Dendrometrical characterization of a firewood plant species (*Anogeissus leiocarpa* (DC.) Guill. & Perr.) in Pendjari Biosphere Reserve and its surrounding land use area (Benin, Western Africa)

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Abstract

Anogeissus leiocarpa is a dominant plant species of woodlands on non-flooded soils. This species is a more used fire wood in peripheral of the Pendjari Biosphere Reserve (PBR). The present study examines the dynamic of the species' population using the size class distribution in Pendjari Biosphere Reserve comparatively to surrounding areas.

Globally, 15 and 10 plots sized 30 m x 30 m were respectively established in PBR and its landuse area. Plots were established in landuse areas'riparian forest and the Reserve'mosaic forest–savanna. Dendrometrical parameters such as diameters of individuals which dbh ≥10 (d), basal areas, heights, size classes distribution of diameters and heights, densities of individuals which dbh <10 cm and dbh≥10 cm were calculated. Both zones were compared using the t-Student test (for diameters, heights and basal areas) and the Man-Whitnay test (for densities). The size class distributions of diameters were analysed using median dbh and Skewness' coefficient. Statistical analyses were performed using Minitab 13.2.

No significant change appeared in the small size class diameters. The big diameter classes (30-60 cm) showed important numbers of individuals in the landuse areas. Moreover the landuse showed higher Median dbh (14.09 versus 11.70 cm in the reserve) with the lower Skewness coefficient (β_1=0.48 versus 0.73 in the reserve). These results highlighted a positive asymmetry distribution by size class diameter in both zones. Big diameters individuals are more important in landuse area than in Reserve. *A. leiocarpa* population is younger in the Reserve than in landuse area where its habitats were reduced to the riparian forests. The class "8–12 m" showed the high frequency of individuals for both zones. These differed significantly for some dendrometrical parameters such as: (i) individuals' diameters (d = 17.82 vs 22.39 cm) with the lower values in protected area; (ii) density of individuals with dbh<10 cm (respectively D_1=230.30 vs 104.76 stem/ha) and; (iii) density of individuals with dbh ≥10 cm (respectively D_2=274.74 vs 176.19 stem/ha) with higher values in protected area. Basal areas and heights were identical. Our results indicated that *A. leiocarpa* would be threatened in the peripheral while apparently healthy in the Reserve.

Key words: *Anogeissus leiocarpa,* Dendrometrical parameter, Size class distribution, Threatened, Pendjari Park, Benin

Introduction

In West and East Africa, Poilecot *et al.,* (1991) documented a high abundance of *Anogeissus leiocarpa* a large deciduous tree, at forest borders in northern Guinea and Sudanian zone. Nansen *et al.,* (2001) point out that *A. leiocarpa* may play an important role in forest succession and this is relatively proved by Hennenberg *et al.,* (2005) through the survey of its size class distribution along forest-savanna ecotones in northern Ivory Coast. In Benin, none studies have been investigated yet on size class distribution of *A. leiocarpa.*

According to IUCN (1994), the protected areas are important for the conservation of biodiversity. The Pendjari Biosphere Reserve is the most managed park (Delvingt *et al.,* 1989) in Benin. In surrounding zone of Pendjari Biosphere Reserve *A. leiocarpa* is more used for fire wood. The vegetation of our study zone is characteristic of sudanian zone and was studied by several authors (Green, 1979; Delvingt *et al.,* 1989). The results show that *Anogeissus leiocarpa* is among the plant species that dominate woodlands on non-flooded soils. Adomou *et al.* (2006), confirm the presence of *Anogeissus leiocarpa* in this zone. The size class distribution is used to understand the dynamic of population's tree (Cunningham, 2001), and is considered as prediction tool more used (Geldenhuys, 1992). This study aims to characterize the structure by size class distribution of *A. leiocarpa* in Pendjari Biosphere Reserve and surrounding area in order to know the status of the population of this species in the study area.
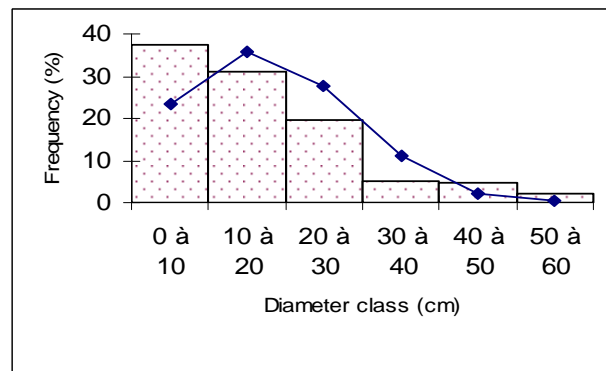
Material and method

The study was carried out in the Pendjari Biosphere Reserve and in two surrounding townships (Tanguieta and Materi) land use areas. The study area is situated at North Western Benin between 10° 30'and 11° 30'North latitude, 0° 50'and 2° 00'East longitude. The climate is sudanian with a rainfall of 1100 mm. The monthly mean temperature ranges from 19°C to 34°C. The potential evapotranspiration is over than 1500 mm. The monthly mean values of relative moisture ranges from 25 to 85%. This zone rainfall pattern is unimodal. The rainy season starts in April or May followed by a prolonged dry season from November to March. The woody vegetation is dominated by *Combretum, Terminalia* (Combretaceae) and *Acacia* (Mimosaceae) on deeper soils. Woodlands are dominated by *Anogeissus leiocarpa* and *Afzelia africana* on non-flooded soils and by *Pseudocedrela kotschyi* on periodically flooded soils. We established 15 and 10 plots (30 m x 30 m) respectively in Pendjari Biosphere Reserve and in land use areas. The plots were established in riparian forest stands of surrounding land use area and in mosaic forest – savanna stands of the Reserve. In the each plot, we collected dendrometrical data on *A. leiocarpa*. We used all data collected to calculate the dendrometrical parameters such as diameter (d) of individuals that dbh ≥10 cm, their basal area (G), the height (H), the size class distribution of diameter and height and the densities by size class. Diameter, basal area, height and density were compared between the Reserve and land use area with the test t of Student (parametric test) and test of Man-Whitnay (nonparametric test). The size class distributions of diameter were analysed with the median dbh (Jayaraman, 1999) and the coefficient of Skewness using Feely *et al.,* (2007). Statistical analyses were performed using Minitab 13.2 software.

Results and discussion

The size class distribution of diameter (figures 1 & 2) revealed that the small class diameter have an important number of individuals as well as in the Reserve and in land use area. But the big diameter classes of 30 cm from 60 cm have an important number in surrounding land use area (stands established in gallery forest habitat) than in the Reserve (stands established in mosaic savannah – forest). This corroborates findings from Hennenberg *et al*. (2005) who showed that *A. leiocarpa* occured in savannah (with more small size class) and in forests (with more individuals of big size class).
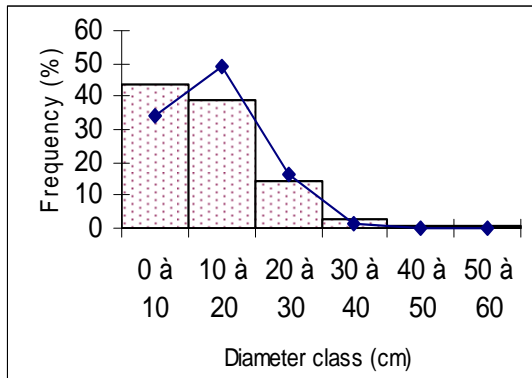
Figure 1: Diameter class distribution in Park   **Figure 2**: Diameter class distribution in land use

In surrounding study zone of Reserve, utilization of *A. leiocarpa* as fire wood, is reducing its habitat at riparian's forest. These last habitats are considered as sacrifice sites by some people. Therefore, riparian's forest habitat are conserved by people as important to assume the seed production and the regeneration of *A. leiocarpa* in land use areas. But the individuals of others habitats (woodland) are more cut for the fire in land use area.

Table 1: Median dbh and coefficients of Skewness of diameter class distribution of *Anogeissus leiocarpa* in Reserve and in land use area.

| Coefficients Area	Median dbh (cm)	β_1
Reserve	11,70	0,73
Land use area	14,09	0,48

Median dbh and coefficient of Skewness calculated are summarized in table 1. The median dbh in land use area is higher than in the Reserve. Therefore, the individuals of big diameter are more important in land use area than in Reserve. The population of *A. leiocarpa* is younger in Reserve than in land use area. In the surrounding land use area, the habitats of *A. leiocarpa* are more reduced at gallery forest habitats. The values of Skewness' coefficient are positives in the both areas and show that the diameter class distributions present all a positive asymmetry.

Table 2: Mean ± standard error of dendrometrical parameters calculated for *Anogeissus leiocarpa.* ***: P< 0. 001; *: P<0. 05;   NS: P>0. 05

Parameters	D (cm)	G (m^2/ha)	H (m)	D1 (stem/ha)	D2 (stem/ha)
Area					
Reserve	17.82 ± 3.06	9.71± 5.64	9.46 ± 3.21	230.30 ±185.33	274.74 ± 74
Land use area	22.39 ± 5.55	9.49 ± 4.18	10.03 ± 3.22	104.76 ± 78.79	176.19 ± 53. 45
Test of signification	***	NS	NS	*	*

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The height size class distribution in Reserve and in land use area (figure 3) reveals that the class 8 – 12 m has the high density of individuals as well as in Reserve and in surrounding land use area. But this density is bigger in land use than in Park. This confirms the presence of big individuals in land use.

The table 2 summarizes the dendrometrical parameters calculated in Reserve and in land use area with the probability of signification
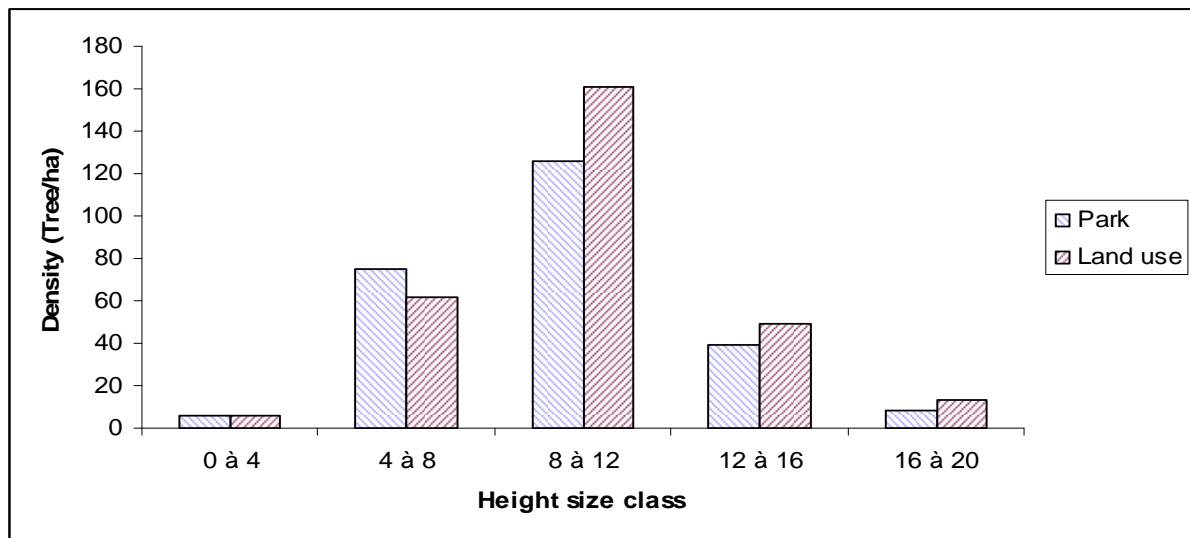
Figure 3: Height class distribution of *Anogeissus leiocarpa* in Park and in land use

Conclusion

A. leiocarpa would be threatened in the peripheral while apparently healthy in the Reserve. But the traditional practices favoured the presence of big diameter individual in riparian's forest. So these individuals can assume the seed production and the regeneration of young stand.

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