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A Survey of Mycorrhizal Colonization in the 50-ha Korup Forest Dynamic Plot in Cameroon

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Abstract

A study was carried out in the 50-ha Korup Forest Dynamic Plot in South West Cameroon, to evaluate the diversity of mycorrhizal associations as well as to determine the effect of habitat types on the type of mycorrhizal association. A total of 781 individual trees belonging to 51 families, 165 genera and 252 tree species, were sampled from the four habitat types found in the plot: low drier, hill slope, ridge top and wetland complexes. In each habitat type, all stems ≤ 1 cm depth at breast height had already been tagged, measured, mapped and identified to the species level. Root samples were collected, cleared, stained and examined microscopically for mycorrhizal type. Of the total number of species sampled, 248 (98.41%) formed mycorrhizal associations with only 4 (1.59%) being non mycorrhizal. For mycorrhizal trees, 232 (93.55%) formed exclusively arbuscular mycorrhiza, 10 (4.03%) formed ectomycorrhiza, while 6 (2.42%) formed both ecto- and arbuscular mycorrhiza. The ridge top harbored the least number (152) of mycorrhizal trees while the low drier area harbored the most number (266) of mycorrhizal trees. Although habitat effect was not significant in influencing mycorrhizal colonization of tree species, some tree species did show aggregated patterns in particular habitats.

Keywords

Korup Forest Dynamic Plot, Arbuscular Mycorrhiza, Ectomycorrhiza, Cameroon

1. Introduction

Some of the most important functions of terrestrial ecosystems as well as interactions between plants take place

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below ground and mycorrhizal fungi play important roles in soil ecology.

Mycorrhizal associations which were previously thought to be limited to temperate zones have been shown to occur in natural tropical forests [1]-[7].

Mycorrhizal fungi are known to play important roles in the mineral nutrition and water uptake of plants, protection against diseases etc. [8]. They give plants access to otherwise unavailable mineral sources. In spite of these important roles that mycorrhizal fungi play in plant growth and development, ecological data on the distribution and abundance of colonization especially in tropical ecosystems, are scarce. Information on the role played by mycorrhizal fungi in nutrient cycling in tropical ecosystems is also sketchy.

The study carried out by [5] was a survey of mycorrhizal infection in an Amazonian rain forest while [3] reviewed mycorrhizas in tropical rain forests. Reference [9] evaluated mycorrhizal associations in the rain forests of South Cameroon. Reference [1] looked at the mycorrhizal status of *Gnetum* spp. in Cameroon. No study has been reported so far on the type of mycorrhizas found in the 50-ha Korup Forest Dynamic Plot (KFDP). Research on mycorrhizas in African tropical forests is expected to help demonstrate their role in the maintenance of high biodiversity and productivity of these forests.

For there to be any meaningful conclusions as to the role of mycorrhizal fungi in biodiversity and productivity in the tropics, there must be a proper inventory on the type of mycorrhizas formed in as many of such systems as possible. This information can then be related to nutrient cycling studies before proper conclusions are drawn.

The 50-Hectare Korup Forest Dynamics Plot (KFDP) which was established in 1996, is an area mapped out within the Korup National Park (KNP), located in the Guineo-Congolian forest in the southwestern part of Cameroon. A detailed description of this plot is given in [10] and [11]. The main objective that led to the establishment of the KFDP was to enable the cataloging, studying and conservation of the extensive biodiversity of Cameroon [10].

A detailed topographic survey of the plot has been carried out and the plot is divided into 1250 quadrats and subquadrats. All trees with a diameter at breast height (dbh) of over 1 cm have been enumerated and each tree identified using standard methods with most herbarium vouchers held at the Limbe Botanic Garden herbarium, National Herbarium in Yaoundé and Missouri Botanic Garden herbarium. Maps have been produced showing the distribution of each species within the 50-ha plot [10]. The results on the plant diversity study carried out on this plot as reported in [10] and [12] go to confirm the richness in plant species diversity in the tropical rain forest of Cameroon.

In order to clearly understand how tropical forests maintain such high levels of species diversity, it would be necessary to evaluate below ground diversity of the KFDP, of which mycorrhiza associations are the most important.

An understanding of mycorrhizal diversity in the forest soil and the integration of such information into already existing data (plant enumeration and forest composition) would therefore help in explaining the role of interactions in ecosystem functioning and dynamics.

The overall objective of this study was therefore to examine the mycorrhizal status of the tree species in the 50-ha KFDP in Korup National Park. The observations would be compared to the nutrient cycling and other relevant data that already exist on this study site, with the hope of improving on the understanding of ecosystem processes.

In the course of the investigation, an attempt was made to answer the following questions; 1) Which mycorrhiza association was more prevalent in the KFDP? 2) Are arbuscular mycorrhizas more abundant as compared to ectomycorrhizas? 3) Are ectomycorrhiza tree species restricted to particular microhabitats? 4) How does mycorrhiza type influence species coexistence and diversity?

2. Materials and Methods

This study was carried out in the year 2010.

2.1. Site Description

The KNP is located between 4˚54' to 5˚28'N latitude and 8˚42' to 9˚16'E longitude and is in the Lower Guinean section of the Guineo-Congolian forest which is the second largest block (127,000 ha) of the tropical rain forest. The 50-ha KFDP is located around the southern end of the KNP in Mundemba, Cameroon. The plot has a dimension of 1000 m (N-S axis) by 500 m (E-W) axis. A detailed description of the site is given by [11].

The 50-ha KFDP was the best site to evaluate the spatial relationship between mycorrhiza status and trees species diversity because of its tree species richness. This plot has 329,026 trees belonging to 62 identified families. The area has been well mapped out into quadrats of 20 m × 20 m. All trees within each quadrat have been identified to the species level and data on the topography of the site is also available [11].

2.2. Plot Layout

100 quadrats of 20 m × 20 m were selected at random within the plot as specific study sites. Selection was such that the different topography was represented. Care was also taken to ensure that quadrats with fewer or no trees were represented. Selection was facilitated by the use of existing topographic survey and tree maps of the area. Within the selected quadrats, five individuals representing each family of tree existing in it were sampled randomly.

2.3. Field Collection of Roots

Root samples were collected from randomly selected plants within the four habitat types in the study site. Fine roots were collected by tracing larger roots from the collar of tagged trees with the aid of a knife and trowel. Samples were washed free of debris and preserved in labeled vials containing 50% ethanol.

Sampling was done four times a year. There was sampling during the dry season, the transition between dry and rainy season, during the rainy season and the transition period between the wet and the dry season.

2.4. Evaluation of Root Samples

This was carried out based on the method reported in [13]. Non-EM root samples and portions of EM root samples were rinsed properly with tap water to remove the ethanol. These were then cleared by immersing in 10% KOH for 48 h. Roots were rinsed with tap water to remove the clearing solution, before staining in 0.05% trypan blue for 2 - 3 days. Stained roots were rinsed in tap water and hand sectioned with the aid of a razor blade into approximately 1 cm long pieces. Pieces were selected at random, placed on a glass slide and gently squashed under a cover slip followed by observation under a compound microscope. The usual basis for determining arbuscular mycorrhiza was the presence of characteristic internal hyphae and arbuscules while ectomycorrhiza was determined by the presence of a hyphal mantle on ultimate-order rootlets and hartig net on sections.

2.5. Data Analysis

Information on diversity of mycorrhizal associations collected would be compared with already existing data on plant species diversity of the study site to see whether there is any correlation. Data was analyzed using the Pearsons chi-square test to determine the effect of habitat type on mycorrhiza colonization, as well as to determine the influence of mycorrhiza in the maintenance of high tree species diversity.

3. Results

3.1. Mycorrhiza Colonization

The 781 individual trees sampled belonged to 51 families, 165 genera and 252 tree species. Of these, 248 species were mycorrhizal with only 4 being non mycorrhizal. Most of the trees (92.06%) formed AM with just 3.97% forming EM. The observations are summarized on **Table 1** and **Appendix**.

Ten tree species formed EM which included; *Angylocalyx oligophyllus* Bak. (Fabaceae), *Angylocalyx pynaertii* (Fabaceae), *Anthonotha fragrance* (Fabaceae), *Anthonotha* sp. (Fabaceae), *Baikiaea insignis* Taub. (Fabaceae), *Baphia capparidifolia* Bak. (Fabaceae), *Berlinia auriculata* Benth. (Fabaceae), *Calpocalyx dinklagei* Harms. (Fabaceae), *Dialium* sp. (Fabaceae) and *Gilbertiodendron demonstrans* Baill. (Fabaceae). Dual associations of AM and EM were found in *Hymenostegia afzelii* Oliv., *Uapaca staudtii* Pax., *Antidesma laciniatum* Muell., *Baphia laurifolia* Baill., *Leptonychia pallida* K. Schum. and *Soyauxia gabonensis* Oliv. but only *H. afzelii* and *U. staudtii* harbored both AM and EM structures in the same root sample. *Lasianthus batangensis* K. Schum., *Trichoscypha preussii* Engl. *Hypodaphnis zenkeri* Engl. and *Memecylon zenkeri* Gilg. did not harbor any mycorrhizal structures. All families formed mycorrhizal associations, with EsM associations being seemingly restricted to the Fabaceae (**Appendix**).

3.2. Effect of Habitat Type on Mycorrhiza Colonization

Table 2 gives a summary of mycorrhiza colonization in the different habitats. Generally, mycorrhiza trees were found in all the four habitat types: low-drier (LD), hill slopes (HS), ridge top (RT) and wetland complexes (WC). Over 98% of the trees sampled in each habitat were mycorrhizal with most of them forming AM nonetheless; a few tree species showed some variability in their status and type of mycorrhiza formed (**Table 3**).

From the two way ANOVA test, habitat type had no significant effect (P = 0.593) on mycorrhization. Pearson correlation test showed that there was no correlation (P = 0.739) between abundance of mycorrhizal tree species per habitat type and tree diversity for the different habitat types.

From the data collected by [10] which gave distribution maps of individual tree species and the number of stem counts, we analyzed and observed that out of the ten tree species that formed EM, 3 of the tree species showed random distribution while 7 tree species were clumped in some habitat types (**Table 4**).

4. Discussions

Over 98.4% of the total number of tree species sampled formed mycorrhiza. This observation was consistent with those of [9] in which all 100 taxa studied were mycorrhizal. In an earlier study carried out by [14] in a different part of the korup national park, 56 tree species were investigated for mycorrhiza colonization and only one species; *Warmekea memcyloides* (Melastomataceae) was non mycorrhizal. Reference [15] also recorded a 100% mycorrhizal presence in their study.

Trees harboring AM structures far exceeded those forming EM. 232 tree species out of the 252 surveyed formed AM. This finding was quite similar to those of previous work carried out in this domain as compiled in [16] and [2]. The results from this study also confirmed the taxonomic dominance of AM tree species in the rain forests. All the four habitat types were glaringly dominated by AM trees both in species and in number of trees, except in the wetland complexes where the number of EM trees exceeded the number of AM trees (**Table 5**).

Table 1. Summary of the results obtained after sampling 781 individual trees for the presence of mycorrhiza structures.

Mycotype	Number of individual trees	Number of tree species	% of tree species
AM	709	232	92.06
EM	57	10	3.97
Dual (AM and EM)	8	6	2.38
Non mycorrhizal	7	4	1.59

Table 2. Summary of mycorrhiza status and type in different habitat types in the 50-ha KFDP.

Habitat type	Total individual trees sampled	Total tree species sampled	Mycotype	Number of individual trees	Tree species	% tree species
Low-lying drier areas	268	147	AM	245	137	93.20
			EM	19	7	4.76
			AM and EM	2	1	0.68
			None	2	2	1.36
Hill slopes and gullies	178	117	AM	160	108	92.31
			EM	15	7	5.98
			AM and EM	2	1	0.86
			None	1	1	0.86
Ridge top	153	81	AM	142	76	93.83
			EM	7	3	3.70
			AM and EM	3	1	1.24
			None	1	1	1.24
Wetland complexes	182	100	AM	162	90	90.00
			EM	16	7	7.00
			AM and EM	1	1	1.00
			None	3	2	2.00

Table 3. Inconsistency in mycorrhiza types of tree species in the different habitats of the 50-ha KFDP.

Species	Family	Low-lying drier areas	Hill slopes and gullies	Ridge top	Wetland complexes
Dactyladenia staudtii	Chrysobalanaceae	AM	AM	X	X
Baphia laurifolia	Fabaceae	AM	EM	—	—
Hymenostegia afzelii	Fabaceae	EM_AM	EM	—	EM
Leptonychia pallida	Malvaceae	—	AM	EM	—
Soyauxia gabonensis	Medusandraceae	AM	—	—	EM
Uapaca staudtii	Phyllanthaceae	EM	EM_AM	EM, AM	EM
Aulacocalyx jaminiflora	Rubiaceae	AM	—	X	—

Note: List of Abbreviations; X = Absence of mycorrhiza structures; EM_AM = AM and EM structures on the same root; EM, AM = AM and EM structures on different root samples; — = tree species were not sampled in the habitat.

Table 4. Distribution of EM tree species and stem count in the 50-ha KFDP.

Distribution pattern	List of EM tree species	Stem count in study site
Random	*Angylocalyx pynaertii*	57
	Anthonotha fragrans	247
	Dialium sp.	66
Aggregated/clumped	*Angylocalyx oligopyllus*	5796
	Calpocalyx dinklagei	3066
	Anthonotha sp.	7
	Baikaea insignis	20
	Baphia capparidifolia	1767
	Berlinia auriculata	726
	Gilbertiodendron demonstrans	288

Table 5. Abundance of mycorrhizal trees in different habitat types in the 50-ha KFDP.

Habitat type	Area per habitat	Abundance of AM trees	Abundance of AM trees per hectare	Abundance of EM trees	Abundance of EM trees per hectare	Tree species diversity per quadrat per habitat type
Low-lying drier areas	15.2 ha	81602	5368.6	3334	219.3	32.09
Hill slopes and gullies	9.5 ha	325581	3429.6	3194	336.2	32.03
Ridge top	9.0 ha	31461	3495.7	1976	219.6	27.57
Wetland complexes	16.ha	46950	2880.4	5609	344.1	26.59

This observation was unlike that of [6] in which endomycorrhizal species dominated in number of species but not in volume.

Ten tree species formed EM and all belonged to the Fabaceae. Reference [8] had earlier shown that only about 3% of tree species do form EM. Similarly [9] found that 26 out of the 100 tree species sampled formed EM. Reference [14] recorded 20 ectomycorrhizal tree species out f the 56 sampled. This was certainly because they set out to sample some species of leguminosae and members of this family had been reported to be ectomycorrhizal [2] [16].

Six tree species formed dual mycorrhizal associations, but just two species; *Hymenostegia afzelii* and *Uapaca staudtii* harbored both EM and AM structures in the same root sample. Reference [17] also found dual mycorrhiza associations in the korup national park. *U. staudtii* was also reported by [16] as being dual mycorrhizal.

Dactyladenia staudtii Engl. was non mycorrhizal in the wetland complexes but formed AM in the hill slopes and gullies. This was probably because the very wet nature of the wetland complexes affected the availability of inoculum as well as the plants' ability to form mycorrhizas. *Aulacocalyx jamiiflora* was AM in low-lying drier areas but non mycorrhizal in the ridge top. The change in altitude might have been the reason for this observation. Reference [2] proposed that inconsistency in mycorrhizal relationships could be attributed to habitat factors that result to adaptation to stressful conditions such as waterlogged soils.

Hypodaphnis zenkeri was non mycorrhizal in this study but had been reported to form AM by [14]. This difference in observation was probably because this plant was only sampled in the wetland complexes in this study. It may have adapted the non mycorrhizal status to enable it survive the waterlogged nature of its surrounding.

5. Conclusion

Since habitat type did not significantly influence mycorrhizal colonization, it was concluded that mycorrhiza could not be seen as a biological tool for driving species diversity in the study site. Most of the trees sampled formed arbuscular mycorrhiza while ectomycorrhiza formation seemed to be restricted to the fabaceae.

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Appendix. Mycorrhizal status and type, of tree species collected at random from four habitat types in the 50-ha KFDP, Korup National Park, Cameroon; including tree species of economic and conservative values.

SN	FAMILY	SPECIES	LD		HS		RT		WC		E/C
			AM	EM	AM	EM	AM	EM	AM	EM	
1	Acanthaceae	*Asystasia macrophylla*	+	-							
2		*Dasylepis blackii*	+	-			+	-	+	-	
3		*Scottelia klaineana*			+	-					
4		*Trichoscypha acuminata*					+	-	+	-	
5		*Trichoscypha klainei*	+	-							
6	Anacardiaceae	*Trichoscypha patens*	+	-	+	-	+	-			EF
7		*Trichoscypha preussii*	-	-							
8		*Trichoscypha* sp.	+	-	+	-					
9		*Trichoscypha* sp. 3			+	-					
10		*Annickia chlorantha*	+	-							M, ND, LT
11		*Isolana campanulata*	+	-	+	-					
12		*Isolana* sp.			+	-					
13		*Pachypodanthium* sp.							+	-	
14		*Piptostigma oyemense*	+	-			+	-	+	-	
15		*Polyceratocarpus parviflorus*	+	-			+	-	+	-	
16	Annonaceae	*Uvariastrum pynaertii*			+	-			+	-	
17		*Uvariodendron* sp.	+	-	+	-	+	-	+	-	
18		*Uvariopsis bakeriana*			+	-					R
19		*Uvariopsis congolana*					+	-			
20		*Uvariopsis korupensis*							+	-	R
21		*Xylopia acutiflora*	+	-					+	-	
22		*Xylopia aethiopica*					+	-			M, LT, EF
23		*Xylopia* sp. 2					+	-			
24		*Alstonia boonei*			+	-	+	-	+	-	M, CT
25		*Funtumia elastica*	+	-							
26		*Hunteria umbellata*	+	-	+	-	+	-			
27		*Pleiocarpa rostrata*	+	-	+	-	+	-			
28	Apocynaceae	*Rauvolfia caffra*	+	-	+	-	+	-	+	-	
29		*Rauvolfia mannii*	+	-					+	-	
30		*Rauvolfia vomitoria*	+	-			+	-			M
31		*Tabernaemontana brachyantha*	+	-					+	-	M
32		*Tabernaemontana crassa*	+	-	+	-					M
33	Asteraceae	*Vernonia frondosa*	+	-					+	-	
34	Bignoniaceae	*Spathodea campanulata*			+	-					
35	Burseraceae	*Dacryodes klaineana*							+	-	36
36		*Santiria balsamifera*	+	-							
37		*Salacia lehmbachii*	+	-	+	-	+	-	+	-	
38	Celastraceae	*Salacia loloensis*	+	-	+	-	+	-	+	-	
39		*Salacia* sp. nov.	+	-	+	-	+	-			R
40		*Chrysobalanus icaco*	+	-	+	-					
41	Chrysobalanaceae	*Dactyladenia staudtii*			+	-			-	-	
42		*Magnistipula glaberrima*	+	-	+	-					
43		*Dactyladenia pallescens*									
44	Clusiaceae	*Endodesmia calophylloides*	+	-			+	-	+	-	
45		*Garcinia conrauana*	+	-							

Continued

46		*Garcinia gnetoides*	+	-	+	-			+	-	
47		*Garcinia kola*	+	-							CEF, CT, M
48		*Garcinia mannii*	+	-	+	-			+	-	
49		*Garcinia ovalifolia*			+	-					
50		*Pentadesma grandifolia*					+	-			
51		*Symphonia globulifera*	+	-			+	-	+	-	
52	Connaraceae	*Jollydora duparquetiana*			+	-	+	-			
53		*Jollydora glandulosa*	+	-			+	-			
54	Dichapetalaceae	*Tapura africana*			+	-			+	-	
55		*Diospyros gabunensis*	+	-	+	-					
56		*Diospyros gracilescens*			+	-					
57		*Diospyros holyeana*	+	-	+	-					
58	Ebenaceae	*Diospyros iturensis*	+	-					+	-	
59		*Diospyros obliquifolia*	+	-					+	-	
60		*Diospyros preussii*	+	-	+	-			+	-	
61		*Diospyros psuedomespilus*			+	-	+	-			R
62		*Diospyros zenkeri*					+	-			
63	Erythroxylaceae	*Erythroxylum mannii*	+	-							
64		*Croton longiracemosus*			+	-					
65		*Crotonogyne strigosa*	+	-							
66		*Crotonogynopsis* sp. nov.	+	-					+	-	R
67		*Dichostemma glaucescens*	+	-			+	-			
68	Euphobiaceae	*Discoglypremna caloneura*							+	-	
69		*Klaineanthus gaboniae*	+	-			+	-			
70		*Macaranga monandra*	+				+	-	+	-	
71		*Maprounea membranacea*			+	-					
72		*Pycnocoma macrophylla*			+	-					
73		*Sapium ellipticum*					+	-			
74		*Angylocalyx oligophyllus*	-	+	-	+	-	+			EF
75		*Angylocalyx pynaertii*			-	+					EF
76		*Anthonatha fragrans*	-	+	-	+					CT
77		*Anthonotha* sp.	-	+							
78		*Baikiaea insignis*	-	+							
79		*Baphia capparidifolia*			-	+	-	+	-	+	
80		*Baphia laurifolia*	+	-	-	+					LT
81		*Berlinia auriculata*	-	+							
82	Fabaceae	*Calpocalyx dinklagei*	-	+	-	+			-	+	
83		*Dialium pachyphyllum*	+	-							LT
84		*Dialium* sp.							-	+	
85		*Gilbertiodendron demonstrans*							-	+	
86		*Hymenostegia afzelii*	+	+	-	+			-	+	
87		*Hymenostegia* sp. nov.	+	-							
88		*Newtonia duparquetiana*							+	-	LT
89		*Piptadeniastrum africanum*	+	-							LT, M
90		*Talbotiella eketensis*	+	-					+	-	
91		*Mostuea brunonis*	+	-					+	-	
92	Gelsemiaceae	*Anthocleista schweinfurthii*			+	-					LT
93		*Anthocleista vogelii*	+	-					+	-	LT

Continued

94	Icacinaceae	*Lasianthera africana*	+	-	+	-	+	-	+	-	LT, EL
95		*Leptaulus daphnoides*	+	-			+	-			
96		*Desbordesia glaucescens*	+	-							LT, ES
97	Irvingiaceae	*Irvingia gabonensis*	+	-					+	-	CES
98		*Klainedoxa trillesii*			+	-					
99	Lamiaceae	*Vitex grandifolia*	+	-			+	-			
100		*Beilschmiedia jacques-felixii*							+	-	
101	Lauraceae	*Beilschmiedia* sp. 2					+	-			
102		*Beilschmiedia* sp. 3									
103		*Hypodaphnis zenkeri*							-	-	LT
104		*Napoleonaea talbotii*	+	-	+	-					
105		*Oubanguia alata*	+	-	+	-			+	-	ES
106	Lecythidaceae	*Oubanguia laurifolia*							+	-	
107		*Rhaptopetalum* sp. nov.					+	-	+	-	R
108		*Scytopetalum klaineana*							+	-	
109	Lepidobotryaceae	*Lepidobotrys staudtii*					+	-			
110		*Cola acuminata*			+	-					CES
111		*Cola cauliflora*	+	-					+	-	
112		*Cola chlamydantha*	+	-							
113		*Cola digitata*	+	-							
114		*Cola lepidota*	+	-							CEF
115		*Cola praeacuta*	+	-	+	-	+	-	+	-	R
116		*Cola rostrata*	+	-	+	-					
117		*Cola semecarpophylla*	+	-	+	-					
118	Malvaceae	*Cola* sp. nov. 2	+	-	+	-	+	-	+	-	
119		*Cola* sp. nov. 3	+	-					+	-	R
120		*Cola suboppositifolia*			+	-	+	-	+	-	R
121		*Cola verticillata*							+	-	CEF
122		*Leptonychia echinocarpa*	+	-					+	-	
123		*Leptonychia pallida*			+	-	-	+			
124		*Microcos coriacea*							+	-	
125		*Scaphopetalum blackii*	+	-					+	-	
126		*Sterculia oblonga*			+	-					CT
127		*Sterculia tragacantha*			+	-					CT
128	Medusandraceae	*Soyauxia talbotii*	+	-					-	+	R
129	Melastomataceae	*Warneckea membranifolia*	+	-	+	-			+	-	
130		*Carapa parvifolia*	+	-					+	-	
131	Meliaceae	*Guarea thompsonii*			+	-					CT
132		*Trichilia* sp.	+	-							
133		*Turraeanthus mannii*	+	-							R
134	Melianthaceae	*Bersama* sp.					+	-	+	-	
135	Memecylaceae	*Memecylon lateriflorum*	+	-					+	-	
136		*Memecylon zenkeri*			-	-					
137	Monimiaceae	*Glossocalyx brevipes*	+	-					+	-	
138	Myristicaceae	*Coelocaryon preussii*							+	-	CT, EF
139		*Pycnanthus angolensis*	+	-	+	-					CT, M
140	Myrtaceae	*Eugenia fernandopoana*	+	-							R
141		*Eugenia talbotii*			+	-					R

Continued

142		*Syzygium rowlandii*	+	-					+	-	
143		*Campylospermum calanthum*			+	-					
144		*Campylospermum mannii*					+	-			
145	Ochnaceae	*Campylospermum sulcatum*	+	-							
146		*Lophira alata*			+	-					CT, M
147		*Ouratea* sp. 1			+	-					
148		*Diogoa zenkeri*	+	-	+	-	+	-			
149		*Heisteria parvifolia*	+	-			+	-	+	-	ES
150		*Octoknema affinis*			+	-	+	-			
151		*Olax latifolia*			+	-					
152	Olacaceae	*Ptychopetalum petiolatum*			+	-					
153		*Strombosia grandifolia*					+	-			
154		*Strombosia pustulata*	+	-	+	-	+	-			
155		*Strombosia scheffleri*					+	-			
156		*Strombosia* sp.					+	-			
157		*Strombosiopsis tetrandra*							+	-	
158	Pandaceae	*Microdesmis puberula*	+	-			+	-			
159		*Panda oleosa*							+	-	
160	Passifloraceae	*Barteria fistulosa*	+	-							
161		*Antidesma laciniatum*							+	+	
162		*Antidesma vogelianum*			+	-			+	-	
163		*Bridelia* sp.			+	-					
164		*Cleistanthus letouzeyi*	+	-							
165	Phyllanthaceae	*Maesobotrya barteri*			+	-	+	-			
166		*Maesobotrya dusenii*	+	-			+	-	+	-	
167		*Maesobotyra staudtii*	+	-	+	-					
168		*Protomegabaria stapfiana*			+	-			+	-	
169		*Uapaca staudtii*	-	+	+	+	+	+	-	+	LT, EF
170	Polygalaceae	*Carpolobia lutea*	+	-	+	-			+	-	
171		*Drypetes ivorensis*							+	-	
172		*Drypetes molunduana*	+	-							
173	Putrangivaceae	*Drypetes principum*	+	-							
174		*Drypetes* sp.	+	-							
175		*Drypetes staudtii*	+	-	+	-	+	-			
176		*Sibangea similes*			+	-					
177		*Aidia genipiflora*					+	-			
178		*Aoranthe cladantha*	+	-							
179		*Aulacocalyx caudata*	+	-			+	-			
180		*Aulacocalyx jaminiflora*	+	-			-	-			
181		*Aulacocalyx talbotii*	+	-	+	-	+	-			
182		*Belonophora wernhamii*	+	-							
183	Rubiaceae	*Bertiera laxa*	+	-							
184		*Bertiera racemosa*			+	-					
185		*Craterispermum aristatum*	+	-							
186		*Didymosalpinx* sp.	+	-	+	-	+	-			
187		*Euclinia longiflora*			+	-			+	-	
188		*Gaertnera bieleri*	+	-							
189		*Heinsia crinita*	+	-							EL

Continued

190		*Ixora hippoperifera*			+	-	+	-	+	-	
191		*Ixora nematopoda*	+	-	+	-					
192		*Lasianthus batangensis*	-	-							
193		*Massularia acuminata*	+	-	+	-	+	-	+	-	
194		*Oxyanthus laxiflorus*	+	-	+	-	+	-			
195		*Pauridantha afzelii*			+	-	+	-	+	-	
196		*Pauridiantha floribunda*							+	-	LD
197		*Pausinystalia macroceras*			+	-	+	-	+	-	M
198		*Pavetta* sp. 1	+	-					+	-	
199		*Petitiocodon parviflorum*	+	-	+	-					
200		*Polysphaeria macrophylla*	+	-	+	-					
201		*Psychotria dorotheae*	+	-	+	-	+	-	+	-	
202		*Psychtria* sp. 8							+	-	R
203		*Rothmannia hispida*	+	-							
204		*Rothmannia talbotii*			+	-					
205		*Rubiaceae* sp. RUBB					+	-			
206		*Rubiaceae* sp. RUBS							+	-	
207		*Schumanniophyton magnificum*							+	-	M
208		*Sericanthe auriculata*			+	-					
209		*Stipularia africana*							+	-	
210		*Tarenna lasiorachis*	+	-							
211		*Tricalysia achoundongiana*	+	-							R
212		*Dracaena bicolor*	+	-	+	-			+	-	
213	Ruscaceae	*Dracaena laxissima*	+	-					+	-	
214		*Dracaena* sp.	+	-							
215		*Araliopsis soyauxii*	+	-							M
216	Rutaceae	*Oricia lecomteana*	+	-	+	-					
217		*Zanthoxylum gilletii*	+	-							
218		*Caloncoba gluaca*			+	-					
219		*Casearia barteri*					+	-			
220	Salicaceae	*Homalium letestui*							+	-	
221		*Homalium longistylum*	+	-	+	-	+	-			
222		*Phyllobotryon spathulatum*					+	-			
223		*Chrysanthus* sp. 2	+	-	+	-					
224		*Chrysanthus* sp. 3			+	-					
225		*Chrysanthus talbotii*							+	-	EF
226	Sapindaceae	*Deinbolia maxima*							+	-	
227		*Deinbollia pychnophylla*	+	-							
228		*Eriocoelum* sp.							+	-	
229		*Laccodiscus ferrugineus*			+	-	+	-			
230		*Placodiscus* sp.	+	-	+	-					
231		*Aporrhiza* sp.			+	-					
232		*Chrysophyllum delevoyi*							+	-	EF
233		*Chrysophyllum* sp. nov.			+	-					
234	Sapotaceae	*Englerophytum* sp. nov.			+	-	+	-			EF
235		*Lecomtedoxa klaineana*	+	-							LT
236		*Synsepallum stipulatum*			+	-					
237		*Zeyherella letestui*			+	-					

Continued

238	Thymelaeaceae	*Dicranolepis disticha*	+	-							
239	Urticaceae	*Musanga cecropioides*	+	-	+	-	+	-	+	-	M, LT
240		*Allexis cauliflora*			+	-					
241		*Rinorea dentata*	+	-	+	-	+	-	+	-	
242		*Rinorea gabunensis*	+	-	+	-	+	-			
243		*Rinorea kamerunensis*	+	-	+	-			+	-	
244		*Rinorea leiophylla*	+	-					+	-	
245	Violaceae	*Rinorea lepidobotrys*	+	-					+	-	
246		*Rinorea oblongifolia*	+	-	+	-	+	-			
247		*Rinorea* sp. 2	+	-	+	-	+	-			
248		*Rinorea subintegrifolia*	+	-	+	-	+	-	+	-	
249		*Rinorea thomasii*	+	-							R
250		*Rinorea woermanniana*	+	-			+	-	+	-	
251	Vochysiaceae	*Erismadelphus exsul*			+	-	+	-	+	-	
252	Unidentified	Unidentified UNID	+	-			+	-			

Note List of Abbreviations: +: Presence of mycorrhiza; -: Absence of mycorrhiza; AM = Arbuscular mycorrhiza; EM = Ectomycorrhiza; LD = Low-Drier areas; HS = Hill Slope; RT = Ridge Top; WC = Wetland Complex; ALL = LD, HS, RT, WC; LT = Local timber; ND = Natural dye; R = Rare species (IUCN); M = Medicinal value; EF = Edible fruits; ES = Edible seeds; CES = commercially edible seeds; EL = Edible leaves; E/C = Economic/Conservative status; CEF = Commercially edible fruits; CT = Commercial timber; Codes refer to species not identified in the families.