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Recommended Citation  
Malik, I. U., Faiz, A. H., & Abbas, F. -. (2014). Biodiversity Assessment and its Effect on the Environment of Shakarparian Forest, _Journal of Bioresource Management, 1_ (2).
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, Fauna, 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 limestone. 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 inhibit 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 quadrate size was determined on the basis of type of vegetation and topography.

**Plant Data Collection**
The whole Shakarpian forest was surveyed and transects were laid after the intervals of two kilometers. Within every third kilometer four transects were laid at 0th, 250th, 500th 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.

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

**Relative Density (RD)**

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

**Relative Frequency (RF)**

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

**Relative Cover (RC)**

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

**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 Shakarprian and Urban Islamabad.

| Parameters                      | Terms of Data Evaluations | Urban Islamabad | Shakarprian |
|---------------------------------|---------------------------|-----------------|-------------|
| 1 Suspended Particulate Matter (SPM µg /m³) | Hourly average data      | 501             | 539         |
|                                 | Hourly maximum data       | 938             | 854         |
|                                 | Hourly average data in city | 520            |             |
| 2 Sulphur Dioxide (SO₂ , ppb)   | Hourly maximum data       | 60              | 47          |
|                                 | Hourly average data in city | 285            |             |
|                                 | Hourly average data       | 2.4             | 1.9         |
| 3 Carbon Monoxide (CO, ppm)     | Hourly average data       | 1.55            | 3.6         |
|                                 | Hourly average data       | 285             |             |
| 4 Nitrous Oxide (NO, ppb)       | Hourly average data       | 95.0            | 70          |
|                                 | Hourly average data       | 173             | 124         |
| 5 NOₓ (x = 2 or 3, ppb)         | Hourly average data       | 148.5           | 12          |
|                                 | Hourly average data       | 8.3             |             |
| 6 Ozone (O₃, ppb)               | Hourly average data       | 48              | 53          |
|                                 | Hourly average data       | 148.5           |             |
|                                 | Hourly average data       | 10.2            |             |
| 7 Methane Hydrocarbons (ppm)    | Hourly average data       | -               | -           |
|                                 | Hourly average data       | -               | -           |
| 8 Non-Methane Hydrocarbons (ppm) | Hourly average data     | -               | -           |
|                                 | Hourly average data       | -               | -           |
| 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 Bufo stomaticus** | Indus toad | **4 Rana cyanophlyctis** | Skipping Frog |
| **2 Bufo melanostictus** | Hazara toad | **5 Rana syhyadreis** | Purple Frog |
| **3 Rana tigrina** | Common Frog | **6 Microhyla ornata** | Ornate Narrow-Mouthed frog or Ant frog |

Reptiles

The reptile fauna of the Shakarparian is represented by the 22 observed 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 Lissamus Punctata | Indian Flapshell Turtle          |
| 2 Hemidactylus brooki | Spotted Indian House Gecko       |
| 3 Hemidactylus flaviviridis | Yellow-bellied House Gecko     |
| 4 Calotes versicolor | Garden Lizard                    |
| 5 Laudakia agroremsis | Agor Valley Agama                |
| 6 Uromastix hardwickii | Common Spiny-tailed Lizard      |
| 7 Mabuya dissimilis | Striped Grass Skink              |
| 8 Lygosoma punctata | Common Dotted Garden Skink       |
| 9 Varanus bengalensis | Indian or Bengal Monitor         |
| 10 Typhlops braminus | Brahminy blind Snake             |
Table 4: Density of Different Lizard Species by Occasional Sighting.

| Species                        | Specimens Found (#) | Species                        | Specimens Found (#) |
|--------------------------------|---------------------|--------------------------------|---------------------|
| 1 Hemidactylus flavivirides    | 200                 | 5 Uromastix hardwickii         | 1                   |
| 2 Hemidactyes brooki           | 3                   | 6 Mabyua dissimilis            | 7                   |
| 3 Calotes versicolor           | 9                   | 7 Lygosoma punctata            | 1                   |
| 4 Laudakia agroensis           | 2                   | 8 Varanus bengalensis          | 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 Nycticorax nycticorax          | Night Heron      | Ardeidae      |
| 2 Ardea cinerea                  | Grey Heron       | Ardeidae      |
| Number | Species                          | Common Name                  | Family       |
|--------|----------------------------------|------------------------------|--------------|
| 3      | Bubulcus ibis                    | Cattle Egret                | Ardeidae     |
| 4      | Egretta garzetta                 | Little Egret                | Ardeidae     |
| 5      | Egretta intermedia              | Intermediate Egret          | Ardeidae     |
| 6      | Ardeola grayii                   | Indian Pond Heron           | Ardeidae     |
| 7      | Milvus migrans                   | Black Kite                  | Accipitridae |
| 8      | Elanus caeruleus                 | Black Winged Kite           | Accipitridae |
| 9      | Circus aeruginosus               | Marsh Harrier               | Accipitridae |
| 10     | Falco tinnunculus                | Eurasian Kestral            | Falconidae   |
| 11     | Francolinus francolinus          | Black Patridge              | Phasianidae  |
| 12     | Francolinus pondicerianus        | Indian Grey Patridge        | Phasianidae  |
| 13     | Coturnix coturnix                | Common Quail                | Phasianidae  |
| 14     | Lophura leucomelana              | Khaleej Pheasant            | Phasianidae  |
| 15     | Amauronis phoenicurus             | White-Breasted Waterhen     | Rallidae     |
| 16     | Gallinula chloropus              | Moorhen Waterhen            | Rallidae     |
| 17     | Himantopus himantopus            | Black Winged Stilt          | Recurvirostridae |
| 18     | Vanellus Indicus                 | Red Walated Lapwing         | Charadridae  |
| 19     | Charadrius dubius                | Little Ringed Ploover       | Charadridae  |
| 20     | Anas crecca                      | Common Teal                 | Anatidae     |
| 21     | Anas querquedula                 | Garganey Teal               | Anatidae     |
| 22     | Anas acuta                       | Northern Pintail            | Anatidae     |
| 23     | Anas clypeata                    | Shoveler                    | Anatidae     |
| 24     | Anas platyrhynchos               | Mallard                     | Anatidae     |
| 25     | Actitis hypoleucus               | Common Sandpiper            | Charadridae  |
| 26     | Larus ridibundus                 | Black Headed Gull           | Laridae      |
| 27     | Chlidonias hybridus              | Whiskered Tern              | Streidae     |
| 28     | Columba livia                    | Common Pigeon               | Columbidae   |
| 29     | Streptopelia decaocto            | Indian Ring Dove            | Columbidae   |
| 30     | Streptopelia chinensis           | Chinese Dove                | Columbidae   |
| 31     | Streptopelia tranquebarica       | Red Turtle Dove             | Columbidae   |
| 32     | Streptopelia senegalensis        | Laughing/Little Brown Dove  | Columbidae   |
| 33     | Psittacula eupatria              | Large Indian Parakeet       | Psittacidae  |
| 34     | Psittacula cyanopephala          | Blossom Headed Parakeet     | Psittacidae  |
| 35     | Psittacula krameri               | Rose Ringed Parakeet        | Psittacidae  |
| 36     | Clamator jacobinus               | Pied/Jacobin Cuckoo         | Cuculidae    |
| 37     | Heirococyx varius                | Common Hawk Cuckoo          | Cuculidae    |
| 38     | Centropus sinensis               | Common Crown Pheasant       | Cuculidae    |
| 39     | Cacomantis merulinus             | Plaintive Cuckoo            | Cuculidae    |
| 40     | Eudynamys scolopacea              | Common Koel                 | Cuculidae    |
| 41     | Athene brama                     | Spotted Little Owl          | Strigidae    |
| 42     | Caprimulgus macrurus             | Long Tailed Nightjar        | Caprimulgidae |
| 43     | Apus affinis                     | Indian house Swift          | Apodidae     |
44 Halcyon smyrnensis White Throated Kingfisher Alcedinidae
45 Ceryle rudis Small Pied Kingfisher Alcedinidae
46 Alcedo atthis Common Eurasian Kingfisher Alcedinidae
47 Ceryle lugubris Crested Kingfisher Alcedinidae
48 Merops philippinus Blue Tailed Bee eater Meropidae
49 Merops orientalis Small Green Bee eater Meropidae
50 Coracias bengalensis Indian Roller Blue Jay Coracidae
51 Upupa epops Hoopoe Upupidae
52 Megalaima haemacephala Coppersmith barbet Capitonidae
53 Pitta brachvura Indian Fairy Pitta Pittidae
54 Galerida cristata Crested Lark Alaudidae
55 Alauda gulgula Oriental Small Sky Lark Alaudidae
56 Hirundo rustica Common swallow Hirundinidae
57 Hirundo smithii White-tailed Swallow Hirundinidae
58 Hirundo daurica Red-rumped Swallow Hirundinidae
59 Motacilla flava Blue Headed Wagtail Motacillidae
60 Motacilla citreola Citrine Wagtail Motacillidae
61 Motacilla caspica Grey Wagtail Motacillidae
62 Motacilla maderaspatensls Large Pied Wagtail Motacillidae
63 Motacilla alba White Wagtail Motacillidae
64 Pycnonotus cafer Red Vented Bulbul Pycnonotidae
65 Pycnonotus leucogenys White Cheeked Bulbul Pycnonotidae
66 Copsychus saularis Magpie Robin Turdinae
67 Saxicola torquata Common Stone Turdinae
68 Saxicola caprata Pied Stone Chat Turdinae
69 Saxicolodes fulicata Indian Robin Chat Turdinae
70 Chaimarrornis leucocephalus Water Redstart Turdinae
71 Myophonus caeruleus Himalayan Whistling Turdinae
72 Cisticola juncidis Fantailed Warbler Sylvidae
73 Prinia subflava Indian Wren Warbler Sylvidae
74 Orthotomus sutorius Indian Tailor Bird Sylvidae
75 Phylloscopus Inornatus Yellow Browed Leaf Warbler Sylvidae
76 Acrocephalus dumetorum Blyth’s Reed Warbler Sylvidae
77 Acrocephalus stentoreus Southern Great Leaf Warbler Sylvidae
78 Terpsiphone paradis Asian Paradise Flycatcher Rhipiduridae
79 Phipidura albicollis Yellow Bellied Fantail Flycatcher Rhipiduridae
80 Pomatorhinus erythrogenys Rusty Cheek Similar Warbler Timilidae
81 Turdoides caudatus Common Babler Timilidae
82 Turdoides striatus Jungle Babler Timilidae
83 Parus melanolophus Spot Winged Black Tit Paridae
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    | 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    |
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 Suncus murinus     | House Shrew         | 13 Naemorhedus goral | Grey goral          |
| 2 Pteropus giganteus | Indian flying fox   | 14 Lepus capensis    | Cape Hare           |
| 3 Macaca mulatta     | Rhesus macaque      | 15 Hystrix indica    | Indian Crested      |
| 4 Manis crassicaudata| Indian pangolin     | 16 Millardia meltada | Porcupine           |
| 5 Canis aureus       | Asiatic jackal      | 17 Rattus rattus     | Field Rat           |
| 6 Vulpes vulpes      | Common red fox      | 18 Ratus turkestanicus| House Rat          |

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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   | 40  |       |
| Asiatic Jackal           | 2    | 0   | 0   | 0   | 0   | 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   | 1   | 1     |
| Indian Grey Mongoose     | 0    | 10  | 2   | 2   | 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   | 13    |
| Cape Hare                | 2    | 3   | 2   | 2   | 4   | 0   | 17  |       |
| Indian Crested Porcupine| 1    | 0   | 1   | 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, Bignoniacae and Rhamnaceae has 2 species while Myrtaceae, Canabaceae, Apocynaceae, Cypiraceae, Solanaceae, Spindaceae, Lythraceae, Meliaceae, Oxalidaceae, Pinaceae, Salicaceae, Bombacaceae, Zygopillaceae, 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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