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INFLUENCE OF FIRE ON CANOPY PLANT DIVERSITY IN THE HIGH GUINEAN SAVANNAH OF DJEREM (ADAMAOUA, CAMEROON)

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ABSTRACT

Numerous anthropogenic pressures, including periodic fires, affect the current functioning and structure of tropical savannas. The objective was to contribute to the evaluation of the effects of fires on the woody cover in the high Guinean savannas of Cameroon. The work took place in the Mbakaou and Ngaoundal districts in the Djerem Division. Floristic inventories were carried out in transects 1 km long and 20 m wide. A total of 100 transects were carried out, covering an area of 30 ha. For each parameter studied, the analysis of variance was performed using XLSTAT and the Excel software was used to produce the graphs. The results show that the specific diversity is globally low with 49 species, 44 genera and 20 families. The most dominant species are Entadaafricana and Piliostigmathonningii. The families of great ecological importance are Fabaceae and Combretaceae. The demographic structure (diameters, heights, dhp) of the savannas follows an "L" shaped distribution. Thus, fires contribute to the erosion of biodiversity. It is urgent to take adequate measures to limit bush fires.

Keywords: Fire, Woody cover, Guinean high savannahs, Adamaoua, Cameroon.

1. INTRODUCTION

In the mitigation of climate change, fires are incriminated for their contribution of 13 to 40% to global GHG emissions in atmospheric carbon equivalent (Bowman and Wilson, 1995). Climate scenarios predict that, for a global temperature increase of 4°C by 2080, the consequence would be an increase in dry season duration and fire factors by 30% and a doubling of burned areas (Koffi et al., 1995). Of the 7 Gt of GHGs emitted per year, 3.4 Gt come from the forestry sector, including 1.1 Gt from fires and bushfires (IPCC, 2007). Through its setbacks, fire can thus threaten the living environment, health and safety of people and property (Vieira et al., 2015). Uncontrolled fires in particular, can also induce a loss of plant biomass (Sawadogo, 2011). The frequency of fires limits, on the one hand, the regeneration of woody species whose seeds and seedlings are destroyed and, on the other hand, the growth in height of woody species, these two actions having an important repercussion on the dynamism of the vegetation and its progression towards the climax (IPCC, 2007). In tropical savannahs in particular, it is established that iterative fires have a negative influence on the sustainability of ecological resources and services (Sawadogo, 2011). This perception has led to a focus on the carbon sequestration capacities of African tropical forests and savannas (UNFCCC, 1992). The Guinean high savannahs of Adamaoua, which are periodically subject to fire, are ecologically fragile ecosystems. These fires represent a key factor in the impoverishment of the biological diversity of these ecosystems.

In Cameroon, the ecological interest of climate change has led to numerous research projects aimed at better understanding its origins and evolutionary mechanisms. In the forest zone (Kotto-Samé et al., 1997; Zapfack, 1998; Zapfack et al., 2005) and northern zone (Ibrahima and Abib, 2008; Tchobsala et al., 2014; Kemeuze et al., 2015), work on carbon stocks is legion.

Improving knowledge on endogenous knowledge, the impact of bushfires on biodiversity conservation will allow a better understanding and contribute to the sustainable management of savanna ecosystems. The above-mentioned gaps motivate and justify the present work, which aims to contribute to the establishment of a reliable database in the perspective of REDD+ mechanisms in the Guinean high savannas of Cameroon, in order to contribute to climate change mitigation and adaptation strategies.

2. MATERIALS AND METHODS

2.1. PRESENTATION OF THE STUDY AREA

The study took place in the Djerem Division. The sites belong to the vast Adamaoua Plateau, located between the 6th and 8th degrees north latitude and between the 10th and 16th degrees east longitude, with an average altitude of 1,000 meters. Its climate is Sudano-Guinean with a humid tendency, with a rainy season from April to October and a dry season from November to March. The average annual rainfall is 1,400 mm, the average annual temperature is 23°C and the relative humidity is 70%. The dominant soils are low modal ferralitic soils developed on granitic rocks and red ferralitic soils developed on ancient basalts (Kotto et al., 1997). The vegetation of Adamaoua is a savanna with Danielliaoliveri and Lophiralanceolata (Letouzey, 1968). The physiognomy of this vegetation is maintained by zoo-anthropic actions such as bush fires, grazing, clearing and anarchic wood cutting (Ibrahima et al., 2007; Mapongmetsem and Akagou, 1997; Ntoupka, 1999).

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2.2. RELIEF

The relief is that of the Adamaoua plateau, but the commune of Ngaoundéré III is dissected by more or less incised rivers. Altitudes vary between 1098 m and 1140 m. However, in the eastern part of the commune, there are several domes of trachytes and phonolites that dominate the relief of the plateau. The most spectacular are Ngao Hora (1301 m), Ngao Belle (1215 m), Ngao Sey (1272 m) and Ngao Mboultama (1291 m).

The soils are ferruginous, tropical intergrades ferralitic (Humbel, 1971) or weakly ferralitic modal soils (Martin and Segalens, 1996) or luvisol and ferrisol. Ferralitic soils or Telvic Acrisols and Nitosols that develop on ancient basalts and occupy most of the plateau. Humbel (1971) distinguishes among the ferralitic soils: weakly unsaturated ferralitic soils rejuvenated, strongly unsaturated soils typical of pseudo-particles, reworked ferralitic soils.

The region has an apparent homogeneity, hence the term plateau, commonly used to designate the Adamaoua highlands. The granites and migmatites of the Mambila Plateau (1800 m) to the west (Nigerian border) are represented by a polyconvex pattern, with much steeper slopes and gradients (300 to 600 m) that appear to be related to the large-scale tectonic movements that led to the formation of the Tikar plains. One meets there domes and piton (Tchabal Gandaba), high plateaus (Tchabal Mbabo).

2.3. VEGETATION

The vegetation of Adamaoua corresponds to a Sudano-Guinean sector ranging from shrub savannah to a deeply anthropized tree savannah. Nevertheless, in terms of flora, the most frequent species are represented by Danielliaoliveri and Lophiralanceolata (Letouzey, 1968). These species are prolific due to anthropogenic zoo factors such as fire, grazing and crop clearing. In the fallows and around the villages, this formation presents the same physiognomy with a herbaceous stratum dominated by numerous Andropogonaceae (Hyparrhenia spp. and Andropogon spp.) and Panicum (Panicum spp.) of great development, which can reach up to 2-3 m at the end of the vegetative cycle in these zones (Yonkeu, 1993). The vegetation of Adamaoua is heavily disturbed and degraded by the local population through firewood cutting, arson or slash-and-burn agriculture (Mapongmetsem et al., 2000; Tchotsoua et al., 2000; Tchotsoua, 2006). Forest galleries with Guinean floristic affinities, severely damaged for agricultural purposes, occupy only a small place within the savannahs of Adamaoua. On the whole, the vegetation is characterized by an apparent floristic development and homogeneity.

2.4. METHODOLOGY

The study was conducted in the high Guinean savannahs of Adamaoua, particularly in the Djerem Division. Two types of savannas were chosen according to the orientations of the local

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population. These are burned shrub savannahs and burned tree savannahs, while the control savannahs are those that have not been burned for at least 10 years. Information on the age of the unburned savannahs was provided on site by the populations of the various districts selected. The types of savannahs were chosen taking into account access to the site (proximity of an easy access road). The work was carried out in two main stages: socio-economic surveys of households and floristic field inventories.

The floristic inventories were conducted in the shrub savannahs and wooded savannahs, whether or not they had been subject to fire, in the villages mentioned above in the districts of Ngaoundal and Mbakaou.

In each type of savannah, transects of 1km in length and 20m in width were installed to inventory the flora. A total of 100 transects were carried out, covering an area of 30 ha. All woody species were systematically counted. All woody species with diameter at breast height (dhp) ≥2.5 cm and height > 2m were systematically enumerated and measured. Botanical reference materials (Arbonnier, 2008, Souane, 1997) were used for species identification in situ. For unidentified species, herbarium samples were collected for later identification at the Laboratoire de Biodiversité et Développement Durable of the University of Ngaoundéré or at the Cameroon National Herbarium in Yaoundé. Thus, the diameter at breast height (dbh) of woody plants was measured with a dbh meter at 1.3 m from the ground for large trees and at 30 to 50 cm from the ground for shrubs and bushes. The inventoried trees were injured in the bands delimited by the strings so as not to be counted several times. In the case of boundary trees, those located on the right edge were counted in the direction of advance in the transects.

The experimental design explored is a split-split-plot with four replications. The main treatment is represented by the savanna facies (shrub savanna and wooded savanna), the type of plot (burned plots, control plots or unburned plots) constitutes the secondary treatment, while the ecological zone, the tertiary treatment and the villages represent the replications.

2.5. ASSESSMENT OF FLORISTIC DIVERSITY

The presence of a species in an environment depends on three factors: its affinity with the conditions of the environment, its capacity to resist competition from other species and finally the possibility that its diaspores reach the environment. Moreover, the abundance and number of species will depend on the interactions between species and the relative distance of seed carriers (Devineau, 1984, cit. Sonké, 1998). Specific diversity according to Barbault (1992) takes into account the relative abundance of species in addition to their number, thus substituting for species richness, which reflects the total number of species present in a community. Guedje (2002) defines species richness as the total number of species in the observed distribution. According to Frontier and Pichod-Viale (1993), taxonomic diversity covers two concepts,

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namely the number of distinct taxa and the way in which individuals are distributed among the different taxa: this is equitability. Numerous indices and mathematical models (Daget, 1976; Frontier and Pichod-Viale, 1993) have been used to highlight the specific diversity of plant communities.

For the present study, Shannon's diversity index (HSI), Piélou's equitability index (EQ) and Simpon's index were used:

- Shannon's diversity index: ISH = $\sum$Ni/N log2 Ni/N where Ni is the species number. It is expressed in bits;

- Piélou's (1966) equitability (EQ): EQ = ISH/log2N; it corresponds to the ratio between the observed diversity and the maximum possible diversity of the number of species N ;

- Simpon's diversity index. Several expressions of this index can be found: D = 1/$\sum$(Ni/N)2 (Begon et al., 1987) or simply D'= -$\sum$(Ni/N)2 (Colinvaux cit. Sonké, 1998).

- The degree of stability of the forest flora was estimated on the basis of the specific quotient (Q) (Sonke, 1998) noted Q=S/Ge ;

where Ge represents the number of genera and S is the number of species

This index is used to compare two similar plant groups or areas. A high value of the specificity quotient indicates that the territory examined is poor in species. On the other hand, a low value of this quotient implies a poverty in genera and a richness in species. When this quotient is 1 or very close to it, it indicates a stable and therefore old vegetation. The specific quotient makes it possible to appreciate the state of maturity of the flora of a given region (Lebrun, 1960).

Analysis of the flora

The frequency of all the species counted and their cover are expressed in percentage. These observations involve the notions of presence, centesimal frequency of a species, the specific contribution and the global cover of Daget and Poissonnet (1972).

Abundance

Abundance refers to the total number of individuals of the species. Species abundance can be absolute or relative. Relative abundance (RA) expresses the importance of a species in terms of its numbers. It is expressed in ratio of the number of individuals of the species i on the total number of sampled individuals; RA=(Number of individuals of the species i)/(Total number of individuals) x 100

Dominance

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The relative dominance which is the importance of a species from the point of view of the diameter of the individuals representing it. It is expressed as the ratio of the sum of the cross sections at 1.30 m from the ground of all the trees of a given species to the sum of the cross sections of all the individuals sampled; DR=(Sum of basal areas of species i)/(Total basal areas of individuals) x 100 .

The basal area of a tree is the cross-sectional area of that tree at 1.30 m above the ground (Rondeux, 1993). It is the area occupied by a tree i per hectare. The basal area of a stand (G) is the sum of the basal areas of the individual trees (g) that make up the stand (Pardré and Bouchon, 1988). They are calculated using the following relations: g = πDi2/4; With :π = 3.14, Di = Diameter of woody i, g = Basal area of woody i (m2/ha).

Frequency

The relative frequency (RF) which is expressed as the ratio of the number of surveys where species i is present to the total number of surveys multiplied by 100.

Density

The absolute density (Ni) or absolute abundance of a taxon corresponds to the total number of stems of this taxon per unit of surface. On the other hand, the relative density (Dr) or relative abundance is the ratio between the number of individuals of a species and the total number of all the individuals of all the species met on a considered surface multiplied by 100.

Dr= (Number of stems of a taxon)/(unit area (ha)) x 100

Importance of Curtis Value

The data from the surveys were used to determine the ecological importance of each species and family. The Index Value Importance (IVI) (Curtis & Macintosh, 1951; Kent and Coker, 2003) and the Family Importance Value (FIV) of Cottam and Curtis (1956) were used. The Importance value index (IVI) defined by Curtis and McIntosh (1950) is equal to the sum of the relative density (total number of individuals of the species, divided by the total number of individuals of all species), the relative basal area (total basal area of the species, divided by the basal area of all species) and the relative frequency (number of surveys where the species is present, divided by the total number of surveys studied). Its value ranges from 0 to 300. Species were then ranked according to their VII, with the species with the highest VII being considered the most ecologically "important" in the survey (Curtis and McIntosh 1950).

The Value Importance Index (VII) = Relative Frequency + Relative Density + Relative Dominance (for the species).

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Family Importance Value (FIV) = Relative frequency of a family + Relative density of a family + Relative dominance of a family.

Characterization of the diametric and vertical structure

The diametric structure reflects the distribution of species numbers in diameter classes.

For the vertical structure, the height classes were retained.

2.6. DATA PROCESSING AND STATISTICAL ANALYSIS

For each parameter studied, the analysis of variance was carried out using Statgraphics plus, XLSTAT and the Excel software was used to produce the graphs and calculation of means.

3. RESULTS AND DISCUSSION

3.1. FLORISTIC RICHNESS AND DIVERSITY OF GUINEAN SAVANNAHS

3.1.1. FLORISTIC RICHNESS OF THE GUINEAN SAVANNAS

A total of 49 species, 44 genera and 20 families were inventoried in Djerem. The number of taxa varies from one Arrondissement to another and also from one plant formation to another (Table 1). The analysis of variance shows a lack of homogeneity between the number of individuals, genera and families of each plant formation (0.0001<0.001). The species of the different plant formations are different (0.000<0.001).

Table 1: Floristic diversity of Guinean savannas

Arrondissements		BSS			BTS			SSW			TSW		
	NI	NE	NG	NF	NE	NG	NF	NE	NG	NF	NE	NG	NF
Ngaoundal	4055	25	23	18	23	18	15	33	31	19	23	20	16
Mbakaou	3054	21	26	17	18	13	9	30	28	20	27	26	11

BSS: burnt shrub savanna, BTS: burnt tree savanna, SSW: shrub savanna witness, TSW: tree savanna witness

3.1.2. FLORISTIC DIVERSITY OF GUINEAN SAVANNAS

Table 2 presents the value of Shannon's index, Pielou's Equitability index, Simpson's index and the specific quotient of woody species in the Guinean high savannas. These indices vary according to the sites and plant formations. In general, when the Shannon index decreases, the Simpson index increases and vice versa. Moreover, the shrub savannah controls are the richest in biodiversity in the entire Division. This situation shows the negative impact of bush fires on

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plant formations. In general, it appears that the Shannon index in the control savannas is greater than 3. Such a result suggests that these control savannas are more diverse than those that are regularly burned. Similar results are reported in Chadian savannas (Dona et al., 2016).

Table 2: Diversity indices in Guinean savannas

Djerem	Ngaoundal				Mbakaou			
Indices	BSS	BTS	SSW	TSW	BSS	BTS	SSW	TSW
Shannon	2,78	2,3	3,003	2,8	2,92	3,17	3,04	3,19
Equitabilité de Pielou	0,9	0,79	0,973	0,9	0,45	0,94	0,92	0,95
Simpson	0,08	0,14	0,065	0,1	0,06	0,05	0,06	0,04
Quotient spécifique	1,09	1,28	1,06	1,15	0,81	1,38	1,07	1,04

BSS: burnt shrub savanna, BTS: burnt tree savanna, SSW: shrub savanna witness, TSW: tree savanna witness

3.1.3 ECOLOGICALLY IMPORTANT SPECIES

The species ecological importance value index (EVI) varies by species and also by site (Table 3). The average EVI varies from 2.73% for Ficussycomorus to 43.12% for Entadaafricana. Entadaafricana is a characteristic species of savannahs. It has a high capacity for natural regeneration (Bellefontaine et al., 2018).

Overall, the majority of species have Ecological Importance Index values above 5% (Table 3). Annona senegalensis, Afzeliaafricana, Anogeissusleiocarpus, Cussoniabarteri, Entadaafricana, Piliostigmathonningii, and Hymenocardiaacida are ecologically important species. Contrary to the work of Mapongmetsem et al (1997) and Letouzey (1968), the Adamaoua region is no longer dominated in density by Lophiralanceolata and Danielliaoliveri but rather by Entadaafricana and Piliostigmathonningii. The phenomenon of shrubbery in the savannahs is accelerating and is increasingly leading to the rarefaction of many species in Adamaoua. This result reveals that in the periodically burned high Guinean savannahs of Adamaoua, the floristic background is made up of these ecologically important species, namely: Annona senegalensis, Afzeliaafricana, Brideliaferruginea, Entadaafricana, Isoberliniadocka, Piliostigmathonningii, Hymenocardiaacida and Terminalia glaucescens. Those with an average IVI ≥ 10% will be exploited in the following work.

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Table 3: Ecologically important species in the Guinean savannas

Species	Ngaoundal	Mbakaou	Total	Species	Ngaoundal	Mbakaou	Total
Acacia sieberiana	9,04		9,04	*Lophiralanceolata*	6,83	7,74	14,57
Afzeliaafricana		37,4	37,4	*Maytenus senegalensis*	7,48	0,02	7,5
Albizia coriara		6,15	6,15	*Margaritariadiscoidea*	0	3,98	3,98
Allophyllus africanus	8,5	9,12	17,62	*Mytraginainermis*	0	6,05	6,05
Antidesmavenosum	4,88	4,85	9,73	*Ochnaafzeli*	0	9,32	9,32
Annona senegalensis	25,19	22,1	47,29	*Parkiabiglobosa*	12,6	12,4	25
Anogeissusleiocarpus	4,22	15,7	19,92	*Phyllanthus muellerianus*	0	9,56	9,56
Bombax costatum	2,52	2,23	4,75	*Piliostigmathonningii*	36,1	2,79	38,89
Borassus aethiopum		8	8	*Sarcocephaluslatifolius*	0	4,61	4,61
Burkeaafricana	4,95		4,95	*Securidacalongepedunculata*	0	4,33	4,33
Brideliaferruginea	5,09	2,13	7,22	*Psorospermumfebrifugum*	6,36	4,23	10,59
Croton macrostachyus	9,51	5	14,51	*Steganotaeniaaraliacea*	7,51		7,51
Cussoniabarteri	7,49	16,2	23,69	*Strychnos lucida*	0	4,7	4,7
Danielliaoliveri		3,05	3,05	*Strychnos spinosa*	3,31	2,18	5,49
Entadaafricana	37,32	5,8	43,12	*Syzygium guineense var. macrocarpum*	5,04	4,19	9,23
Ficus sycomorus	2,73		2,73	*Terminaliaglaucescens*	8,19	9,48	17,67
Gardeniaaqualla	6,1	5,58	11,68	*Terminaliamacroptera*	27,8	33,7	61,5
Harunganamadagascariensis	6,22		6,22	*Trichiliaemetica*	0	16,4	16,4
Hymenocardiaacida	17,6	9,6	27,2	*Vitex doniana*	2,38	2,34	4,72
Isoberlinadoka	12	0,07	12,07	*Ximenia americana*	1,65		1,65
Jatropha curcas	4,68	6,12	10,8				

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3.1.4. FAMILIES OF ECOLOGICAL IMPORTANCE IN THE GUINEAN SAVANNAHS

The families of ecological importance are variable. The ecologically important families are Fabaceae (184.72%) and Combretaceae (111.66%) (Table 4). These families have the largest land areas because they are more resistant to anthropogenic activities in all plant formations. These results are contrary to those obtained by Tiokeng (2018) in southwestern Cameroon where Burseraceae, Apocynaceae and Rubiaceae play an important ecological role. These are families containing species that develop adaptation strategies to resist periodic fires confirming their ecological importance and whose main ones have been described. In the savannahs of Tandjilé - East in Chad, Dona et al. (2016) report similar results.

Table 4: Family of ecological importance of species in the high Guinean savannahs of Adamaoua

Families	Ngaoundal	Mbakaou	Total	families	Ngaoundal	Mbakaou	Total
Anacardiaceae	3,53	2,29	5,82	Loganiaceae	3,31	4,88	8,19
Annonaceae	24,19	19,11	43,3	Meliaceae		16,41	16,41
Araliaceae	7,49	16,22	23,71	Moraceae	2,74		2,74
Arecaceae		8	8	Myrtaceae	5,64	11,84	17,48
Asteraceae		6,37	6,37	Ochnaceae	6,84	17,06	23,9
Malvaceae	2,52		2,52	Olacaceae	1,65	0	1,65
Celastraceae	7,49	0,02	7,51	Phyllanthaceae	29,6	26,02	55,62
Combretaceae	45,89	65,77	111,66	Polygalaceae		4,34	4,34
Euphorbiaceae	14,2	7,13	21,33	Primulaceae	3,2		3,2
Fabaceae	113,99	70,73	184,72	Rubiaceae	6,11	16,25	22,36
Clusiaceae	13,6	0,23	13,83	Sapotaceae	7,12		7,12
Lamiaceae		7,1	7,1				

3.2. STRUCTURES OF THE VEGETATION OF THE GUINEAN HIGH SAVANNAS

3.2.1. DIAMETRIC DISTRIBUTION OF SPECIES

The different plant formations are dominated by trees with a diameter at breast height ranging from < 0.15 m to 1.30 m. From the diameter range [0.15 - 0.30[cm, numbers decrease sharply as diameter increases above 60 cm where very few stems are observed (Fig. 1). This result demonstrates the dominance of the Guinean savannah by shrubs and the vulnerability of this formation to fire and other degradation actions. Regarding the diameter at breast height (dbh) of trees in the plant formations, the control shrub savannas have a high number of trees in all

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intervals, except those in the interval [< 0.15]. In the less disturbed control shrub savannas, crown closure of emergents prevents the development of young regenerations.

The shape of the histograms for tree diameters in the shrub savannas follows an "L" distribution. This result is in agreement with that of Mapongmetsem et al. (2011) on Vitellaria paradoxa in the Guinean high savannas. This pattern suggests that regeneration of shrub-savanna and tree-savanna control species is satisfactory and that maintenance of adult trees is difficult. The maintenance of adult species in periodically burned tree savannas is explained by the fact that these individuals no longer have the anato-morphological structures capable of dedifferentiation. This result indicates that a small number of individuals have a dhp greater than 1.30 m in regularly burned plant formations. It is in this sense that some researchers claim that bushfires are a real cause of savanna disturbance (Jakko et al., 2000).

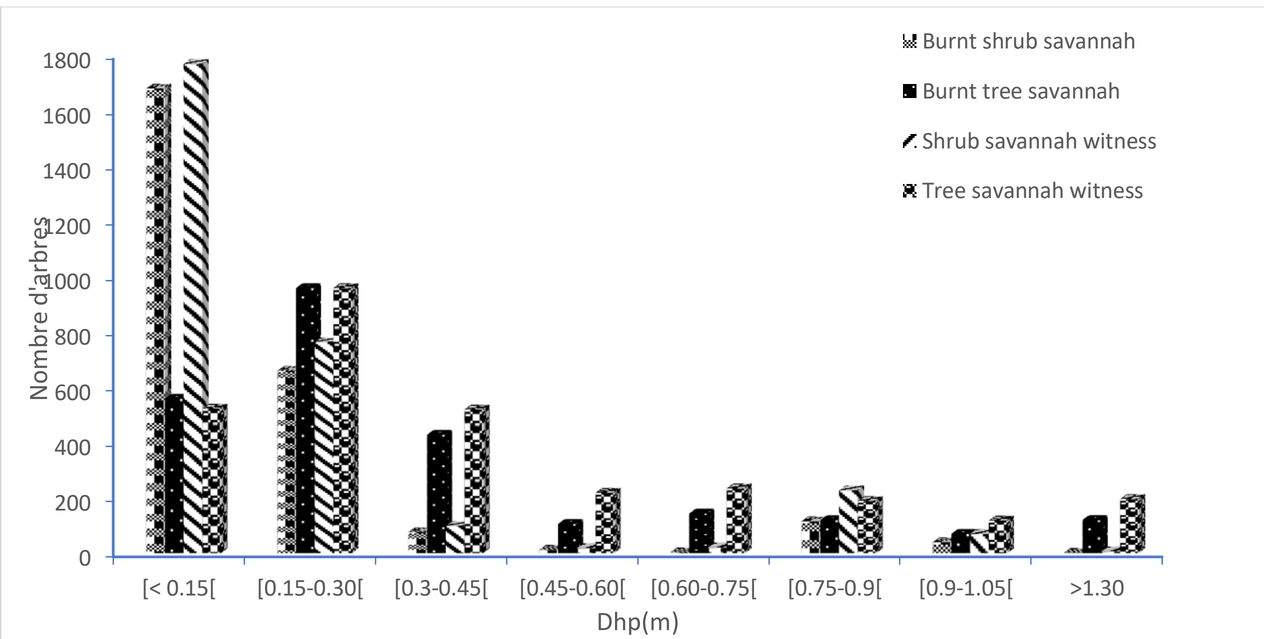

Figure 1: Diameters at breast height of plant species

The diametric distribution of the plant population is variable between districts. In this regard, the structure at the stand level shows a very important distribution of individuals in the first classes of average diameter (Fig. 2). This situation indicates that the savannas of these sites are dominated by small-diameter trees. These results are similar to those of Tchobsala (2011) in the peri-urban savannas of Ngaoundéré. The author showed that the vegetation is essentially made up of individuals with diameters between 10 and 20 cm. This "L" shape suggests that the regeneration of shrub and tree savanna species is good and that the maintenance of adult trees is difficult in the high Guinean savannas (Mapongmetsem et al., 2011). These physical changes

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lead to changes in the development of individual diameters. This result is in agreement with those of Sani (2009) and Boubacar (2010) and confirms one of the characteristics of savannah ecosystems, which are generally made up of relatively medium-sized individuals facing various fire regimes. Our results are also similar to those of Rippstein (1985) and Marcel et al. (2001) who observed respectively, in Cameroon and Benin that the total number of large diameter species is higher in the control plots and lower in those subjected to the fire regime.

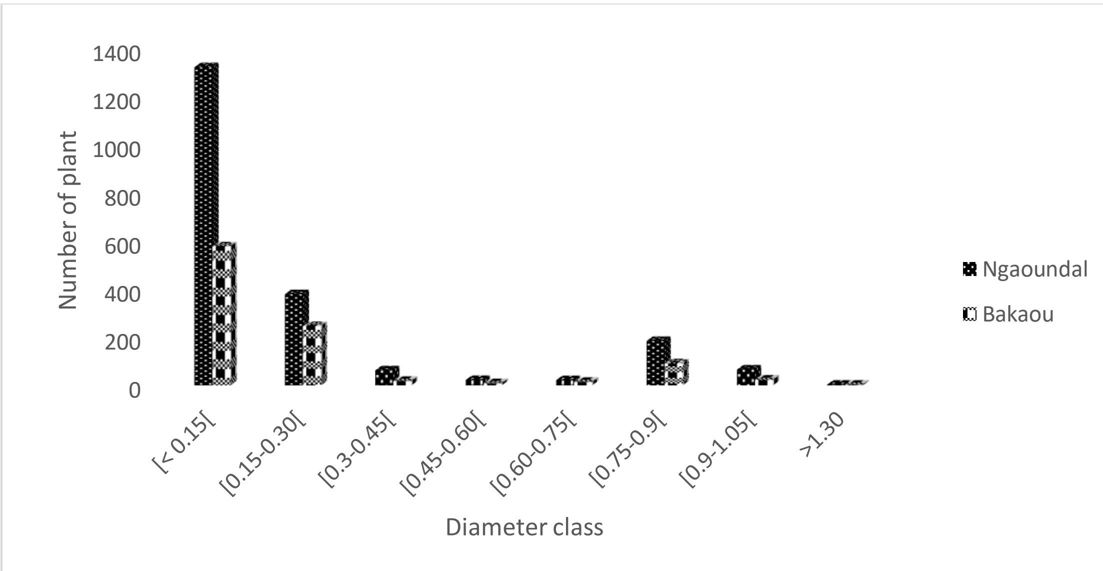

Figure 2: Diameter structure of species in the savannahs according to the Arrondissements

At the Djerem site, the number of individuals varies from 6 (Ngaoundal) to 563.25 individuals at Mbakaou. The interval [0.5-2.5] is more abundant in species. There is no homogeneity between sites (Fig. 3). Our results are in complete agreement with those of Marcel et al. (2001), who report that certain practices (agriculture, grazing, etc.) specific to each village could have impacts on tree development. The authors state that very violent fires are detrimental to flora, vegetation and soils.

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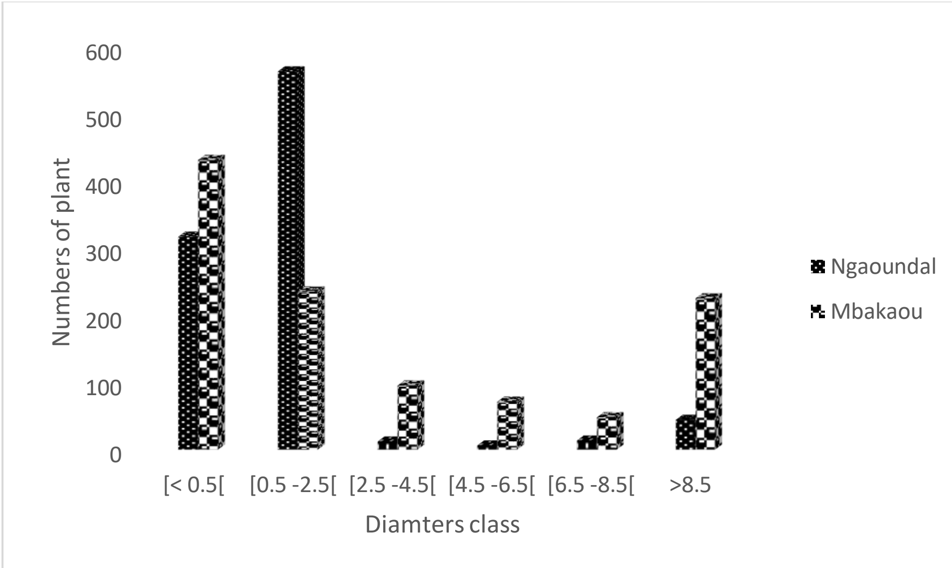

Figure 3: Diameters of the top of the species according to the Districts

3.2.3. VERTICAL DISTRIBUTION OF TREES IN THE GUINEAN HIGH SAVANNAS

Figure 4 presents the vertical structure of plant formations in the study sites according to height classes. In general, individuals with a height greater than 0.5 meters are in the majority, confirming the results described in the previous paragraphs. The number of trees decreases from low height classes (<0.5 m) to high height classes (>5m) (Fig. 4). Trees with a height of less than 0.5 m are in the majority. In contrast, those in the interval [3.5 -4[are the least numerous. Overall, this vertical structure sufficiently shows that the least represented stems are the mature stems except in the shrub savannas. The exception in the shrubby savannahs would be justified by the factors that induce (cutting, fire, etc.) the rejections. Severe fires lead to a considerable decrease in the successive dynamics as shown by Monnier (1973) in the comparison of vegetation types established in the plots of late fires and those of early fires. Notwithstanding the fact that savanna species are generally dwarfed, repeated periodic fires in these formations contribute to a reduction in tree size and phytomass in general.

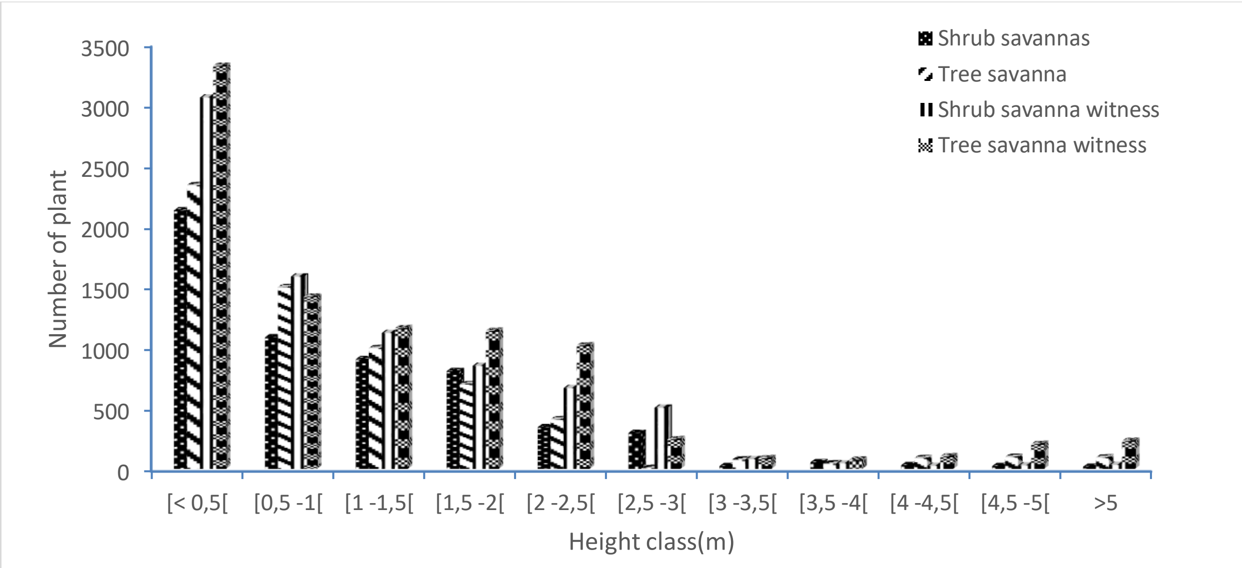

Figure 4: Distribution of species by height classes

CONCLUSION

The objective of this study was to evaluate the effects of fire on the woody cover in the high Guinean savannahs of Adamaoua.

From this study, it appears that the floristic diversity of the Guinean high savannas of Cameroon has become relatively low. A total of 49 species, 44 genera and 20 families were inventoried. The most dominant species are Annona senegalensis and Piliostigmathonningii. The ecologically important families in all the Guinean high savannas are represented by the Fabaceae and Combretaceae. The population structure (diameters, heights, diameter at breast height, crown) of woody species in the savannas follows an "L" shaped distribution. The actions of fires on woody species have an important impact on the dynamism of the vegetation and its progression towards the climax. Unburned savannas (trees and shrubs) are richer in biodiversity throughout the Division than burned savannas.

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