

Full Length Research Paper

Ethnobotany and population structure of *Balanites aegyptiaca* (L.) Delile in Sahelian zone of Cameroon

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Indigenous tree species have multiple functions and the strong pressure exerted on them threatens their populations. The study aims to investigate the main uses of *Balanites aegyptiaca* and assess its population structure in the Sahelian zone of Cameroon. The study was carried out using ethnobotanical and quantitative ecological methods. The results showed that the species is multipurpose and produces six different products and services. The first three most mentioned were food, firewood and handicraft. The fruits and leaves were the most appreciated parts of the species. In all, 1026 individuals were recorded and it occurred at a density of 114 individuals.ha⁻¹. Individuals belonging to 5-15 cm dbh were most important (49.55%) and the adult trees (>75 cm dbh) represented only 3%. An analysis of population structure showed that the population was essentially young and presented an "L" shape. The absence of old individuals in the area showed that the regeneration and the management of this species were unsustainable. Studies on the forestry of the species are necessary to satisfy the local population needs because the vulgarization of knowledge on the species can lead to its exploitation at a large scale.

Key words: *Balanites aegyptiaca*, regeneration, medicinal plant, Sahelian zone, Cameroon.

INTRODUCTION

Balanites aegyptiaca (L.) Delile, commonly known as the desert date (Matig et al., 2000) is a woody plant belonging to the family, Balanitaceae. This species originates from tropical Africa and grows in the Sahel

region where it faces multiple challenges such as desertification and poor agricultural practices. *B. aegyptiaca* plays a multifunctional role in the lives of local people. In previous ethno-botanical studies (Ouédraogo

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et al., 2000; Chevallier et al., 2003; Malaisse, 2010), its importance as food and medicine for local people throughout Africa was illustrated (Arbonnier, 2000).

Ecologically, *B. aegyptiaca* is considered as a resilient species and highly versatile towards Sahelian soil and climatic conditions (Parkan, 1993; Hiernaux et al., 2006). *B. aegyptiaca* is widely found in the Sahelian zone, a region situated in the Far North region of Cameroon. Unfortunately, the population of *B. aegyptiaca* has decreased continuously. Because of the rising prices of commodities, local communities fall back on the multipurpose species or non-timber forest products (NTFPs) to resolve their problems. NTFPs fulfill different roles in their sustenance and make them to live with less cash (Vedeld et al., 2007). This recourse to NTFPs exercises a strong pressure on the species and has resulted in the decline of the species throughout the region among which is *B. aegyptiaca*. Demographic explosion was cited as one of the factors leading to the loss of the species (Bitariho et al., 2006) and to reduction in the availability of products (Birkett and Stevens-Wood, 2005). Many studies were carried out on *B. aegyptiaca* in the Sudan-Sahelian zone of Cameroon. The most important is the vegetative propagation of some selected germplasm (Noubissie et al., 2011). However, nothing has been reported or published on the ethnobotanical studies. This will provide important information for its large scale production or its domestication. The objectives of this work were to investigate the uses and population structure of *B. aegyptiaca* in the Sahelian zone of Cameroon.

MATERIALS AND METHODS

Study area and species description

This work was conducted in the Sahelian region of Cameroon. The study area is situated between latitudes 10.29181 and 10.95590°N and longitude 13.61175 and 14.93973°E. The relief is made of plains around the Mandara Mountains and a massif at the border with Nigeria (Figure 1). The average altitude is 1000 m in mountainous areas and about 300 m in plains. The climate is the Sahelian type with two seasons: a long dry season between November and June and a short rainy season from July to October of about 800 mm per year. At the peak of the dry season, temperature is about 35°C. The vegetation is dominated by the thorny Sahel steppes. A distinction can be made between the thorny Steppe and the periodically flooded meadows. The spiny steppe forms a brush of thorns which colonize the calcareous soils whose main constituent species are *Acacia seyal*, *B. aegyptiaca*, *Capparis* spp., *Combretum aculeatum* and *Ziziphus abyssinica*. Periodically flooded meadows destabilized by intensive grazing, bush fires and industrial agriculture present a wooded landscape whose main colonizers of its black clay soils are *A. seyal* and sometimes *Acacia nilotica* var. *adansonii* (Letouzey and Combrouz, 1959; Donfact, 1998). The presence of some species such as *Anogeissus leocarpa* on loose and uncleared soil and *Boswellia dalzielii* on stony soil is most noted (Boutrais, 1978).

B. aegyptiaca is an Afro Asiatic tree. It has a vast geographical

distribution (Berhaut, 1979; Lebrun et al., 1992; Arbonnier, 2000; Sands, 2003). On the Asian continent, the tree is found in the Middle East from south to north as far as latitude 35° 25' N, in Arabia, Burma, India and Pakistan and all along the Persian Gulf. In Africa, its range extends west to east, in the Sahelian band from the Atlantic Ocean (Senegal, Mauritania) as far as Eritrea. It developed in the Sahelian to Sudano-Sahelian zones. It has few soil requirements but prefers sandy, stony or heavy soils. *B. aegyptiaca* is an indicator of overgrazing.

Methods

The study was carried out using both ethnobotanical and ecological methods. The ethnobotanical study was conducted through interview of elderly persons resident in the region. The latter was based on their availability and willingness to participate. Semi-structured interviews were conducted using questionnaires in four villages (Petté, Mindif, Moutourwa and Kalfou). A total of 300 persons were interviewed at the rate of 75 persons per village. Questions were asked with respect to habitat of the species, methods of harvest, different parts harvested and their uses and the availability of the species.

The ecological assessment was carried out during the dry season because of the inaccessibility of the area due to bad roads in the rainy season. Plots of 30 x 30 m were installed along a transect of 20 km in the savannah separated by a distance of at least 200 m. The number of plots in each site varied depending on the frequency of the searched species. A total of 100 plots at the rate of 25 plots per village were installed and all individuals of *B. aegyptiaca* were marked. Dendrometric parameters such as diameter at breast height (dbh) and height of the *B. aegyptiaca* trees were measured. *B. aegyptiaca* saplings were counted within plots whereas seedlings were counted beneath adult trees. According to Gouwakinnou et al. (2009), any young plant with basal diameter (at ground level) less than 1 cm were considered as seedlings and those with stem greater than 1 cm basal diameter or more than 1 m height but less than 5 cm dbh and/or less than 1.5 m height was considered as saplings.

Data analysis

The ethnobotanical data were coded and summarized as diagrams. From the quantitative inventory, the density of *B. aegyptiaca* was calculated. A size class frequency distribution plot (SCD) was drawn by plotting the density against size class.

RESULTS AND DISCUSSION

Used parts and services

The results of the survey show that the uses of *B. aegyptiaca* are numerous. Respondents indicated that all parts of the species are used and Figure 2 presents various uses of *B. aegyptiaca* plant parts harvested by the local communities. Six different services were noted in the Sahelian zone of Cameroon. Generally, all uses were cited by more than 50% of respondents. Food and firewood were cited by all the local communities (100%). Handicraft came second in 89% of people interviewed. Fifty eight percents of the respondents used *B.*

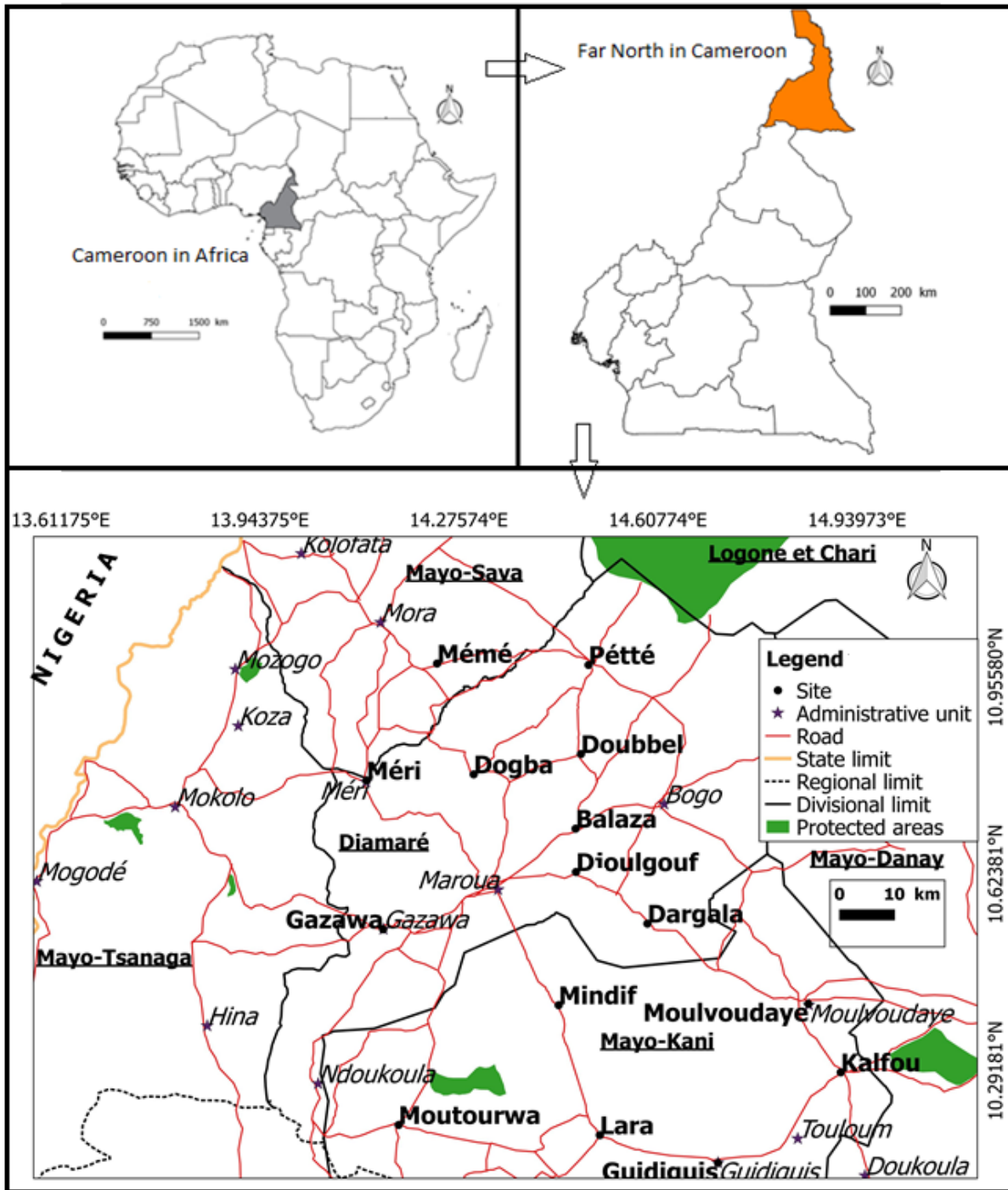


Figure 1. Localization of the study area.

aegyptiaca in the fishing domain contrary to Sagna et al. (2014) in Senegal where this usage was not reported.

Figure 3 shows the percentage of usage of different parts of *B. aegyptiaca* in the Sahelian zone of Cameroon. Fruit and leaves were the most used parts by local

people and cited by 100% of respondents, followed by wood and bark (Figure 3). In Senegal, wood came in second position on the list of different used parts (Sagna et al., 2014). Contrary to the latter authors, the third position of wood in the present study could be justified by

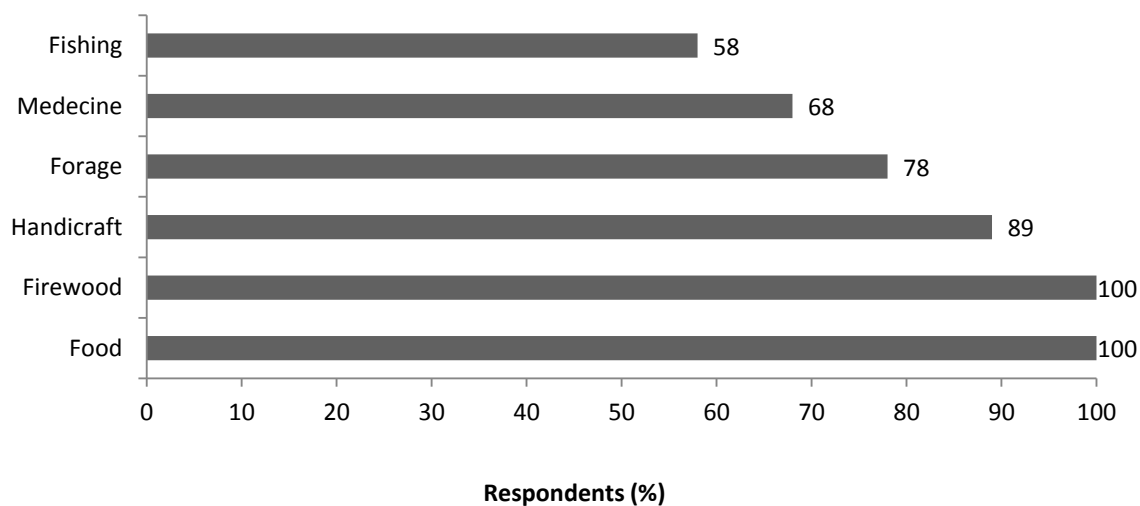


Figure 2. Services of *B. aegyptiaca* in Sahelian zone of Cameroon.

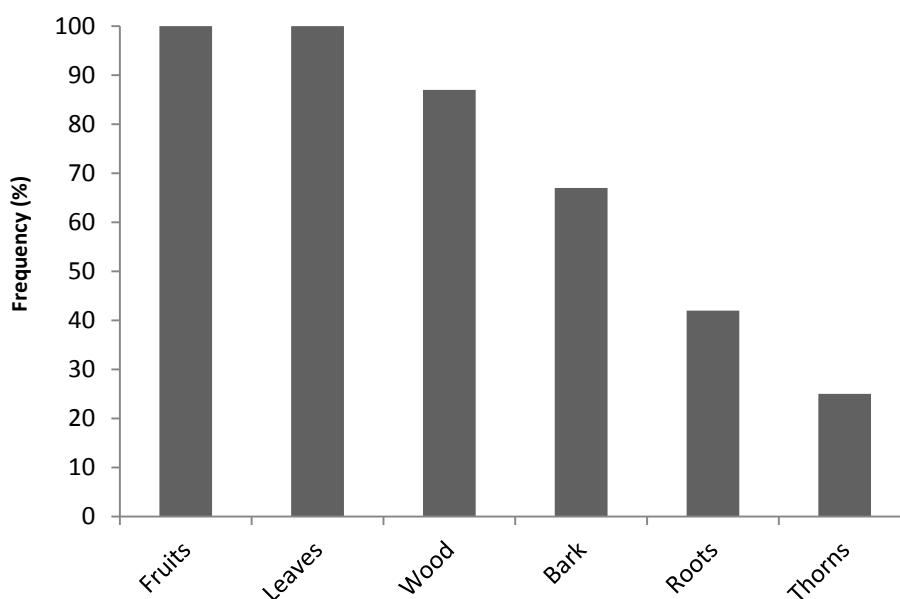


Figure 3. Different parts of *B. aegyptiaca* (L.) Delile used by local people in the Sahelian zone of Cameroon.

the fact that in the Sahelian zone of Cameroon people have other possibilities to get wood for their needs. The results corroborate with those of Folefack and Abou (2009) in Sahelian zone of Cameroon.

Uses

Medicinal uses

The use of *B. aegyptiaca* in traditional medicine was

multiple. In the study area, different parts of the plant were cited by local communities for the treatment of various human ailments (Table 1). In Senegal, Sagna et al. (2014) reported ten ailments treated by different parts of *B. aegyptiaca*. The most cited ailments in the study area are: high blood pressure (31.6%), constipation (28.4%) and gastric ulcer (25.5%). Its use to treat other ailments (hemorrhoids, eye infections, stomach-ache, and anthrax) is less reported. The medicinal uses of *B. aegyptiaca* reported by local communities in the Sahelian zone were cited by other local communities of other

Table 1. Frequency and parts of *B. aegyptiaca* (L.) Delile used.

Diseases	Frequency (%)	Treatments (parts used)
Gastric ulcer	25.5	Squeezed pulp
Hypertension	31.6	Squeezed pulp
Constipation	28.4	Squeezed pulp
Abdominal pains	20.3	Macerated Young plants
Anthrax	20.1	Macerated Young plants
Cold	17.3	Calcinated bark
Burns	10.2	Calcinated bark
Hemorrhoids	8.8	Macerated bark
Tooth decay	8.4	Twigs

countries throughout the various regions of Africa (Saboo et al., 2014). A comparison of the data on the medicinal uses of this plant shows that there are several similarities within the regions. For example, this species is used for the treatment of several sorts of illnesses and symptoms which are most reported are infectious diseases (smallpox, anthrax and yellow fever), digestive tract ailments (gastric ulcer, constipation and hemorrhoids), sexually transmissible disease (syphilis), and chronic illnesses (hypertension and diabetes). Similarities of medicinal uses of this species in its distribution range are proof that it has some medicinal and pharmacological potential. However, there are uses that appear specific to certain regions. For instance, both roots and leaves were not reported for medicinal use in the Sahelian region of Cameroon, whereas macerated leaves are used to treat nose bleeding in Algeria, and jaundice in Sudan and Egypt, root powder is used as laxative for treatment of stomach and constipation in Chad. Like Chothani et al. (2011) and Sagna et al. (2014), the current results illustrate the widespread use of *B. aegyptiaca* for medicinal purposes.

In addition, these authors reported that all parts of the plant (bark, fruit, kernels and leaves) possess a wide array of active biomolecules justifying the diversity of its uses in medicine. Adamu et al. (2005) further asserts that the bark of *B. aegyptiaca* has antimicrobial properties against *Escherichia coli*, *Staphylococcus aureus* and *Pseudomonas aeruginosa*. In the study area, thorns were used to solve the problem of luxation. In the other region, the use of *B. aegyptiaca* in veterinary medicine is well known. In Burkina Faso for example, decoction of the bark and roots is used for treating animal anthrax; the leaves and bark are ground and used as poultice on wounds (Chevallier et al., 2003).

Food uses

B. aegyptiaca leaves as well as the, fruit pulp and the kernel are used for food. Despite the bitter taste, it is

sucked and greatly enjoyed by people. Using the pulp for making juice was sometimes reported (42.5%). The juice is used for preparing traditional dish called “gari” most appreciated by the Muslim community during the Ramadan periods. The use of kernels was indicated by 75% of respondents. After breaking the seeds, kernels are extracted and prepared. The resulting product can be dried and eaten like peanut and it is most appreciated by local people. According to some respondents (20%), oil extracted from the kernels is used sporadically in the region. Unfortunately, the extraction technique was not known in the region. Consequently, the use of its oil was not widespread contrary to the findings of Sagna et al. (2014) in the region of Ferlo (Senegal) where local Wolof people use it frequently. With regards to flowers and leaves, their use for food seems to be widespread. However, report of the use, control of these different parts and their harvesting methods remained primitive. Women use sickles to cut the leaves and branches. But to avoid destruction of the entire branch, they climb trees to harvest stem leaves. In all cases, women put the different plant parts harvested in their scarves or calabashes. To facilitate the collection of great quantities of *B. aegyptiaca* leaves, the branches are cut and staked. Once the heap is dry, women give a few blows on the heaps and pick up the leaves after removing the thorny branches. The leaves are used in the preparation of a sauce eaten with millet, maize or rice. Leaves were cited for culinary purposes by 87% of respondents. The cooking techniques varied according to cultures and tastes. Nevertheless, in the region, almost all ethnic groups knew these different cooking techniques of the sauce at *B. aegyptiaca* leaves. Very often, it was cooked with the groundnut paste. Somewhere else, it was mixed with *Vigna unguiculata* grain and *Ceratheca sesamoides* leaves making it sticky.

Use of wood

A high consumption of *B. aegyptiaca* wood was reported

by local people in the Sahelian zone (Figure 2). The wood is widely used for building huts (78.8%), fencing (48%) and animal pens (51.6%). Other uses of wood reported by the local communities included cooking (85.2%), charcoal (68.4%), making stands for the Koran (40%) and pestles (52%). For cooking, *B. aegyptiaca* supplies local people with combustible wood commonly used in households. According to respondents, the *B. aegyptiaca* wood was excellent firewood and most appreciated by local people. Contrary to other species, *B. aegyptiaca* was mostly used despite the irritating effect of the smoke to the eyes as reported by some households. This irritation problem was noted in Senegal (Sagna et al., 2014). *B. aegyptiaca* wood was cited among the most used in the handicraft. The trunk was used for making mortar, pestle, etc. The thorns were used by Muslim women to beautify the lip of young girls.

Use as forage

The tree is particularly appreciated for the fodder that it supplies to animals for a large part of the year. The aerial parts of the plant were most palatable and cited in descending order: leaves (100%), fruits (85.3%) and young plants (23%). Fruits are consumed exclusively by small ruminants that eat them when they fall on the ground and very often animals spend the whole day under *B. aegyptiaca* trees to wait fruits fall. In Burkina Faso, *B. aegyptiaca* is also considered as one of the important species due to its quasi-permanent feed availability (leaves, branches and fruit); consumption of its fodder particularly increases in the dry season when pasture is scarce (Chevallier et al., 2003).

Population structure

The analysis of ligneous populations according to Kemeuzé et al. (2009) is centred on three elements which are:

1. The distribution of individuals in height or diameter classes, as an indirect indicator of balance between the age class and phases lived by the population in terms of disturbance or regeneration;
2. The bad state of the population;
3. The intensity of regeneration, as a symbol of population renewal.

Population distribution

A total of 1026 *B. aegyptiaca* individuals were recorded from the study area. The species occurred at a density of 114 individuals/ha. It was noted that the diameter of the

population of *B. aegyptiaca* varied from 5 to less than 90 cm. Individuals belonging to the diameter class of 5 to 15 cm were the most abundant (49.65%). They were followed by those belonging to the 15 to 30 cm class (36.16% of the total population). Adult trees represented approximately 3% of the population of *B. aegyptiaca*. Contrary to the results of Geerling (1987) in West Africa, the population in the Sahelian zone presented a weak diameter class.

The size class distribution showed that the *B. aegyptiaca* population was made up mostly of juveniles and that there was a remarkable absence of adult individuals. The population distribution presented the "L" shape which suggests that the population of *B. aegyptiaca* regenerates well in the Sahelian zone but that the older individuals were few and did not maintain themselves. Seedling mortality was high (about 89.5%) (Figure 4). Results of the quantitative inventory equally revealed that the population density of this Balanitaceae was estimated at 114 individuals/ha of which the majority (66 individuals/ha) were young belonging to the 5 to 30 cm diameter class. This result implied that the species was overexploited by the local population in the region.

The size class diameter (SCD) plots (Figure 4) showed a higher density of young individuals of *B. aegyptiaca* but these died out before they developed into mature individuals. This loss of young individuals thus weakened the population. For a population to maintain itself, it needs to have abundant juveniles which will grow into adult size classes (Bationo et al., 2001). Similarly, the weak density of adult individuals affects regeneration in the population by lack of seeds (Ky-Dembele et al., 2007). The high mortality of seedlings may be explained by the constant disturbance of overexploitation for different uses. Most respondents related the precarious status of young individual of *B. aegyptiaca* to overexploitation and land clearance. Grazing has also an important negative effect on this category of individuals of the species. Indeed, in the dry season, animals graze the leaves and the tender branches of young individuals causing their disappearance in nature (Tabuti and Mugula, 2007).

Regeneration

In the study area, few individuals were in flowering or fruiting, indicating that the majority of the populations were young. Old individuals considered as seed producers were almost absent (Figure 4). This suggests that these young individuals were derived from seeds that were dispersed from elsewhere. This explains the gap between generations. This same observation was reported in Burkina Faso by Ouédraogo et al. (2006). This situation causes the species to be in a regressive dynamic characterized by the rarefaction or absence of

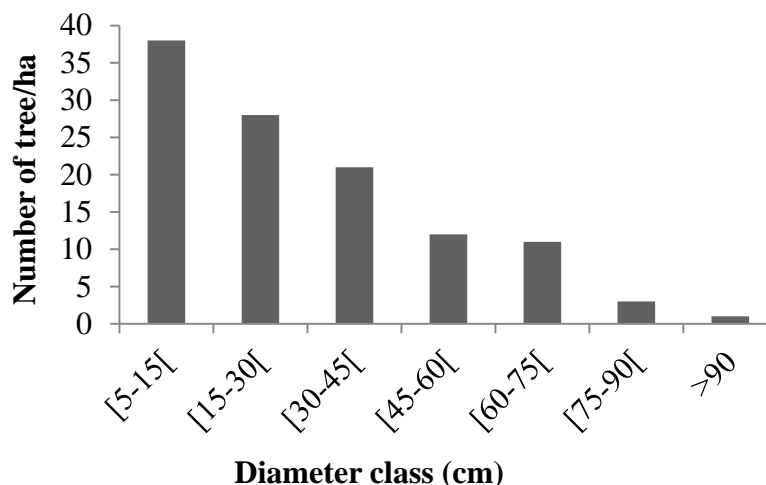


Figure 4. Population distribution by diameter class.

individuals of intermediate diameter classes able to ensure a bridge between the young individuals (seedlings, suckers, stump sprouts or woody tubers) and ageing individuals. Young individuals rarely reach adult age because of overexploitation and overgrazing. To solve this problem of seed production, artificial regeneration seems to be the most appropriate. Unfortunately, local communities in the region lack knowledge of artificial regeneration techniques. Moreover, when the local community is asked whether they are willing to regenerate this species, the majority do not find any interest in this practice. According to them, *B. aegyptiaca* is a "gift from God" and like most other local species, it will always be available.

Conclusion

B. aegyptiaca (L.) Delile occupies an important place in the ethnobotanical patrimony of the people of the Sahelian region of Cameroon. The multiplicity of usage of its different parts and the solicitation frequency classify it among the most appreciated species in the region. The analysis of the population structure show a juvenile population characterized by a quasi-rarity of old individuals. These young individuals could not all reach maturity because of overexploitation and overgrazing arising from absence of seed trees that denote a poor regeneration of the species in area. In the study area, the leaves, wood and fruits which constitute the used biological materials are harvested constantly and in great quantities. The harvest techniques of these different parts do not respect the norm for a sustainable management. Though the exerted pressure on the species could not put it in danger in the area, the vulgarization of the

indigenous knowledge on the species can expose it to measures to be taken such as the creation of national parks and vulgarisation of vegetative propagation to improve its regeneration and increase its density in the area.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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