

## Dispersal pattern of some tree species of Mukundara Hills National Park

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### ABSTRACT

*The dispersal mode of 103 woody species from Mukundara Hills National Park was investigated for their relationship with disturbance and anthropology. The species were characterized as zoochorous, anemochorous, and autochorous. A test of independence between evergreen/deciduous and dispersal mode showed that more than the expected number of deciduous species was zoochorous. Studies pertaining to dispersal strategies along a disturbance gradient presents that how disturbance affects community structures.*

**Key Words-** Evergreen, Deciduous, Disturbance, Anthropology, Community Structures

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### INTRODUCTION

Seed dispersal is the movement or transport of seeds away from the parent plant. Plants have limited mobility and consequently rely upon a variety of dispersal vectors to transport their propagules, including both abiotic and biotic vectors. Seeds can be dispersed away from the parent plant individually or collectively, as well as dispersed in both space and time. Dispersal of propagules is essential for the persistence of populations, and is a fundamental mechanism involved in the organization and maintenance of species richness in a habitat<sup>1,2</sup>. The extent of these pressures in a habitat, and opportunities available for adopting a different mode of dispersal, would shape the diversity of dispersal modes in a given habitat. Disturbances, especially those induced by human activities, are also known to alter the community and the dispersal modes<sup>3</sup>. Forests impacted by human disturbances tend to have a thinner canopy and relatively drier environment<sup>4</sup>. It has been observed that the dominance of species with abiotic modes of dispersal (wind or mechanical) tends to increase with increased disturbance<sup>3</sup>.

In this paper, we have attempted to characterize the profile of the dispersal modes of a community of woody species Mukundara Hills National Park (MHNP) in Kota. Lack of focused studies on dispersal modes, and frugivore behaviour in this area is a major challenge in understanding changes in the forest community under anthropogenic pressures like mining, deforestation, road and railway construction. In view of this, we have attempted to (a) examine the dispersal spectrum of the woody species from the MHNP; (b) test the relation if any between the dispersal mode and disturbances in the area; and (c) understand whether different dispersal modes are associated with the leaf habit (evergreen and deciduous) and with the phenology of the plant species.

### STUDY AREA:-

Kota is one of the eastern districts of Rajasthan, situated between 24.2° and 25.2° N and 75.37° and 77.26° S of south-east of Rajasthan. Mukundara series of Vindhyan hills represents its elevation. None of the part of this region is included in the category of desert.

**Mukundara Hills National Park** was formerly declared as **Darrah Wildlife Sanctuary** in 1995 with 5 regions of Rajasthan. In 1984-85 it was included in wild life reserves. It is situated 55 Km. far from Kota on Kota-Jabalpur NH-12 and it is attached with Dehli-Mumbai rail line at Darrah Satation. *Darrah is named due to 80 km. long and 5-6 km. broad natural valley of parallel hills of height of 335-505 m.*

The four rivers which form the boundary of this valley are Amzhar, Aahu, Kalisindh and Chambal. This National Park is now considered as 3<sup>rd</sup> Tiger Reserve of Rajasthan state of total 759.99 km<sup>2</sup> area.

### MATERIAL AND METHODS

**Sampling and Data analysis:-** The present study was carried out as a part of a national-level survey project entitled, 'Survey of Flora and Fauna of Kota District', supported by the INTACH of the Government of India. The total area included in the study was approx 4000 sq. km. All woody plants with girth at breast height (gbh)  $\geq$  15 cm were enumerated along the belts. Dispersal modes were assigned to each species based on first-hand observations of the morphology of the dispersal units, the fruit types and by consulting relevant literature<sup>5</sup>.

Accordingly the species were classified as Anemochorous (An, wind-dispersed), Autochorous (At, mechanically dispersed) and Zoochorous (Z, animal-dispersed). The animal-dispersed species were mainly dispersed by mammals and birds (Willson *et al.*, 2000). Along with the dispersal modes, the evergreen (E) or deciduous (D) nature of the species, were also recorded. Chi-square contingency tables were set up to relate the different modes of dispersal of species with their phenology and vegetation type, and these attributes were tested for independence<sup>6</sup>.

### OBSERVATIONS AND RESULTS

During the survey conducted in the National Park, we recorded 103 woody plant species (Table-1) among 711 species. Among these woody species, there was a predominance of the zoochorous mode of dispersal (66.34 %) followed by anemochory (18.26 %) and autochory (14.42 %). The most abundant species exhibiting zoochorous mode was *Ziziphus mauritiana* and *Syzygium cumini*. Seeds of *Z. mauritiana* and *S. cumini* were observed in the excreta of the Sloth Bear [*Melursus ursinus* (Shaw)], while seeds of *Holoptelea integrifolia* and *Pithecellobium dulce* were consumed by the Five striped Palm Squirrel (*Funambulus pennanti*), Hanuman Langur (*Semnopithecus entellus*) and Rose-Ringed Parakeet (*Psittacula krameri*) which could be its probable disperser. Small seeded fruits of *Phoenix sylvestris* were consumed by small birds like Common Tailorbird (*Orthotomus sutorius*) and Baya Weaver (*Ploceus phillippinus*). Fruits of *Adansonia digitata* and *Terminalia cattapa* were consumed by House Bat (*Scotophilus kuhlii*) and Indian False Vampire (*Megaderma lyra*) in the study area. The most common anemochorous species were *Anogeissus pendula* and *Anogeissus latifolia*; whereas common autochorous species were *Tectona grandis* and *Mitragyna parvifolia*. Among the 40 families recorded, Mimosaceae and Apocynaceae were exclusively zoochorous, while Apocynaceae with few species was exclusively anemochorous. Few species of Caesalpiniaceae was autochorous (Table-2)

The study area was dominated by deciduous species (58.65 %) species, as against evergreen (41.34 %) ones. Out of 69 zoochorous species, 50.72 % were deciduous (D) and 49.27 % evergreen (E), A test of independence for the different modes of dispersal in evergreen and deciduous species showed that more than the expected number of deciduous species were dispersed by animals, and fewer by wind or autochory; while the reverse was true for evergreen species ( $\chi^2 =$  , d.f. = ,  $P <$  ; Table 3).

### CONCLUSION

The dominance of zoochory (66.34 %) in woody plants, as observed during this study, was reported earlier by others working in tropical forests; e.g. in Barro Colorado Island, Panama (72 % - 76 % :<sup>7</sup>, in Arunachal Pradesh of North East India (78 % : Datta and Rawat 2008) and in the northern Western Ghats<sup>8</sup>. The predominance of zoochory could be attributed to the two specific advantages in this mixed deciduous forest ecosystem. A first advantage of zoochory is that the propagules are dispersed to a much greater distance by birds and mammals than by anemo- and autochory. Second, the propagules have a higher likelihood of reaching habitats suitable to them, because their animal dispersers largely restrict their foraging efforts to specific habitats of their preference, which in this case would be of those plants from

which they gather the fruits and seeds. Consequently, in such heterogeneous ecosystems, the propagules of zoochorous plants have a higher probability of survival and establishment. Zoochorous species were characterized by bright coloured, ripe fruits or arils, which helps to attract the animal vectors. The anemochorous species (18.26 %) in these forests generally occurred along the forest edges and in patches. In such open habitats their dispersal ability is enhanced, because of the reduced hindrance to wind movement. In arid environments such as grasslands and open wastelands, mechanisms for wind and mechanical dispersal predominate.

Disturbance creates gaps and open spaces in the forest, and pioneering species that occupy such open spaces would generally be anemochorous. Accordingly the proportion of anemochorous species and/or individuals may be expected to increase with disturbance. The proportion of zoochory can be expected to decrease with disturbance.

Our results showed that, with the change in proportion of zoochorous species their population also decreased with disturbance. This could be attributed to the possible immigration of propagules from sites immediately adjacent to the areas of disturbance.

Human activities like agriculture, mining, presence of NH-12, railway track and deforestation tend to reduce the populations both of a species and of its biotic vectors.

Lokesha *et al.* (1991) showed that animal-dispersed species are more prone to become rare and endangered than those dispersed passively or by wind<sup>9</sup>. Because some fruit-eating animals are likely to be more severely affected by forest fragmentation than others, it is likely that any effect of forest fragmentation on tree populations will vary with the identity of effective dispersal agents that eat their fruits<sup>10,11</sup>. However we could not find any specific trend for species endemism in this area but it may be a serious problem in coming few years.

**TABLE-1: DISPERSAL PATTERN IN VARIOUS TREE SPECIES**

S.No.	Species	Family	DM	DU	E/D	FC
1.	<i>Acacia catechu</i>	<i>Mimosaceae</i>	At	-	D	Brown
2.	<i>Albizia lebbek</i>	<i>Mimosaceae</i>	An	Seed with part of fruit	D	Yellow
3.	<i>Albizia odoratissima</i>	<i>Mimosaceae</i>	At	Seed with part of fruit	D	Brown
4.	<i>Acacia leucophloea</i>	<i>Mimosaceae</i>	Z	Entire fruit	D	Brown
5.	<i>Acacia nilotica</i>	<i>Mimosaceae</i>	Z	Entire fruit	D	Brown
6.	<i>Acacia Senegal</i>	<i>Mimosaceae</i>	Z	Entire fruit	D	Green
7.	<i>Albizia procera</i>	<i>Mimosaceae</i>	An	Seeds	D	Brown
8.	<i>Leucaena latisiliqua</i>	<i>Mimosaceae</i>	Z	Entire fruit	E	Brown
9.	<i>Pithecellobium dulce</i>	<i>Mimosaceae</i>	Z	Seeds with aril	E	Brown-Black
10.	<i>Prosopis cineraria</i>	<i>Mimosaceae</i>	Z	Entire fruit	E	Brown
11.	<i>Prosopis juliflora</i>	<i>Mimosaceae</i>	Z	Entire fruit	E	Yellow
12.	<i>Alstonia scholaris</i>	<i>Apocynaceae</i>	An	Seed	E	Brown
13.	<i>Carissa congesta</i>	<i>Apocynaceae</i>	Z	Entire fruit	E	Reddish
14.	<i>Tabernaemontana alternifolia</i>	<i>Apocynaceae</i>	Z	Seed with covered aril	D	Yellow
15.	<i>Wrightia tinctoria</i>	<i>Apocynaceae</i>	An	Seed	D	Brown
16.	<i>Holorrhena pubescens</i>	<i>Apocynaceae</i>	An	Seed with silky hair	D	Brown
17.	<i>Wrightia arborea</i>	<i>Apocynaceae</i>	An	Seeds	D	Green
18.	<i>Artocarpus lakoocha</i>	<i>Moraceae</i>	Z	Seed with fleshy bracts	D	Yellow
19.	<i>Ficus hispida</i>	<i>Moraceae</i>	Z	Fig	E	Yellow
20.	<i>F. racemosa</i>	<i>Moraceae</i>	Z	Fig	D	Red
21.	<i>F. benghalensis</i>	<i>Moraceae</i>	Z	Fig	E	Bright Red

22.	<i>F. palmate</i>	<i>Moraceae</i>	Z	Fig	E	Bright Red
23.	<i>F. rumphii</i>	<i>Moraceae</i>	Z	Fig	D	Black
24.	<i>F. virens</i>	<i>Moraceae</i>	Z	Fig	D	Black
25.	<i>Bauhinia racemosa</i>	<i>Caesalpiniaceae</i>	At	Seed	D	Brown
26.	<i>B. variegata</i>	<i>Caesalpiniaceae</i>	At	Seed	D	Brown
27.	<i>Cassia fistula</i>	<i>Caesalpiniaceae</i>	Z	Seed with pulp	D	Black
28.	<i>C. siamea</i>	<i>Caesalpiniaceae</i>	At	Seed	D	Brown
29.	<i>Delonix regia</i>	<i>Caesalpiniaceae</i>	Z	Entire fruit	D	Reddish Brown
30.	<i>Hardwickia binate</i>	<i>Caesalpiniaceae</i>	Z	Entire fruit	D	Reddish Brown
31.	<i>Tamarindus indica</i>	<i>Caesalpiniaceae</i>	Z	Entire fruit	E	Brown
32.	<i>Bombax ceiba</i>	<i>Bombacaceae</i>	An	Seed	D	Brown
33.	<i>Adansonia digitata</i>	<i>Bombacaceae</i>	Z	Entire fruit	D	Brown
34.	<i>Boswellia serrate</i>	<i>Burseraceae</i>	At	Seed	D	Brown
35.	<i>Bridelia retusa</i>	<i>Euphorbiaceae</i>	Z	Entire fruit	D	Black
36.	<i>Mallotus philippensis</i>	<i>Euphorbiaceae</i>	Z	Seed	E	Black
37.	<i>Phyllanthus emblica</i>	<i>Euphorbiaceae</i>	Z	Entire fruit	D	Pale Yellow
38.	<i>Butea monosperma</i>	<i>Fabaceae</i>	An	Seed with part of fruit	D	Brown
39.	<i>Dalbergia sissoo</i>	<i>Fabaceae</i>	An	Seed with part of fruit	E	Brown
40.	<i>Erythrina suberosa</i>	<i>Fabaceae</i>	At	Seed	D	Brown
41.	<i>Pongamia pinnata</i>	<i>Fabaceae</i>	At	Seed	E	Brown
42.	<i>Casuarina equisetifolia</i>	<i>Casuarinaceae</i>	Z	Entire nut	D	Brown
43.	<i>Cordia dichotoma</i>	<i>Boraginaceae</i>	Z	Fruit	D	Cream
44.	<i>Ehrentia laevis</i>	<i>Ehretiaceae</i>	Z	Entire fruit	D	Yellow/Reddish-Orange
45.	<i>Diospyros melanxylon</i>	<i>Ehretiaceae</i>	Z	Entire fruit	E	Green
46.	<i>Diospyros Montana</i>	<i>Ebnaceae</i>	Z	Entire fruit	E	Green
47.	<i>Flacourtia indica</i>	<i>Ebnaceae</i>	Z	Entire fruit	D	Brown
48.	<i>Grevillea robusta</i>	<i>Proteacea</i>	An	Entire fruit	E	Brown
49.	<i>Ixora arborea</i>	<i>Rubiaceae</i>	Z	Entire fruit	E	Brown
50.	<i>Mitragyna parvifolia</i>	<i>Rubiaceae</i>	At	Seed	D	Black
51.	<i>Adina cordifolia</i>	<i>Rubiaceae</i>	At	Seed	D	Brown
52.	<i>Anthocephalus chinensis</i>	<i>Rubiaceae</i>	Z	Entire fruit	E	Brown
53.	<i>Morinda tomentosa</i>	<i>Rubiaceae</i>	Z	Entire fruit	E	-
54.	<i>Kydia calyeina</i>	<i>Malvaceae</i>	An	Winged Fruit	D	Brown
55.	<i>Thespesia populnea</i>	<i>Malvaceae</i>	Z	Seed	E	Black
56.	<i>Lagerstroemia parviflora</i>	<i>Lythraceae</i>	An	Entire fruit	D	Brown
57.	<i>Lanea coromandelica</i>	<i>Anacardiaceae</i>	Z	Entire fruit	D	Red
58.	<i>Mangifera indica</i>	<i>Anacardiaceae</i>	Z	Seed	E	Yellow
59.	<i>Manilkara hexandra</i>	<i>Sapotaceae</i>	Z	Seed	E	Yellow
60.	<i>Mimusops elengi</i>	<i>Sapotaceae</i>	Z	Seed	E	Yellow
61.	<i>Madhuca indica</i>	<i>Sapotaceae</i>	Z	Seed	D	Green
62.	<i>Murraya paniculata</i>	<i>Rutaceae</i>	Z	Seed	E	Red
63.	<i>Pterospermum acerifolium</i>	<i>Sterculiaceae</i>	An	Seed	E	Brown
64.	<i>Sterculia urens</i>	<i>Sterculiaceae</i>	Z	Seed	D	Orange
65.	<i>Guazuma ulmifolia</i>	<i>Sterculiaceae</i>	Z	Fruit	D	-
66.	<i>Sterculia villosa</i>	<i>Sterculiaceae</i>	Z	Fruit	D	Purple
67.	<i>Syzygium cumini</i>	<i>Myrtaceae</i>	Z	Fruit	E	Red
68.	<i>Syzygium jambos</i>	<i>Myrtaceae</i>	Z	Fruit	E	Purple
69.	<i>Psidium guajava</i>	<i>Myrtaceae</i>	Z	Fruit	E	Green
70.	<i>Eucalyptus globosus</i>	<i>Myrtaceae</i>	At	Fruit	D	Black
71.	<i>Tectona grandis</i>	<i>Verbenaceae</i>	At	Fruit in balloon like calyx	D	Yellow
72.	<i>Vitex negundo</i>	<i>Verbenaceae</i>	An	Seed	E	Black
73.	<i>Terminalia bellarica</i>	<i>Combretaceae</i>	Z	Entire fruit	D	Brown
74.	<i>Terminalia alata</i>	<i>Combretaceae</i>	Z	Entire fruit	D	Brown
75.	<i>Anogeissus pendula</i>	<i>Combretaceae</i>	An	Winged seeds	D	Black
76.	<i>Anogeissus latifolia</i>	<i>Combretaceae</i>	An	Winged seeds	D	Black

77.	<i>Terminalia arjuna</i>	Combretaceae	Z	Entire fruit	D	Brown
78.	<i>Terminalia catappa</i>	Combretaceae	Z (Bats)	Entire fruit	E	Green
79.	<i>Woodfordia fruticosa</i>	Lythraceae	At	Entire fruit	D	-
80.	<i>Ziziphus mauritiana</i>	Rhamnaceae	Z	Entire fruit	D	Orange
81.	<i>Annona squamosal</i>	Annonaceae	Z	Seed with aril	E	Green
82.	<i>Miliusa tomentosa</i>	Annonaceae	Z	Seed with aril	D	
83.	<i>Crataeva nuevola</i>	Capparidaceae	Z		D	
84.	<i>Grewia sclerophylla</i>	Tiliaceae	Z		D	
85.	<i>Aegle marmelos</i>	Rutaceae	Z		D	
86.	<i>Feronia limonia</i>	Rutaceae	Z		E	
87.	<i>Ailanthus excels</i>	Simaroubaceae	An		D	Red
88.	<i>Azadirachta indica</i>	Meliaceae	Z		E	
89.	<i>Melia azadirachta</i>	Meliaceae	Z		D	
90.	<i>Cassine glauca</i>	Celastraceae	Z		E	
91.	<i>Moringa conconesis</i>	Morngaceae	Z		D	
92.	<i>Punica granatum</i>	Punicaceae	Z		E	
93.	<i>Kigelia pinnata</i>	Bignoniaceae	Z	Entire fruit	E	Brown
94.	<i>Millingtonia hortensis</i>	Bignoniaceae	Z		E	
95.	<i>Spathodea campanulata</i>	Bignoniaceae	An	Seeds	E	Brown
96.	<i>Stereospermum colasis</i>	Bignoniaceae	An	Seeds	D	
97.	<i>Santalum album</i>	Santalceae	Z	Seeds	E	Purple
98.	<i>Holoptelea integrifolia</i>	Ulamaceae	Z	Entire fruit	D	Brown
99.	<i>Trema orientalis</i>	Ulamaceae	Z	Entire fruit	E	
100.	<i>Ephedra ciliate</i>	Gnetaceae/Ephedraceae	At		D	White
101.	<i>Smilax zeylanica</i>	Smilacaceae	Z		D	Bright Red
102.	<i>Phoenix sylvestris</i>	Arecaceae	Z	Entire fruit	E	Black
103.	<i>Prunus zeylanica</i>	Rosaceae	Z	Entire fruit	E	Red

- DM - Dispersal Medium  
 DU - Dispersal Unit  
 E/D - Evergreen or Deciduous  
 FC - Fruit Colour  
 At - Autochorous  
 An - Anemochorous  
 Z - Zoochorous

**TABLE-2: MODE OF SEED DISPERSAL IN VARIOUS FAMILIES IF ANGIOSPERM**

S.No.	Family	Z	At	An	Total
1.	Mimosaceae	7	2	2	11
2.	Apocynaceae	2	-	4	6
3.	Moraceae	7	-	-	7
4.	Caesalpiniaceae	4	3	-	7
5.	Bombacaceae	1	-	1	2
6.	Burseraceae	-	1	-	1
7.	Euphorbiaceae	3	-	-	3
8.	Fabaceae	-	2	2	4
9.	Casuarinaceae	-	1	-	1
10.	Boraginaceae	2	-	-	2
11.	Ebenaceae	2	-	-	2
12.	Flacourtiaceae	1			1
13.	Proteaceae	-	-	1	1
14.	Rubiaceae	3	2	-	5
15.	Malvaceae	1	-	1	2

16.	<i>Lythraceae</i>			1	1
17.	<i>Anacardiaceae</i>	2	-	-	2
18.	<i>Sapotaceae</i>	3			3
19.	<i>Rutaceae</i>	3			3
20.	<i>Sterculiaceae</i>	3		1	4
21.	<i>Myrtaceae</i>	3	1	-	4
22.	<i>Verbenaceae</i>	-	1	1	2
23.	<i>Combretaceae</i>	4	-	2	6
24.	<i>Lythraceae</i>	-	1		1
25.	<i>Rhamnaceae</i>	1	-	-	1
26.	<i>Annonaceae</i>	2	-	-	2
27.	<i>Capparidaceae</i>	1			1
28.	<i>Tiliaceae</i>	1			1
29.	<i>Simarobaceae</i>	-		1	1
30.	<i>Meliaceae</i>	2			2
31.	<i>Celastraceae</i>	1			1
32.	<i>Moringaceae</i>	1			1
33.	<i>Punicaceae</i>	1			1
34.	<i>Bignoniaceae</i>	2		2	4
35.	<i>Santalaceae</i>	1			1

At - Autochorous  
 An - Anemochorous  
 Z - Zoochorous

**Table 3:** Number of species with different dispersal modes

Dispersal modes	No. of species		
		E	D
Z	Obs.	36	35
	Exp.	43	40
At.	Obs.	1	12
	Exp.	7	15
An.	Obs.	7	12
	Exp.	10	10

$\chi^2 = 4.41$ , d.f. = 5,  $P < 0.001$

N = 103

(Z: Zoochorous, At: Autochorous, An: Anemochorous) and different leaf habit (E: Evergreen, D: deciduous). Values in parentheses are those expected if habit and dispersal mode were independent

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