Floristic Diversity of the Natural Forests of Dimbokro Region, Centre-Eastern Côte d'Ivoire

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Abstract

This study, carried out in three types of forest types (reserve, riparian and of plateaus) in a savannah and forest mosaic region of Côte d'Ivoire, aims to arise up the floristical characteristics of these natural forests. Trees and lianas with DBH≥10 cm were sampled into 30 plots of 50mx20m per forest type and named botanically. The floristic diversity and taxa distribution were analyzed using various coefficients and a Factorial Correspondence Analysis respectively. We found 89 species belonging to 77 genera and 36 families. The most abundant taxa were Verbenaceae family (43%), Leguminosae-Caesalpinioideae subfamily (19%), Leguminosae-Mimosoideae subfamily (6%), Malvaceae family (6%), Sapotaceae family (6%), Moraceae family (4%) and Leguminosae-Papilionoideae subfamily (3%). Both riparian forests and forests of plateaus showed higher species richness and diversity and were similar for these parameters. Average species richness varied from 5 in forest reserve to 9 in both riparian forests and forests of plateaus respectively. Shannon-Weaner's diversity index was set between 0.832 in the forest reserves and 1.723 in the riparian forests while the equitability index of Pielou varied from 0.516 in the forest reserves to 0.789 in the riparian forests. The forest reserves and of plateaus showed similar spatial distribution of the woody plants with DBH ≥ 10 cm.

Keywords: Woody plants, richness and diversity, savannah and forest mosaic, West Africa

Introduction

The destruction of the tropical forests causes a considerable reduction of the biodiversity in the world (Myers *et al*., 2000). Thus, it mainly modifies the microclimate within the forest fragments by a reduction in moisture and an increase in light availability (Heithecker *et al*., 2007; Laurance *et al*., 2008). The annual rate of deforestation was estimated at more than 6.5 million hectares between 1990 and 2015 (Myers *et al*., 2000; FAO, 2015). Due to poverty, the most important loss of forest surfaces was recorded in the developing countries (FAO, 2015).

In Côte d'Ivoire, the forest cover which amounted to 15 million hectares in 1900 (SODEFOR, 1996), is estimated today less than 2.7 million hectares (Païvinen *et al*., 1992; Chatelain *et al*., 2004; Kouamé, 2016). Dimbokro region is not in margin of this forest loss. Indeed, since 1950, cocoa and coffee were very cultivated in Dimbokro region and led to large forest surfaces transformed into plantations (Louppe *et al*., 2013). This forest degradation is a threat for the forest ecosystems and its biodiversity. Therefore, it is necessary to preserve the integrity of the forests of Dimbokro region in the way of local biodiversity conservation.

The effectiveness of this protection could be appreciated through the study of local plant diversity. This study aims at describing the floristic composition of the three main local natural forest types through an assessment of the big and woody trees and lianas. Due to their proximity and the similar anthropogenic activities that are submitted, we hypothesize to find similar richness and diversity in all forest types.

Study zone location

This study was carried out in the Department of Dimbokro located in Centre-eastern Côte d'Ivoire. Dimbokro (Figure 1) administrative region named N'zi region is limited in the North by Bocanda administrative area, in the South by Tiémélékro administrative area, in the East by Bongouanou administrative area and in the West by Toumodi and Yamoussoukro administrative areas (Zouhou, 2005). Its geographical surface extends between 6°37' and 6°47' from Northern latitudes and between 4°38' and 4°45' western longitudes and covers 161.9 km^2 (Figure 1). The relief is slightly broken with an overall monotony low hills. Local soil is mostly ferralitic while the hydrographic network is composed of N'Zi, Agnéby, Comoé rivers and their tributaries. The vegetation of Dimbokro region belongs to the West African Tropical forest-savanna mosaic (Monnier, 1983; White, 1983) which is a mixt of a semi-deciduous rain forest islands in the Guinean savanna. The local savanna sub-types are the woody savannas, the shrubby savannas and grassy savannas (White, 1983). The local forest sub-types are the forest reserves

managed by Ivorian forest Service (SODEFOR, 1996), the riparian forests and the forests of plateaus.

Data gathering

Data were carried out in a total of ninety (90) rectangular plots of 50 m X 20 m subdivided each into 10 subplots of 10 m X 10 m as recommended Thiombiano *et al*. (2010) and Kouamé (2016) for the assessment of African Tropical rainforests. Thus, 30 plots in each type of local forest types (reserve, riparian and of plateaus) where sampled for the scientific names of woody plants with diameter at breast height (DBH) equal or larger than 10 cm.

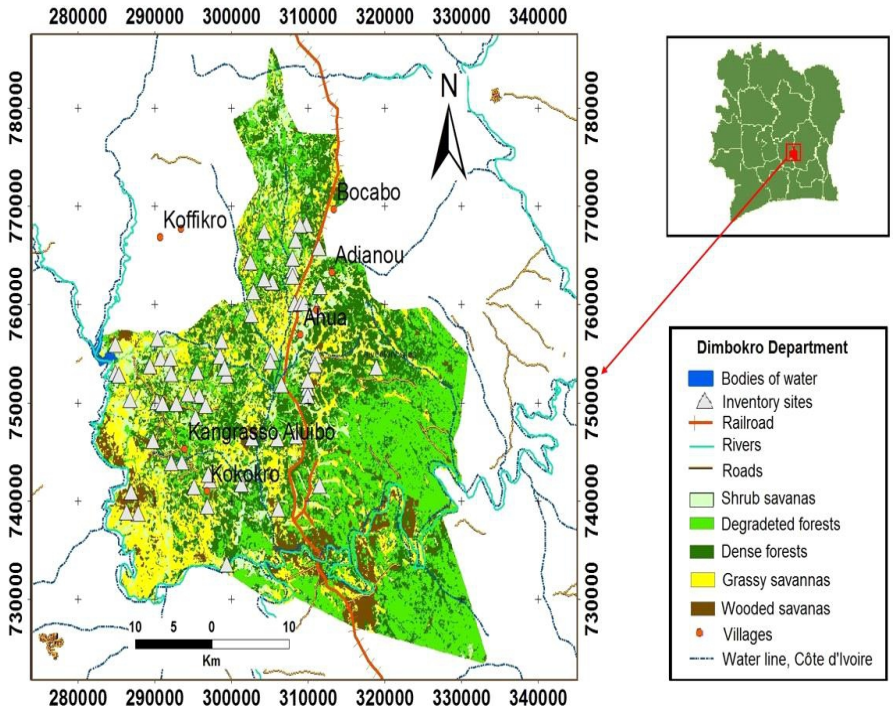

Figure 1. Location of the studied plots in Dimbokro department
The original map has downloaded from Google Earth and modified by Biagné

Data analysis

Botanical analysis consisting of the species and genera names, and the endemism categories were provided by the current checklist of vascular plants of Côte d'Ivoire (Aké-Assi, 2001; 2002). But the nomenclature was updated through APG (2016) for the families' names. The main plant families of the local flora were compared through the genera index which is the average of the species number per genus. The Morisita-Horn's similarity coefficient was use to set the link between the forest types based on their common richness. The floristic diversity was analyzed using various indices such as Shannon-Weaner index, Simpson diversity index and Piélou's equitability index. These

indices and the richness in plots were compared using Kruskal-Wallis non-parametric test. Taxa distribution was analyzed through a Factorial Correspondence Analysis. Statistical tests were performed using R and XLSTAT software.

Results

General floristic composition

The total richness of woody plants with DBH ≥ 10 cm assessed in the 90 plots is about 89 species belonging to 77 genera and 32 families (Appendix). The Leguminosae family is the richest (Table 1) with 19 genera (44%) and 23 species (45%). The Malvaceae and the Sapindaceae families, with 5 genera (12%) and 6 species (12%) each represent the second most recorded families (Table 1) followed by the Anacardiaceae family with 4 genera (9%) and 5 species (10%).

The spectrum of endemic species highlights the abundance of the introduced species (i) with 89% in the forest reserves, 30% in the riparian forests and 22% in the forests of plateaus (Figure 2). The Guineo-Congolian and the Sudano-Zambezian transition endemic species (GCSZ) showed the proportions of 48% in the forests of plateaus, 44% in the riparian forests and 5% in the forest reserves (Figure 2). The Guineo-Congolian endemics (GC) with 27% in the forests of plateaus, 19% in the riparian forests and 6% in the forest reserves are spread as well. The Sudano-Zambezian endemics (SZ) and the Upper Guinea Rainforest Endemics (GCW) are present only in the riparian forests and forests of plateaus in low proportions.

Table 1. The richest woody plants families recorded in the forests of Dimbokro region

Order	Families	Species	Genera	Genera index
1	Leguminosae	23	19	1.21
2	Malvaceae	6	5	1.20
3	Sapindaceae	6	5	1.20
4	Anacardiaceae	5	4	1.25
5	Moraceae	5	3	1.66
6	Verbenaceae	4	4	1.00
7	Sapotaceae	2	2	1.00

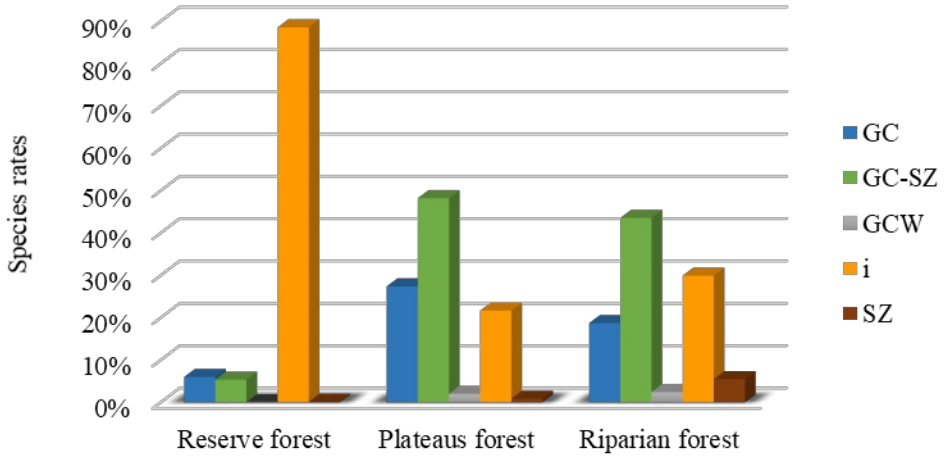

Figure 2. Repartition of the flora of the forest types inside the species endemic groups GC: Guineo-congolian endemics; SZ: Sudano-zambezian endemics; GC-SZ: Guineo-congolian and Sudano-zambezian's transition endemics, i: introduced species.

Plot richness

Analysis of floristic richness by forest type (Tables 2, 3) showed that there were no significant differences in floristic richness between riparian forests and plateaus forests. However, significant differences (F 17.693, ddl=2, p< 0.0001) were reported between the forest reserves and the riparian forests and between the forest reserve and the plateaus forests (Tables 2, 3). This number is significantly higher in the forest reserves than in the riparian and plateaus forests (Figure 3).

According to the scale factor of Morisita-Horn, the floristical similarity between the three groups of forests assessed in Dimbokro region is strong because higher than 60% (Table 4, Appendix). The highest floristical similarity (about 74.2%) was observed between the riparian forests and the forests of plateaus while the lowest was observed between the forest reserve and the riparian forests (Table 4, Appendix). Thirty species are common to the three forest groups (Appendix).

Plot diversity

The riparian forests and the forests of plateaus experienced higher species richness, Shannon-Weaner's diversity index, Simpson's diversity and Pielou's equitability index of woody plants with DBH≥10 cm than the forest reserve in Dimbokro Region (Table 2). The riparian forests showed the lowest standard deviation for these parameters (Table 2). For Simpson's index and Pielou's index, the forest reserves experienced higher standard deviation values than the forests of plateaus (Table 2). But for the species richness and Shannon-Weaner's index, the standard deviation values are higher in the

forests of plateaus in comparison to the forests reserve (Table 2). The difference of richness between the forest reserves and the two other forest groups is very highly (Chi square = 25,618; P < 0,0001) significant.

Table 2. Species richness and diversity inside the forest types

Parameters		Types of forest		
		Plateaus	Riparian	Reserves
Index of Shannon-Waener	Minimum	0.210	0.657	0.000
	Maximum	2.579	2.583	1.870
	Mean	1.601[a]	1.723[a]	0.832[b]
	Standard deviation	0.610	0.460	0.551
Index of Simpson	Minimum	0.102	0.289	0.000
	Maximum	0.906	0.916	0.783
	Mean	0.675[b]	0.737[b]	0.413[a]
	Standard deviation	0.204	0.137	0.258
Index of Piélou	Minimum	0.303	0.408	0.000
	Maximum	0.980	0.954	0.990
	Mean	0.753[b]	0.789[b]	0.516[a]
	Standard deviation	0.178	0.124	0.285
Species richness	Minimum	2.000	3.000	1.000
	Maximum	17.000	15.000	12.000
	Mean	8.833[b]	9.200[b]	4.867[a]
	Standard deviation	3.761	2.987	2.921

Table 3. Comparison of the floristic richness between the couples of forest types according to Tukey's test
Modalities with a 95% confidence interval

Contrast	Difference	Standardized difference	Critical value	P	Significant
Forest Reserve vs Forest Plateaus	19.387	5.430	2.385	< 0.0001	Yes
Forest Reserve vs Riparian Forest	17.000	4.802	2.385	< 0.0001	Yes
Riparian Forest vs Forest Plateaus	2.387	0.669	2.385	0.782	No

Table 4. Matrix of Morisita-Horn's similarity coefficient

	Types of forest		
	Forest reserves	Riparian forest	Plateaus forest
Forest reserve	100		
Riparian forest	66.7	100	
Plateaus forest	69.3	74.2	100

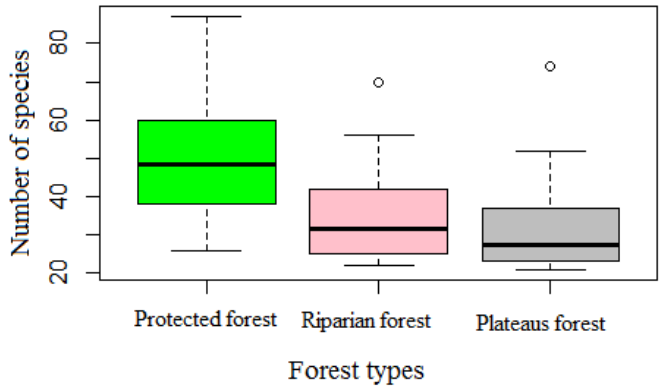

Figure 3. Boxplot of floristic richness in the different study plots according to protected forests, riparian forests and plateaus forests

Species distribution

The factorial analysis of correspondence of the woody plants with forest types showed two main groups of forest on the axis 2 that represents the forest type (Figure 4) except forest reserve plot 3 (FC 3).

The biggest group with 56 plots is constituted by all the forest of plateaus plots except FP3, FP6, FP13, FP14, FP15, FP28 and FP29, once part, and all the forest reserves plots except FC14, FC16 and FC23, other part (Figure 4). Some riparian forest plots (FG4, FG5, FG8, FG12, FG17, FG22 and FG23) are included in this group. Within this group, woody plant species are separated into an exotic species group gathering *Antiaris toxicaria* Loes. (Ant-tox), the only one native species which coexists with *Anacardium occidentale* L. (Ana-occ), *Gmelina arborea* Roxb. (Gme-arb), *Psidium guajava* L. (Psi-gua), *Senna siamea* (Lam.) Irw. & Barn. (Cas-sia), *Tectona grandis* L.f. (Tec-gra), and a native species group made of *Aidia genipifolia* (DC.) Dandy (Aid-gen), *Albizia adianthifolia* (Schum.) W.F.Wight (Alb-adi), *Allophylus africanus* P.Beauv. (All-afr) *Calycobolus africanus* (G.Don) Heine (Cal-afr) that is a liana, *Detarium macrocarpum* Harms (Det-mic), *Distemonanthus benthamianus* Baill. (Dis-ben), *Terminalia superba* Engl. & Diels (Ter-sup) and *Triplochiton scleroxylon* K.Schum. (Tri-scl). Between these two groups, there are *Glyphaea brevis* (Spreng.) Monachino (Gly-bre) and *Oxyanthus subpunctatus* (Hiern) Keay (Oxy-sub) at a median position (Figure 4).

The second group of 33 plots gathers all the riparian forest plots except FG4, FG5, FG8, FG12, FG17, FG22 and FG23 (Figure 4) and few plots of forest reserves (FC14, FC16 and FC23) and forest of plateaus (FG4, FG5, FG8, FG12, FG17, FG22 and FG23). Within this group, woody plant species are mostly native to savanna or to forest except *Azadirachta indica* A.Juss. (Aza-ind) which is exotic (Figure 4). The full savanna species are

Adansonia digitata L. (ada-dig), *Borassus aethiopum* Mart. (Bor-aet), *Bridelia ferruginea* Benth. (Bri-fer), *Daniellia oliveri* (Rolfe) Hutch. & Dalz. (Dan-oli), *Ficus vallis-choudae* Del. (Fic-val), *Parkia biglobosa* (Jacq.) R.Br. ex G.Don (Par-big) and *Pterocarpus erinaceus* Poir. (Pte-eri) to which can be added the water linked species such as *Millettia rhodantha* Baill. (Mill-rho) and *Pheonix reclinata* Jacq. (Pho-rec). The forest species (Figure 4, Appendix) are *Albizia adianthifolia* W.Wight (Alb-adi), *Albizia ferruginea* Benth. (Alb-fer), *Anthocleista djalonensis* A.Chev. (Ant-vog), *Aphania senegalensis* Radlk. (Aph-sen), *Celtis zenkeri* Engl. (Cel-zen), *Lannea nigritana* (Scott Elliot) Keay (Lan-nig) and *Mangifera indica* L. (Man-ind) to which can be added the water linked species like *Carapa procera* DC. (Car-pro) and *Cynometra megalophylla* Harms (Cyn-meg), and the forest edge species such as *Cola cordifolia* Sim (Col-cor) and *Pouteria alnifolia* (Baker) Robertgy (Pou-aln). These savanna species and forest species (Appendix) are spread on both.

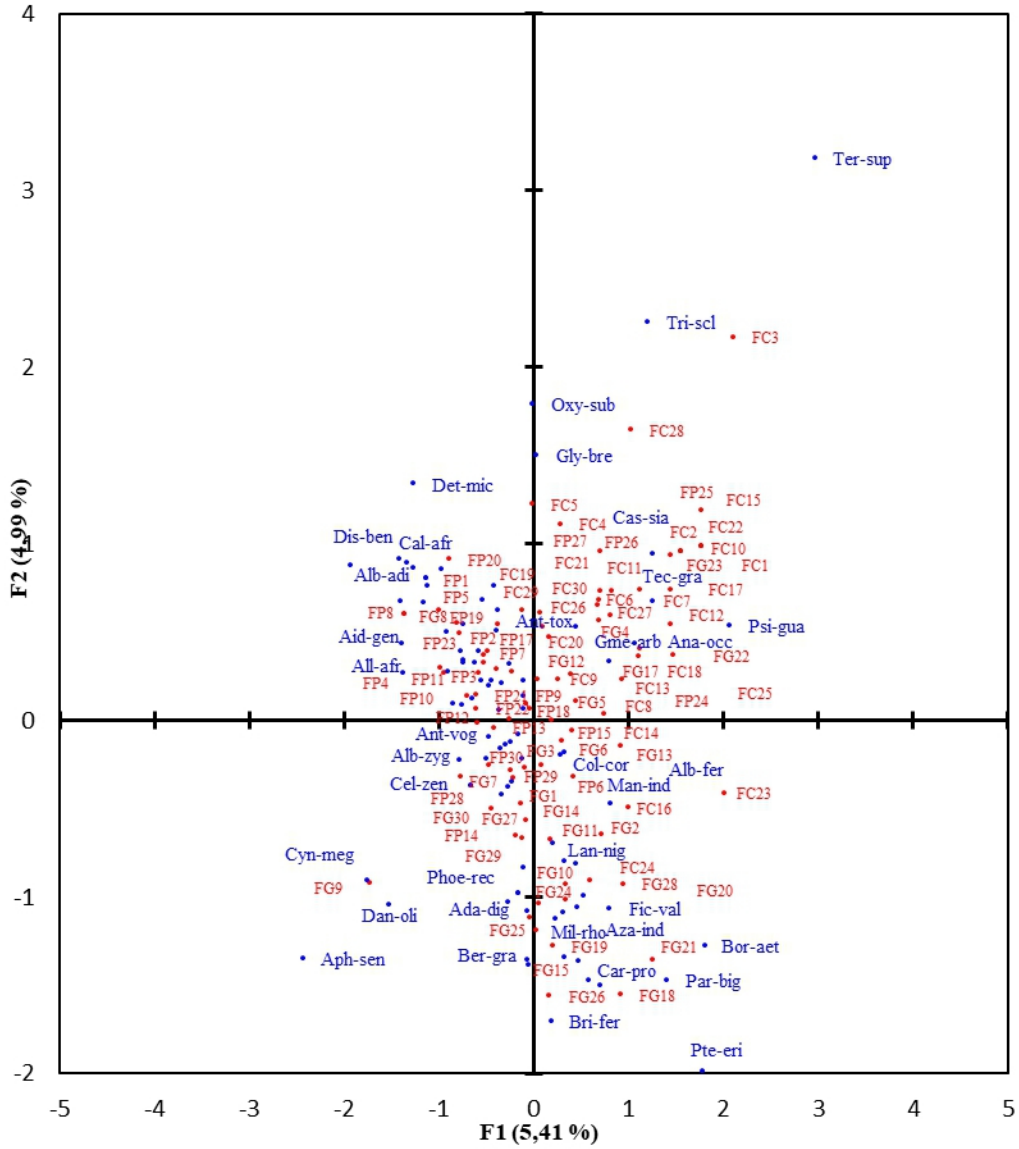

Figure 4. Factorial analysis of correspondence of the woody species and the plots on the two first axes

These first 2 axes absorb 10.40% of the total inertia with axis 1 that absorbs 5.41% of the total inertia and represents the openness of the vegetation. Axis 2 that absorbs 4.99% of the total inertia represents the slope. Read riparian forest for FG, forest reserve for FC and forest of plateaus for FP.

Woody plant species names (Appendix) are abbreviated using the three first letters of both genus and specific epithet names.

Keay (Lan-nig) and *Mangifera indica* L. (Man-ind) to which can be added the water linked species like *Carapa procera* DC. (Car-pro) and *Cynometra megalophylla* Harms (Cyn-meg), and the forest edge species such as *Cola cordifolia* Sim (Col-cor) and *Pouteria alnifolia* (Baker) Robertgy (Pou-aln). These savanna species and forest species (Appendix) are spread on both left and right sides of the axis 2 depending more of the vegetation openness (Figure 4).

The thirty commonest species to three forest groups encompass some natural forest species, some introduced species and some forest edge species (Appendix). These natural forest species are *Albizia adianthifolia* (Schumach.) W.F.Wright, *Albizia ferruginea* (Guill. & Perr.) Benth., *Albizia zygia* (DC.) J.F.Macbr., *Anthonotha macrophylla* P.Beauv., *Antiaris toxicaria* Loes. var. *africana* C.C.Berg, *Baphia pubescens* Hook.f., *Bersama abyssinica* Fresh ssp. *paullinioides*, *Blighia sapida* De Koenig, *Bombax buenopozense* P.Beauv., *Ceiba pentandra* (L.) Gaerth., *Chrysophyllum ubanguiense* D.J.Harris, *Dialium guineense* Willd., *Ficus exasperata* Vahl, *Ficus sur* Forsk., *Lannea nigritana* (Sc.Elliot) Keay, *Lecaniodiscus cupanioides* Planch., *Milicia excelsa* (Welw.) Benth., *Newbouldia laevis* (P.Beauv.) Seem. ex Bureau, *Sterculia tragacantha* Lindl., *Tricalysia macrophylla* K.Schum. and *Trichilia prieureana* A.Juss. ssp. *prieureana* (Appendix). The introduced species common to the three forest groups are *Delonix regia* Raf., *Gmelina arborea* Roxb., *Mangifera indica* L., *Senna siamea* (Lam.) Irw. and *Tectona grandis* L.f. (Appendix). The forest edge species such as *Cola cordifolia* Sim, *Dichrostachys cinerea* (L.) Wight & Arn. and *Pouteria alnifolia* (Baker) Robertgy are also common to the three forest groups (Appendix).

In terms of the species abundance, *Gmelina. arborea* Roxb., *Senna. siamea* (Lam.) Irw. and *Tectona. grandis* L.f. which are planted for logs showed the highest values of occurrence and individual number inside the plots and the forest groups (Appendix). These taxa experienced each between 15-26 occurrences (50-87%) and 225-775 individuals (29-50%) in the forest reserves (Appendix); together they represent 89% of the individuals in this forest group.

Discussion

The total number of 89 woody plant species with DBH≥10 cm found in the 9 ha plots of this stud) is similar to the 85-89 woody plant species found in a hectare plot of the natural forest of Scio forest Reserve (Nusbaumer *et al*., 2005; Kouamé *et al*., 2015; Kouamé, 2016) which is an evergreen rain forest type (Kouamé and Zoro Bi, 2010). But this richness is also slightly higher than the 71-78 woody plant species found in a hectare plot of the natural Haut-

sassandra forest Reserve (Kouamé, 1998) that is a semi-deciduous forest type (Kouamé and Zoro Bi, 2010). But the natural forest of Dimbokro region which is part of savanna and forest mosaics is almost similar to the semi-deciduous forest in Côte d'Ivoire with the predominance of the families Anacardiaceae, Leguminosae, Malvaceae, Moraceae, Sapindaceae, Sapotaceae, and Verbenaceae, (Table 1) as had shown White (1983) for the African rain semi-deciduous forest. Indeed, these families dominate the rain semi-deciduous forests of Côte d'Ivoire and of tropical Africa for woody plants with DBH≥10 cm (Kouamé, 1998; N'Da *et al*., 2008, Sonké, 1998).

The weaker richness and diversity of woody plants with DBH≥ 10 cm in forest reserves than the riparian forests and the forests of plateaus of Dimbokro region (Table 2) could be explained by the management technics applied in these forest reserves. In fact, the forest reserves are mostly planted ecosystems made of exotic timber trees like *Gmelina. arborea* Roxb. or *Tectona. grandis* L.f. (Appendix). But the maximum richness of 12 species (Table 2) found in these forest reserves shows that some areas of this group forest harbor the natural woody plants in association or not with the above exotic species as had found Kouamé (2016) in Duekoué forest reserve. The vegetation of this forest group undergoes transformations by man inducing the appearance of new plant species that are generally pioneers or weeds and play an important role by increasing local floristic richness (Kouamé, 2016). The highest values of the introduced species in the forest reserves shows how the flora of this forest type is highly transformed by the management activities. Dimbokro region forest reserves are similar to the most forest reserves in Côte d'Ivoire (Ahimin, 2006) that are planted for logs after the cutting of the natural forest vegetation (Sodefor, 1996; Kouamé, 1998). The predominance of the endemic species from the Guineo-congolian and Sudano-zambezian's transition area (GC-SZ) in both the riparian forests and the forests of plateaus confirms the status of the forest and savanna mosaic always attributed to natural vegetation of Dimbokro region (Monnier, 1983; White, 1983; Chatelain et al., 2004). According to Sinsin (1993), such vegetation shows a high proportion of the broad distribution area species.

The anthropogenic activities including annual bush fire and persistent agriculture in both riparian forests and forests of plateaus induce some exotic introduced species in these areas (Appendix) as had found Asia et al. (2008) and Akoègninou (2004). Depending on the intensity of the bush fires related to the annual drought and the quantity of the vegetation burn these forest groups can have a drastic decrease in plant richness (Sangne *et al*., 2008). But these two forest groups harbor higher richness, diversity and equitability of woody plants with DBH≥ 10 cm than the forest reserves in Dimbokro region (Table 2). That suggests the lower impacts of both bush fire and local

agriculture on the woody plant richness and distribution in comparison to those of the management process in the forest reserves.

The values of the diversity indices obtained within the 3 types of forest of Dimbokro region (Table 2) are lower than those found in several areas in Côte d'Ivoire. Indeed, the maximum diversity index value of Dimbokro region forest is lower than the minimum value of this index in Scio forest reserve natural vegetation (Kouamé *et al*., 2015; Kouamé, 2016) and other forests of Western Côte d'Ivoire (Bakayoko, 2005). But Dimbokro region forest types experienced higher Shannon-Weaner index values than the coffee and cocoa farms in the Duekoué and Scio forest reserves (Kouamé *et al*., 2015; Kouamé, 2016). These results could be explained by the extensive exploitation of woods by the forest owners and the rural populations in the study area. Group of woody plant species are usually cut or burnt for agricultural, social, economic and cultural purposes by local populations. Additionally, the local annual drought and bush fire are extremely severe due to the high temperature in the region (Eldin *et al*., 1979) and led to a selection of woody plant species that can survive in such conditions. Amongst these naturally selected woody plants there are 9 species with particular status according the red list of the UICN (2015) and 2 species on the list of Aké-Assi (1988). That gives a particular interest of conservation to Dimbokro region forests as had suggested Myers *et al*. (2000) that efforts of conservation of endemic species, rare species and threatened species of extinction must be a priority.

The two groups of forests shown by the factorial analysis of correspondence rather than three groups (riparian, plateaus and reserve) considered in this study illustrate that the forests in Dimbokro region depend only on the slope and the vegetation openness. Most of riparian forests are along the streams in the valleys with a low slope and meandering in the savanna area. Therefore, their flora is a combination of savanna species able to live in conditions of water saturated soil and of medium shade tolerance, and of forest species able to survive to the local annual drought and bush fire as had shown Spichiger and Pamard (1973), Spichiger (1977) and Devineau (1984) in Lamto region. Due to their short width, they are not explicitly subject of introduction of exotic woody plants like *Gmelina. arborea* Roxb., *Senna. siamea* (Lam.) Irw. & Barn. and *Tectona. grandis* L.f. The presence of these species within some riparian forests could be explained by the plant natural distribution agents like the wind, the animals and the water's flux that bring their seeds in the milieu. Both forest reserves and of plateaus are at the high slopes harbor the exotic species introduced during the forest management activities and the semi-deciduous forest natural species as demonstrated Adjonou *et al*. (2010). Finally, the forests of plateaus have a medium position amongst the three forest groups studied in Dimbokro region. In terms of

richness and diversity, they are similar to the riparian forests while in terms of species spatial distribution, they are rather closed to the forest reserves.

Conclusion

The flora of woody plants with DBH ≥ 10 cm assessed in the 90 plots of 1000 m² in Dimbokro region forest types showed 89 species 77 genera and 32 families among which the main are families Leguminosae, Malvaceae, Sapindaceae, Anacardiaceae, Moraceae and Verbenaceae. Despite their lower richness in comparison to other rainforests in Côte d'Ivoire, Dimbokro region forests harbor at least 11 species with particular status consisting of 9 species on the red list of UICN and 2 species on the list of Aké-Assi. The forests of plateaus and the riparian forests harbor the same richness about 9 species of woody plants with DBH ≥ 10 cm per plot of 1000 m² dominated by the Guineo-congolian and the Sudano-zambezian transition endemic species. Both forest types experienced similar diversity and equitability but are different in terms of the species spatial distribution driven by the slope height and the vegetation openness. The forest reserves were poorer with 5 species plot of 1000 m² and showed lower diversity and equitability; their flora was mostly reduced to the planted species by the forest service to which few remaining natural species were sometime associated. The height of the slope and the vegetation openness of these forest reserves led to similar spatial distribution of the woody plants with DBH ≥ 10 cm as the forests of plateaus. Finally, our hypothesis to have similar richness and diversity in overall forests of Dimbokro due to short distance between them and the similar anthropogenic activities that they are submitted is rejected.

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Appendix

Occurrences and individual number of the woody plant species in the forest types of Dimbokro region

	Forest types	Forest reserves		Riparian forests		Forests of plateaus	
N°	Species	Occurrence	Individual number	Occurrence	Individual number	Occurrence	Individual number
1	*Adansonia digitata* L.					1	1
2	*Aidia genipiflora* (DC.) Dandy			4	7	7	22
3	*Albizia adianthifolia* (Schumach.) W.F.Wright	2	6	3	5	11	31
4	*Albizia ferruginea* (Guill. & Perr.) Benth.	5	19	8	27	5	25
5	*Albizia zygia* (DC.) J.F.Macbr.	1	1	8	12	15	54
6	*Allophylus africanus* P.Beauv.					2	2
7	*Alstonia boonei* De Wild.	1	9	1	2	3	5
8	*Anacardium occidentalis* L.			2	3		
9	*Anthocleista vogelii Planch*.			1	4	3	6
10	*Anthonotha macrophylla* P.Beauv.	2	3	5	37	4	18
11	*Antiaris toxicaria Loes*. var. *africana* C.C.Berg	6	8	2	2	9	19
12	*Aphania senegalensis* (Juss. ex Poir.) Radlk.			1	1		
13	*Aubrevillea kerstingii* (Harms) Pellegr.			1	3	1	3
14	*Azadirachta indica* A. Juss.			5	17		
15	*Baphia pubescens* Hook.f.	3	13	5	21	8	26
16	*Berlinia grandiflora* (Vahl) Hutch. & DaIz.			7	22		
17	*Berlinia occidentalis* Keay			2	7	4	5
18	*Bersama abyssinica* Fresh ssp. *paullinioides*	1	1	3	3		

19	*Blighia sapida* De Koenig	1	1	2	5	11	15
20	*Blighia unijugata* Baker					3	4
21	*Bombax buenopozense* P.Beauv.	4	4	4	6	10	17
22	*Borassus aethiopum* Mart.	1	3	3	3		
23	*Bridelia ferruginea* Benth.			4	5		
24	*Calycobolus africanus* (G.Don) Heine	1	1			1	1
25	*Carapa procera* (DC.) De Wilde			1	12		
26	*Ceiba pentandra* (L.) Gaerth.	4	10	7	12	13	43
27	*Celtis zenkeri* EngI.			1	1	4	6
28	*Chaetacme aristata* E.Mey. ex Planch.			1	6		
29	*Christiana afrïcana* DC.					1	2
30	*Chrysophyllum ubanguiense* D.J.Harris	1	1	1	1	1	1
31	*Cola caricaefolia* (G. Don) K.Schum.					2	2
32	*Cola cordifolia* (Cav.) R.Br.	5	9	8	49	6	19
33	*Croton aubrevillei* J.Léanard					1	1
34	*Cussonia arborea* Hochst. ex A.Rich.					1	1
35	*Cynometra megalophylla* Harms			2	13		
36	*Dalbergia oblongifolia* G.Don					1	1
37	*Daniellia oliveri* Hutch. & Dalz.			2	16		
38	*Delonix regia* Raf.	1	4	2	15	3	84
39	*Dennettia tripetala* Bak.f.					1	2
40	*Detarium microcarpum* Guill. & Perr.					1	1
41	*Dialium guineense* Willd.	4	12	7	27	11	29

42	*Dichapetalum crassifolium* Chodat					1	1
43	*Dichrostachys cinerea* (L.) Wight & Arn.	1	2	1	1	3	5
44	*Distemonanthus benthamianus* Baill.			1	1	1	1
45	*Dracaena mannii* Baker					3	8
46	*Erythrophleum suaveolens* Brenan			2	3	2	6
47	*Ficus exasperata* Vahl	2	2	6	8	3	5
48	*Ficus sur* Forsk.	3	6	13	98	1	1
49	*Ficus vallis-choudae* Del.			2	4	1	1
50	*Glyphaea brevis* (Spreng.) Monachino	3	4			1	1
51	*Gmelina arborea* Roxb.	20	375	14	122	12	99
52	*Harrisonia abyssinica* Oliv.					1	3
53	*Holarrhena floribunda* (G.Don) Dur. & Schinz			10	16	7	12
54	*Lannea barteri* (Oliv.) Engl.			9	14	2	2
55	*Lannea nigritana* (Sc.Elliot) Keay	1	2	1	3		
56	*Lecaniodiscus cupanioides* Planch.	5	8	2	7	7	16
57	*Mangifera indica* L.	3	6	3	12	1	1
58	*Margaritaria discoidea* (Baill.) Webster			6	18	1	1
59	*Milicia excelsa* (Welw.) Benth.	2	2	2	3	2	2
60	*Millettia rhodontha* Baill.			7	18	3	10
61	*Millettia zechiana* Harms			2	2	1	8
62	*Newbouldia laevis* (P.Beauv.) Seem. ex Bureau	1	1	2	2	2	3
63	*Ochthocosmus africanus* Hook.f.					2	13
64	*Olax subscorpioidea* Oliv.			2	2	1	3

65	*Oxyanthus subpunctatus* (Hiern.) Keay	1	1				
66	*Parkia biglobosa* (Jacq.) Benth.	1	1	2	3		
67	*Phoenix reclinata* Jacq.			5	15	1	1
68	*Piliostigma thonningii* Millne-Redhead			6	18		
69	*Pouteria alnifolia* (Bak.) Roberty	3	4	10	54	13	131
70	*Psidium guajava* L.			1	1		
71	*Pterocarpus erinaceus* Poilr.			1	1		
72	*Ricinodendron heudelotii* (Baill.) Pierre ex Pax	1	1			4	14
73	*Rothmannia hispida* (K.Schum.) Fagerl.	1	1	2	2		
74	*Sarcocephalus latifolius* (Smith) Bruce			4	4		
75	*Scottellia klaineana* Pierre					2	2
76	*Senna siamea* (Lam.) Irw.	15	225	8	90	5	81
77	*Smeathmannia pubescens* Soland ex R.Br.			2	3	1	1
78	*Spondias mombin* L.	3	4	7	10	10	18
79	*Sterculia tragacantha* Lindl.	2	2	6	28	5	9
80	*Tectona grandis* L.f.	26	775	11	79	2	28
81	*Terminalia schimperi* Hochst.	1	1	9	33	3	5
82	*Terminalia superb*a Engl. & Diels	1	2				
83	*Tricalysia macrophylla* K.Schum	2	5	5	11	6	9
84	*Tricalysia reflexa* Hutch. var. *reflexa*					1	1
85	*Trichilia prieureana* A.Juss. subsp. *prieureana*	2	3	2	3	5	7

86	*Triplochiton scleroxylon* K.Schum.	4	15				
87	*Vitex doniana* Sweet			6	10	1	1
88	*Warneckea membranifolia* (Hook.f.) Jac.-Fél.					1	4
89	*Zanthoxylum leprieurii* Guill. & Perr.					1	1
	General total number	30	1553	30	1043	30	961