European Journal of Botany, Plant Sciences and Phytology
Vol.6, No.1, pp.30-50, 2021
Print ISSN: 2055-8139(Print), Online ISSN: 2055-8147(Online)

FLORISTIC COMPOSITION, DIVERSITY AND STRUCTURE OF TWO PROPOSED COMMUNITY FORESTS IN THE DENG DENG NATIONAL PARK-BELABO COUNCIL FOREST CONSERVATION CORRIDOR, EAST REGION OF CAMEROON

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ABSTRACT: *The assessment of floristic composition of every ecosystem is very important in ecological planning and productivity. The main objective of this study was to determine the species composition, structure and diversity in two community forests between the Deng Deng National Park and the Belabo Council Forest. The transect method was employed in data collection. Four long transects were established parallel to each other in each community forest at a distance of 2km apart. In each transect, plots of 20x500m were established at interval of 500m. A total of 25 plots 20x500m (1ha each) were established in the two community forests; 13 plots in community forest one (KEBO) and 12 plots in community forest two (KEPOL). This gave a total of 0.25% of the total land surface sampled in both community forests. Within each plot, all individual trees≥10cm were identified, measured, and recorded. A subplot of 10x10m was established in each plot to identify trees of <.10cm. The identification of plants was done using a combination of characters such as the general form of the tree (butresses, roots systems, bark texture; slash colour, smell, leaf type and shape) as well as the flowers, and fruits of the trees. The dbh of all trees were measured at 1.3 using the dbh metal tape. The height of trees was measured through estimation (average estimates of all field researchers). Results revealed a total of seven thousand eight hundred and seventeen (7817) individual plants with dbh ≥10cm in the entire study area. From this number, 4108 tree stems ≥10cm were identified and measured in community forest (KEBO) one. This belongs to 156 species in 41 families. In community forest two (KEPOL), a total of and 3708 stems were identified and measured. This belongs to 149 species in 41 families. Fabaceae ,Malvaceae , Euphorbiaceae and Rubiaceae were found to be the most dominant plant families while Drypetes sp, Annonidium manii and Funtumia africana were found to be the most dominant plant species. Species composition and diversity varied in the two community forests. Community forest one was characterized by high diversity and similar species composition shown by the Shannon diversity index of 3.6 while community forest two showed signs of poor diversity as seen from the index of 3.41. Tree basal area was high in KEPOL than KEPOL. Species in the different plots were similar but with outliers of plot 4 in KEBO and plot 12 in KEPOL had species which were far more different from the rest of the plots.*

KEY WORDS: floristic, composition, diversity, structure, basal area

INTRODUCTION

There is great variation in the species composition and diversity in the world ecological setup and forest ecosystems. It is noted that Forests cover 31 percent of the global land area which are not equally distributed around the globe with total forest area is 4.06 billion (FAO, 2020). These forest ecosystems have different species composition and diversity. About 60 percent of all vascular plants are found in tropical forests (FAO, 2020). Throughout the world, the Amazon basin and the Congo basin have been known as the biodiversity seats when it comes to species composition and diversity. These two basins have the highest number of species with estimated 10, 000 species of tropical plants in the Congo Basin of which 30 percent are unique to the region (Ian et al., 2016) and 50,000 plant species have been estimated in the Amazon basin (Hubbell, et al 2008). This Ecological diversity of world forest is the degree at which life forms varies within the context of a particular ecosystem, biome, or entire planet (Uno et al., 2001). This encompasses all species of plants, animals and microorganisms, the ecosystem, and ecological processes of which they belong. It is a general term for the extent of nature's variety, including both number and frequency of ecosystems, species, or genes in a given assemblage. Rawat and Agarwal (2015) define Biodiversity as the variety of different forms of life on earth, including the different plants, animals, micro-organisms, the genes they contain and the ecosystem they form.

The variation in the different ecological and geological zones of the world support various types of floristic composition. This **floristic** composition distinguishes and help in understanding plants richness in more optimal ways (Masroor,2011; Ezekiel et al., 2014). The knowledge and understanding of the factors influencing the spatial variation patterns of composition, diversity, and structure of species is a challenge in community ecology (Lomolino, 2001). It has been shown that altitude is one of the main drivers on the emergent properties of plant communities (Gaston, 2000; Guo et al., 2013). For instance, changes in forest structure and composition of forests such as the decrease of living biomass in the soil; the increase of stem density with the altitude (Hernández et al., 2012); and a tendency of leaves to become smaller, thicker, and harderhave been observed. There are several abiotic factors that change forest structure and species composition with elevation. For instance a reduction of the number of species as well as productivity was observed (K€orner (2007). Such changes were influenced by abiotic factors such as temperature, decreasing atmospheric pressure, and solar radiation increases with elevation (Christy and Jonh 2010). Besides the abiotic factors, biotic factors such as farming, urbanization, wild fire, grazing and logging also affects plant composition (Etienne et al., 2012)

It has been noted that biodiversity especially plant plays an important role in ecosystem function, particularly in productivity (Cadotte,2013). While some studies have not mentioned this, several studies have found positive relationships between biodiversity and productivity, measured through biomass (Coelho de Souza et al., 2019). This linkage has been explained as a function of the added value between plant life strategies and use of resources (Gross et al., 2007). However, the negative relationships between biodiversity and productivity (biomass) result from the selection effect, that is, the caused effect when a set of dominant species excludes those less productive species (Turnbull et al., 2013). In addition, most of the studies have been carried out in grasslands, in which fast-growing species dominate and the structure of the community is less, both types of relationships remain controversial in tropical forest ecosystems (Fraser et al., 2015).

Studies of the main tropical forest ecosystems have shown that African rainforests have relatively poor diversity compared to the highest diversity regions of Asia and the Americas (Parmentier et al., 2007). However, based on this overall pattern of diversity, current understanding of the local-scale community-assembly mechanisms for tropical African tree communities is very limited and complicated by previous sampling designs. For instance, inventories based on1ha plots spread across a wide area capture fewer than half of the local species, with many represented only by a single individual. In addition, most of these inventories focus on large trees with diameter at breast height (dbh) 10 cm (Hall and Swaine,1981; Hardy and Sonke, 2004) and in some cases only include selected taxa (Hall et al., 2004). These small plots limit the identification of habitats at scales that could provide meaningful inferences on plant populations. It also preclude comparisons of degrees of habitat specificity with other tropical forests thus having the misconception of poor diversity of the African rainforest.

Besides other African countries, Cameroon is one of the most diverse countries in terms of plant, with over 7,850 plant species (Onana 2011), for which 815species are endangered (Onana and Cheek 2011). The Cameroon heterogeneous landscape presents different vegetation types among which are the Biafran forest with high rainfall, the Congolese forest, and thesemi-deciduous forest with low rainfall (Letouzey, 1985). The vegetation of Cameroon ranges from lowland evergreen rainforest, semi deciduous, deciduous, savannah woodland, and savannah grassland forest, at different altitudinal gradient of lowland to sub-montane, alpine and montane forest (Letouzey, 1985; Achoundong, 2007). It forms part of the Guineo-Congolian region of endemism (White, 1983).Thus, Cameroon encompasses an intricate mosaic of diverse habitats; moist tropical forest dominating the south and south-east and covering 54% of the country, mountain forest and savannah in the highlands and sub- Sahelian savannah and near desert in the far north (Sunderland et al., 2003). Further studies conducted by Barthlottet al. (1996) ranked Cameroon among the top countries in tropical Africa for plant species diversity per degree square. Similar studies equally confirmed the high diversity of endemism of plant species, as found in the 50ha plot in central Korup National Park, with close to 500 tree species (Thomas et al., 2003) and over 250 liana species. Most of this high diversity is usually preserved in protected areas through gazettement. Though the flora is highly studied, new species are recorded every year (Lachenaud et al., 2013).

In the East Region of Cameroon, there are five protected areas including the Dja Biosphere Reserve being one of the world heritage sites. Recent studies of floristic diversity observed 171 species belonging to 115 genera and 40 families in the periphery of the Deng Deng national Park (Louis el al, 2018) and 312 species in 60 genera belonging to 54 families and 293 species belonging to 170 genera in 60 families in the Dja reserve (Sonke and Couvreur (2014) with nothing shown in the corridor linking the two protected areas. Thus, there is still a knowledge gap in species composition in the corridor linking these two protected areas. It is for this reason that this study was primordial to assess the floristic composition in two community forests between the Deng Deng National Park and the Belabo Council forest which is a continuous corridor to the Dja Biosphere Reserve.

MATERIAL AND METHODS

Location of the study area

The two proposed community forests are located in the corridor between the Deng Deng National Park and the Dja Biosphere Reserve. The two proposed Community Forest Reserves (CFRs)

Print ISSN: 2055-8139(Print), Online ISSN: 2055-8147(Online)

measure the size of 5,000 ha for community forest one (KEBO) and 4,588ha for Community Forest two (KEPOL). KEBO is located between latitude 5°0'06.09'' – 5°05'55.17'' North of the Equator and longitudes 13°19'44.60''–13°27'07.73''East of the Greenwich Meridian while KEPOL is located between latitudes 5°07'06.14''–5°12'57.47''North of the Equator and longitudes 13°28'46.32''–13°33'07.45''East of the Greenwich meridian.

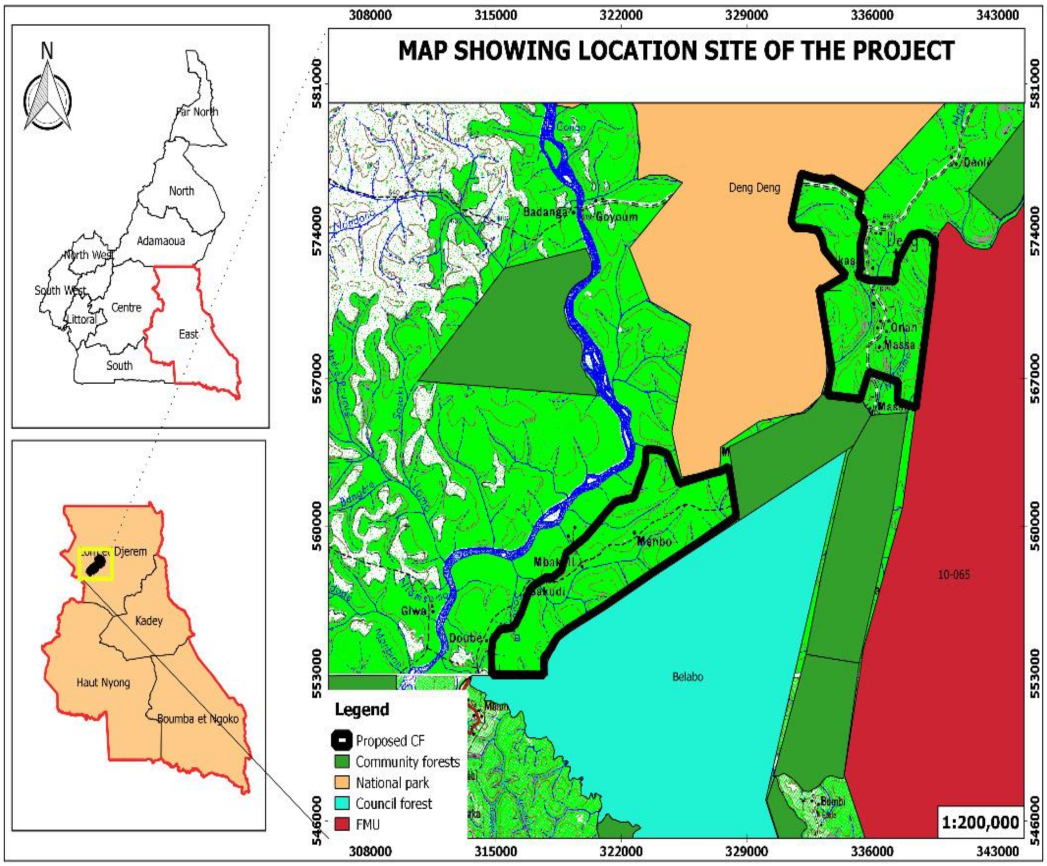

Figure 1: Location map of the study area

The biophysical environment of Deng Deng National Park-Belabo Council Forest Conservation Corridor is described by its characteristics climate, relief, vegetation types and hydrology. Annual rainfall in the park ranged from 1500 mm to 1600 mm (COTCO 2011). The park and its surrounding landscape feature a typical equatorial and humid climate (Fotso et al. 2002) defined by the rainfall regime in this area. Seasonal pattern in the park area is characterized by distinct but unequal dry and wet season periods. Heavy wet season starts from August to November, a light wet season from April to June, a long dry season from December to March and a short dry season from July to mid-August. With a mean annual temperature of 23° C, annual minimum and maximum temperatures within the park area ranged from 15° C and 31° C (COTCO 2011, Fotso et al. 2002). The park consists largely of flat and gently undulating terrain. Elevation within the park varies from 100 m in the south to 920 m above sea level in the north. Granitic and basalt rock outcrops (Plate 1) particularly in the north and northeast corner of the park characterizes the park's relief and also makes it an important geological site.

These proposed community forests are home to a variety of primates, ungulates, rodents, reptiles and birds. Importantly they are habitats of great apesuch as the Western lowland Gorillas and the Central Chimpanzees. The ecosystems here involve a dense mosaic of evergreen primary forest, secondary forest, shrubland and grassland. The primary forests are characterized by thick undergrowth and a closed canopy cover from the tall trees distributed across the landscape. Secondary forest is a resultant of human activities mainly from abandoned farmlands. There are also swamps in the forest which have led to the production of the raffia forest ecosystems. The proposed community forests are surrounded by 10 small villages, namely Deng Deng, Kambocassi, Hona, Mansa, Mbaki, Mbaki 2, Satando, Mbambo, Sakoudi, Tamtsek and Biombe with a total population of about 6,264 persons. These villages derive their livelihood directly from the forest. This is gotten through hunting, logging, farming and collection of non timber forest products. Thus, to conserve plant species in the landscape, it is therefore very vital to know the present species in the face to growing anthropogenic activities.

Materials

The following materials were used for the study included a portable field press, collecting bags, a machete, a sonny camera, a GPS, field note book, two 100m measuring tapes and a diameter tapes.

Sampling Method

The survey employed the transect technique as described by Tchouto (2004), Buckland et al., (2007).The transects were established parallel to each other at a distance of 2.5km. In each transect, plot of 20mx500m were established. at interval of 500m. A total of 25 plots of 20x500m (1ha each) were established in the two community forest s (13 plots in KEBO and 12 plots in KEPOL). This gave a total of 0.25% of the total land surface surveyed per community forests. Within each plot, all individual trees ≥ 10cm were identified, measured, and recorded in a prepared data sheet. A subplot of 10x10m was established in each plot to identify trees of <.10cm. The identification of plants were done using a combination of characters such as the general form of the tree (butresses, roots systems, bark texture; slash colour, smell and exudates, leaf type and shape) as well as the flowers, and fruits of the trees.

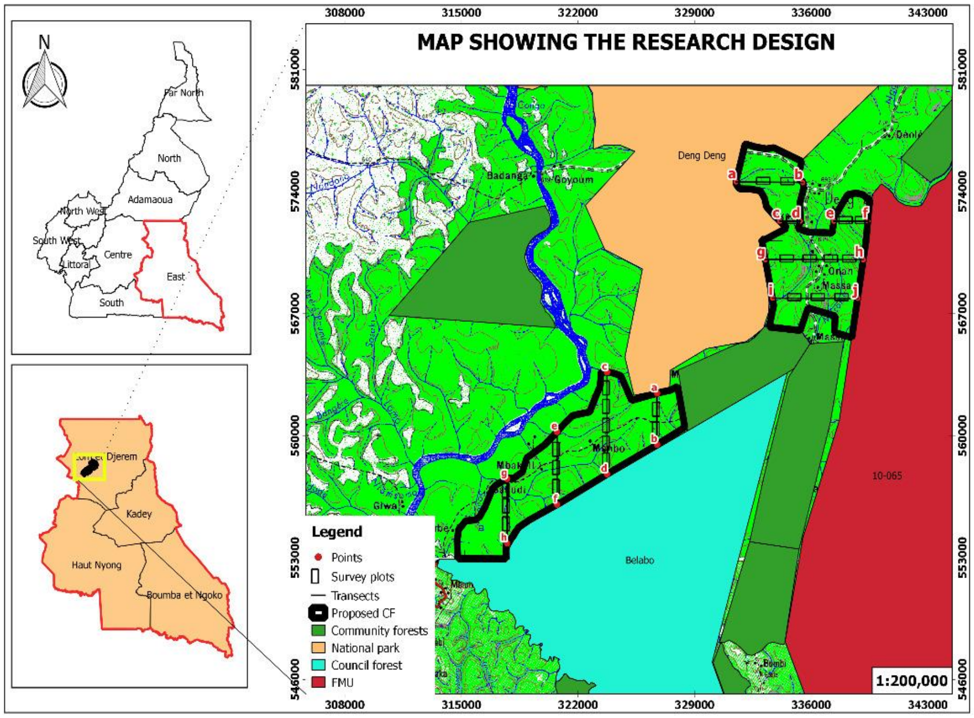

Figure 2: Map showing the layout of transect

In each transect, records of all species of vascular plants were taken. Trees that were unable to be identified in the field, the leaves were collected, pressed and sent to the Limbe Botanic Garden herbarium for identification. Each live tree within the plot was identified and measured at 1.3 m dbh using the dbh metal tape. The height of trees was measured by estimation (average estimates of all field research team). Field manuals, field text books all on plants were used to help in the identification of the plants/trees in the field. At the start, each geographical coordinates were taken with the help of a GPS (Global- Positioning-System) Garmin 64S, which are so accurate in the forest, inexpensive and works adequately under forest canopy

DATA ANALYSIS

Field data were compiled using Microsoft Excel version 20 package and analysis was done using the PC ORD package Version 7. For vegetation structure, the quantitative characteristics such as Plant Diversity, Relative Density (RD),) Dominance (D), Relative Frequency (RF), Relative Dominance (RD), Important Value Index (IVI) were calculated. A similar statistical analysis in wetland plants diversity was carried out by Mueller-Dombois (1974).

Tree Basal Area (TBA) = (½ DBH) 2 x π

$$\text{Stem density (stems/ha)} = \frac{\text{Tree in plot (stems)}}{\text{Plot area (ha)}}$$

$$\text{Percentage (\%) Dominant species} = \frac{\text{Number of species at that elevation}}{\text{Total number of species at that elevation}} \times 100$$

Print ISSN: 2055-8139(Print), Online ISSN: 2055-8147(Online)

The assessment at the various altitudes was described based on the species "important value index" (IVI). Thus species or families with the highest IVI are referred to as the most "important" at that vegetation type. The IVI is calculated as follows:

$$\text{Relative Density} = \frac{\text{Number of Individuals of species}}{\text{Number of individuals of all species}} \times 100$$

Basal Area (BA) = (½ DBH) 2 x π

$$\text{Relative Basal Area} = \frac{\text{BA of species}}{\text{BA of all species}} \times 100$$

$$\text{Relative Frequency} = \frac{\text{Frequency of a species}}{\text{Frequency of all species}} \times 100$$

Important value index (IVI) = CVI + Relative Frequency

Measures of species diversity was done using the Shannon- Weiner index (H') and Simpson's index (DS) (Shannon and Weiner, 1963) which have been shown to be more representative of diversity in larger areas. Shannon's index is a measure of uncertainty, providing the probability of picking a dominant species at random. Comparison was made possible by bringing the plot under the same level, that is, 12 plot each in each community forest. .

H' = -ΣpiIn pi

where pi is the proportion of individuals of species (Relative density of species/100), and In is the natural logarithm. The maximum value of H' is the natural logarithm of the number of species (In S). Evenness (E) describes the distribution among species, reaching a value of 1 when all species have equal numbers of individuals. Pielou's evenness is described by the following equation:

$$E = \frac{H'}{\text{In } S}$$

The Simpson's index was introduced in 1949 by Edward Simpson to measure the degree of concentration when individuals are classified into various types.

The formula for calculating Simpson's index is:

D= $\underline{\sum ni\text{(n-1)}}$,N(N 1)

Where N = the total number of all organisms

n*i*= the numbers of individuals of each individual species

RESULTS

Species Composition

Results revealed a total of seven thousand eight hundred and seventeen (7817) individual plants with dbh ≥10cm in the entire study area. From this, a total of four thousand one hundred and eight (4108) individual stems were measured in KEBO and three thousand seven hundred andseven (3707) stem of dbh ≥10cm were measured andidentified in KEPOL. These individual plants belong to 184 species in 45 families. The dominant species in KEBO and KEPOL was *drypetes sp.* This is shown by the highest importance Value Index (Table1). The following species, *Drypetessp,*

Print ISSN: 2055-8139(Print), Online ISSN: 2055-8147(Online)

Annonidium manii, Gambeyaafricana, Tabernaemontanacrassa, Hylodendrongabunense, Celtis sp, Chythranthussp, Greenwayodendronsuaveolens Sterculia rhinopetala, Funtumiaafricana dominated KEBO. On the other hand, KEPOL was dominated by *Drypetessp, Celtis sp, Albizia zygia, Petersianthus macrocarpus, Annonidium manii, Hylodendrongabunense, Trilepisium madagascariense, Myrianthus aboreus, Sterculia rhinopetala and Musanga cecroploides*. This is shown by their IVI values as presented in table 1.

Table 1. Important Value Index for the first 20 species in KEBO

SN	KEBO species	Family	Abundance	Rden	RF	RBA	IVI	BA_m2_ha
1	*Drypetes sp*	Putranjivaceae	8.7	2.531	2.531	64.416	**69.478**	2313.37
2	*Annonidium manii*	Annonaceae	28.5	9.005	9.005	2.335	**20.344**	83.845
3	*Funtumia africana*	Apocynaceae	14.2	4.502	4.502	1.075	**10.079**	38.597
4	*Tabernaemontana crassa*	Apocynaceae	14.5	4.6	4.6	0.512	**9.711**	18.376
5	*Hylodendron gabunense*	Fabaceae	12.6	3.991	3.991	1.077	**9.06**	38.691
6	*Celtis sp*	Cannabaceae	12.1	3.821	3.821	0.785	**8.427**	28.199
7	*Chythranthus sp*	Sapindaceae	11.3	3.578	3.578	0.502	**7.657**	18.011
8	*Greenwayodendron suaveolens*	Annonaceae	10.5	3.334	3.334	0.677	**7.346**	24.325
9	*Sterculia rhinopetala*	Malvaceae	9.9	3.139	3.139	0.854	**7.133**	30.669
10	*Gambeya africana*	Sapotaceae	9.5	3.018	3.018	0.601	**6.637**	21.584
11	*Musanga cecroploides*	Urticaceae	9.1	2.434	2.434	1.046	**5.913**	37.559
12	*Rinorea oblongifolia*	Violaceae	8.8	2.555	2.555	0.33	**5.441**	11.844
13	*Macaranga monandra*	Euphorbiaceae	8.2	2.385	2.385	0.48	**5.25**	17.249
14	*Petersianthus macrocarpus*	Lecythidaceae	7.1	2.069	2.069	0.757	**4.894**	27.181
15	*Pterygota bequeertii*	Malvaceae	7.2	1.923	1.923	0.856	**4.701**	30.75
16	*Xylopia sp*	Annonaceae	7.5	2.02	2.02	0.301	**4.341**	10.806
17	*Annickia chlorantha*	Annonaceae	5.2	1.655	1.655	0.461	**3.771**	16.572
18	*Guarea thompsonii*	Meliaceae	5.4	1.704	1.704	0.31	**3.717**	11.125
19	*Pausinystalia johimbe*	Rubiaceae	6.2	1.655	1.655	0.373	**3.683**	13.391
20	*Trichilia rubescens*	Meliaceae	4.8	1.533	1.533	0.205	**3.272**	7.368

Footnote: Rden=Relative density, RF=Relative frequency, RBA= Relative Basal Area, IVI=Important Value Index, BA= Basal Area, M2 = Meter square, ha= hectare

European Journal of Botany, Plant Sciences and Phytology
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Print ISSN: 2055-8139(Print), Online ISSN: 2055-8147(Online)

Table2: Important Value Index of first 20 species in KEPOL

SN	Species KEPOL.	Family	Abundance	Rden	RF	RBA	IVI	BA_m2_ha
1	*Drypetes sp*	Putranjivaceae	34.4	8.435	8.44	3.89	**20.757**	59.328
2	*Celtis sp*	Cannabaceae	25.6	7.673	7.67	4.56	**19.91**	69.66
3	*Albizia zygia*	Fabaceae	15.2	4.136	4.14	3.98	**12.25**	60.728
4	*Musanga cecroploides*	Urticaceae	14.2	3.864	3.86	3.68	**11.409**	56.201
5	*Annonidium manii*	Annonaceae	15.3	4.163	4.16	2.64	**10.964**	40.265
6	*Hylodendron gabunense*	Fabaceae	12.2	3.973	3.97	2.6	**10.542**	39.642
7	*Trilepisium madagascariense*	Moraceae	10.2	3.32	3.32	1.64	**8.283**	25.09
8	*Myrianthus aboreus*	Urticaceae	11.3	2.776	2.78	1.64	**7.188**	24.997
9	*Sterculia rhinopetala*	Malvaceae	10.1	2.748	2.75	1.41	**6.91**	21.583
10	*Petersianthus macrocarpus*	Lecythidaceae	7.5	2.041	2.04	2.56	**6.636**	39.001
11	*Streblus usambarensis*	Moraceae	19.5	2.122	2.12	1.67	**5.918**	25.548
12	*Margaritaria discoidea*	Phyllanthaceae	14.8	2.014	2.01	1.81	**5.832**	27.557
13	*Pterygota bequeertii*	Malvaceae	6.3	1.551	1.55	1.89	**4.995**	28.894
14	*Greenwayodendron suaveolens*	Annonaceae	6.6	1.605	1.61	1.27	**4.482**	19.401
15	*Funtumia africana*	Apocynaceae	5.9	1.605	1.61	1.05	**4.26**	16.009
16	*Ficus exasperata*	Moraceae	5.6	1.524	1.52	1.1	**4.149**	16.816
17	*Albizia sp*	Fabaceae	6.9	1.306	1.31	1.49	**4.105**	22.788
18	*Ficus mucuso*	Moraceae	5.8	0.952	0.95	1.96	**3.868**	29.976
19	*Chythranthus sp*	Sapindaceae	4.75	1.551	1.55	0.58	**3.681**	8.844
20	*Gambeya africana*	Sapotaceae	6.3	1.361	1.36	0.88	**3.597**	13.369

Footnote: Rden=Relative density, RF=Relative frequency, RBA= Relative Basal Area, IVI=Important Value Index, BA= Basal Area, M^2 = Meter square, ha= hectare

Dominant plant families in the study area

In the entire study area, the family with the highest number of species was fabaceae (21). This was followed by Malvaceae (14 species), Euphorbiaceae with 13 species (Figure 3).

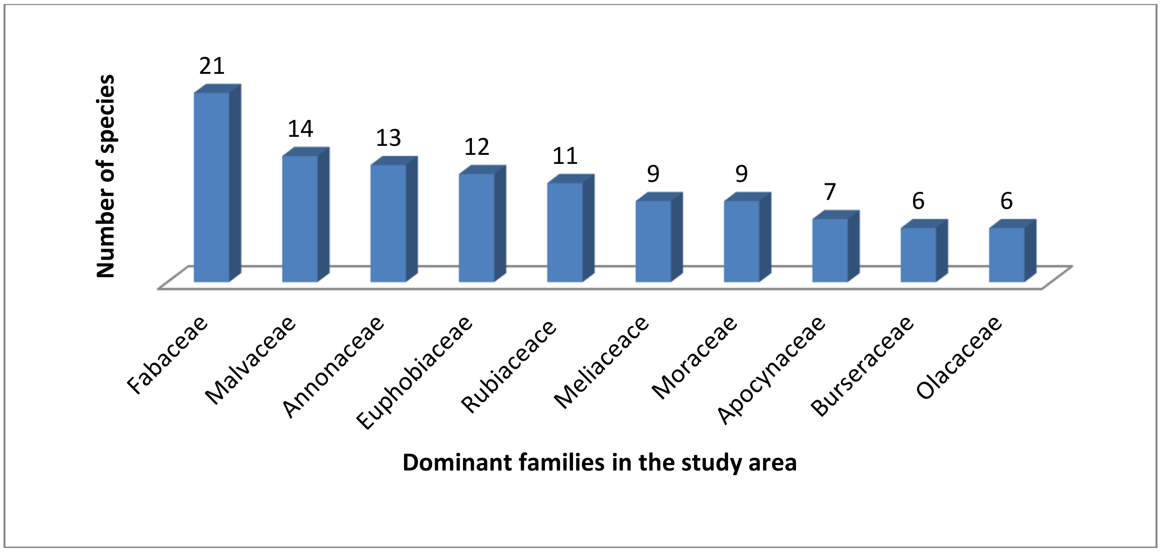

Figure 3: The dominant families in the study area.

Going by community forest, the family with the highest number of species in KEBO was Fabaceae (13 species). This was the richest family in KEBO and was followed by Malvaceae 12 species and Annonaceae with 11 species. These10 families have a total of 86 species from the 145 species and 2945 individual plants from the 4108. In KEPOL, the family with the highest number of species was Fabaceae (19). This was followed by Malvaceae (14) and Annonaceae with (12). These 10 families have a total of 96 species from the 156 species and 1990 individual plants from the 3707representing 53.7% of the total plant (figure 4).

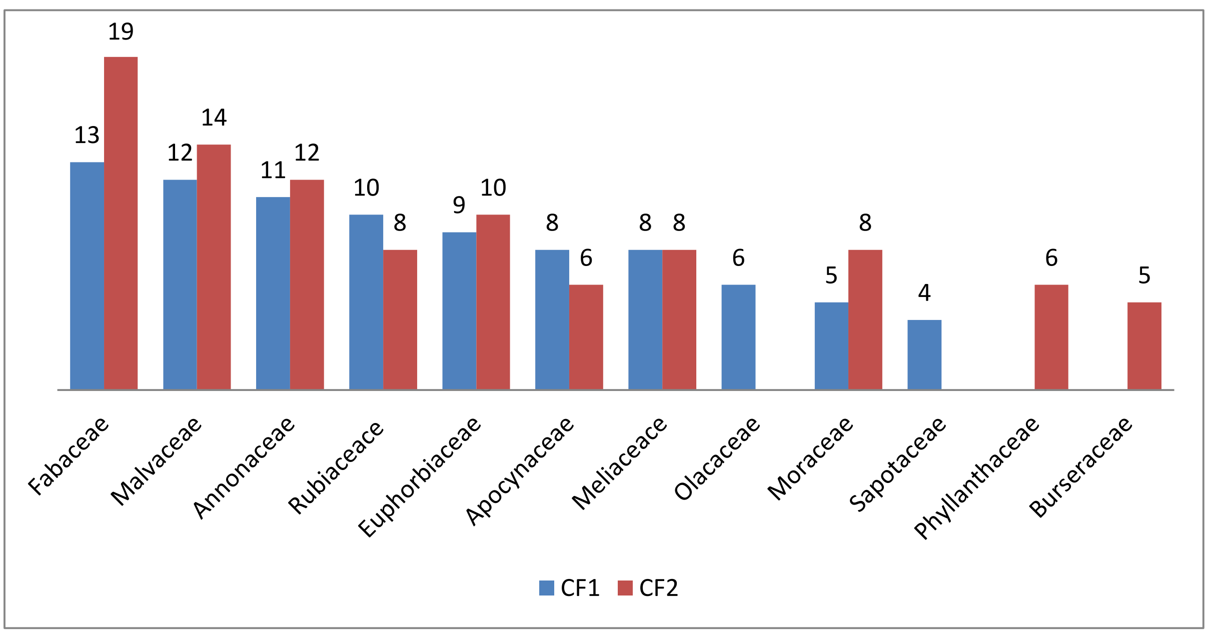

Figure 4. First ten families in community forest one and two in descending order.

Vol.6, No.1, pp.30-50, 2021
Print ISSN: 2055-8139(Print), Online ISSN: 2055-8147(Online)

The family with the highest number of individuals in KEBO was Annonaceae with a total of 780 individual plants almost 19% of the total plant population sampled in this community forest. This was followed by Apocynaceae with 612 individual plants, almost 15% of the total plant surveyed. The least was Moraceae with just 28 individual plants. **In KEPOL, the family with the highest number of individuals was** fabaceae with a total of 501 individual plants representing 13.5% of the total plant population. This was followed by Annonaceae with 323 individual plants, almost 8.7% of the total plant surveyed. The least from the first ten families was Burseraceae with 59 individual plants.

Table 3: Number of individual plants from the first ten families

KEBO	**Family**	**Fab**	**Mal**	**Anno**	**Rub**	**Eupho**	**Apo**	**Mel**	**Ola**	**Mor**	**Sap**
	No of spp	13	12	11	10	9	8	8	6	5	4
	No of Indiv	387	375	780	117	167	612	221	65	28	193
KEPOL	Family	Fab	Mal	Anno	Eupho	mel	Mor	Rub	Apo	Phy	Bur
	No of spp	19	14	12	10	8	8	8	6	6	5
	No of ind	501	292	232	99	130	236	64	144	142	59

Footnote: Fab=Fabaceae, Mal=Malvaceae. Anno= Annonaceae. Rub = Rubiaceae. Eupho=Euphobiaceae, Apo=Apocynaceae Mel=Meliaceae, Ola=Olacaceae, Mor=Moraceae Sap=Sapotaceae, Phy=Phylanthaceae, Bur=Burseraceae, spp= species, ind=individuals

Species Diversity

According to Margalef‟s index of species richness, representing an intermediate mathematical measure between Species and Number (S/N) and S, KEBO was the most diversified than KEPOL. The ANOVA test (P-value = 0.201) shows that there is no significant difference between the two community forest. Shannon-Wiener‟s information index, which combines species richness and evenness into a single value, indicated that the diversity of the two community forest were not very different, but community forest two was poor because its value is less than 3.5. Simpson index which is a measure of dominance (D) showed that the community forest one remained very rich. As D increases, diversity (in the sense of evenness) decreases.

Table 4. Floristiccharacteristic of the two community forest

SN	**Site**	**Stem Number**	**Number of species**	**Shannon's Index (H')**	**Evenness (E)**	**Simpson' Index (D)**
1	C F1	3777	149	**3.5933**	0.86	**0.8067**
2	CF2	3709	156	**3.4134**	0.53	**0.85973**

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Tree basal Area

Tree basal area(TBA) is the common term used to describe the average amount of an **area** (usually an acre) occupied by **tree** stems. It is defined as the total cross-sectional **area** of all stems in a **stand** measured at breast height, and expressed as per unit of land **area**(Reference) (typically square feet per acre). Measuring the basal area for the two community forests, KEBO recorded a higher basal area (189.17) across the different plots as against 170.67 in KEPOL (Table 2).

Table 5. Tree Basal area per square meters per plot

Site	Plot 1.	Plot 2.	Plot 3.	Plot 4.	Plot 5.	Plot 6.	Plot 7.	Plot 8.	Plot 9.	Plot 10.	Plot 11.	Plot 12.	Plot 13.	Av_BA	Std dve
CF1.	167.97	235.07	164.21	140.03	188.96	208.83	187.40	215.12	169.53	170.66	245.94	176.29	192.02	189.17	31.30
CF2.	156.30	163.29	120.02	223.00	191.78	192.47	182.35	176.70	124.01	144.71	171.57	201.77	00	170.67	30.86

Structure of the forest (spatial distribution pattern, size diversity, species diversity, crowding degree diversity)

A total of 7817 stems with circumference of≥10cm from 184 species were recorded in the two community forests. The distribution of stems by the circumference classes in the different community forest differ. Most individual plants, 3402 (43.52) were concentrated in the first class of 10-20 cm. From this number, 1906 (24.38%) were concentrated in KEBO and 1496 (30.9%) in KEPOL. between the class of 21 and 30, a total of 1555 (19.89%) were concentrated. From this, 412 were concentrated in CF1 and 422 concentrated in CF2. For the Class 100+ which was the highest recorded DBH class, a total of 165 individual were detected; 107 belonging to CF1 and 58 concentrated in CF2.

Table 6: The distribution of the number of stems

CF	**Distribution of DBH Classes**										
	10 -. 20	21 - 30	31 - 40	41 -50	51 - 60	61 -70	71 - 80	81 - 90	91 - 100	100+	**Total**
CF1	1906	691	412	240	222	221	149	84	77	107	**4109**
CF1	1496	864	422	194	196	184	128	98	70	58	**3708**
Total **%**	**3402**	**1555**	**834**	**434**	**418**	**405**	**277**	**182**	**147**	**165**	**7817**

From the table, it is realized that the number of trees decreases with the increase in the size of the trees.

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Print ISSN: 2055-8139(Print), Online ISSN: 2055-8147(Online)

The vertical structure of the forest was grouped into four main classes; four at interval of 10m defined by their maximum attainable heights as follows: treelets (small trees) (≤10 m), understory (11–20 m), canopy (21–30 m), and emergent (>30 m). A major of the trees in the two community forest were the understory. This was followed by the small trees whose heights were less than 10m. The least were the emergent. This shows that the two community forests are young and highly productive.

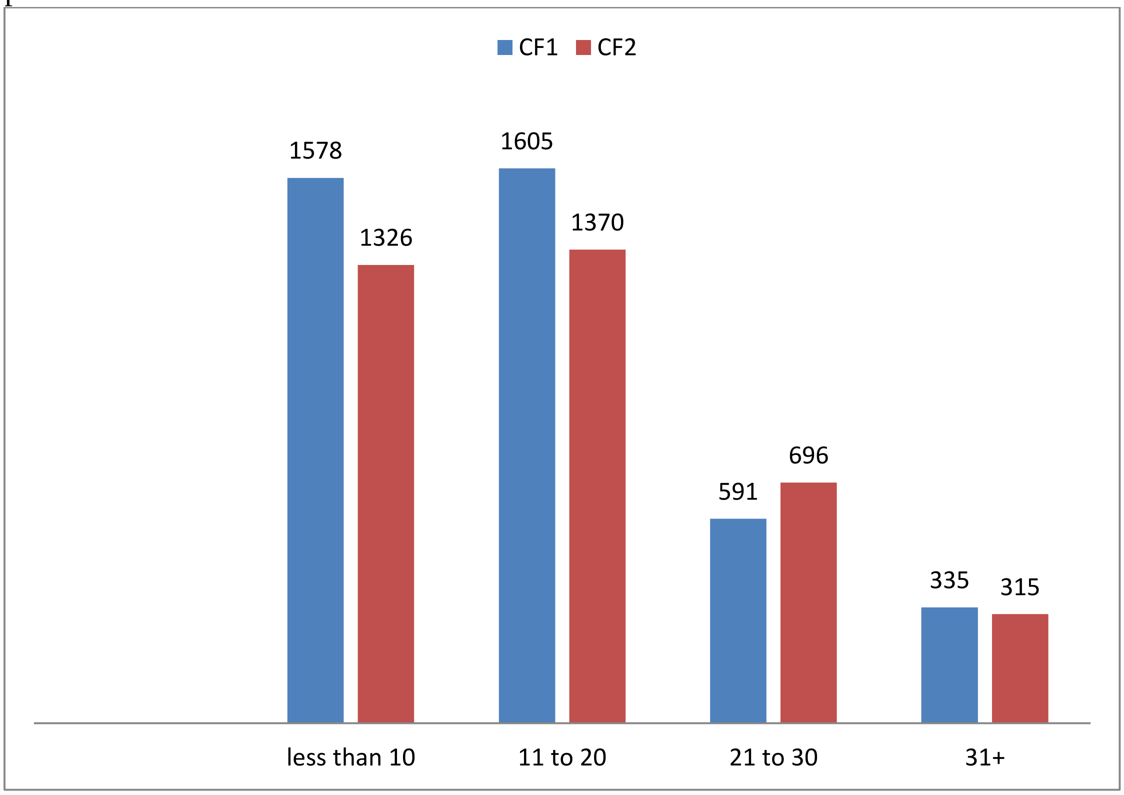
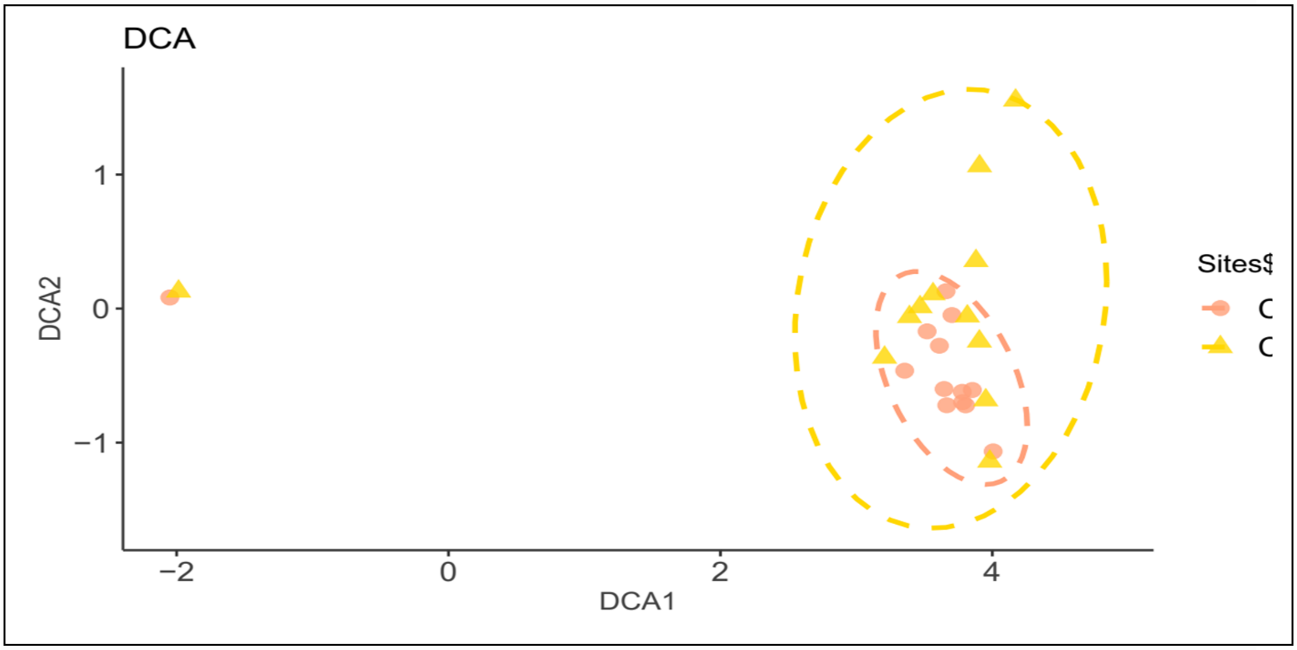


Figure 5: Vertical Structure of the two CFs

Similarity between species in the two community forest

The cluster analysis revealed high similarity levels between thetwo community forest. Similarity in species composition occurs whenthe analysis is focused on the same type of vegetation(Rodrigues and Nave, 2000). From the cluster analysis (figure 6), it is seen that the two community forests are quite different but have very similar species composition. However, there are some outliers in plot 4 in KEBO and plot 12 in KEPOL. These two plots are far off from the rest showing that a majority of the species in these plots are not related to those of other plots in the two CFs



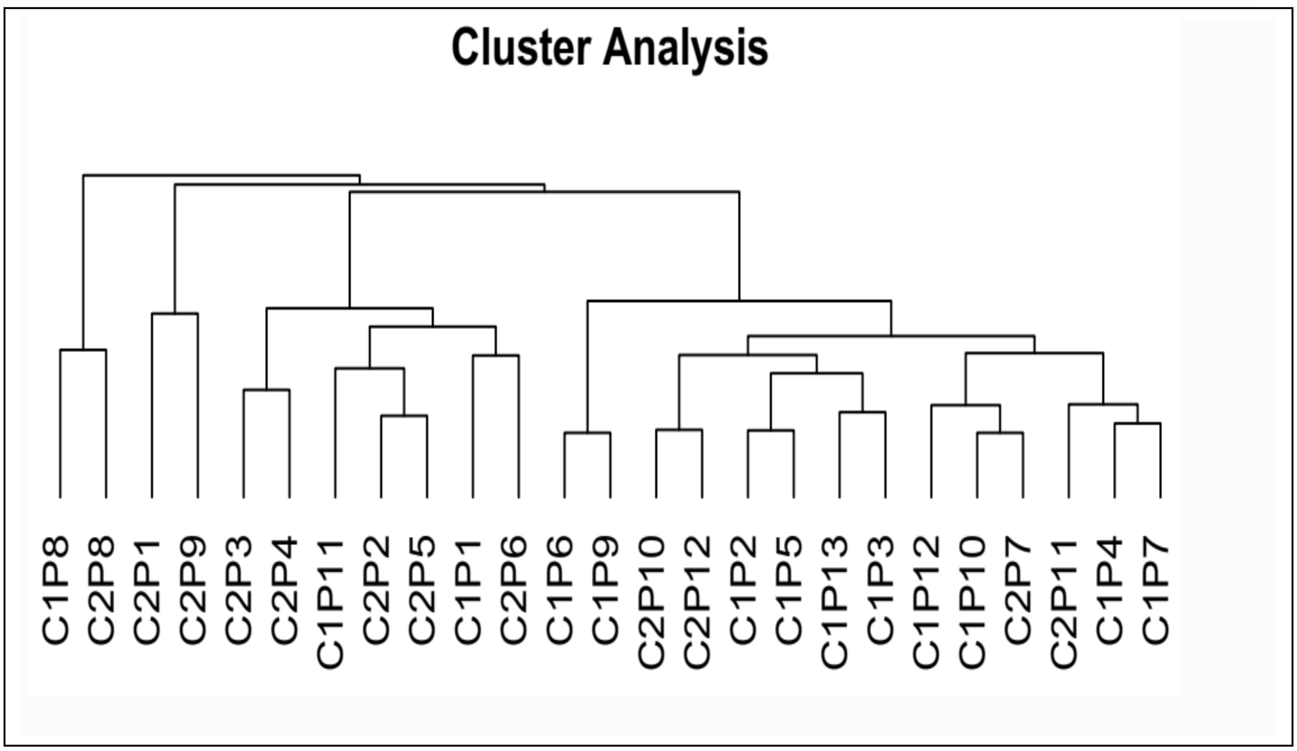


Figure 7. Cluster analysis dendrogram of different vegetation types showing similarity indices, derived from the analysis

From the dendrogram, plot 7 in KEBO has species that are very much similar to plot 4 in KEPOL which are almost similar to those of plot 11 in community forest two. Plot 7 in community forest two has species which are very similar to those plot 10 in community forest one. Species in these two plots are similar to those of plot 12 in community forest 1. Species of plot 8 in KEBO and

Plot 8 in KEPOL and those of Plot 1 in KEPOL and 9 in KEPOL are not very similar to the species of the other plots in the study area. This is likely due to the fact that these plots were found in new secondary forests where there has been a lot of open land.

DISCUSSION

This study identified the ecological properties of two community forests, such as species richness, composition, and structure. This is meant to have a practical floristic monitoring with implications for conservation and sustainable management of biodiversity (Miles et al., 2006). A total of 184 tree species were found in 25 plots distributed throughout the two community forests.

Important Value Index (IVI)

Data from relative density (RD), relative frequency (RF) and relative dominance (RD) were used to calculate the importance value index (IVI) of the vegetation. It indicates the relative ecological importance of a given species at a particular site (Kent and Coker 1992). High species importance value index (SIV) is attributed to their high basal area, high relative frequency and high relative density. The greatest SIV reflects the degree of dominancy and abundance of a given species in relation to the other species in the area. It is also used for setting priority/ranking species management and conservation practices and helps to identify species a dominant or rare species (Kent and Coker, 1992). In the study, *Drypetes sp, Annonidium manii, Hylodendron gabunense, Celtis sp, Chythranthussp, Greenwayodendron suaveolens, Sterculia rhinopetala,* Funtumiaafricana, *Albizia zygia and Petersianthus macrocarpus* dominated the forest. The dominant of *Drypetes sp* as species with the highest IVI is different from the observation made by Louis et al, (2018) in their study of Floristic diversity and carbon stocks in the periphery of Deng-Deng National Park. They observed *Triplochiton scleroxylon* as the dominant plant species.

Abundance family

Fabaceae, Malvaceae Annonaceae Rubiaceae and Euphorbiaceae were the most rich families observed in the community forest. These species contributed much to the diversity of plants in the study area. In this study, fabaceae was the most abundant plant family. This is in line with a study conducted on Tree diversity of the Dja Faunal Reserve, southeastern Cameroon (Sonké B, Couvreur T., 2014) in which Fabaceae, was the most species rich. The abundant of fabaceae has been observed in many flora studies in Cameroon. **Fobane et al.** (2017) observed fabaceae as the most dominant family in the Atlantic forest of Cameroon. In the same vein fabaceae has been noted as the most dominant plant family in the Kimbi Fungom National Park (Sainge et al; 2016; Zeh et al, 2019). This confirmed the idea that Fabaceae always fall among the three most dominant families in the world. In studies using DBH≥10 cm, Fabaceae is considered hyperdominant. Fabaceae had been noted to have the greatest species richness and it is commonly cited as the richest family in other Amazon forest types (Pitman et al., 2002 ; ter Steege et al., 2006).

Species diversity

In comparing the two community forests, the number of sampling plots was brought to the same level to make sampling effort equal. For most methods of species richness comparison, it is assumed that individuals have a random spatial distribution in the environment (Kobayashi **1983**), sample sizes are sufficiently large, and populations are sampled in the same manner (Abele and

Walters 1979).Based on this, the analysis was done using sample size of 12 ha in each community forest. We eliminated plot 13 in community forest one to bring the total to 12 as in community forest 2. The total number of individuals (N) as well as species richness (S) was high in community forest one than in community forest two. The flora of any given ecosystem is said to be rich if it has a Shannon diversity value ≥3.5 (Kent and Coker, 1992; Gonmadje et al., 2012). Whittaker (1970) stated that vegetation diversity is dependent on two characteristics of the vegetation. One is the number of species present, identified as S, which indicates species richness, whereas the other describes the distribution of the individuals in the population among the species, symbolized by N. In our study site, KEBO had Shannon- Weaver diversity indices of 3.6 and KEPOL had an index of 3.4. This shows that the KEBO is rich while KEPOL is poor. This could be due to the fact that the KEBO is less exploited than KEPOL where there are intense human activities. large plantations of cocoa, palms, maize, and cassava were observed to be cultivated in the KEBO which the popular 40ha farm (Popular called Chante de Bamenda or Bamenda farm), a high diversity index was still recorded for the different meaning that species or families are well distributed have been erased due to these high anthropogenic factors.

Species similarity

Similarity between species in the two community forests was assessed using a cluster analysis. For two or more areas to be considered alike, they must have at least 25% of species in common (Muller-Dubois and Ellenberg, 2003). Based on this criterion, our cluster analysis revealed high similarity levels between the two community forests. Comparisons revealed similarity values greater than 75% between the two community forests. Similarity in species composition occurs when the analysis is focused on the same type of vegetation (Rodrigues and Nave, 2000). One of the factors that influenced the grouping was forest size and proximity to other vegetation types.

Forest structure

The distribution of trees in circumference classes was uneven. The study recorded 11 dbh classes indicating that, structurally, the forests are probably mature, stable and highly likely to continue perpetuating their constituent species. The smallest diameter trees (10-20cm dbh) were 3402 (43.5%) abundant showing that the ecological importance of small-trees in the structure, diversity and biomass to tropical forests (Memiaghe et al., 2016). This means that the two community forests are much more supported by younger trees than old ones. Despite the fact that some species rarely go above 40cm like the *Tabernamontana crassa*, which also presented a high IVI, a majority go above this range. Thus these two community forests are under regeneration as there have been affected by anthropogenic activities. This result shows that total number of plant species was found to decrease with increasing DBH, suggesting that seedlings and sapling were more in number than the mature/older plant species. This in turn shows that the vegetation of these forests was generally in a good regeneration status. From the population dynamics point of view, examination of patterns of species population structure could provide valuable information about their regeneration and/or recruitment status as well as viability status of the population that could further be employed for devising evidence-based conservation and management strategies (Demel Teketay, 2005).This scenario was also observed by Zeh et al, 2019 in their study of floristic composition of species in the Kimbi Fungom National park These results were similar to those of Savadogo et al. (2007) in Tiogo Forest who demonstrated that at dbh of > 10 cm, a great number of stems were recorded from the circumference class 10 - 30 to 30 - 50 cm, indicating the high number of small trees and the higher contribution of shrub species which developed small circumference. This is partly due to rampant destruction of the forests basically, the suppression and the falling of big trees in addition to other factors that limited the sustainability of species (David and William, 2016).

CONCLUSION

The Deng Deng National Park-Belabo Council Forest Conservation corridor is an ecoregion which is composed of primary forest, major vegetation types; lowland rainforest. This vegetation vegetation types had sub vegetation types likethe swampy forest which could be found in any of the major vegetation type, and the secondary which wereheavily disturbed gallery forests. Species richness was high in the lowland forest than any other forest types. Themost abundant family recorded was Fabaceae with 31 species. Most of the forest had a high density of smallspecies of less than 9.9 cm. The renewal of species through the regeneration was weak, the vulnerability of young plants to grazing, drought and farming and most importantly bush fire slow down the sustainability ofwoody species. This is termed an ecological, and environment problem that is contributing to thedegradation of the floras in the park. The woody and grassland savannas need high conservation effort asthey are always burnt, and are also fertile grazing environments.

The management of the forest ecosystem and its environs including localpopulation and habitat regeneration is inevitable to save this corridor area fromdestruction, save their flora and fauna species from localextinction and to maintain a viable population size in theface of growing anthropogenic activities. This conservation corridor is however, equally rich compared to other areas in Cameroon. It should benoted that species richness and its diversityare under serious threats from anthropogenic. The corridor needs urgent conservation effort. Measures shouldtherefore be taken toward good management andmonitoring of this corridor the improvement of rural livelihood that may free their dependent on the forest ecosystem. Measures to supportthe regeneration of tree species should also be taken, inorder to increase the main abundance of trees especially in fragmented landscapes. However, successful restorationrequires involvement from many disciplines especial with the consent of the surrounding local communities. This will improve the species pocket of the corridor which is likely to reinforce the ecological stability thereby enhancing the effectiveness in the existence of our wildlife in the corridor.

Acknowledgment

Our sincere thanks go to World Land Trust, for providing funds to conduct the study. The authors also appreciate the Regional Delegation of Forestry and Wildlife, East Region of Cameroon and local communities in the East for their collaboration in providing the information and understanding while undertaking surveys. We also wish to acknowledge the expertise of the botanist, Felix Okon towards the realization of this project.

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