Original Research Article

Characterization of grazed vegetation within mountainous areas in the plateau region of Togo (West Africa)

ABSTRACT

Objectives: Livestock production systems in Togo are still dependent on the availability of natural vegetation formations for livestock feed. The present study aims at characterizing the grazed formations of the Plateaux Region. More specifically, the aim is to inventory forage species and analyze their diversity.

Methodology: In order to characterize the grazed plant formations of the zone, phytosociological surveys were carried out at six sites, namely: Nyidové and Djamakondji (Agou), Dalia (Haho), Tchella (Ogou), Onè (Amou) and Mempeassem (Danyi). A total of 140 plots (10mx10m), twenty per site, were installed and investigated using the Braun-Blanquet stigmatization method. Ecological parameters (bush fires, grazing, biomass removal, etc.) are the main factors responsible for the loss of forage diversity and degradation of plant cover on the sites.

Abstract: A total of 87 species were inventoried, mainly in the families Asteraceae, Poaceae, Fabaceae, Euphorbiaceae and Rubiaceae. Among the species identified, the most palatable are *Panicum maximum* (Poaceae), *Centrosema pubescens* (Fabaceae), *Sporobolus pyramidalis* (Poaceae) and *Tridax procubens* (Asteraceae).The palatability index of available vegetation varies from site to site. It is low (IS<4) on two of the sites without good grasses or legumes (Dalia and Tchella) and average (IS<5) on the other sites with good quality. As for biological families, the most represented are Asteraceae, Poaceae, Euphorbiaceae, Fabaceae, etc. Mesophanerophytes, champhytes, therophytes, microphanerophytes, nanophanerophytes and hemicryptophytes are the most predominant biological life forms while pantropicals are more represented in Dalia (40%) and Tchella (49%). *Chromolaena odorata* (92.85%), Imperata cylindrica (78.57%), Tridax procumbens (64.28%) non-consumed invasive species are very much represented and reflect the state of degradation of grazed vegetations.

Translated with www.DeepL.com/Translator (free version)

Conclusion: The results of this study will be used for pastoral management work in the area.

Key words: botanical identification, fodder species, association, forages, phytosociology.

ABREVIATIONS

GDP: Gross Domestic Product

RM: Average Recovery

GPS : Global Positioning System

ITRA : Togolease Institut of Agronomic Research

INTRODUCTION

Globally, terrestrial ecosystems such as, forestland, savannah, shrubs lands and grassland are recognized as sources of several ecosystem services that support livestock production [1, 2].

Livestock is a sector of activity that contributes significantly to fight for food security and to national GDP in tropical Africa. In the context of climate change, access to pastoral resources faces several constraints and the management of fodder resources is a priority that should be understood in its entirety because of natural hazards, the plurality of users, the diversity of spaces and the land implications, which themselves vary.

In West Africa, livestock activities depend closely on these grazing ecosystems throughout the whole year [3]. Forage of these areas support over 20 million of rural people in Africa who are often vulnerable to land degradation and climate change impacts [4]. During this last decade, these pastoral resources are increasingly facing the problem of overgrazing and degradation in tropical area where rural population depend on livestock economy [5]. Main sources of forage for livestock, plant communities are challenged by pastoral pressure for livestock feeding in Africa [6]. In this climate change context where food insecurity affects the most vulnerable populations in tropical zone, the management of pastoral natural resources becomes a great concern [7]. The supply of fodder for livestock remains dependent on the plant resources of grazing areas. Vegetation formations remain the main basis of food for local and transhumant livestock. In view of this situation, the characterization of pastoral landscapes is becoming a concern at the national level.

Like the countries of the West African sub-region, ruminant livestock in Togo remains dependent mainly on the availability of fodder from natural pastures [8-11] . However, in the face of ever-increasing demographics, grazing areas are decreasing face of advancing of agricultural front. This leads to an overcrowding of grazed rangelands, drastically influencing the phytosociological composition of available forage formations [12]. Several other factors, including rainfall, human activities, etc., are driving forces of degradation and loss of forage diversity in the floristic composition of grazed plant formations [13]. It is with the aim of contributing to the sustainable management of grazed flora in Togo that the present study was undertaken in Plateaux region. The objective of our study is to characterize the natural grazing areas of the target environments. More specifically, it is to inventory the diversity of grazed plant formations in the area and to analyze the impact of ecological factors on the floristic composition of the plant cover.

MATERIAL AND METHODS

The methodological approach adopted in this study is based on surveys of grazed vegetation within 100 m^2 plots installed at each site (Nyidové and Djamakondji in Agou Prefecture, Dalia in Haho, Tchella in Ogou, Onè in Amou and Mempeassem in Danyi Prefecture) (Figure 1). Within each plot, species were recorded in presence/absence following the Braun-Blanquet method.

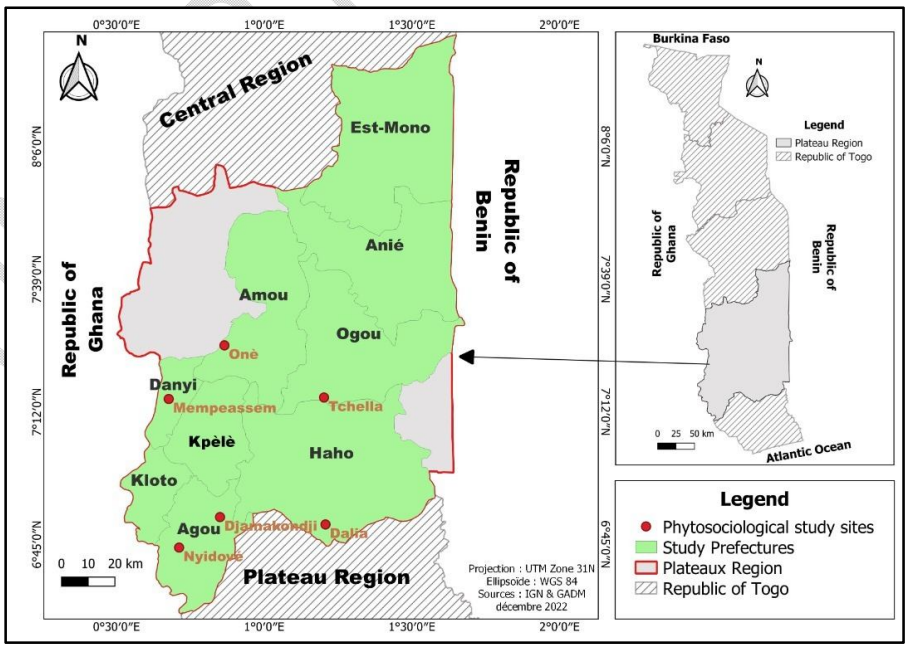


Figure 1: Phytosociological study sites in the Plateau Region

Phytosociological surveys were carried out on the six (6) sites following the quadrat point method of Braun Blanquet [14]. For each site, the geographical coordinates were recorded with a GARMIN GPS. Depending on the vegetation facies present on each site, 15 to 25 square plots (10m square) were installed. In total, one hundred and forty (140) plots were surveyed for plant species. The unidentified species were collected in a herbarium and sent for identification to the Laboratory of Botany and Plant Ecology of the Université de Lomé via the flora of Togo [15, 16], Keay & Hepper [17](1954-1972), and Benin [18].

The main information collected on each plot includes: species present and their abundance and dominance coefficients, typology of plant formations grazed, mean cover (MC) etc. In addition to this information, ecological factors such as: soil type and soil texture, human activity indices, etc. were also collected.

The data were entered into the Excel table and subjected to various statistical treatments to bring out the relative frequencies, curves and graphs. The appetence indices were assigned to each species for an analysis of the bromatological value of the studied plant formations. The indices of palatability or specific quality [IS] ($0 < IS \leq 5$) denote their bromatological value. The palatability indices (IS) used in this study are those defined for the flora of African tropical regions [19] complemented by those of the work of Amégnaglo [4]. For each plant species surveyed, an index is assigned that shows whether or not this species is palatable to animals. These indices are defined as follows:

- miscellaneous non-fodder or refusal (DNF): IS = 0,
- miscellaneous forages (DF): IS > 0,
- poor grasses (GME): (IS = 1),
- average grasses (GMO): (IS = 2),
- good grasses (BG): $3 \leq IS \leq 4$,
- very good grasses (VG): IS = 5
- poor legumes (LME): (IS = 1),
- medium legumes (LMO): (IS = 2),
- good pulses: $3 \leq IS \leq 4$, and
- very good legumes (VLL): IS = 5.

RESULTS AND DISCUSSIONS

1. Diversity of grazed plant formations

1.1. Frequency of species

A total of 87 species were recorded in the study area. The most frequent species are *Chromolaena odorata* (92.85%), *Imperata cylindrica* (78.57%), *Tridax procumbens* (64.28%) present a relative frequency of more than 50%, hence the dominance of these species in all sites. Eleven (11) species have a relative frequency ≥ 40%. These are: *Ageratum conyzoides* (50%), *Commelina erecta* (50%), *Annona senegalensis* (42.85%), *Calopogonium mucunoides* (42.85%), *Centrosema pubescens* (42.85%), *Conyza aegyptiaca* (42, 85%), *Daniellia oliveri* (42.85%), *Flueggea virosa* (42.85%), *Hyptis suaveolens* (42.85%), *Mucuna poggei* (42.85), *Sida acuta* (42.85), *Triumfetta cordifolia* (42.85%). Forty-four (44) species have a relative frequency between 14-35%. These are *Acanthospermum hispidium* , *Rourea coccinea*, *Sporobolus pyramidalis*, *Triumfetta rhomboidea*, *Aspilia helianthoides*, *Eriosema psoraleoides*, *Mimosa invisa*, *Panicum maximum*, *Vernonia galamensis*, *Amaranthus dubius*, *Andropogon gayanus*, *Andropogon tectorum*, *Azadirachta indica*, *Cajanus cajan*, Cyperus pectinatus, *Gmelina arborea*, *Gomphrena celosoides*, *Justicia flava*, *Phyllanthus amarus*, *Sarcocephalus latifolius*, *Schwenckia americana*, *Sida acuta*, *Strychnos spinosa*, *Vitellaria paradoxa*, *Ampelocissus bombicyna*, *Chamaecrista rotundifolia*, *Crotalaria retusa*, *Cynodon dactylon*, *Diodia sarmentosa*, *Dissotis sp*, *Eragrostis irvingiana*, *Eulesine indica*, *Euphorbia hirta*, *Hygrophila pobeguinii*, *Lippia multiflora*, *Mitragyna inermis*, *Momordica charantia*, *Paspalum scrobiculatum*, *Pennisetum pedicellatum*, *Pupalia lappacea*, *Sterculia tragacantha*, *Syzygium guineense*, *Vernonia cinerea*, *Waltheria indica*. Finally, 27 species have relative frequencies ≤ 7%.

This distribution of specific frequencies indicates that the sampled stands are more or less floristically homogeneous with variants related to the ecological site conditions. The distribution curve of specific frequencies showing a decreasing trend well fitted to a logarithmic function illustrates this result (Figure 2). This indicates a high representativeness of some plant species compared to others. The

high frequency of species such as *Chromolaena odorata*, *Imperata cylindrica* is a sign of degradation and loss of forage diversity of the sites investigated in this study.

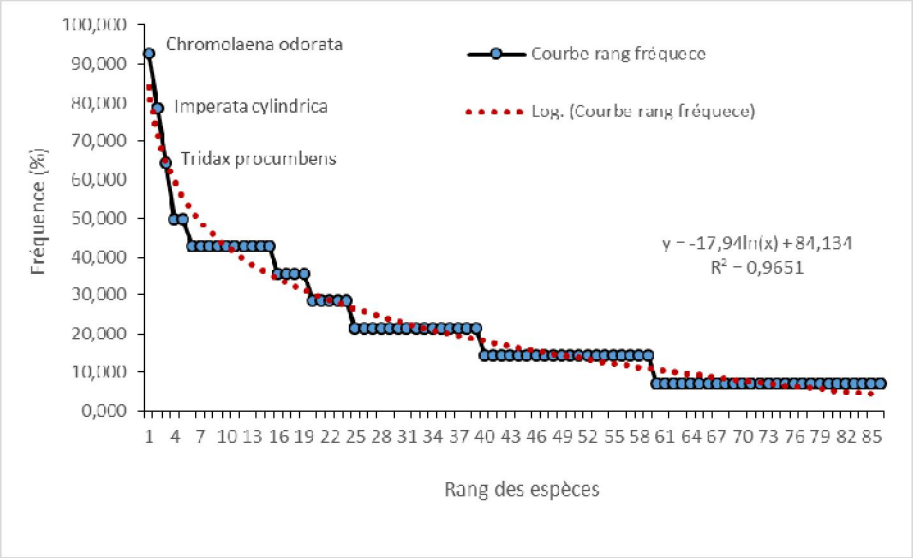


Figure 2: Frequency of forage species

1.2. Botanical families of the forage formations in the study area

Figure 3 below shows the botanical families' composition of the six (6) study sites. Thus, the botanical investigations carried out within Nyidové stand allowed for the identification of 38 species grouped into 29 genera and 16 families. The three (3) most represented families are: Poaceae (6 species), Asteraceae (5 species), and Euphorbiaceae (5 species). In Djamakondji, 31 species were recorded in 23 genera and 8 families. Three (3) families are the most represented. These are Fabaceae (9 species), Poaceae (8 species), Commelinaceae (5 species). As for the site of Dalia, it is noted 41 species distributed in 34 genera and 12 families whose three (3) most represented are: Asteraceae (11 species), Poaceae (9 species) and Caesalpiniaceae (5 species). In Tchella, botanical explorations carried out within the settlement of this site have allowed us to identify 40 species assembled into 31 genera and 11 families. Three (3) families are the most represented namely: Asteraceae (13 species), Amaranthaceae (6 species), Euphorbiaceae (5 species). Botanical research carried out within the Onè settlement led to the identification of 58 species divided into 48 genera and 14 families of which two (2) are the most represented: Asteraceae (19 species) and Poaceae (8 species). Regarding the Mempeassem site, botanical investigations conducted within the settlement of this site resulted in the identification of 47 species gathered in 33 genera and 15 families. As shown in Figure 3, two (2) families are the most represented. These are Fabaceae (12 species) and Asteraceae (6 species). The diversity of botanical families on the sites with an under-representation of Fabaceae shows a low representativeness of forage species on the whole area.

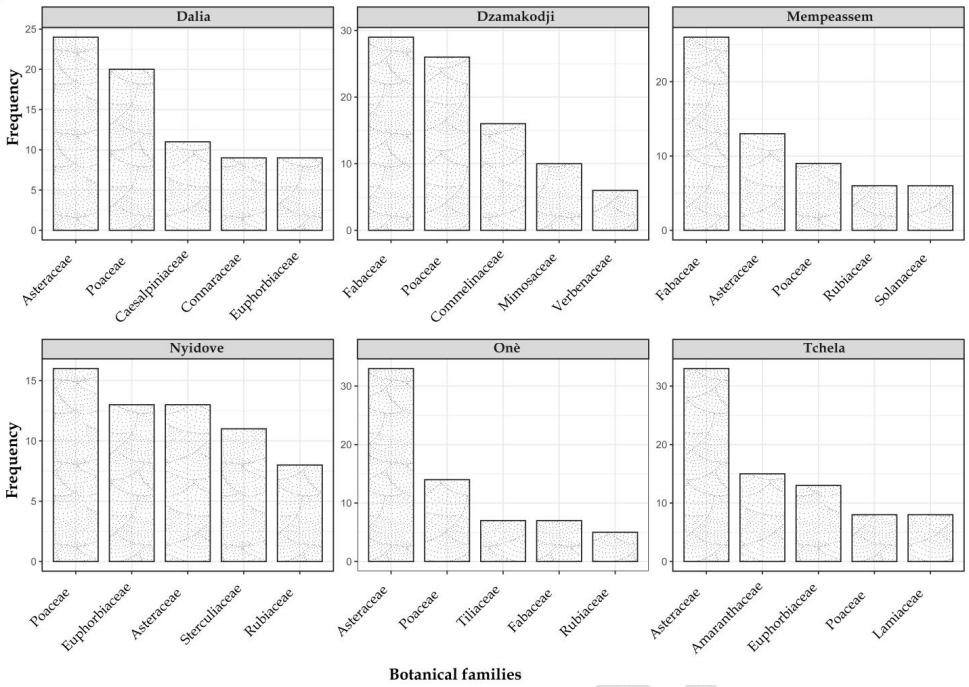
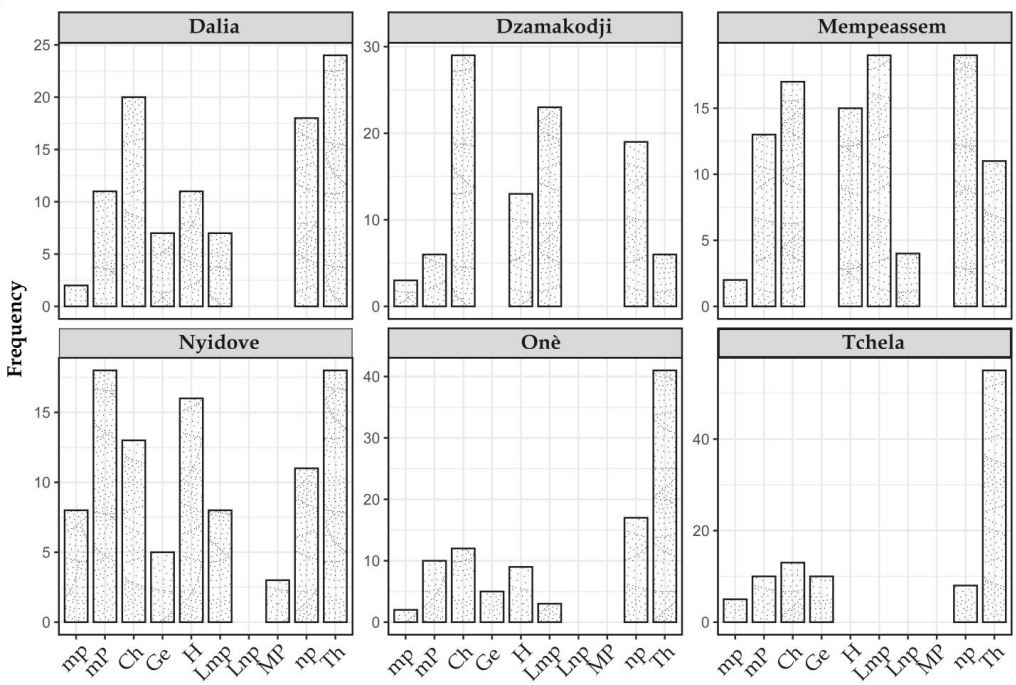


Figure 3: Botanical families of the forage formations

1.3. Biological types of the forage formations of the study area.

Figure 4 below presents the biological types of the forage formations of the six (6) sites studied by the present work. Indeed, on the Nyidové site, the gross biological spectrum shows the predominance of mesophanerophytes (18.18%) followed by therophytes (18%), chaméphytes (15.15%), microphanerophytes (15.15%) and hemicryptophytes (12.12%). Geophytes, nanophanerophytes and lianas are poorly represented. In Djamakondji, the gross biological spectrum shows the predominance of champhytes (30.10%) and nanophanerophytes (21.03%). Hemicryptophytes, microphanerophyte lianas, climbing microphanerophyte lianas, microphanerophytes and therophytes are less represented. As shown in Figure 4, the gross biological spectrum at the Dalia site shows the predominance of therophytes (29.90%), champhytes (24.25%), mesophanerophytes (15%), nanophanerophytes (14.22%) and others are less represented. At Tchella, the gross biological spectrum shows the predominance of therophytes (60.10%), microphanerophytes and champhytes; geophytes are less represented. The crude biological spectrum in Onè, shows the predominance of therophytes (40.20%), champherophytes (15.10%), nanophanerophytes (15.10%) and the other biological types are less represented. As for the gross biological spectrum of Mempeassem, we note the predominance of champhytes (18.19%), hemicryptophytes (17%), microphanerophyte lianas (17%), nanophanerophytes (16.50%), mesophanerophytes (14.50%), therophytes (12%). The other biological types are less represented.

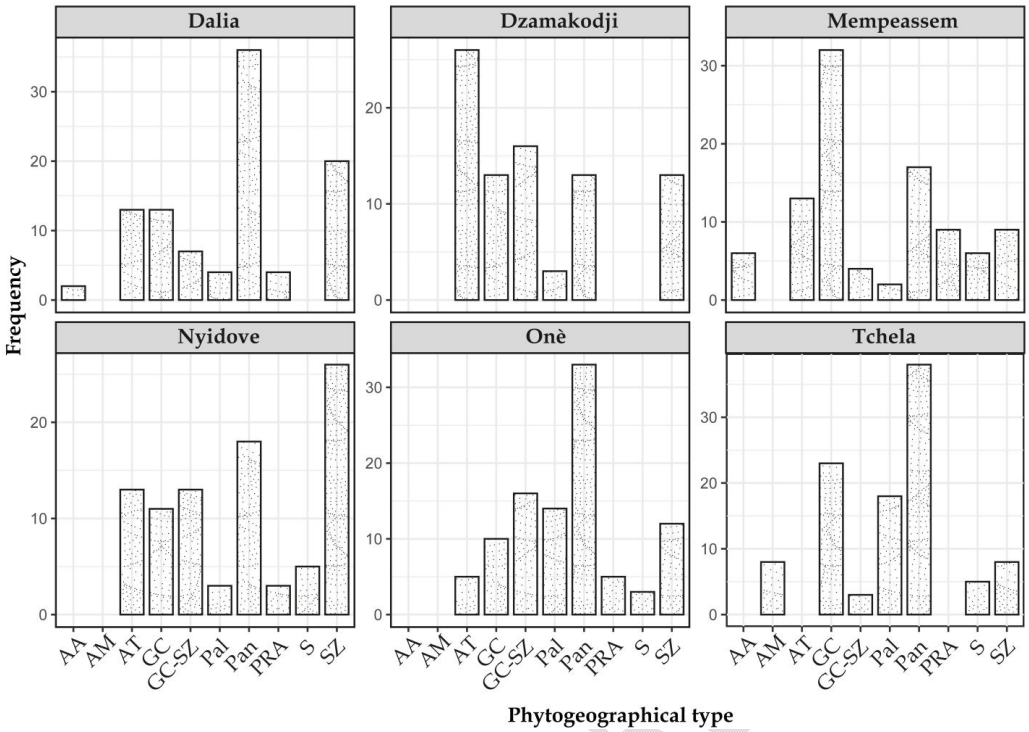


mp : microphanérophytes, mP : mésohanérophyte, Ch : chaméphytes, Ge : géophytes, H : hémicryptophytes, Lmp : Lianes microphanérophytes, Lnp : lianes nanophanérohytes, MP : mésophanérophyte , np : nanophanérophytes, Th : thérophyte.

Figure 4: Biological types of forage formations

1.4. Phytogeographical types of forage formation in the study area.

The various phytogeographic types found on the study sites through the available forage formations are illustrated in Figure 5 below. Thus, at Nyidové, the woody species in the forests are mainly represented by Sudano-Zambezian species (30%), followed by Pantropical (18.18%), Afro-Tropical (15.15%), Guineo-Congolian (9.09%) and Sudano-Guinean (9.09%) species. The Sudanese base element, the paleotropics and the African multiregionals are less represented. In Djamakondji, forest woody species are mainly represented by Afrotropical species (27.80%), followed respectively by Guinean-Congolese & Sudano-Zambezian species (17.5%) and introduced species (17.5%). Pantropical, Sudano-Zambezian, Guinean-Congolian and paleotropical species are less represented. In Dalia, forest trees are mainly represented by pantropical species (40%), followed by Sudano-Zambezian (25.60%) and Afrotropical (18.20%) species. The Guineo-Congolese, paleotropical and African multi-regional species are less represented. As for the Tchella site, forest ligneous species are mainly represented by pantropical species (49%), followed by paleotropical species (26.30%) and the others are less represented. As for the Onè site, the woody species of the forests are mainly represented by pantropical species (32%), followed respectively by Sudano-Zambezian (25.60%) and Afrotropical (19.15%) species, paleotropical (18.10%). The others are less represented. Through Figure 5, we observe that in Mempeassem, on the chorological level, the woody species of the forests are mainly represented by Guineo-Congolese species (29.30%) followed by pantropical species (19%), followed respectively by paleotropical species (26.30%) and the others less represented.



AA : afro-africaine, AM : afro-malgache, AT : afrotropicales, GC : guineo-congolaises, GC-SZ : guineo-congolaises et soudano-zambezien, Pal : Paléotropicales, Pan : Pantropicales, PRA : plurirégionales africaines, S : élément-base soudanien, SZ : soudano-zambezien.

Figure 5: Phytogeographical types of forage formations

1.5. Morphological types of forage formations in the study area

The morphological types of forage formations at the six (6) study sites are illustrated in Figure 6 below. In fact, at the Nyidové site, the available forage formations are dominated by herbaceous plants (38%) and woody plants (29%) at the expense of grasses (25%) and legumes (8%). In Djamakondji, on the other hand, legumes (41%) and grasses (26%) dominate the available forage in comparison to grasses (23%) and woody plants (10%). The fodder rangelands of Dalia show a dominance of herbaceous (33%) and woody (29%) species over grasses (20%) and legumes (18%). As for the Tchella site, there is a complete lack of legumes and a low representation of grasses (9%) in the available forage formations, which are dominated by grasses (64%) followed by woody plants (27%). At Onè, the available forage formations are dominated by grasses (50%) followed by woody plants (25%) at the expense of grasses (19%) and legumes (6%). On the Mempeassem site, there is a low representation of grasses (9%) compared to a preponderance of forbs (38%) and legumes (32%) followed by a relatively good representation of woody species (21%). Overall, grass biomass is less represented in the flora studied. This translates into a decrease in forage potential at the scale of the zone.

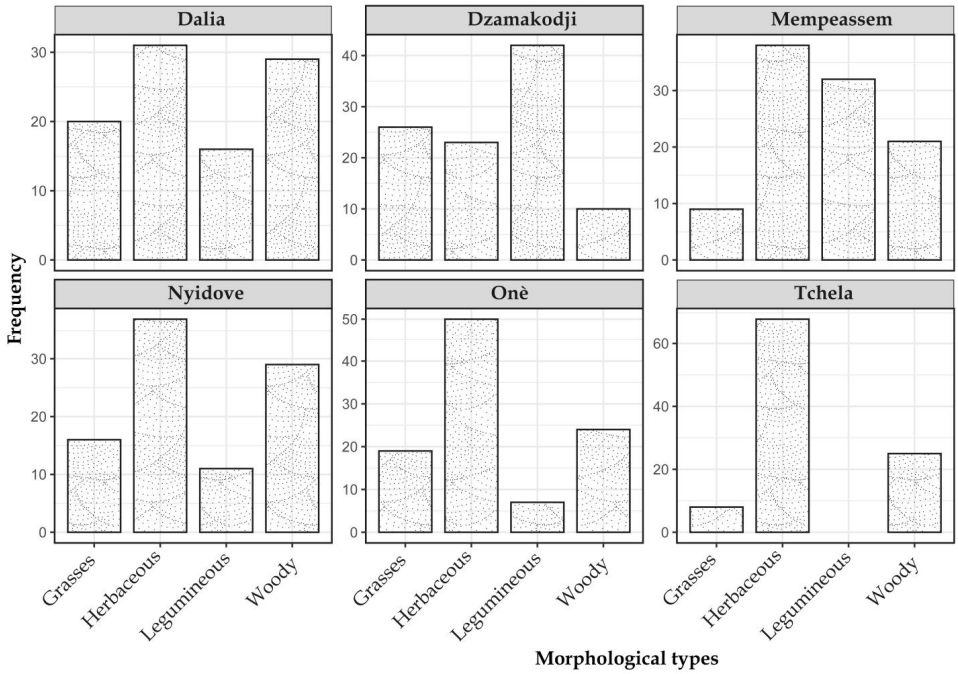


Figure 6: Morphological types of forage formations

2. Analysis of the bromatological value of the grazed plant formations

2.1. Palatability index of the forage formations in the study area

Figure 7 below illustrates the level of palatability of the forage formations available at each site involved in this study.

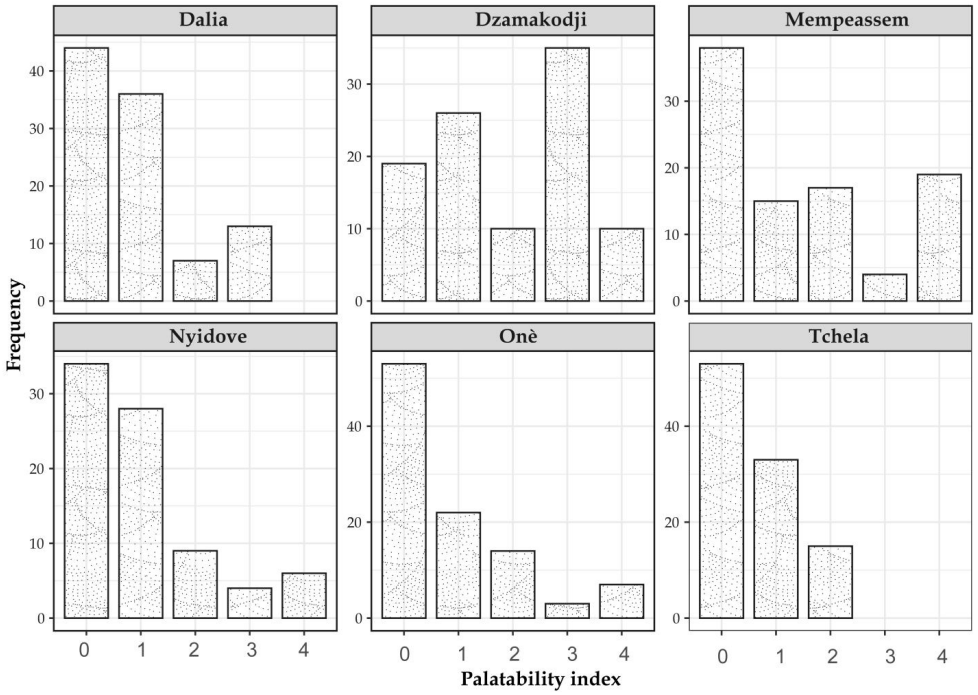


Figure 7: Palatabily index of the forage formations

Analysis of Figure 7 shows that the palatability of available forage varies from site to site. Thus, at the Dalia and Tchella sites, the available forage formations have a relatively low palatability (IS<4) and

contain neither good grasses nor good legumes. As for Nyidové and Onè sites, the available forage formations have average palatability (IS<5). There are species (grasses and legumes) of good and very good quality. At Djamakondji and Mempeassem, the forage formations available on the study sites have a fairly good palatability in terms of good quality forage species composition (IS<5).

It should be noted that the Djamakondji site is an ITRA station where the available forage is improved by the introduction of forage species, whereas at Mempeassem, the vegetation cover has not been sufficiently degraded as in other environments of the Plateaux Region.

2.2. Fodder potentialities

2.2.1. Plateau Region level

The distribution of biological forms in plant groups reflects the ecological conditions of the station in which they evolve [20]. Their analysis and monitoring over time give an idea of the dynamics of a plant community [21]. At the level of all the sites (Plateau Region), the synthesis of the specific spectrum of families, the frequency of families and the frequency of species listed give an idea of the forage potential of the grazing areas. Indeed, the state of a pasture depends on the proportion of grasses, the most productive species and the most consumed by livestock [22, 23] . In our study area, the Poaceae (12 species) represent a relatively large proportion of about 14% of all species recorded (87 species). This proportion of Poaceae can be explained by the fact that they have a very high possibility of tillering and regrowth after grazing when the environmental conditions become favorable again [24]. The specific contributions of the miscellaneous herbaceous plants consumed are above 50%. This means that the proportion of herbaceous plants contributes to the diet of ruminants present in the study area. These results corroborate those obtained in Côte d'Ivoire [24].

We note the presence of species indicative of poor pastoral management, or even overgrazing. These are species classified as refusing, such as *Chromolaena odorata* (92.85%) and *Imperata cylindrica* (78.57%), which are present in all stations. These are species that multiply to the detriment of species of good forage value. They are considered indicators of overgrazing [15]. Indeed, a work in the Sahelian zone of Niger shows that in the case of heavy grazing in ecosystems grazed during the rainy season, the vegetation is dominated by one species or a small number of species that represent on average 50% of the specific contribution of the species recorded [25].

2.2.2. Particularities of the different sites

Among the six (06) sites studied, some present particularities in terms of forage availability. Although all of the sites are being progressively colonized by certain species, including *Chromolaena odorata*, some sites already have a high rate of coverage by this invasive non-fodder species. These are mainly the Dalia and Nyidové sites where the coverage is between 25 and 50% with a presence of between 20 and 40%. In addition, the Djamakondji site, which is a state station whose grazing areas are mostly installed in *Panicum maximum* (T1 and C1), is being progressively invaded by non-fodder Mimosaceae, namely *Mimosa invisa*. As for the site of Tchella, the non-fodder species *Hyptis suaveolens* is becoming more and more established in the grazing areas.

2.2.3. Guiding factors for degradation of grazing areas

The high frequency of unpalatable species such as *Chromolaena* and *Imperata* is a sign of advanced degradation of the grazing areas surveyed. Indeed, these species have the capacity to produce a lot of seeds (*Chromolaena*) and vegetative multiplication allowing them to compete with other species. This mechanism reduces the diversity of forage species on the site and induces frequent movements of livestock at the landscape scale. The same biological mechanisms in the degradation of natural pastures have been observed in the Mono plain [11]

The progressive predominance of certain unpalatable species (*Chromolaena odorata*, *Hyptis suaveolens*, *Mimosa invisa*, etc.) on grazing areas is mainly explained by exogenous factors such as: bush fires, overgrazing, misuse of herbicides, conversion of grazing areas to other purposes such as mechanized cultivation, exploitation of soil (laterite) or subsoil resources, hosting transhumant herds, etc.

The predominance of these non-fodder species is thus progressively reducing the real fodder availability of these areas, which used to be the preferred areas for livestock feeding.

CONCLUSION

A total of 87 species have been recorded during the investigation. Asteraceae, Poaceae, Fabaceae, Euphorbiaceae Rubiaceae are the most represented families. Among the species recorded, the most palatable are *Panicum maximum* (Poaceae), *Centrosema pubescens* (Fabaceae), *Sporobolus pyramidalis* (Poaceae) and *Tridax procubens* (Asteraceae) with the highest forage palatability index. Significantly, the above species contribute to biomass production and dominated by good grasses and medium legumes. Regardless of the threats to the study sites, the forage productivity of these sites allows them to cover the food needs of a significant number of livestock, given that the Plateaux region is one of the regions of the country that hosts a large number of transhumant herds (mostly from Sahelian countries) during periods of drought. This region therefore deserves special attention from the authorities and breeders in order to maintain and make the most of the fodder potential that it abounds. The ultimate goal is to achieve food security and optimize foreign exchange. The palatability index of available vegetation varies from site to site. Asteraceae, Poaceae, Euphorbiaceae, Fabaceae, etc. are the most represented families while Mesophanerophytes, champhytes, therophytes, microphanerophytes, etc. are the predominant biological life forms. *Chromolaena odorata* (92.85%), Imperata cylindrica (78.57%), Tridax procumbens (64.28%) non-consumed invasive species are very much represented and reflect the state of degradation of grazed vegetations.

REFERENCES

[1] Hopping, K.A., et al., *Warming and land use change concurrently erode ecosystem services in Tibet.* Global Change Biology, 2018. **24**(11): p. 5534-5548.

[2] Deng, L., et al., *Effects of grazing exclusion on carbon sequestration in China's grassland.* Earth-Sci. Rev. , 2017. **173**: p. 84-95.

[3] Mitsch, W.J., B. Bernal, and M.E. Hernandez, *Ecosystem services of wetlands.* International Journal of Biodiversity Science, Ecosystem Services & Management, 2015 **11**(1): p. 1-4.

[4] IPCC, *Climate Change 2014: Impacts, Adaptation, and Vulnerability: Working Group II Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, V.R. barros, et al., Editors. 2014: Cambridge University Press, New York, NY.

[5] Guuroh, R.T., et al., *Drivers of forage provision and erosion control in West African savannas-A macroecological perspective.* Agriculture, Ecosystems and Environment, 2018. **251**(257-267 p).

[6] Bechir, A.B., L.Y. Mopate, and C.Y. Kabore-Zoungrana, Evaluation of the seasonal availability of woody forage in the Sudanian zone. Int. J. Biol. Chem. Sci. 2009. 3: p. 135-146.

[7] Naah, J.-B.S.N. and R.T. Guuroh, *Factors influencing local ecological knowledge of forage resources: Ethnobotanical evidence from West Africa's savannas.* Journal of Environmental Management, 2017. **188**: p. 297- 307 p.

[8] Nenonene, Y.A., Contribution à l'étude des pâturages naturels de la basse vallée du zio : cas du Centre d'Application Agropastoral de Kovié. 1991, UL: ESA. p. 117.

[9] Dewa Kassa, K.A., *Inter-State transhumance in Togo: Causes, organization and consequences in Togo," University of Lomé.* 2008.

[10] Dewa Kassa, K.A., Study of the growth of two varieties of Panicum maximum and effects of their association with two legume species. 2013, Univ. Lome p. 36.

[11] Amegnaglo, K.B., et al, Characterization of grazed plant formations in the Guinean zone of Togo: typology, biomass assessment, diversity, forage value and regeneration Int. J. Biol. Chem. Sci. 2018a. 12(5): p. 2065-2084 p.

[12] SAWADOGO, I., Ressources fourragères et représentations des éleveurs, évolution des pratiques pastorales en contexte d'aire protégée Cas du terroir de Kotchari à la périphérie de la réserve de biosphère du W au Burkina Faso. 2011, IRD: Ecole Doctorale Sciences de la Nature et de l'Homme - ED 227.

[13] Sodré, E., Caractérisation des pâturages naturels du terroir de Kotchari et de la partie voisine du Parc W (côté du Burkina Faso). 2009, IDR/UPB, Burkina Faso. p. 63.

[14] Braun-Blanquet, J., *Plant sociology*, ed. M.G. Hill. 1932, New York, London. 330 p.

[15] Hutchinson, J. and J.M. Dalziel, eds. *Flora of West Tropical africa*. 1954. .

[16] Hutchinson, J. and J.M. Dalziel, *Flora of West Tropical africa*, in *Crow agente of then colonies*. 1954: London. p. 646.

[17] Keay, R.W.J. and F.N. Hepper, *Flora of West Tropical Africa*, n.e. Millbank, Editor. 1954-1972: London.

[18. Akoegninou, A., et al, La flore analytique du Bénin. 2006.

[19] Daget, P. and J. Poissonet, Prairies and pastures: field study methods and interpretations. 2010, CIRAD. 955 p.

[20] Wala, K., La végétation de la chaîne de l'Atakora au Bénin: Diversité floristique et impact humain. 2004, University of Lomé, Togo. p. 104.

[21] Zoffoun, A.G., et al, Inventaire du potentiel fourrager pour l'élevage des bovins dans la commune d'Athiémé au sud-ouest du Bénin. Bulletin de la Recherche Agronomique du Bénin, 2009. 66 p. 2130.

[22]. Fournier, A., Phenology, growth and plant production in some West African savannas, ed. ORSTOM. 1991, Paris. 1-312.

[23] Cesar, J., Étude de la production biologique des savanes de la Côte d'Ivoire et son utilisation par l'homme. Biomass, pastoral value and fodder production. 1992, Université Pierre et Marie Curie: Paris, France. p. 672 p.

[24] Akossoua Faustine, K., et al., *Fodder production potential of a grazed area threatened with destruction: case of the Port-Bouët and Grand-Bassam coastal strip"* J.Appl. Biosci., 2014. **82**(1): p. 7403-7410.

[25] Banon, M. and F. Achard, Place de la jachère dans les systèmes d'élevage et Comportement alimentaire du bétail sur un terroir du sud-ouest du Niger, in Jachère et systèmes agraires, Tiko, Editor. 1998: Proceedings of the workshop in Niamey, Niger, September 30-October 2, 1998. p. 99-110.

Table 1: Floristic database of the study sites

Site	N°	Species	Familly	Forage type	Live forms	Phyto-geographic type	Abundance-Dominance
Nyidové	1	*Panicum maximum*	Poaceae	Grasses	He	SZ	4
	2	*Andropogon tectorum*	Poaceae	Grasses	He	SG	3
	3	*Chromolaena odorata*	Asteraceae	Herbaceous			3
	4	*Mallotus oppositifolius*	Euphorbiaceae	Herbaceous	mp	AT	3
	5	*Tridax procumbens*	Asteraceae	Herbaceous	Th	Pan	3
	6	*Aspilia helianthoides*	Asteraceae	Herbaceous	Th	SZ	2
	7	*Imperata cylindrica*	Poaceae	Grasses	Ge	Pan	2
	8	*Lippia multiflora*	Verbenaceae	Herbaceous	mp	SZ	2
	9	*Momordica charantia*	Cucurbitaceae	Creepers	Lmp	GC-SZ	2
	10	*Commelina erecta*	Commelinaceae	Herbaceous	Ch	AT	1
	11	*Mitragyna inermis*	Rubiaceae	Woody	mPh	SZ	1
	12	*Pandiaka involucrata*	Amaranthaceae	Herbaceous	Th	S	1
	13	*Waltheria indica*	Sterculiaceae	Herbaceous	Ch	Pan	1
	14	*Acacia polyacantha*	Mimosaceae	Woody	mP	SZ	+
	15	*Annona senegalensis*	Annonaceae	Woody	np	PRA	+
	16	*Bridelia ferruginea*	Euphorbiaceae	Woody	mp	AT	+
	17	*Daniellia oliveri*	Caesalpiniaceae	Légumineuse	mPh	SZ	+
	18	*Euphorbia hirta*	Euphorbiaceae	Herbaceous	Th	Pan	+
	19	*Euphorbia sp*	Euphorbiaceae	Herbaceous	Th	Pan	+
	20	*Fadogia agrestis*	Rubiaceae	Woody	Ch	S	+
	21	*Flueggea virosa*	Euphorbiaceae	Woody	Ch	Pal	+
	22	*Hygrophila pobeguinii*	Acanthaceae	Herbaceous			+
	23	*Indigofera sp*	Fabaceae	Légumineuse			+
	24	*Mucuna poggei*	Fabaceae	Légumineuse	Lmph	AT	+
	25	*Parinari curatellifolia*	Chrysobalanaceae	Woody	MP	GC	+
	26	*Rourea coccinea*	Connaraceae	Woody	nph	AT	+
	27	*Sterculia tragacantha*	Sterculiaceae	Woody	mPh	GC	+
Djamakondji	1	*Panicum maximum*	Poaceae	Grasses	He	SZ	5
	2	*Centrosema pubescens*	Fabaceae	Légumineuse	Lmp	GC	4
	3	*Mimosa invisa*	Mimosaceae	Légumineuse	np	GC-SZ	3
	4	*Sporobolus pyramidalis*	Poaceae	Grasses	He	SZ	3
	5	*Commelina erecta*	Commelinaceae	Herbaceous	Ch	AT	2
	6	*Sida acuta*	Malvaceae	Herbaceous	Ch	Pan	2
	7	*Azadirachta indica*	Meliaceae	Woody	mp	Pal	1
	8	*Cajanus cajan*	Fabaceae	Légumineuse	np	I	1
	9	*Cassia tora*	Caesalpiniaceae	Légumineuse			1
	10	*Cynodon dactylon*	Poaceae	Grasses	Ch	GC-SZ	1

	11	*Eulesine indica*	Poaceae	Grasses	Th	Pan	1
	12	*Mucuna poggei*	Fabaceae	Légumineuse	Lmph	AT	1
	13	*Gmelina arborea*	Verbenaceae	Woody	mP	I	+
Dalia	1	*Ageratum conyzoides*	Asteraceae	Herbaceous	Th	Pan	3
	2	*Chromolaena odorata*	Asteraceae	Herbaceous			3
	3	*Imperata cylindrica*	Poaceae	Grasses	Ge	Pan	2
	4	*Sporobolus pyramidalis*	Poaceae	Grasses	He	SZ	2
	5	*Tridax procumbens*	Asteraceae	Herbaceous	Th	Pan	2
	6	*Emilia sonchifolia*	Asteraceae	Herbaceous	Th	GC	1
	7	*Eragrostis sp*	Poaceae	Grasses			1
	8	*Eriosema psoraleoides*	Fabaceae	Légumineuse	Ch	PRA	1
	9	*Mimosa invisa*	Mimosaceae	Légumineuse	np	GC-SZ	1
	10	*Paullinia pinnata*	Sapindaceae	Woody	LmP	AA	1
	11	*Rottboellia cochinchinensis*	Poaceae	Grasses	Th	Pan	1
	12	*Rourea coccinea*	Connaraceae	Woody	nph	AT	1
	13	*Sida acuta*	Malvaceae	Herbaceous	Ch	Pan	1
	14	*Triumfetta cordifolia*	Tiliaceae	Woody	Ch	Pan	1
	15	*Vernonia galamensis*	Asteraceae	Herbaceous	Th	SZ	1
	16	*Ampelocissus bombicyna*	Vitaceae	Creepers	Lmph	GC	+
	17	*Daniellia oliveri*	Caesalpiniaceae	Légumineuse	mPh	SZ	+
	18	*Euphorbia hirta*	Euphorbiaceae	Herbaceous	Th	Pan	+
	19	*Flueggea virosa*	Euphorbiaceae	Woody	Ch	Pal	+
	20	*Piliostigma thonningii*	Caesalpiniaceae	Woody	mph	AT	+
	21	*Vitex doniana*	Verbenaceae	Woody	mP	AT	+
Tchella	1	*Hyptis suaveolens*	Lamiaceae	Herbaceous	Th	Pal	4
	2	*Gomphrena celosoides*	Amaranthaceae	Herbaceous	Th	Pan	3
	3	*Tridax procumbens*	Asteraceae	Herbaceous	Th	Pan	3
	4	*Conyza aegyptiaca*	Asteraceae	Herbaceous	Th	SZ	2
	5	*Imperata cylindrica*	Poaceae	Grasses	Ge	Pan	2
	6	*Triumfetta cordifolia*	Tiliaceae	Woody	Ch	Pan	2
	7	*Acanthospermum hispidium*	Asteraceae	Herbaceous	Th	Pan	1
	8	*Amaranthus dubius*	Amaranthaceae	Herbaceous			1
	9	*Chromolaena odorata*	Asteraceae	Herbaceous			1
	10	*Eclipta prostrata*	Asteraceae	Herbaceous			1
	11	*Flueggea virosa*	Euphorbiaceae	Woody	Ch	Pal	1
	12	*Phyllanthus amarus*	Euphorbiaceae	Herbaceous	Th	GC	1
	13	*Strychnos spinosa*	Loganiaceae	Woody	mP	AM	1
	14	*Stylochaeton hypogeum*	Araceae	Herbaceous	Ge	S	1
	15	*Urena lobata*	Malvaceae	Herbaceous	Ch	Pan	1
	16	*Azadirachta indica*	Meliaceae	Woody	mp	Pal	+
	17	*Vitellaria paradoxa*	Sapotaceae	Woody	mP	S	+
Onè	1	*Ageratum conyzoides*	Asteraceae	Herbaceous	Th	Pan	3

	2	*Chromolaena odorata*	Asteraceae	Herbaceous			2
	3	*Conyza aegyptiaca*	Asteraceae	Herbaceous	Th	SZ	2
	4	*Crotalaria retusa*	Fabaceae	Légumineuse	Th	Pan	2
	5	*Cyperus pectinatus*	Cyperaceae	Grasses	He	GC-SZ	2
	6	*Hyptis suaveolens*	Lamiaceae	Herbaceous	Th	Pal	2
	7	*Imperata cylindrica*	Poaceae	Grasses	Ge	Pan	2
	8	*Paspalum scrobiculatum*	Poaceae	Grasses	He	Pal	2
	9	*Pennisetum pedicellatum*	Poaceae	Grasses	Th	Pal	2
	10	*Pupalia lappacea*	Amaranthaceae	Herbaceous	np	GC-SZ	2
	11	*Sarcocephalus latifolius*	Rubiaceae	Woody	mph	AT	2
	12	*Sida acuta*	Malvaceae	Herbaceous	Ch	Pan	2
	13	*Tridax procumbens*	Asteraceae	Herbaceous	Th	Pan	2
	14	*Triumfetta rhomboidea*	Tiliaceae	Woody	Ch	Pan	2
	15	*Vernonia cinerea*	Asteraceae	Herbaceous	Th	SZ	2
	16	*Vernonia galamensis*	Asteraceae	Herbaceous	Th	SZ	2
	17	*Annona senegalensis*	Annonaceae	Woody	np	PRA	1
	18	*Bidens pilosa*	Asteraceae	Herbaceous	Th	GC-SZ	1
	19	*Calopogonium mucunoides*	Fabaceae	Légumineuse	Lmp	GC	1
	20	*Dissotis irvingiana*	Melastomataceae	Herbaceous	np	GC-SZ	1
	21	*Acanthospermum hispidium*	Asteraceae	Herbaceous	Th	Pan	+
	22	*Elaies guinenensis*	Arecaceae	Woody	mPh	GC	+
	23	*Flueggea virosa*	Euphorbiaceae	Woody	Ch	Pal	+
	24	*Grewia flavescens*	Tiliaceae	Woody	mp	GC-SZ	+
	25	*Mnesithea granularis*	Poaceae	Grasses			+
	26	*Vitellaria paradoxa*	Sapotaceae	Woody	mP	S	+
Mempeassem	1	*Centrosema pubescens*	Fabaceae	Légumineuse	Lmp	GC	3
	2	*Andropogon gayanus*	Poaceae	Grasses	He	S	2
	3	*Aspilia helianthoides*	Asteraceae	Herbaceous	Th	SZ	2
	4	*Calopogonium mucunoides*	Fabaceae	Légumineuse	Lmp	GC	2
	5	*Chamaecrista rotundifolia*	Caesalpiniaceae	Légumineuse	Th	Pan	2
	6	*Chromolaena odorata*	Asteraceae	Herbaceous			2
	7	*Eriosema psoraleoides*	Fabaceae	Légumineuse	Ch	PRA	2
	8	*Schwenckia americana*	Solanaceae	Herbaceous	He	AA	2
	9	*A+C3:H39geratum conyzoides*	Asteraceae	Herbaceous	Th	Pan	1
	10	*Albizia adianthifolia*	Mimosaceae	Légumineuse	mP	GC	1
	11	*Annona senegalensis*	Annonaceae	Woody	np	PRA	1
	12	*Commelina erecta*	Commelinaceae	Herbaceous	Ch	AT	1
	13	*Desmodium adscendens*	Fabaceae	Légumineuse	np	GC	1
	14	*Diodia sarmentosa*	Rubiaceae	Herbaceous	Lnp	GC-SZ	1
	15	*Elephantopus mollis*	Asteraceae	Herbaceous	Th	SZ	1

	16	*Justicia flava*	Acanthaceae	Herbaceous	np	GC	1
	17	*Mucuna poggei*	Fabaceae	Légumineuse	Lmph	AT	1
	18	*Sida acuta*	Malvaceae	Herbaceous	Ch	Pan	1
	19	*Sporobolus pyramidalis*	Poaceae	Grasses	He	SZ	1
	20	*Syzygium guineense*	Myrtaceae	Woody	mPh	AT	1
	21	*Gmelina arborea*	Verbenaceae	Woody	mP	I	+
	22	*Lippia multiflora*	Verbenaceae	Herbaceous	mp	SZ	+
	23	*Magaritaria discoidea*	Rubiaceae	Woody	mPh	AT	+
	24	*Tectona grandis*	Verbenaceae	Woody	mP	Pal	+
	25	*Triumfetta cordifolia*	Tiliaceae	Woody	Ch	Pan	+