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## **BIODIVERSITY ASSESSMENT AND ITS EFFECT ON THE ENVIRONMENT OF SHAKARPARIAN FOREST**

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### **ABSTRACT**

Shakarparian is known for its scenic beauty and wilderness and has a significant recreational value. It is a part of Margalla Hills National Park (MHNP), Islamabad and can be a good recourse to conduct various environmental studies. This study was aimed to explore the overall biodiversity of Shakarparian forest in terms of flora and its associated fauna. Phytosociological survey was carried out in order to identify the existing plant communities. The plant associations were then correlated to the existing fauna of the area. The results will provide the baseline data to support further studies on biodiversity analysis of ecologically rich natural recourse base of our country. A total of 155 Animal species have been observed in the study area. Out of these species 23 species of Mammals, 104 of Birds, 22 of Reptiles and 6 species of Amphibians have been recorded. The dominating plant species of the zone are *Cassia fistula*, *Carrisa apeca*, and *Lantana camara*.

**Keywords:** Biodiversity, Flora, Fuana, Shakarparian forest, Margalla Hills National Park (MHNP).

### **INTRODUCTION**

Margalla Hills National Park (MHNP) was established in 1980 under S.R.O 443 (1)/80 and include Margalla Hills range (12,605 hectares) located at North of Islamabad city, Rawal Lake (1,902 hectares), Shakarparian (1376 hectares). Thus, it

makes a total area of 15,883 hectares which constitutes a remarkable diversity of ecological, cultural and recreational environment. The latitude and longitude of Shakarparian forest is 73° 39' N and 33° 44' E (Shinwari and Khan, 2001). Margalla Hills National Park consists of dry and semi-evergreen vegetation

and is a habitat to numerous species of animals and birds because it combines three types of landscapes. Therefore, it offers outstanding recreational and educational opportunities to the people of our country. About a hundred thousand visitors from Pakistan and abroad, visit the MHNP each year. With only five percent of land area in Pakistan under forest cover and very few parks, MHNP is an exceptional natural asset. However, poor capture of revenues and limited budgetary allocations limit its potential and underscore the need of new strategies to help in maintaining this park efficiently.

The park area has rugged topography and elevation ranges from 457 to 610 meters which comprises mainly of steep slopes and gullies, where rock structure is mainly lime stone. The soil of the area is derived from wind, water laid deposits and sedimentary rocks. The sub-soil is usually calcified or calcareous silt loam (Shinwari and Khan, 2001). The conventional biodiversity definition does not only mean number of species, it also represents the discipline of biology of whole organism systematic ecology, behavior and field of comparative biology. Because of acceleration in

environmental degradation, the global biodiversity losses in recent decades are interesting (Craft, 1995). Around 174 mammal species have been reported in Pakistan. Out of these there are at least three endemic species and a number of endemic and near endemic sub-species. Six hundred and sixty eight bird species have been recorded in Pakistan. Out of them three hundred and seventy five were recorded as breeding. A total of fourteen species of turtles, ninety of lizards and sixty five of snakes have been reported, while thirteen species are believed to be endemic. Being a semi-arid country, only twenty two species of amphibians have been recorded, of which nine species are endemic. Pakistan has one hundred and ninety eight native and introduced fresh water fish species (GoP, 1999).

No detailed study in phytosociology in the study area is found in the literature; however, reports suggest that the vegetation of area is thickly covered with a variety of species. The overall vegetation is dominated by herbs, shrubs and trees. Around sixteen species of herb/grasses are found in the area and shrubs make a second larger cover in the area with around 15 species. The tree cover with at least nine tree

species makes the forest thickly populated in the area which provides an ideal condition for faunal species to inhabit the area (IUCN, 1991).

### **Objectives**

The present study was designed to gather information about existing flora in the study area enabling to better understand the biodiversity of Shakarparian. Currently, very scattered information about flora is available related to this area. We therefore prepared an inventory of different vegetation types present in Shakarparian forest resort. We estimated the percentage cover, density and frequency of vegetation present, and recorded and enlisted associated fauna of major plants associations.

## **MATERIAL AND METHODS**

### **Environmental Assessment Parameters**

The air quality parameters were studied in the Shakarparian and in urban Islamabad. For this purpose, three sites in both of the regions were selected for the sampling and assessment of parameters. The average of these three readings was considered as the main reading of the

region. The sampling sites in urban Islamabad were Chowk Abpara, Industrial area I-9 and Pirwadhai. In Shakarparian forest resort three points were marked as S-East, S-west and S-South. The average of three points in Shakarparian was considered as the data of Shakarparian and the average of three points of Islamabad was considered as the data of urban Islamabad.

### **Vegetation Analyses**

The vegetation type of the Margalla Hills National Park is the type found in subtropical dry semi-evergreen zones. Acacia and Olive (*Olea ferruginea*) are dominant. The overall vegetation is scrub forest dominated by certain shrubs as *Dodonaea viscosa*, *Justicia adhatoda* and *Carissa opaca* (GoP, 1999). Considering the shrubby vegetation of the area, "Line Transect Method" was used for the measurement of vegetation cover and composition while density. The frequency was determined by using Quadrates of varying sizes. The selection of quadrature size was determined on the basis of type of vegetation and topography.

### **Plant Data Collection**

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The whole Shakarparian forest was surveyed and transects were laid after the intervals of two kilometers. Within every third kilometer four transects were laid at 0<sup>th</sup>, 250<sup>th</sup>, 500<sup>th</sup> and 1000 m distance. Then the next site was selected at the 2 kilometer distance and so on.

Percent cover, composition, density, frequency, etc. was determined by using following equations (Shaukat *et al.*, 1976; Chul and Mody 1983; Shukla and Srivastava, 1992).

$$\% \text{ Cover} = \frac{\sum \text{intercepts by a species on all the transects}}{\text{Total length of all the transects}} \times 100$$

$$\% \text{ Composition} = \frac{\sum \text{intercepts by a species on all the transects}}{\sum \text{intercepts by all species on all the transects}} \times 100$$

### Density

Density relates to the number of plants rooted within each quadrant. The sum of individuals per species will be calculated for the total area sampled by the quadrant method.

$$\text{Density} = \frac{\text{Individuals of a species in all quadrates}}{\text{Total area sampled}} \times 100$$

### Frequency

Frequency relates to the percentage of total quadrates that contain at least one rooted individual of species.

$$\text{Frequency (\%)} = \frac{\text{No. of quadrates in which a species occurred}}{\text{Total no. of quadrates sampled}} \times 100$$

$$\text{Relative Density (RD)} = \frac{\text{Total individuals of a species}}{\text{Total individuals of all species}} \times 100$$

$$\text{Relative Frequency (RF)} = \frac{\text{Frequency of a species}}{\text{Total frequency value of all species}} \times 100$$

$$\text{Relative Cover (RC)} = \frac{\text{Total intercept length of a species}}{\text{Total intercept length of all species}} \times 100$$

### Importance value (IV)

Importance value (sum of relative density, relative frequency, and relative cover) was determined (Barbour *et al.*, 1980). On the basis of importance value, sampled vegetation was delineated into different plant communities. The communities

within each stand were named as the species having highest Importance Value. When two or more species closely approach each other in order of importance value then the communities share the names of these dominants. The name of the species with highest Importance Value was appearing first followed by other dominant species. Once the plant communities / associations were delineated, the associated fauna, including different kinds of mammals, birds, reptiles, etc. were recorded by either observation or by listing all reported fauna found in the Shakarparian forest resort.

## RESULTS

In the present study, almost the whole area of the Shakarparian was surveyed to study different environmental parameters, phytosociology, and faunal biodiversity of the region. Different strategies were adapted for different groups to study.

### Environmental Parameters

To assess the deterioration in the air of Shakarparian and its comparison with the urban Islamabad was done through measuring different air quality parameters in two different

localities. Air quality monitoring is the first measure in determining the level of air pollution in a forest resort (Shakarparian) and urban Islamabad.

A comparison was done and Table 1 was set to show a marked difference of quantity of air pollutants in both selected sites.

### Animal Diversity

A total of 155 animal species have been observed in the current study area. Out of these species 23 species of Mammals, 104 of Birds, 22 of Reptiles and 6 species of Amphibians have been recorded.

### Amphibians

The amphibian fauna of the Shakarparian belongs to only one single order that is "Anura", three species representing three different families. Table 2 clearly indicates the detailed account of all species present in the study area.

**Table 1: A Comparison of Environmental Parameters in Shakarparian and Urban Islamabad.**

	Parameters	Terms of Data Evaluations	Urban Islamabad	Shakarparian
1	Suspended Particulate Matter (SPM $\mu\text{g}/\text{m}^3$ )	Hourly average data	501	539
		Hourly maximum data	938	854
		Hourly average data in city	520	
2	Sulphur Dioxide ( $\text{SO}_2$ , ppb)	Hourly average data	36	21
		Hourly maximum data	60	47
		Hourly average data in city	285	
3	Carbon Monoxide (CO, ppm)	Hourly average data	2.4	1.9
		Hourly maximum data	6.7	3.6
		Hourly average data in city	1.55	
4	Nitrous Oxide (NO, ppb)	Hourly average data	120	70
		Hourly maximum data	355	192
		Hourly average data in city	95.0	
5	$\text{NO}_x$ (x = 2 or 3, ppb)	Hourly average data	173	124
		Hourly maximum data	350	239
		Hourly average data in city	148.5	
6	Ozone ( $\text{O}_3$ , ppb)	Hourly average data	8.3	12
		Hourly maximum data	48	53
		Hourly average data in city	10.2	
7	Methane Hydrocarbons (ppm)	Hourly average data	-	-
		Hourly maximum data	-	-
		Hourly average data in city	-	
8	Non-Methane Hydrocarbons (ppm)	Hourly average data	-	-
		Hourly maximum data	-	-
		Hourly average data in city	-	
9	Biochemical Oxygen Demand BOD (ppm)		58.0	57.6
10	Chemical Oxygen Demand COD (ppm)		89.3	83.7
11	TSS		50.0	358.0



**Table 2: Amphibian species present in the area.**

	Zoological Name	Common Name		Zoological Name	Common Name
1	<i>Bufo stomaticus</i>	Indus toad	4	<i>Rana cyanophlyctis</i>	Skipping Frog
2	<i>Bufo melanostictus</i>	Hazara toad	5	<i>Rana syhyadrensis</i>	Purple Frog
3	<i>Rana tigrina</i>	Common Frog	6	<i>Microhyla ornata</i>	Ornate Narrow-Mouthed frog or Ant frog

### Reptiles

The reptile fauna of the Shakarparian is represented by the 22 species, belonging to 19 genera, 9 families and 2 orders. All the

observed species have been systematically represented in Table 3.

The density of lizards in the study area has been given in the Table 4.

**Table 3: Reptiles species present in the area.**

	Zoological Name	Common Name
1	<i>Lissemus Punctata</i>	Indian Flapshell Turtle
2	<i>Hemidactylus brooki</i>	Spotted Indian House Gecko
3	<i>Hemidactylus flaviviridis</i>	Yellow-bellied House Gecko
4	<i>Calotes versicolor</i>	Garden Lizard
5	<i>Laudakia agorensis</i>	Agror Valley Agama
6	<i>Uromastix hardwickii</i>	Common Spiny-tailed Lizard
7	<i>Mabuya dissimilis</i>	Striped Grass Skink
8	<i>Lygosoma punctata</i>	Common Dotted Garden Skink
9	<i>Varanus bengalensis</i>	Indian or Bengal Monitor
10	<i>Typhlops braminus</i>	Brahminy blind Snake

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11	<i>Spalerosophis diadema</i>	Eastern Diadem Snake
12	<i>Lycodon aulicus</i>	Common Wolf Snake
13	<i>Lycodon striatus</i>	Northern Wolf Snake
14	<i>Boiga trigonata</i>	Indian Gamma Snake
15	<i>Psammophis schokari</i>	Afro-asian Sand Snake
16	<i>Psammophis condanarus</i>	Indian Sand Snake
17	<i>Coluber ventromaculatus</i>	Plain's Racer
18	<i>Xenochrophis piscator</i>	Checkered Keelback
19	<i>Ptyas mucosus</i>	Indian Rat Snake
20	<i>Bungarus caeruleus</i>	Krait
21	<i>Naja naja</i>	Indian Cobra
22	<i>Vipera russelli</i>	Russell's Viper

**Table 4: Density of Different Lizard Species by Occasional Sighting.**

	Species	Specimens Found (#)		Species	Specimens Found (#)
1	<i>Hemidactylus flavivirides</i>	200	5	<i>Uromastix hardwickii</i>	1
2	<i>Hemidactyles brooki</i>	3	6	<i>Mabyua dissimilis</i>	7
3	<i>Calotes versicolor</i>	9	7	<i>Lygosoma punctata</i>	1
4	<i>Laudakia agrorensis</i>	2	8	<i>Varanus bengalensis</i>	6

### Birds

A total of 104 species of birds belonging to 16 orders, 42 families

and 73 genera were observed in the Shakarparian forest resort. The details are given in Table 5 and 6.

**Table 5: Birds species present in the study area.**

	Name of Species	Common Name	Family Name
1	<i>Nycticorax nycticorax</i>	Night Heron	Ardeidae
2	<i>Ardea cinerea</i>	Grey Heron	Ardeidae

3	<i>Bubulcus Ibis</i>	Cattle Egret	Ardeidae
4	<i>Egretta garzetta</i>	Little Egret	Ardeidae
5	<i>Egretta Intermedia</i>	Intermediate Egret	Ardeidae
6	<i>Ardeola grayii</i>	Indian Pond Heron	Ardeidae
7	<i>Milvus migrans</i>	Black Kite	Accipitridae
8	<i>Elanus caeruleus</i>	Black Winged Kite	Accipitridae
9	<i>Circus aeruginosus</i>	Marsh Harrier	Accipitridae
10	<i>Falco tinnunculus</i>	Eurasian Kestrel	Falconidae
11	<i>Francolinus francolinus</i>	Black Partridge	Phasianidae
12	<i>Francolinus pondicerianus</i>	Indian Grey Partridge	Phasianidae
13	<i>Coturnix coturnix</i>	Common Quail	Phasianidae
14	<i>Lophura leucomelana</i>	Khaleej Pheasant	Phasianidae
15	<i>Amauronis phoenicurus</i>	White-Breasted Waterhen	Rallidae
16	<i>Gallinula chloropus</i>	Moorhen Water hen	Rallidae
17	<i>Himantopus himantopus</i>	Black Winged Stilt	Recurvirostridae
18	<i>Vanellus Indicus</i>	Red Wailed Lapwing	Charadriidae
19	<i>Charadrius dubius</i>	Little Ringed Plover	Charadriidae
20	<i>Anas crecca</i>	Common Teal	Anatidae
21	<i>Anas querquedula</i>	Garganey Teal	Anatidae
22	<i>Anas acuta</i>	Northern Pintail	Anatidae
23	<i>Anas clypeata</i>	Shoveler	Anatidae
24	<i>Anas platyrhynchos</i>	Mallard	Anatidae
25	<i>Actitis hypoleucos</i>	Common Sandpiper	Callidridae
26	<i>Larus ridibundus</i>	Black Headed Gull	Laridae
27	<i>Chlidonias hybridus</i>	Whiskered Tern	Stemidae
28	<i>Columba Livia</i>	Common Pigeon	Columbidae
29	<i>Streptopelia decaocta</i>	Indian Ring Dove	Columbidae
30	<i>Streptopelia chinensis</i>	Chinese Dove	Columbidae
31	<i>Streptopelia tranquebarica</i>	Red Turtle Dove	Columbidae
32	<i>Streptopelia senegalensis</i>	Laughing/Little Brown Dove	Columbidae
33	<i>Psittacula eupatria</i>	Large Indian Parakeet	Psittacidae
34	<i>Psittacula cyanocephala</i>	Blossom Headed Parakeet	Psittacidae
35	<i>Psittacula krameri</i>	Rose Ringed Parakeet	Psittacidae
36	<i>Clamator jacobinus</i>	Pied/Jacobin Cuckoo	Cuculidae
37	<i>Heirocoryx varius</i>	Common Hawk Cuckoo	Cuculidae
38	<i>Centropus sinensis</i>	Common Crown Pheasant	Cuculidae
39	<i>Cacomantis merulinus</i>	Plaintive cuckoo	Cuculidae
40	<i>Eudynamis scolopacea</i>	Common Koel	Cuculidae
41	<i>Athene brama</i>	Spotted Little Owl	Strigidae
42	<i>Caprimulgus macrurus</i>	Long Tailed Nightjar	Caprimulgidae
43	<i>Apus affinis</i>	Indian house Swift	Apodidae

44	<i>Halcyon smyrnensis</i>	White Throated Kingfisher	Alcedinidae
45	<i>Ceryle rudis</i>	Small Pied Kingfisher	Alcedinidae
46	<i>Alcedo atthis</i>	Common Eurasian Kingfisher	Alcedinidae
47	<i>Ceryle lugubris</i>	Crested Kingfisher	Alcedinidae
48	<i>Merops philippinus</i>	Blue Tailed Bee eater	Meropidae
49	<i>Merops orientalis</i>	Small Green Bee eater	Meropidae
50	<i>Coracias bengalensis</i>	Indian Roller Blue Jay	Coracidae
51	<i>Upupa epops</i>	Hoopoe	Upupidae
52	<i>Megalaima haemacephala</i>	Coppersmith barbet	Capitonidae
53	<i>Pitta brachyura</i>	Indian Fairy Pitta	Pittidae
54	<i>Galerida cristata</i>	Crested Lark	Alaudidae
55	<i>Alauda gulgula</i>	Oriental Small Sky Lark	Alaudidae
56	<i>Hirundo rustica</i>	Common swallow	Hirundinidae
57	<i>Hirundo smithii</i>	White-tailed Swallow	Hirundinidae
58	<i>Hirundo daurica</i>	Red -rumped Swallow	Hirundinidae
59	<i>Motacilia flava</i>	Blue Headed Wagtail	Motacillidae
60	<i>Motacilia citreola</i>	Citrine Wagtail	Motacillidae
61	<i>Motacilla caspica</i>	Grey Wagtail	Motacillidae
62	<i>Motacilla maderaspatensis</i>	Large Pied Wagtail	Motacillidae
63	<i>Motacilla alba</i>	White Wagtail	Motacillidae
64	<i>Pycnonotus cafer</i>	Red Vented Bulbul	Pycnonotidae
65	<i>Pycnonotus leucogenys</i>	White Cheeked Bulbul	Pycnonotidae
66	<i>Copsychus saularis</i>	Magpie Robin	Turdinae
67	<i>Saxicola torquata</i>	Common Stone	Turdinae
68	<i>Saxicola caprata</i>	Pied Stone Chat	Turdinae
69	<i>Saxicolodes fulicata</i>	Indian Robin Chat	Turdinae
70	<i>Chaimarrornis leucocephalus</i>	Water Redstart	Turdinae
71	<i>Myophonus caeruleus</i>	Himalayan Whistling	Turdinae
72	<i>Cisticolia juncidis</i>	Fantailed Warbler	Sylvidae
73	<i>Prinia subflava</i>	Indian Wren Warbler	Sylvidae
74	<i>Orthotomus sutorius</i>	Indian Tailor Bird	Sylvidae
75	<i>Phylloscopus Inornatus</i>	Yellow Browed Leaf Warbler	Sylvidae
76	<i>Acrocephalus dumetorum</i>	Blyth's Reed Warbler	Sylvidae
77	<i>Acrocephalus stentoreus</i>	Southern Great Leaf Warbler	Sylvidae
78	<i>Terpsiphone paradisi</i>	Asian Paradise Flycatcher	Rhipiduridae
79	<i>Phipidura albicollis</i>	Yellow Bellied Fantail Flycatcher	Rhipiduridae
80	<i>Pomatorhinus erythrogenys</i>	Rusty Cheek Similar Warbler	Timilidae
81	<i>Turdoides caudatus</i>	Common Babler	Timilidae
83	<i>Turdoides striatus</i>	Jungle Babler	Timilidae
84	<i>Parus melanolophus</i>	Spot Winged Black Tit	Paridae

85	<i>Nectarina asiatica</i>	Purple Sun Bird	Necatarinidae
86	<i>Zosterops palpebrosa</i>	Oriental White Eyed	Zosteropidae
87	<i>Oriolus oriolus</i>	Golden Oriole	Oriolidae
88	<i>Lanius schach</i>	Rufous Backed Shrike	Oriolidae
89	<i>Lanius vittatus</i>	Bay Packed Shrike	Oriolidae
90	<i>Dicrurus adsimilis</i>	Black Drongo	Dicuridae
91	<i>Dicrurus leucophaeus</i>	Ashy Drongo	Dicuridae
92	<i>Dendrocitta vagabunda</i>	Indian Tree Pie	Corvidae
93	<i>Corvus splendens</i>	Common Crow	Corvidae
94	<i>Dendrocitta formosae</i>	Himalayan/Grey Tree Pie	Corvidae
95	<i>Acridotheres tristis</i>	Common or Indian Myna	Sturnidae
96	<i>Sturnus pagodarum</i>	Brahminy myna	Sturnidae
97	<i>Acridotheres ginginianus</i>	Bank Myna	Sturnidae
98	<i>Passer domesticus</i>	House Sparrow	Passeridae
99	<i>Petronia xanthocollis</i>	Yellow Throated Sparrow	Passeridae
100	<i>Ploceus phillppinus</i>	Baya Weaver	Ploceidae
101	<i>Extarilda amandava</i>	Red adavat	Estrilididae
102	<i>Lonchura punctulata</i>	Spotted Munia	Estrilididae
103	<i>Carpodacus erythrinus</i>	Common Rose Finch	Carduelinae

**Table 6: Population density by point counts method for some birds from different sites.**

	Species	April	May	June	Aug	Sept	Oct	Total
1	Pond Heron	6	6	15	5	5	2	42
2	Grey Heron	1	0	0	1	1	0	03
3	Black Partridge	4	2	7	9	2	1	29
4	Grey Partridge	0	1	2	2	0	2	08
5	White Breasted Water Heron	0	0	2	2	0	0	06
6	Common Moorhen	0	1	1	4	1	0	09
7	Common Teal	1	0	0	0	0	0	01
8	Mallard	2	0	0	0	0	1	03
9	Rock Dove	1	0	0	1	0	0	02
10	Ring Dove	1	0	13	7	2	3	30
11	Chinese Dove	10	0	19	13	0	3	76
12	Black Drongo	0	13	18		0	0	49
13	House Crow	20	15	40	0	2	2	128
14	Indian Myna	0	0	8	3	5	5	31
15	Common Kingfisher	0	7	16	12	7	7	59

16	Pied king Fisher	9	2	31	10	5	2	86
17	Red-vented Bulbul	2	2	9	14	2	0	25
18	Black Drongo	1	1	4	1	0	47	9
19	White Cheeked Bulbul	37	0	125	1	47	4	566
20	Rose Ringed Parakeet	4	0	23	166	4	47	77
21	Alexandrine Parakeet	25	0	73	9	47	131	318
22	Pied Crested	231	13	275	50	131	167	1442
23	White Breasted King fisher	191	2	207	230	161	21	1053
24	Common Koel	192	0	23	106	87	23	1054

### Mammals

A total of 23 mammalian species have been observed out of which 8 species belong to the family Mufidae while Canidae, Viverridae and Herpestidae, each have two

member species in this area. Furthermore the Families Soricidae, Pteropidae, Cercopithecidae, Mantidae and Felidae are also present. List of mammals present in Shakarparian and their population density is given in Table 7 and 8.

**Table 7. List of Mammals present in Shakarparian.**

	Zoological Name	Common Name		Zoological Name	Common Name
1	<i>Suncus murinus</i>	House Shrew	13	<i>Naemorhedus goral</i>	Grey goral
2	<i>Pteropus giganteus</i>	Indian flying fox	14	<i>Lepus capensis</i>	Cape Hare
3	<i>Macaca mulatta</i>	Rhesus macaque	15	<i>Hystrix indica</i>	Indian Crested Porcupine
4	<i>Manis crassicaudata</i>	Indian pangolin	16	<i>Millardia meltada</i>	Field Rat
5	<i>Canis aureus</i>	Asiatic jackal	17	<i>Rattus rattus</i>	House Rat
6	<i>Vulpes vulpes</i>	Common red fox	18	<i>Ratus turkestanicus</i>	Turkestani Rat

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7	<i>Viverricula indica</i>	Small Indian civet	19	<i>Mus musculus</i>	Hose Mouse
8	<i>Paguma larvata</i>	Palm civet	20	<i>Mus booduga</i>	Little Field Mouse
9	<i>Herpestes javanicus</i>	Small asian mongoose	21	<i>Golunda ellioti</i>	Bush Rat
10	<i>Herpestes edwardsi</i>	Indian grey mongoose	22	<i>Tatera indica</i>	Indian Gerbil
11	<i>Panthera pardus</i>	Panther	23	<i>Meriones hurrianae</i>	Indian Desert Jird
12	<i>Sus scrofa</i>	Indian wild boar	-	-	-

**Table 8: Population Density of Some Mammals by Occasional Sighting from the Shakarparian.**

Species	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
Indian Flying Fox	500	1	0	0	0	0	600	1101
Rhesus Macaque	40	0	0	0	0	0	0	40
Asiatic Jackal	2	0	0	03	0	9	0	2
Common Red Fox	1	15	4	1	2	3	10	45
Small Indian Civet	1	0	0	1	0	0	0	3
Small Asian Mongoose	0	0	0	1	0	1	0	1
Indian Grey Mongoose	0	10	2	2	0	0	0	7
Panther	2	1	11	3	4	2	1	4
Indian Wild Boar	1	0	1	1	1	0	2	10
Grey Goral	0	0	0	1	0	0	0	0
Cape Hare	1	0	3	1	0	1	0	13
Indian Crested Porcupine	2	1	0	1	1	8	0	0
Cape Hare	2	3	2	2	2	4	0	17
Indian Crested Porcupine	1	0	1	0	0	0	0	6

### Plant Diversity

A vegetation analysis of the Shakarparian was carried out by selecting three different sampling sites in the area. These sites were selected in such a way that a Phytosociological study of the area could be carried out smoothly. 30 transects were laid, 10 in each sampling site and an average for each site was recorded. A total of 61 plant species were recorded. Most of the area sampled was found to be covered with the grass and shrubby vegetation with a considerable amount of tree cover.

A total of 61 plant species were observed there belonging to 28 different families, including 8 species of Fabaceae, 10 of Poaceae, 4 of each Acanthaceae and Euphorbiaceae, 3 of both Amaranthaceae and Asteraceae. Asparagaceae, Moraceae, Malvaceae, Verbenaceae, Bignoniaceae and Rhamnaceae has 2 species while Myrtaceae, Canabaceae, Apocynaceae, Cypraceae, Solanaceae, Spindaceae, Lythraceae, Meliaceae, Oxalidaceae, Pinaceae, Salicaceae, Bombacaceae, Zygophyllaceae, Ehertiaceae, Simaroubaceae and Buxaceae all have one species growing in the study area. The dominant vegetation

communities were *Cynodon dactylon*, *Carissa opaca*, *Justicia adhatoda*, *Lantana camara*, *Cassia fistula* *Dodonaea viscosa*.

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