



FLORISTIC STUDY OF THE PROTECTED AREA FROM YACOLIDABOUO, LOCATED AT SOUBRÉ, CÔTE D'IVOIRE

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Abstract: At the instigation of the CES (Conseil Economique et Social) of the Republic of Côte d'Ivoire, the natives and senior staff of the Yacolidabouo village decided to maintain and perpetuate the Voluntary Natural Reserve (VNR) of the aforesaid village. Such a project could be expanded to approximately twenty other sites of the region expressing a comparable status. For this purpose, the knowledge of the existing flora was necessary. The CES funded a mission from 20 to 22 September 2013. It mainly aimed the assessment of the man's influence on the environment represented by the VNR and the village plantations planted with cocoa tree associated with rubber tree and coffee tree. Methodology used was both based on review of the scientific literature and floristic itinerant inventory. It emerged from results that the environment represented by the village plantations was fundamentally damaged. In contrast, the VNR was relatively conserved environment. Within this latter, with respect to floristic, the present survey showed that this area consisted of 139 plant species, derived from 118 genus and 56 vascular plant families. In this same area, we met 2 types of plant formation: forest gallery and fallow. In such biotopes, we counted some species with particular status. These are 10 endemic species at the forest region of West Africa, 10 species are become rare for ivorian flora and recorded on the red list of the International Union for Conservation of Nature (IUNC). In addition, 70 useful species and 29 others used in trade in Côte d'Ivoire were counted there. Special status species, namely the medicinal ones, the threatened ones of extinction as well as the used ones as softwood lumber must be regenerated of emergency.

Keywords: Conserved environment; Plantations; Rare species; Threatened species; Voluntary Natural Reserve.

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INTRODUCTION

Since its accession to the independency, the Republic of Côte d'Ivoire focused its economic development on the forest exploitation. This one was linked with the development of big industrial crops such as sugar cane, oil palm, coconut tree, pineapple, rubber tree among others. This triggered drastic reduction of the forest cover. Indeed, with area about 16 000 ha in 1960's, today this forest only represents 2 000 ha. This corresponds to 13% of the national forest cover, as against 20% considered to be the critical threshold for climate and vegetation (Anonymous, 1989). This triggered the damage of ecosystems and thus erosion of the biological

diversity. From which the necessity not only to conserve, but especially reafforest the sites damaged. Yacolidabouo is sub-prefecture of the department of Mont-Cavally, Côte d'Ivoire. Its area was about 500 ha in 2013, its counts about 7,000 inhabitants. A forest about 3 ha was transformed in VNR. By reason of human actions, this forest is also threatened of disappearance. About 20 forests disseminated through this department are also concerned and will be part of the study later. Its vegetation is part of the coast overgreen forest (Nguessan and Zoro Bi, 2010). The ecoclimatic conditions place this forest submitted to our survey in the ombrophile category of the Guinea-Congolese

domain. The latter is characterised by the dense humid evergreen forest or rainforest that especially derives from the *Diospyro-Mapanietum* plant association or hydrophilic forest described by Mangelot (1955). According to Aké Assi (1998), the vegetation of this forest is constituted of more than 80% woody phanerophytes. This vegetation is multi-stratified and mostly constituted of high trees whose height ranges from 40 to 60 m, for higher stratum, bearing large buttresses. The light undergrowth is dominated by bushes and shrubs. The lianas representing more than one third of the woody plants, are frequent and often show big impressive stems. Indeed the majority of the areas of the village is quasi-occupied by large plantations. Those from rubber tree occupy the biggest proportion. In Côte d'Ivoire the human influence on the environment, particularly the forest is very important (Guillaumet and Adjanohoun, 1971). To date, no information is available regarding the man's impact on the environment represented by the VNR and village plantations planted with the cocoa tree associated with rubber tree and coffee tree. Thus, the man's influence on the environment, represented by the VNR and village plantations planted with the cocoa tree associated with rubber tree and coffee tree, has stayed badly known. The knowledge of this influence through results from the inventory, could allow the adoption by the CES of remedial measures of reforestation of the VNR. The artificial replanting with forest species of this VNR could avoid its disappearance. From this, we postulated that the environment represented by the VNR and village plantations planted with the cocoa tree associated with rubber tree and coffee tree is damaged by the man. The study aimed to assess the man's influence on the environment represented by the VNR and the village plantations planted with the cocoa tree associated with the rubber tree and coffee tree.

EXPERIMENTAL

Study area and approach used

The area concerned by this study is a portion of forest situated at the Yacolidabouo village, region of Lower Sassandra, Department of Soubré. It is located at 5° 57 North latitude and 6° 33 West longitude. This forest, transformed in VNR, is

limited to the North by the Zozoro River, to the South by the Yacolidabouo village, to the East by the cemetery of this village and to the west by rubber plantation. The mission was carried out from 20 to 22 September 2013 (Figure 1). The team of study consisted of 3 people. One man to open trail, another to note in notebook and another to identify and count encountered species. Regarding materials, the machete, pencil, pen and notebook were used. The used approach to inventory flora was the itinerant floristic inventory consisting in visiting the site in all senses following the imaginary transect. The observed species, in this type of inventory, were recorded. Likewise, the samples were collected to complete the list of general flora of the site. The traces of human activities, especially cuts of woods and those from lianas, among others, were observed and recorded.

Analysis method of floristic data

It consisted in analysis of the floristic and specific diversity. The floristic richness is defined as the number of recorded species within a given territory (Aké Assi, 1984). Its measure consists in making the deduction of all species counted in all fields without taking into account their abundance. Thus, the obtained lists are regrouped to constitute a general list of the species inventoried. The qualitative diversity was analyzed two-level *i.e.* floristic composition and the species with special status. The analysis of the floristic composition consisted in recording for all identified species, namely their family, their biological type, their chorological affinity as reported in Aké Assi (1998; 2001; 2002). In this survey, we counted the species with particular status. These are i) endemic West African species (GCW), ii) rare or become rare or endangered species of the ivorian flora and registered on the list of IUNC and, iii) species of commercial interest in Côte d'Ivoire. These particular status were established thanks to particular lists pre-established for the Côte d'Ivoire in Kouamé (2000), Aké Assi (1998, 2001, 2002) and IUCN (2010).



Figure 1. Geographical location of the municipality of Yacolidabouo on the administrative map of the Republic of Côte d'Ivoire. a, the square portion in red represents the municipality of Yacolidabouo. **b,** enlargement of the red square portion showing clearly the municipality of Yacolidabouo relatively to three regions surrounding it, namely those of Lower Sassandra, Southern Bandama and Middle Cavally.

RESULTS AND DISCUSSION

The study area consists of flora and vegetation, general floristic composition of the site and special status species.

Flora and vegetation: Here, only the typology of vegetation was analyzed.

Typology of vegetation: It comprised the forest gallery and fallow. It lost all its aspect and structure as described in methodology. This is due to the intensity of the human activities undertaken. Two biophysical locations were met there. These are the forest gallery that borders the Zozoro river and the fallow circumscribed in the square represented by the cemetery, road which goes across the village, rubber plantation and forest gallery.

Forest gallery: It is a damaged forest showing open canopy composed of 3 strata. It was characterized by undergrowth with low litter, more or less light with a few lianas. There was here

and there, the presence of some big trees and other mid-sized plants, residues of the original vegetation described above. The upper stratum, that is to say the first stratum, whose we estimated the cover to about 15%, consisted of big species able to reach 25 to 30 m in height, scattered on the site. Among them, we can mention: the Tiama or *Entandrophragma angolense* (Meliaceae), the Dabéma or *Piptadeniastrum africanum* (Mimosaceae), the Faro or *Daniellia thurifera* (Caesalpiniaceae), the Kotibé or *Nesogordonia papaverifera* (Sterculiaceae), the Ilomba or *Pycnanthus angolensis* (Myristicaceae), among others (Figure 2). The mid stratum or second stratum with cover rate about 35%, was composed of mid-sized species whose height varied between 8 and 25 m. Their tops were more or less contiguous. We can cite for instance: *Albizia zygia* (Mimosaceae), *Trichilia monadelpha* (Meliaceae), *Myrianthus arboreus* (Moraceae), *Microdesmis keayana* (Pandaceae), *Tabernaemontana crassa* (Apocynaceae), among others. Among these species, we observed numerous seedlings suggesting a good reforestation (Figure 3). The lower stratum, or third stratum, was essentially composed of seedlings of the aforementioned species. Among these woody the presence of *Microdesmis keayana*, *Dorstenia turbinata* and *Baphia nitida* is remarkable. Climbing species with large leaves belonging to the family of the Marantaceae such as *Maranthochloa leucantha* and *Hypselodelphys violacea* were inventoried. Among these ones, there were numerous lianas at different heights (Figure 4).

Fallow: It is low vegetation with dense undergrowth constituted of small-sized species and numerous lianas whose slender stems. The litter is thick in some places, but light in others, especially where it was washed. The rate of the herbaceous species was important enough with that of the woody plants. Within the latter, isolated seedlings or in nursery of rubber tree were numerous. As woody species we can cite: *Alchornea cordifolia* (Euphorbiaceae), *Chromolaena odorata* (Asteraceae), *Millettia zechiana* (Fabaceae), *Trichilia monadelpha* (Meliaceae), *Anthocleista djalonsensis* (Loganiaceae), *Phyllanthus reticulatus* (Euphorbiaceae), *Ficus exasperata* (Moraceae)

among others. The lianas were in majority represented by *Paullinia pinnata* (Sapindaceae), *Cissus aralioides* (Ampelidaceae), *Centrosema pubescens* (Fabaceae), *Secamone afzelii* (Asclepiadaceae) among others. The herbaceous plants were dominated by *Panicum maximum* and *Rhottboellia cochinchinensis* (Poaceae; Figure 5). Such a structure allowed the classifying of this forest in category of Diospyro-Mapanietum plant formation described in Mangenot (1955).



Figure 2. Picture showing the species *Nesogordonia papaverifera* belonging to the upper stratum



Figure 3. Picture illustrating the species *Trichilia monadelphha* derived from the mid stratum.



Figure 4. Picture showing the undergrowth of the lower stratum



Figure 5. View of a *Panicum maximum* population in the fallow



Figure 6. Young seedling of *Antiaris toxicaria* var. *africana* (Ako) cut.

General floristic composition of the site

The exploitation of the files of recording of floristic data allowed the listing of 139 plant species distributed themselves between 118 genus and 56 families. The richest families in species were those from the Caesalpinaceae

and Fabaceae with 11 species each. Followed by the Moraceae with 9 species and Euphorbiaceae with 8 species. The other families shared between 1 and 8 species each. There were numerous species some of which played a facial role (Aké Assi, 1998).

Special status species: They consisted of endemic, rare, threatened or vulnerable and useful species as well as species of commercial interest.

Endemic species: A list of 10 endemic species from large group of the African West forest (GCW) were evidenced (Table 1).

Rare or vulnerable species and those threatened of extinction: We detected 10 special status species according to the red list of the IUNC. These plants were vulnerable (VU) or threatened of extinction (LR/lc) by reason of the abusive exploitation of the forest. This triggered the loss of biodiversity (Table 2).

Useful species: The analysis of our data revealed 70 useful species for food, medicinal uses and others. We enumerated 16 food species and 2 considered to be sacred. These are *Disthemonanthus benthamianus* and *Milicia regia*. The others whose most are used in traditional medicine, have various uses. These species must be pharmacologically analyzed to value the active principles that they contain (Aké Assi, 2001).

Species of commercial interest: In the course of our survey we inventoried 29 species of commercial interest of which 8 high-grade (P1), 13 showing middle quality (P2), 5 expressing good quality (P3), and 3 displaying less good quality (P4; Table 4). They must be artificially regenerated to value them.

Threats: The proximity between the forest portion and the village exposes this forest to permanent threats. Indeed, we fear a probable extension of the cemetery toward the forest

because of the increasing of the demography of the village. Likewise, the withdrawal of wood for various uses could participate in the destruction of this forest. For instance, the young seeding of *Ako* or *Antiaris toxicaria* var. *africana* cut and showed on picture below. The bark of this plant was used in manufacture of traditional cloth (Figure 6). These threatened species must be cloned to save them.

Table 1. List of West African endemic species

Species	Family	Status
<i>Cola caricifolia</i>	Sterculiaceae	GCW
<i>Copaifera salikounda</i>	Caesalpiniaceae	GCW
<i>Crossostemma laurifolium</i>	Passifloraceae	GCW
<i>Daniellia thurifera</i>	Caesalpiniaceae	GCW
<i>Dialium aubrevillei</i>	Caesalpiniaceae	GCW
<i>Dicranolepis persei</i>	Thymeleaceae	GCW
<i>Maesobotria barteri</i> var. <i>sparsiflora</i>	Euphorbiaceae	GCW
<i>Myrianthus libericus</i>	Moraceae	GCW
<i>Rinorea longicuspis</i>	Violaceae	GCW
<i>Soyauxia floribunda</i>	Medusandraceae	GCW

Table 2. List of special status species found on the site of study

Species	Family	Status
<i>Pterocarpus santalinoides</i>	Fabaceae	LR/lc
<i>Copaifera salikounda</i>	Caesalpiniaceae	VU
<i>Entandrophragma angolense</i>	Meliaceae	VU
<i>Entandrophragma utile</i>	Meliaceae	VU
<i>Guarea cedrata</i>	Meliaceae	VU
<i>Guibourtia ehie</i>	Caesalpiniaceae	VU
<i>Milicia regia</i>	Moraceae	VU
<i>Nesogordonia papaverifera</i>	Sterculiaceae	VU
<i>Rhodognaphalon brevicuspe</i>	Bombacaceae	VU
<i>Terminalia ivorensis</i>	Combretaceae	VU

Table 3. List of Useful Species inventoried

Species	Name in Bété	Uses		
		As Food	Like medicinal	Other
<i>Acacia pennata</i>	kpléahi		Scabies, chicken pox	Vegetable sponge
<i>Adenia lobata</i>			Against the bad spirits	
<i>Albizia adianthifolia</i>	gnimpô-dazôrô		Hemorrhoids, dizzy	
<i>Alchornea cordifolia</i>	gbroméhi		Tooth and stomach aches, pelvic pains	dyeing
<i>Anthonotha crassifolia</i>			Gibbosity	
<i>Antiaris toxicaria</i> var. <i>africana</i>			Healing of the skin	Traditional cloth
<i>Bidens pilosa</i>	zégbéhi-zagagbè		Asthma, difficult childbirth	

<i>Cassia occidentalis</i>			Malaria, azoospermia, conjunctivitis	
<i>Cleistopholis patens</i>			Muscular soreness	Rope
<i>Cnestis ferruginea</i>			Conjunctivitis	
<i>Cola gigantea</i>			Small pox	
<i>Combretum paniculata</i>			Hemorrhoids	
<i>Costus afer</i>	dohi		Conjunctivitis, cough	
<i>Croton hirtus</i>			Malaria	
<i>Cyathula prostrata</i>	dôgbôkôkoukoueu		Tooth ache	
<i>Dacryodes klaineana</i>		Fruits		
<i>Daniellia thurifera</i>			Dizy, Healing of the skin	Softwood lumber
<i>Desmodium adscendens</i>			Various stomach aches, heart palpitations	
<i>Dialium aubrevillei</i>		Fruits		
<i>Diospyros mannii</i>				Firewood
<i>Discoglyprena caloneura</i>				Sacred firewood
<i>Distemonanthus benthamianus</i>	gouiènègeupkahi		Sacred	Sacred softwood lumber
<i>Elaeis guineensis</i>		Seed, oil and palm wine, heart	Lack of appetite in babies	Brooms, soap, cosmetics
<i>Entandrophragma angolense</i>	zézé		Stomach ache	Softwood lumber
<i>Entandrophragma utile</i>				Softwood lumber
<i>Eremospatha hookeri</i>				Rope, esparto articles
<i>Ficus esxasperata</i>	gnangnoumhi		Tuberculosis of bones, cataract	Scraper
<i>Ficus sur</i>		Fruit	Thrush of children	
<i>Heterotis rotundifolia</i>			Accelerate walking of children, hemorrhoids, Cough, diarrhea	
<i>Laccosperma secundiflorum</i>		Heart		Esparto articles
<i>Maesobotria barberi var. sparsiflora</i>		Fruit	Furuncle	
<i>Manniophyton fulvum</i>	dôbouhi		Healing of the skin, hemorrhoids	
<i>Maranthochloa leucantha</i>	liguè			Packaging
<i>Mikania cordata</i>	lolowoulou		Febrifuge	
<i>Milicia regia</i>	djédjé		Sacred	Softwood lumber, sacred
<i>Millettia zechiana</i>				Firewood
<i>Momordica charantia</i>	gnangnin		Febrifuge, jaundice	
<i>Montandra guineensis</i>				Brooms
<i>Morinda morindoides</i>			Malaria	
<i>Myrianthus arboreus</i>		Vegetative bud		
<i>Myrianthus libericus</i>	djadja	Vegetative bud		
<i>Napoleonaea vogelii</i>		Fruit	Rheumatism	Manufacture of handle for tools
<i>Nephrolepis biserrata</i>			Contraception	Cushion
<i>Nesogordonia papaverifera</i>				Softwood lumber, Manufacture of mortar and pestle
<i>Neuropeltis acuminata</i>				
<i>Pachypodanthium staudtii</i>			Muscular soreness	Perfumery
<i>Parkia bicolor</i>			Reduction of fractures, healing of the skin	Softwood lumber
<i>Pennianthus patulinervis</i>			Aphrodisiac	
<i>Piptadeniastrum africanum</i>				Softwood lumber
<i>Pouzolzia guineensis</i>	méawlè		Asthma	
<i>Pycnanthus angolensis</i>	doudouihi		Tooth ache	Softwood lumber
<i>Raphia hookeri</i>	loulou	Heart, Wine		Rope, traditional clothes
<i>Rauvolfia vomitoria</i>	tropkéhi		Malaria, gonococcal infection, madness	

<i>Rhodognaphalon brevicuspe</i>				Softwood lumber
<i>Rinorea ilicifolia</i>			Aphrodisiac	
<i>Secamone afzelii</i>	loboligbeu-tikéhi		bloating, indigestion, aphrodisiac	
<i>Salacia owariensis</i>		Fruit		
<i>Sarcocephalus pobeguini</i>				Softwood lumber, Manufacture of mortar
<i>Sida acuta</i>			Aphrodisiac	
<i>Solenostemon monostachyus</i>	dodoba		Healing of the skin	
<i>Spondias mombin</i>	totohi	Fruit	Early pregnancy, intractable cough	Delimiting of areas
<i>Sterculia tragacantha</i>		Ecorce	Calming of nerves	
<i>Strombosia pustulata</i>		Fruit	Muscular soreness,	
<i>Tabernaemontana crassa</i>	dogbeuhi		Malaria, control of female infertility	
<i>Tapinanthus bangwensis</i>			Rheumatism	
<i>Terminalia ivorensis</i>				Softwood lumber
<i>Tiliacora dinklagei</i>	kolalipkeu		Control of scabies, fever	Rope
<i>Treculia africana</i>		Seeds		
<i>Trichilia monadelpha</i>	zadréhi			Softwood lumber
<i>Uapaca gineensis</i>		Fruit		

Table 4. List of the Species of Commercial Interest counted in our zone of Study

Species	Family	Common Name	Category
<i>Albizia zygia</i>	Mimosaceae	Ouochi	P3
<i>Ampiphimas pterocarpoides</i>	Caesalpiniaceae	Lati	P4
<i>Anthonotha crassifolia</i>	Caesalpiniaceae	Réré des savanes	P4
<i>Antiaris toxicaria var. africana</i>	Moraceae	Ako	P3
<i>Berlinia grandiflora</i>	Caesalpiniaceae	Mélégba des galeries	P2
<i>Cleistopholis patens</i>	Annonaceae	Sobou	P2
<i>Cola gigantea</i>	Sterculiaceae	Gd ouara	P2
<i>Copaifera salikounda</i>	Caesalpiniaceae	Etimóé	P3
<i>Dacryodes klaineana</i>	Burseraceae	Adjouaba	P1
<i>Daniellia thurifera</i>	Caesalpiniaceae	Faro	P2
<i>Dialium aubrevillei</i>	Caesalpiniaceae	Kropio	P2
<i>Discoglyperma caloneura</i>	Euphorbiaceae	Akoret	P4
<i>Distemonanthus benthamianus</i>	Caesalpiniaceae	Movingui	P1
<i>Entandrophragma angolense</i>	Meliaceae	Tiama	P1
<i>Entandrophragma utile</i>	Meliaceae	Sipo	P1
<i>Funtumia africana</i>	Apocynaceae	Pouo	P3
<i>Guarea cedrata</i>	Meliaceae	Bossé	P1
<i>Guibourtia ehie</i>	Caesalpiniaceae	Amazakoué	P2
<i>Milicia regia</i>	Moraceae	Iroko	P1
<i>Nesogordonia papaverifera</i>	Sterculiaceae	Kotibé	P2
<i>Parkia bicolor</i>	Mimosaceae	Lo	P1
<i>Piptadeniastrum africanum</i>	Mimosaceae	Dabéma	P2
<i>Pycnanthus angolensis</i>	Myristicaceae	Ilomba	P2
<i>Rhodognaphalon brevicuspe</i>	Bombacaceae	Kondroti	P1
<i>Sarcocephalus pobeguini</i>	Rubiaceae	Sibo	P2
<i>Sterculia tragacantha</i>	Sterculiaceae	Poré poré	P2
<i>Strombosia pustulata</i>	Olacaceae	Poé	P2
<i>Terminalia ivorensis</i>	Combretaceae	Framiré	P2
<i>Uapaca guineensis</i>	Euphorbiaceae	Riko	P3

Recommendations

At the end of this study, the following recommendations are suggested:

- to establish map of the Yacolidabouo village forest using GPS in order to obtain its exact area for sustainable management,
- to develop the eco-tourism by creation of botanical pistes and those for health restoration.

The labeling of the interesting species for their discovery by the general public.

-to rehabilitate of the spaces damaged through a process of reforestation in order to homogenize the structure of the long-term forest.

-to inform populations to the strict respect of the environment through sessions of projection of movies, slides, posters and theater scenes especially environmental education.

-to set up seedbed for species regeneration with special status and the noble ones, from which will be developed other spaces of the region while being inspired by the example of Yacolidabouo.

CONCLUSION

We made the hypothesis that the environment represented by the VNR and the village plantations planted with the cocoa trees associated with the rubber tree and the coffee tree has been damaged by the man. In fact, the portion of forest, crossed by the Zôzôrô River, is damaged by the man. In the same way, the plantation of rubber tree around the aforesaid forest, the existence of a fallow under regeneration, the progressive silting of the aforementioned river among others, are examples for others caused by mankind. Thus, the portion of forest that was the subject of this survey is rich of 139 species descending of the 2 types of plant formations inventoried, namely a forest gallery and a fallow. These plant species were distributed between 118 genus and 96 families. The analysis of the results stated, in spite of the weak extent of the forest, the existence of species with special status. These are rare, threatened of the extinction species and the endemic ones to the African West forest block of which some are registered on the red list of the IUCN. The presence of the species with special status confers to this portion of forest a great value for the conservation of the national and international biodiversity. Also their presence as well as that of some big trees will allow the transforming of this biotope in location of conservation of interesting species for the science and promotion of eco-tourism for the village. The largest proportion of encountered seedlings in the undergrowth demonstrated the beginning of reforestation and allowed to state

that if this portion forest is installed the nature will be restored.

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