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Density, structure, sanitary conditions, phenological, anthropogenic activities of *Afzelia africana* ex person Smith (Fabaceae) stands in the Benue National Park (North Cameroon).

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Abstract

Afzelia africana is a woody forage resource of the Sudano Sahelian savannas listed on the IUCN red list in the vulnerable species category. The Benue National Park is located in the northern Cameroon and overexploited by transhumans shepherds to feed their animals. Archaic foot pruning practiced in combination with other anthropogenic activities significantly affects its ecological resilience capacities. The present work aims to study the dynamics, structure and influence of pruning on the health of the *Afzelia africana* stands in the National Park of Benue. The experimental plan installed is a split-plot (3x3) x 3 by which the sectors (south, east, west, central and north) are the main treatments and transects secondary treatments. A total of 270 hectares were inventoried. The results showed that: mean densities of this specie range from 20 to 630 individuals per hectare in the north and west of the park respectively. For circumference averages, they range from 1 to 3 m and have been grouped into seven amplitude classes of 0.3. The class of]1.8; 2.2 [presenting(41.4 %), has the highest percentage in the entire study site. Average discharges numbers observed are West (10 m), South (6 m), East (5.5 m) and Centre (3.5 m). For the average crown, West of GNP (6.23 m) has the largest average. For the DBH, the results obtained show the following averages: 5.4 m for the Centre ; 4.25 m for the North; 4.23 m for the South; and 4.14 m for the East. Generally, the DmH is between 4 and 6. Finally the average heights are 21.33; 18.95; 16.75 and 11.75 respectively for the North, the West, the South, the Centre and the East. For the phenological phases (leaves-fall periodicity and fruiting) of *Afzelia africana*, it appears that 100 % of the trees remain leaf-covered and the fall of the old leaves occurs without particular tendancy. The flowering of *Afzelia africana* begins in early June with the appearance of flower buds and ends on all the trees in the early August. The full flowering itself takes place in a few weeks, two in average of between mid-June and mid-July, when the rains fall abundantly. Fruiting takes place from September to January.

Keywords: Influence, dynamics, structure, phenology, *Afzelia africana*, Benue National Park, North Cameroon.

Introduction

The northern region of Cameroon is a strong breeding area that is at the crossroads Nigerian markets and the southern consumption bassins (Mabonne *et al.,* 2003). It is also an important area for conservation. However, protected areas are teeming with woody forage resources useful to pastoralists. In Benue National Park, the most pruned species is *Afzelia africana* (Ouedraogo *et al.,* 2006; Sinsin *et al.,* 2004; Onana and Dev, 2002; Baloch *et al.,* 2000). This specie is listed on the IUCN Red List as a vulnerable specie (IUCN, 2012). But in Cameroon, it is threatened with extinction (Gérard *et al.,* 2011). In the Benue National Park it is under pressure from the associated actions of grazing of the giraffes and the transhumane shepherds. There is a strong regression of the density of this specie. The pruning phenomenon exposed *Afzelia africana* to serious plant diseases. To safeguard this specie, we are proposed to conduct a study on the dynamics, structure, phenologic and healthy stands of *Afzelia africana* in a view of safeguarding this specie which is both the source of giraffes and pets food.

Materials and Methods

Location of the study site

The Benue Operational Technical Unit (UTO) comprises the Benue National Park and its peripheral ZIC cover an area of 800 000 ha (180 000 for the park and 620 000 for the ZIC). It straddles the northern regions (80 %) and the Adamawa (20 %) in Cameroon. The vegetation is the Sudano-Sahelian type and an important hydraulic network focused on the Benue flows. The richness of this area includes: 15 vegetation types with 692 species of plants, more than 30 diurnal mammals, about 306 species of birds and 77 species of fish. The UTO is crossed by two very important roads, namely the national N ° 1 connecting it to Garoua, Ngaoundere and the road Guidjiba-Tcholliré (Figure 1). These axes are factors leading to an increase of human pressure in general and poaching, mostly all its annexes, National Park of the Benue and its periphery by the international transnational shepherds searching for the food resources. With the ease of access by these roads, about 60 000 people live in the few 100 villages located in the periphery and their lives depend entirely on natural resources.

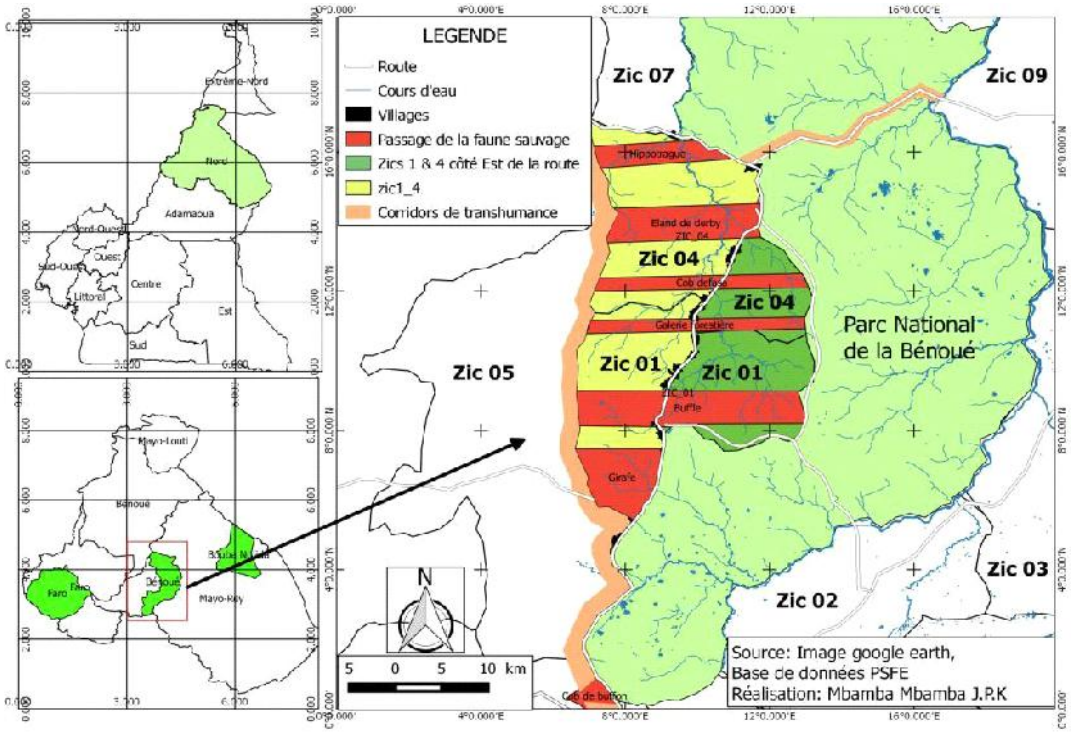

Figure 1: Location map of the study area

Experimental Survey Device

The study was conducted in the Benue National Park (North Cameroon) and took place during the months of January to April 2017 on 15 transects divided into five sectors (South, Central, West, North and East).

In each transects only an area of 3000 x 30 m x 3 representing a rectangle whose side of the triangle is one of the sides and a width of 20 m (Figure 2). A total of 270 hectares were inventoried.

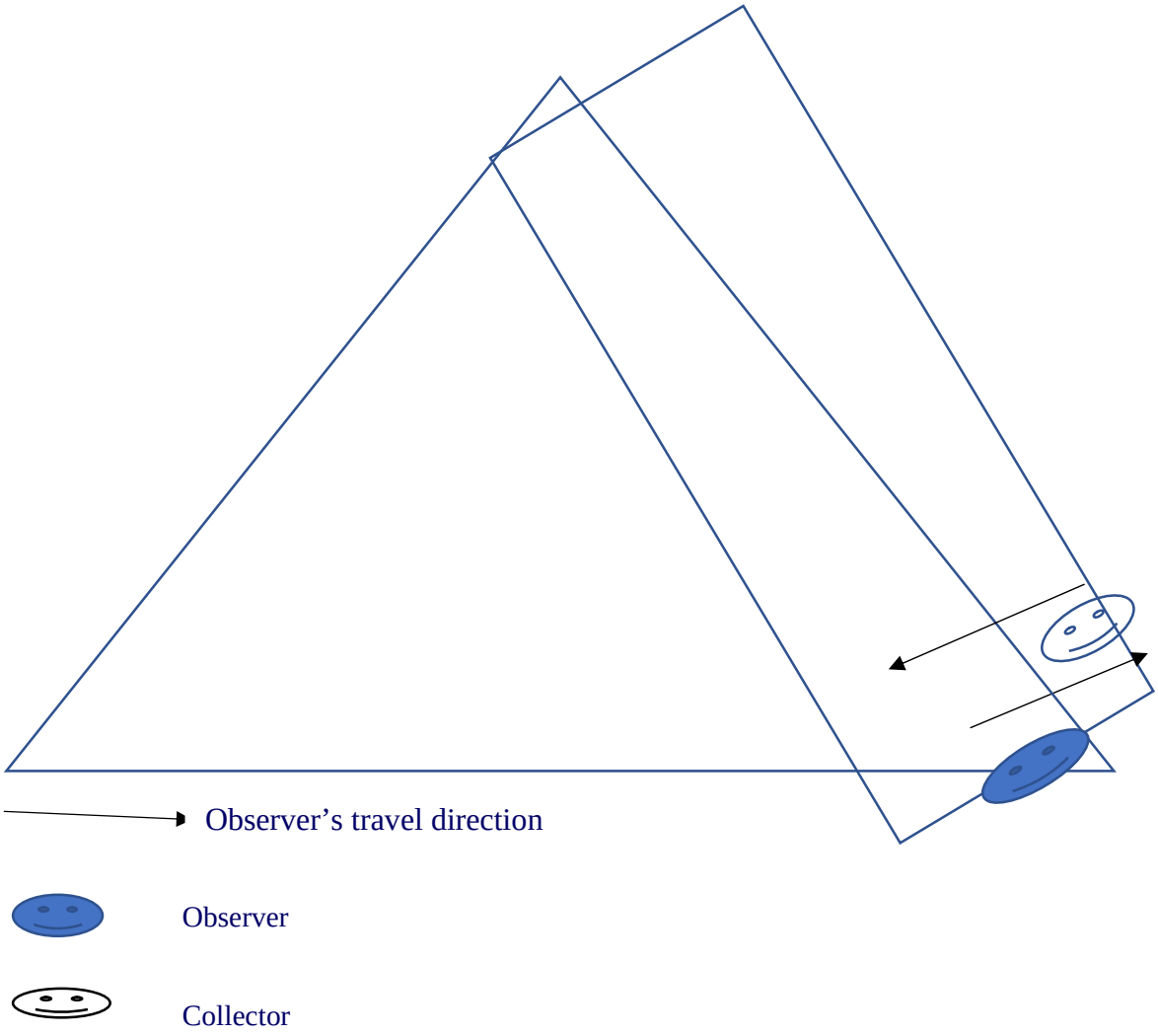

Figure 2: Operatory mode of the *Afzelia africana* Inventory

Survey of dendrometric parameters of *Afzelia africana*. The height of each *Afzelia africana* stem has been estimated using a nestable graduated pole. The 2 diameters of each crown (North-South and East-West) are measured by means of a 50 m metric tape. They are used to calculate the average crown diameter required to estimate the ground cover rate (Houerou, 1980).

Stems belonging to the same strain (rejects, suckers) were distinguished both in measurement and counting.

The measurements and observations have been led to the following different characteristics :

- density : this is the number of foot stems reported per hectare (N/ha);
- the recovery rate : it translates the vertical projection of the crowns to the ground. This parameter is used to evaluate woody biomass (Carriere, 1995). The following formula is used to calculate: $R = (SH \div SS) \times 100$.

With :

R = recovery rate in %
SH = crown basal area; SH= πDmH ²
SS = transect surface
Dmi = average crown diameter
Dmi = (DE-o + DN-S)/2
DE-o = East-West diameter of crown
DN-S = North-South diameter of crown
The structure of the stand or a classical distribution of trunk diameters of *Afzelia africana*;

- Stratification : it is the distribution of wood according to the height classes.

Height < 8 m: shrub stratum height ~ 8 m: Tree stratum.

Total biomass and forage available

The evaluation of the production of a woody forages was done according to the direct method known as destructive or indirect method which is not destructive. Direct biomass measurement is generally long, costly and tedious (CISSE, 1980). The non-destructive method based on allometric relationships was retained in our study.

The estimate of forage biomass was made using the following allometric relationship established by Breman and Ridder (1991):

$$PF = N \times 1200 \text{ (kg/ha)} \times R (\%) \times 1.5$$

With :

- PF = Forage production in kg/ha;
- N = average number of foliage layers in the area. N is equal to 5 for the southern-Sudanian zone with rainfall between 1000 and 1300 mm water per year;
- R (%) = recovery rate of the species;
- 1200 (kg/ha) = specific weight of the sheet corresponding to 12 mg/cm^2.

The amount of available forage accessible by livestock was estimated to be 15 % of the total calculated biomass (Breman and De Ridder, 1991).

The mean content of 41 % of Ms of woody leaves (Doulkoum, 2000) was assigned to this formula to estimate the forage production in Kg of Ms.

Load capacity

The load capacity is the amount of livestock that can sustain a pasture without degrading, the cattle having to remain in good maintenance condition, even gain weight or produce milk while on the pasture (Black, 1984). It is expressed in UBT/ha. The calculation of the load capacity was made according to the relationship proposed below by Black Bird (1984):

P (kg of MS/ha) x K (%) cc = 6.25 (kg ms/UBT/JR) x time of use.

MS = dry matter
K (%) = coefficient of use corresponding to 1/3 in Sahelian zone
UBT = Tropical Bovine unit. It is a hypothetical animal of 250 kg of live weight (PV) whose average daily consumption is estimated to be 6.25 kg.M.

Pruning influence on the phenology and health status of *Afzelia africana*.

This impact was assessed on the basis of the pruning period (beginnng, middle and end of the dry season) and a control lot. The trees were all located in the central part of the park near the Black Buffalo encampment. 300 feet of *Afzelia africana* so 100 trees for each period were studied. During the three periods, we found the trees in bloom and the fruit trees. To check the healthy state of the tree, the mushroom readings, sunburn, browning of the leaves, soil condition (compacted soil) etc. were carried out at the five (5) study sites (Central, East, South, West, North).

Results

Afzelia africana foot density results based on sites

Figure 3 shows the density of *Afzelia africana* according to the sites. This density has an inverted ' U ' curve. This figure reveals that the average density of this specie varies according to the sites. Densities of *Afzelia africana* are ranked in order of importance (West (630 individuals / hectare); Centre (125.9 individuals / hectare); South (78 individuals / hectare); (65 individuals / hectare) and North (20 individuals / hectare)).

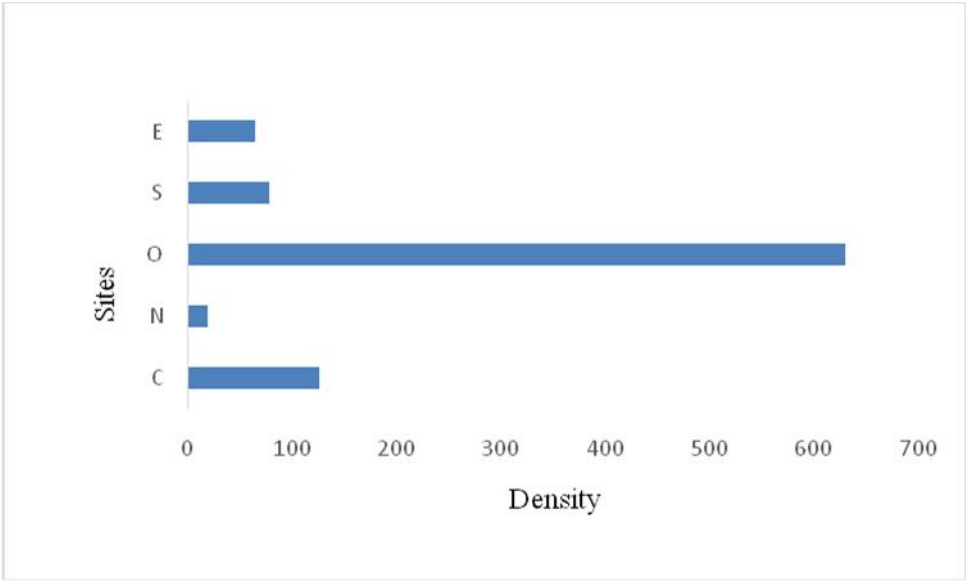

Figure 3: Distribution of density (individuals / ha) of *Afzelia africana* according to the sites

Distribution of *Afzelia africana* as a function of circumference classes

Figure 4 shows the distribution of *Afzelia africana* as a function of circumference and classes. The circumference of the wood is between 1 and 3m. Class of] 1.8; 2.2 [(41.4 % of the workforce) is best represented in the overall study areas taken. This class is followed by one with circumferences between 1.4 and 1.8 (26.4 % of individuals), classes]1.1; 1.4[;]2.2 ; 2.6[;]2.6 ; 3[and]3 ; 3.4[have respectively 5.75 % ; 2.30 % and 1.15 % distribution in study sites.

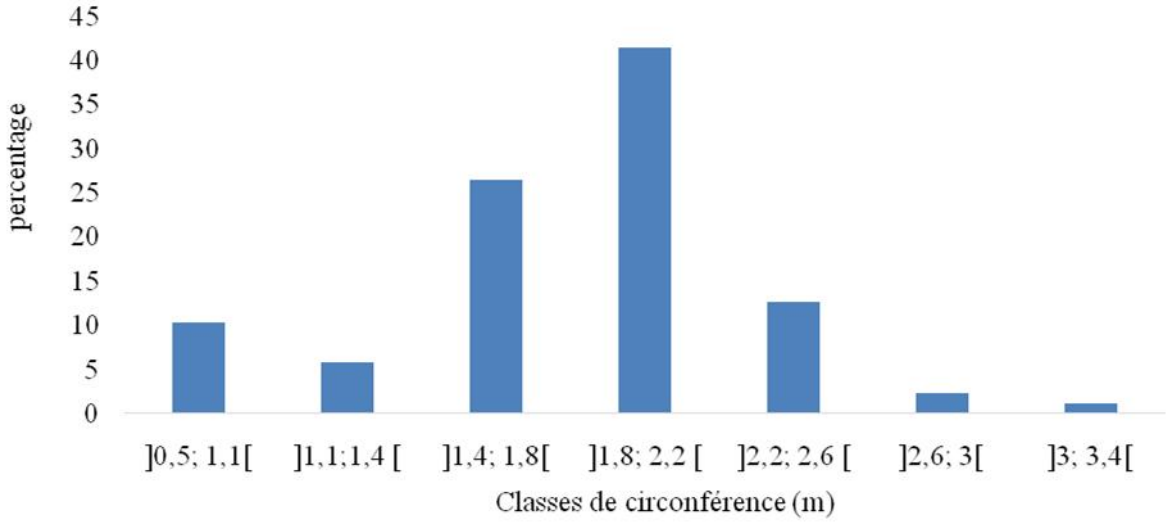

Figure 4 : Distribution of *Afzeliaafricana* as a function of circumference classes (cm)

Distribution of *Afzelia africana* according to the classes of heights

Table 1 is the distribution of the averages of the stands of *Afzelia africana* according to the sites. It is apparent from the latter that these averages are 33 m; 18.95 m; 16.75 m, 14.28 m and 11.75 m respectively for the North, West, South, the Centre and East.

Table 1: Average height of *Afzelia africana* in all the sites

Sector	Average Heights (m)
Center	14.28 ± 3.22^{ab}
East	11.75 ±5.4^{a}
North	21.33 ± 6.56^{c}
West	18.95 ± 5.75^{c}
South	16.75 ± 3.86^{bc}

Distribution of discharges of *Afzelia africana* based on sites.

Figure 5 shows the distribution of the mean crowns expressed in meters of the *Afzelia africana* in relation to the sites. It appears that West (6.23m) of GNP has the largest average crown. The later is followed respectively from the center (5.4m); North (4.25m); South (4.25m) and East (4.14m). Generally the BmH is between 4 and 6 meters.

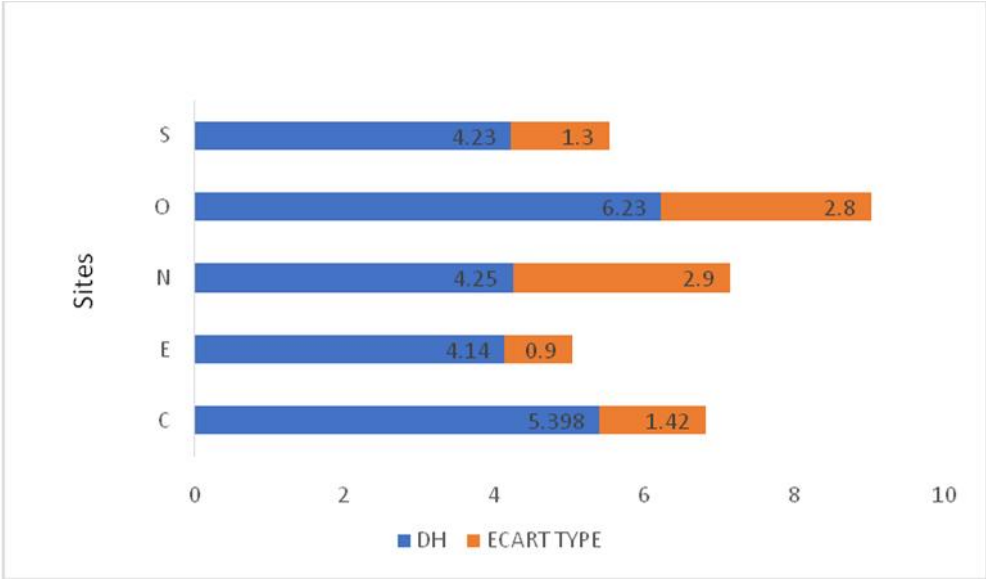

Figure 5: distribution of crowns of *Afzelia africana* in function of sites

Relationship between crown and height of *Afzelia africana*

Figure 6 shows the relationship between crown and height. The linear regression curve between the two parameters showed a non-significant correlation between height and crown with a correlation coefficient of (r^2 = 2.69723; p = 0.10; F = 6 709).

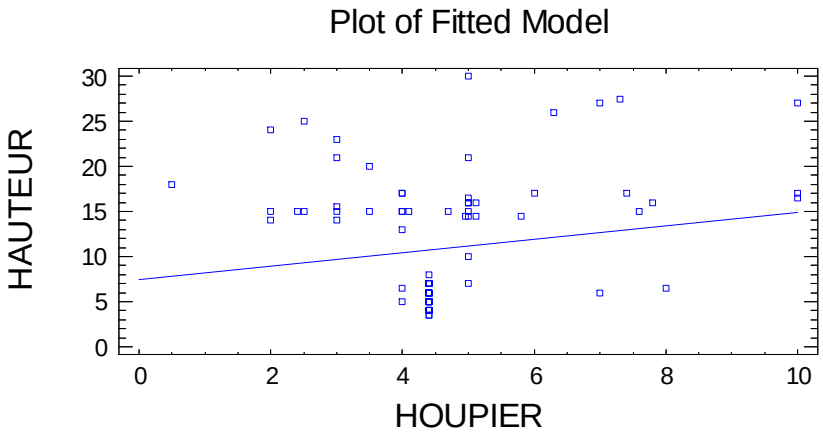

Figure 6: Relationship between crown and height of *Afzelia africana*

Distribution of the recovery rate and biomass of *Afzelia africana*

Table 2 presents the distribution of the recovery rate (R), forage production (PF) and bovine load capacity of the *Afzelia africana* stands according to the study sites. For the recovery rate, it is $13x10^{-3}$; $78X10^{-4}$; $75X10^{-4}$; $79X10^{-4}$ and $17x10^{-3}$ respectively for the Centre, South, East, North and West. Productivity yields are 11.45 kg MS. Ha^{-1}; 7.02 kg MS. Ha^{-1}; 6.73 kg MS. $Ha^{-1}1$; 7.089 kg Ms. $Ha^{-1}$and 15.23 kg Ms. Ha^{-1} in respectively the Centre, South, East, North and West. Finally, the calculated charge capacity gives the following means: 0.012 UBTIha/150j; 0.003 UBTIha/150j; 0.003 UBTIha/150j; 0.0032 UBTIha/150j and 0.0068 UBTIha/150j respectively for the Centre, South, East, North and West.

Table 2: Distribution of the recovery rate and the Biomasses of *Afzelia africana* according to the sites

	C	S	E	N	O	Moyenne
CDm	5,4	4,23	4,14	4,25	6,23	4,85±0,93
CA=	22,89	14,05	13,45	14,18	30,47	19±7,5
PS	1800000	1800000	1800000	1800000	1800000	1800000
RR	$13x10^{-3}$	$78x10^{-4}$	$75x10^{-4}$	$79x10^{-4}$	$17x10^{-3}$	$11x10^{-3}$±$42x10^{-4}$
FP	11,45	7,02	6,73	7,089	15,23	9,5±3,76
CC	0,012	0,003	0,003	0,0032	0,0068	0,0057±0,004

Indexes : FP= forage production ; load capacity ; CDm= crown diameter ; CA= crown area ; PS= parcel size ; RR= recovery rate

Pruning Influence on the phenological phases of *Afzelia africana*

Figure 7 shows the phenological phases (leaves-fall periodicity and fruiting) of 100 feet of *Afzelia africana* in the Black Buffalo site of GNP. It appears from the latter that 100 % of the trees (curved in grey) are still covered with leaves and the old leaves falls occurs without particular rhythm. The flowering of *Afzelia africana* begins in early June with the appearance of flower buds and ends in early August on all the trees (curve in blue). The full flowering itself takes place in a few weeks, two on average and is between mid-June and mid-July, when the rains begin to be abundant. Our observations show that this species blooms once a year while some savanicoles species bloom more than once a year. The curve representing the fruiting process of *Afzelia africana* shows that the latter takes place from September to January.

Our observations show that fruits of *Afzelia africana* are large flattened and green woody pods when not yet matured and black when they are. The results show also that the fruit maturation of *Afzelia africana* is long (about 3 months).

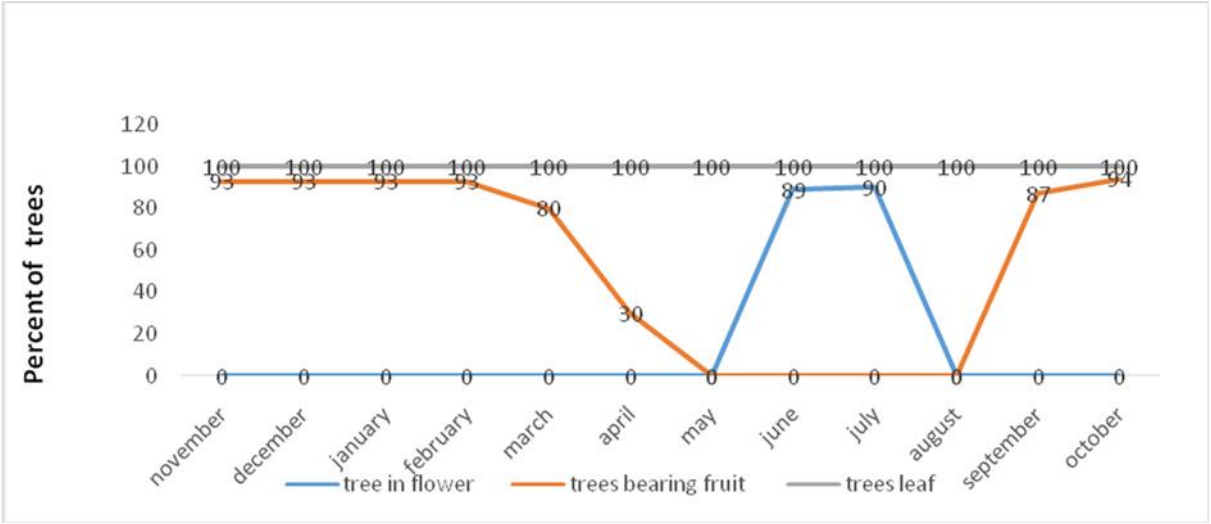

Figure 7: phenological stages of *Afzelia africana*

Impact of pruning on the sanitary status of *Afzelia africana*

Table 3 presents the averages of trees pruned by disease-affected sites. It appears from the latter that the compaction of the soil at the feet of the trees is total in all the sites (100). The presence of fungi has a general average of 90.2 ± 4.08 for all sites with a large proportion for the northern and western sites that have 94 while those of Centre-South and East have respectively 87; 91 and 85. Sunburn has a general average of 86.8 ± 10.06 with 78 respectively; 74; 92; 94 and 96 respectively for the Central-East, South, West and North. The browning of leaves has a general average of 83.2 ± 4.82 and the sites Central-East, South, West and North with respectively 78; 86; 82; 80 and 90.

Table 3: Sanitary status of *Afzelia africana* according to the sites

	Center	East	South	West	North	Mean /standard deviation
Mushroom	87	85	91	94	94	90.2 ± 4.08^{b}
Sunburn	78	74	92	94	96	86.8 ± 10.06^{ab}
Browning of Leaves	78	86	82	80	90	83.2 ± 4.82^{a}
Compacted soil	100	100	100	100	100	100^{c}
Means ± standard deviations	85.75±10.40	86.25±10.66	91.25±7.36	92±8.48	95±4.16	

Distribution of anthropogenic activities affecting *Afzelia africana* according to study sites based on field surveys

Table 4 shows the anthropogenic activities identified during patrols. A total of 10 activities have been identified, thus, the proportions of the breeding are 20 or 100 % in all sites; of poaching means: 5; 7 4 9 and 9 respectively for the Central, South, East, West and North sites; Cuts by which means are 10 in the South, 13 in the North, 10 in the West (10), 9 in the East, and 0 in the Centre; The fishery which has a general mean of 8.5 quite large.; Corruption has been observed in all the studied sites with means ranging from 2 for West to 15 for the North; The panning is in order of importance in the Western (9), North (9) Centre (5), South (7) and East (4) sites; Agriculture with only 4.4 is much more present in the migratory corridors of wild fauna where individuals of *Afzelia africana* are systematically removed to avoid conflicts with breeders; The honey harvest (1.2) and public works activities (0.6) are the least represented.

Table 4: Distribution of anthropogenic activities affecting *Afzelia africana* based on study sites

Activités	Center	South	East	West	North	Mean /standard deviation
Breeding	20	20	20	20	20	20 ± 0^{e}
Panning	5	7	4	9	9	6.8 ± 2.28^{c}
Poaching	15	9	10	11	16	12.2 ± 3.11^{d}
Poaching	0	10	9	10	13	8.4 ± 4.93^{cd}
Public Works	0	0	0	1	2	0.6 ± 0.9^{a}
Fishing	7	8	0	10	15	8 ± 5.43^{cd}
HoneyHarvest	0	0	2	2	2	1.2 ± 1.1^{a}
Agriculture	0	4	8	0	10	4.4 ± 4.56^{ab}
Corruption	10	3	2	8	15	7.6 ± 5.32^{cd}
Mean	6.33 ± 7.4^{a}	6.78 ± 6.18^{a}	6.11 ± 6.45^{a}	7.89 ± 6.23^{a}	11.33 ± 6.20^{a}	

Deforestation indices influencing the *Afzelia africana* in the Benue National Park between 2003 and 2018

Table 5 shows the main deforestation indices in the study sites. There are seven so the most important are: pruning (96.8), trampling (91), burning (84); however the least importants are grazing (8.8), debarking (6.4), cuts (5.6), grubbing (3.2).

Table 5: Deforestation indices in Benue National Park between 2003 and 2018

	North	Center	West	South	East	Means
Debarking	7	6	5	5	5	5,6±0,89[a]
Cups	15	3	7	4	3	6,4±5,08[a]
Pruning	100	100	95	93	96	96,8±3,11[d]
Grubbing	2	1	2	5	6	3,2±2,17[a]
Grazing	0	5	12	11	16	8,8±6,30[a]
Burn	75	68	90	92	95	84±11,81[b]
Trampling	80	95	98	93	89	91±6,96[bc]
Means	39,858	39,71	44,14	43,29	44,29	42,25

Discussion

The density of *Afzelia africana* is more important in the West because it would have been recently invaded by transhumant shepherds to the North and East because of their proximity to the riparian villages and easily accessibility was the first to be invaded by Transhumane shepherds. The permanent absence of forest control posts on the road and indicative plates would greatly contribute to the decrease in this density. The opposite results were obtained by Onana (2002) for whom, the importance of this density was due to the good natural disposition of its regeneration. Savadogo (2002) and Tiogo found a density of 2390 strains / ha in shrubby savanna. Our result is due to the fact that it is a targeted estimate of the density of the 10 main woody forage species that has been carried out in different anthropogenic forest formations while ours is just interested in a single forage specie in a PA. Moreover, our study is 23 years later than that of Onana, which at that time already foresaw the reduction of this density following the traditional management of this resource. Variance analysis shows that there is a significant difference (P = 0.000 ≤ 5%).Low-circumference individuals are poorly represented in all the sites. This can be explained by the fact that the regeneration of this species is difficult in particular because of the anthropogenic pressure. In the different areas of the RBB, the most pruned population structure of this specie is used to assess the state of its stands by providing some subsidiary indications of the different circumference classes. These results are contrary to those obtained by Onana (2002), which found a large proportion of individuals with a small circumference proving that the natural regeneration of this specie in the studied environment was present. However, he had to emphasize that this regeneration was not significant enough because it was disturbed by anthropogenic pressure. Hamawa (2015) and Nchoupouen *et al*. (2009) in their respective studied on *Verpris heterophylla* and on the management of plant biodiversity in the same ecological areas and they found similar results to ours and attributed this low representativeness to human causes and in particular the behaviour of the population who would use the latter without possible management method. Analysis of variance (0.0171028 ≤ 5 %) showed that there was a significant difference between Central, East, West, and North. However, there is no significant difference between the East and the North.

The fact that individuals are not found at a high height can be attributed to anthropogenic activities in particular wood cutting and pruning. The North and West have high averages compared to the others. In the North, the few individuals in the park are not satisfied of the foraging needs in the large herds that are found in the grounds. These trees would be scarcely lost because the shepherds are looking for sites where *A. africana* is very dense and the case of the West area recently invaded by Transhuman Shepherds. This pressure mainly affects old Individuals who had the time to normally grow in the absence of wood cuts in this area; because of its location it is an additional explanation for the presence

of large individuals. These results are contradictory to those obtained by Arbonnier (2000) for whom, the height of this species varied around 25-30 or even 35 meters. Similar behavior was observed on *Verpris herophylla* by Hamawa (2015).

This difference can be explained by the anthropogenic pressures and ecological conditions in each region. In addition, when cutting wood for various uses such as charring, old individuals are primarily cut to facilitate the production of coal. Similar observations were made by Nkemeuzeu *et al.* (2009) on populations of *Clausena anisata* (Wild) Hook. F. Ex-Benth in the community forest of Kilum-Idjim in the northwest of Cameroon. This practice entrains the disappearance of older individuals. The land of agriculture is growing rapidly in the study area because of the different migrants from the far North region that is also a significant source of the disappearance of older individuals. In fact, during clearing, all individuals of large sizes are cut off to give a way of different cultures. This practice has serious consequences for biodiversity because it contributes to the loss of habitats of several species and consequently to their disappearance. Keita and Ouatara (1995) did the same study in Mali. Analysis of variance shows that there is a significant difference between the Center, the East, and the North, however, there is no significant difference between the North and West at the P-Value = Threshold (0.00000413273 $\leq$ 5 %). The low presence of young people can be explained by the intensification of human activities in particular those related to livestock (grazing at juvenile stage of seedlings by oxen and bush fires that consume the few seedlings that have resisted the teeth of ruminants). This loss of young individuals reduces the population of this specie. This observation had already been made on the population of this specie by Sinsin *et al.* (2004). Recovery of this specie would be done by the abundance of young individuals in the population which would replace adult populations (Lykke, 1992). Conversely, the absence of adult individuals explains the rarity or absence of seeds that would enable it to ensure the ecological resilience process that guarantees the survival and renewal of individuals of the specie (Hall and Bawa, 1993). His same observation is observed in adult individuals with respect to this specie. Once again we can say that, the absence of seed would mean that adult individuals are rare, absent or that pruning coincides with the reproductive period of this specie, a reverse leaves process. Moreover, this crop of leaves does not take into account the renewal of the population of this specie. Similar results were reported on the collection of *Pyrenancatha sylvestris* leaves in Uganda by Agea *et al.* (2007) according to these authors, overexploitation of this resource has a negative effect on the regeneration of this species. Moreover the localization of these two sectors although being a disadvantage because being easily accessible proves to be also an advantage for them to be an advantage because of the permanence of surveillance patrols therefore relatively protected by Managers, including the manager of ZIC 5 by the south and the conservative of the Benue by the west, who retaliate against the systematic slaughter of the oxen that were in the enclosure of their protective zones. Similar results were obtained by Onana (2002), Working on this species in the area the same study area; Ntoutpouen *et al.* (2009). In its study on was already referring to anthropogenic activities which would greatly contribute to the reduction of this rate of regeneration in GNP. The variance analysis reveals that there is a significant difference between the South, the central and the West; Between the north, the West and the south (0.01 $\leq$ 5%) However, this analysis revealed that there was no significant difference between the central, Eastern, northern and southern sites; sites in the West and south. The opposite results were obtained by Arbonnier (2000). However, Ntoupka (1999), Dialo *et al.* (2011) and Haiwa (2017), which showed that this difference would be explained by the intensity of anthropogenic activities resulting in the scarcity of adult individuals and hence of the inability of trees to grow normally. The sites where this DmH is weak represent sites where this anthropogenic activity has been rampant for a long time see twenty years because of their proximity to the communication pathways as had been revealed by Onana (2002). Analysis of variance shows that there is a significant difference (0.0414879 $\leq$ 0.05). The study of phenology allows us to infer that this species does not have a net and regular leaf rhythm in the absence of human effects such as pruning and bush fires. Observations show that the fall of the leaves of *Afzelia africana* is not total like most trees in the Sudano-Sahelian zone. During this period the leaves are slightly reddish and tough in the whole GNP. The leaves are completely renewed during the month of March-April just before the return of the good season. They have a bright green color and the replacement of leaves watches is done as they show signs of senescence or yellowing. Similar behavior was observed on *Vepris heterophylla* by Hamawa (2015). Mapongmetsem *et al*. (1998) underline a similar behaviour that he describes as leaf lightening in *Pycnanthus angolensis* in Cameroon. However KC

(2005) reported contrary behavior on *Détarium microcarpum* during the same season.

The flowering of *Afzelia africana* corresponds in relation to the study area in the middle of the rainy season. Abudhabi *et al.* (1995) reported that *A. africana* tree normally gives flowers in a small rainy season, from March to April in Benin this observed difference can be explained by the ecological zone addition, Ouedraogo (2009), Hamaoua (2015) reported that the flowering of *Detarium microcarpum* and *Verpris heterophylla* occurred between the end of the dry season and the beginning of the rainy season. The above mentioned reasons can also be argued for this case in addition to the fact that the specie is different. The results showed that this specie blooms once per year and the same observations were made on different species such as: *Acacia senegal, Anogeosus leiocarpus, Balanites aegyptiaca* (Seighieri, 1990).

Hamaoua (2015) showed that the fruits of *Verpris heterophylla* get ripe between months from May to June. The fruits of most woody species Savanicoles find their maturity at the beginning of the rainy season. In the other hand Sakala UE. (1997) and KC (2005) show that most of the fruits of savanicoles species mature during the dry season. These results are contrary to those obtained by Hamaoua (2015) on *Verpris heterophylla.* These results make it possible to understand that *Afzelia africana* is a specie with reverse phenology i.e. the renewal of these leaves occurs in the middle of the dry season corresponding to that in which the other savana species lose all their leaves to be able to withstand the dry season. But this period is also the critical period for breeders who are no longer able to find herbaceous forage resources for their livestock. The only recourse remaining is the woody resource available. Our own observations allow us to conclude that it is also this period that corresponds to that or pruning of the *Afzelia africana* stands are intensified. Similar results were obtained by Ouedraogo-Kone *et al.* (2008) on the phenology of *Afzelia africana* in southern Burkina Faso. Our results suggest that forage productivity evolves in the same direction as the recovery rate. The highest rate of recovery was noted in the West and the Centre representing the most anthropogenic sites and therefore the largest foliar production was observed in the other sites that had already undergone aanthropization that gradually led to their death feft by the Transhumans. For foliar biomass in general, it is no longer important to meet the food needs of wildlife such as domestic, because of the low productivity correlated with the low forage availability of *Afzelia africana* with (0.0057 ± 0.004 UBTIha/150 days), so this site will not be able to support a large number of cattle, to join the bird (1975), without being deteriorated. In terms of Biomass supply, Central and West respectively with $13x10^{-3}$UBTIha/150 days and $17x10^{-3}$UBTIha/ 150 days, are able to support a large number of UBT as compared to the other sites. These results explain the difficulties encountered by the breeders in foraging for their flocks during the dry season, the study area having constituted a place of reception for the transhumans herds from the neighbouring countries of North Cameroon among the Nigerian, Chadian and African herds. Such a situation had already been mentioned by Agonyissa and Sinsin (1998) in the Sudano-Guinean zone of the classified forest of WariMaro in central Benin. This may result in higher load potential with the joint presence of domestic and wild ungulates. The reasons for the sanitary stands of *Afzelia africana* are that the trees stressed as a result of pruning would lead a compaction of the severe soil due to the animals that graze on the feet of the trees, of branches broken or damaged roots are more susceptible to staining, browning and leaf blight, as well as other diseases caused by fungi and bacteria. These results are in agreement with those presented by Ontario Ministry of Natural Resources (1995). Analysis of variance shows that there is a significant difference in the 5% threshold between all conditions ($P = 0.000 \leq 0.05$). Breeding directly affects the stands of this specie. The main reason why shepherds enter the park remains intimately related to the search for this forage tree. This could be explained by the lack of forage resource for much of the year (six months) in the peripheral and certainly also by the lack of pasture. The reasons put forward by some were that, the poachers used the wood of this specie to smoke the meat and most often under the feet of the trees already badly in point by the weight of pruning. In the other hand, some felt that it is difficult to dissociate the transhumans from the poachers because the Transhumans must feed during its longer or shorter period in the GNP and it is not these animals that it will consume, then to make provisions itself smoked meat with the wood of *Afzelia africana*. Also from our own observations, some individuals cut firewood for the camps. In addition, activities related to the practice of timber cuttings have a direct profitability for the populations bordering on NPB. This wood is sold in the form of coal or in the form of firewood stored in piles along the road connecting Ngaoundere to Garoua, two cities where fuelwood consumption is important leading to

the growing population and IR Regularity in the domestic gas market. This can be explained by the fact that some sites are close to the villages, Guidjiba to the North and Gamba to the South specialized village in the carbonari. The carbonari requires a lot of wood to produce coal. Coal Timberlake (1985) showed that it took 5 to 6 tons of wood to produce a ton of coal. It is true that this specie at the outset is not popular for the production of coal, but giving the scarcity of large-trunk woody species, the operator does no longer choosing gasoline, the purpose being simply to produce coal is destined for sale. This assertion was confirmed by some operator during our multiple interviews. In general, coal is produced in all the villages and most often, it is the alien people who do not find interest in maintaining trees on the plots that do not belong to them. The relationship between fishermen and the degradation of *Afzelia africana* stands is indirect. Moreover, the peasants have revealed to us that, apart from the fish smoking which is mostly done with dead wood, there would be no direct incriminating causes for fishermen. However, certain behaviours have been reported to us talking about Fishermen who cut the trees not necessarily this specie in order to make the wooden provisions for the same causes.

Corruption has a proven importance in the disappearance of specie to GNP since it affects all levels of decision-making bodies either on the ecoguard sides or on the traditional authorities. This could be explained by the fact that in the areas bordering the GNP some villages like Sackdje, Banda and Gamba are villages where migrants in search of a fast wealth abound and have access in the villages of miners to GNP is easily unlike to those of Guidjiba.

Other reasons advanced by the populations to point the finger at the panning's share in the disappearance of the stands of *Afzelia africana* is that, the panning is done extensively and destroys all the plants that are found in an environment where the basement is likely to contain gold. According to our own observations, panning in the GNP is not only practiced on the banks of the river Benue but on the extent of GNP.

This could be explained by the fact that during our descent on the ground work was carried out on the road that connects the department of Mayo Rey. The material such as the laterite was taken from the protected areas and after that, an earthwork of about one hectare destroying all the vegetation. This Assertion is illustrated in the photos A and B. In A, harvest of laterite in the protected area and B, laterite spilled in the work of National Road No. 1. Analysis of variance shows that there is a highly significant difference between activities ($F = 12.98$; $P = 0.00$). However, there was no significant difference between sites ($F = 0.98$; $P = 0.4288$).

Moreover, the peasants revealed that, apart from the fish smoking which is mostly done with dead wood, there would be no cause directly incriminating the fishermen. However some behaviors were reported to us talking about fishermen who cut trees not necessarily this specie for the purpose of making wood provisions for the same causes.

Photo A

Photo B

For the deforestation index only fires are considered less dangerous in savanna as compared to the forest area (Allen and Star, 1982; Fournier). Indeed, the site of this conservation unit located in the Welda-Sahelian area has for some years been exposed to the fires of bush which attacks all the biodiversity and the pruning of the *Afzelia africana* stands for most forage needs. Analysis of variance showed that there was a significant difference between factors (P = 0,007) and sites (P = 0.002).

The number (17) of forage woody species known to the population is less than 100 woody speciepalatable found by Toutain (1980) in Sudanian area, 51 (Saleem*et. al.*,2013) and 48 discovered by Sewadé *et al.*(2015). Our result can be explained by the forgetfulness of the quotes or the faint knowledge of the woody animals. The strong dominance of legumes can be explained by the fact that the vegetation of this area is dominated by this family (Arbonnier, 2002). However, twelve (12) of these woody species are found among those inventoried by Yanra (2004) in three villages in the province of Kénédougou. These results comfort the idea that natural vegetation is much used for livestock feeding during the dry season (Onana *et al.*, 2002; Saleem *et al.*, 2013 and Séwade *et al.*,2016). Analysis of variance shows that there is a significant difference between species at the threshold.

Conclusion and Perspectives

This study of the dynamics, stand structure, and health status of *Afzelia africana* Ex person Smith (Fabaceae) in the Benue National Park of North Cameroon showed that mean density of this specie oscillates between 20 and 630 Individuals per hectare in the North and West of the park, respectively; The mean circumferences ranged from 1 to 3 m and were grouped into seven 0.3 amplitude classes. The class of] 1.8; 2.2 [present with 41.4% the highest percentage throughout the study site; the average number of releases observed is West of 10, South of 6, East 5.5 and Centre 3.5. For the average crown, the West (6.23 m) of GNP has the largest average. For the DBH, the results obtained show the following averages: 5.4 for the Centre; 4.25 for the North; 4.23 for the South; and 4.14 for the east. Generally the DmH is between 4 and 6;The average heights are 21.3333;18.95; 16.75 and 11.75 respectively for the North, West, South, Centre and the East. This study is essential to gradually reach the knowledge of the impact that pruning has on the stands of *Afzelia africana* especially on the implication of the latter on the disappearance of this species which becomes inevitable if no concrete action is taken. They will allow, among other things, more rational management of the individuals very few available in the National Park of the Benue GNP) and its environs by improving the methods and techniques of protection of the wood in fields applied by the farmers in the region.

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