRODUCTION

Western Indian desert has been divided into five major phytogeographical divisions (PHD'S) i.e. sand dunes, sandy plains, stony and hilly tracts, gravel and compact tracts and saline area [1]. Basically these PHD'S differ from each other in their floristic composition due to topographical and geological formations. Being the position of Ajmer in central Aravallis and just on the line of demarcation between western arid and middle semiarid zone (Fig-1) the climatic conditions are slightly favorable and the area shares the floristic elements of both hilly and sandy tracts. Since the sand dunes and sandy plains surveyed for the present phytosociological study are situated in the northwest Aravalli gaps has not been studied phytosociologically except a list of trees and shrubs given by [2] Sharma (1958) has studied the vegetation of some hilly and sandy tracts of Ajmer and [3] Sharma et al (1990) had given a list of grasses.

## MATERIALS AND METHODS

Phytosociological analysis of various shrubs and tree species was studied in terms of frequency, density, cover and I V I as per the method described by Misra (1968) [4]. For trees and shrubs 20 quadrates of 10x10 m were counted. Frequency, density, abundance cover and I V I were calculated by the following formulae

$$\% \text{ Frequency} = \frac{\text{No. of quadrates of occurrence}}{\text{Total No. of quadrates studied}} \times 100$$

$$\text{Density} = \frac{\text{Total No. of individuals of a species}}{\text{Total No. quadrates studied}}$$

$$\text{Abundance} = \frac{\text{Total No. of individuals of a species}}{\text{Total No. of quadrates of occurrence}}$$

$$\text{Basal area} = \pi r^2 \text{ (r=radius)}$$

$$\text{Cover} = \text{Density} \times \text{Basal area}$$

$$\text{Relative Frequency} = \frac{\% \text{ Frequency of a species}}{\text{Total \% of frequency of all species}}$$

$$\text{Relative Density} = \frac{\% \text{ Frequency of a species}}{\text{Total \% of density of all species}}$$

$$\text{Relative Dominance} = \frac{\% \text{ Frequency of a species}}{\text{Total \% of cover of all species}}$$

## Site of study

The area of the study is located at a distance of 10 Km N-W to Ajmer, a centrally situated city of Rajasthan, lies between 26° 25' and 26° 29' N latitude and 74° 37' and 74° 42' E longitude. The area is represented by Aravalli hillocks, sand dunes, sandy plains, agricultural fields and fresh water bodies (Fig-2). The region may be regarded as 'ecotone' between NW drier and SE humid climate. The sand dunes selected for the investigation i.e. [Pushkar Valley Base (PVB) Leela Sewri (LS) and Pachkund (PK) are situated in 48 sq. Km. Area in the north-west foot hills of Nagaphar a prominent mountain belt of central Aravallis. A major part of these sand dunes

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and sandy plains is stabilized (under the sand dune stabilization programmes by the Forest Department) with plantations of some indigenous (*Prosopis cineraria*, *Prosopis chilensis*), exotic but

acclimatized well *Acacia senegal*, *Maytenus emarginata*) and exotic (*Acacia tortilis*, *Eucalyptus camaldulensis*) plant species.

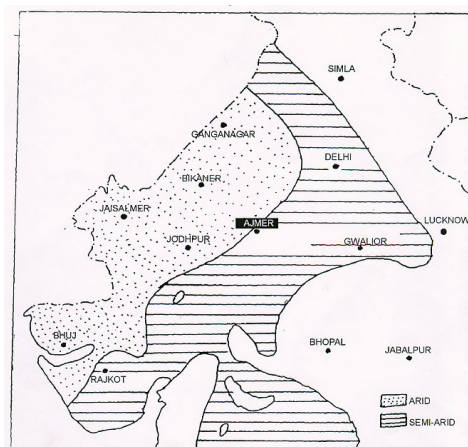


Fig 1. North West part of India showing arid (Dotted area) and semi arid (horizontal lined area) of Rajasthan. Ajmer is situated in the transitional zone between arid and semi-arid

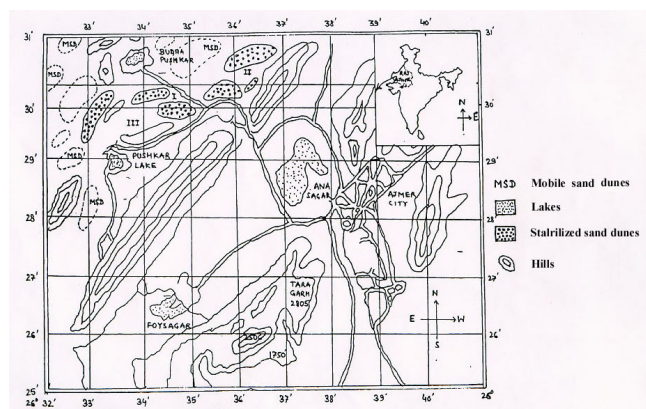


Fig 2. Map of Ajmer Aravalli region showing sites of study I. Leela Sewri, II. Pushkar Valley Base, III. Pachkund area

## RESULTS AND DISCUSSION

Data on mean height, girth, frequency, density and

abundance of various trees/shrubs growing in the three localities are given in tables 1, 2 & 3 and fig 3&4.

Table 1. Frequency, density and abundance of various tree/shrub species of Pushkar Valley sand dunes (Data based on twenty 10X10 m quadrat)

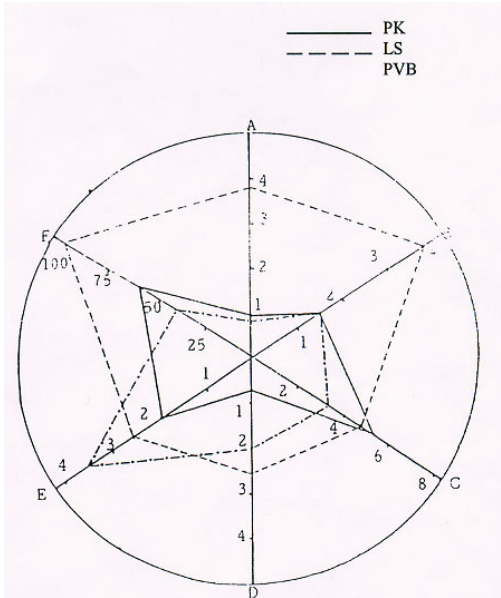
Tree/Shrub Species	Height (m)	Girth (m)	Frequency (%)	Density	Abundance
<i>Acacia senegal</i>	2.33	0.25	100	10.13	10.13
<i>A. tortilis</i>	3.50	0.20	39.9	0.60	1.50
<i>Zizyphus nummularia</i>	1.66	0.05	25.0	0.60	2.40
<i>Prosopis glandulosa</i>	5.66	0.25	13.3	0.13	2.0
<i>Acacia leucophoea</i>	4.32	0.84	10	0.10	1.00
<i>Maytenus emarginata</i>	2.33	0.06	0.66	0.06	1.00

Table 2. Frequency, density and abundance of various tree/shrub species of Leela Sewari sand dunes (Data based on twenty 10X10 m quadrat)

Tree/Shrub Species	Height (m)	Girth (m)	Frequency (%)	Density	Abundance
<i>Acacia senegal</i>	4.33	0.25	100	3.80	3.80
<i>A. tortilis</i>	3.33	0.20	70	1.70	2.42
<i>Opuntia dilenii</i>	1.10	0.30	20	0.25	1.20
<i>Acacia leucophoea</i>	5.60	0.84	15	0.05	1.00
<i>Maytenus emarginata</i>	4.20	0.45	5	0.05	1.00

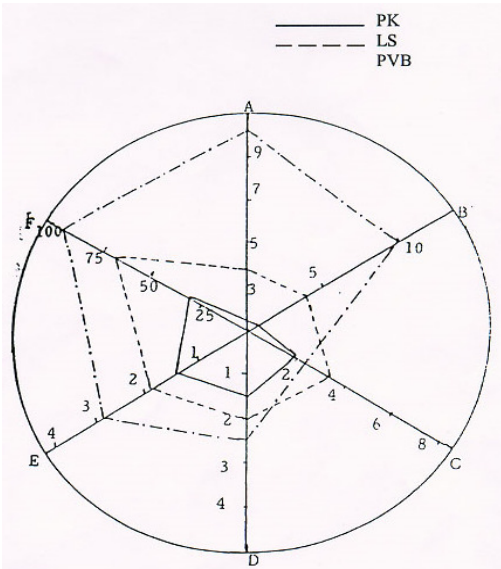
Table 3. Frequency, density and abundance of various tree/shrub species of Pachkund (Data based on twenty 10X10 m quadrate in June, 1990)

Tree/Shrub Species	Height (m)	Girth (m)	Frequency (%)	Density	Abundance
<i>Eucalyptus camaldulensis</i>	1.5	0.70	85	2.10	2.47
<i>Acacia senegal</i>	4.66	0.07	60	0.90	1.50
<i>A.tortilis</i>	2.00	0.15	30	0.30	1.00
<i>Maytenus emarginata</i>	2.33	0.30	25	0.40	1.60
<i>Prosopis chilensis</i>	3.33	0.55	25	0.50	2.00
<i>Zizyphus nummularia</i>	1.66	0.05	25	0.60	2.40
<i>Acacia leucophoea</i>	6.66	0.65	15	0.35	2.33



A: Density, B: Abundance C: Height, D: Girth, E: Width, F: Frequency

Fig 3. Polygraphy showing variation in measurement of some characteristics of *Acacia senegal* from Pachkund (PK), Leelasewri (LS), and Pushkar Valley Base (PVB) sand dunes



A: Density, B: Abundance C: Height, D: Girth, E: Width, F: Frequency

Fig 4. Polygraphy showing variation in measurement of some characteristics of *Acacia senegal* from Pachkund (PK), Leelasewri (LS), and Pushkar Valley Base (PVB) sand dune

A perusal of table 1 Indicates that stabilized sand dunes and sandy plains of Pushkar Valley Base are dominated by *Acacia tortilis* with the highest value of frequency (100%) and density (10.13). This is followed by *Acacia senegal* with comparatively lower values of frequency (39.9%), density (0.6) and abundance (2.4). The other trees/shrubs at this site are *Acacia leucophloea*, *Maytenus emarginata*, *Zizyphus nummularia* and *Prosopis glandulosa*. The lower frequency (6.6%) was observed for *Maytenus emarginata*. Maximum height 94.32m and girth (0.84m) was recorded for *Acacia leucophloea*, while minimum height (1.66m) and girth 0.05m) was recorded for the desert shrub *Zizyphus nummularia*.

As shown in table 2 Leela Sewri sand dunes are dominated by *Acacia senegal* (Frequency 100% density and abundance 3.8each). At this site *Acacia tortilis* is a sub-dominated tree) frequency 70% density 1.7 and abundance 2.42). The site is also

represented by *Opuntia dillenii*, *Acacia leucophloea* with low frequency values i.e. 20%, 15% respectively. *Acacia leucophloea* with low frequency had the maximum girth (0.84m) and height (5.6m).

Phytosociological data of trees/shrubs of Pachkund sand dunes are given in table 3. The stands of this area comprised of 7 trees/shrub species out of which *Eucalyptus camaldulensis* is a dominant tree with maximum frequency (85%), density (2.1), and abundance (2.47). It has been observed that some stands are represented only by *Eucalyptus camaldulensis* and give an appearance of dense forest. This exotic tree is followed by *Acacia senegal* with 60% frequency. The other tree/shrub species include *Acacia tortilis*, *Maytenus emarginata*, *Zizyphus nummularia*, and *Bosevellia serrata* as codominants and *Acacia leucophloea* as a rare tree in this locality. However there is no correlation exist between frequency, girth and height of these tree/shrub taxa.

Table 4. Size of frequency classes for tree/shrubs in tree sand dune localities of Ajmer

Frequency Classes	Frequency	No of tree/shrubs			% of Tree/shrubs		
		PVB	LS	PK	PVB	LS	PK
Class-A	0-20	3	3	4	50	60	57.14
Class-B	21-40	2	0	1	33.33	0	14.28
Class-C	41-60	0	0	1	0	0	14.28
Class-D	61-80	0	1	0	0	20	0
Class-E	81-100	1	1	1	16.66	20	14.28

PVB = Pushkar Valley Base, LS = Leela Sewari, PK = Pachkund

Table 5. Frequency of various tree/shrub species of three sand dune localities of Ajmer

Tree/Shrub Species	PVB	LS	PK
<i>Acacia leucophloea</i>	10.0	15.0	15.0
<i>A. senegal</i>	39.9	100.0	60.0
<i>A. tortilis</i>	100.0	70.0	30.0
<i>Eucalyptus camaldulensis</i>	-	-	85.0
<i>Maytenus emarginata</i>	6.6	5.0	25.0
<i>Opuntia dillenii</i>	-	20.0	-
<i>Prosopis glandulosa</i>	13.3	-	-
<i>Zizyphus nummularia</i>	25.0	-	25.0

PVB = Pushkar Valley Base, LS = Leela Sewari, PK = Pachkund

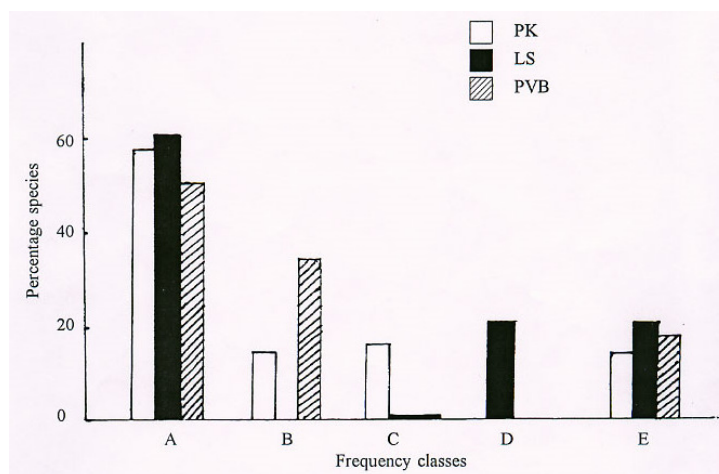


Fig 5. Frequency classes of trees/shrubs from Pachkund (PK), Leelasewri (LS), and Pushkar Valley Base (PVB) sand dune

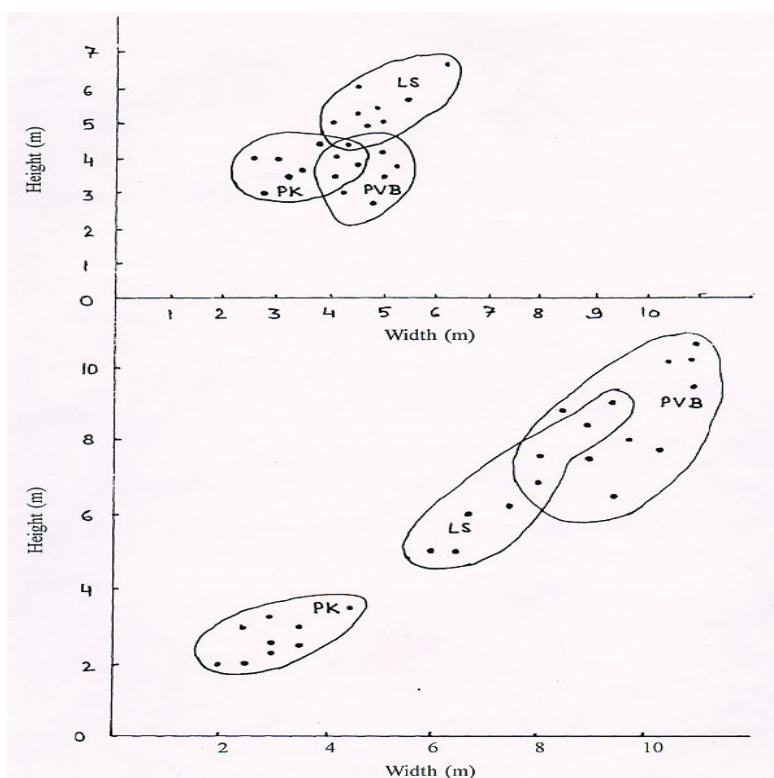


Fig 6. Tree size scatter diagram of *Acacia Senegal* and *Acacia tortilis* species at Pachkund (PK), Leelasewri (LS), and Pushkar Valley Base (PVB) sand dune

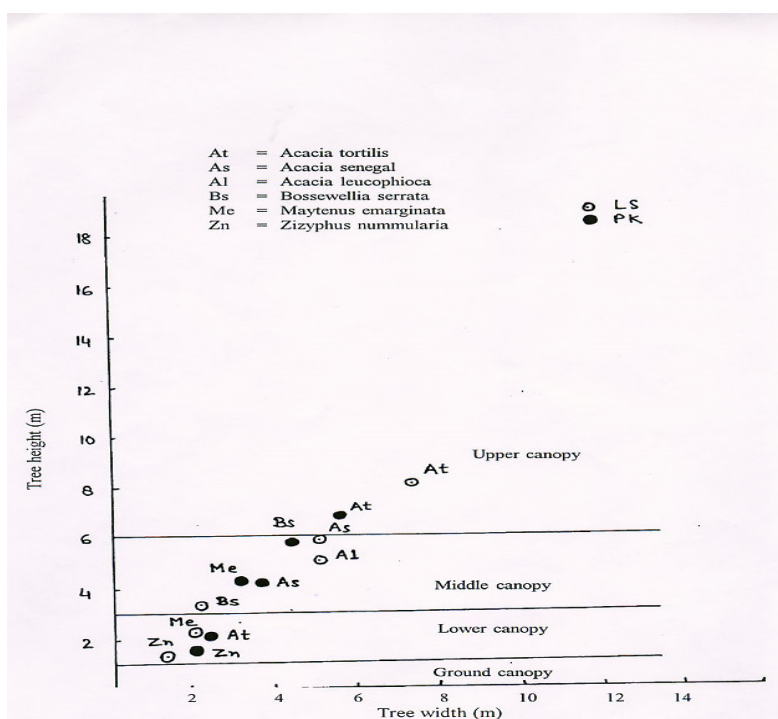


Fig 7. Canopy status of various trees in Leelasewri (LS) and Pachkund (PK) sand dunes

Numbers of trees/shrubs of the three sites were categorized into various frequency classes (Table-4). Majority of species from each site belongs to class-A, which represented by 50 to 60% trees/shrubs. Plant species from Pachkund equally belong to class-B, class-C and class-E (14.28%) of trees/shrubs, while species with frequency 61-80% (class-D) are absent. On the other hand Leela Sewri and dunes, beside class A (60%) are represented by class-D and E (20% of trees/shrubs for each class). The species of Pushkar Valley Base belong to frequency class-A (50%) class-B (33%) and class-E (16.66%) only. It is obvious from the data presented in Table-4 that three sites of present study are dominated by *Acacia Senegal* (Leela Sewri), *Acacia tortilis* (Pushkar Valley Base) and *Eucalyptus camaldulensis* (Pachkund). All these three species are represented by highest frequency value in class-A (Fig-5). A comparative statement in terms of frequency values of various trees/shrubs of three sites is given in table 5.

In the present study vegetation of sand dunes was also differentiated on the basis of scattering patterns of height and canopy width. Scattering patterns obtained by plotting height and canopy width of *Acacia senegal* and *Acacia tortilis* (Fig-6) were also observed to be different for three localities. The vegetation of both the sites Leela Sewri and Pachkund may be divided into three strata vertically (Fig-7). The lower strata extended up to 1 meter height consists of herbaceous species. The second stratum, (1 to 3 m) consists of short height species of *Zizyphus nummularia*, *Maytenus emarginata* and *Acacia tortilis* (3 to 6 m). The third stratum consists of *Bosevelia serrata* and *Acacia senegal* and *Acacia leucophloea*. Upper most strata have only *eucalyptus camaldulensis* trees, which were present only in Pachkund area. It should be pointed out that each stratum has no horizontal continuity species grows naturally some times adds more strata to the existing vegetation on sand dunes.

Three sites, which were selected for the present study, were found different in respect to dominance of tree species. The sand dunes of Pushkar Valley Base. Leela Sewri and Pachkund area are dominated by the plantations of *Acacia tortilis*, *Acacia senegal* and *Eucalyptus camaldulensis* respectively. However tree/shrub species like *Acacia leucophloea*, *Maytenus emarginata* and *Zizyphus nummularia* are also present with very low frequency. It is interesting to note that *Acacia senegal* and *Acacia tortilis* present in all three localities are different in respect of phytosociological parameters, height, and girth and canopy width. Tree species other than dominants at various sites have negligible impact on ground vegetation and organic matter dynamics of the sand dunes. However present study reveals that both microclimatic and biotic conditions in the sand dune area are mainly governed by the input of organic matter from the dominant tree species at various sand dune sites.

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