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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 of Cameroon, a study of non cultivated plain of Moutourwa was carried 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. Caesalpiniaceae 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 was moderate diversity with more or less equitable species. The wild fruittree species were numerous (pi*100 = 32.76%; D = 59.7 stems/ha). *A. senegalensis* 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 to the valorization of 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 tothe 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. Numerous wild plants species are used in various ways by locales populations for food and medicinal purposes and so on (Mapongmetsem *et al*., 1997; 2002; www.prota.org).

The wild landscape of Moutourwa is dotted with several ecological units like the h, 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 sahelo-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 to Boutrais (1984), the Far-North Region of Cameroon is dominated by trees species among which *Azadirachta indica, Balanitesa egyptiaca, Anogeissus leiocarpus* and Boswellia *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 offlowering of plants (Aril-May-June 2015), using the transect method to inventory woody plants. The developed method was recommended by Lejoly (1993), Hall & Bawa (1993) and Guedje (2002). Five linear transects (20 m × 1000 m) were establishedon the base of 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).

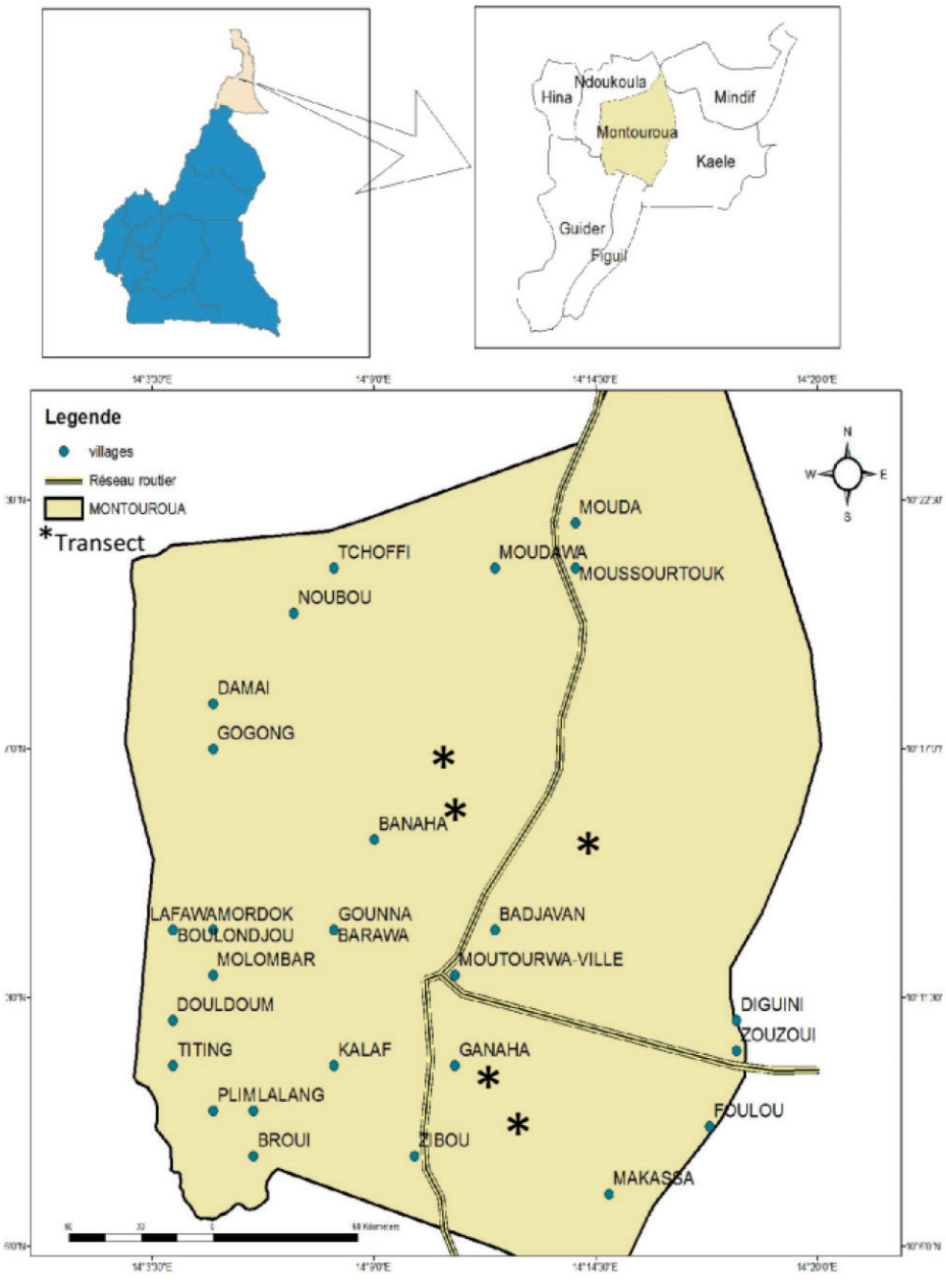

Figure 1- Location map of study site

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.

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:
  $Pi*100 = \frac{ni}{Nt} \times 100$ 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:
  $D = \frac{ni}{Sa}$ 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 indexes of specific diversity. These indexes are widely employed toassure biological diversity (Magurran, 2004).

- The Simpson index iscalculated according to formula:
  $E = 1 - \sum_{S=1}^{S} pi^2$ S is the number of collected species.

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

- The Shannon Weaver index iscalculated according to formula:
  $H = -\sum_{S=1}^{S}(pi * \ln pi)$

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

- The equitability index of Pielou is calculated according to formula:

$$J = \frac{H}{H_{max}} = \frac{H}{\ln S}$$

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, 28 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 leftover stocks represented each by relative abundance inferior to 3.0% were grouped in "Others". Caesalpiniaceae is the most abundant family with relative abundance of 34.41% followed by Annonaceae (14.23%), Combretaceae (9.41%) and Mimosaceae (7.78%). The least abundant families were Polygalaceae (0.16%), Rutaceae (0.16 %), Tiliaceae (0.11%) and Ulmaceae (0.11%).

Diversity and relative abundance of genera

In total, 54 genera were inventoried but only 21 genera with relative abundance superior to 1.0 were represented in Figure 3 for the best visibility. The leftover stock

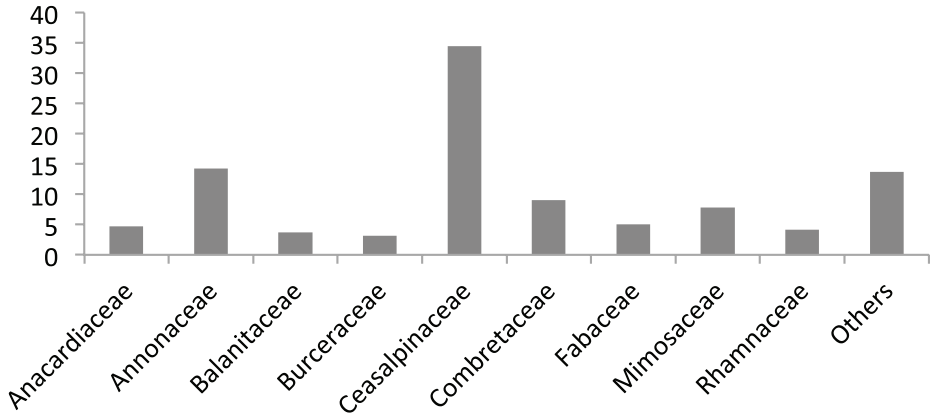

Figure 2 - Relative abundance of most representative families

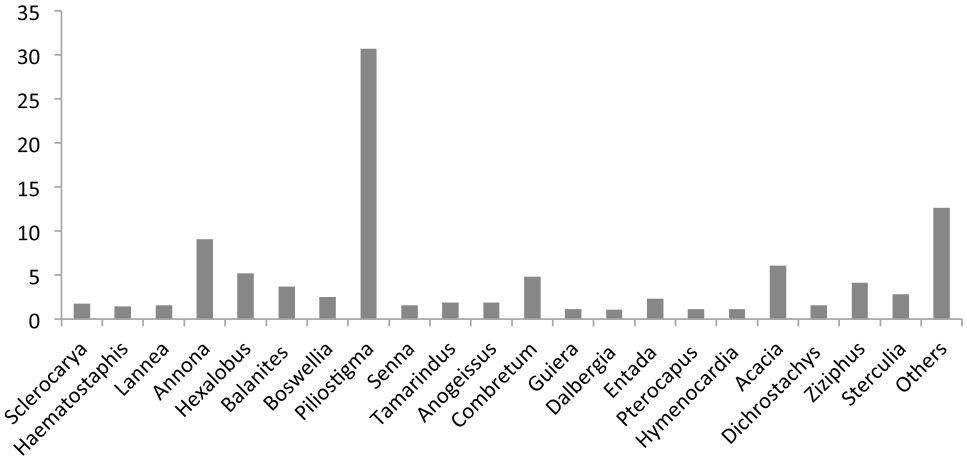

Figure 3 - Relative abundance of most representative genera

of genera represented each by relative abundance inferior to 1.0% was 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.

Relative abundance anddensity 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). Seven species: *Adansonia digitata, Cadaba farinosa, Combretum aculeatum, Crossopteryx febrifuga, Detarium microcarpum, Lannea microcarpa, Vepris heterophylla* were least represented (pi^2*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 belonging to Caesalpiniaceae, the dominant family and *Piliostigma reticulatum* was must represented species. In total, 28 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). In line with our, Tchobsala *et al.* (2010) recorded 34 families, 60 genera and 140 species in the h of Adamawa. In the Kalamaloue National

Park, 11 families and 21 species were recorded (Mahamat, 1991). These differences may be due to micro-climate factors and difference of anthropogenic pressure.

The fruits from the plants are mainly harvested by women, consumed and commercialized in the local and regional markets (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= 59.7stems/ha). A. senegalensis 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 those of Mapongmetsem *et al.* (2012) in the sudano-sahelian zone of Cameroon. According to these authors, *Adansonia digitata, Balanites aegyptiaca, Borassus aethiopum, Detarium microcarpum, Diospyros mespiliformis, Haematostaphis barteri, Hyphaena thebaica, Parkiabi globosa, Sclerocarya birrea, Ximenia americana, Vitellaria paradoxa, Vitex doniana, Tamarindus* indica and *Ziziphus mauritiana* represented 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 vegetation

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 savannah 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-savannah transition in Ivory Coast. The species were more or less equitable 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 too. However, shrubs individuals were in the majority. About 63.88% of total individuals were shrubs and Trees were about 27.53 % (Table 1). In addition to this proportion and according to visual observations, the vegetation is grassy of which grasses are usually burned annually. Among this grassy covering of Gramineae, trees and shrubs are scattered. The vegetation of the Moutourwa non cultivated plain is a shrubby h.

Table 1 - Number of observations per biological type

Biological types	Numbers and percentages 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 vegetation of the Moutourwa non cultivated plain is a shrubby savannah. It has many woody species including important useful plants to be likely to take into account. Many of these local species have edible fruits which are 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 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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Annex 1 - List of all species, their biological type and their relative abundance

FAMILIES	SPECIES	BIOLOGICAL TYPES	Ni	Pi^2*100	DENSITY (/ha)
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 fruticosa**	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
Caesalpiniaceae	*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
	Combretumglutinosum	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 glaucescens	shrub	13	0.71	1.3
Ebeneceae	*Diospiros mespiliformus**	tree/shrub	12	0.66	1.2
Euphorbiaceae	*Bridelia 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

Annex 1 - continued

FAMILIES	SPECIES	BIOLOGICAL TYPES	Ni	Pi^2*100	DENSITY (/ha)
Fabaceae	*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 ataxacantha	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 longipedunculata*	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
Rutaceae	*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