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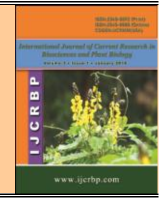

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Floristic Inventory of Woody Species of the Oku Sacred Forest in the North-West Cameroon, Theoretical and Philosophical Approach

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Abstract

This survey articulates around three aims; (1) to study the vegetation structure and woody species diversity in the hilly Oku sacred forest (2200-2300m of altitude) of northwestern Cameroon, (2) to compare our results with those of other tropical sacred forests, and (3) to appreciate the hygrothermality of the plant species. A quantitative inventory was realized on trees with diameter at breast height $\geq$ 10cm covering a cumulative surface area of 1.25-ha, from 9 rectangular plots of 50m x 25m (1250m^2). Standard methodology to calculate floristic diversity was employed. A total of 934 trees belonging to 31 species, 27 genera and 19 families were recorded with a total basal area of 246.87m^2 per hectar. Most trees had a height between 10 and 15m and diameter of 10-20cm. However some individuals reached heights of 25 to 30m. Three species namely *Schefflera abyssinica* (1 individual), *Schefflera mannii* (2 individuals) and *Syzygium guineense* (2 individuals) had a diameter of 220-230cm. The 4 most important families in term of density, diversity and dominance were Araliaceae, Myrtaceae, Meliaceae and Rubiaceae. They represented 150.7 of Family Importance Value (FIV). The species composition was dominated by five common species (16.12%) (*Schefflera mannii*, *Carapa grandiflora*, *Syzygium guineense*, *Xymalos monospora* and *Piptadeniastrum africanum*), representing 162.47 of the Index of Value importance (IVI). Three plant species were represented by only one individual. The peculiarity of the Oku sacred forest is the presence and high IVI (26.55) of *Piptadeniastrum africana*, the lone *Leguminosae*, a characteristic of mesophile forests (order of the *Piptadenio-Celtidetalia*). The Oku sacred forest has low species diversity, considerably high stem abundance compared to most forests of tropical regions and a highest dominance. The forest structure and formation is characterised by big trees (in terms of diameter), covered from top to bottom by the strangler epiphytes. With respect to species climatological considerations, the Oku sacred forest is dominated by hygro-oligothermal (afro-montane) vegetation, hygro-mesothermal (submontane) vegetation and hygro-megathermal (lower and middle altitudes) vegetation. All these characteristics argue for the syngenetic status of Oku sacred forest.

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Introduction

The Cameroon Mountains form a floristic archipelago similar to that of eastern and southern Africa (White, 1983) and is host to important floristic sites. One of such important sites is the Oku mountain situated at the northwestern edge of Cameroon, from latitude 6°07´-6°17´ and longitude 10°20´- 10°35´ UTM 32N - WGS

84. It summits at 3011m (also known as Kilum summit) is only second to mount Cameroon (4095m). On the western slope is the Ijim Crete that reaches 2500m in altitude. This survey was carried out in the northwestern sector of the sacred forest with altitude between 2200-2300m (Fig. 1).

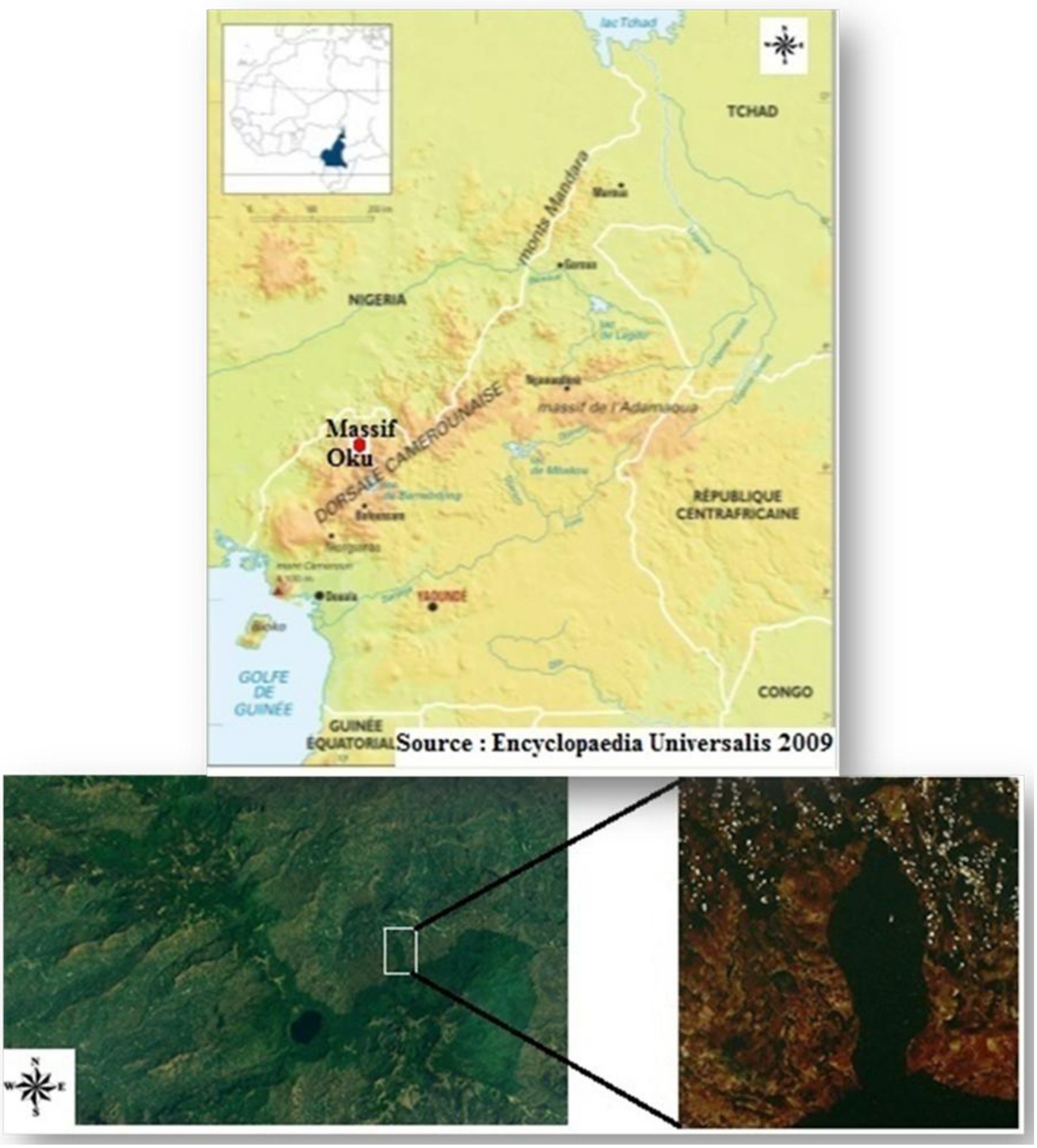

Fig. 1: Location of the Oku sacred forest along the Cameroon Mountain (*top*). View of the sacred forest from google map(https://www.google.com/maps/). The white rectangle indicates the position of the sacred forest (*bottom left*) and Oku Lake (*bottom right*). The white point on the dark strip is reflection of light by the metal sheet of the roofing of the slots of the rituals. The small white points in hood on the dark strip represent the houses of dwelling of the local populations.

The Oku sacred forest is located in a large valley on the Oku Mountain. It is remarkable for its dense vegetation delimited by a row of *Prunus africana*. Two ritual houses have been raised in the middle of the sacred forest. The survival and management of the sacred forest and its biological diversity rest on the customary laws such as restriction to debark important species such as *Prunus africana* for medicinal purposes, felling of soft wood like *Polyscias fulva* for sculptures and other art works, burning from traditional agriculture or hunting for bushmeat.

This study is based one an axiom: a plant formation is a group of species gathered by the non reciprocal attraction exercised on them by the various factors of the middle. The theory is: to discern a plant formation like a group of species gathered by the non reciprocal attraction exercised on them by the various factors of the middle, and to establish some flora – middle affinities. The philosophy developed from this was to focus attention on the flora and the vegetation and to have the visions of the phenomena who took place before the present stage.

Several studies on the structure and biodiversity have been realised in the low and middle altitudes forests of African, Malagasy and the Neotropic regions (Villanueva, 1991; Pichiger et al., 1992, 1996; Lejoly, 1995; Rabevohitra et al., 1996; Sonke, 1998; Collin, 1998; Rakotomalaza and Messmer, 1999; D'Amico and Gautier, 2000; Senterre et al., 2004). These studies highlighted quantitative measures for families and the species diversities of these forest types. Some investigations in the submontane and afro-montane forests have been conducted following similar methodology (Mohandass and Davidar, 2009; Noumi, 2012, 2013 and 2015). Could the structural characteristics and the species diversity of the Oku sacred forest permit a singular scientific status just as its current social status?

The goals of the present survey were (1) to inventories tree species in the Oku sacred forest by means of forest plots, while taking into account the trees species ≥ 10cm diameter at breast height (dbh), (2) to quantify the parameters of diversity and structure, and (3) to characterize the plant formation in relation to existing data in various forests.

Study area

Oku area has humiferous ferralitic soils (Hawkins et al., 1965) classified by FAO as ferralitic sols. McLeod (1987) identified the presence of three types of ferralitic soils in the Oku forest area: trachyte, basalt and cemented ashes. These soils have rich organic content because of its altitude and climate. The massif carries a highlander forest interrupted by herbaceous vegetation carpet where goats (*Capra hircus*, Caprinae) and sheeps (*Ovis ammon*, Ovinae) (Fig. 2) graze. These herbaceous zones make as agricultural earth office (Momo, 2009).

Fig. 2: A shepherd and his sheeps on the summit of the Oku massif.

The local climate of the Oku forest area can be deduced from that of Kumbo city (1000m altitude) situated at 30km from the Kilum summit, with annual precipitations of 2305.1mm, average annual temperature of 19.8°C and relative humidity above 86% throughout the year. The ombrothermic diagram is presented in Fig. 3. We thus expected the rainfall in the Oku forest to be higher because of higher altitude than Kumbo.

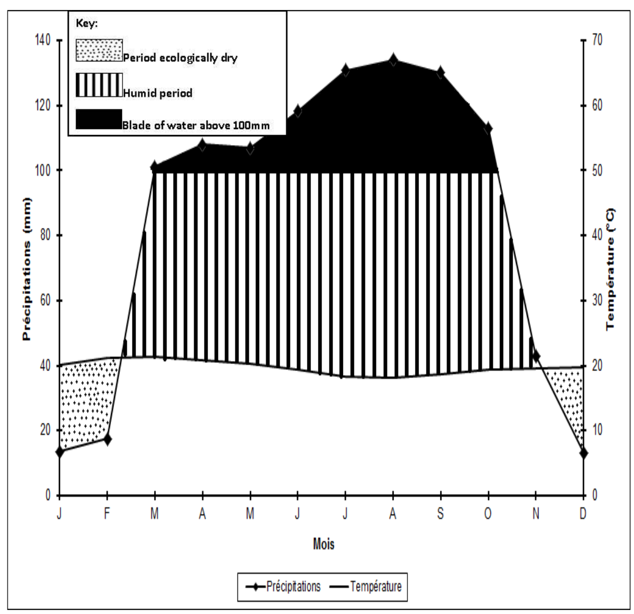

Fig. 3: Ombrothermic diagram of Kumbo by Bagnouls and Gaussen (1957), modified according to the method of Walter and Lieth (1964): on the curve of monthly mean of rainfalls, the scale is reduced to the 1/10 from 100mm. (Source: Divisional delegation of Agriculture at Kumbo).

The local climate of the Oku forest area can be deduced from that of Kumbo city (1000m altitude) situated at 30 km from the Kilum summit, with annual precipitations of 2305.1mm, average annual temperature of 19.8°C and relative humidity above 86% throughout the year. The ombrothermic diagram is presented in Fig. 3. We thus expected the rainfall in the Oku forest to be higher because of higher altitude than Kumbo.

Landscape and vegetation of some summits

Fall (blank) of a tributary, to the level of a subsidence, in a talweg

Oku lake in a crater (plane rear), 2200m of altitude

Fig. 4: Cross section of some landscapes of the Oku massif.

The high rainfall around this forest area has created a dense network of permanent water tributaries and waterfalls (Cheek et al., 2000). Part of the water flows into River Katsena and Benue *via* the Lui village or toward the Mbam down to River Sanaga. The smaller tributaires nourish Lake Oku at altitude 2200-2300m (Fig. 4). The natives are constituted by the populations of 3 villages or ‘’fondon’’ that share the sommits: Oku and Nso villages (in the Bui Division) and Kilum village (in Boyo Division). The emigrants are especially the Bamilékés, planters of coffee (*Coffea arabica*, Rubiaceae) and the Bororos or Fulanis, nomads and breeder of the bovidae and installed in the prairies enclosed inside the forests. They live there since 60 years (Thomas et al., 2001).

Materials and methods

Fieldwork was conducted in 2012-2013 in the Oku sacred forest. Woody plant diversity was inventoried by sampling nine plots of 25m x 50 m (1250m^2). These plots were all identical to the mesologic and physionomic point of view. A trail of 50m in the center of rectangle facilitated the sampling of 12.5 m on one side, then on the other of the trail. All trees and lianas with diameter at breast height (dbh) $\geq$ 10cm, i.e., 130cm above the ground were measured. Some species are determined on foot (Norman, 1965, Vivien and Faure, 1985). Unidentified species were collected as vouchers for further identification at the laboratory of Botany of the Department of the Biological Sciences, Higher Teachers' Training College. Confirmation of the identification were also done at the National Herbarium of Cameroon (YA) with the assistance of mounted specimens, identification keys, local flora, and check list (Aubréville et al., 1963-1998), Flora of West Tropical Africa, FWTA (Hutchinson and Dalziel, 1954-1972), and some books (Norman, 1965; Cheek et al., 2000; Cable and Cheek, 1998).

Floristic analysis

The floristic data was used to build a species-accumulation curve as attempt to evaluate the strength of the sampling (Gounot, 1969). Different indices were also calculated; basal area defined as the projected surface area covered all stems measured at ≥ 10cm dbh. We used data on species and family abundance to calculate the Importance Value Index (IVI; Curtis and Mc-Intosh, 1951; Cottam and Curtis, 1956) and the Family Importance Value index (FIV; Mori et al. 1983). Some details are given in supplementary material (Appendix 3)

We equally used the Shannon and Pielou indices to measure diversity and equitability (Shannon and Weaver, 1949; Pielou, 1966).

$$H = -\sum_{i=1}^{S} \frac{n_i}{N} \log_2 \frac{n_i}{N}$$

Equitability of EQ = ISH/log$_2$S;

Where, S is the number of species of a given parcel; n_i is the number of the species i and N the strength of all species.

Phytogeographic and phytosociologic analysis

Information on species distribution was obtained from the literature and floras (Keay and Hepper, 1954–1972; Aubréville and Leroy, 1961–1992, 1963–1978; Hallé, 1961–1987; Letouzey, 1968, 1985; Lebrun and Stork, 1991–1997) and of other publications (White, 1983; Stuart and Cheek, 1998). The analysis concerned 30 determined taxons to the level of the species. Phytogeographic classification was based on White (1979, 1983) as:

A. Widely distributed species

- Afro-tropical (At); species present in the intertropical African zone;
- At + sub-At
- Pantropical (Pant); species present in Africa, America and tropical Asia;
- Paleotropical (Pal); species known in Africa and tropical Asia as well as to Madagascar and in Australia;
- Species of liaison; species where the distribution covers two or several floristic African regions and that are extensively widespread or abundant in places to be considered like sub-endemic (G-Sz). These elements are either the chorological or ecological transgressors, either merely the species with large distribution and with enough uniform ecology.

B. Guineo - Congolese sub-endemic species

- Species that spread to the adjacent transition zones or that overflow slightly beyond these last as marginal intrusion species or as species forming some satellites populations weakly distant.
- Guineo- Congolese endemic species.

+ Omni-Guinéo-Congolese (G): present in the whole Guineo-Congolese region;
+ Centro-Guineo-Congolese (Cg): species whose distribution covers the domain of lower Guinean (from the South of Nigeria to the Democratic Republic of Congo) and Congolese domain;
+ Lower Guinean (Lg): species widespread in the under lower Guinean center, from the South of Nigeria to the South of Republic of Congo;
+ Endemic of the Cameroonian afro-montane archipelago, including Bioko (ex Fernando po) possibly (End-Cam).

The botanical nomenclature used is the one adopted by Lebrun and Stork (1991–1997). The taxonomic authorities of all species listed in this survey are given in supplementary material (Appendix 1).

C. Phytosociological groups of African forests

<u>Ombrophile forest groups:</u>

+ The equatorial ombrophile forests. Class of the *Strombosio-Parinarietea* (Lebrun and Gilbert, 1954) (Str).
+ The basis and average altitudes ombrophile forests. Order of the *Gilbertiodendretalia dewevrei* (Lebrun and Gilbert, 1954) (Gil)
+ The ombrophile submontane forests. Order of the *Garcinietalia* (Noumi, 1998) (Gar)
+ The ombrophile afromontane forests. Order of the *Ficalhoeto-Podocarpetalia* (Lebrun and Gilbert, 1954) (Fic)

<u>Mesophile forest (hemi - deciduous) Groups:</u>

+ The hemi-deciduous forests. Order of the *Piptadenio-celtidetalia* (Lebrun and Gilbert, 1954) (Pip).

<u>Secondary forest groups:</u>

+ The secondary forests of low and middle altitudes. Class of the *Musango-Terminalietea* (Lebrun and Gilbert, 1954) (Mus)
+ The mountane recru and secondary forests. Order of the *Polyscietalia fulvae* (Lebrun and Gilbert, 1954) (Pol).

Results

Structure of the forest

The inventory in the Oku sacred forest has been summarised from nine plots of 25m × 50m each, covering a total surface of 11 250m^2 (1.125 ha). A total of 934 individuals of dbh ≥ 10cm were identified, consisting 31 species (Table 1), 27 genera and 19 families. The species recorded in the Oku sacred forest are quantitatively represented in Fig. 5-1.

Table 1. Floristic list of the montane sacred forestof Oku, with the number of individuals by class average of diameter (dbh ≥ 10 cm).

Species	10 to 20	20 to 30	30 to 40	40 to 50	50 to 60	60 to 70	70 to 80	80 to 90	90 to 100	100 to 110	110 to 120	120 to 130	130 to 140	140 to 150	150 to 160	160 to 170	170 to 180	180 to 190	190 to 200	200 to 210	210 to 220	220 to 230	230 to 240	240 to 250	250 to 260	260 to 270	270 to 280	280 to 290	Total trees
Aidia micrantha	20	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**26**
Allophylus bullatus	15	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	**17**
Ardisia cynosa	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**3**
Bersama abyssinica	20	10	7	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**40**
Bersama engleriana	10	5	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**18**
Carapa grandiflora	190	55	19	13	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**284**
Clausena anisata	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**7**
Croton macrostachyus	8	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**12**
Eugenia gilgii	12	6	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**20**
Ficus macrophylla	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**1**
Ficus thonningii	1	0	1	1	0	1	1	0	0	0	0	0	1	0	0	0	1	0	1	0	1	0	0	0	0	0	1	1	**11**
Ixora breviflora	8	3	1	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**16**
Maesa lanceolata	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**4**
Maesa sp.	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**3**
Neuropeltis acuminata	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**20**
Nuxia congesta	6	0	2	3	1	2	2	2	1	1	0	2	2	0	0	0	0	2	0	0	0	1	0	0	0	1	0	0	**28**
Piptadeniastrum africanum	12	4	2	1	0	2	3	3	1	2	0	2	3	1	0	2	2	1	1	0	0	0	0	0	0	0	0	0	**42**
Pittosporum viridiflorum	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**5**
Polyscias fulva	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**3**
Psydrax arnoldiana	25	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**27**
Rapanea melanophloeos	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**2**
Rauvolfia macrophylla	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**40**
Rytigynia neglecta	25	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**27**
Schefflera abyssinica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	**1**
Schefflera mannii	3	0	2	1	2	1	1	2	1	0	2	1	0	1	2	1	1	2	4	4	2	2	3	1	0	1	1	0	**41**
Shirakiopsis elliptica	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**2**
Solanecio mannii	11	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**12**
Syzygium guineense	30	7	6	1	2	1	5	4	4	2	3	2	2	2	2	2	0	1	0	1	0	0	1	0	0	1	1	1	**81**
Trema orientalis	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**4**
Xymalos monospora	98	24	8	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**136**
Zanthoxylum heitzii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	**1**
Total	**579**	**129**	**56**	**29**	**13**	**10**	**13**	**11**	**7**	**5**	**6**	**7**	**9**	**6**	**4**	**6**	**4**	**7**	**7**	**6**	**3**	**3**	**5**	**1**	**0**	**3**	**3**	**2**	**934**

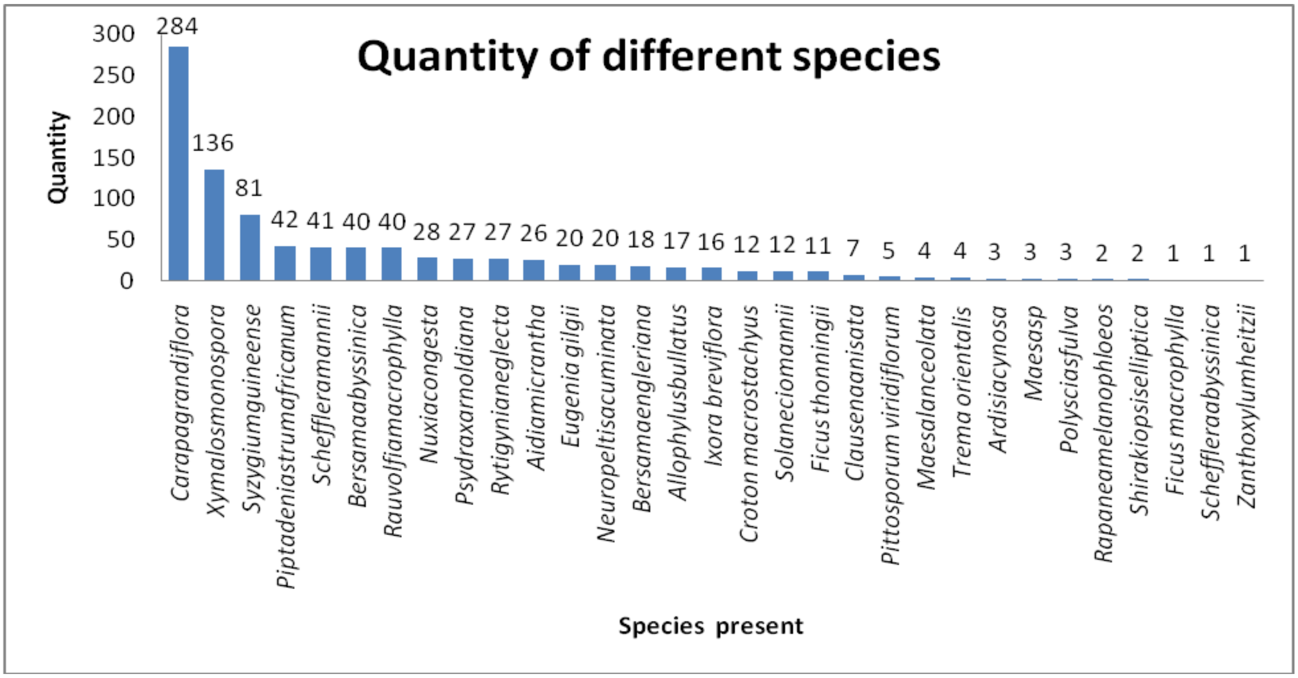

Fig. 5-1: Quantitative distribution of floristic diversity. The numbers of recorded individuals are indicated for every species.

Fig. 5-2: Photographs of the widened bases of *Syzygium guineense* and 2 strangler epiphytes. **A.** The form and structure of *Ficus chlamydocarpa* with fluted stem, in the Oku Sacred forest but equally distributed in other Mountain forest of Cameroon and Bioko (Fernando Po). **B.** Fissured trunck of *Syzygium guineense*. A native harvesting edible mushrooms from that hollow trunck. **C.** Form and architecture of a mountain forest *Schefflera mannii*. Notice the height of the buttress relative to two researchers close by.

Except for one herbarium specimen identified to the genus level, all others were identified to the level of the species. The more diversified families were the *Rubiaceae* and *Araliaceae* with each having four and three species respectively. Seven other families were represented by 2 species only and included *Euphorbiaceae*, *Maesaceae*, *Melianthaceae*, *Moraceae*, *Myrsinaceae*, *Myrtaceae* and *Rutaceae*. The names of the authors of the species appear in the Appendix 1. To reduce identification bias, three controversial families (*Caesalpiniaceae*, *Fabaceae* and *Mimosaceae)* were grouped as *Leguminosae*.

Considering the forest structure with respect to tree diameter, 75.8 % i.e. 708 individuals fall under the diameter class 10-30cm, 11.56 % i.e. 108 individuals belonged to diameter class 30-70cm and 12.53 % i.e. 118 individuals were identified in the middle interval of 70-230cm diameter class. Five individuals of the diameter class of big trees (220-230cm) occupied < 1 % of total individuals. Other species such as *Syzygium guineense* (*Myrtaceae*) and *Schefflera mannii* (*Araliaceae*) recorded 2 individuals each while *Schefflera abyssinica* recorded only a single individual.

During our survey period, *Syzygium guineense* was recorded with highest blooming. It reaches very big diameter (Fig. 5-2). But this horizontal development is not followed by the vertical growth. The species doesn't pass 35m of height. *Schefflera abyssinica* and *S. mannii* were the strangler epiphytes as well as *Ficus thonningii* that reach the dbh of 217cm.The roots of these hemi-epiphyte, sometimes lianescentes, descend on the contour of the trunk of the plant host or straight up from some branches. They themself anastomose in an atypical stems of big diameters around the host's trunk that will end up degenerating. The dbh class distribution revealed an inverse-shaped curve (Fig. 6).

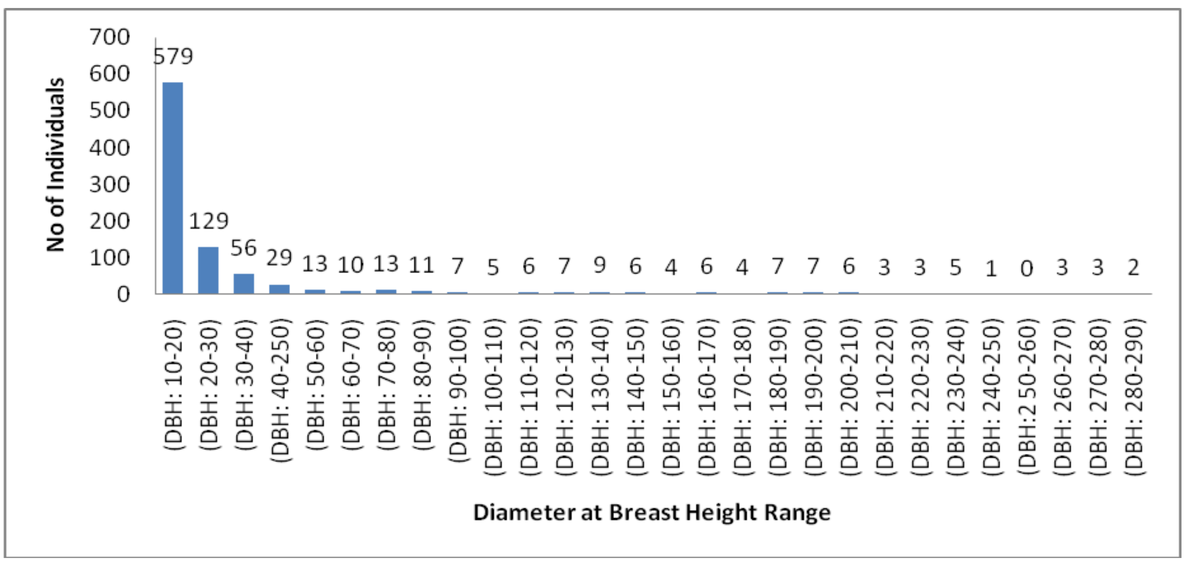

Fig. 6: Distribution of trees in 10 cm dbh interval size classes. The numbers of recorded individuals are indicated for every size class.

The number of species sampled per plot varied from 17 to 31 with an average of 26.22 species per plot. The species accumulation curve was calculate by the logarythmic equation y = 6.53ln(x) + 17.50 with correlation coefficient (R = 0.97) corresponding to a coefficient of determination, R^2 = 0.95. The curve describes a landing paralel to X- axis, testifying the reach of the minimal area (Fig. 7).

The species individual curves are drawn for 3 intervals of diameter (Table 2; Fig. 8). The observation of the slope to the origin of the curve shows a faster increasing of the number of lower stratum species. The curve of the woody in 10 ≤ dbh < 30cm presents a faster growth and describes a landing subparallel to the axis of the abscissas. That lower stratum is always the more diversified. The curve of the superior stratum stays below the other by the number of species, but however passes the one in 30 ≤ dbh < 70cm by the numbers individuals.

On the same level of sampling effort, for 108 individuals observed in every stratum, the results are presented in Table 3. The lower stratum (woody with 10 ≤ dbh < 30 cm) is the more varied with 18 plant species.

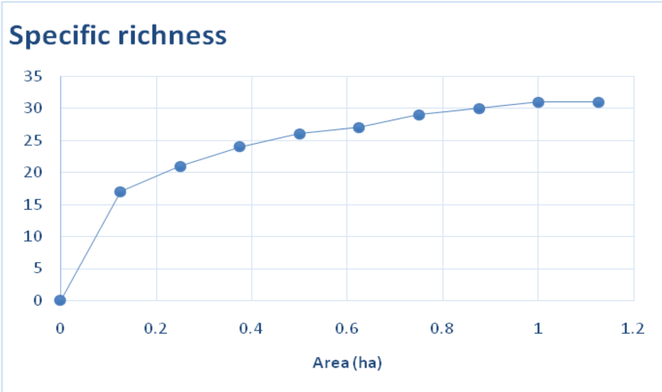

Fig. 7: Species accumulation curve of the Oku sacred forest.

Some spectra of Oku sacred forest

Phytogeographic affinities

The floristic fund of the Oku sacred forest shows the abundance of the guinea-Congolese species (more than 54% of the total species), against 45% of the large distributed species (Table 4). Among this latter, 12.91% belong to the group of endemic species of the Cameroonian highlander archipelago, including Bioko, 2850m (ex Fernando Po) (Letouzey, 1985; Stuart and Cheeck, 1998).

Table 2. Diversity of 3 strata (RS: specific richness, N: number of ligneous species whose distribution is observed, ISH: Shannon specific diversity index values and EQ: Pielou equitability index values.

Plant strata	diameter classes	RS	N	ISH	EQ
Highest stratum	dbh ≥ 70cm ,	12	118	2.60	0.73
Middle stratum	30 ≤ dbh < 70cm	14	108	3. 7	0.81
Lower stratum	10 ≤ dbh <30cm	28	708	3.48	0.72

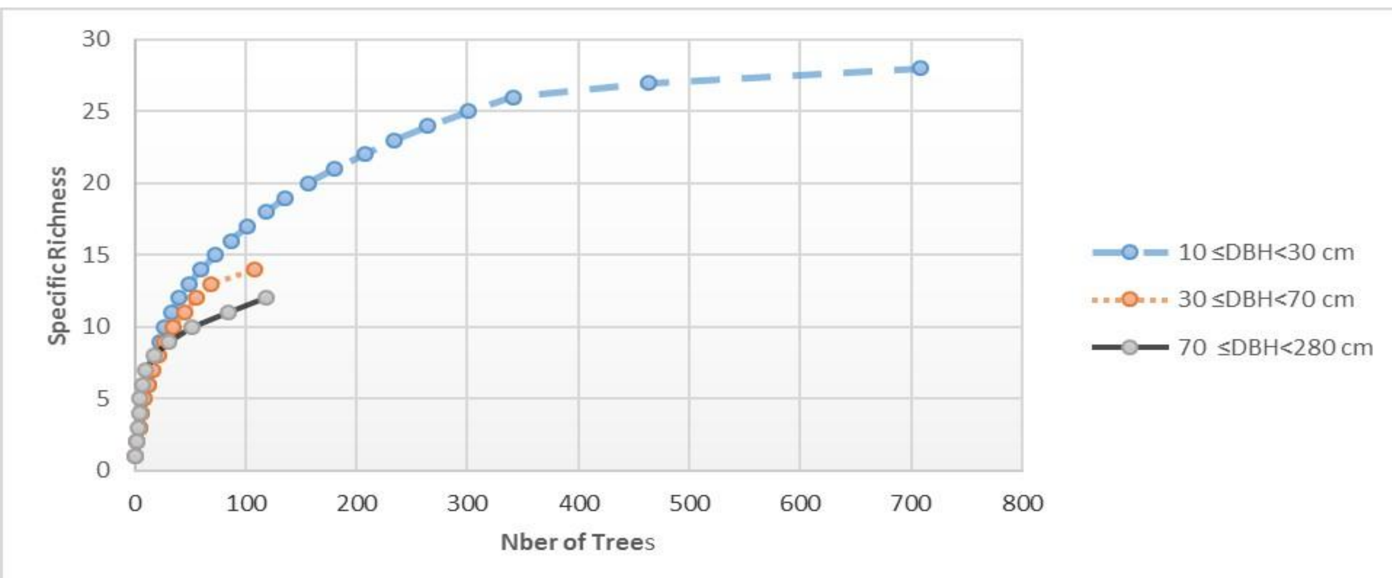

Fig. 8: Species strength accumulation curve of 3 categories of dbh (dbh ≥ 70, 30 and 10cm) on the entirety of the inventory, with respect to each of these categories.

Table 3. Size of the sampling and diversity of 108 woody by stratum (RS: specific richness, N: number of woody species whose distribution is observed, ISH: values of index of specific diversity of Shannon and EQ: values of the index of the Pielou equitability).

Strata plantation	Classes of diameter	Number of individuals	Number of species	ISH	EQ
Highest stratum	70 ≤ dbh < 280cm	108	12	2.60	0.73
Middle stratum	30 ≤ dbh < 70cm	108	14	3.07	0.81
Lower stratum	10 ≤ dbh < 30cm	108	18	3.97	0.95

Table 4. Spectra of phytogeographic groups.

Phytogeographic Types	Species		Abundance	
	Number	%	Number of individuals	%
Widespread species				
Inter - tropical Africa (At)	7	22.58	111	11.88
Tropical and subtropical Africa (At + sub-at)	2	6.45	15	1.61
Pantropical (Pant)	1	3.23	4	0.43
Paleotropical (Pal)	1	3.23	2	0.21
Species of link (G-Sz)	3	9.68	156	16.70
Guineo - Congolese endemic species				
- Eendemic Cameroonian and Bioko (C- end)	4	12.90	151	16.17
-Omni – Guineo-Congolese:	8	25.81	432	46.25
- Centro - Guineo Congolese Cg)	3	9.68	59	6.32
- Low Guinea (Lg)	1	3.23	1	0.11
-Unspecified	1	3.23	3	0.32
Total	**31**	**100**	**934**	**100**

Spectra of the altitudinal variations

The regroupings by altitudinal floor of the specific whole give the absolute values and the centesimal proportions reported in Table 5. For the aspects of forestry and altitudinal successions, the categories are deducted of the temperaments of the species. Only the intermediate combinations between two successive types of the pressure gradient (and non-disconnected) are generally feasible for species of link (Senterre, 2005; Noumi, 2013) (Table 5). The highlander groupings (5 and 6 of the Table 4) showed a total of 15 species (48.38%), with 73.34% of individuals. They are followed by the submontane groupings that totalize 9 species, either 29% of the set of the species represented by 10.28% of individuals.

The floristic tendency of the species

The data of the Table 5 (columns 2) revalued according to the number of species, gave a total of 41 altitudinal antecedents (Table 6). The strong floristic tendency of the species are Afro highlander; 53.66% of the species. The floristic tendency of low and middle altitudes species (17.07%) with a weak abundance (14.88%). Two species can bring up in the Afro subalpin floor.

Table 5. Spectra of the altitudinal floors or altitudinal antecedents.

Species bound to the Antecedents altitudinaux	Altitudinal antecedents	Altitudes (m)	Species		Abundance	
			Number	%	Individuals number	%
1. Species typically of low and middle altitudes	Bm	1 à 1000	4	12.90	112	11.99
2. Species connexion low and middle /submontane altitudes	Bmt/Sm		3	9.68	41	4.39
3. Species typically submontane	Sm	1000 à 2000	4	12.90	73	7.82
4. Species of connexion submontane / Afro highlander	Sm/Mi		5	16.13	23	2.46
5. Species typically Afro highlander, with strong hygrometry (Afro highlander floor)	Mi	2000 à 3000	13	41.94	655	70.13
6. Species of connexion Afro highlanders / Afro subalpin, with weak hygrometry,	Mi/Ms		2	6.45	30	3.21
7. Species typically Afro subalpin (weak humidity)	Ms	3000 à 4000 (Cameroon mount)				
Total			**31**	**100**		**100**

Bm (lower and middle altitudes), Bm + Sm (low and medium altitudes going up to Sm), Sm (Submountane altitude), Sm + Mi (Submountane going up in Mi), Mi (lower highlander, (strong hygrometry), Mi + Ms (lower highlander going up in Ms), Ms (superior highlander, weak) hygrometry).

Table 6. Spectra of the groups of the floristic altitudinal tendencies and their species, to the different floors.

Floristic altitudinal tendencies	Species		Abundance	
	Number	%	Individuals number	%
Floristic tendency of low and middle altitude (Bm)	7	17.07	153	14.88
Floristic tendency f submontane (Sm)	12	29.27	137	13.33
Floristic tendency Afro highlander (strong hygrometry) (floor Afro highlander) (Mi)	20	48.78	708	68.87
Floristic tendency Afro subalpine (weak humidity) (Ms)	2	4.88	30	2.92
Total	41	100	1028	100.00

Table 7. Spectra of the ecosociologic groups.

Ecosociologic groups	Species		Abundance	
	Number	%	Number Individuals	%
Fic - *Ficalhoeto-Podocarpetalia* (Lebrun and Gilbert, 1954)	13	41.94	677	72.48
Gar - *Garcinietalia* (Noumi, 1998)	4	12.90	64	6.85
Gil - *Gilbertiodendretalia dewevrei* (Lebrun and Gilbert, 1954)	3	9.68	47	5.03
Mus - *Musango-Terminalietea* (Lebrun and Gilbert, 1954)	2	6.45	44	4.71
Pip - *Piptadenio-celtidetalia* (Lebrun and Gilbert, 1954)	1	3.22	42	4.49
Pol - *Polyscietalia* fulvae (Lebrun and Gilbert, 1954)	5	16.13	27	2.89
Str - *Strombosio-Parinarietea* (Lebrun and Gilbert, 1954)	3	9.68	33	3.53
Total	**31**	**100**	**934**	**100**

The exam retailed of the types of ecosociologic groups of the whole specific (Table 7) gave the groups and values encoded consigned in the Table 8. The highlander taxons (Fic and Pol) reach 58.06% of the total species and the plants (Gil, Mus and Pip) 19.3%.

Any phytosociologic grouping obeys to own mesologic parameters or at least climatic. The different phytosociologic groupings established (Table 8), reveal a telescoping of different climatic parameters in the Oku sacred forest, so much so that one would qualify them of syngenetic groupings (formed together; whose birth is common).

Floristic composition

Family level– Nineteen families were recorded in the sampling 1.125-ha. The 10 most important families for each relative parameter and FIV are listed (Table 9). The complete results for every family are given in Appendix 2.

Table 8. Phytogeographic and phytosociologic affinities of the identified species of the Oku sacred forest sampling.

Altitudinal strata	**Lowlands stratum**			**Submontane stratum**	**Lower montane stratum (high hygrometry)**	
Phytogeographic affinities	**Bm, Bm/Sm**			**Sm, Sm/Mi**	**Mi, Mi/Ms**	
			Strombosio-Parinarietea (Lebrun and Gilbert, 1954): 3species (9.68%); 33 individuals (3.53%)			
Phytosociologic groups	*Musango-Terminalietea* (Lebrun and Gilbert, 1954)	*Piptadenio-celtidetalia* Lebrun and Gilbert, 1954	*Gilbertiodendretalia dewevrei* (Lebrun and Gilbert, 1954)	*Garcinietalia* (Noumi, 1998)	*Ficalhoeto-Podocarpetalia* (Lebrun and Gilbert, 1954)	*Polyscietalia fulvae* (Lebrun and Gilbert, 1954)
Number of species (and percentage)	2 (6.45%)	2 (6.45%)	2 (6.45%)	4 (12.90%)	13 (41.94%)	5 (16.13%)
Number of individuals (and percentage)	44 (4.71%)	43 (4.60%)	46 (4.93%)	64 (6.85%)	677 (72.48%)	27 (2.89%)

Bm (lower and middle altitudes), Bm/Sm (low and medium altitudes going up to Smt), Sm (Submountain altitude), Sm + Mi (Submountain going up in Afro-mountain altitude), Mi (lower highlander, strong hygrometry), Mi + Ms (lower highlander going up in Ms), Ms (superior highlander, weak hygrometry).

Table 9. Families with highest values of relative diversity, relative density, relative dominance and FIV in decreasing order. Families that do not rank among the ten most important in FIV value appear in bold type.

Relative diversity	[x 100%]	Relative density	[x 100%]	Relative dominance	[x 100%]	FIV	[x 300%]
Rubiaceae	12.90	*Meliaceae*	30.41	*Araliaceae*	34.65	*Araliaceae*	49.15
Araliaceae	9.68	*Monimiaceae*	14.56	*Myrtaceae*	21.77	*Myrtaceae*	39.03
Euphorbiaceae	6.45	*Myrtaceae*	10.81	*Leguminosae*	10.82	*Meliaceae*	37.88
Maesaceae	6.45	*Rubiaceae*	10.28	*Moraceae*	9.65	*Rubiaceae*	24.64
Melianthaceae	6.45	*Melianthaceae*	6.21	*Buddlejaceae*	9.17	*Monimiaceae*	19.48
Moraceae	6.45	*Araliaceae*	4.82	*Meliaceae*	4.25	*Leguminosae*	18.54
Myrsinaceae	6.45	*Leguminosae*	4.50	*Melianthaceae*	2.98	*Moraceae*	17.39
Myrtaceae	6.45	*Apocynaceae*	4.28	*Monimiaceae*	1.70	*Melianthaceae*	15.64
Rutaceae	6.45	*Buddlejaceae*	3.00	*Sapindaceae*	1.46	*Buddlejaceae*	15.39
Apocynaceae	3.23	*Convolvulaceae*	2.14	*Rubiaceae*	1.45	*Rutaceae*	8.54

For each family the numbers of individuals and species; the basal area, the values of diversity, density and dominance relative as well as those of FIV are given (Appendix 2). A diagram represents the weight of each of the three factors composing the FIV of the sampling on 1.125-ha, for the 10 families (in decreasing order) whose FIV values are the most important (Fig. 9).

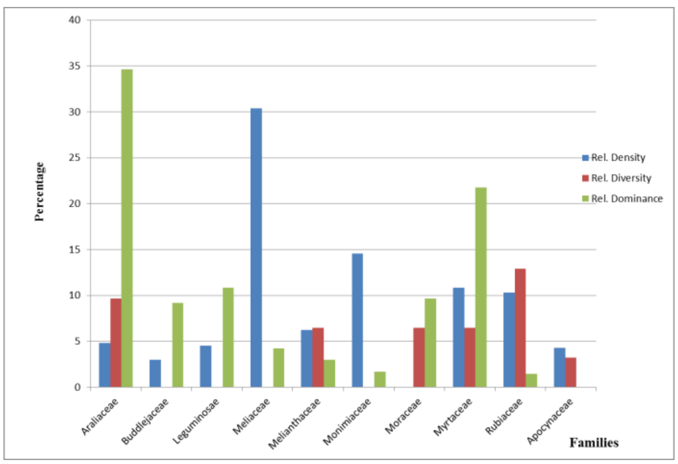

Fig. 9: Relative diversity, Relative density and Relative Dominance of the ten most important families in FIV.

Regarding relative density, the 4 most abundant families are, *Meliaceae, Monimiaceae, Myrtaceae* and *Rubiaceae*, regrouping 66.06% of all recorded individuals. The density of the *Meliaceae* exceeds 30% whereas the 5th species in density doesn't reach 7%. The families with the highest values in dominance are *Araliaceae Myrtaceae, Leguminosae, Moraceae* and *Buddlejaceae*. Together they reach 86.06% of dominance of all trees counted in the summary. The 10 richest families are specifically *Rubiaceae, Araliaceae, Euphorbiaceae, Maesaceae, Melianthaceae, Moraceae, Myrsinaceae, Myrtaceae, Rutaceae* and *Apocynaceae*. The relative diversity of *Rubiaceae* (4 species) represents 12.9% of the total species diversity of the sampling. Ten families are represented by a single species, 7 by 2 species, 1 by 3 species and 1 by 4 species (Appendix 2).

With regard to Family Importance Value (FIV), *Araliaceae* are the most important family in the sampling with a FIV of 49.15. They also have the highest relative dominance and relative diversity, and occupy the 6th rank in relative density values. When comparing FIV and the 3 relative values of the ten most important families, only *Araliaceae, Myrtaceae, Rubiaceae* and *Melianthaceae* appeared among the first ten families for all parameters, and *Meliaceae Monimiaceae, Leguminosae, Moraceae, Buddlejaceae* for 2 parameters. *Rutaceae* are tenth in FIV due to their relative diversity. *Rubiaceae* are 1st in relative diversity but they drop to the position 4th in FIV because of their low relative density and dominance. Considering relative dominance, *Sapindaceae* have some appreciated values and account for 1.46% of the total basal area, but are represented by only one species and a few individuals respectively. Thus that family is not among the ten families with the highest FIV; so as *Apocynaceae*, 8th in relative density and 10th in relative diversity. *Euphorbiaceae, Maesaceae Myrsinaceae* have the 3th position in relative diversity (6.45 %) and the weak values in the two other parameters, thus, these families are not among the ten families with the highest FIV.

Specific level – We recorded thirty-one species in the sampling. The authors of scientific name appear in Appendix 1. Table 10 lists the ten most important species in each relative parameter. The values of each parameter for the ten species with the higher IVI are represented in Table 5. Appendix 3 gives the results for all species. A small group of species dominates the plot: 3 species *Carapa grandiflora, Xymalos monospora* and *Syzygium guineense* (0.096% of the total number of species) account for 53.64% of all trees. The majority of species (32.25%) are represented by less than 5 individuals: 2 species are represented by 2 individuals, and 3 species (0.096%) are represented by a single individual. Regarding relative dominance, less than 1% of the species contribute 65.22% of total basal area.

Table 10. Species with highest values of relative frequency, relative density, relative dominance and IVI in decreasing order. Species that do not rank among the ten most important in IV I value appear in bold characters.

Relative frequency	[x 100%]	Relative density	[x 100%]	Relative dominance	[x 100%]	IV I	[x 300%]
Carapa grandiflora	5.88	*Carapa grandiflora*	30.41	*Schefflera mannii*	33.01	*Schefflera mannii*	43.29
Schefflera mannii	5.88	*Xymalos monospora*	14.56	*Syzygium guineense*	21.39	*Carapa grandiflora*	40.54
Syzygium guineense	5.88	*Syzygium guineense*	8.67	*Piptadeniastrum africanum*	10.82	*Syzygium guineense*	35.95
Xymalos monospora	5.88	*Piptadeniastrum africanum*	4.5	*Nuxia congesta*	9.17	*Xymalos monospora*	22.14
Bersama abyssinica	5.23	*Schefflera mannii*	4.39	*Ficus thonningii*	8.58	*Piptadeniastrum africanum*	20.55
Nuxia congesta	5.23	*Bersama abyssinica*	4.28	*Carapa grandiflora*	4.25	*Nuxia congesta*	17.39
Piptadeniastrum africanum	5.23	*Rauvolfia macrophylla*	4.28	*Bersama engleriana*	2.23	*Ficus thonningii*	13.02
Rauvolfia macrophylla	5.23	*Nuxia congesta*	3	*Xymalos monospora*	1.7	*Bersama abyssinica*	10.26
Rytigynia neglecta	5.23	***Psydrax arnoldiana***	2.89	***Schefflera abyssinica***	1.56	*Rauvolfia macrophylla*	9.77
Psydrax arnoldiana	4.58	*Rytigynia neglecta*	2.89	***Allophylus bullatus***	1.46	*Rytigynia neglecta*	8.31

High dominance can be achieved by a great number of small trees or by a few large trees. *Allophylus bullatus* is 10th in relative dominance but drops to 15th position in relative density. *Psydrax arnoldiana* is 9th in relative density, but it is 18th in relative dominance as *Rytigynia neglecta*. Thus, in spite of the 10th rank occupied in relative frequency, it is not among the first 10 species with the strongest values in IVI (Fig. 10).

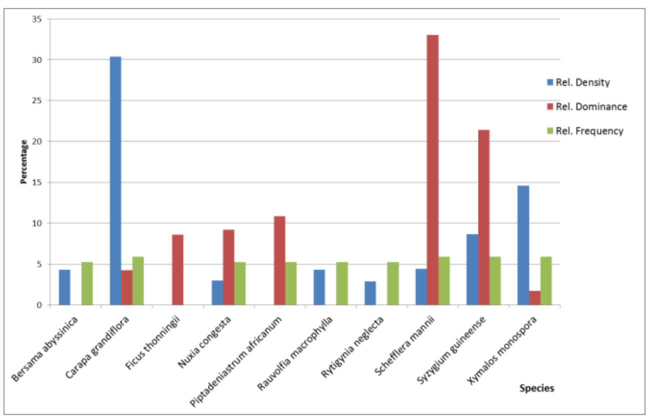

Fig. 10: Relative frequency, relative density, and relative dominance of the ten most important species in IVI.

Discussion

The comparisons between the data of this survey and those of other dense forests of Africa, Madagascar and Neotropic region are based on the floristic and structural, quantitative and qualitative parameters. The main aim was to determine the parameters that make the differences and those that bring them closer, to highlight the features closed to the Oku highlander sacred forest.

Oku sacred forest structure

The species-area accumulation curve for the plot is drawn and compared to those of some samplings of central Africa (Fig. 11). In any case, the expression of the study area shows quantitatively low data. It follows a classical accumulation curve. In the two last consecutive quadrats, any new species was encountered making it easy to determine that one ha is satisfactory for a fully representative sample for the forest. In fact it is observable in the accumulation curve. Nevertheless in the other central highlander African forests, new species always occur in spite of the altitude and of the inventoried surface. One can presume that in this study, 1-ha surface is suitable for the study (D'Amico and Gautier, 2000; Nusbaumer et al., 2005).

The density of 934 trees ≥ 10cm dbh per 1.125-ha, or 830 per hectare, is within the range of 167 to 1947 individuals per hectare reported by (Gentry, 1982) for Neotropical forests sampled by different methods, and the range of 554 to 1269 trees/ha (dbh ≥ 10cm) (Table 11) recorded in a series of plots set high elevation rainforests, in different hills and mountains of Cameroon.

The comparison with inventoried trees of tropical rainforests sampled in various continents shows that tree density seems to have a high similar range of variation in the mountain forests throughout the world (Mohandass and Davidar, 2009) but, no matter the altitude (Table 11). The classes of diameters go from 10 to 230cm (Figs. 12A, 12B). Some more modest dimensions has been observed in the forests of the highlands: 10 – 135cm in the Kouoghap sacred submontane forest, 10-120cm in the Manengouba montane forest (Noumi, 2012 and 2013), in the Messa submontane forest (Tagne, 2007) the big diameters are between 200 and 230cm. The trees with diameters equal or superior to those of the Oku sacred forest are observed in the temperate countries; 6 to 8m for *Sequoiadendron giganteum* (Lindley) J. Buchholz, 1939 (*Cupressaceae*) (Fig. 12C); the most imposing specimen is 'General Sherman', in the national Park of

Redwood (United States) (Robert, 2001) ; 2 to 3m for *Pseudotsuga menziesii* (Mirb.) Free, 1950 (*Pinaceae*) (Mailleux et al., 2007); 2m for *Abies nordmanniana* (Steven) Spach, 1841 (*Pinaceae*) (Julve, 1998).

The stability of the forest protected from the anthropisation by the customary rules permitted the development of the epiphytes stranglers trees, in terrestrial trees (13% of the species) with a stem built from top to bottom all around of the trunk of the plant host. This one degenerates and let in place the strangler's atypical stem, fluted, large and hollow. Among these last one has in the Oku sacred forest 2 Araliaceae (*Schefflera abyssinica* and *Schefflera mannii*) and 2 Moraceae (*Ficus chlamydocarpa* and *Ficus thonningii*) whose dbhs reach 2m and more.

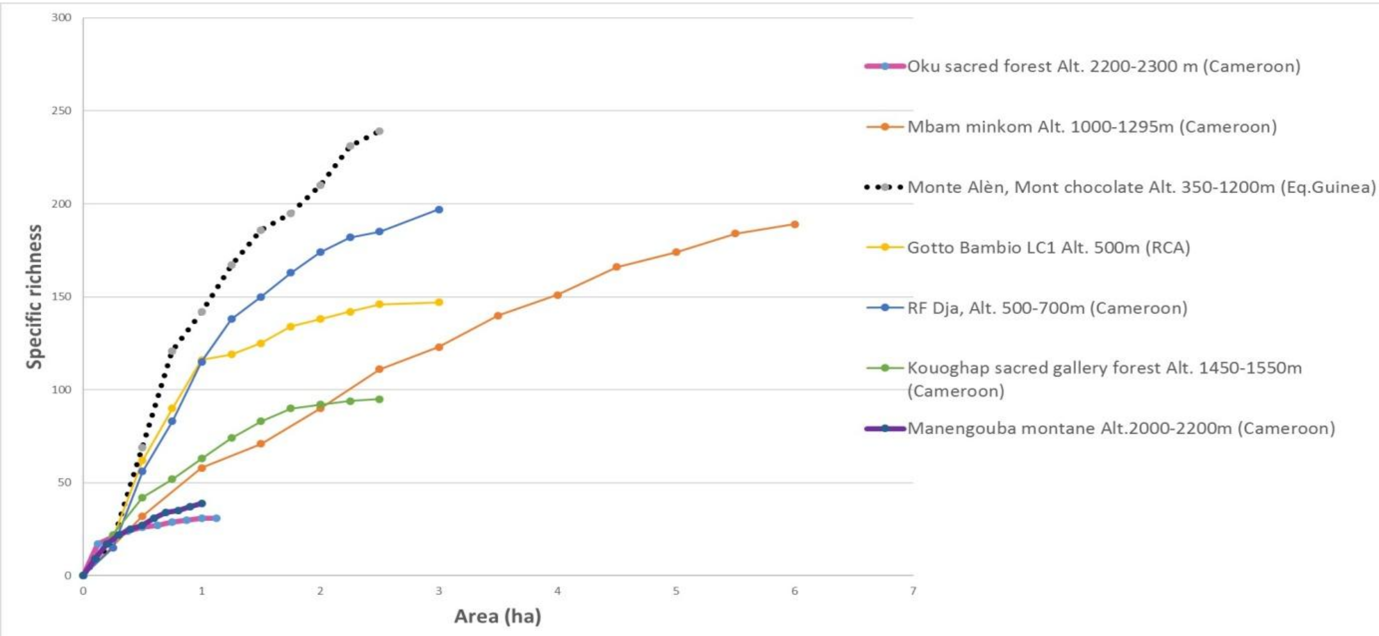

Fig. 11: Species-area accumulation curve of the 1.125-ha plot in the Oku highlander forest (each sub-unit is represented by 50 x 25 m = 0.125 ha) and 6 species-area accumulation curves achieved in Atlantic central Africa; Gotto, Bambio (Lejoly, 1996); Monte Alèn (Van Reeth, 1997); Dja (Sonke, 1998); Kouoghap (Noumi, 2012); Manengouba (Noumi, 2013); Mbam minkom (Noumi, 2015); Oku (present study, the lower curve).

A machete on a malformed, bumpy and fluted stem carrying the hollows, of *Syzygium guineense* (Myrtaceae); dbh = 227cm .
(A)

Small fluted going up the irregular stem of *Ficus thonningii* (Moraceae); dbh = 213cm .
(B)

A car owing a foot of *Sequoiadendron giganteum*. National park of Redwood (United States); dbh = 600cm about.
(C)

Fig. 12: Some specimens of big diameters stems in the Oku sacred forest facing the one of *Sequoiadendron giganteum* the biggest tree of the world in volume. The gigantic redwood champion is the "General Sherman" with a volume of 1486 m^3, a circumference of 31.3m (diameter = 9.97m) and a height of 83.8m.

The structure the Oku sacred mountain forest is in a high range as the montane Shola forests of the Nilgiris (Mohandass and Davidar, 2009). The basal area (230.64 m^2/1.125-ha or 205.02 m^2/ha) is more elevated than the value reported in the highlander forests (Table 12) and those reported by Mori et al. (1983) for five moist lowland neotropical forests (ranging from 21.5-53.0 m^2/ha) sampled by the point centered quarter method (Cottam and Curtis, 1956). Basal areas have also been found in other lowland rainforests of Madagascar sampled using the permanent 1-ha plot method: 34.1 m^2/ha at Andohahela (Rakotomalaza and Messmer, 1999), and a range of 19.0 to 38.9 m^2/ha in ten different eastern lowland forests (Rabevohitra et al., 1996), or in African lowland rainforest of : 19.2 m²/ha in Cameroon (Lejoly, 1996) ; 42.32 m²/ha in Benin (Sokpon, 1995) ; 30.82 m²/ha in Côte-d'Ivoire (Nusbaumer et al., 2005). In this study the value of the basal area and the distribution of the diameter classes observed are typical of a forest in good state of conservation (Rollet, 1979). The forest remains always in the state of growth, due to its mesologic characters (Lebrun and Gilbert, 1954). The individuals of the montane ombrophile species (*Syzygium guineense* and *Zanthoxylum heitzii*) gain dimension.

Floristic composition

The floristic list is composed of 31 species with one not identified (Appendix 1) from which are derivate 27 genera and 19 families. The nomenclature follows Lebrun and Stork (1991-1997). *Family level*: In the plot sampled, more than 55% of all trees are represented by 3 families (*Meliaceae*, *Monimiaceae* and *Myrtaceae*). According to Rabevohitra et al. (1996), 4, 5 or 6 families always represent more than 50% of total trees in littoral forests along Madagascar's East coast. Table 13 shows that in Oku sacred forest and others highlander forests inventories in Guinean region and Madagascar, *Meliaceae Monimiaceae*, *Myrtaceae and Rubiaceae* are frequently among the ten most abundant families. *Melianthaceae* and *Buddlejaceae* (former *Loganiaceae*) seem to be the only numerically important families of the Oku sacred forest that do not occur in the first ten positions in other lowland and highland plots in Guinean region and Madagascar.

Table 11. Number of trees per hectare (dbh≥10 cm) in Oku sacred rainforest and in lowland rainforests sites in Africa, Madagascar and Neotropic regions, by decreasing density.

Sites	Countries	References	Number trees/ha
Highland forests			
Kouoghap sacred forest	Cameroon	Noumi (2012)	1269
Shola montane evergreen forest	Nilgiri, India	Mohandass and Davidar (2009)	832
Oku sacred forest	Cameroon	Present study	830
Manengouba forest (Mbouroukou)	Cameroon	Present study	763
Mbam minkom submountain forest	Cameroon	Noumi (2015)	554
Messa submountain forest	Cameroon	Tagne (2007)	1008
Kupe	Cameroon	Tchoua (2014)	1184
Kala submountain forest	Cameroon	Madiapevo (2008)	2107
Lowland forests			
Andranomintina (plot 1),	Madagascar	Rabevohitra et al. (1996)	1223
Yasuni (unflooded forest),	Ecuator	Balslev et al. (1987)	728
Lowland rainforest in Manongarivo	Madagascar	D'Amico and Gauthier (2000)	728
Yapo (unfloodplain forest),	Côte d'Ivoire	Corthay (1996)	649
Alto Ivon,	Bolivia	Boom (1986)	649
Forest of Ngotto	Centrafrican Republic	Lejoly (1995)	549
Forestry Reserve of Dja (Alat 1.7)	Cameroon	Sonké (1998)	513
Forest with *Cleistopholis patens* and *Ficus mucuso*	Benin	Sokpon (1995)	494
Oveng	Gabon	Reitsma (1988)	485
Jenaro Herrera	Peru	Spichiger et al. (1996)	482
Bees forest	Gabon	Gesnot (1994)	458
Yasuni (floodplain forest),	Ecuator	Balslevet al. (1987)	417
Classified forest of Scio	Côte d'Ivoire	Nusbaumer et al. (2005)	413
Lopé (site 1)	Gabon	White (1992)	304
National Park of Odzala (layon Andzoyi)	Congo	Lejoly (1996)	294.7

Table 12. Basal area/ha in the Oku sacred forest and other highland, lowland rainforests altitudes, in Africa and other areas, in decreasing dominance.

Sites	Countries	References	Basal area (m²)
	Highland forests		
Oku sacred forest	Cameroon	Present study	205.02
Kala submountain,forest	Cameroon	Madiapavo (2008)	124
Kouoghap sacred forest	Cameroon	Noumi (2012)	90.36
Manengouba forest (Mbouroukou)	Cameroon	Noumi (2013)	61.69
Mbam minkom submountain forest	Cameroon	Noumi (2015)	54.36
Messa submountain forest	Cameroon	Tagne (2007)	82.13
Shola montane evergreen forest	Nilgiri, India	Mohandass and Davidar (2009)	53.55
	Lowland forests		
Cleistopholis patens and *Ficus mucuso* forest	Benin	Sokpon (1995)	42.3
Yapo classified forest	Côte-d'Ivoire	Corthay (1996)	40.0
Dja Forestry Reserve (Alat 1.7)	Cameroon	Sonké (1998)	34.2
Yasuni (unflooded forest)	Ecuator	Balslev et al. (1987)	33.7
Scio Classified forest	Côte d'Ivoire	Nusbaumer et al. (2005)	30.82
Andranomintina (plot 1)	Madagascar	Rabevohitra et al. (1996)	27.9
Andranomintina (plot 2)	Madagascar	Rabevohitra et al. (1996)	25.3
Jenaro Herrera	Peru	Spichiger et al. (1996)	22.6
Manongarivo	Madagascar	D'Amico and Gauttier (2000)	22.4

Table 13. The ten most abundant families in Oku sacred forest and other African and Malagasy forests (altitudes available). Families among the ten most abundant in at least 6 plots appear in bold type.

Classed forest of Scio, Côte d'Ivoire	**Manongarivo forest, Madagascar**	**Andohahela Nat. Reser., Madagascar**	**Messa forest, Cameroon**	**Kala forest, Cameroon**
Nusbaumer et al. (2005)	D'Amico and Gautier (2000)	Rakotomalaza and Messmer (1999)	Tagne (2007)	Madiapevo (2008)
Alt. average: 230m	750-1.200m	750-2000m	Alt. 900-101 m	Alt. 1000-1156m
Leguminosae	*Clusiaceae*	*Rubiaceae*	*Sterculiaceae*	*Myristicaceae*
Annonaceae	*Myrtaceae*	*Clusiaceae*	*Moraceae*	*Clusiaceae*
Rubiaceae	*Euphorbiaceae*	*Lauraceae*	*Euphorbiaceae*	*Leguminosae*
Apocynaceae	*Rubiaceae*	*Myrsinaceae*	*Leguminosae*	*Annonaceae*
Flacourtiaceae	*Myristicaceae*	*Monimiaceae*	*Meliaceae*	*Rubiaceae*
Violaceae	*Burseraceae*	*Anacardiaceae*	*Apocynaceae*	*Sterculiaceae*
Olacaceae	*Erythroxylaceae*	*Aquifoliaceae*	*Caricaceae*	*Meliaceae*
Combretaceae	*Lauraceae*	*Liliaceae*	*Myristicaceae*	*Apocynaceae*
Irvingiaceae	*Sapotaceae*	*Sapotaceae*	*Lauraceae*	*Burseraceae*
Sterculiaceae	*Arecaceae*	*Myrtaceae*	*Ulmaceae*	*Euphorbiaceae*
Kouoghap Sacred forest (SF)	Manengouba forest	Kupe submontane forest, Cameroon	Mbam minkom forest	Oku sacred forest
Noumi (2012)	Noumi (2013)	Tchoua (2014)	Noumi (2015)	Present study
Alt. 1400-1550m, Cameroon	Alt. 2200-2396m, Cameroon	Alt. 1000-1800m, Cameroon	Alt. 1000-1295m, Cameroon	Alt. 2200-2300m, Cameroon
Rubiaceae	*Rubiaceae*	*Meliaceae*	*Clusiaceae*	*Meliaceae*
Meliaceae	*Euphorbiaceae*	*Rubiaceae*	*Sterculiaceae*	*Monimiaceae*
Moraceae	*Araliaceae*	*Burseraceae*	*Burseraceae*	*Myrtaceae*
Bignoniaceae	*Moraceae*	*Menispermaceae*	*Leguminosae*	*Rubiaceae*
Apocynaceae	*Myrsinaceae*	*Malvaceae*	*Annonaceae*	*Melianthaceae*
Sapotaceae	*Meliaceae*	*Euphorbiaceae*	*Meliaceae*	*Araliaceae*
Leguminosae	*Rutaceae*	*Clusiaceae*	*Myristicaceae*	*Leguminosae*
Euphorbiaceae	*Cyatheaceae*	*Olacaceae*	*Apocynaceae*	*Apocynaceae*
Araliaceae	*Sapindaceae*	*Anacardiaceae*	*Euphorbiaceae*	*Buddlejaceae*
Clusiaceae	*Opiliaceae*	*Moraceae*	*Olacaceae*	*Convolvulaceae*

Family composition of highland forest of Cameroon tends to be similar. 14 families (*Araliaceae, Burseraceae, Clusiaceae, Euphorbiaceae, Leguminosae, Maesaceae, Meliaceae, Melianthaceae, Monimiaceae, Myrtaceae, Rubiaceae, Rutaceae, Sapotaceae* and *Sterculiaceae)* contribute half of the species to many samples in highland tropical forests in Cameroon. At least eight of these families are always among the ten richest species in Africa and Madagascar as well. In the highland Oku sacred forest, 8 families contribute to 85.87% of the species richness on 1.125-ha plot (*Meliaceae, Monimiaceae, Myrtaceae, Rubiaceae, Melianthaceae, Araliaceae, Leguminosae* and *Apocynaceae*).

The *Leguminosae* is among the first families in FIV in the lowland and submontane forests (Table 14). It no longer has a representative in the highlander Manengouba forest and Kupe slopes above 1000m (Noumi, 2013, Tchoua, 2014). The same scarcity is observed in an inventory of all plants ≥ 1 cm dbh recorded in 19 sholas of total area 11.5 ha (Mohandass and Davidar, 2009). The Leguminosae are present in the study area with only one species: *Piptadeniastrum africanum.*

Gentry (1988) remark the dominance of *Leguminosae* in Neotropics and Africa is equal when only trees ≥ 10cm dbh are considered. But in the high altitudes the *Leguminosae* decrease in abundance and even disappear in the highlander floor (Mohandass Davidar and, 2009; Noumi, 2013 ; Tchoua, 2014) , whereas the *Rubiaceae* win in abundance with trees ≥ 10cm dbh and invade the undergrowths with bushes < 10cm dbh in Manengouba. Among the above mentioned families *Araliaceae, Myrtaceae, Meliaceae, Rubiaceae, Monimiaceae, Leguminosae, Moraceae, Melianthaceae, Rutaceae, Euphorbiaceae, Apocynaceae* and *Maesaceae* are among the 15 most important families for relative diversity and FIV in the plot sampled here (Table 14).

Leguminosae is less important in Oku sacred forest with ony 1 species but they are 6th in FIV (FIV values: 18.54). On the other hand, in Oku sacred forest *Araliaceae* and *Myrtaceae* are the much more dominant and more abundant. At the present state of research in the description of the composition of the Cameroonian rainforests of altitude (submontane or transition forests and highlander forests), the above cited families, indicated like being the most representative, distribute themselves in 4 groups on the slopes and the humid and rainy reliefs, as followed (Noumi, 2015):

- goup of hygro - megathermal families (on the lowland floor) of which the relative density and the indications of the basal area decrease from 800 m of altitude : *Leguminosae, Apocynaceae*;

- Group of hygro - mesothermal families (on the submontane floor) of which the relative density and the indications of the area basal grow from 800 m of altitutde : *Burseraceae, Clusiaceae, Meliaceae, Sapotaceae, Sterculiaceae*;

- Group of hygro-oligothermal families (on the Afro-montane floor) of which the relative density and the indications of the basal area grow regularly of low and middle altitudes to the altitudes highest or are confined to these altitudes: *Araliaceae, Rubiaceae Monimiaceae Maesaceae, Melianthaceae, Myrtaceae and Rutaceae.* They present high values in FIV in the Oku sacred forest (Table 8); But only *Rubiaceae* are the richest species (4 species);

- Group of the thermal indifferent families of which most species are hygromegathermal, some hygromesothermal and of other hygro-oligothermal: *Euphorbiaceae, Moraceae* (7th in FIV) in Oku (Table 8).

Either 14 families who share this vital space: *Araliaceae, Burseraceae, Clusiaceae, Euphorbiaceae, Leguminosae, Maesaceae, Meliaceae, Melianthaceae, Monimiaceae, Myrtaceae, Rubiaceae, Rutaceae, Sapotaceae* and *Sterculiaceae.*

It is remarkable that in the Cameroonian highland forests, *Rubiaceae* seem to be more important than in neotropical and African lowland forests. At Manengouba it is the first in FIV accumulation values (FIV: 56.19), while it is 4th with an FIV of 24.64 in the Oku sacred forest, 4th with an FIV of 21.23 at Manongarivo (D'Amico and Gautier, 2000), 6th with an FIV value of 14.71 at Yasuni (Balslev et al., 1987), 10th with an FIV value of 8.3 at Alto Ivon (Boom, 1986), 14th with an FIV value of 7.79 at Jenera Herrera (Spichiger et al., 1996).

The scarcity of *Rubiaceae* is observed as recorded in many lowland forests (Table 14). On the one hand in Cameroon, *Rubiaceae* are much more abundant and more species-rich in the highland forests (Tagne, 2007; Madiapevo, 2008; Noumi, 2012). On the other hand at Oku *Meliaceae, Monimiaceae* are the much more abundant, the *Rubiaceae* and *Araliaceae* are the most diversified.

Table 14. Family Importance Value of the 15 most important plant families in Oku and other Cameroonian submontane forests (5), montane forests (2) and 5 lowland tropical forests reported by D'Amico and Gautier (2000)

Messa forest Cameroon) (Tagne, 2007)		**Kala forest (Cameroon) (Madiapevo, 2008)**		**Mbam minkom forest (Cameroon) (Noumi, 2015)**		**SF Kouoghap (Cameroon) (Noumi, 2012)**	
Families	**FIV**	**Families**	**FIV**	**Family**	**FIV**	**Families**	**FIV**
Leguminosae	47.60	*Leguminosae*	31.00	*Clusiaceae*	60.01	*Meliaceae*	33.38
Sterculiaceae	33.17	*Clusiaceae*	27.90	*Sterculiaceae*	33.85	*Leguminosae*	32.63
Moraceae	28.93	*Myristicaceae*	26.80	*Burseraceae*	23.48	*Moraceae*	31.81
Euphorbiaceae	26.11	*Burseraceae*	21.77	*Leguminosae*	17.28	*Sapotaceae*	26.83
Meliaceae	17.26	*Sterculiaceae*	21.41	*Annonaceae*	16.81	*Rubiaceae*	26.12
Apocynaceae	13.90	*Annonaceae*	18.24	*Meliaceae*	15.82	*Bignoniaceae*	21.16
Myristicaceae	12.59	*Rubiaceae*	17.96	*Myristicaceae*	14.86	*Apocynaceae*	19.49
Ulmaceae	12.26	*Meliaceae*	17.83	*Apocynaceae*	14.52	Euphorbiaceae	15.74
Caricaceae	10.57	*Euphorbiaceae*	15.78	*Euphorbiaceae*	13.86	*Verbenaceae*	12.51
Rubiaceae	10.12	*Apocynaceae*	13.76	*Olacaceae*	9.54	*Annonaceae*	11.23
Bombacaceae	7.44	*Irvingiaceae*	8.18	*Rubiaceae*	7.73	*Burseraceae*	9.65
Cecropiaceae	7.38	*Moraceae*	8.13	*Oleaceae*	7.33	Sterculiaceae	9.33
Combretaceae	7.37	*Cecropiaceae*	7.92	*Moraceae*	6.25	*Araliaceae*	7.70
Lauraceae	7.19	*Flacourtiaceae*	7.43	*Sapotaceae*	5.45	*Agavaceae*	6.83
Olacaceae	6.85	*Sapotaceae*	7.38	*Sapindaceae*	5.10	*Clusiaceae*	6.66

Oku sacred forest (Cameroon), present study		**Manengouba forest (Cameroon), Noumi, 2013**		**Kupe submontane forest (Cameroon) Tchoua, 2014**		**Manongarivo (Madagascar), (D'Amigo and Gautier, 2000)**	
Families	**FIV**	**Families**	**FIV**	**Families**	**FIV**	**Families**	**FIV**
Araliaceae	49,15	*Rubiaceae*	56.19	*Meliaceae*	41.22	*Clusiaceae*	40.78
Myrtaceae	39,03	*Euphorbiaceae*	55.71	*Rubiaceae*	32.40	*Euphorbiaceae*	29.09
Meliaceae	37,88	*Araliaceae*	51.03	*Euphorbiaceae*	30.94	*Myrtaceae*	27.17
Rubiaceae	24,64	*Myrsinaceae*	49.52	*Malvaceae*	23.55	*Rubiaceae*	21.23
Monimiaceae	19,48	*Meliaceae*	16.06	*Burseraceae*	21.25	*Myristicaceae*	19.04
Leguminosae	18,54	*Moraceae*	8.33	*Clusiaceae*	20.13	*Lauraceae*	16.32
Moraceae	17,39	*Rutaceae*	7.95	*Moraceae*	17.24	*Burseraceae*	13.77
Melianthaceae	15,64	*Cyatheaceae*	7.40	*Olacaceae*	15.53	*Sapotaceae*	10.48
Buddlejaceae	15,39	*Opiliaceae*	6.66	*Sapotaceae*	14.29	*Erythroxylaceae*	9.51
Rutaceae	8,54	*Sapindaceae*	6.19	*Menispermaceae*	13.78	*Annonaceae*	9.37
Euphorbiaceae	8,14	*Thymelaeaceae*	5.59	*Annonaceae*	13.05	*Sarcolaenaceae*	8.27
Apocynaceae	7,76	*Rosaceae*	5.14	*Sapindaceae*	12.80	*Asteraceae*	8.22
Maesaceae	7,25	*Melianthaceae*	4.26	*Leguminosae*	12.53	*Leguminosae*	7.71
Myrsinaceae	7,04	*Asteraceae*	3.14	*Apocynaceae*	12.14	*Ebenaceae*	7.57
Sapindaceae	6,51	*Alangiaceae*	3.10	*Myristicaceae*	10.74	*Arecaceae*	7.17

Yasuni (Ecuator) (Balslev et al., 1987)		**Yapo (Côte d'Ivoire) (Corthay, 1996)**		**Alto Parana (Paraguay) (Spichiger et al., 1992)**		**Alto Ivon (Bolivia) (Boom, 1986). (Submountain going up in lower highlander)**	
Famille	**FIV**	**Famille**	**FIV**	**Famille**	**FIV**	**Famille**	**FIV**
Arecaceae	55.66	*Sapotaceae*	34.15	*Meliaceae*	44.4	*Moraceae*	53.3
Moraceae	36.48	*Leguminosae*	32.27	*Lauraceae*	42.4	*Myristicaceae*	41.1
Leguminasae	23.73	*Burseraceae*	24.83	*Sapotaceae*	39.4	*Palmae*	35.7
Bombacaceae	19.66	*Euphorbiaceae*	18.88	*Leguminosae*	31.9	*Leguminosae*	30.1
Myristicaceae	19.59	*Meliaceae*	18.70	*Rutaceae*	25.4	*Melastomataceae*	20.1
Rubiaceae	14.73	*Sterculiaceae*	18.57	*Moraceae*	20.4	*Cecropiaceae*	15.3
Meliaceae	11.62	*Ebenaceae*	15.49	*Boraginaceae*	14.7	*Vochysiaceae*	13.9
Euphorbiaceae	8.15	*Clusiaceae*	14.85	*Arecaceae*	11.1	*Annonaceae*	8.7
Cecropiaceae	7.86	*Olcaceae*	13.51	*Annonaceae*	10.1	*Chrysobalanaceae*	8.3
Lecythidaceae	7.54	*Chrysobalanaceae*	12.08	*Bignoniaceae*	8.2	*Rubiaceae*	8.3
Lauraceae	7.37	*Flacourtiaceae*	11.91	*Solanaceae*	4.6	*Lauraceae*	7.2
Sterculiaceae	6.72	*Combretaceae*	8.75	*Myrtaceae*	3.5	*Burseraceae*	6.8
Flacourtiaceae	6.18	*Lecythidaceae*	6.64	*Sapindaceae*	3.2	*Euphorbiaceae*	5.7
Polygonaceae	6.07	*Irvingiaceae*	6.37	*Flacourtiaceae*	2.7	*Flacourtiaceae*	5.2
Sapotaceae	5.59	*Scytopetalaceae*	6.35	*Euphorbiaceae*	2.5	*Myrtaceae*	4.5

Specific level - In the present study 31 species were encountered. The number of species per hectare seems to be fluctuating in African highlander forest (31-106) (Table 15), as in other tropical lowland forests in Madagascar: 38-146 (Rakotomalaza andMessmer, 1999; Rabevohitra et al., 1996) and in the Neotropical region: 94 at Alto Ivon (Bolivia) (Boom, 1986), but less than -228- in Amazonian Ecuador (Balslev et al., 1987). Lower diversity values were always recorded in the tropical montane forests like in Sao Tomé (P. N. Obo) where White (1983) found 40 species/ha, like in Cameroon (Manengouba) where Noumi (2013) found found 41 species/ha and in the present study where the authors found 30 species /ha. The proportion 70 species/ha found by Mohandass and Davidar (2009) in Nilgiri, India concern the woody with dbh ≥ 1 cm and would be well least so only the woody with dbh ≥ 10cm had been taken in account.

Table 15. Number of species tallied (dbh > 10cm) per ha in Mbam minkom, and African other, Malagasy and neotropic rainforests (altitudes available).

Sites	Middle altitude (m)	Country	Reference	Number of species/ha
Low elevation rainforests sites				
Scio Classified forest alt. moyenne	230	Côte d'Ivoire	Nusbaumer et al. (2005)	89
Yapo classified forest	230	Côte-d'Ivoire	Corthay (1996)	57
Dja Forestry Reserve (Alat 1.7)	500-700	Cameroon	Sonké (1998)	79
Submontane rainforests sites				
P.N. Mt. Alen	350-1200	Equatorial Guinea	Van Reeth (1997)	106
Manongarivo	750-1.200	Madagascar	D'Amico and Gauttier (2000)	90
Messa	900-1015	Cameroon	Tagne (2007)	151
Kala	1000-1156	Cameroon	Madiapevo (2008)	178
Mbam minkom sub-moutane forest	1000-1295	Cameroon	Noumi (2015)	58
Kouoghap sacred Forest	1400-1550	Cameroon	Noumi (2012)	31
Kupe submontane forest,	1000-1800	Cameroon	Thoua (2014)	156
Montane rainforests sites				
P.N Obo	0-2024	Sao Tomé	White (1983)	40
Shola montane evergreen forest	2000-2633	Nilgiri, India	Mohandass and Davidar (2009)	70
Oku sacred forest	2200-2300	Cameroon	Present study	30
Manengouba forest (Mbouroukou)	2200-2396	Cameroon	Noumi (2013)	41

In the lowland forests and according to Rollet (1983), 50% of individuals on average are represented by 20 species in disturbed lowland Amazonian forests of Venezuela. In Manonagrivo, half of the trees are represented by only 11 species. A similar value (12 species) was found at Andohahela, Madagascar (Rakotomalaza and Messmer, 1999). In the submontane forests the number of species that reach 50% of individuals decreases with the altitude: - 17 species (52.01% of individuals) at Messa in Cameroon (Tagne, 2007); -15 species (52.53% of individuals) at Kupe in Cameroon (Tchoua, 2014); - 6 species (50% of individuals) at Kala in Cameroon (Madiapevo, 2008); - 5 species (54.07 of individuals) at Mbam minkom in Cameroon (Noumi, 2015).

In the undisturbed montane forest, more than 50% of individuals are only represented by some species: 53.64% of the trees at Oku (present study) by 3 species; 53.08% of trees at Manengouba in Cameroon by 4 species. One can evoke for the Afrotropical highlander forests, the character often gregarious of the dominant species, having for consequence the small number of species associated in the superior strata, and a certain floristic poverty of the specifically arborescent core. These plant species are among the ten first in FIV due to their relative density. In high altitude numerous plants are gregarious.

The Shannon diversity index (H') (Shannon and Weaver, 1949) permits a good approach of the diversity on the different plots because it takes into account the number of species and the distribution of abundances. Its calculated values for different Guinean forests are between 4 and 6.5. The Oku sacred formation presents a low value (H' = 3.71), which shows a less diversified forest, with gregarious species (Table 15).

Table 16. Family Importance Value of the 10 most important plant species in Oku sacred forest and other Guinean forests.

Messa forest, Cameroon (Tagne, 2007). Alt. Cameroon,		Kala forest, Cameroon (Madiapevo, 2008). Alt. 1156 m		Mbam Minkom forest, Cameroon (Noumi, 2015). Alt. 1000-1295 m		Koupe forest, Cameroon, (Tchoua, 2014). Alt 1000-1800 m	
Species	**IVI**	**Species**	**IVI**	**Species**	**IVI**	**Species**	**IVI**
Cylicomorpha solmsii	11.40	*Allanblackia gabonensis*	20.71	*Garcinia lucida*	38.52	*Santiria trimera*	19.64
Anthonotha fragrans	11.13	*Strombosia grandifolia*	14.40	*Cola verticillata*	24.29	*Carapa procera*	19.31
Trilepisium madagascariensis	11.05	*Santiria trimera*	9.93	*Santiria trimera*	21.04	*Cola acuminata*	15.56
Cola cordifolia	10.76	*Tarbernaemontana crassa*	8.11	*Allanblackia gabonensis*	18.34	*Penianthus longifolius*	14.72
Pycnanthus angolensis	9.26	*Oelocarion preussii*	7.19	*Pycnanthus angolensis*	9.39	*Dripetes leonensis*	13.01
Ricinodendron heudelotii	7.92	*Cola verticillata*	6.45	*Tabernaemontana crassa*	8.01	*Strombosia pustulata*	12.30
Triplochiton scleroxylon	7.29	*Pycnanthus angolensis*	6.44	*Linociera oreophila*	5.80	*Turraeanthus africanus*	11.58
Tabernaemontana crassa	6.91	*Aulacocalyx jasmiflora*	6.28	*Leplaea mayombensis*	5.52	*Pycnanthus angolensis*	10.27
Sterculia tragacantha	6.79	*Cola attiensis*	5.65	*Drypetes parviflora*	5.42	*Englerophytum stelechanthum*	9.87
Carapa procera	6.70	*Greenwayodendron suaveolens*	5.62	*Strombosia grandifolia*	5.41	*Allanblackia gabonensis*	8.72
Kouoghap sacred forest, Cameroon (Noumi, 2012). Alt. 1400-1550 m		**Oku sacred forest, Cameroon (present study). Alt. 2000-2200 m**		**Manengouba forest, Cameroon (Noumi, 2013). Alt 2200-2295 m**		**Forêt classée de Scio (Côte d'Ivoire), (Nusbaumer et al., 2005). Alt. Moyenne: 230 m**	
Species	**IVI**	**Species**	**IVI**	**Species**	**IVI**	**Species**	**IVI**
Syncepalum cerasiferum	28.24	*Schefflera mannii*	43.29	*Macaranga occidentalis*	37.35	*Calpocalyx brevibracteatus*	32.01
Tricalysia macrophylla	24.04	*Carapa grandiflora*	40.54	*Rapanea melanophloeos*	30.48	*Polyalthia oliveri*	27.76
Trilepisium madagascariensis	17.87	*Syzygium guineense*	35.95	*Maesa lanceolata*	26.08	*Piptadeniastrum africanum*	16.16
Markhamia tomentosa	17.29	*Xymalos monospora*	22.14	*Polyscias fulva*	24.16	*Petersianthus macrocarpus*	15.98
Funtumia africana	14.98	*Piptadeniastrum africanum*	20.55	*psydrax arnoldianum*	23.44	*Baphia pubescens*	14.16
Vitex grandifolia	13.92	*Nuxia congesta*	17.39	*Rothmannia urcelliformis*	22.30	*Scottellia klaineana*	10.48
Lovoa trichilioides	10.01	*Ficus thonningii*	13.02	*Schefflera barteri*	18.85	*Erythrophleum ivorense*	9.57
Polyscias fulva	8.87	*Bersama abyssinica*	10.26	*Carapa grandiflora*	11.64	*Corynanthe pachyceras*	9.04
Dracaena arborea	7.50	*Rauvolfia macrophylla*	9.77	*Schefflera mannii*	10.57	*Funtumia elastica*	8.92
Trichilia rubescens	7.21	*Rytigynia neglecta*	8.31	*Croton macrostachyus*	9.81	*Strombosia pustulata*	8.52

Mori et al. (1983) consider as rare species those who are found only once in the sample. In a lowland forest of eastern Brazil 41% species were rare according to this definition. The percentages of species represented by only one individual were 55% in unflooded forest and 62% in a floodplain forest of Ecuador (Balslev et al., 1987). A forest inventory in Andohahela, Madagascar (Rakotomalaza and Messmer, 1999) recorded a value of 38.8%.

In the highland forests, the percentages of rare species are: – 20.54%- (Noumi, 2015) in Mbam minkom; – 28 % - (Tagne, 2007) in Messa; - 32.5% - (Noumi, 2013) in Manengouba. In this study the percentage of species represented by only one individual (9.67%) is much lower than these reported in all the above mentioned studies and is close to the value reported in Kala - 12,5 % - (Madiapevo, 2008). The ratio of individual/species in the 1.125-ha plot of Oku sacred forest is 30.12. It is higher than the one of Menengouba montane forest, 18.65. In other 1-ha plots in Madagascar, recorded values were 6.1 (Rakotomalaza and Messmer, 1999) and 9.17 to 22.1 (Rabevohitra et al., 1996). In Cameroon the individual/species ratios found in the submontane forest are -8.03- Tagne (2007) and -10.05 -Madiapevo (2008). A series of 1-hectare forest inventories sampled in the neotropics recorded the following values: 8.42 in Southern Bahia, Brazil (Mori et al., 1983); 2.05 in Jenaro Herrera (Spichiger et al., 1996). The high individual/species ratio shows a less diversified forest, with gregarious tendency of species.

The IVI of *Schefflera mannii*, the species with the highest value in the plot, is 43.29. Similar values were recorded in a gallery forest of Mogi-Guaçu, Brazil (Spichiger et al., 1996) where the highest IVIs were 37.7 and 43.5; in Manengouba - 37.35 – (Noumi, 2013); in Mbam minkom – 38.49 – (Noumi, 2015) and these values fall to 28,24 (Noumi, 2012); to the 12.5-28.7 range of highest IVI recorded by Mori & Boom(1987) in the lowland moist forests (Baslev et al., 1987); to -20.71- (Madiapevo, 2008) at Kala forest and to -16.37- (Tagne, 2007) at Messa forest.

One would say that strongest IVI values don't depend to the mesologic characters, evolve with the altitudinal gradient pressure, therefore inversely proportional to the thermal pressure gradient. It is necessary to notice that in all inventories of the Table 16 a species with an IVI value higher than 10 always belongs to one of the ten highest IVIs of the sample.

The structure and diversity of the Oku sacred montane forest were a bit similar to that of the Manengouba montane forest. About 9 (29.03%) of the species were common, indicating a common heritage of the two forests which are about 160 km apart in the South-Northern axis. They are *Allophylus bullatus*, *Bersama abyssinica*, *Carapa randiflora*, *Croton macrostachyus*, *Maesa lanceolata*, *Polyscias fulva*, *Psydrax arnoldiana*, *Rapanea melanophloeo*, *Schefflera abyssinica* and *Schefflera mannii*. Both Oku and Manengouba supported low-diversity forests with high basal area contributed by large trees specialy at Oku (Noumi, 2013).

Phytogeographical affinities

The phytogeographic affinities of the species recorded falls within ten major distributions (Fig. 13); 54.87% species are widespread in the Guineo-congolese element. The extensively widespread species (45.17%) are either endemic of the Cameroonian highlander archipelago, including Biko (ex Fernando Po), either distributed in the tropical region with the montanes of Oriental Africa and southern Africa, and their populations are thus geographically discontinuous.

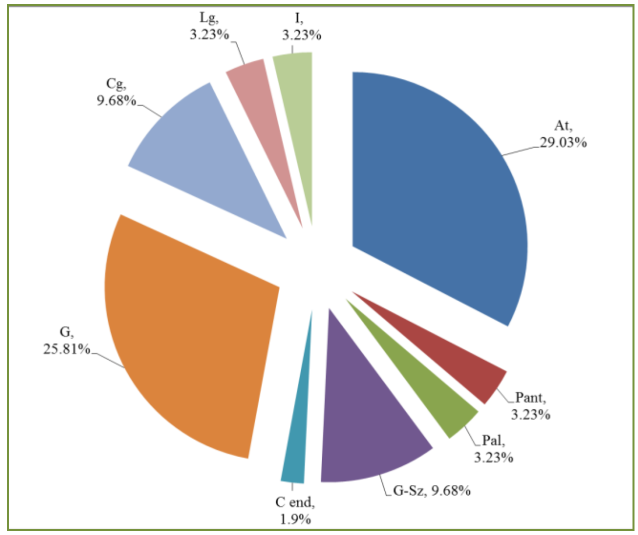

Fig. 13: Distribution of the identified speciesif the Oku 1.125-ha plot according to main geographic patterns. ***Wide distribution species;*** At: Tropical Africa, Pant: Pantropical; Pal: Paleotropical; G-Sz: Guineo-Sudano-Zambezian. ***Guineo-congolian species;*** End C: endemic to Cameroonian high montane achipelago; G: Omni or sub omni Guineo-Congolian; Centro-guineo-congolian; Lg: Lower Guinian; I: indeterminate.

Phytosociological affinities

The site of the Oku sacred forest is in a depression safe from the monsoon (humid wind) coming from the Atlantic Ocean. The continentality and the phenomenon of side opposition orient the hygrometric pressure gradient downwards. The 31 species are shared with rainforests, secondary and mesophiles forests (Fig. 14). This last is represented by *Piptadeniastrum africanum*, tolerant heliophyte plant species, scattered by win, deciduous leaves, whose individuals reach some diameters superior to 198 cm, an abundance of 42 individuals and a basal area of 30.05m^2. However the luminous fraction to the level of soil is revealed at the time of the period of strong defoliation of the sylve (December - February) (Fig. 3), also due to the clear undergrowth as upper-indicated (in the Study erea).The species is one of features of the semi - caducifolious forests mesophiles of low and middle altitudes; order of the *Piptadenio-celtidetalia* Lebrun and Gilbert 1954 (of *Piptadeniastrum africanum* and *Celtis div.* sp.). However, the presence of *Piptadeniastrum africanum* to

2200-2300m of altitude, under a rainfall of more than 2305.1mm per year, appears to be independent of the climatic considerations. There is in the Oku sacred forest the discrepancies of sociological belongings that raises a lot more to paleogeomorphological phenomena and that make of this plant formation a sygenetic forest (with the formed together plant species, whose birth is common).

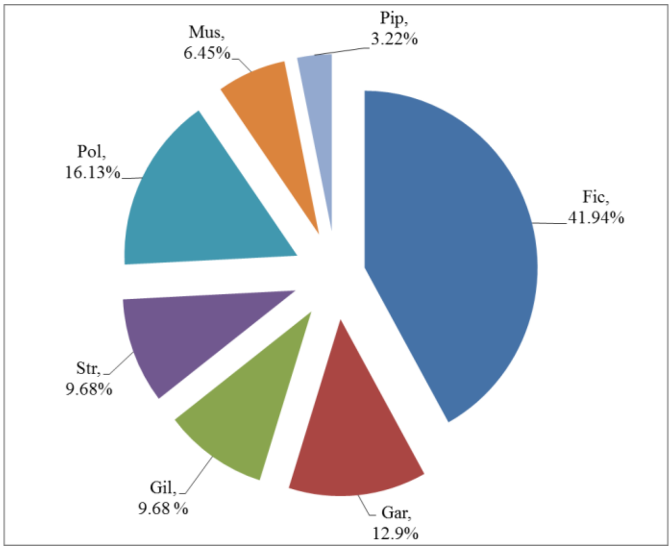

Fig. 14: Distribution of the identified species of the Oku 1.125-ha plot according to main ecosociological patterns. **Rainforests**; Fic: *Ficalhoeto-Podocarpetalia,* Gar: Garcinietalia, Gil: *Gilbertiodendretalia dewevrei,* Str: *Strombosio-Parinarietea.* **Secondary forests**; Pol: *Polyscietalia fulvae*, Mus: *Musango-Terminalietea.* **Mesophile forest**; Pip: Piptadenio-celtidetalia.

Conclusion

The comparison between the data of the Oku sacred forest and those of the Manengouba highlander forest and 4 submontanes forests (Kouoghap, Mbam minkom, Kala and Messa), bring closer the studied forest to the type Afro-highlander, hygro-oligothermal, if one only considers the trees of dbh $\geq$ 10cm, by the Family Importance Values (FIV) and the Index of Importance Value of the species (IVI). About the point of view of the structure, the formation shows big diameter trees constructed by the stranglers' epiphytes from top to bottom. These elements make of the Oku sacred sylve a forest, singular by atypical trees stems descended of the stranglers' epiphytes. If one considers all ecosociological types, the comparisons bring more the forest studied closer to those of transition (hygro-mesothermal) and to those of low and middle altitudes (hygro-megathermal) with as characteristic *Piptadeniastrum africanum*. This remark is valid for the qualitative and quantitative data as the specific diversity of the families or the presence of the exclusive species of these three types of forest.

The philosophy developed from this shows that the Oku sacred forest is not the expression of the climate. It represents a plant formation particular enough containing therefore the species of the 3 different forest ecologies. These fundamental arguments make of the Oku sacred forest a syngenetic formation. They show the interest of the conservation of the Oku sacred forest that is structurally intact to the level of the strata, that of the flora. The back-up strategy of the forester heritage setting up by the villager collectivity must be encouraged.

Conflict of interest statement

Authors declare that they have no conflict of interest.

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Appendix 1. Floristic list of the Oku sacred forest, with some synthetic characteritics [individuals with diameter (db h) ≥ 10cm].

Families	Species	Phytogeo-graphical types	Altitudinal variations	Ecosociological groups
Rubiaceae	*Aidia micrantha* (K. Schum.) F. White	G	Bm	gil
Sapindaceae	*Allophylus bullatus* Radlk.	End-Cam	Mi	Fic
Myrsinaceae	*Ardisia staudtii* Gilg.	Cg	Sm/ Mi	gar
Melianthaceae	*Bersama abyssinica* Fresen.	At	Mi	fic
Melianthaceae	*Bersama englerana* Gürke	G-sz	Sm	gar
Meliaceae	Carapa grandiflora Sprague	G	Mi	Fic
Rutaceae	*Clausena anisata* (Willd.) Hook. f. ex Benth.	At	Mi	fic
Euphorbiaceae	*Croton macrostachyus* Hochst. ex Del.	G	Sm	pol
Myrtaceae	*Eugenia gilgii* Engl. & V. Brehm.	G	(Bm/Sm)	gil
Moraceae	*Ficus chlamydocarpa* Milbr. & Burret	(Bg) Basse guinée	Mi	fic
Moraceae	*Ficus thonningii* Blume	At + sub-at	Sm/ Mi	str
Rubiaceae	*Ixora breviflora* Hiern.	Cg	Sm	gar
Maesaceae	*Maesa lanceolata* Forssk	At + sub-at	Sm/ Mi	pol
Maesaceae	Maesa sp.		Sm/ Mi	pol
Convolvulaceae	*Neuropeltis acuminata* (P. Beauv.) Benth.).	G	(Bm/Sm)	str
Buddlejaceae (Loganiaceae)	*Nuxia congesta* R. Br. Ex Fresen	At	Mi /Ms	fic
Leguminosae	*Piptadeniastrum africanum* (Hook. f.) Brenan	G	Bm	Pip
Pittosporaceae	*Pittosporum mannii* Hook. f.	At	Mi	pol
Araliaceae	*Polyscias fulva* (Hiern) Harms	At	Mi	pol
Rubiaceae	*Psydrax arnoldiana* (De Wild. & Th. Dur.) Hepper	G	Sm	gar
Myrsinaceae	*Rapanea melanophloeos* (L.) Mez	G-sz	Mi / Ms	fic
Apocynaceae	*Rauvolfia macrophylla* Stapf	Cg	Bm	mus
Rubiaceae	*Rytigynia neglecta* (Hiern) Robyns	At	Mi	fic
Araliaceae	*Schefflera abyssinica* (Hochst. ex A. Rich.) Harms	At	Mi	fic
Araliaceae	*Schefflera mannii* (Hook. f.) Harms	End-Cam	Mi	fic
Euphorbiaceae	*Shirakiopsis elliptica* (Hochst.) Esser.	Pant	Sm/ Mi	str
Asteraceae	*Solanecio mannii* (Hook. f.) C. Jeffrey	End-Cam	Mi	fic
Myrtaceae	*Syzygium guineense* (Willd.) DC.	End-Cam	Mi	fic
Ulmaceae	Trema orientalis (L.) Bl.	Pal	Bm	mus
Monimiaceae	*Xymalos monospora* (Harv.) Baill. ex Warb.	G-sz	Mi	fic
Rutaceae	*Zanthoxylum heitzii* (Aubr. & Pellegr.)P.G. Waterman	G	(Bm/Sm)	Pip

Appendix 2. Diversity, density, basal area and FVI of the plant families encountered in the 1.125-ha sampling, in the Oku montane sacred Forest, presented by decreasing FIV.

Family	Number of species	Relative diversity (%)	Number of trees	Relative density (%)	Basal area	Relative dominance (%)	FIV
Araliaceae	3	9.68	45	4.82	96.24	34.65	49.15
Myrtaceae	2	6.45	101	10.81	60.45	21.77	39.03
Meliaceae	1	3.23	284	30.41	11.80	4.25	37.88
Rubiaceae	4	12.90	96	10.28	4.04	1.45	24.64
Monimiaceae	1	3.23	136	14.56	4.71	1.70	19.48
Leguminosae	1	3.23	42	4.50	30.05	10.82	18.54
Moraceae	2	6.45	12	1.28	26.81	9.65	17.39
Melianthaceae	2	6.45	58	6.21	8.27	2.98	15.64
Buddlejaceae	1	3.23	28	3.00	25.45	9.17	15.39
Rutaceae	2	6.45	8	0.86	3.42	1.23	8.54
Euphorbiaceae	2	6.45	14	1.50	0.51	0.19	8.14
Apocynaceae	1	3.23	40	4.28	0.71	0.25	7.76
Maesaceae	2	6.45	7	0.75	0.12	0.04	7.25
Myrsinaceae	2	6.45	5	0.54	0.15	0.05	7.04
Sapindaceae	1	3.23	17	1.82	4.05	1.46	6.51
Convolvulaceae	1	3.23	20	2.14	0.35	0.13	5.49
Asteraceae	1	3.23	12	1.28	0.24	0.09	4.60
Pittosporaceae	1	3.23	5	0.54	0.23	0.08	3.84
Ulmaceae	1	3.23	4	0.43	0.10	0.04	3.69
Total	**31**	**100**	**934**	**100**	**277.73**	**100**	**300**

Appendix 3. Ocurrency, density, basal area and IVI of the plant species encountered in the 1.125-ha sampling in the Oku mountane sacred forest, presented by decreasing IVI.

Species	Occurrence	Relative occurrence [x 100%]	Number of trees	Relative density [x 100%]	Basal area	Relative dominance [x 100%]	IVI [x 300%]
Syzygium guineense	10	6.53	82	8.78	62.71	22.58	37.9
Carapa grandiflora	9	5.88	284	30.41	11.80	4.25	40.54
Shirakiopsiselliptica	1	0.65	2	0.21	0.04	0.01	0.88
Rauvolfia macrophylla	8	5.23	40	4.28	0.71	0.25	9.77
Ficus chlamydocarpa	1	0.65	1	0.11	2.99	1.08	1.84
Eugenia gilgii	5	3.27	20	2.14	1.04	0.38	5.79
Croton macrostachyus	5	3.27	12	1.28	0.48	0.17	4.73
Piptadeniastrum africanum	8	5.23	42	4.50	30.05	10.82	20.55
Psydra xarnoldiana	7	4.58	27	2.89	0.54	0.19	7.66
Schefflera mannii	9	5.88	41	4.39	91.69	33.01	43.29
Polyscias fulva	2	1.31	3	0.32	0.21	0.08	1.70
Ardisia staudtii	2	1.31	3	0.32	0.08	0.03	1.66
Pittosporum viridiflorum	3	1.96	5	0.54	0.23	0.08	2.58
Nuxia congesta	8	5.23	28	3.00	25.45	9.17	17.39
Rapanea melanophloeos	2	1.31	2	0.21	0.07	0.02	1.55
Trema orientalis	3	1.96	4	0.43	0.10	0.04	2.43
Clausena anisata	4	2.61	7	0.75	0.12	0.04	3.41
Rytigyni aneglecta	8	5.23	27	2.89	0.54	0.19	8.31
Xymalos monospora	9	5.88	136	14.56	4.71	1.70	22.14
Bersama abyssinica	8	5.23	40	4.28	2.07	0.75	10.26
Solanecio mannii	3	1.96	12	1.28	0.24	0.09	3.33
Schefflera abyssinica	1	0.65	1	0.11	4.34	1.56	2.32
Maesa sp.	3	1.96	3	0.32	0.05	0.02	2.30
Allophylus bullatus	6	3.92	17	1.82	4.05	1.46	7.20
Neuropeltis acuminata	6	3.92	20	2.14	0.35	0.13	6.19
Bersama engleriana	6	3.92	18	1.93	6.19	2.23	8.08
Ixora breviflora	4	2.61	16	1.71	2.15	0.77	5.10
Ficus thonningii	5	3.27	11	1.18	23.82	8.58	13.02
Maesa lanceolata	1	0.65	4	0.43	0.07	0.03	1.11
Aidia micrantha	6	3.92	26	2.78	0.81	0.29	7.00
Total	**153**	**100**	**934**	**100**	**277.73**	**100**	**300**