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Savannas Highlands of Cameroon: Floristic Composition, Functional Traits and Conservation Status

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Authors' contributions

This work was carried out in collaboration among all authors. Author WTJB planned the research, conducted the field sampling and identified the plant species, performed the statistical analyses. Authors WTJB, ATML, FM, CNNM, NVF and FT participated in discussion of the results and the writing of the manuscript. All authors read and approved the final version.

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ABSTRACT

Background: The savannas flora has been widely neglected in science and conservation policy throughout the world, so that this biodiversity component remains largely unknown.
Aims: The objective of this study was to assess floristic diversity, ecological characteristics and conservation status of the savannas of the mounts Bamboutos (Western Cameroon).

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Study Design: The savannas studied were located in the Eastern slope of the mounts Bamboutos, in the Western Highlands of Cameroon. The natural savannas ecosystems had a significant biodiversity, a level of disturbance by local people like overgrazing, bush fires, collection of fuelwoods, etc.
Place and Duration of Study: The field work was conducted in the Eastern slope of the mounts Bamboutos (5°30' - 5°45' N and 10°03' - 10°15' E) between May and November 2012, 2013 and 2014.
Methodology: Plant species identified were characterized by floristic diversity and life traits (habit, life form, leaf size, type of diaspore, dispersal syndromes and phytogeographical affinities).
Results: The flora consisted of 231 taxa belonging to 154 genera and 70 families. Poaceae (39 species), Asteraceae (37 species) and Fabaceae (20 species) were the dominant families. The most frequent life forms were phanerophytes (41.12%) followed by chamaephytes (21.64%) and therophytes (20.34%). Leaf size classes of plants consisted of mesophylls (30.73%), nanophylls (25.54%) and microphylls (25.10%). Anemochory (45.88%) was dominated dispersal mode followed by zoochory (30.73%). Investigation of the geographical distribution of plant species indicated that 27.27 % belonged to the afrotropical zone and 18.61% pantropical species. Four species were endemic and four subendemic to Cameroon dorsal. 17 species were threatened according to IUCN red list.
Conclusion: Protection and conservation of natural resources of savannas is crucial for sustainable utilization of accessible natural flora so, it is strongly suggested to overgrazing and agricultural activities.

Keywords: Cameroon; endemic species; ecological characteristics; floristic composition; mounts Bamboutos; savannas.

1. INTRODUCTION

Mountain environments throughout the world host highly specialized flora and fauna [1]. The mounts Bamboutos are part of the Western Highlands of Cameroon, high-elevation habitats are represented by few isolated peaks. This area contains endemics and rare plants and constitute hotspots of plant diversity [1,2]. The vegetation of this area was in in the past largely covered with forest. It has been progressively deforested and degraded to give way to the savanna, cropland or pasture; though today only very few patches of forests are present [3].

The floristic diversity and functional traits are among the most significant ecological attributes of a particular ecosystem, which show variations in response to environmental and anthropogenic factors, and elucidating how these factors drive the assemblage of plant communities remains an important challenge in ecological research [4]. The diversity in mountain environments is in part due to the particular climatic conditions which rapidly vary over very short distances along altitudinal gradients. In addition to altitude, topography and geomorphological processes also play an important role in creating a great variety of microhabitats that differ significantly in species composition over short spatial scales [5]. On the other hand, the microhabitat diversity may allow the cold-adapted species to maintain a refugium along valley slopes following local temperature gradients and within topographic/geomorphological traps [6].

Previous studies on the flora and vegetation of the mounts Bamboutos have been carried out by several authors [7,8,9,10,11]. Very few studies have focused on the drivers of variations of floristic composition and functional traits of plant communities. Such information is useful not only in understanding the impact of changed environmental conditions on plant community structure, but also in providing insight into the environmental requirements of the species needed for successful ecological restoration and biodiversity protection.

The aim of this study was to assess floristic diversity, ecological characteristics and conservation status of the savannas of the mounts Bamboutos.

2. MATERIALS AND METHODS

2.1 Study Site

The study was carried out in the Eastern slope of the mounts Bamboutos, in the Western Highlands of Cameroon. The study area is located between 5°30' - 5°45' N and 10°03' - 10°15' E (Fig. 1). This mountain with its

maximum height of 2740 m is one of the major volcanic mountains in Cameroon. The climate is defined as Cameroonian altitude type, with a long rainy season (March-November) and a short dry season (December-February). The annual average rainfall varies between 1750 to 2500 mm yearly. The annual average temperature varies from 10-12 to 23.5°C. The predominant soils are andosols, andic ferralitic soils and battleship ferralitic soils. The selected community savannas are natural ecosystems having significant biodiversity and level of disturbances due anthropogenic activities like overgrazing, bush fires, collection of fuelwoods, etc. The herbaceous stratum is dominated by *Pennisetum purpureum* and *Imperata cylindrica*. The ligneous cover is also strongly influenced by anthropogenic activities [9,10].

2.2 Data Collection

The field work was conducted in the rainy season during the months of May and June 2012, 2013 and 2014. A total of 54 plots of 10 m × 10 m were marked randomly to sample the floristic data and vascular plants. The trees and shrubs were observed within quadrats of 100 m² and herbs within five sub-quadrats of size 1×1m placed within 10 m × 10 m quadrats. Some Plants species were identified directly in the field using monograph; for other species, specimens were collected and compared to those available in the National herbarium of Cameroon.

The habit of the plant's species was determined in field by the observation. Life form were determined and classified according to location of species in the vertical stratification of the ecosystem indicate the ability of species to occupy space and seasons [12]. Leaf sizes are a response to altitude, local weather conditions and regional orographic [13]. The types and modes of diaspore dispersal inform on the ability of species to colonize new sites and to regenerate and persist locally [14]. Phytogeographical distribution types characterized among other things, by the distribution pattern of vegetation and level of endemism of communities is likely to provide information about phytogeographic affinities, maturity, and stability of the flora [15]. These traits and categories are shown in appendix. The Red List of threatened species in the Cameroon was used to establish IUCN Conservation status of species [16].

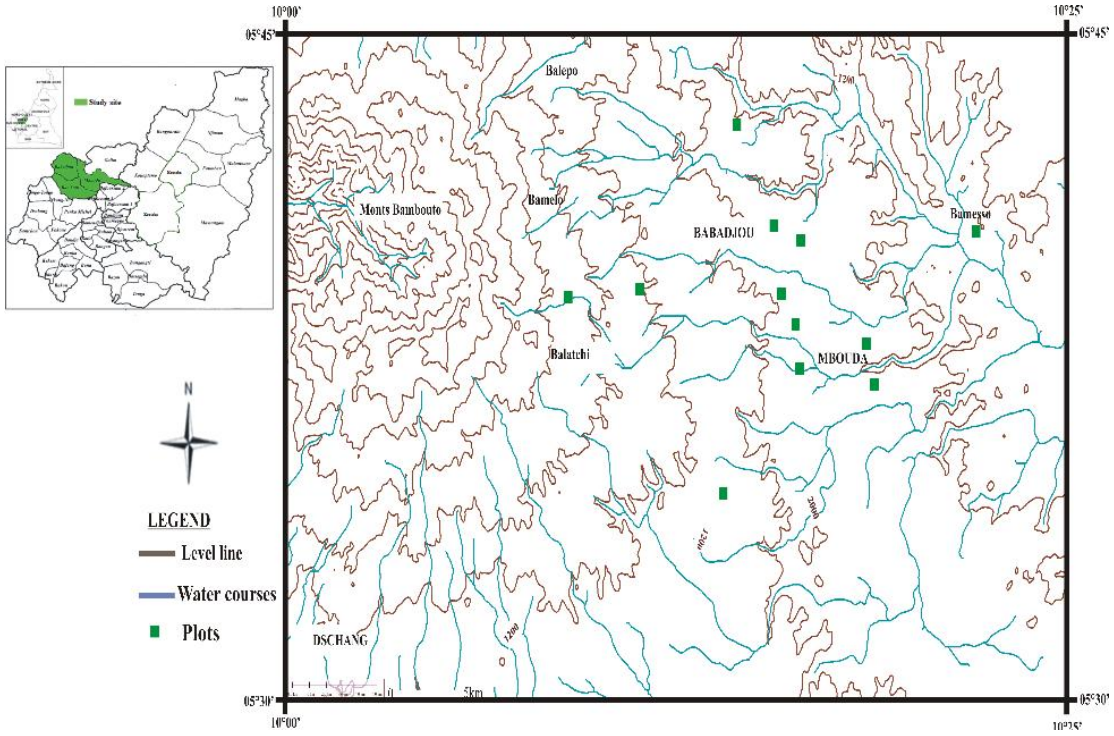

Fig. 1. Location of the study area on the mounts of Bamboutos (Western Cameroon)

3. RESULTS AND DISCUSSION

3.1 Floristic Diversity

3.1.1 Floristic Composition

A total number of 231 taxa belonging to 154 genera and 70 families (APG III) were recorded in 54 plots from the study area (Appendix A). The Shannon-Weaver diversity index was 4.72 and the evenness index was 0.61. The families Poceae (39 species), Asteraceae (37 species), Fabaceae (20 species), Rubiaceae (8 species), Lamiaceae (7 species), and Cyperaceae, Hypericaceae, Malvaceae, Moaraceae each represented with 6 species were the richest families in terms of the number of species. The remaining families were represented by five or less than five species.

Poaceae, Asteraceae and Fabaceae have emerged as the common families in the investigated area. These findings are similar with the results of [17] in Venezuela, [18,19] in Abidjan in Ivory Coast, [20] in Burundi, [21] in Pakistan and [10] in Cameroon. [10] stated that the high presence of species of the Poaceae family is explained by the fact that savannahs are grass-dominated ecosystems. Moreover, Poaceae taxa have a high tilling potential and a high regrowth rate after grazing if environmental conditions are favourable. The abundance of Asteraceae can be attributed to their great range of ecological tolerance and great capacity of seed dispersion [9]. The species of Poaceae and Asteraceae due to their wide ecological amplitude are diverse in their habitat occurrence. The high value of the Shannon-Weaver diversity index and the Pielou equitability index showed that this site was diversified. The diversity could be explained by the diversity of the observed biotope diversity (lowland, hilltop and slope zone).

3.1.2 Endemic and Subendemic Taxa

In term of endemism, 8 taxa belonging to 8 genera and 7 families were recorded. *Brachystelma omissum* (Asclepiadaceae), *Bafutia tenuicaulis* (Asteraceae), *Helichrysum cameroonense* (Asteraceae), *Adenocarpus mannii* (Fabaceae) were endemics to and *Impatiens sakerlana* (Basalminaceae), *Lobelia columnaris* (Campanulaceae), *Erica mannii* (Ericaceae) and *Helictotrichon mannii* (Poaceae) were subendemic to Cameroonian mountains archipelago included Bioko.

The presence of eight endemic species of the Cameroon dorsal in the study area is not surprising. Indeed, these mountains are on the Cameroon volcanic line which belongs to the ‘‘25 hotspots’’ of biodiversity identified as priority zones of conservation at worldwide scale [1]. According to [19], these hotspots are particularly rich, but also shelter many endemic species.

3.2 Functional Traits

3.2.1 Plant Habits

On the basis of habit, the most common species were herbs (157 species, 67.96%) followed by shrubs (39 species, 16.88%) and trees (28 species, 12.12%) (Fig. 2).

The high proportion of herbs should be explained by climatic factors (relatively dry climate) and anthropogenic pressures (bush fire, overgrazing and fuel wood collection). The dominance of herbaceous species in savannas communities agree with previous studies [11,17].

3.2.2 Life Forms Spectrum

The life form gives us an idea of the physiognomy of the flora and vegetation structure, which are the effects of all life processes in combination with environment. Life form classification is more dependable, which is measure upon the major of position and degree of protection to perennating bud during the unfavourable and favourable condition. The dominated life form were phanerophytes (95 species, 41.12%) represented by nanophanerophytes (33 species, 14.28%), microphanerophytes (24 species, 10.38%), macrophanerophytes (23 species, 9.95%), mesophanerophytes (11 species, 5.26%) and megaphanerophytes (3 species, 1.29%). They were followed by chamaephytes (50 species, 21.64%) and therophytes (47 species, 20.34%) (Fig. 3). The least represented life forms were the geophytes (10.38%) and hemicryptophytes (6.49%).

Besides the spatial variations in the species composition of plant communities, the dominance of phanerophytes, chamaephytes, therophytes over other life forms might be a response to the hot climate, topographic variations and the anthropogenic pressure. Similar conclusions were also reported by [21] in Khanpur Dam, Pakistan. The dominance of

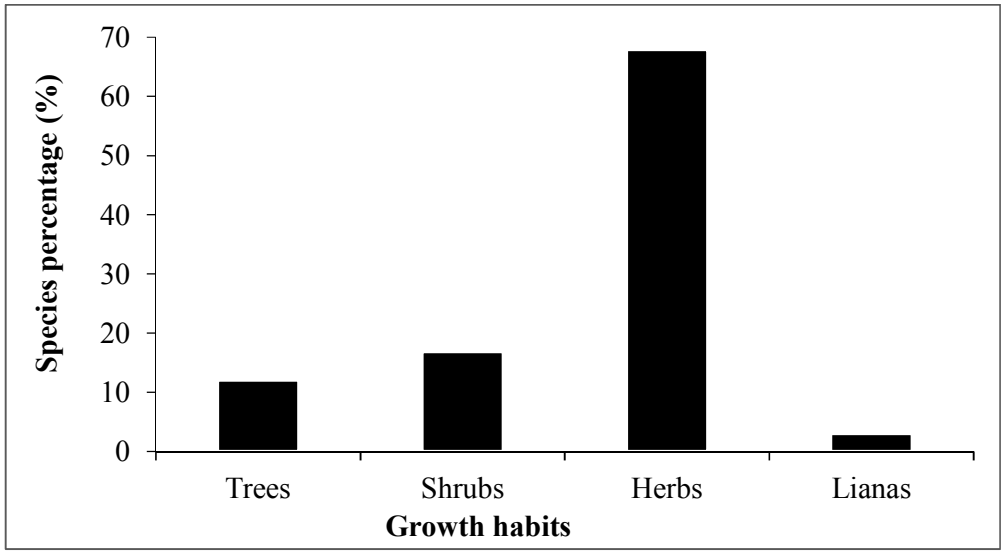

Fig. 2. Growth habit of plant species recorded from the study area

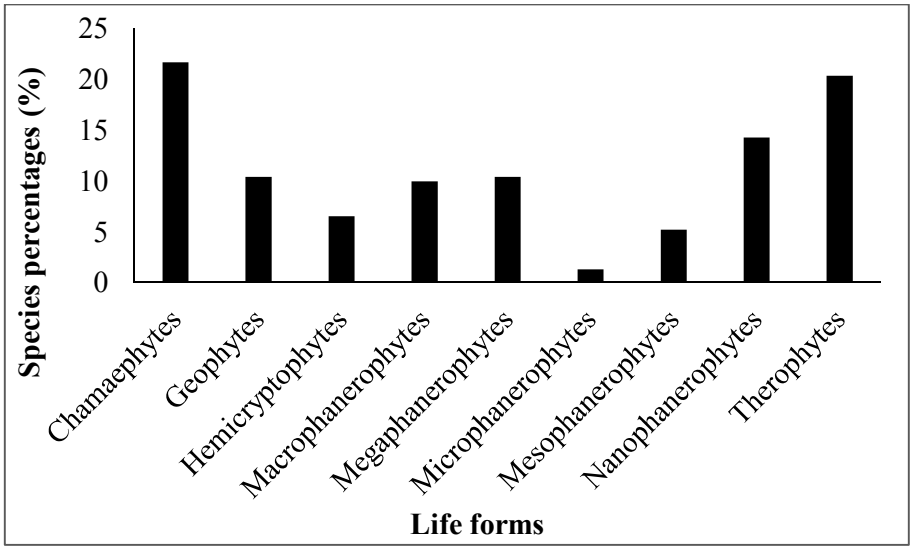

Fig. 3. Distribution of plant species in the various life form spectra

phanerophytes translates the adaptive strategies of plants which correspond to the competitive strategy. The high representation of nanophanerophytes showed of preponderance of shrubs formation. Indeed, the coexistence of the species is based on the sharing and the use of the common resources, where the species adapt to the various forms of competition, stress or disturbance [22]. The phanerophytes of this study are mainly made-up by trees and shrubs of savannas which are equipped with devices enabling them to resist the passage current fires (the thickening of the bark): *Protea madiensis* (Proteaceae), *Entada africana* (Fabaceae), *Terminalia glaucescens* (Combretaceae), *Vitellaria paradoxa* (Sapotaceae) are particularly demonstrative in this respect ; these trees are never jointed. [20] made the same report in wooded savannas with *Protea madiensis, Cussonia arborea, Combretum* sp., *Hymenocardia acida, Pericopsis angolensis,* and *Entada abyssinica* met in the Ruvubu National Park, Burundi. The plants of the regions which undergo bush fires with certain periodicity present a series of adaptations assuring survival or allowing a fast colonization of the medium.

Among these adaptations, underline the capacity to reject stumps, the existence of underground organs (bulbs, rhizomes), a thick bark allowing to resist to the high temperatures, the release of seeds or the stimulation of their germinative capacities after the passage of fires [23]. Therophytes life form indicates disturbed environmental conditions in the study area and biotic pressure on vegetation which increase the short live species, higher occurrence of this life form indicates some anthropogenic and overgrazing effects in the study area. The preponderance of therophytes can also be related to their high reproductive capacity, ecological, morphological and genetic plasticity under higher degree of disturbance [24].

3.2.3 Leaf Size Spectrum

Leaf size are a response to altitude, local weather conditions and regional orographic gradient. The most common leaf size were mesophylls with 71 species (30.73%), followed by notophylls 59 species (25.54%) and microphylls 58 species (25.10%) (Fig. 4). The species with large leaf size (megaphylls and macrophylls) and small leaf size (nanophylls and leptophylls) were lower in abundance. Aphyllous species were absent.

Species with large leaves take place in warmer wet climates while smaller leaves are characteristic of cold and arid climates and degraded habitats. The higher abundance of mesophyllous, microphyllous and notophyllous plants could be due to the environmental fluctuations such as temperature, altitude and edaphic factors. The percentage of microphylls and nanophylls were positively linked with the increasing altitude. During our field survey, microphyllous species were mostly observed at hilly tracks, where vegetation was comparatively rich due to fewer anthropogenic activities. The species with microphyllous leaves were abundant due to ecological adaptation for these arid conditions. The present findings agree with those of [25] in the Vegetation of Sheikh Maltoon Town District Mardan, Pakistan. The high proportion of nanophyllous is linked to the presence of highlander species e.g *Adenocarpus mannii*, *Erica mannii*, *Gnidia glauca* and *Hypericum revolutum* which have small leaves due to climatic and edaphic constraints. The presence of leptophylls and nanophylls reveals the adaptive nature of vegetation to unfavourable conditions.

3.2.4 Types of Diaspores and Seed Dispersal Syndromes

The types and modes of diaspore dispersal expresses the ability of species to colonize new sites and to regenerate and persist locally. Our description of dispersal syndromes is based on the total data set (N= 228). The sarcochores (25.11%) were the most dominant diaspores type followed by sclerochores (20.34%) and ballochores (19.48%). Most of the diaspores taxa in the mounts Bamboutos (45.88%) are dispersed by wind (anemochorous species) followed by zoochory (30.73%) and autochory (22.51%) (Table 1).

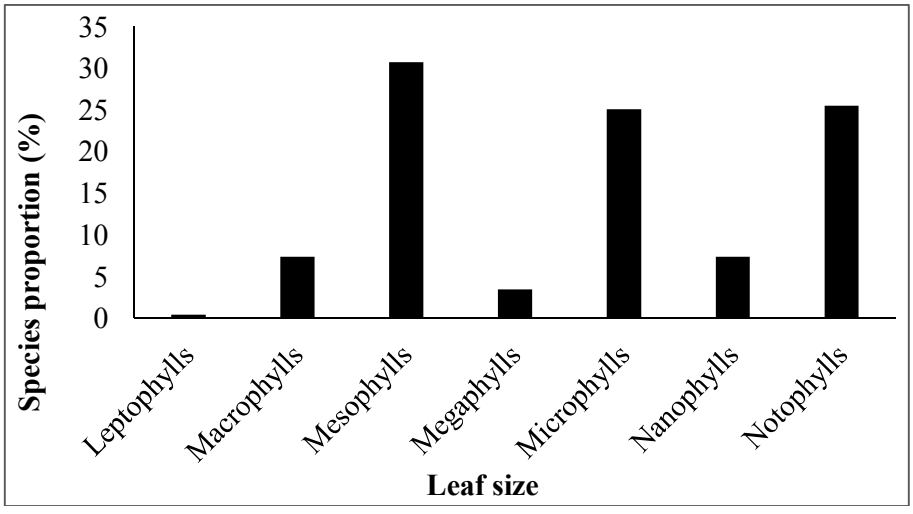

Fig. 4. Distribution of plant species according to leaf size spectra

Table 1. *S*pecies proportion showing different types of diaspores and dispersal syndromes

Diaspores types	Dispersal syndrome	Species number	Proportion (%)
	Anemochory	106	45.88
Sclerochores		47	20.34
Pterochores		10	4.33
Pogonochores		39	16.88
Sporochores		10	4.33
	Zoochory	71	30.73
Acanthochores		6	2.59
Sarcochores		58	25.11
Desmochores		7	3.03
	Autochory	51	22.07
Ballochores		45	19.48
Barochores		6	2.59
Undetermined		3	1.30

The seed dispersal spectrum of the studied mounts Bamboutos savannas was characterized by the dominance of anemochory, followed by zoochory and autochorous species. These results are consistent with those reported for other savannas [20,26]. Anemochory species (sclerochores, pterochores, sporochores and pogonochores) are widely spread throughout the world but are especially prominent in open habitats as summits and high mountain slopes, steppes, prairies, garrigue, screes and deserts [27]. Seed dispersal is often regulated by climatic conditions e.g. the local climatic variability significantly impacts seed dispersal distances. The importance of sarcochores over other types of diaspores can be justified by the fact that these species are transported either by the birds or by other animals and have the chances to arrive at destination. Moreover, the observed abundance of species with zoochorous seed dispersal in high-altitude environments, has been previously found in other open habitats [5,20]. Zoochory is a common strategy for the dispersal of diaspores at lower altitudes, in disturbed habitats and in grazed vegetation types [28]. The relative abundance of autochores would be due to the species of Fabaceae family.

3.2.5 Phytogeographical Affinities

Investigation on the geographical distribution of plants species indicated that the total flora was composed mostly of afro-tropical species (27.27%) followed by pantropical species (18.61%), Sudano-Zambezian (10.82%) and paleotropical (10.39%) (Table 2).

The high proportion of species with continental distribution (afro-tropical) and with broad distribution (paleotropical and pantropical) indicate disturb zone [29]. The importance of species with broad phytogeographical amplitude translates the loss of identity of the vegetation by the invasions of species with broad distribution. The high proportion of largely distributed taxa express the opening of this flora to external

Table 2. Geographical distribution of plant showing number of species in each chorotype

Phytogeographical affinities	Proportion (%)
Afro-American	2.16
Afro-Tropical	27.27
Afro-Magaches	3.03
Cosmopolitan	6.49
Guineo-Congolian	3.89
Paleotropical	10.39
Pantropical	18.61
Pluriregional African	4.76
Sudano-Guinean	0.43
Sudano-Zambezian	10.82
Only in Cameroonian mountain	6.93
Linked of Sudano-Zambesian region	1.29
Undetermined	3.89

Table 3. Threatened species of the mounts Bamboutos

N°	Species	Family	IUCN Status
1	*Allophylus abyssinicus*	Sapindaceae	VU
2	*Bafutia tenuicaulis*	Asteraceae	VU
3	*Echinops giganteus*	Asteraceae	NT
4	*Eriosema bauchiense*	Fabaceae	NT
5	*Helichrysum cameroonense*	Asteraceae	EN
6	*Helictotrichon mannii*	Poaceae	EN
7	*Impatiens sakerlana*	Basalminaceae	VU
8	*Lobelia columnaris*	Campanulaceae	VU
9	*Phyllanthus mannianus*	Phyllanthaceae	NT
10	*Psorospermum aurantiacum*	Hypericaceae	VU
11	*Raphia mambillensis*	Arecaceae	NT
12	*Schefflera hierniana*	Araliaceae	VU
13	*Schefflera mannii*	Araliaceae	VU
14	*Sporobolus montanus*	Poaceae	EN
15	*Vernonia acrocephala*	Asteraceae	NT
16	*Vernonia bamendae*	Asteraceae	VU
17	*Vernonia guinensis*	Asteraceae	VU

EN: Endangered, VU: Vulnerable, NT: Near Threatened

influences. These species (afro-tropical, cosmopolitan, paleotropical and pantropical) are generally ruderary or species of disturbed mediums, can be used as indicator of degraded ecosystem. This disturbance could be due to the grazing and agricultural activities which highly modify the original flora. Most of the pantropical species are weedy annuals. These results are similar to previous investigations, African distribution species constitute a remarkable proportion of the studied flora [20].

3.3 Conservation Status of the Species

Many endangered plants are found in this study, identifying it as of great importance in terms of the biodiversity of Cameroon. So far, 17 threatened tree species representing 7.36% of total flora have been recorded (Table 3). Amongst these, 9 species were vulnerable, 5 near threatened and 3 endangered.

Presence of threatened species/vulnerable/ endangered species in the study highlights the fact that this savanna is an important ecosystem that needs to be identified as a plot for the conservation of the species. The study site is highly subjected to various anthropogenic activities such as grazing, bush fires and agriculture. The government must take immediate steps for intensive conservation of these mountains by preserving understory vegetation. Judicious use of available forest resources must be ensured by the government and measures taken to control human and animals exploitation of the mountains, to prevent extinction in the next decades and make it be available for the future generations. The rapid and extensive land-use change to the mounts Bamboutos vegetation reinforces the need to implement effective conservation strategies, and our study can provide necessary inputs for devising these strategies.

4. CONCLUSION

The current study provides an insight into the floristic diversity, habit, life-form, leaf size, types of diaspores, dispersal modes, chorological spectrum and IUCN status of mounts Bamboutos. The results revealed the presence of 231 taxa, belonging to 154 genera and 70 families. Poaceae, Asteraceae and Fabaceae were dominant families. Four taxa were endemics while four taxa were subendemics. Phanerophytes were the most frequent life form followed by chamaephytes and therophytes. The most dominant leaf size were mesophylls, microphylls and notophylls. Anemochory was the main strategy of dispersion followed by zoochory. Chorological analysis revealed that the afro-tropical species was the most dominant chorotype followed by pantropical and paleotropical species. In order to conserve the threatened species, effective in-situ conservation strategies should be adopted.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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APPENDIX

Appendix A. Floristic composition, family name, habit, life form, diaspores, seed dispersion, leaf size and chorotype of each species

Species	Families (APGIII)	Habit	Leaf form	Diaspores	Dispersal syndromes	Leaf size	Phytochoria
Acanthospermum brasilum Schrank	Asteraceae	Herb	Ch	Ballo	Auto	No	AA
Achyrantes aspera (L)	Amaranthaceae	Herb	Ch	Desmo	Zoo	No	Pan
Acroceras amplectens Stapf	Poaceae	Herb	Th	Sclero	Ane	Na	Pan
Adenocarpus mannii (Hook.f) Hook.f	Fabaceae	Shrub	MaPh	Ballo	Auto	Na	PA
Aframomum sp.	Zigiberaceae	Tree	Ge	Sarco	Zoo	Mg	Und
Agarista salicifolia G.Don	Ericaceae	Tree	MaPh	Ballo	Auto	No	PA
Ageratum conyzoides L. var. *conyzoides*.	Asteraceae	Herb	Th	Pogo	Ane	No	Pan
Ageratum conyzoides L. var. *hustonianuim* Mill.	Asteraceae	Herb	Th	Pogo	Ane	Na	Pan
Aira caryophyllea Linne	Poaceae	Herb	Th	Sclero	Ane	No	AT
Alchemillia cryptanta Steud. Ex A. Rich	Rosaceae	Herb	Ch	Sclero	Ane	Mi	AT
Allophylus abyssinicus (Hochst.) Radlk.	Sapindaceae	Tree	MsPh	Sarco	Zoo	Me	Mo(DC)
Andropogon amethystinus Steud.	Poaceae	Herb	He	Sclero	Ane	Me	Pal
Annona senegalensis Pers.	Annonaceae	Shrub	McPh	Sarco	Zoo	Me	PA
Arthraxon hispidus (Thunb.) Makino	Poaceae	Herb	Th	Sclero	Ane	Na	Pal
Arundinaria alpina (K.Schum.)	Poaceae	Herb	Th	Sclero	Ane	Mi	Mo(DC)
Aspilia africana (Pers.) C. D Adams	Asteraceae	Herb	NnPh	Pogo	Ane	Mi	PA
Asplenium abyssinicum Fée	Aspleniaceae	Herb	Ge	Sporo	Ane	Me	Pan
Asplenium mannii Hook.	Aspleniaceae	Herb	Ge	Sporo	Ane	Me	Cos
Azolla africana (Desc)	Salviniaceae	Herb	Ge	Sporo	Ane	Me	Cos
Bafutia tenuicaulis C. D. Adams	Asteraceae	Herb	Th	Pogo	Ane	Mi	Mo(DC)
Beckeropsis uniseta (Nees) K. Schum	Poaceae	Herb	Th	Sclero	Ane	Mi	GC
Bidens pilosa (L)	Asteraceae	Herb	Th	Pogo	Ane	Me	Pan
Biophytum ombraculum Welw.	Oxalidaceae	Herb	Th	Ballo	Auto	No	Pal
Bridelia scleroneura Müll.Arg.	Euphorbiaceae	Shrub	McPh	Sarco	Zoo	Me	Pal
Brillantaisia vogeliana Benth.	Acanthaceae	Herb	Ch	Ballo	Auto	Mg	AT
Bromus leptocladus Nees	Poaceae	Herb	Ch	Sclero	Ane	Mi	AT
Brucea antidysenterica J.F.Mill.	Simaroubaceae	Tree	MsPh	Sarco	Zoo	Me	Pal
Calopogonium mucunoides Desv	Fabaceae	Herb	Ch	Sclero	Ane	Me	Pan
Canarium schweinfurthii Engl.	Burseraceae	Tree	MaPh	Ballo	Auto	Ma	AT
Canthium henriquesianum (K. Schum & G. Taub)	Rubiaceae	Herb	NnPh	Baro	Auto	Me	Pal
Cardamine trichocarpa Hochst.	Brassicaceae	Herb	Ch	Ballo	Auto	Mi	Pan
Cassia alata L.	Fabaceae	Shrub	McPh	Ballo	Auto	No	Pan

Species	Families (APGIII)	Habit	Leaf form	Diaspores	Dispersal syndromes	Leaf size	Phytochoria
Cassia mimozoides (Linn.)	Fabaceae	Herb	NnPh	Ballo	Auto	Le	Pal
Caucalis melanantha (Steud. Ex Hochst.) Benth. et Hook.f	Apiaceae	Herb	Ch	Sporo	Ane	No	AT
Chromolaena odorata (L.) R.M. King & H. Rob.	Asteraceae	Herb	NnPh	Pogo	Ane	Me	Pan
Cissus sp.	Vitaceae	Liana	NnPh	Sarco	Zoo	Me	Und
Clausena anisata (Willd.) Hook.f. ex Benth.	Rutaceae	Shrub	McPh	Sarco	Zoo	Mi	LSZ
Clematopsis scabiosifolia (DC) Hutch	Ranunculaceae	Herb	Ch	Pogo	Ane	Mi	Pal
Cleome iberidella Welw. ex Oliv.	Cleomaceae	Herb	Ch	Ballo	Auto	Me	AT
Commelina benghalensis L.	Commelinaceae	Herb	Ch	Ballo	Auto	Mi	Pal
Convovulus sp.	Convolvulceae	Liana	NnPh	Ballo	Auto	Mi	Und
Conyza sumatrensis (Retz.) E.Walker	Asteraceae	Herb	Ch	Pogo	Ane	No	Pan
Crinum sp.1	Amaryllidaceae	Herb	Ge	Und	Und	Me	Und
Crinum sp.2	Amaryllidaceae	Herb	Ge	Und	Und	Me	Und
Crotalaria hyssopifolia (Klotsch.)	Fabaceae	Herb	NnPh	Ballo	Auto	Mi	AT
Crotalaria junceae L.	Fabaceae	Herb	NnPh	Ballo	Auto	Mi	Pan
Ctenitis sp..	Aspidiaceae	Herb	He	Und	Und	Me	Und
Cussonia aborea Hochst. Ex. A. Rich	Araliaceae	Tree	MaPh	Sarco	Zoo	Mg	AT
Cyathea camerooniana Hooker	Cyatheaceae	Herb	McPh	Ballo	Auto	Ma	AT
Cyperus difformis L.	Cyperaceae	Herb	Ge	Ptero	Ane	No	Pan
Cyperus dilatatus (Schum & Thonn)	Cyperaceae	Herb	He	Ptero	Ane	No	AT
Cyperus distans (Linn. F)	Cyperaceae	Herb	Ge	Ptero	Ane	No	Pan
Cyperus rotundus L	Cyperaceae	Herb	Ge	Ptero	Ane	Na	Pan
Cyphostemma junceum (Webb) Descoings	Vitaceae	Liana	NnPh	Sarco	Zoo	Me	AT
Delphinium dasycaulon Fres.	Ranunculaceae	Herb	Ch	Ballo	Auto	No	AT
Desmodium repandum (Vahl) DC.	Fabaceae	Herb	NnPh	Desmo	Zoo	No	Pan
Desmodium scalpe DC.	Fabaceae	Herb	NnPh	Desmo	Zoo	No	Pal
Digitaria abyssinica (Hochst. ex A. Rich.) Stapf	Poaceae	Herb	Th	Sclero	Ane	Mi	Pal
Digitaria diagonalis (Nees) Stapf	Poaceae	Herb	Th	Sclero	Ane	Me	AT
Digitaria horizontalis Willdenow	Poaceae	Herb	Th	Sclero	Ane	Mi	Pan
Dioscorea alata L.	Dioscoreaceae	Liana	Ge	Baro	Auto	Ma	AT
Dioscorea villosa wild yam	Dioscoreaceae	Liana	Ge	Ptero	Ane	Ma	AT
Disa nigerica (Rolf.)	Orchidaceae	Herb	Ch	Sclero	Ane	No	AT
Dissotis perkinsiae Gilg	Melastomataceae	Herb	Ch	Sarco	Zoo	Me	GC
Dissotis phaeotricha (Hochst.) Hook. f.	Melastomataceae	Herb	Ch	Sarco	Zoo	Me	AT
Dissotis princeps (Bompl.) triana	Melastomataceae	Herb	Ch	Sarco	Zoo	No	AT

Species	Families (APGIII)	Habit	Leaf form	Diaspores	Dispersal syndromes	Leaf size	Phytochoria
Dracaena arborea (Willd.) Link	Asparagaceae	Tree	MaPh	Sarco	Zoo	Ma	AT
Drymaria cordata (L.) Willd.	Caryophyllaceae	Herb	Ch	Ballo	Auto	Mi	Pan
Echinops giganteus A. Rich	Asteraceae	Herb	Ch	Pogo	Ane	Ma	AT
Echinops gracilis (O. Hoffen)	Asteraceae	Herb	Ch	Pogo	Ane	Na	AT
Echinops longifolus A. Rich	Asteraceae	Herb	Ch	Pogo	Ane	Me	AT
Eleusine indica (Linne) Gaertner	Poaceae	Herb	Th	Sclero	Ane	No	Pan
Emilia coccinea (Sims) G. Don	Asteraceae	Herb	Ch	Pogo	Ane	No	Pan
Ensete gilletii (De Wild)	Musaceae	Herb	Ch	Ballo	Auto	Mg	SZ
Entada africana (Guill & Perr.)	Fabaceae	Tree	MaPh	Ballo	Auto	Ma	SZ
Eragrostis olivacea K. Schum.	Poaceae	Herb	Ch	Sclero	Ane	Mi	SZ
Eremomastax speciosa (Hochst.) Cufod.	Acanthaceae	Herb	Ch	Ballo	Auto	Me	AT
Erica mannii (Hook.F) Beentje	Ericaceae	Shrub	MsPh	Ballo	Auto	Na	AT
Eriosema bauchiense (Huth.R) Dalg	Fabaceae	Herb	Ge	Ballo	Auto	No	AT
Eucalyptus globulus Labill	Myrtaceae	Tree	MaPh	Ballo	Auto	Me	Pal
Eucalyptus saligna Hort. Berol ex Maiden	Myrtaceae	Tree	MaPh	Ballo	Auto	Me	Pal
Eulophia cristata Steud	Orchidaceae	Herb	Ge	Sclero	Ane	Na	AT
Eulophia cucullata (Afz. ex Swartz) Steud	Orchidaceae	Herb	Ge	Sclero	Ane	Na	AT
Euphorbia heterophylla Desf.	Euphorbiaceae	Herb	Th	Sarco	Zoo	Me	AT
Euphorbia hirta (L)	Euphorbiaceae	Herb	Th	Sarco	Zoo	Mi	Pan
Festuca abyssinica Hochst.	Poaceae	Herb	Th	Sclero	Ane	Me	AT
Ficus capense (Thumb.)	Moraceae	Tree	MaPh	Sarco	Zoo	Me	Pal
Ficus glumosa Delile	Moraceae	Tree	MaPh	Sarco	Zoo	Me	Pal
Ficus mucuso Ficalho	Moraceae	Tree	MaPh	Sarco	Zoo	Me	GC
Ficus ovata Vahl	Moraceae	Tree	MaPh	Sarco	Zoo	Me	LSZ
Ficus sur Forssk	Moraceae	Tree	MaPh	Sarco	Zoo	Me	SG
Ficus vallis-choudae Delile	Moraceae	Tree	MaPh	Sarco	Zoo	Me	LSZ
Galium Biafræ Hiern	Rubiaceae	Herb	Ch	Sarco	Zoo	Mi	Mo(DC)
Galium simense Fresen	Rubiaceae	Herb	Ch	Sarco	Zoo	Mi	Cos
Geranium arabicum Forssk.	Geraniaceae	Herb	Ch	Ballo	Auto	Na	Mo(DC)
Gloriosa simplex L.	Colchicaceae	Herb	He	Sporo	Ane	No	Pal
Gnidia glauca (Fresen.) Gilg	Thymelaeaceae	Tree	McPh	Baro	Auto	No	AT
Helichrysum albiflorum (Moeser)	Asteraceae	Herb	Th	Pogo	Ane	No	Mo(DC)
Helichrysum antunesi Volkens & O. Hoffm.	Asteraceae	Herb	Th	Pogo	Ane	No	Mo(DC)
Helichrysum cameroonense (Hutch. & Dalziel)	Asteraceae	Herb	Th	Pogo	Ane	Me	Mo(DC)
Helichrysum cymosum (L) Less	Asteraceae	Herb	Th	Pogo	Ane	No	AT

Species	Families (APGIII)	Habit	Leaf form	Diaspores	Dispersal syndromes	Leaf size	Phytochoria
Helichrysum fruticosurn Vatke	Asteraceae	Herb	Th	Pogo	Ane	No	AT
Helichrysum mechowianum Klatt	Asteraceae	Herb	Th	Pogo	Ane	No	AT
Helichrysum odoratissimum (L.) Sweet	Asteraceae	Herb	Th	Pogo	Ane	No	PA
Helichrysum rhodolepis Bak	Asteraceae	Herb	Th	Pogo	Ane	No	AT
Helichrysum sp.	Asteraceae	Herb	Th	Pogo	Ane	No	Und
Helictotrichon mannii (Pilger) C.E. Hubbard	Poaceae	Herb	Th	Sclero	Ane	Na	Mo(DC)
Helictotrichon rigidulum C.E. Hubh.	Poaceae	Herb	Th	Sclero	Ane	Na	Mo(DC)
Hydrolea glabra (Schum. & Thonn)	Boraginaceae	Herb	Th	Acan	Zoo	Me	PA
Hyparrhenia involucrata (Stapf.)	Poaceae	Herb	He	Sclero	Ane	Na	SZ
Hypericum lanceolatum Lam	Hypericaceae	Shrub	McPh	Ballo	Auto	No	AT
Hypericum quartilianum A. Rich.	Hypericaceae	Shrub	McPh	Ballo	Auto	No	AT
Hypoestes cancellata Nees	Acanthaceae	Herb	Th	Ballo	Auto	No	PA
Impatiens sakerlana Hook. f.	Basalminaceae	Herb	Ch	Sarco	Zoo	Me	SZ
Imperata cylindrica (L) var africana	Poaceae	Herb	Ge	Sclero	Ane	No	Pan
Kotschya strigosa (Benth.) Dewit& Duvigen	Fabaceae	Shrub	NnPh	Ballo	Auto	Na	SZ
Kyllinga squamulata (Beauv)	Cyperaceae	Herb	Th	Ptero	Ane	Mi	SZ
Laggera pterodonta (de Candolle) Schultz-Bipontinus	Asteraceae	Herb	Ch	Pogo	Ane	No	SZ
Leea guineensis G.Don	Vitaceae	Shrub	McPh	Sarco	Zoo	Ma	Pal
Leucaena leucocephala (Lam.) de Wit	Fabaceae	Tree	MsPh	Pogo	Ane	Ma	Pan
Leucas orthacantha Hook. f.	Lamiaceae	Herb	Th	Sclero	Ane	Mi	Pan
Lippia adoensis (Hoscht)	Verbenaceae	Herb	NnPh	Ptero	Ane	Mi	AA
Lippia sp.	Verbenaceae	Herb	NnPh	Ptero	Ane	Mi	Und
Lobelia columnaris (Hook.f.)	Campanulaceae	Herb	Ch	Sarco	Zoo	Mi	AT
Loudetia arundinacea (Hochst. ex A. Rich.) Steud	Poaceae	Herb	He	Sclero	Ane	Mi	AT
Loudetia camerunensis (Stapf) C.E. Hubbard	Poaceae	Herb	He	Sclero	Ane	No	AT
Maerua pseudopetalosa De Wild	Capparaceae	Shrub	McPh	Ballo	Auto	Mi	AT
Maesa lanceolata (Forssk.)	Primulaceae	Shrub	McPh	Sarco	Zoo	Me	AT
Mangifera indica L.	Anacardiaceae	Tree	McPh	Baro	Auto	Mg	Pan
Margaretta rosea Oliv	Asclepiadaceae	Herb	McPh	Sarco	Zoo	Mi	Cos
Mariscus cylindristachyus Steud.	Cyperaceae	Herb	Ge	Sclero	Ane	No	Pal
Markhamia lutea K. Schum	Bignoniaceae	Tree	MaPh	Ptero	Ane	Me	SZ
Melinis minutiflora P. Beauv.	Poaceae	Herb	Th	Sclero	Ane	Mi	Pan
Mentha viridis L.	Lamiaceae	Herb	Ch	Sarco	Zoo	Mi	Cos
Microchloa abyssinica Hochst	Poaceae	Herb	Ch	Sclero	Ane	No	Pan

Species	Families (APGIII)	Habit	Leaf form	Diaspores	Dispersal syndromes	Leaf size	Phytochoria
Microglossa angolensis	Asteraceae	Shrub	MsPh	Pogo	Ane	Me	Pal
Microlepia speluncae (i) Moore	Dennstaediaceae	Herb	He	Sporo	Ane	No	Pan
Mimosa pudica L.	Fabaceae	Herb	NnPh	Pogo	Ane	Mi	Cos
Mitracarpus vullossus (Sw)	Rubiaceae	Herb	Th	Sporo	Ane	Mi	Pan
Mitragyna inermis (Willd.) Kuntze	Rubiaceae	Shrub	McPh	Sporo	Ane	Mi	SZ
Neslsonia canescens (Lam.) Spreng	Acanthaceae	Herb	He	Ballo	Auto	Mi	AA
Oxytenanthera abyssinica Mimro	Poaceae	Herb	He	Sclero	Ane	Na	AT
Panicum maximum (Jacq.)	Poaceae	Herb	He	Sclero	Ane	Mi	PA
Panicum pusillum Hooker f.	Poaceae	Herb	He	Sclero	Ane	Na	SZ
Paspalum conjugatum Bergius	Poaceae	Herb	He	Sclero	Ane	Mi	GC
Passiflora edulis Sims.f.	Passifloraceae	Liana	NnPh	Sarco	Zoo	Me	Pan
Paullinia pinnata L.	Sapindaceae	Liana	NnPh	Sarco	Zoo	Me	AA
Pennisetum clandestinum Chiovenda	Poaceae	Herb	Th	Sclero	Ane	Me	Pan
Pennisetum polystachion (Linne) Schultes	Poaceae	Herb	Th	Sclero	Ane	Me	Pan
Pennisetum purpureum Schumacher	Poaceae	Herb	Th	Sclero	Ane	Mi	AT
Pennisetum unisetum (Nees) Bentham	Poaceae	Herb	Th	Sclero	Ane	No	SZ
Pentas purpurea (Oliv.)	Rubiaceae	Herb	Ch	Ballo	Auto	No	SZ
Pentas schimperiana (A. Rich.) Vatke	Rubiaceae	Herb	NnPh	Ballo	Auto	No	GC
Peperomia vulcanica Baker et Wright	Piperaceae	Herb	Ch	Sclero	Ane	Mi	GC
Persea americana Mill.	Lauraceae	Tree	MaPh	Baro	Auto	Me	Pan
Phoenix reclinata Jacq.	Arecaceae	Shrub	NnPh	Baro	Auto	Me	Pal
Phyllanthus mannianus Muell.	Euphorbiaceae	Shrub	NnPh	Ballo	Auto	Na	AT
Physalis alkekengi L.	Solanaceae	Herb	Th	Sarco	Zoo	No	Cos
Physalis angulata (L)	Solanaceae	Herb	Th	Sarco	Zoo	No	Pan
Piliostigma thonningii (Schumach.) Milne-Redh.	Fabaceae	Shrub	MsPh	Ballo	Auto	Me	SZ
Pittosporum mannii Hook. f.	Pittosporaceae	Shrub	MsPh	Sarco	Zoo	Me	Mo(DC)
Podocarpus mannii Hook. f.	Podocarpaceae	Shrub	MsPh	Sarco	Zoo	Mi	AT
Polystichum aculeatum	Dryopteridaceae	Herb	Ge	Sporo	Ane	Me	Cos
Protea argyrophaca Hutch.	Proteaceae	Shrub	Mcph	Pogo	Ane	Me	AT
Protea madiensis Oliv.	Proteaceae	Shrub	McPh	Pogo	Ane	Me	SZ
Prunus africana (Hook.f.) Kalkman	Rosaceae	Tree	MaPh	Sarco	Zoo	Me	AT
Psidium guajava (L.)	Myrtaceae	Tree	MaPh	Sarco	Zoo	Me	Pan
Psorospermum aurantiacum (Engl	Hypericaceae	Shrub	McPh	Sarco	Zoo	Me	SZ
Psorospermum senegalense (Stems & Le)	Hypericaceae	Shrub	McPh	Sarco	Zoo	Me	AT
Psorospermum febrifugum Spach	Hypericaceae	Shrub	McPh	Sarco	Zoo	Me	SZ

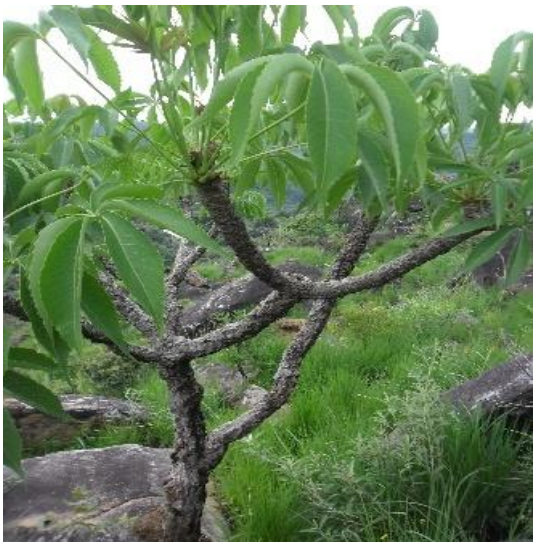
Species	Families (APGIII)	Habit	Leaf form	Diaspores	Dispersal syndromes	Leaf size	Phytochoria
Psorospermum ferruginea (Le)	Hypericaceae	Shrub	McPh	Sarco	Zoo	Me	AT
Pteridium aquilinum (L.) Kuhn	Dennstaediaceae	Herb	Ge	Sclero	Ane	Ma	Cos
Pteris acanthoneura (Alston.)	Pteridaceae	Herb	Ge	Sporo	Ane	Ma	Cos
Pychnostachys meyeri Gürke	Lamiaceae	Herb	NnPh	Sarco	Zoo	No	AT
Raphia humilis A. Chevalier.	Poaceae	Shrub	MgPh	Sarco	Zoo	Mg	AM
Raphia mambillensis Otedoh	Poaceae	Shrub	MgPh	Sarco	Zoo	Mg	AM
Raphia vinifera P.Beauv.	Poaceae	Shrub	MgPh	Sarco	Zoo	Mg	AM
Rubus apetalus Poir.	Rosaceae	Shrub	NnPh	Sarco	Zoo	No	Cos
Rubus pinnatus Willd.	Rosaceae	Shrub	NnPh	Sarco	Zoo	No	AT
Rumex abyssinicus Jacq.	Polygonaceae	Herb	Ge	Acan	Zoo	Ma	Mo(DC)
Rumex nepalensis Spreng.	Polygonaceae	Herb	Ge	Acan	Zoo	Me	Mo(DC)
Satureja pseudosimensis Brenan	Lamiaceae	Herb	Ch	Sarco	Zoo	Mi	AM
Satureja punctata (Benth.) R.Br. Ex Briq.*	Lamiaceae	Herb	Ch	Sclero	Zoo	No	AT
Satureja robusta (Hoof.F) Brenan	Lamiaceae	Herb	Ch	Sarco	Zoo	No	AM
Scadoxus multiflorus (Martyn)	Amaryllidaceae	Herb	Ge	Sarco	Zoo	Mi	Pan
Schefflera abyssinica (Hochst. ex A. Rich.) Harms	Araliaceae	Tree	MaPh	Sarco	Zoo	Ma	AT
Schefflera hierniana Harms	Araliaceae	Shrub	MsPh	Sarco	Zoo	Me	SZ
Schefflera mannii (Hook.f.) Harms	Araliaceae	Tree	MaPh	Sarco	Zoo	Ma	Mo(DC)
Sesbania sesban (L.)Merr.	Fabaceae	Shrub	McPh	Ballo	Auto	Mi	Pal
Setaria barbata (Lam.) Kunth	Poaceae	Herb	He	Sclero	Ane	Ma	Cos
Setaria poiretiana (Schultes) Kunth	Poaceae	Herb	Ge	Sclero	Ane	Ma	AA
Setaria sphacelata (Schumacher) Moss	Poaceae	Herb	Th	Sclero	Ane	Me	AT
Sida acuta Burm. F.	Malvaceae	Herb	NnPh	Acan	Zoo	Mi	Pan
Sida corymbosa (R.E) Fries	Malvaceae	Herb	Th	Desmo	Zoo	Mi	Pan
Sida rhombifolia (L)	Malvaceae	Shrub	NnPh	Acan	Zoo	Mi	GC
Sida rhomboidea Jacq.	Malvaceae	Herb	Th	Desmo	Zoo	Mi	AT
Solenostemon sp.	Lamiaceae	Herb	Ch	Sarco	Zoo	Mi	Ind
Solidago virgaurea L.	Asteraceae	Herb	Ch	Sclero	Ane	No	Cos
Spermacoce pusilla (Wall.)	Rubiaceae	Herb	Ch	Ballo	Auto	Mi	SZ
Spermacoce verticillata L.	Rubiaceae	Herb	Ch	Ballo	Auto	Mi	PA
Sporobolus indicus (Linne) R. Brown	Poaceae	Herb	Th	Sclero	Ane	Mi	AM
Sporobolus montanus Engl.	Poaceae	Herb	Th	Sclero	Ane	Mi	AM
Sporobolus pyramidalis P. Beauv.	Poaceae	Herb	He	Sclero	Ane	Mi	Pal
Stenotaphrum secundatum (Walter) Kuntze	Poaceae	Herb	Ch	Ballo	Auto	Mi	Cos
Stylosanthes hamata (L.) Taub.	Fabaceae	Herb	Ch	Ballo	Auto	No	Cos

Species	Families (APGIII)	Habit	Leaf form	Diaspores	Dispersal syndromes	Leaf size	Phytochoria
Syzygium guineense (Willd.) DC.	Myrtaceae	Shrub	MsPh	Sarco	Zoo	Me	GC
Syzygium montanum Aubréville	Myrtaceae	Tree	MaPh	Sarco	Zoo	Me	GC
Tephrosia preussii (Engl.)	Fabaceae	Herb	NnPh	Ballo	Auto	No	Mo(DC)
Tephrosia vogelii Hook. f.	Fabaceae	Shrub	MsPh	Ballo	Auto	Me	AT
Terminalia glaucescens Planch. ex Benth.	Combretaceae	Tree	MaPh	Ptero	Ane	Me	SZ
Tithonia diversifolia A. Gray (nat.)	Asteraceae	Herb	NnPh	Sclero	Ane	Me	Pan
Trema guineensis (Schum. & Thonn.) Ficalho	Cannabaceae	Shrub	MsPh	Sarco	Zoo	Me	Pal
Trifolium simense Fresen.	Fabaceae	Herb	Ch	Ballo	Auto	Mi	AT
Trifolium subrotundum Steud	Fabaceae	Herb	Ch	Ballo	Auto	Mi	AT
Triumfetta rhomboidea Jacq.	Tiliaceae	Herb	Th	Acan	Zoo	Me	Pan
Urena lobata L	Malvaceae	Herb	Ch	Desmo	Zoo	No	Pan
Vernonia acrocephala (Klatt)	Malvaceae	Herb	Ch	Desmo	Zoo	No	Pan
Vernonia ambigua (Kotschy & Peyr)	Asteraceae	Herb	NnPh	Pogo	Ane	Mi	SZ
Vernonia amygdalina (Delile)	Asteraceae	Shrub	McPh	Pogo	Ane	Me	Pal
Vernonia bamendae C. D. Adams	Asteraceae	Herb	Ch	Pogo	Ane	Me	Mo(DC)
Vernonia calvoana (Hook.f.) Hook.f.	Asteraceae	Shrub	McPh	Pogo	Ane	Me	PA
Vernonia cinerea (Linn.) Less	Asteraceae	Shrub	McPh	Pogo	Ane	Me	PA
Vernonia guinensis Benth	Asteraceae	Herb	Th	Pogo	Ane	Mi	Pan
Vernonia kotschyana Sch.Bip. Ex Walp.	Asteraceae	Herb	Ch	Pogo	Ane	No	SZ
Vernonia nester (S.Moore)	Asteraceae	Herb	NnPh	Pogo	Ane	Me	SZ
Vernonia saussureoides Hutch	Asteraceae	Herb	NnPh	Pogo	Ane	No	SZ
Vernonia smithiana (Less)	Asteraceae	Herb	NnPh	Pogo	Ane	No	AT
Vernonia undulata (Oliv & Hiern)	Asteraceae	Herb	NnPh	Pogo	Ane	No	AT
Vitellaria paradoxa C.F.Gaertn.	Sapotaceae	Herb	NnPh	Pogo	Ane	No	SZ
Vitex grandifolia Gürke	Lamiaceae	Tree	MaPh	Sarco	Zoo	Ma	AT
Xyris subrubella Maime	Xyridaceae	Herb	Ge	Ballo	Auto	Mi	AT

Life form: Ge : Geophytes ; Ch : Chamaephytes ; He : Hemicryptophytes; MgPh : Megaphanerophytes ; MsPh : Mesophanerophytes ; McPh : Microphanerophytes ; NnPh : Nanophanerophytes ; Th : Therophytes. Types of diaspores: Acan: Acanthocores; Ballo: Ballochores; Desmo: Desmochores; Pogo: Pogonochores; Ptero: Pterochores; Sarco: Sarcochores; Sclero: Sclerochores. Dispersal syndromes: Ane: Anemochory; Auto: Autochory; Zoo: Zoochory. Leaf size: Le : Leptophylls; Ma : Macrophylls ; Me : Mesophylls ; Mg : Megaphylls ; Mi : Microphylls ; Na : Nanophylls ; No : Notophylls. Phytochoria: AA : Afro-American ; AT : Afro-Tropical; AM : Afro-Malgaches ; Cos : Cosmopolitan ; GC : Guineo-Congolian ; Pal : Paleotropical ; Pan : Pantropical ; PA : Pluriregional African ; SG : Sudano-Guinean, SZ : Sudano-Zambezian ; Mo(DC): endemic in the Cameroonian mountains archipelago; Und : Undetermined

Appendix B: Some photos of the plant species in the mounts Bamboutos

Helichrysum odoratissimum



Cussonia aborea

Gnidia glauca

Helichrysum cameroonense

Kotschya strigosa

Eulophia cucullata

Helichrysum mechowianum

Protea madiensis

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