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Secondary Forests in Equatorial Africa

Côte d'Ivoire - Cameroon - F. E. A.

Photo 1.
Forêt secondaire de la Nkoulounga au Gabon en 1958.
Photograph P. Sarlin, CTFT-CIRAD 1958.

André Aubréville

RÉSUMÉ

LES BROUSSES SECONDAIRES EN AFRIQUE ÉQUATORIALE

La « brousse secondaire » s'oppose à la « forêt primaire », forêt « noble » aux grands arbres. C'est une forêt exubérante, inextricable, avec plus de lianes et de petits bois que d'arbres, succédant à l'agriculture sur brûlis. Dans les régions habitées, elle entoure communément les villages et borde les routes, la forêt primaire étant reléguée aux collines rocheuses et marécages. En Afrique équatoriale, la « brousse secondaire » représente actuellement 50 à 75 % des surfaces forestières. La formation des brousses secondaires procède en trois phases : (i) l'apparition de semis d'espèces héliophiles (*Musanga* sp., *Vernonia* sp., *Anthocleista* sp.) à croissance rapide, qui diffèrent des espèces de « forêt primaire » et dont les graines sont dispersées sur de longues distances ; (ii) la formation d'un sous-bois, constitué cette fois des mêmes espèces arbustives qu'en « forêt primaire », et où se mêle un second groupe d'espèces héliophiles banales, caractéristiques de la « brousse secondaire » et rattrapant le précédent, voire le surcimant ; (iii) la lente reconstitution de la « forêt primaire », riche en sapotacées, guttifères et légumineuses au bois dur, capables de se régénérer dans les sous-bois, et parmi lesquelles de très grands arbres finissent par percer la voûte des cimes. L'Okoumé (*Aucoumea klaineana*), essence précieuse typique des « brousses secondaires », est ainsi fréquent dans les prétendues « forêts primaires » du Gabon, forêts qui ont été en réalité autrefois défrichées. On ne saurait admettre aujourd'hui que le fort potentiel des « brousses secondaires » soit invariablement réduit en cendres. Il faut au contraire apprendre à guider et hâter leur évolution en faveur d'espaces à haute valeur économique.

Résumé adapté par la rédaction de la revue.

Mots-clés : *Aucoumea klaineana*, *Musanga* sp., dynamique forestière, espèce héliophile, groupes fonctionnels, forêt primaire, forêt secondaire, Gabon.

ABSTRACT

SECONDARY FORESTS IN EQUATORIAL AFRICA

"Secondary" forests are very different to "primary", "noble" forests with their tall trees. Their exuberant, inextricable vegetation, with more lianas and small shrubs than trees, grows on formerly forested lands cleared for agriculture. In inhabited regions, they generally surround villages and grow along roadsides, pushing the primary forest back to rocky hillsides and swamps. In Equatorial Africa, "secondary" forests account today for 50 to 75% of all forested areas. These forests form in three stages: (i) seedlings appear of fast-growing sun-loving species (*Musanga* sp., *Vernonia* sp., *Anthocleista* sp.), which are not the same as primary forest species and which disperse their seeds over long distances; (ii) formation of an understorey, made up of the same shrub species as in "primary" forests but mixed in this case with a second group of banal sun-loving species characteristic of "secondary" forests, which quickly grow as high as the first group and sometimes higher; (iii) gradual reconstitution of "primary" forest with abundant Sapotaceae, Guttiferae and hard-wooded legu-minous species that are capable of regenerating in the undergrowth and through which some very tall trees eventually grow through the canopy. Okoumé (*Aucoumea klaineana*), a valuable species typical of "secondary" forests, is common in the so-called "primary" forests of Gabon, which in fact are on formerly cleared forest land. Today, the high potential of these "secondary" forests must not be allowed to "go up in smoke". Quite the reverse: we must learn to guide their development to hasten the establishment of commercially valuable species.

Abstract adapted by the editorial team.

Keywords: *Aucoumea klaineana*, *Musanga* sp., forest dynamics, heliophilous species, functional groups, primary forest, secondary forest, Gabon.

RESUMEN

LOS MATORRALES SECUNDARIOS EN ÁFRICA ECUATORIAL

El "matorral secundario" se opone al "bosque primario", el bosque "noble" con árboles de gran porte. Es un bosque exuberante e intrincado, con más lianas y monte bajo que árboles y que sucede a la agricultura de roza y quema. En las regiones habitadas, estas áreas boscosas suelen estar alrededor de los pueblos y a lo largo de los caminos, mientras que el bosque primario se ve relegado a colinas rocosas y esteros. En África ecuatorial, el "matorral secundario" ocupa actualmente del 50 al 75% de las áreas forestales. La formación de estos matorrales se realiza en tres fases: a) aparición de pimpollos de especies heliófilas (*Musanga* sp., *Vernonia* sp., *Anthocleista* sp.) de crecimiento rápido diferentes de las especies del "bosque primario" y cuyas semillas se dispersan en amplias distancias; 2) formación de un sotobosque, compuesto ahora por las mismas especies arbustivas que el "bosque primario" y en el que se mezcla un segundo grupo de especies heliófilas comunes, típicas del "matorral secundario", que acaban alcanzando e incluso superando en altura al grupo anterior; 3) lenta reconstitución del "bosque primario", con abundancia de sapotáceas, gutíferas y fabáceas de madera dura, capaces de regenerarse en el sotobosque y que producirán árboles de gran porte que acabarán perforando el dosel. El okumé (*Aucoumea klaineana*), valiosa especie típica de los "matorrales secundarios", está muy presente en los supuestos "bosques primarios" de Gabón; unos bosques que, en realidad, fueron en su día desbrozados. No podemos permitir actualmente que el importante potencial de los "matorrales secundarios" acabe siempre reducido en cenizas. Se debe, por el contrario, guiar y acelerar su evolución creando bosques de gran valor económico.

Resumen adaptado por la redacción de la revista.

Palabras clave: *Aucoumea klaineana*, *Musanga* sp., dinámica forestal, especie heliófila, bosque primario, bosque secundario, grupos funcionales, Gabón.

All those living in equatorial forest regions in the colonies have become familiar with the term "secondary forests", which are visibly distinct from "primary forests", those noble forests that stir the imagination with their mysterious shadows, their cathedral-like architecture, the impressive size of their giant trees and their vast extent across the equatorial regions where Pygmies formerly roamed and are now the domain of loggers in search of african mahogany and other fine timber for cabinet-making. Instead of giant trees, these luxuriant secondary forests abound with lianas, foliage, woody vines and herbaceous stems, and trees are no more than 20 to 25 m in height: these are the forests that uniformly line the roads and tracks that criss-cross our forest colonies and mask the true rainforest, and more or less densely surround the villages depending on how long they have been established: in regions that have long been inhabited by a relatively dense and stable population, they have entirely replaced the old-growth forests, fragments of which sometimes remain on rocky outcrops or in swampy valleys. Vast tracts of old-growth forest nevertheless remain in uninhabited regions, but for how long? This is hard to say, given the absence of maps, but the frenzied clearing by native populations of ancient and magnificent stands along newly opened roads, sometimes on slopes so steep one can barely walk upright, suggests that their years are numbered, except where the forestry services are taking measures to conserve them. When attempts are made to estimate the proportion of secondary forests in a colony, the usual figure ranges from 50 to 75%. A recent estimation made in Cameroon by M. Grandclément, the head of the forestry service for that country, gives the following in the table I.

These secondary forests therefore cover very large areas. They are made up of small trees with soft timber, which are specific species not usually found in primary forests, whose trees, in contrast, mainly grow tall and produce hard or very hard timber. These two types of forest, with their two types of flora, are contiguous and sometimes inextricably meshed together, but they are different nevertheless. Until today, these lower-growing secondary forests have attracted little attention, being considered as forest waste, offering no usable timber; foresters scorned such plebeian vegetation, giving all their attention to the lords of the forest, those great trees producing giant logs, fine timber and large tonnages for export. Yet if we look beyond the conventional merchant's view of high quality wood produced by classic timber trees, we will see that some secondary forest species, which may be mediocre as trees but are fast-growing, could become outstanding sources of cellulose that can be easily felled and used for new colonial industries, fibres, paper pulp, and other purposes. Secondary forests could therefore be of considerable interest for the future.

Table I.
Recent estimation, of croplands versus forests, made in Cameroon by M. Grandclément, the head of the forestry service for that country, gives the following.

	Area	Croplands/ Forests
Crops and palm plantations	2,830,000 ha	approx. 54%
Secondary forest	5,750,000 ha	
Primary forest	7,300,000 ha	approx. 46%
Mangroves	60,000 ha	
TOTAL	**15,940,000 ha**	

What assessment can be made of their current and potential value?

For those who are unfamiliar with the equatorial regions, it is hard to imagine the aspect of these forests, their structure, their composition and how they evolve. This article has therefore been written for those who have never visited a tropical country, and who therefore cannot have an accurate picture of these banal forest formations. France also has secondary forests, formed by the untidy regrowth that quickly appears after felling, but because it is temporary and not extensive, nobody has thought to refer to it as "secondary forest". In equatorial countries, they are indeed forests, of low height but so dense that, when the regrowth is recent, the only means of access is by wielding a machete to slash a narrow passage through the impenetrable tangle of stems, lianas, spiny palms and giant monocotyledons.

As we know, this secondary growth appears wherever a clearing has been made in the uninterrupted blanket of forest, which, we remind our readers, every native farmer must do to expose his subsistence crops to the sunlight. Farmers cut down the trees and burn them during the dry season. This is a very rudimentary method of cultivation because, after cutting, burning and spreading the wood ash, the native farmer merely places cuttings and seeds directly into the ground without ploughing, in between fallen and partly burned tree trunks and large branches.

After one or two harvests, the farmer considers that the soil is exhausted, abandons the land and moves on to make another clearing in the forest. The abandoned plot is soon covered with an exuberant tangle of shoots, lianas, herbaceous plants and tree seedlings, which grow extremely quickly. As the plants for the sunlight, they become tangled together, suffocate, grow ever upwards until a layer of brush several metres in height completely covers the former clearing and the partly burned stumps and stems that slowly decompose and re-form a layer of humus.

Usually, after leaving the ground fallow for some time, often about ten years, the native farmer returns to the initial plot, where the layer of humus has reformed and where there will be enough ash after burning the regrowth to make it possible to harvest a new crop.

This, then, is the well-known origin of these expanses of secondary forest, which have become so extensive because forest-dwelling populations have been slashing and burning in this way since cultivation began.

Because they are so common but have so far been devoid of any commercially exploitable resources, few studies have been made on secondary forests. In order to provide some knowledge of their structure through descriptive drawings supplemented with information from botanical surveys, we used a method of sampling based on exhaustive inventories of narrow strips of forest, with which profiles can be easily established. The method can be quickly and simply applied elsewhere to compare the results in different types of forest where it would be materially difficult to undertake repeated counts over large areas. The method involves marking off a narrow strip 50 m in length and 45 m in width, divided into squares of 4 x 4 metres or 5 x 5 metres. In each square, the position, height and diameter of each woody plant more than 1 m in height is noted, along with a sketch of any tree or bush with a particular conformation. Once they have been measured, each tree and bush is felled in such a way that the standing trees that remain are entirely visible in the area of forest that has been cleared. The secondary formations are thus measured and felled, plot by plot. The smaller-diameter trunks are then sawn and stacked, and the larger trunks simply assessed for cubic volume. With this information, it is a relatively simple matter to set down on paper the profile of the forest at the chosen spot, and to make an approximation of the standing timber volume from the results of several such operations.

Below are given the inventories and documentation from five such surveys made in Gabon, in secondary forests of varying age, from young 2 to 3 year-old formations to very old secondary forests that have grown to closely resemble a primary forest. The first three were undertaken in the listed forest of La Mondah, located about 30 km to the west of Libreville on the road to Cape Esterias. The fourth was conducted in a secondary forest two and a half years of age that appeared to contain a great many young umbrella trees, near the Foulenzen logging concession obtained by the French rail network consortium in the southern part of the Gabon estuary.

The fifth survey, in a very old secondary forest, was conducted on the edge of the Kango experimental rubber plantation, beyond the eastern extremity of the Gabon estuary on the road to Njolé.

In Côte d'Ivoire, four surveys were made in the listed forests of Mamba and Yapo, between Abidjan and Agboville. With these few examples, we believe we can provide a fairly accurate picture of these bewildering secondary forests.

Origin: First Phase

If we observe how forest vegetation becomes re-established or in soils where indigenous slashing and burning has taken place, with incineration of the vegetation, we notice first of all, that a great many seedlings become established. Many belong to species different to those of the initial stand and some are not even present in the immediate vicinity of the plot under observation. These species are truly characteristic of secondary forests. The most outstanding, by far, is the umbrella tree (*Musanga cecropioides*), which takes its name from the umbrella shape of its delicate of large fan-shaped leaves. All colonials know that after simply exposing the ground in the middle of a forest to sunlight, for example when building a road or establishing a plantation, young umbrella trees will appear within a few months, often in dense clumps, even when there are no seed-bearing umbrella trees in the vicinity. Thus, in former clearings, umbrella tree saplings become established, first as polewood thickets and eventually forming the umbrella tree clumps that are so common in African forests. The stems are sometimes very close together. In the Téké primary forest along the Abidjan-Agboville railway, which was clear-felled to provide firewood for the engines, the rulebook required the felled areas to be replanted with Azobé (*Lophira procera*), an excellent source of firewood for railway engines. Across the entire felled area, the regenerating umbrella trees quickly became so dense that the Azobé saplings died off beneath them.

The sudden proliferation of umbrella trees in primary forests where none existed before is a surprising phenomenon. After again noting the abundance of umbrella tree growth along a recently opened forest road in the Mamba forest, we commissioned the Côte d'Ivoire Water and Forests Service to extract the surface soil (to 5 cm in depth) from a 2x2 metre square, marked off under intact forest about 25 metres from the road. Sorting out the parasol seeds was not easy because of their small size, but 498 of them were collected from the soil sample. This provided proof that their seemingly miraculous regeneration originated from numerous seeds that were already present in the soil, remaining dormant until the warmth of the sun penetrating into the clearing triggered their germination. The tiny seeds of the umbrella tree usually do not readily germinate as they are protected by a relatively thick shell, which, on the other hand, endows the dormant seeds with great longevity.

Other seeds also germinate on the newly bare soil, brought by the small animals, birds and insects that are often attracted to sunlit clearings.

A great many seedlings of lianas and herbaceous, bushy and woody species thus appear. A distinction must be made between them: some, like the umbrella tree, are sun-loving species, small trees that belong to the primary forest environment; others are lianas, also sun-loving, which immediately twine around any nearby stems; a third group, finally, is made up of primary forest species, especially woody undergrowth, but also large tree species.

Finally, in amongst these numerous seedlings, shoots will also appear from the stumps of small or average sized trees. Trees in primary forests do not usually shoot from the stump, but some young trees and some shrubby species are the exception to the rule.

The hierarchy between all these growing stems soon becomes apparent. Stump shoots, lianas and sun-loving secondary forest species quickly begin to shade out the seedlings of species normally found in primary forests, which grow much more slowly. From the outside, secondary forests seem fairly uniform, as only the dominant species that emerge from the rest are visible, in other words, the small number of species characteristic of secondary forest. However, a whole complex community of slower-growing shade-tolerant species develops beneath them.

Within about 10 years, the sun-loving species typical of secondary forests rapidly grow to their maximum height of 15 to 20 metres, and sometimes more: this may be considered as the final stage in the first phase.

Second phase

An understory made up of the same shrubby species as in primary forests has now formed. The tree species characterising the first phase have remained after reaching their maximum height. A second group of sun-loving species, often more slow-growing with soft or semi-hard wood, has caught up with the first group and is tending to grow taller, with dominant crowns: these are large trees that will go to 30 or 40 metres in height or more. They are also secondary forest species characterised by their frequency in these environments and, conversely, their increasing rarity in primary forest, and by their sun-loving temperament and rapid growth.

Reconstitution of primary forest

In this, the *third phase*, the character of the forest again begins to change. The secondary species from the first phase have long disappeared; those from the second phase have reached maturity and are now large trees. In the understory, other species are patiently growing, slowly but steadily. Amongst these are many sapotaceae, guttiferae and leguminous species with hard or very hard wood. Once they manage to grow through the canopy above them, they revert to their natural place at the top of the stand's hierarchy. These are often very tall trees typical of primary forests, which are in harmony with the environment as a whole. They probably live longer than those that previously made up the upper story; they are capable of regenerating in the understory, which sun-loving species cannot do. As time is on their side, they will inevitably keep their place in the sun, where they will remain forever as long as humans do not intervene, because, as their seeds are often heavy, they regenerate in situ, unlike many sun-loving species whose winged seeds disperse far away from the parent trees and can therefore only multiply from the parent if they fall by chance in a sufficiently sunlit spot.

Their development thus comes full circle, but this does not always happen. Most often, it is interrupted before the final phase. These secondary forests are forest fallows that people return to cultivate within variable period, usually 10 to 15 years, and sometimes only a few years in regions with a relatively large population. The survivors from the old-growth forest then tend to disappear, remaining only as isolated trees in crop fields, because their wood is too hard, because they are too large or because their high crowns are light enough not to shade out the crops below, or as thickets on soils that are hard to cultivate. Eventually, secondary forests will thus lose the latent components that could reconstitute a primary forest; because they are periodically cultivated and the rotations are too short, these species can no longer develop. This is why entire regions are now uniformly covered in this dull vegetation. Many different degrees of retrograding plant cover can be observed: from vegetation that still seems luxuriant to low, stunted growth invaded by herbaceous plants, on the edges of equatorial forests, adjacent to savannah land, and in regions where the dry season is quite long and they are liable to be directly destroyed by fires propagating from nearby savannah. This phase is the beginning of the end for forest cover of this kind.

Composition

The results of the surveys we have mentioned in this note show that the composition of secondary forests is still very heterogeneous. In each of the small 400 to 500 square metres parcels, 19 to 39 different species were counted, or twenty-nine on average. It should be noted that, in theory, the counts included all woody vegetation more than 1 m in height.

The vegetation is as heterogeneous as any that might be surveyed in a primary forest. It must be remembered that these secondary formations include true secondary sun-loving species on the one hand, and remnants of cleared primary forests on the other hand, growing as stump shoots, saplings or trees that have not been felled. We did not make any surveys in exhausted secondary forests where no old-growth species are found at all. When the normal habitat of all forest species is known, it is fairly easy to distinguish several groups. We observe, first of all, that a small number are significantly larger in size than all of the others. These are, on the one hand, the most fast-growing species that are characteristic of secondary forests, generally dominated by umbrella trees, and will determine their shape for many years; and on the other hand, a few trees from the cleared forest that have been conserved by native farmers will suddenly begin to grow rapidly once the sun reaches them: these will be found at a later stage among the high stands of the second phase, and perhaps also in the reconstituted primary forest.

Finally, the many species forming the understory include numerous shrubby trees from the cleared forest undergrowth and some young specimens of large tree species. The latter, after a period of slow growth, will eventually grow taller than the sun-loving species that currently shade them out to form the high stands of the second phase.

Thus, only a few years after the formation of secondary forest cover, the trees that will eventually form a new primary forest can already be found, provided they are given time to grow. In the lists below, all the species that may become high forest trees in the second phase are shown in bold.

This experience has enabled us to draw up lists of the secondary forest species that become established in the first and second phases, in Côte d'Ivoire, in Gabon and, in part, in the Brazzaville region (tables II).

Although incomplete, these lists are still rather long: indeed, secondary forests over a whole colony are much more complex than they appear in a single locality. But in general, these forests seem fairly uniform: the same species are found everywhere. There is an apparent anomaly here that needs an explanation. The main species in the second phase are undeniably banal and widespread over large areas; they are found for example in Côte d'Ivoire, Gabon, the Congo, Uganda and Angola. The range of distribution of

Tables II.
This experience has enabled us to draw up lists of the secondary forest species that become established in the first and second phases, in Côte d'Ivoire, in Gabon and, in part, in the Brazzaville region.
In the lists below, all the species that may become high forest trees in the second phase are shown in bold.

COTE D'IVOIRE FIRST PHASE PIONEER SPECIES	
Ivorian vernacular name	***Scientific taxonomy***
Parasolier	***Musanga cecropioides*** R . Br.
Ouologbaoué	***Tetrorchidium didymostemon* (Baill.)** Pax & K. Hoff.
Ouombé	***Harungana madagascariensis*** Lam. ex Poir.
Adaschia	***Trema orientalis*** (L.) Blume
Tofé	***Macaranga barteri*** Müll. Arg., ***M. spinosa*** Müll. Arg., ***M. hurifolia*** Beille
Brobro	***Anthocleista nobilis*** G. Don
Akoré	***Discoglypremna caloneura*** (Pax) Prain
Eho	***Ricinodendron africanum*** Müll. Arg.
Oualélé	***Pycnanthus angolensis* (Welw.) Warb.**
Bangbaye	***Albizia gummifera*** (J. F. Gmel.) C. A. Sm.
Ouochi	***Albizia zygia*** (DC.) J. F. Macbr.
Framiré	***Terminalia ivorensis*** A. Chev.
Fromager	***Ceiba pentandra*** (L.) Gaertn.
Tekbé	*Psydrax subcordata* (DC.) Bridson var. subcordata
Poupouia	*Monosis conferta* (Benth.) C. Jeffrey
Bahé	*Fagara macrophylla* (Oliv.) Engl.
Sobou	*Cleistopholis patens* (Benth.) Engl. & Diels
Aiélé	*Canarium schweinfurthii* Engl.
Iroko	*Milicia excelsa* (Welw.) C. C. Berg
Effeu	*Hannoa klaineana* Pierre ex Engl.
Loloti	*Lannea welwitschii* (Hiern) Engl.
Dédé	*Ficus exasperata* Vahl
Doumbourou	*Ficus mucuso* Welw. ex Ficalho
Ndechavi	*Rauvolfia vomitoria* Afzel.
Tchikué	*Bridelia micrantha (Hochst.) Baill.* (Hochst.) Baill.
Blébendou	***Treculia africana*** Decne.
Wounian	*Myrianthus arboreus* P. Beauv. *Ficus vogeliana* (Miq.) Miq.
Poro	*Ficus* sur Forssk. *Cnestis ferruginea* DC.
Pétépré	*Calpocalyx brevibracteatus* Harms (also in primary forest undergrowth, especially humid ground)
Poto	*Dichaetanthera africana* (Hook. F.) Jacq.-Fél.
Aplati	*Gaertnera paniculata* Benth. *Pleioceras barteri* Baill. *Holarrhena floribunda* (G. Don) T. Durand & Schinz *Holarrhena floribunda* (G. Don) T. Durand & Schinz *Vitex grandifolia* Gürke
Alambi	*Premna hispida* Benth.
Balié	*Newbouldia laevis* (P. Beauv.) Seem. ex Bureau
Aboké	*Randia acuminate* (G. Don) Benth. (also in primary forest under-growth, especially humid or swampy ground)

Aplati	*Psychotria venosa* (Hiern) E.M.A. Petit *Alchornea cordifolia* (Schumach. & Thonn.) Müll. Arg. *Mallotus oppositifolius* (Geiseler) Müll. Arg.
Mingki	*Zanthoxylum parvifoliolum* (A. Chev. Ex Keay) W.D. Hawth.
Baingou	*Harrisonia abyssinica* Oliv.
Banaye	*Trichilia monadelpha* (Thonn.) J. J. de Wilde
Ouangran	*Allophylus africanus* P. Beauv.
Ouomobéhiapi	*Vismia guinensis* (L.) Choisy
COTE D'IVOIRE SECOND PHASE OLD SECONDARY FOREST	
Ivorian vernacular name	***Scientific taxonomy***
Oualélé	*Pycnanthus angolensis* (Welw.) Warb.
Fromager	*Ceiba pentandra* (L.) Gaertn.
Framiré	*Terminalia ivorensis* A. Chev.
Fraké	*Terminalia superba* Engl. & Diels.
Samba	*Triplochiton scleroxylon* K. Schum.
Acajou	*Khaya ivorensis* A. Chev.
Loloti	*Canarium schweinfurthii* Engl.
Oussoupalié	*Erythrina milbraedii* Harms
Méléfoufou	*Homalium letestui* Pellegr.
Bon	*Cordia platythryrsa* Baker
Tulipier du Gabon	*Spathodea campanulata* P. Beauv.
Lié	*Phyllanthus discoideus* (Baill.) Müll. Arg.

Blénodiro	*Pierreodendron kerstingii* (Engl.) Little
Aiélé/Ayous	*Canarium schweinfurthii* Engl.
Aribanda	*Trichilia tessmannii* Harms
Blékoré	*Pseudospondias microcarpa* (A. Rich.) Engl.
Monbin	*Spondias mombin* L.
Poré-Poré	*Sterculia tragacantha* Lindl.
Iroko	*Milicia excelsa* (Welw.) C. C. Berg
GABON (estuary region) FIRST PHASE PIONEER SPECIES	
Gabonian vernacular name	***Scientific taxonomy***
Parasolier	***Musanga cecropioides* Tedlie**
Esoma	***Rauvolfia macrophylla***
Ahinébé	***Anthocleista nobilis*** G. Don
Essessang	***Ricinodendron africanum*** Müll. Arg.
Atsu	***Harungana madagascariensis*** Lam. ex Poir.
Nkabi	***Alchornea cordifolia*** (Schumach. & Thonn.) Müll. Arg.
Okala	***Xylopia aethiopica*** (Dunal) A. Rich.
Evegeu	***Trema orientalis*** (L.) Blume
Séneu	***Albizia gummifera*** (J. F. Gmel.) C. A. Sm.
Kanguélé	***Maesopsis eminii*** Engl.
Ngourangouran	***Oncoba glauca*** (P. Beauv.) Planch.
Okoumé	***Aucoumea klaineana*** Pierre

Akol	***Ficus exasperata*** Vahl
Ezelfou	*Sterculia tragacantha* Lindl.
Medzimékourou	*Psychotria venosa* (Hiern) E.M.A. Petit
Assas	*Bridelia micrantha* (Hochst.) Baill. (Hochst.) Baill.
Avomé	*Cleistopholis patens* (Benth.) Engl. & Diels.
Nvouma	*Xylopia quintasii* Engl. & Diels. (humid ground)
Ovala	*Pentaclethra macrophylla* Benth.
Tol	*Ficus vogeliana* (Miq.) Miq.
Olon, Olonvogo	*Fagara macrophylla* (Oliv.) Engl.
Iroko, Abang	*Milicia excelsa* (Welw.) C. C. Berg
Mississé	*Calpocalyx klainei* Pierre ex Harms
Fira	*Calpocalyx dinklagei* Harms
Nsa	*Maprounea membranacea* Pax & K. Offm.
Akana	*Dichostemma glaucescens* Pierre
Vakfiné	*Diospyros* sp.
Keyio	*Trichoscypha* sp.
Atégué	*Discoglypremna caloneura* (Pax) Prain *Monosis conferta* (Benth.) C. Jeffrey *Polyscias letestui* Norman (Mbigou range around 1000 m asl)
Noumasas	*various Macaranga (gabonica, Gilletii, le tchibangensis, Testui, monandra)*
Essan	*Dichaetanthera africana* (Hook. F.) Jacq.-Fél. *Newbouldia laevis* (P. Beauv.) Seem. ex Bureau *Croton oligandrus* Pierre ex Hutch.

GABON (Estuary region) SECOND PHASE OLD SECONDARY FOREST	
Ivorian vernacular name	***Scientific taxonomy***
Ilomba	*Pycnanthus angolensis* (Welw.) Warb.
Soro, Ossoko	*Scyphocephalium mannii* (Benth.) Warb.
Niové	*Staudtia kamerunensis* var. gabonensis (Warb.) Fouilloy
Ekoune	*Coelocaryon preussii* Warb.
Aiélé, Abeule	*Canarium schweinfurthii* Engl.
Pindja, Mvana	*Hylodendron gabunense* Taub.
Ozigo, Assia	*Pachylobus buettneri* (Engl.) H.J. Lam
Onzabili	*Antrocaryon klaineanum* Pierre
Ebais	*Cordia platythyrsa* Baker
Nkouarsa	*Tetrapleura tetraptera* (Schumach.) Taub.
Movingui	*Distemonanthus benthamianus* Baill.
Lonlaviol	*Daniella* spp. especially riverbanks
Andoum	?
Bilinga, Aloma	*Nauclea diderrichii* (De Wild. & T. Durand) Merr. cool ground
Acajou, Zmainguila	*Khaya ivorensis* A. Chev.
Limbo	*Terminalia superba* Engl. & Diels.
MIDDLE CONGO BRAZZAVILLE REGION	
Ivorian vernacular name	***Scientific taxonomy***
	Sclerocrton cornutus (Pax) Kruijt & Roebers

	Caloncoba welwitschii (Oliv.) Gilg
	Vernonia brazzavillensis Aubrév. Ex Compère
	Hymenocardia ulmoides Oliv.
	Milleria L.
	Gaertnera paniculata Benth.
	Allyphyllus africanus P. Beauv.
	Macaranga barteri Müll. Arg.
	Alchornea cordifolia (Schumach. & Thonn.) Müll. Arg.
	Bridelia micrantha(Hochst) Baill.
	Trema orientalis (L.) Blume
	Harungana madagascariensis
	Strychnos pungens Soler., *S. variabilis* De Wild.
	Pentaclethra eetveldeanna De Wild. & T. Durand
	Platycalyx N. E. Br.
GABON LOWLAND REGION	
Ivorian vernacular name	***Scientific taxonomy***
Pinédo	***Chrysolbalanus ellipticus***
Okoumé	***Aucoumea klaineana*** Pierre
Oxouga	***Sacoglottis gabonensis*** (Baill.) Urb.
Medzimékouro	*Psychotria articulate* (Hiern) E.M.A. Petit *Gaertnera paniculata* Benth. *Eugenia* sp.
Tomgouna	*Casearia* Jacq.

the umbrella tree thus coincides approximately with that of dense humid forests across Africa as a whole, while *Harunga madagascariensis* and *Trema orientalis* are found throughout Africa from Casamance to Madagascar. However, they are not evenly distributed across these vast areas; furthermore, many secondary forest species have a much smaller range of distribution, which means that these forests vary in type in different localities and different countries. It could be said that secondary forest species occur in communities – others might say associations – around Musanga, Trema, Carungana, Anthocleista, Rieinodendron, Albizia, Macaranga, Discoglypremna, etc. – in fact, most of the species listed above. Chance alone will therefore favour the establishment of Umbrella trees, Anthocleista, Vernonia and other communities in a forest clearing, given of course that it is located within the overall range distribution of the species, and depending on circumstances: pre-existing seeds, seed-bearing trees that remain in the immediate vicinity of the clearing, etc. The role of chance is such that it is impossible to forecast, with any certainty, the composition of the bush that will replace a cleared forest, and still less its composition in the second phase. We know that there will be a mixture of secondary species characteristic of the region, but with no certainty as to the frequency of each one.

In tropical forestry, there is an element of uncertainty that does not exist, or much less so, in temperate forests. Plant cover in a cleared forest evolves differently from one station to the next and can only be predicted in general terms, based on qualitative rather than quantitative observations made in the natural environment. If a secondary forest is then cleared in turn, it will not necessarily be replaced by the same species composition, unless all of the stumps produce shoots, which is by no means certain. Foresters have been surprised to observe that it is very difficult to regenerate a stand made up purely of Musanga, even though this species spontaneously and vigorously invades any clearing made in a primary forest. Every attempt up to now has partly or entirely failed: despite clearing the ground and preserving seed-bearing trees, there has been no significant regeneration, while coppicing attempts have not produced any satisfactory results: some of the stumps produce shoots, which are often fragile, while other stumps simply rot. The Musanga is a small tree growing from aerial roots; its shoots grow from dormant buds that form at the base of the trunk above the aerial roots 1, 2 or 3 metres above the soil and cannot form individuals with their own roots: they either reform the parent tree from its stump or disappear. Very little is known at present on the evolution of secondary forests or on the conditions their species need to regenerate: sylvicultural knowledge on these forests does not yet exist.

Origin of characteristic secondary forest species

Where do all these species come from, which are unknown in primary forests, yet have become so common and are steadily spreading further to the point that they could one day replace the old-growth forest? Because, after all, before clearing began on such a large scale, at a time when Pygmies were perhaps the only human beings living in equatorial forests – and even before them – primary forests reigned supreme. The knowledge we have about the temperament of these secondary forest species, and the observations made in various undoubtedly primitive stations, since humans have not been able to modify them, indicate that they often originate in swampy areas and from riverbanks. Before humans arrived, they would only become established on recently dewatered alluvial soils, and along the edges of dense forest, where water and light were abundant. But if the soil dried out for any reason (changes in the relief, etc.), they would be suppressed by the primary forest species that could become established among them. This, in all likelihood, is where the origins of these characteristic secondary forest species may be found – those growing from aerial roots such as *Musanga*, *Macaranga*, *Bridelia*, *Xylopia*, *Anthostema* or *Myrianthus*, and all the other species growing on wet ground but without aerial roots, such as *Cleistopholis* or *Trema*, both much less widespread today: by clearing the forest, man himself opens up broad tracts of forest where they could not previously survive as normal plant communities.

The origins of other species are more hypothetical, because stations that are indisputably untouched by man and where they are certain to be found are very rare. Many species probably come from the undergrowth in high semi-dry stands, or from the high stands that previously marked the transition between humid equatorial forests and forests in regions with a long dry season. These are probably the sources of species such as *Anthocleistia*, *Fagara*, *Harungana*, *Trema*, *Phyllanthus*, *Vernonia*, *Albizia*, *Holarrhena*, *Allophyllus*, *Sterculia* and *Tragantha*. Finally, many probably descend from xerophyllous scrublands, low-growing sunlit formations forming on rocky ridges, and steep mountain slopes where they are still found today.

All the species inhabiting stations in full sunlight, all those capable of rapid growth and of producing and disseminating large quantities of seeds that germinate easily have multiplied in the artificial clearings made by man. This is the origin of the “pioneer” species in secondary forests. However, for many other species, of which we know too little, we cannot say at present what their original environment might have been among many possible candidates.

The origins of the high trees peopling older secondary forests are generally different. Many are capable of regenerating in primary forests, but not well, as there is not enough sunlight. Saplings that vegetate for some time in the undergrowth will begin to grow as soon as a natural clearing appears when a large tree dies or is felled by a strong wind or struck by lightning. These species therefore existed in old-growth forests, but were not as frequent as in today’s forests that have developed from clearings. This is likely to be the case for all the species producing the finest trees and the best timber in these forests: (*Terminalia superba* and *T. ivorensis*), mahogany (*Khaya spp.),* which also originate from riverbanks and swamps, *Triphochiton scleroxylon*, *Pycnanthus*), Iroko (*Milicia*), and so on.

We have treated three outstanding trees as a special case: the Gaboon mahogany, kapok tree and oil palm (*Elaeis guineensis*). All three have become widespread in today’s African forest landscapes. Mahogany, the pride of Gabon, is often abundant in forests, but does not usually regenerate. It is a pioneer species in secondary forests, but unlike the umbrella tree and others, it is tall and long-lived. We have shown elsewhere that this species probably originated in the compacted, dried-out alluvial soils of Gabon’s coastal lake and delta region, and became established in the country’s humid forests thanks to man-made clearings.

The giant Kapok tree (*Ceiba pentandra*), a common species from the tropical Americas to Malaysia, probably did not originate in Africa but emigrated fairly recently, from the Americas according to some, or from Indo-Malaysia according to others. We do not have enough material to give an opinion on this subject, but it is certain that without forest clearing, the species would not be as widespread as it is today in Africa’s forests.

Oil palm groves are very old secondary formations in which palm trees, first dispersed and now respected by native populations, became established. Some in Dahomey [Benin] and Togo are true plantations recently established by native farmers, mainly to harvest palm wine, but most are sub-spontaneous. Oil palms are not a primary forest species, although stunted specimens may be found that do not develop or reproduce. Their origin is certainly in Africa. The species undoubtedly grow spontaneously in swampy areas on dewatered soils where there is abundant light and water: this is probably its original habitat.

The economic value of secondary forests

All pioneer species are fast-growing with soft timber. They often reach a suitable felling diameter, usually 25 to 35 cm, within 10 to 15 years. They are therefore small trees that cannot be used for construction timber, which is why they have been ignored up to now, as loggers are only interested in large trees. When considered from the angle of cellulose production, however, they are clearly of particular interest for their yields in terms of annual woody growth and the relative ease of felling and processing. This is why, given the hopes held out for colonial forests by possibilities for establishing large-scale mechanical and chemical timber processing industries to manufacture cellulose pulp, fibre board, plastics, etc., the question of short-rotation felling of all secondary forests species has been raised. However, numerous objections immediately arise.

Young secondary forests produce fewer cubic metres of timber than might be thought on seeing their luxuriant vegetation. In fact, their lianas, foliage and vines form a mass of greenery that conceals their wood so that its quantities are over-estimated. The wood is also of highly variable quality, as our profiles show: these formations are very irregular, especially when they contain remnants of cleared forest, either in the undergrowth and particularly among high trees: some almost empty parcels contain large herbaceous monocotyledons 5 to 8 m in height (*Aframomum* in particular) and an abundance of slender or knotty shrubs. Our production estimates vary from 55 to 750 stacked cubic metres per hectare. It is also difficult, and even impossible, when counting trees in these forests, to calculate average growth in volume with any certainty, because the age of the stands cannot be assessed. According to previous measurements made in Côte d'Ivoire in dense natural stands of umbrella trees, whose age was known within one two years, estimated volumes range from 200 to 250 m^3 per hectare on average, when logs more than 5 cm in diameter are stacked, or 165 to 200 m^3 when only logs more than 10 cm in diameter are considered usable.

These figures only concern pioneer species. If an older secondary forest is logged, they will obviously increase considerably. In young secondary forests, annual woody growth may be estimated at 14 to 17 stacked cubic metres of wood more than 10 cm in diameter, or 10 to 13 m^3 per year. These figures for natural forests are certainly much lower than those one would obtain for a cultivated forest or plantation.

The irregularity in the qualitative and quantitative distribution of woody material in secondary forests is a considerable handicap when attempting to forecast production. If we disregard the remnants of the previously cleared forest to consider only true secondary species, these forests are still very heterogeneous in their composition.

Not enough surveys have been made to make it possible to determine, to an acceptable degree of approximation, the average composition of secondary forests in a given region. By increasing the number of surveys or tree counts, over areas of 1 ha for example, there is a obviously a much greater probability of reaching a close estimation of the real average, but it must be admitted that we do not know a great deal about the subject since no major study has been conducted to date.

It is nevertheless unfortunate to have to rely purely on the qualitative stability of secondary forests, in other words, to have no certainty, when logging a forest today, of finding the same composition 10 to 20 years later when felling is next planned. We discussed this problematical issue of forest reconstitution at some length in the paragraphs above. It is possible, for example, that large stands of Musanga will disappear in secondary forests that have been cultivated for many centuries. We will not venture to express a formal opinion on this point, but it is not improbable; we must await more thorough knowledge on the biology of the species to form a definitive opinion on the subject.

In short, the question of exploiting wild secondary forests involves a great deal of uncertainty as to their current and future potential.

It should be remembered, nevertheless, that the option of cellulose production exists for these forests. If it were possible to multiply the trees through simple and inexpensive processes, the solution we are seeking may well emerge from this approach. What are the species concerned? We have provided an indicative list based on our impressions, although it is neither exhaustive nor definitive. This list is based on the spontaneous frequency of the species in secondary forests, broad dissemination of the species, their apparently rapid growth and the technological value of the tree (height, diameter and habit).

The umbrella tree indisputably leads the field. No other species has such rapid growth, frequency or aptitude to form pure stands. If the problem of natural propagation by preserving individuals during felling, coppicing or artificial seeding were resolved – and unfortunately, as we have said, it is not – our forest colonies would provide a source of cellulose of great interest.

We will now list all these species, which current knowledge does not permit us to rank in order of value (table III).

Need for methodological studies

With a very few exceptions, we have virtually no knowledge, if any, on secondary forests and their timber in terms of mechanical, chemical and technological properties. These formations need to be systematically studied from all these angles in order to determine their value for the manufacture of paper pulp, fibre board, hydrolysed glucose, etc.

Sylviculture in these forests also needs to be systematically researched. We have seen that easy natural regeneration does not necessarily mean easy artificial regeneration. It would be essential to investigate possibilities for abundant propagation of the species, to determine the growth rates of trees and stands and to measure their productivity by means other than observations in the wild on spontaneous vegetation, of which we know virtually nothing as regards circumstances and conditions. Experimental plantations should therefore be established. About 10 ha per species would suffice: given that trials are needed on some fifty species, this would require planting about 500 ha in each major forest colony. There is by no means a vast undertaking, but it is essential nevertheless: until such plantings are established and methodically followed up, doubts, illusions and lack of forethought will continue to be the norm.

Concerning propagation trials for umbrella trees, a methodology testing programme was set up in Côte d'Ivoire in 1941-42. This was followed up methodically despite the World War context by successive foresters working in the country. The results were negative on the whole, but the trials should be taken up again and pursued with much more perseverance, taking the lessons from the first attempts into consideration. It is inconceivable that we should fail to identify the conditions for spontaneous germination of the umbrella tree: a careful and observant experimenter needs only a lucky chance, but that chance will only arise through a series of experiments.

Finally, exotic species should not be ignored. Some are very fast-growing and produce more cellulose than local species. The scope of the trials can be productively expanded with innumerable species that include Gmelina, Macaranga, Ochroma, Virgilia, Styrax and many more.

Secondary forests in the second phase

The characteristics of species in these forests are as follows: they are sun-loving, or at least require generous light during their growth, regeneration is impossible or mediocre

Table III.
List all these species, which current knowledge does not permit us to rank in order of value.

Vernacular name	Scientific name	Particularities
The kapok tree	*Ceiba pentandra* (L.) Gaertn.	a very large fast-growing tree, easily propagated by seeding or cuttings, suitable for short rotations
Ouombé, Atsui	*Harungana madagascariensis* Lam. ex Poir.	provides straight poles, highly invasive
Adaschia, Evégeu	*Trema orientalis* (L.) Blume	appears to be much less frequent in Gabon than in Côte d'Ivoire
Kanguélé (g)	*Maesopsis eminii* Engl.	rare in Côte d'Ivoire, common in Gabon, grows to a fairly large size
Tofé, Noumasas	*Macaranga* spp.	numerous species of unequal value, choices to be made
Bangbaye, Séneu	*Albizia gummifera* (J. F. Gmel.) C. A. Sm.	appears to be more abundant in Côte d'Ivoire than in Gabon
Akoré, Atégué	*Discoglypremna caloneura* (Pax) Prain	frequent in Côte d'Ivoire especially
Poré-Poré, Ezelfou	*Sterculia tragacantha* Lindl.	
Brobo, Ahinébé	*Anthocleista nobilis* G. Don Vogelii	
Framiré (C. I.)	*Terminalia ivorensis* A. Chev.	found only in Côte d'Ivoire, tall, very rapidly growing tree, risk of serious insect attacks
Qualélé, Ilomba	*Pycnanthus angolensis (*Welw.) Warb.	mainly a second-phase species
Eho, Esessang	*Ricinodendron africanum* Müll. Arg.	very soft wood, listed pending possibilities for use
Fraké, Limbo	*Terminalia superba* Engl. & Diels.	taller than all others, very fast-growing in full sunlight, possibilities for creating pure stands, possibilities for short-rotation felling for cellulose production if seed-bearing trees are preserved to ensure natural regeneration

in shady undergrowth, and density is low or average in many cases. When they account for only a small proportion of trees in a stand and when trees with hard or very hard wood are dominant, then the environment is a primary or at least a virtually untouched forest. Conversely, when the former make up the majority of the stand and the latter are absent or in the minority, the environment is an old secondary forest. It is not unusual for primary forests to contain only a small number of species, but these are always shade-loving, usually have heavy seeds have become well established and reproduce on the spot in deep shade, thus preventing other species from developing amongst them. The most typical example is *Macrolobium Dewevrei*, a very abundant species in the Congo Basin where it is found in pure or almost pure stands. Other examples are the numerous species found in the middle and lower storeys and those found in humid and swampy ground.

When a sun-loving species is found in abundance in an apparently primary forest, this generally indicates that it originated in a secondary forest. This can be proved through studies of stand composition and latent regeneration. If a forest has an abundance of species like Mahogany, Limba, Iroko and Kapok trees, it is probably of secondary origin, which it is possible to confirm, with a few exceptions. This is particularly evident for Gaboon mahogany, a sun-loving species of the first order, which is a pioneer species in secondary forests but is also long-lived and persists in secondary forests that are so old that they take on the aspect of primary forests. We reported on the remarkable case of Gaboon mahogany in another research note and came to the conclusion that the very fortunate extension of this species into large tracts of Gabon's forests was certainly due to earlier clearing; the surprising fact is that these regions are now virtually uninhabited. This inescapably suggests that Gabon was formerly much more densely populated than it is today. This conclusion may seem astonishing, but on second thoughts, colonials who are familiar with the speed with which village populations disappear in Gabon's forests, even today, will not find it so surprising.

The same is true in Côte d'Ivoire and in Cameroon, and also elsewhere whenever a forest is dominated by second-phase species of secondary forests. Thus, vast tracts of uninhabited forest that appear to be untouched, with their gigantic trees, shadowy undergrowth, enormous lianas and almost bare soil, were in fact cleared a long time ago, if we go by the conclusions drawn from the composition of their plant communities. These forests were formerly inhabited, as were Gabon's mahogany forests. Human settlement therefore probably began earlier and across wider areas in equatorial forests than is generally thought.

To return to the case of the umbrella tree, its seemingly miraculous regeneration in apparently primary forests is due to pre-existing dormant seeds in the humus layer, but where did these seeds come from? Animals, and especially birds, certainly disperse them over large areas, but the density of seedlings in some areas suggests a different but plausible hypothesis, which is that a stand of umbrella trees existed previously in the location occupied today by the supposedly primary forest, but that it disappeared as part of the normal evolution of secondary forests, leaving an abundance of seeds in the shadows to await the chance event of fresh forest clearing to trigger their germination.

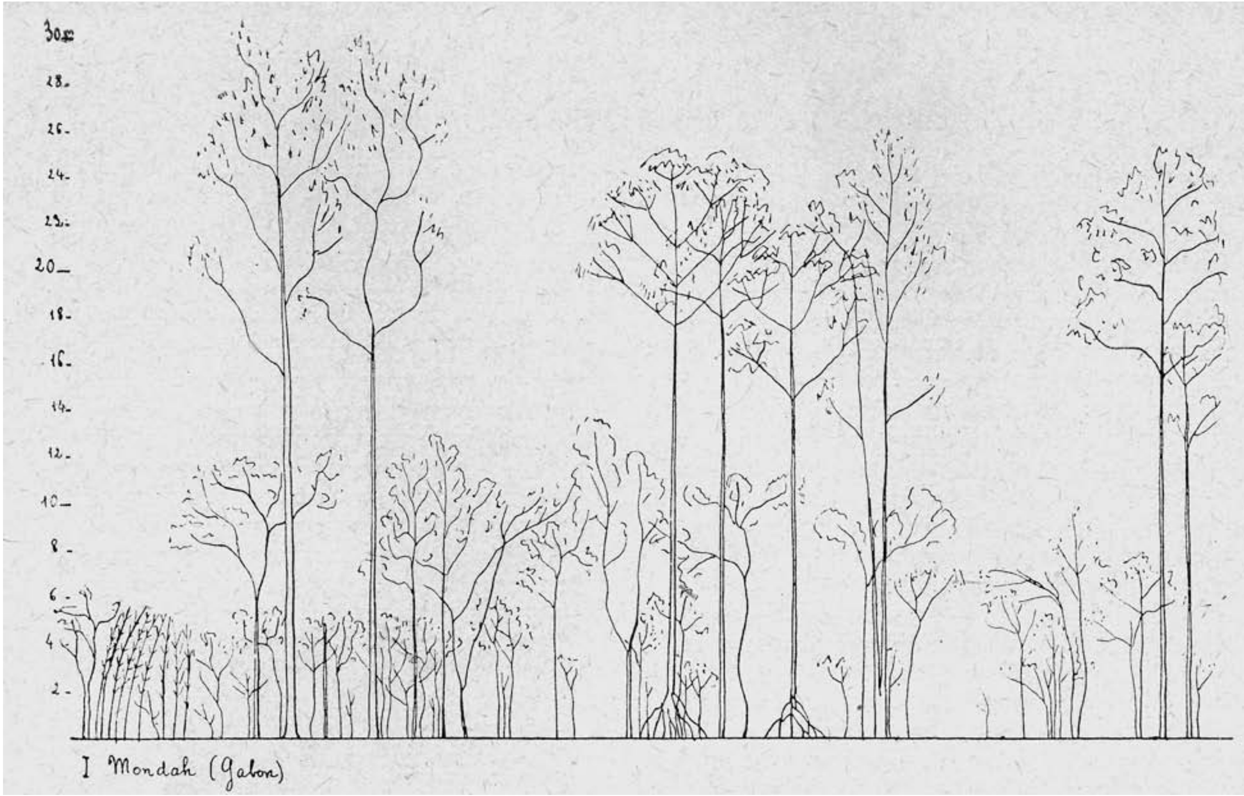
From the point of view of a forest's value, should these changes in its composition wrought by man in ages past be a cause for complaint? Clearly not, because in fact, it is the sun-loving species such as mahogany, iroko, African whitewood or limba that are most sought after, while we have no idea how to use the innumerable trees forming very hard timber that can be extracted from indisputably primary forests. But despite these happy outcomes of forest clearing, we should not unthinkingly cry “Long live the forester's axe!” nor yet entertain the fond hope that no regulatory obstacles should prevent clearing for crops. Because the anarchic freedom enjoyed by natives to cut down parcels of forest whenever they wish, notwithstanding the ultimate effect of encouraging the growth of certain useful species, also most certainly destroys existing stands in which useful trees, such as mahogany, are already in place, and subsequently, with a few blows of the axe or machete, destroys the trees that are already regenerating. It is not acceptable to allow old or young stands of valuable species to be massacred and vanish into a thin layer of ash and heavy clouds of smoke.

The lesson we should draw from these observations on the influence of human actions of the evolution of a forest is that it is possible to guide and hasten its evolution by applying sylvicultural techniques, to transform existing forests with few choice species into forests that are much richer. There is no lack of material with which to work: all these valuable trees and timber make up an economically and biologically varied resource with which foresters could create vast wealth for the future.

A. Aubréville, Inspector-General for Water and Forests in the Colonies.

The following pages contain the 12 “survey” pages annexed to Mr. Aubréville's study.

Photo 2.
Forêt exploitée près d'Oumé, Côte d'Ivoire en 1957.
Photograph A. Aubréville, 1957.

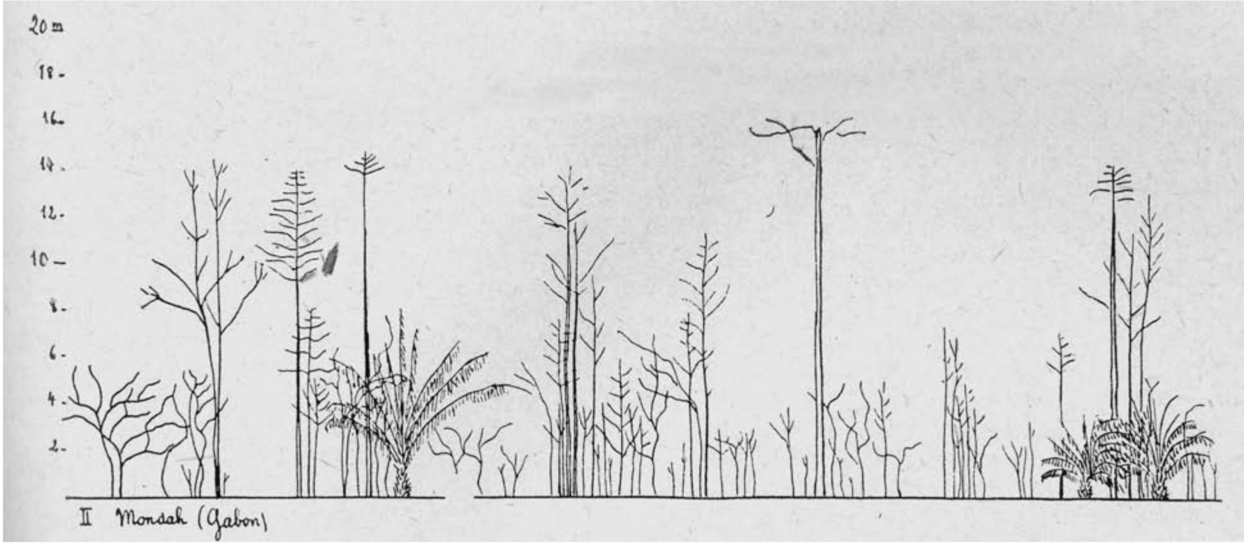


SURVEY N° 1 MONDAH FOREST (Gabon) 0.025 ha.

BUSH ABOUT 8 YEARS OF AGE, WITH EARLIER RESERVES OF GABOON MAHOGANY

Tree heights in metres		**≤ 5**	**≤ 10**	**≤ 20**	**≤ 30**	**< 30**	**Totals**
Okoumé	***Aucoumea klaineana*** Pierre	-	4	1	2	1	8
Paras olier	*Musanga cecropioides* Tedlie	-	-	-	1	1	2
Esessang	*Ricinodendron africanum* Müll. Arg.	-	-	1	1	-	2
Kanguélê	*Maesopsis eminii* Engl.	-	-	-	1	-	1
Oka ha	*Dichostemma glaucescens* Pierre	-	-	2	-	-	2
Nsa	*Maprounea membranacea* Pax & K. Offm.	-	-	1	-	-	1
Ngourangouran	*Oncoba glauca* (P. Beauv.) Planch.	4	1	-	-	-	5
Engoung	-	2	1				3
lroko	***Chlorophora excelsa***		1				1
Tol	*Ficus vogeliana* (Miq.) Miq.		1				1
Enak	*Macrolobium macrophyllum*	4					4
Ebiara	*Berlinia bracteosa*	4					4
Ovala	*Pentaclethra macrophylla*	3					3
Ndoutnaireu	-	13					13
Pindja	***Hylodendrwon gabunense*** Taub.	2					2
Miaminégouma	-	2					2
Ezelfou	*Sterculia tragacantha* Lindl.	1					1
Ofos	*Haematostaphis Pierreana*	1					1
Noumakoul	-	1					1
Eveus	***Klainedoxa gabonensis***	1					1
Evoumi	*Coula edulis*	1					1
		39	**8**	**5**	**5**	**2**	**59**

Volume: 6.3 stacked m^3 + 3.9 m3 ≠ 12 stacked m^3, I. e. 480 stacked m^3 per hectare

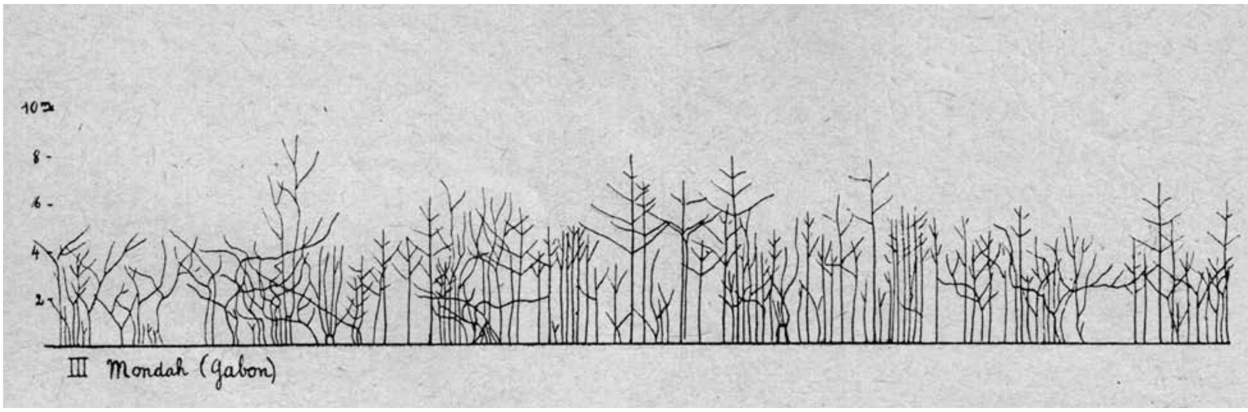


SURVEY N° 2 MONDAH FOREST (GABON) 0.025 ha.

BUSH ABOUT 10 YEARS OF AGE, ON HUMID GROUND

Tree heights in metres		**≤ 5**	**≤ 10**	**≤ 20**	**≥ 20**	**Totals**
Esoma	*Rauvolfia macrophylla*			1		1
Atégué	*Discoglypremna caloneura* (Pax) Prain				1	1
Avome	*Cleistopholis patens* (Benth.) Engl. & Diels.	1	1	1		3
Ahinébé	*Anthocleista nobilis* G. Don			1		1
Ozouga	*Sacoglottis gabonensis* (Baill.) Urb.			1		1
Ossongo	*Anthostema Aubryanum*			1		1
Bilogbikélébé	***Scotellia kamerounensis***			1		1
Olonvogo	*Fagara macrophylla* (Oliv.) Engl.			1		1
Enak	*Macrolobium macrophyllum*	12	2			14
Ezelfou	*Sterculia tragacantha* Lindl.	1	2			3
Andok	***Irvingia gabonensis***		1			1
Eyen	***Distemonanthus benthamianus*** Baill.		1			1
Eveus	***Kainedoxa gabonensis***	3	1			4
Padouk	***Pterocarpus soyauxii***		1			1
Pindja	***Hylodendron gabunense*** Taub.	1	1			2
Heyio	*Trichoscypha* sp.	1	1			2
Ndoumaireu	-	1	1			2
Niové	***Staudtia kamerunensis*** var. gabonensis (Warb.) Fouilloy	12				12
Mvouma	*Xylopia quintasii* Engl. & Diels.	5				5
Soro	***Scyphocephalium mannii*** (Benth.) Warb.	3				3
Vakfine	*Diospyros* sp.	3				3
Nkabi	*Alchornea cordifolia* (Schumach. & Thonn.) Müll. Arg.	2				2
Ngorangouran	*Oncoba glauca* (P. Beauv.) Planch.	1				1
Okess	*Garcinia Mannii*	2				2
Ilomba	*Pyenanthus kombo*	1				1
Ebiara	*Berlinia bracteosa*	1				1
Ake	*Cola*	1				1
Viass	*Heisteria*	1				1
Otounga	*Anonacée*	1				1
Nzolé	-	1				1
Enedok	-	1				1
African oil palm or macaw-fat	*Elaeis guineensis*	3				3
Unknown species	-	3				3
		61	**12**	**7**	**1**	**81**

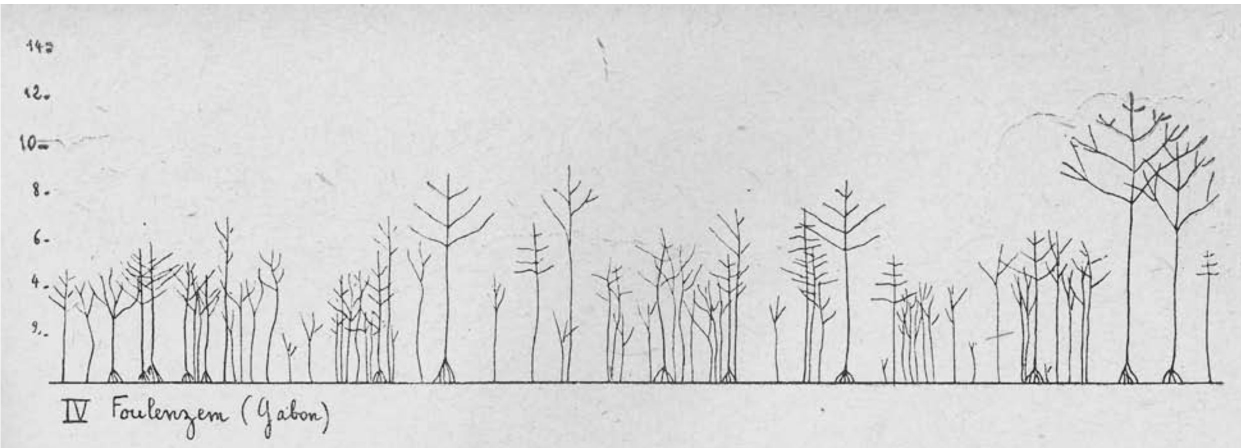
Volume: 3 stacked m^3, *i. e.* 120 stacked m^3 per hectare



SURVEY N° 3 MONDAH FOREST (GABON) 0.025 ha.

2 YEAR-OLD BUSH

Tree heights in metres		**≤ 2**	**≤ 4**	**≤ 6**	**> 6**	**Totals**
Atsu	*Harungana madagascariensis* Lam. ex Poir.	1		2	5	8
Nouùmasas	*Macaranga monandra*		1	2	2	5
Seneu	*Albizia gummifera* (J. F. Gmel.) C. A. Sm.		1	1	1	3
Nkabi	*Alchornea cordifolia* (Schumach. & Thonn.) Müll. Arg.	7	6	7	1	21
Ezelfou	*Sterculia tragacantha* Lindl.				1	1
Avome	*Cleistopholis patens* (Benth.) Engl. & Diels.			5		5
Medzimekouro	*Psychotria venosa* (Hiern) E.M.A. Petit		9	10		19
Okala	*Xylopia aethiopica* (Dunal) A. Rich.	4	7	6		17
Kanguélé	*Maesopsis eminii* Engl.			2		1
Okoumé	***Aukoumea klaineana***		1	3		4
Noumebiara	*Berlinia*			1		1
Essan	*Dichaetanthera africana* (Hook. F.) Jacq.-Fél.			2		2
Essessang	*Ricinodendron africanum* Müll. Arg.			2		2
Ngourangouran	*Oncoba glauca* (P. Beauv.) Planch.		8	4		12
Enak	*Macrobolium macrophyllum*	4	7			11
Nsa	*Maprounea membracea*		1	1		2
Boulésou	-			1		1
Ahinébé	*Anthocleista nobilis* G. Don		4			4
Atélem	*Newbouldia laevis* (P. Beauv.) Seem. ex Bureau		4			4
Assas	*Bridelia micantha* (Hochst.) Baill.		2			2
Ndoumaireu	-	6	3			9
Esoma	*Rauvolfia macrophylla*		1			1
Evegeu	*Trema orientalis* (L.) Blume		1			1
Onzabili	*Antrocaryon klaineanum* Pierre		1			1
Akaha	*Dichostemma glaucescens* Pierre		1			1
Soro	***Scyphocephalium mannii*** (Benth.) Warb.		1			1
Eveus	***Klainedoxa gabonensis***	1				1
Ngaha	-	2				2
		25	**59**	**48**	**10**	**142**



SURVEY N° 4

POULENZEN REGION (GABON) 0.025 ha.

MUSANGA BUSH, 2.5 YEARS OF AGE

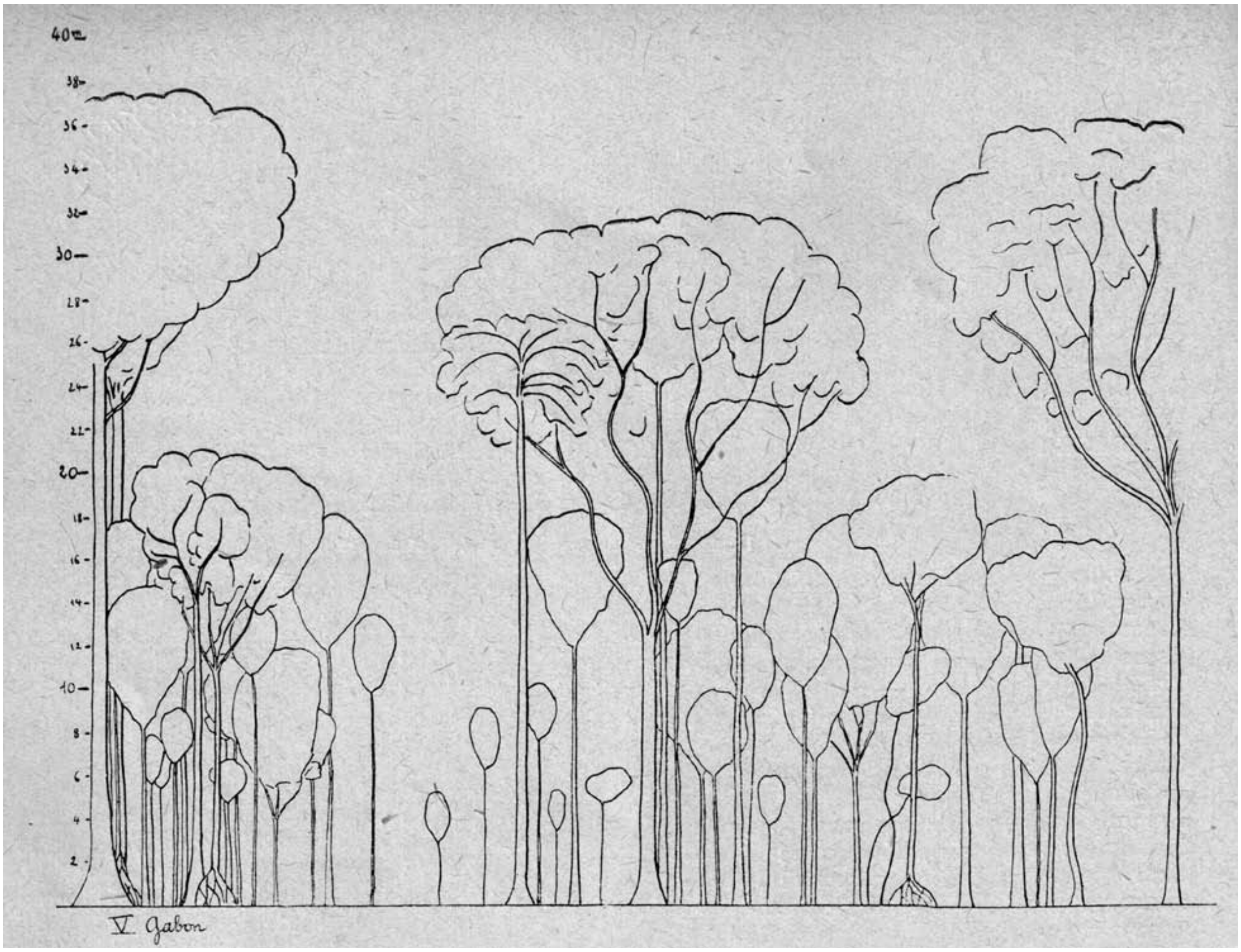
Tree heights in metres		≤ 4	≤ 6	≤ 8	≤ 10	> 10	Totals
Parasolier	*Musanga cecropioides* Tedlie		7	2	3	1	13
Kanguélé	*Maesopsis eminii* Engl.		2	2	1		5
Esoma	*Rauvolfia macrophylla*	4	4	2			10
Assas	*Macaranga* sp.		1	2			3
Tzilé	-		1	1			2
Okala	*Xylopia aethiopica* (Dunal) A. Rich.	1	1	1			3
Editoghe	-	3	3				6
Evegeu	*Trema orientalis* (L.) Blume		4				4
Nvimkoué	-	1	3				4
Eyoum	*Dialium* sp.	1	1				2
Medzimekouro	*Psychotria venosa* (Hiern) E.M.A. Petit	6	1				7
Okol	*Ficus exasperata* Vahl	1	4				5
Avome	*Cleistopholis patens* (Benth.) Engl. & Diels.		1				1
Olonvogo	*Fagara macrophylla* (Oliv.) Engl.		1				1
Ahinébé	*Anthocleista nobilis* G. Don	1					1
Toum	***Piptadenia Africana***	1					1
Eveus	***Klainedoxa gabonensis***	1					1
Padouk	***Pterocarpus soyauxii***	1					1
Aboudkoulo	-	2					2
		23	**34**	**10**	**4**	**1**	**72**

SURVEY N° 5

KANGO REGION (GABON) 0.025 ha.

VERY OLD SECONDARY FOREST RESEMBLING PRIMARY FOREST

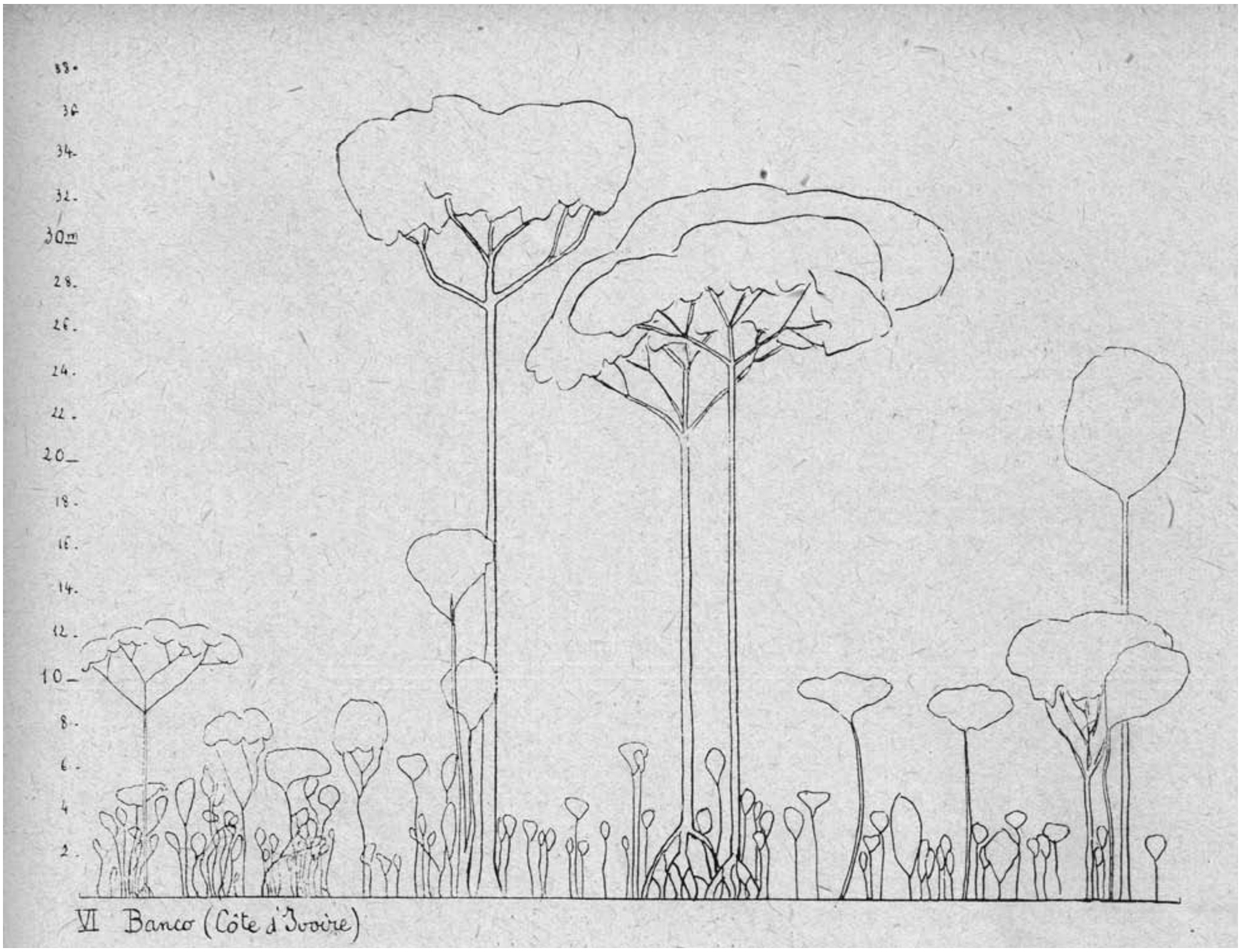
Tree heights in metres		≤ 5	≤ 10	≤ 15	≤ 20	≤ 25	≤ 30	≤ 40	Totals
Alep	*Desbordesia oblonga*							1	1
Assié	*Pachylobus buettneri* (Engl.) H.J. Lam					1		1	2
Niové	Staudtia kamerunensis var. gabonensis (Warb.) Fouilloy.	2						1	3
Okoumé	*Aucoumea klaineana* Pierre						2		2
Soro	*Scyphocephalium mannii* (Benth.) Warb.						1		1
Eba	*Pachylobus balsamifera*			1	1	1			3



SURVEY N° 5 (suite) KANGO REGION (GABON) 0.025 ha.

VERY OLD SECONDARY FOREST RESEMBLING PRIMARY FOREST

Tree heights in metres		**≤ 5**	**≤ 10**	**≤ 15**	**≤ 20**	**≤ 25**	**≤ 30**	**≤ 40**	**Totals**
Owui	*Hexalobus crispiflorus*		2			1			3
Atom	*Pachylobus* sp.			3	3				6
Andok	*Irvingia gabonensis*			2	1				3
Padouk	*Pterocarpus soyauxii*		1		1				2
Otounga	-		2	3	1				6
Ekouné	*Coelocaryon preussii* Warb.				1				1
Ekoba	*Stombiopsis Zenkeri*		1		1				2
Vakfine	*Diospyros* sp.		1	1	1				3
Adzem	-	2		1					3
Akak	*Duboscia macrocarpa*			1					1
Ebame	*Chrysophyllum lacourtianum*		1	2					3
Engoung	-		1						1
Essoula	*Plagiostyles Africana*	1							1
Ekokoum	*Barteria*	1							1
Ngeneu	-	1							1
Etou	-	2							2
Kara	-	1							1
Andoung	-	1							1
Kese	*Thomandersia laurifolia*	4							4
		15	**9**	**14**	**10**	**3**	**3**	**3**	**57**



SURVEY N° 6 CÔTE D'IVOIRE

BANCO FOREST (Series IV - Parcel 1 - 0.02 ha).

Valley bottom - Old secondary forest with regenerating primary understorey

Tree heights in metres		**≤ 4**	**≤ 6**	**≤ 8**	**≤ 10**	**≤ 12**	**≤ 15**	**≤ 20**	**≤ 25**	**≤ 30**	**> 30**	**Totals**
Parasolier	*Musanga cecropioides* R . Br.	1				1					2	4
Fromager	*Ceiba pentandra* (L.) Gaertn.										1	1
Poé	*Stombosia pustulata*								1			1
Tofé	*Macaranga* sp.					1		1				2
Adjouaba	*Pachylobus deliciosa*						1					1
Effeu	*Hannoa klaineana* Pierre ex Engl.					1						1
Piegba	*Conopharyngia durissima*	10	6	4	3							23
Pouo	*Funtumia latifolia*	1			1							2
Avodiré	*Turreanthus africanus*	1		1								2
Kkoi	*Microdesmis puberula*	22	2									24
Efi	*Pleiocarpa mutica*	1	1									2
Akéato	*Cola gabonensis*	12	1									13
Moué	*Monodora myristica*	3	1									4
Colatier	*Cola nitida*		1									1
Akédé	*Antiaris welwitschii*	1	1									2
Koto	*Pterygota* sp.		1									1
Azadau	*Afzelia bella*	1										1
Ouroviti	*Isolana campanulata*	1										1

SURVEY N° 6 (suite) CÔTE D'IVOIRE

BANCO FOREST (Series IV - Parcel 1 - 0.02 ha).

Valley bottom - Old secondary forest with regenerating primary understorey

Tree heights in metres		≤ 4	≤ 6	≤ 8	≤ 10	≤ 12	≤ 15	≤ 20	≤ 25	≤ 30	> 30	Totals
Dabéma	*Piptadenia Africana*	1										1
Okoué	*Baphia* sp.	1										1
Akhoissi	*Homalium Aylmeri*	1										1
Doloko	*Cola mirabilis*	2										2
Azobé	*Lophira procera*	1										1
Sohoué	*Holarrhena Africana*	1										1
Assié blessou	-	1										1
Akaingo	*Craserispermum gracile*	1										1
Bodioa	*Anopyxis gracile*	1										1
Okoué	*Raphia* sp.	1										1
		67	**14**	**5**	**4**	**3**	**1**	**1**	**1**		**3**	**99**

Volume: 2.75 stacked m^3 + 8.2 $m^3 \neq$ 15 stacked m^3, *i. e*. 750 stacked m^3 per hectare

SURVEY N° 7 CÔTE D'IVOIRE

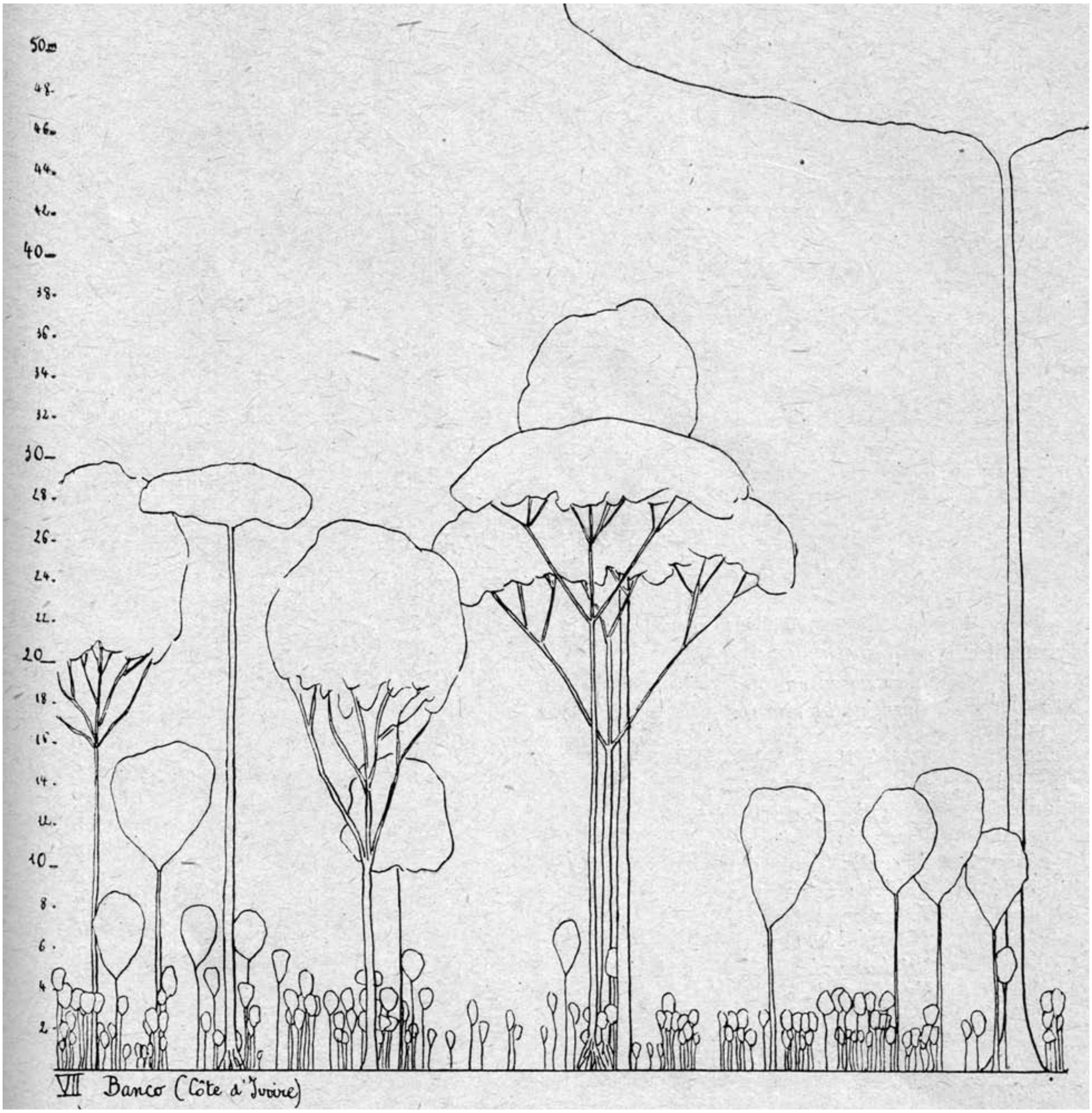
BANCO FOREST (0.02 ha - Parcel 2).

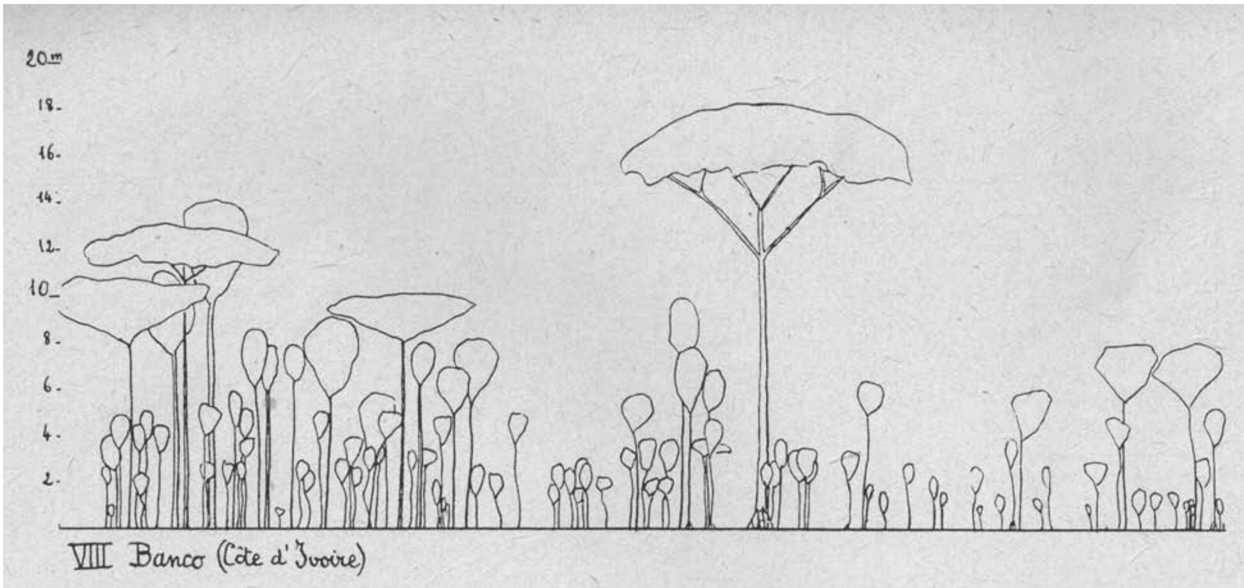
Valley bottom - parcel parallel to Survey 6 and 10 metres distant.
Old secondary forest with some primary forest reserves, regenerating primary understorey

Tree heights in metres		≤ 4	≤ 6	≤ 8	≤ 10	≤ 12	≤ 15	≤ 20	≤ 30	≤ 40	≤ 50	≤ 60	Totals
Dabéma	***Piptadenia Africana***	1										1	2
Parsolier	*Musanga cecropioides* R. Br.		1							1	2		3
Kaka	***Philodiscus bancoensis***	1								1			2
Adjouaba	*Pachylobus deliciosa*						2		1				3
Tofé	*Maracanga* sp.								1				1
Colatier	*Cola nitida*								1				1
Abalé	***Combretodendron africanum***						1						1
Poé	***Strombosia pustulata***						1						1
Andofiti	*Vitex micrantha*					1							1
Piegba	*Conopharyngia*	21	1	2	1								25
Aribanda	*Trichilia tessmannii* Harms			1									1
Avodiré	***Turreanthus africanus***	11	2										13
Moué	*Monodora myristica*	6	1										7
Ouatéra	*Allamblackia parviflora*	1	1										2
Akohissi	***Homalium alymeri***		1										1
Séléma	*Baphia* sp.	1	1										2
Akéato	*Cola gabonensis*	30											30
Kokoi	*Microdesmis puburela*	20											20
Doloko	*Cola mirabilis*	4											4
Bossé	***Guarea cedrata***	5											5
Efi	*Pleiocarpa mutica*	7											7
Okoué	*Baphia* sp.	4											4
Banaye	*Trichilia monadelpha* (Thonn.) J. J. de Wilde	2											2
Akédé	***Antiaris Welwitschii***	2											2
Baoué	*Enantia polycarpa*	2											2
Soamon	-	2											2
Ourovili	*Isolana campanulata*	1											1

Effeu	***Hannoa klaineana*** Pierre ex Engl.	1											1
Afambéou	*Dialum dinklagei*	1											1
Dao	*Trichosypha arborea* A. Chev.	1											1
Tivi	*Randia hispida*	1											1
Sampou	*Drypetes gilgiana*	1											1
Losso	***Ledermannia chrysochlamys***	1											1
Wounian	*Myrianthus arboreus* P. Beauv.	1											1
Poupouia	*Monosis conferta* (Benth.) C. Jeffrey	1											1
Akohissi	***Homalium aylmeri***	1											1
Elo	*Xylopia villosa*	1											1
Iroko	***Milicia excelsa*** (Welw.) C. C. Berg	1											1
		132	**7**	**3**	**1**	**1**	**4**		**4**	**3**		**1**	**156**

Volume: 4 stacked m³ + 14.8m³





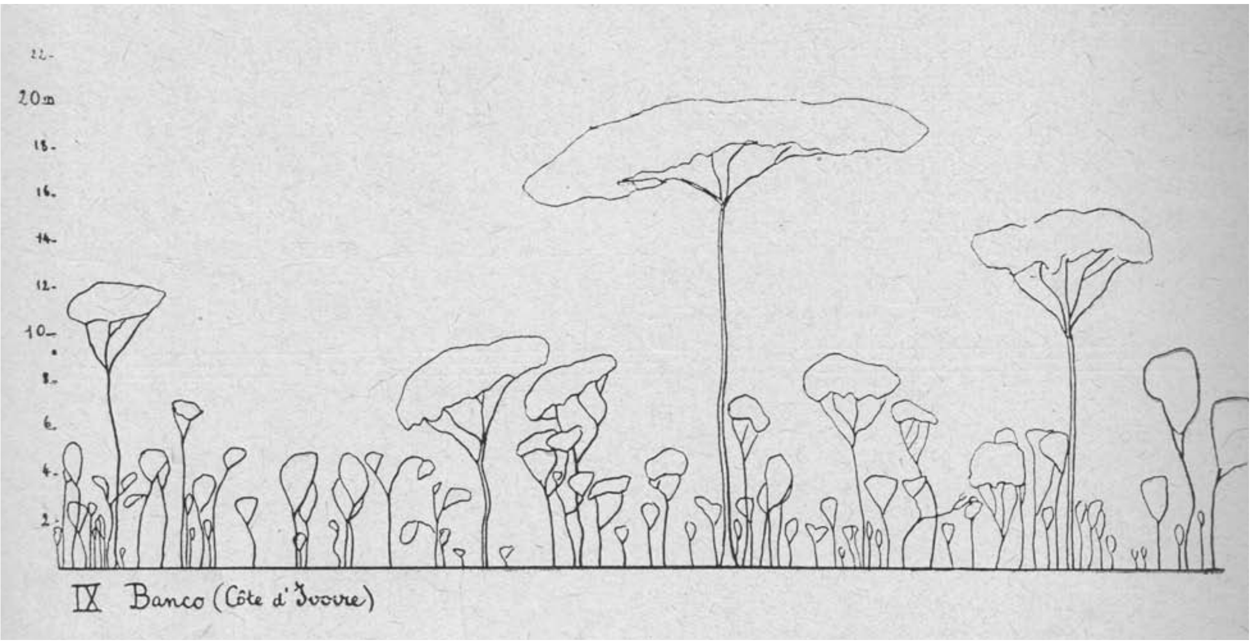
SURVEY N° 8 CÔTE D'IVOIRE

BANCO FOREST 0.02 HA

Plateau (Parcel 3) - Young secondary forest

Tree heights in metres		**≤ 4**	**≤ 6**	**≤ 8**	**≤ 10**	**≤ 12**	**≤ 15**	**≤ 20**	**Totals**
Parasolier	*Musanga cecropioides* R . Br.							1	1
Tofé	*Macaranga* sp.	3	1				1		5
Framiré	*Terminalia ivorensis*						1		1
Bangbaye	*Albizia gummifera* (J. F. Gmel.) C. A. Sm.				1	1			2
Kaka	*Philodiscus bancoensis*	1				1			2
Oualélé	*Pycanthus kombo*		1		1				2
Piegba	*Conopharyngia durissima*	1	2	1	1				5
Poupuia	*Vernonia conferta*			3					3
Poré poré	*Sterculia tragacantha* Lindl.	1	1	1					3
Tchikué	*Bridelia micrantha* (Hochst.) Baill.	1		1					2
Alibkouo	*Tylostemon Mannii*	6		1					7
Réré	*Macrolobium macrophyllum*	5	1	1					7
Dao	*Trichoscypha arborea* A. Chev.			1					1
Abalé	*Combrtodendron africanum*			1					1
Okoué	*Baphia* sp.	10	3						13
Wouniam	*Myrianthus arboreus* P. Beauv.	1	2						3
Rikio	*Uapaca guineensis*	1	1						2
Akoré	*Discoglypremna caloneura* (Pax) Prain		1						1
Aplati	*Gaertnera paniculata* Benth.								1
Azobé	*Lophira procera*								1
Moué	*Monodora myristica*	2							2
Poé	*Strombosia pustulata*	2							2
Akédé	*Antilaris welwitschii*	2							2
Kokoi	*Microdesmis puberula*	5							5
Akossika	*Scotellia kamerunensis*	1							1
Dibétou	*Lovoa triclisioides*	6							6
Banaye	*Trichilia monadelpha* (Thonn.) J. J. de Wilde	2							2
Baoué	*Enantia polycarpa*	1							1

Dabéma	*Piptadenia Africana*	1							1
Akéato	*Cola gabonensis*	5							5
Brobro	*Anthocleista nobilis* G. Don	1							1
Bodioa	*Anopyxis ealaensis*	1							1
Assié blessou	-	1							1
Tuibesso	*Baphia* sp.	1							1
Félétou	-	3							3
Colatier	*Cola nitida*	1							1
Bahé	*Fagara macrophylla* (Oliv.) Engl.	1							1
Bahé	*Fagara achnacée*	1							1
Ouré ouré	*Cléistanthus polytachus*	1							1
		68	**15**	**10**	**3**	**2**	**2**	**1**	**101**



SURVEY N° 9 CÔTE D'IVOIRE

BANCO FOREST (Plateau - Parcel 3 - 0.02 ha)

Secondary forest, young, species-poor, no distinct character

Tree heights in metres		**≤ 4**	**≤ 6**	**≤ 8**	**≤ 10**	**≤ 12**	**≤ 15**	**≤ 20**	**Totals**
Dabéma	***Piptadenia Africana***							1	1
Tchikoué	*Bridelia micrantha* (Hochst.) Baill.				1		1		2
Melegba	***Berlinia acuminate***				1		1		2
Kaka	***Phialodiscus bancoensis***	2	1	2	1				6
Atiokoué	*Tylostemon heudelotii*	7	1		1				8
Bangbaye	*Trichilia monadelpha* (Thonn.) J. J. de Wilde	1		1					2
Okoué	*Baphia* sp.	14	3	1					18
Effeu	***Hannoa klaineana*** **Pierre ex Engl.**		2						2
Dona	*Carapa procera*		1						1
Gbona	-		1						1

SURVEY N° 9 (suite) CÔTE D'IVOIRE

BANCO FOREST (Plateau - Parcel 3 - 0.02 ha)

Secondary forest, young, species-poor, no distinct character

Tree heights in metres		≤ 4	≤ 6	≤ 8	≤ 10	≤ 12	≤ 15	≤ 20	Totals
Kokoi	*Microdesmis puberula*	7	1						8
Piegba	*Conopharyngia durissima*		1						1
Poré poré	*Sterculia tragacantha* Lindl.		1						1
Bodia	***Anophyxis ealaensis***		1						1
Atroka	-		1						1
Tuibesso	*Baphia* sp.	1							1
Baouéfou	*Polyalthia oliveri*	2							2
Oklé	-	1							1
Bleu	*Carpolobia lutea*	1							1
Elo	*Xylopia* sp.	2							2
Gbagba	*Dichapetalum flexuosum*	2							2
Wouniogba	*Maesobotrya sparsiflora*	1							1
Réré	*Macrolotium macrophyllum*	3							3
Ga	*Eriocoelum racemosum*	1							1
Félétou	-	2							2
Akéato	*Cola gabonensis*	3							3
Kiokio	*Glyphea lateriflora*	1							1
Poé	***Strombosia pustulata***	1							1
Abalé	***Combretodendron africanum***	1							1
		53	**14**	**4**	**4**		**2**	**1**	**78**

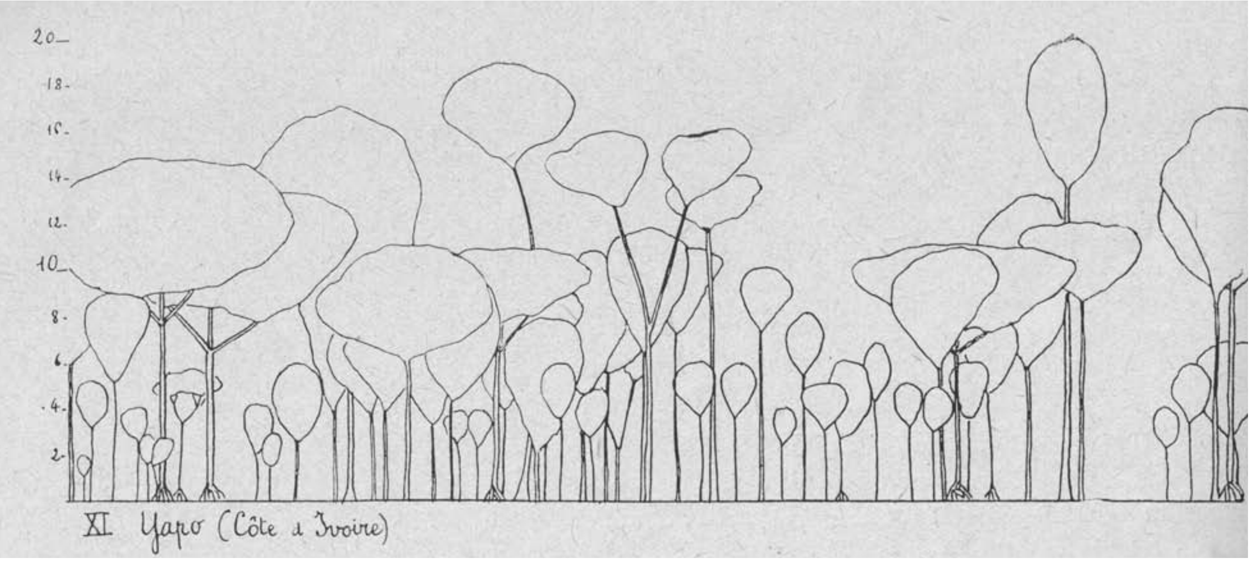
Volume: 1.1 stacked m³, i. e. 55 stacked m³ per hectare

SURVEY N° 10 CÔTE D'IVOIRE

MAMBA FOREST (km 65, Agboville road) 0.02 ha
Old secondary forest

Tree heights in metres		≤ 5	≤ 10	≤ 15	≤ 20	≤ 30	Totals
Parasolier	*Musanga cecropioides* R . Br.				2	1	3
Poé	***Strombosia pustulata***	2				1	3
Akossika	***Scotellia chevalieri***					1	1
Aninguiri red	***Chrysophyllum beguei***	1	3	2	4		10
Tofé	*Macaranga* sp.		1		2		3
Akoré	*Dicoglypremna caloneura*						1
Ouotéra	*Allanblackia parviflora*				1		1
Adjouaba	*Pachylobus deliciosa*		1	3			4
Moué	*Monodora myristica*		1	1			2
Banaye	*Trichilia monadelpha* (Thonn.) J. J. de Wilde			1			1
Dona	*Carapa procera*	2	1	1			4
Okoué	*Baphia nitida*	2		1			3
Sanza minika	*Dyospiros sanza* minilka		1	1			2
Rikio	*Uapaca guineensis*			1			1
Lo	***Parkia bicolor***			1			1
Badi	***Nauclea diderrichii*** (De Wild. & T. Durand) Merr.	3	1				4
Gaigai	*Napolenoa leonensis*		1				1
Kaka	***Philodiscus bancoensis***	1	1				2
Ngavi	*Diospyros heudelotii*		1				1
Ouara	*Cola maclaudii*		1				1
Anloukéti	***Pachypodanthium straudtii***		1				1
Atiokouo	*Tylostemon Mannii*	1					1
Beu	*Symphonia gabonensis*	1					1
Attia	*Coula edulis*	1					1
Ouokouti	*Randia genipaeflora*	1					1
Abrabassa	*Octhtocosmus africanus*	1					1
Ndéchavi	*Rauvolfia vomitoria*	1					1
Aplati	*Gaertnera paniculata* Benth.	1					1
Fondé	*Xylopia staudtii*	1					1
		19	**14**	**12**	**10**	**3**	**58**

Volume: 8 stacked m^3 + 3.34 m^3 = about 13 stacked m^3 *i. e.* 55 stacked m^3 per hectare



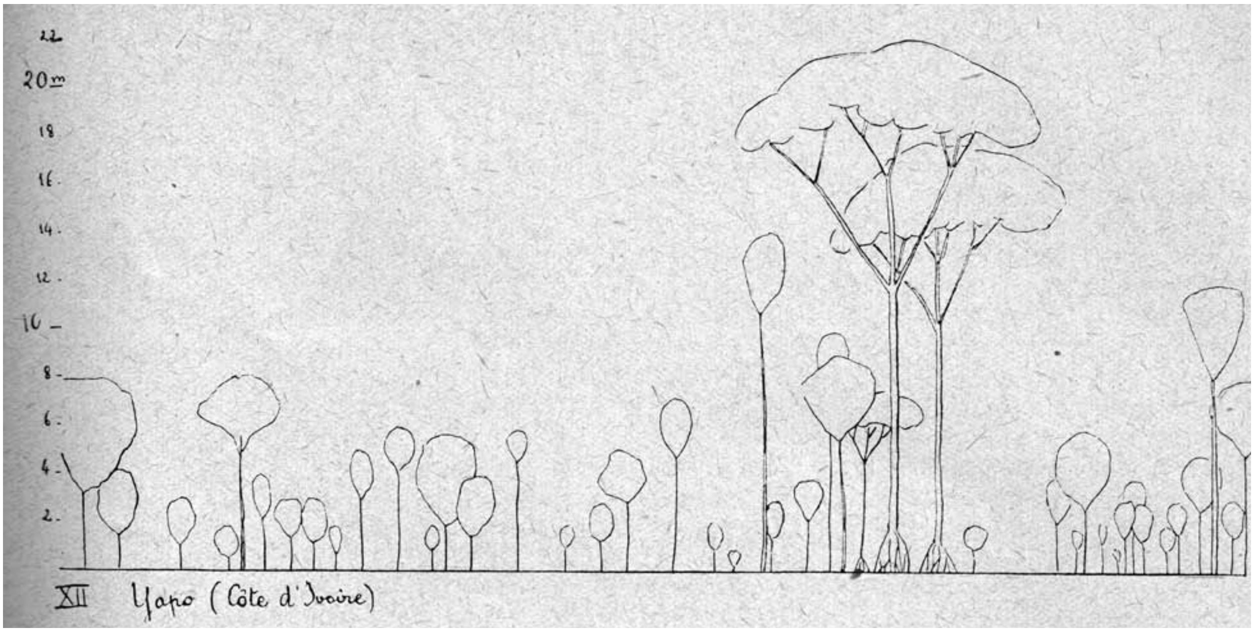
SURVEY N° 11 CÔTE D'IVOIRE

YAPO FOREST (PARCEL 1) 0.02 HA

Young secondary forest

Tree heights in metres		≤ 4	≤ 6	≤ 8	≤ 10	≤ 12	≤ 15	≤ 20	Totals
Tofé	*Macaranga* sp.					1		1	2
Ouombé	*Harungana madagascariensis* Lam. ex Poir.							1	1
Poé	***Strombosia pustulata***			1	1			1	3
Oya	*Mareya spicata*				1			1	2
Tohikuébi	***Bridelia aubrevillei***						1		1
Mottikoro	*Drypetes Afzelii*		1	2			1		4
Kékémi	*Diospyros gabonensis*						1		1
Akoré	*Discoglypremna caloneura* (Pax) Prain		4	1		2			7
Parasolier	*Musanga cecropioides* R . Br.					2			2
Sanza minika	*Dyospiros gabonensis*		1	1		1			3
Brobro	*Anthocleista nobilis* G. Don				1	1			2
Kainkain	*Aporrhiza talbotii*					1			1
Djilika	*Spondiathus preussii*				1				1
Aguis	***Omphalocarpum anocentrux***				1				1
Wounian	*Myrianthus arboreus* P. Beauv.			1					1
Rikio	*Uapaca guineensis*			1	1				2
Adjouaba	*Pachylobus deliciosa*			1					1
Tiama	***Entandophragma angolense***			1					1
Losso	*Ledermannia chrysochlamys*		1						1
Okoué	*Baphia nitida*		2						2
Boborou	*Irvingia gabonensis*		1						1
Kondroti	***Bombax breviscupe***		1						1
Okoué	*Baphia bancoensis*	1							1
Gaigai	*Napoleona leonensis*	1							1
Kaka	***Phialodiscus bancoensis***	1							1
Lo	***Parkia bicolor***	2							2
		5	**11**	**9**	**6**	**8**	**3**	**5**	**47**

Volume: 3.5 stacked m³ i. e. 175 stacked m³ per hectare



SURVEY N° 12 CÔTE D'IVOIRE

YAPO FOREST (Parcel 2) 0.02 ha

Very poor secondary forest

Tree heighs in metres		**≤ 4**	**≤ 6**	**≤ 8**	**≤ 10**	**≤ 12**	**≤ 15**	**≤ 20**	**Totals**
Parasolier	*Musanga cecropioides* R . Br.			1				2	3
Poé	***Strombosia pustulata***	1	1				1		3
Effeu	***Hannoa klaineana*** Pierre ex Engl.					1			1
Sobou	*Cleistopholis patens* (Benth.) Engl. & Diels.				1				1
Kamaïa	*Rubiacée*				1				1
Loloti	*Lannea welwitschii* (Hiern) Engl.			1					1
Bodioa	***Anopyxis Ealaensis***			1					1
Dahé	*Fagara macrophylla* (Oliv.) Engl.		2	1					3
Okoué	*Baphia bancoensis*	2	1						3
Moué	*Monodora myristica*		1						1
Colatier	*Cola nitida*	1	1						2
Wounian	*Myrianthus arboreus* P. Beauv.	1	1						2
Acajou	***Khaya ivorensis*** A. Chev.	1							1
Gaigai	*Napoleana leonensis*	2	1						3
Sanza Minika	*Diospyros gabonensis*	1							1
Daocou	*Bosquiea phoberos*	2							2
Mélegba	***Berlinia acuminate***	1							1
Oyia	*Mareya spicata*	1							1
Ngavi	*Diospyros heudelotii*	1							1
Bahia	***Mytragine ciliata***	1							1
Banayé	*Trichilia monadelpha* (Thonn.) J. J. de Wilde	1							1
Kokoi	*Microdesmis puberula*	1							1
Onotéra	*Allanblackia parviflora*	1							1
Aoudogba	*Cuviera nigrescens*	1							1
Koué	*Baphia nitida*	4							4
Ehoué	*Rinorea elliottii*	1							1
Ndéchavi	*Rauvolfia vomitoria* Afzel.	1							1
		25	**8**	**4**	**2**	**1**	**1**	**2**	**43**

Volume: 3.1 stacked m³ + 0.06 m³ ≠ 4 stacked m³ *i. e.* 200 stacked m³ per hectare

List of scientific names used in the text and figures by the author, and corrected or modernized by the revue with the help the botanist researcher Michel Arbonnier (Cirad).

Corrected name of genus and species or botanic synonymy	Botanic name used by the author and transcribed in the original article
(Mbigou range around 1000 m asl)	(Mbigou range around 1000 m asl)
***Albizia gummifera* (J. F. Gmel.) C. A. Sm.**	*Albizia gummifera*
***Albizia zygia* (DC.) J. F. Macbr.**	*Albizia zygia*
***Alchornea cordifolia* (Schumach. & Thonn.) Müll. Arg.**	*Alchornea cordifolia*
Allophylus africanus P. Beauv.	*Allophyllus africanus*
Anthocleista nobilis G. Don	*Anthocleista nobilis*
Antrocaryon klaineanum Pierre	*Antrocaryon Klaineanum*
***Aucoumea klaineana* Pierre**	*Aucoumea klaineana*
Bridelia micrantha (Hochst.) Baill. (Hochst.) Baill.	*Bridelia micantha*
***Caloncoba welwitschii* (Oliv.) Gilg**	***Coloncoba welwitschii***
Calpocalyx brevibracteatus Harms	*Calpocalyx brevibracteatus*
Calpocalyx dinklagei Harms	*Calpocalyx aff. Dinklagei*
Calpocalyx klainei Pierre ex Harms	*Calpocalyx Klainei*
Canarium schweinfurthii Engl.	*Canarium schweinfurtii*
Casearia Jacq.	*Casearia*
***Ceiba pentandra* (L.) Gaertn.**	*Ceiba pentandra*
Chrysolbalanus ellipticus	*Chrysolbalanus ellipticus*
Cleistopholis patens (Benth.) Engl. & Diels	*Cleistopholis patens*
Cnestis ferruginea DC.	*Cnestis ferruginea*
Coelocaryon preussii Warb.	*Caelocaryon Klainei*
Cordia platythyrsa Baker	*Cordia platythyrsa*
Croton oligandrus Pierre ex Hutch.	*Croton oligandrum*
Daniella spp.	*Daniella spp.*
Dichaetanthera africana (Hook. F.) Jacq.-Fél.	*Skersia africana*
Dichostemma glaucescens Pierre	*Dichostemma glaucescens*
Diospyros sp.	*Diospyros*
***Discoglypremna caloneura* (Pax) Prain**	*Discoglypremna caloneura*
Distemonanthus benthamianus Baill.	*Distemonanthus banthamianus*
Erythrina milbraedii Harms	*Erythrina altissima*
Eugenia sp.	*Eugenia*
Fagara macrophylla (Oliv.) Engl.	*Fagara macrophylla*
Ficus exasperata Vahl	*Ficus exasperata*
Ficus mucuso Welw. ex Ficalho	*Ficus mucuso*
Ficus sur Forssk.	*Ficus capensis*

Ficus vogeliana (Miq.) Miq.	*Ficus vogeliana*
Gaertnera paniculata Benth.	*Gaertnera paniculata*
Hannoa klaineana Pierre ex Engl.	*Hannoa klaineana*
Harrisonia abyssinica Oliv.	*Harrisonia occidentalis*
***Harungana madagascariensis* Lam. ex Poir.**	*Harongana madagascariensis*
Holarrhena floribunda (G. Don) T. Durand & Schinz	*Holarrhena africana*
Homalium letestui Pellegr.	*Homalium dolichophyllum*
Hylodendron gabunense Taub.	*Hylodendron gabonense*
Hymenocardia ulmoides Oliv.	*Hymenocardia ulmoides*
Khaya ivorensis A. Chev.	*Khaya ivorensis*
Lannea welwitschii (Hiern) Engl.	*Lannea welwitschii*
Macaranga barteri Müll. Arg.	*Macaranga barteri*
***Macaranga barteri* Müll. Arg., *M. spinosa* Müll. Arg., *M. hurifolia* Beille**	*Macaranga bartyeri, spinosa, huraefolia*
***Maesopsis eminii* Engl.**	*Maesopsis Eminii*
Mallotus oppositifolius (Geiseler) Müll. Arg.	*Mallotus oppositifolius*
Maprounea membranacea Pax & K. Offm.	*Maprounea mambranacea*
Milicia excelsa (Welw.) C. C. Berg	*Chlorophora excelsa*
Milleria L.	*Milleria versicolor Laurentii*
Monosis conferta (Benth.) C. Jeffrey	*Vernonia conferta*
***Musanga cecropioides* R . Br.**	*Musanga Smithii*
***Musanga cecropioides* Tedlie**	*Musanga Smithii*
Myrianthus arboreus P. Beauv.	*Myrianthus arboreus*
Nauclea diderrichii (De Wild. & T. Durand) Merr.	*Sarcocephalus diderrichii*,
Newbouldia laevis (P. Beauv.) Seem. ex Bureau	*Newbouldia laevis*
***Oncoba glauca* (P. Beauv.) Planch.**	*Caloncoba glauca*
Pachylobus buettneri (Engl.) H.J. Lam	*Pachylobus buttneri*
Pentaclethra eetveldeanna De Wild. & T. Durand	*Pentaclethra eetveldeanna*
Pentaclethra macrophylla Benth.	*Pentaclethra macrophylla*
Phyllanthus discoideus (Baill.) Müll. Arg.	*Phyllanthus discoideus*
Pierreodendron kerstingii (Engl.) Little	*Mannia simarubopsis*
Platycalyx N. E. Br.	*Platucalys Verderysti*
Pleioceras barteri Baill.	*Pleioceras barteri*
Polyscias letestui Norman	*Polvscias Le Testui*
Premna hispida Benth.	*Premna hispida*
Pseudospondias microcarpa (A. Rich.) Engl.	*Pseudospondias microcarpa*

Psychotria articulate (Hiern) E.M.A. Petit	*Grumilea articulata*
Psychotria venosa (Hiern) E.M.A. Petit	*Grumilea venosa*
Psydrax subcordata (DC.) Bridson var. subcordata	Canthium glabriflorum
Pycnanthus angolensis (Welw.) Warb.	*Pycnanthus kombo*
Randia acuminate (G. Don) Benth. *(also in primary forest undergrowth, especially humid or swampy* ground)	*Randia acuminata*
Rauvolfia macrophylla	*Rauwolfia macrophylla*
Rauvolfia vomitoria Afzel.	*Rauwolfia vomitoria*
***Ricinodendron africanum* Müll. Arg.**	*Ricinodendron africanum*
***Sacoglottis gabonensis* (Baill.) Urb.**	*Saccoglottis gabonensis*
***Sclerocrton cornutus* (Pax) Kruijt & Roebers**	***Saplum cornutum***
Scyphocephalium mannii (Benth.) Warb.	*Scyphocephalium Ochocoa*
Spathodea campanulata P. Beauv.	*Spathodea campanulata*
Spondias mombin L.	*Spondias monbin*
Staudtia kamerunensis var. gabonensis (Warb.) Fouilloy	*Staudita gabonensis*
Sterculia tragacantha Lindl.	*Sterculia tragacantha*
Strychnos pungens Soler., *S. variabilis* De Wild.	*Strynchos pungens, variabilis*
Terminalia ivorensis A. Chev.	*Terminalia ivorensis*
Terminalia superba Engl. & Diels.	*Terminalia superba*
Tetrapleura tetraptera (Schumach.) Taub.	*Tetrapleura tetraptera*
***Tetrorchidium didymostemon* (Baill.) Pax & K. Hoff.**	*Tetrorchidium didymostemon*
***Treculia africana* Decne.**	*Treculia africana*
***Trema orientalis* (L.) Blume**	*Trema guineensis*
Trichilia monadelpha (Thonn.) J. J. de Wilde	*Trichilia Heudelotii*
Trichilia tessmannii Harms	*Trichilia lanata*
Trichoscypha sp.	*Tricoscypha*
Triplochiton scleroxylon K. Schum.	*Triplochiton scleroxylon*
***Vernonia brazzavillensis* Aubrév. Ex Compère**	***Vernonia brazzavilliensis***
Vismia guinensis (L.) Choisy	*Vismia leonensis*
Vitex grandifolia Gürke	*Vitex grandifolia*
***Xylopia aethiopica* (Dunal) A. Rich.**	*Xylopia aethiopica*
Xylopia quintasii Engl. & Diels.	*Xylopia quintasii*
Zanthoxylum parvifoliolum (A. Chev. Ex Keay) W.D. Hawth.	*Fagara parvifolium*