**Woody plants diversity and type of vegetation in non cultivated plain of Moutourwa, Far-North, Cameroon**

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**ABSTRACT**

In order to valorize the wild vegetal resources for the efficient conservation and sustainable use in sahelo-sudanian zone in Cameroon, a study of non cultivated plain of Moutourwa was carry out to assess thefloristic richness, the specific diversity and the type of vegetation. The inventory of all trees and shrubs (dbh ≥ 2.5 cm) and the determination of the vegetation cover were done in five linear transects (20 m × 1000 m). In total, 27 families, 54 genera and 75 species were found. Caesalpinaceae is the most abundant family that relative abundance (pi\*100) is 34.41%, the most abundant genus was *Piliostigma* (pi\*100 = 30.66%) and the most represented species was *Piliostigma reticulatum* (pi\*100 = 29.56%; D = 53.6 stems/ha). The Simpson index (E= 0.89), the Shannon index (H= 3.2) and the equitability index of Pielou (J= 0.74) indicated that there were moderate diversity with more or less equitable species. The wild fruits species were numerous (pi\*100 = 32.76%; D = 59.7 stems/ha). *A. senegalensis* is was the most represented (pi\*100 = 9.04 ; D = 16.4) followed by *Hexalobus* *monopetalus* (pi\*100 = 5.16 ; D = 9.4) and *Balanites aegyptiaca* (pi\*100 = 3.69 ; D = 6.7). These results contribute efficaciously to valorize the wild vegetal resources for efficient conservation and sustainable use.

*Keywords*: Woody plants diversity, conservation, sustainable use, sahelo-sudanian, Moutourwa

**INTRODUCTION**

The sudano-zambesian region occupies most of the northern part of Cameroon, with a progressive diminution of rainfall with increasing latitude. The dry season lasts 6-8 months (Letouzey, 1985). According the Rio Earth Summit in 1992, intense anthropogenic activities have long been considered as significant drivers of dynamics and diversity through loss of biodiversity and consequently species extinction. In the sahelo-sudanian zone, agriculture, pasture and exploitation of firewood damage considerably the locale biodiversity. When several wild plants species are used in various ways by locales populations for food and medicinal purposes and for other uses (Mapongmetsem et al. 1997; 2002;[www.prota.org](http://www.prota.org)).

The wild landscape of Moutourwa is dotted with several ecological units like the savannah, mountains, rivers and hardés. The vegetation is fragile and it undergoes demographic pressure due to the extension of the field, the removal of firewood and services, and animals as well as anthropogenic bushfires.

The main objective of this work is to valorize the wild vegetal resources for the efficient conservation and sustainable use in sahelo-sudanian zone in Cameroon. The specific objectives are to assess thefloristic richness, the specific diversity and the type of vegetation of non cultivated plain of Moutourwa.

**METHODOLOGY**

**Study area**

Study has been conducted in wild landscape of Moutourwa, Sub-Division of Mayo Kani Division, and Far-North Region of Cameroon (Figure 1) which is rallied out by six mountains. The dominant ethnic is Guiziga, native people. This area is located in sahel-sudanian area, between 4’39 and 4’49 north; and 11’4 and 11’19 east. Altitude of plain varies from 600 to 900 m. Annual precipitation is 867 mm on average. The mean annual temperature is 27 °C with a maximum of 38 °C from March to April and a minimum of 18 °C from December to January (Suchel, 1987). According Boutrais (1984), the Far-North Region of Cameroon is dominated by trees species like *Azadirachta indica*, *Balanites aegyptiaca*, *Anogeissus leiocarpus* and *Boswillia dalzielii* which grow on loose and rocky soils. Moutourwa Sub-Division is limited in the south by Guider and Figuil Sub-Divisions; in the north by Mindif Sub-Division, in the east by Kaélé Sub-division and in the west by Doukoula Sub-Division.

**Data collection**

Representative and homogeneous vegetation types were selected on the basis of physical physiognomy of the forest and non-perturbed by cultivation. Sampling was done during the peak of flowering of plants (Aril-May-June 2015), using the transect method to inventory ligneous plants. This method was developed and recommended by Lejoly (1993), Hall & Bawa (1993) and Guedje (2002). Five linear transects (20 m × 1000 m) were established basing on the poor density of vegetation. In total, 10 ha were covered. In order to represent the maximum of species, transects were established about more than 500 m one away from each other. Three transects (T1, T2 and T3) were located in southern of Moutourwa and two transects (T4 and T5) were located in northern. These transects were established in the non cultivated plain. All transects were recorded with a global positioning system (GPS) (Garmin Map 62S).

Within each transect all trees and shrubs (dbh ≥ 2.5 cm) were systematically recorded and characterized. Scientific identification of the most common species was done directly in the field whenever possible. Some specimens were collected in order to authenticate scientific names in laboratory of Agriculture and Development Research Institute (IRAD) in Maroua.

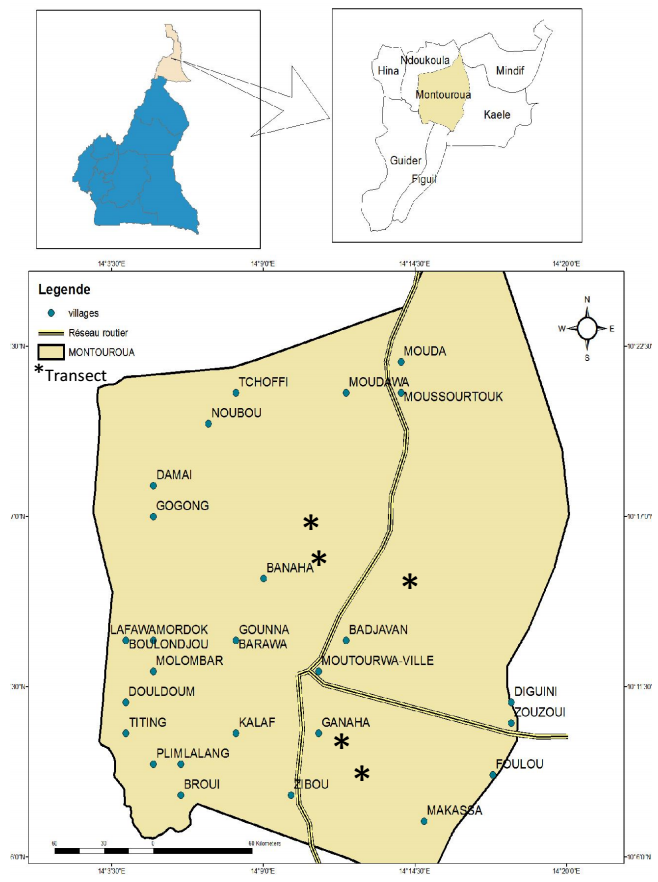
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Figure 1. Location map of study site

**Data analysis**

***Floristic richness***

- For the floristic analysis, all of the data of each transect were pooled and the total number of species and individuals were tallied. Using the pooled data, overall species richness, genera and family level richness were calculated.

- The relative abundances of families, of genera and of species were calculated according to Curtis and McIntosh (1950) formula:

ni is the number of individuals belonged to taxum i and Nt is total number of individuals of all sample.

- The densities (stems/ha) of each species were calculated according this formula:

 ni is the number of individuals belonged to species i and Sa is the expected area in hectare.

***Specific diversity***

The species composition of the site was described using the following parameters. The indexes of specific diversity. These indexes are widely employed to measure biological diversity (Magurran, 2004).

- The Simpson index iscalculated according to formula:

 S is the number of collected species.

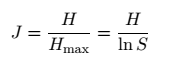
This index is dominance index because it focuses on common species. It is the probablity that two individuals belongs to two different species. It ranges between 0 and 1.

- The Shannon Weaver index iscalculated according to formula:



If H < 3, the diversity is low ; if 3 ≥ H > 4, the diversity is moderate and if H ≥ 4, the diversity is hight (Yédomonhan, 2009).

* The equitability index of Pielouiscalculated according to formula:



This index means that the degree of diversity reaches the possible maximum ratio. It ranges between 0 and 1. If J = 0, one species is present in the site and if J = 1, all of species have same probability.

***Type of vegetation***

The vegetation was characterized by calculating the number of trees and the number of shrubs according the plant formation classification of Letouzey (1969) revised by Huggett (1986) and combining the visual observation of the vegetation considering Gramineae and woody plants.

**RESULTS AND DISCUSSION**

**Diversity and relative abundance of Families**

In total, 27 families were inventoried. For the best visibility, only nine Families represented by more than 3.0% of all species were illustrated in Figure 2. The leftovers represented each by relative abundance inferior to 3.0% were grouped in “Others”. Caesalpinaceae is the most abundant family that relative abundance is 34.41% followed by Annonaceae (14.23%), Combretaceae (9.41%) and Mimosaceae (7.78%). The least abundant families were Polygalaceae (0.16%), Tiliaceae (0.11%) and Ulmaceae (0.11%).

Figure 2. Relative abundance of most representative families

**Diversity and relative abundance of genera**

In total, 54 genera were inventoried. Only 21 genera were represented in Figure 3 for the best visibility. Their relative abundance was superior to 1.0%. The leftovers genera represented each by relative abundance inferior to 1.0% were grouped in “Others”. The most abundant genus was *Piliostigma* that the relative abundance was 30.66% followed by *Annona* (9.04%), *Acacia* (6.06%) and *Hexalobus* (5.18%). The least abundant genera were *Adansonia* (0.05%), *Cadaba* (0.05%), *Crossopteryx* (0.05%), *Detarium* (0.05%) because they were represented by one only species.

Figure 3. Relative abundance of most representative genera

**Relative abundance and density of species**

In total, 1816 plants grouped into S = 75 species were recorded in 10 ha. Total plants density was 181.6 stems/ha. The most represented species was *Piliostigma reticulatum* (pi\*100 = 29.56%; D = 53.6 stems/ha) followed by *Annona senegalensis* (pi\*100 = 9.04%; D = 16.4 stems/ha). Six species: *Adansonia digitata*, *Cadaba farinosa*, *Combretum aculeatum, Crossopteryx febrifuga*, *Detarium microcarpum*, *Lannea microcarpa* were least represented (pi2\*100= 0.05% and D = 0.1 stems/ha) because they were represented by one only individual (Annex 1).

In the dry land, Lebrun et al. (1991) reported that the woody flora includes 55 families, 214 genera and 376 species (with 96 exotic species). The non cultivated plain of Moutourwa has large number of woody species. The woody flora was dominated by shrubs species that Caesalpinaceae was dominant family and *Piliostigma* *reticulatum* was must represented. In total, 27 families, 54 genera and 75 species were found in non cultivated plain of Moutourwa. These results were similar to the ones of Kalfou Forest Reserve where 28 families, 58 genera and 86 species were recorded (Froumsia et al. 2012). Whereas, there were about 34 families, 60 genera and 140 species in the Savannah of Adamawa (Tchobsala et al., 2010) and 11 families and 21 species in the Kalamaloue National Park (Mahamat,1991). These differences may be due to micro-site factors and difference of anthropogenic pressure.

The fruits from the plants are mainly harvested by women, consumed and commercialized in the local and regional market (Mapongmetsem et al., 1997; Tchiégang-Megueni et al., 2001). They contribute to struggle against poverty and famine in soudanian and sahelian zones. The fruits species in wild landscape of Moutourwa (in total 25 species) were numerous (pi\*100 = 32.76%; D = 59.7 stems/ha). *A. senegalensis* is was the most represented (pi\*100 = 9.04 ; D = 16.4) followed by *Hexalobus* *monopetalus* (pi\*100 = 5.16 ; D = 9.4) and *Balanites aegyptiaca* (pi\*100 = 3.69 ; D = 6.7). These results confirm ones of Mapongmetsem et al. (2012). According these authors, *Adansonia digitata, Balanites aegyptiaca, Borassus aethiopum, Detarium microcarpum, Diospyros mespiliformis, Haematostaphis barteri, Hyphaena thebaica, Parkia biglobosa, Sclerocarya birrea, Ximenia americana, Vitellaria paradoxa, Vitex doniana, Tamarindus indica* and *Ziziphus mauritiana* figure in the top sixteen. They are among the most preferred and the most commercialized fruits in Adamawa, Far-North and North Regions (Cameroon).

**Floristic diversity and type of plant formation**

According the Simpson index (E= 0.89), the Shannon Weaver index (H= 3.2) and the equitability index of Pielou (J= 0.74), there were moderate diversity of woody plants in Moutourwa with more or less equitable species. The systematic record of all trees and shrubs (dbh ≥ 2.5 cm) enabled to check off quasi-totality of woody plants in transects. The specific richness recorded (S = 75 species) show moderate diversified flora (3 < H = 3.2 < 4) but sufficient for savanna landscape. The Shannon-Wiener index was usually found to fall between 1.5 and 3.5 and is rarely above 5.0 (Magurran, 2004). The values found in this inventory fall within the expected range. Coulibaly Siendou et al. (2013) found H = 3.93 in forest-savanna transition in Ivory Coast. The species were more or less equitable species in non cultivated plain of Mourtourwa (J = 0.74) contrary to Kalfou Forest Reserve with J = 0.34 (Froumsia et al. (2012). In tropical rain forest to South-Cameroon, Guedjé (2002) found: S = 199; D = 629; H = 5.55; J = 0.61.

In the study site, 33 species were represented by trees and 33 species by shrubs. However, shrubs were in the majority. About 63.8 8% of total individuals were shrubs (Table 1). In additional of this proportion and according the visual observations, the vegetation is grassy of which grasses are usually burned very year. Among this grassy covering of Gramineae, trees and shrubs are dispersed. Then the plants formation is the tree savanna but shrubs were in the majority.

Table 1. Number of observations per biological type

|  |  |  |
| --- | --- | --- |
| Biological types | Number and percentage of observations | |
| Species | Individuals |
| trees | 33 (44%) | 500 (27.53%) |
| shrubs | 33 (44%) | 1160 (63.88%) |
| trees/shrubs | 9 (12%) | 156 (8.59%) |

**CONCLUSION**

The non cultivated plain of Moutourwa has large number of woody species including more useful plants to be likely to take in account. There are a lot of indigenous edible fruits much commercialized in local markets. The study of the floristic richness, the specific diversity and the type of vegetation is the contribution to valorize the wild vegetal resources for efficient conservation and sustainable use moreover in the sahelo-sudanian zone. The non cultivated plain of Moutourwa is presented like interesting landscape to conserve for its indigenous useful plants.

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**REFFERENCES**

## Froumsia M., Zapfack L., Mapongmetsem P. M. & Nkongmeneck M-A., 2012), Woody species composition, structure and diversity of vegetation of Kalfou Forest Reserve, Cameroon. Journal of Ecology and the Natural Environment 4(13): 333-343.

## Guedje N. M., 2002. La gestion des populations d’arbres comme outil pour une exploitation durable des produits forestiers non-ligneux: exemple de *Garcinia cola* (Sud-Cameroun). Trobenbos-Cameroun Programme, Cameroun. 266 p.

## Hall p & Bawa K., 1993. Methods to assess the impact extraction non-timber forest products on plant population*.* Economic Botany 47(3), 234-247.

## Huggett R., Wite F., Harrison M. & Rameau J., 1986. Manual of forest botany. Tropical forest. Vol. 1, 2nd edition, revised and brought up to date. Centre Technique forestier, Nogent sur Marne (France). 194 p.

## Lebrun J. P. & Stork A. L., 1991. Enumération des plantes à flore d’Afrique Tropicale. Vol. 1. Editions de Conservation et Jardin Botaniques de Génève, Génève, Suisse.

## Lejoly J., 1993. Méthodologie pour les inventaires forestiers (partie flore et vegetation) Rapport ECOFAC. Agreco/Cirad-Forêt, Montpellier, France. 53 p.

## Letouzey R., 1969. Manuel de botanique forestière. Afrique tripicale. Vol. 1, 1ère édition. Centre Technique Forestier tropical (France) et Ministère de l’Enseignement Supérieur et Tehnique (Cameroun). 194 p.

## Letouzey R., 1985. Notice de la carte phytogéographique du Cameroun au 1:500 000. Institut de la Carte Internationale de la Végétation, Toulouse, France.

## Mahamat H., 1991. Contribution à l’aménagement intégré des zones protégées de l’Extrême nord-Cameroun: Cas du Parc National de kalamaloue. Mémoire de fin d’étude. COD/INADER, Dschang. Cameroun. 94 p.

## Magurran A. E., 2004. Measuring Biological Diversity. Blackwell Publishing, Malden, Oxford and Victoria. 256 p.

## Suchel J. B., 1987. Rainfall patterns and regimes rainfall in Cameroon. Doc. Geographic tropical, No. 5, CEGET-CNRS, Talence, 287 p.

## Tchobsala, Amougou A. & Mbolo M., 2010. Impact of wood cuts on the structure and floristic diversity of vegetation in the peri-urban zone of Ngaoundere, Cameroon, Journal of Ecology and the Natural Environment 2(11): 235-258.

## Yédomonhan H., 2009. Plantes mellifères et potentialités de production de miel en zones guinéenne et soudano-guinéenne au Bénin. Thèse de Doctorat, Université d’Abomey-Calavi, Bénin. 273 p.

## Mapongmetsem P. M., Tchiégang–Megueni C., Nkongmeneck B. A., Kapseu C. & Kayem J. G., 1997. Agroforestry potentials of the indigenous agroforestry tree species in the northern Cameroon. Cameroon Journal of Biology and Biochemical Sciences 7(1): 21-25.

Mapongmetsem P. M., Kapchie V. N. & Tefempa B. H., 2012. Diversity of local fruit trees and their contribution in sustaining the rural livelihood in the northern Cameroon. Ethiopian Journal of Environmental Studies and Management 5(1): 32-46.

## Tchiégang-Megueni C., Mapongmetsem P. M., Akagou Zedong H. C. & Kapseu C., 2001. An ethnobotanical study of indigenous fruit trees in northern Cameroon. Forests, Trees and Livelihoods 11: 149-210.

Annex 1. List of all species, their biological type and their relative abundance

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Families | Species | biological type | Ni | Pi2\*100 | Density (ha-1) |
| Anacardiaceae | *Sclerocarya birrea*\* | tree | 32 | 1.76 | 3.2 |
|  | *Haematostaphis barteri*\* | tree | 26 | 1.43 | 2.6 |
|  | *Lannea acida*\* | tree | 3 | 0.16 | 0.3 |
|  | *Lannea friticosa*\* | shrub | 14 | 0.77 | 1.4 |
|  | *Lannea microcarpa*\* | tree | 1 | 0.05 | 0.1 |
|  | *Lannea shimperi*\* | tree | 10 | 0,55 | 1 |
| Annonaceae | *Annona senegalensis*\* | shrub | 164 | 9.04 | 16.4 |
|  | *Hexalobus monopetalus*\* | shrub | 94 | 5.18 | 9.4 |
| Araliaceae | *Steganotaenia araliacea* | shrub | 7 | 0.38 | 0.7 |
| Balanitaceae | *Balanites aegyptiaca*\* | tree | 67 | 3.69 | 6.7 |
| Bignoniaceae | *Stereospermum kunthianum* | tree/shrub | 8 | 0.44 | 0.8 |
| Bombacaceae | *Adansonia digitata\** | tree | 1 | 0.05 | 0.1 |
|  | *Bombax costatum* | tree | 13 | 0.71 | 1.3 |
| Burceraceae | *Boswellia dalzielii* | tree | 45 | 2.48 | 4.5 |
|  | *Commiphora africana* | tree | 10 | 0.55 | 1 |
|  | *Commiphora pedunculata* | tree | 3 | 0.16 | 0.3 |
| Capparaceae | *Cadaba farinosa* | shrub | 1 | 0.05 | 0.1 |
|  | *Capparis sepiaria* | shrub | 7 | 0.38 | 0.7 |
|  | *Crateva adansonii* | shrub | 2 | 0.11 | 0.2 |
|  | *Maerua angolensis* | tree/shrub | 8 | 0.44 | 0.8 |
| Ceasalpinaceae | *Cassia arereh* | tree | 4 | 0.22 | 0.4 |
|  | *Detarium microcarpum*\* | tree | 1 | 0.05 | 0.1 |
|  | *Piliostigma reticulatum* | shrub | 536 | 29.56 | 53.6 |
|  | *Piliostigma thonningii* | shrub | 20 | 1.10 | 2 |
|  | *Senna singueana* | shrub | 29 | 1.56 | 2.9 |
|  | *Tamarindus indica*\* | tree | 34 | 1.87 | 3.4 |
| Celastraceae | *Maytenus senegalensis* | shrub | 10 | 0.55 | 1 |
| Combretaceae | *Anogeissus leiocarpus* | tree | 34 | 1.87 | 3.4 |
|  | *Combretum aculeatum* | shrub | 1 | 0.05 | 0.1 |
|  | *Combretum collinum* | tree/shrub | 6 | 0.33 | 0.6 |
|  | *Combretum adenogonium* | tree/shrub | 23 | 1.27 | 2.3 |
|  | *Combretum nigricans* | tree/shrub | 4 | 0.22 | 0.4 |
|  | *Combretum glutinosum* | tree/shrub | 49 | 2.70 | 4.9 |
|  | *Combretum molle* | shrub | 4 | 0.22 | 0.4 |
|  | *Guiera senegalensis* | shrub | 21 | 1.15 | 2.1 |
|  | *Terminalia avicennioides* | shrub | 9 | 0.49 | 0.9 |
|  | *Terminalia glausecens* | shrub | 13 | 0.71 | 1.3 |
| Ebeneceae | *Diospiros mespiliffformus*\* | tree/shrub | 12 | 0.66 | 1.2 |
| Euphorbiaceae | *Bridellia scleroneura*\* | shrub | 8 | 0.44 | 0.8 |
| Fabaceae | *Dalbergia melanoxylon* | shrub | 19 | 1.04 | 1.9 |
|  | *Entada africana* | tree | 42 | 2.31 | 4.2 |
|  | *Erythrina senegalensis* | tree | 10 | 0.55 | 1 |
|  | *Pterocapus erinaceus* | tree | 15 | 0.82 | 1.5 |
|  | *Pterocarpus lucens* | tree | 5 | 0.27 | 0.5 |
| Hymenocardiaceae | *Hymenocardia acida* | tree | 21 | 1.16 | 2.1 |
| Loganiaceae | *Strychnos innocua* | shrub | 5 | 0.27 | 0.5 |
|  | *Strychnos spinosa*\* | shrub | 6 | 0.33 | 0.6 |
| Meliaceae | *Azadirachta indica* | tree | 7 | 0.38 | 0.7 |
|  | *Khaya senegalensis* | tree | 7 | 0.38 | 0.7 |
| Mimosaceae | *Acacia albida* | tree | 9 | 0.49 | 0.9 |
|  | *Acacia ataxacanta* | shrub | 31 | 1.71 | 3.1 |
|  | *Acacia gerardii* | shrub | 10 | 0.55 | 1 |
|  | *Acacia hockii* | shrub | 5 | 0.27 | 0.5 |
|  | *Acacia senegal* | tree/shrub | 38 | 2.09 | 3.8 |
|  | *Acacia seyal* | tree | 9 | 0.49 | 0.9 |
|  | *Acacia sieberiana* | tree | 8 | 0.44 | 0.8 |
|  | *Dichrostachys cinerea* | shrub | 29 | 1.60 | 2.9 |
|  | *Parkia biglobosa\** | tree | 2 | 0.11 | 0.2 |
|  | *Prosopis africana* | tree | 2 | 0.11 | 0.2 |
| Moraceae | *Ficus ingens*\* | tree | 6 | 0.33 | 0.6 |
|  | *Ficus sycomorus*\* | tree | 5 | 0.27 | 0.5 |
| Polygalaceae | *Securidaca longipedonculata* | shrub | 3 | 0.16 | 0.3 |
| Rhamnaceae | *Ziziphus mauritiana*\* | shrub | 53 | 2.92 | 5.3 |
|  | *Ziziphus mucronata*\* | shrub | 22 | 1.21 | 2.2 |
| Rubiaceae | *Crossopteryx febrifuga* | shrub | 1 | 0.05 | 0.1 |
|  | *Feretia apodenthera* | shrub | 18 | 0.99 | 1.8 |
|  | *Gardenia aqualla*\* | shrub | 15 | 0.82 | 1.5 |
|  | *Sarcocephalus latifolius*\* | tree/shrub | 8 | 0.44 | 0.8 |
|  | *Vepris heterophylla* | shrub | 3 | 0.16 | 0.3 |
| Sapotaceae | *Vitellaria paradoxa*\* | tree | 6 | 0.33 | 0.6 |
| Sterculiaceae | *Sterculia setigera* | tree | 51 | 2.81 | 5.1 |
| Tiliaceae | *Grewia venusta* | shrub | 2 | 0.11 | 0.2 |
| Ulmaceae | *Celtis integrifolia* | tree | 2 | 0.11 | 0.2 |
| Verbenaceae | *Vitex doniana*\* | tree | 4 | 0.22 | 0.4 |
|  | *Vitex madiensis*\* | shrub | 3 | 0.16 | 0.3 |
| / | */* | / | 1816 | 100 | 181.6 |

\*= fruit species, Ni = number of individuals for species i, pi2\*100 = relative abundance for species i