



Dynamic of *Sacoglottis gabonensis* – *Aucoumea klaineana* couple in the Congolese coast Forest (Brazzaville – Congo)

Kimponi V.^{1*}, Loumeto J.^{2*} and Mizingou J.^{3*}

¹École normale supérieure, Université Marien Ngouabi, B.P. 237, Brazzaville, CONGO

²Faculté des sciences, Université Marien Ngouabi, B.P. 2820, Brazzaville, CONGO

³Service National de Reboisement, B.P. 839, Pointe-Noire, CONGO

Available online at: www.isca.in

Received 11th April 2013, revised 24th May 2013, accepted 30th June 2013

Abstract

The ecological markers of *Sacoglottis gabonensis* in the Congolese coast forest highlight that this species develops at the limit of its geographic area. This species is often associated to *Aucoumea klaineana* in forest typology or characterizing forest on the Atlantic littoral. It posts a degree of sociability contrary to the known data of the Gabonese forest. Moreover our study confirms the absence of the typical Biafra forests on the Congolese littoral, and the non concomitance of the distribution of *Sacoglottis gabonensis* and *Aucoumea klaineana*.

Keywords: Costal forest, ecology index, geographic area, *Sacoglottis gabonensis*, *Aucoumea klaineana*.

Introduction

Aucoumea klaineana forests of the Atlantic littoral of the Nigero-Cameroon-Gabonese area are often characterized, in their typology, like facies with *Aucoumea klaineana* and *Sacoglottis gabonensis* (Baill.) Urban in co-dominance or monodominance¹⁻⁴. Many data confirm the coupling from these two species like the symbol with the endemism low-Guinean with the Guineo-Congolese area, and especially characteristic of the “biafréennes” forests of the Atlantic element of the Nigero-Cameroon-Gabonese⁵.

In spite of *Sacoglottis gabonensis* presence on the Congolese littoral, the existence of the forests dominated by this species remains an enigma in this area¹. The typology studies on the forest facies with *Aucoumea klaineana* and *Lophira alata* of the Congolese littoral, show that the ecological parameters raised on *Sacoglottis gabonensis*, are contrary to the known data of the Cameroon-Gabonese littoral^{1,6-9}.

Thus, the objective of this study is answer interrogations on existence of typical “biafréenne” forest on the Congolese littoral. This work is focused on the ecological and structural markers of *Sacoglottis gabonensis* in the *Aucoumea klaineana* forest of the Congolese littoral.

Physical data of the Congolese littoral: Climate: The various forest facies of the Congolese littoral develop under a climate qualified subequatorial or low Congolese^{6,7,10-16}. Its main characteristics are: i. precipitations average ranging between 1200 and 1400 mm/year^{6,7,14-16}, ii. one dry and fresh season of 4 - 5 months (May-September) and a rainy and hot season from October to May, with a very marked attenuation of precipitations during January and February^{1,15,16}, iii. an annual

average temperature of 25°C and an annual thermal amplitude of 4–6°C^{1,15,16}.

Soils: The general presentation of the soils of the area shows that they belong primarily to the subclass of the impoverished psammitic and ferrallitic soils¹⁷. Their description distinguishes three principal horizons: i. humus-bearing horizon (A1) of approximately 40 cm thickness. It consists of two pennies horizons: a surface horizon (0 – 10 cm), covered by a thick layer with litter (10 – 15 cm) often made up of the three horizons L, F and H. the subjacent horizon (10 – 40 cm) is distinguished from the precedent, primarily by its physical properties (compaction, structure) which are different; i. horizon of transition (A3 or B1), of colour brown dark having a thickness varying between 15 and 25 cm; iii. horizon of accumulation (B2), yellowish colour brown. It is characterized by a content of clay slightly more important than in the overlying horizons.

Vegetation: The description and the characteristics of the natural vegetation and the flora of the Congolese littoral are reported by many authors^{6-10,12-14,18,19}.

Material and Methods

Localization of the zones of the botanical statements: The various statements of inventory and floristic investigations are carried out in the sectors identified under the denominations of Kayes “A” and Kayes “B” (figure-1). These contiguous sectors cover each one an area going of the Atlantic border to the buttresses of Mayombe.

The geographical contact of Kayes “A” is presented below⁷: i. 11° 28' 34".33 E – 03° 53' 13".19 S, ii. 11° 39' 2' 2".19 E – 03° 53' 13".21 S, iii. 11° 39' 22".70 E – 03° 55' 53".89 S, iv.

11° 40' 04''.66 E – 03° 55' 53''.37 S, v. located at the junction of the line of coordinate East of point 4 with sea border, vi. located at the junction of the line of coordinate East of point 1 with sea border.

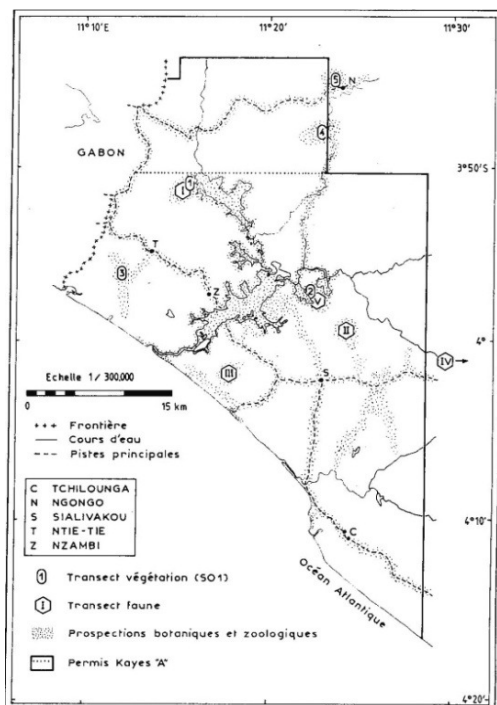


Figure-1a

Localization of the zones of inventories and botanical prospection in the forests of the littoral and Mayombe (Western Congoles littoral sector)

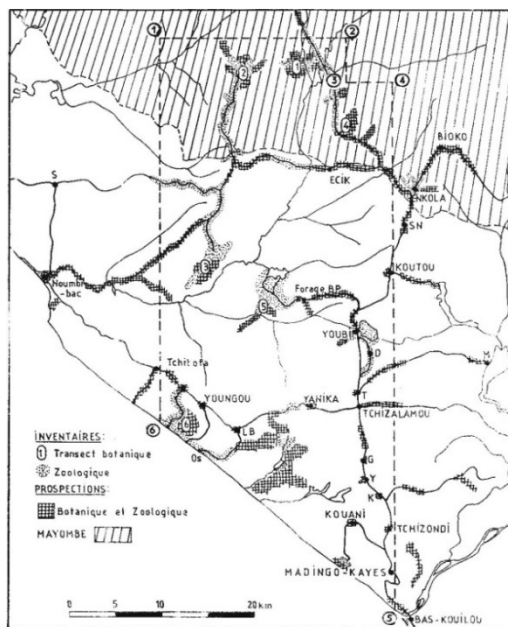


Figure-1b

Localization of the zones of inventories and botanical prospection in the forests of the littoral and Mayombe (East Congoles littoral sector and buttresses of Mayombe)

Methodology: The investigations on *Sacoglottis gabonensis* and *Aucoumea klaineana* are based on two complementary approaches. They rest on: i. data collected on the station: inventories of vegetable biodiversity, ethnobotany investigations and botanical prospection; ii. bibliographical compilation: phytosociological and inventories flora data analysis are available.

Inventories: The inventories are carried out according to the methodology of the transects, in forest facies of various ages and degree of disturbance. The trees selected have a diameter at breast height (dbh at 1.30 m from the ground) equal or higher than 10 cm. According to the dbh, the listed trees set out again in 9 classes of diameter, whose progression is of 10 in 10 cm. The 9th class gathers all the individuals having a dbh \geq 90 cm.

During the botanical prospection, all the *Sacoglottis gabonensis* individuals are listed. The raised parameters are the biological type, of dbh, and the degree of sociability (isolated or gregarious individual).

Data on the statements of floristic inventory: The floristic inventory of the monospecific forest with *Aucoumea klaineana* of the Congoles littoral is based on 22 statements. According to the surface of inventory and dbh, they divide into 3 category. 13 raised of 1 ha for the trees of dbh \geq 10 cm; 1 statement of 1.2 ha for the trees of dbh \geq 10 cm; 8 statements of 0.04 ha for the trees of dbh \geq 5 cm but lower than 10 cm.

Results and Discussion

The results presented in table-1 characterize the floristic statements of higher or equal to surface 1 ha; the statements of low area did not highlight the specimens of *Sacoglottis gabonensis*. This floristic inventory highlights 42 trees of *Sacoglottis gabonensis* for an area of approximately 13 ha, that is to say an average 3.2 trees.ha⁻¹ (table-1). In this woody settlement, the densities of *Sacoglottis gabonensis* vary from 1 to 37 trees.ha⁻¹; while basal area oscillate, of the young facies to oldest, between 0.75 and 1.8 m².ha⁻¹. These specimens are distributed in 6 diameter classes, with a better representation of classes 1 (57.14%) and 2 (23.81%). They include almost 81% of individuals.

The basal area by density report, which is an ecological index making it possible to characterize a population or a species, its lies between 0.45 and 5.7. The relative frequency of *Sacoglottis gabonensis* is on the other hand very weak.

As a whole, the ecological markers of *Sacoglottis gabonensis* are parameters described as weak (table-1). The clearest traces are obtained in the young forest facies under installation where *Aucoumea klaineana* typify a facies almost monospecific, as shows it statement 1 of the sector Kayes "B". On the contrary, the oldest or disturbed forest stages, has a weaker presence of *Sacoglottis gabonensis*.

The botanical prospection made it possible to note a space and temporal distribution disparate specimens of *Sacoglottis gabonensis*. This species often meets in zone of savanna like precursor of colonization by *Aucoumea klaineana*. The individuals observed are, as Table-1 shows it, of low diameter with a clear predominance of classes 1 and 2, and low branchy. The maximum diameter recorded on three isolated specimens, in grassy savannas with *Hyparrhenia diplandra* and shrubby lies between 45 and 60 cm to 1.30 m of the ground.

The phytopharmacological, traditional uses of its bark, and artisanal of the physical properties of its wood make *Sacoglottis gabonensis* well-known and is exploited by the populations^{10,20}.

The floristic composition of the various statements is very variable. It is function of the stage of development and the degree of disturbance of the forest^{4,7,8,9}. In all the cases, the principal species is *Aucoumea klaineana*. The ecological parameters of *Sacoglottis gabonensis*, compared to other species of the woody vegetation, show that this species does not accompany *Aucoumea klaineana* in the forests by the Congolese littoral^{6,7,8,9}.

On the other hand, one notes on the Gabonese littoral perfect a co-dominance between *Sacoglottis gabonensis* and *Aucoumea klaineana* or with *Lophira alata* in the characterization of the forest facies, on the one hand, and, on the other hand, of the typical facies with *Sacoglottis gabonensis*^{1,3,4,10}. That is not observed on the Congolese littoral. This species has behaviour different in these two parts of its area dispersion.

The floristic statements being made between the Atlantic Ocean and the buttresses of Mayombe, the got results show that the *Sacoglottis gabonensis* area is restricted with the littoral fringe,

whereas that of *Aucoumea klaineana* reaches the buttresses of Mayombe. This reduced space-time distribution of *Sacoglottis gabonensis* is at the origin of the weak frequencies observed for the whole of the region^{6,7}. Indeed, this species which is rather abundant in the young stages of installation of the forest with *Aucoumea klaineana*, rarefies as progresses forest dynamics towards the old stages, as the curve of density of figure-2 shows it. The data analysis on the densities shows that *Sacoglottis gabonensis* badly supports the interspecific competition^{8,9,21}.

The dendrometric analysis reveals a bad recruitment of *Sacoglottis gabonensis* in the various classes of diameter. Indeed, except a statement which has 2 trees, it is recorded in the 4/5 only one class of diameter and a tree specimen (table-1). The inexistence of the individuals in certain classes of diameter reveals its bad regeneration on the Congolese littoral^{5,6,22}. That is confirmed by the absence, in most statements, individuals whose diameter lies between 5 and 10 cm^{6,7}.

The data of basal area show that *Sacoglottis gabonensis* occupies a weak surface per unit of area. This one is in fluctuating from one statement to another (figure-2). The best occupancy rates of the soil are observed in the statements with strong density of *Sacoglottis gabonensis* or having trees of large diameter. This parameter coupled with biological specificities of the species, in particular its lack of interspecific competitiveness, is a factor limiting to its regeneration under dense cover. This observation is supported by the index of report ST/D (basal area /density). Indeed, the values are very weak and lower than 1, for the majority (Figure-2). *Sacoglottis gabonensis* is characterized on the Congolese littoral, whatever the stage of development forest facies, by weak parameters of density and diameter.

Table-1
Ecological main features of *Sacoglottis gabonensis* in the forests of the Congolese littoral

Sector	Number of statements	N° of order and area		Structure and ecologic parameters of <i>Sacoglottis gabonensis</i>					
		N° of statement	Area (ha)	Density (trees.ha ⁻¹)	Classes of d.b.h.	Density (%)	Basal area (m ² .ha ⁻¹)	Basal area /density	Relative frequency
Kayes B	3	1*	1	37	1, 2, 3, 4	7,06	1,80	0,73	3
		2*		2	0,63	0,07	0,45		
		3*		1	8	0,29	0,50	0,77	
	6	3		1	2	0,45	0,05	0,48	2
5		1	9	0,53	0,75	5,70			
Kayes A	5	4 6	1,2	-	-	weak	weak	weak	weak

(*) Reference No. 8, 9, 4, 6.

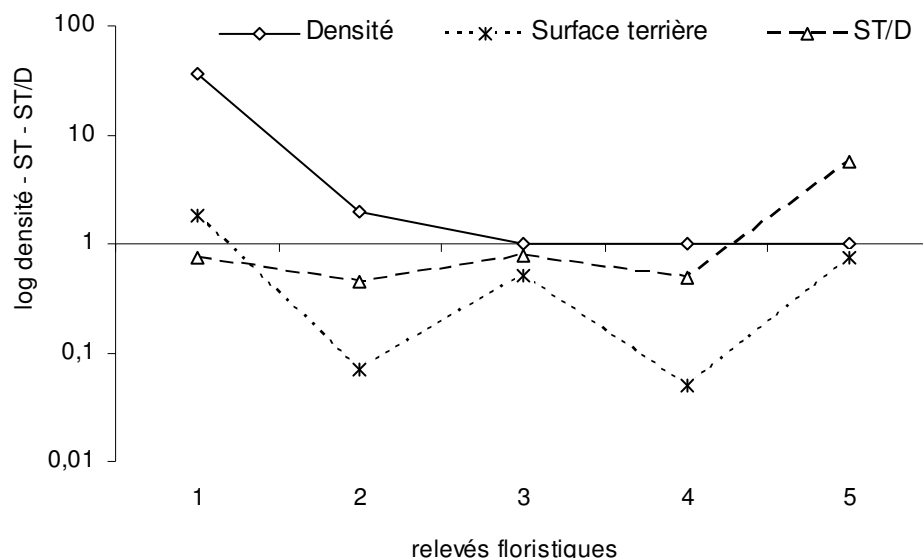


Figure-2
Evolution of the structural and ecological parameters of *Sacoglottis gabonensis* (density and basal area)

In spite of the mechanisms of dissemination which are respectively endozoochore for *Sacoglottis gabonensis* (mainly by the elephant: *Loxodonta africana cyclotis*) and anemochore for *Aucoumea klaineana*, these two taxa have biological and ecological behaviours very similar^{6,4,23,24}. These qualified species pioneers and the heliophilous ones are at the base of the colonization of savannas by the forest. In this dynamics of occupation of the soil, the progression is assured almost exclusively by *Aucoumea klaineana* which forms a monospecific pioneer face. Though these two species are badly adapted to the interspecific competition, taking into consideration *Sacoglottis gabonensis*, their ecological characteristic seems to be more vulnerable. The endozoochore dissemination seems to justify the precocity of this species in coastal savannas.

Ecological characteristics of *Sacoglottis gabonensis* in the forest facies of the Congolese littoral, compared with those noted in the other zones of its dispersion area (ex: Gabonese littoral), show that this species seems badly adapted to the conditions of this station. This species which has a primarily low-Guinean distribution is restricted with the sector of the littoral of the Atlantic element of the Nigero-Cameroono-Gabonese area. In spite of a noticed presence, the conditions of an optimal development are not met on the Congolese littoral. The values of all its ecological parameters mentioned seem to prove that it would be found in extreme cases of its distribution area. This seems more obvious by integrating this data in the chorology system of the Guineo-Congolese area^{25,26,27}. *Sacoglottis gabonensis* is a low-Guinean endemic species whose optimum of development is in the Cameroono-Gabonese forest sector of the Atlantic element of the Nigero-Camerouno-Gabonese area¹⁰.

The comparison of the various ecological and structural parameters, characterizing *Sacoglottis gabonensis* on the Congolese littoral, shows that these forests form the skirt of biafréenne forest, which is the typical ecosystem of the Atlantic element of the Nigero-Cameroono-Gabonese area^{1,2,4}. The development of *Sacoglottis gabonensis* would be correlated at the rhythm and the precipitation degree.

Headings: *Aucoumea klaineana* forest of the Congolese coast

Conclusion

The typology of the forest facies of the Congolese littoral shows that those are primarily in *Aucoumea klaineana* in the first stages of development. These formations are definitely different from those of the Cameroono-Gabonese littoral, where the principal species, *Aucoumea klaineana* and *Sacoglottis gabonensis*, are Co-dominant, or characterize facies individually. The supposed importance of *Sacoglottis gabonensis* in the formations with *Aucoumea klaineana* of Congolese littoral is not found. To the phytogeographical plan, the various analyzed ecological parameters bring the proof on the southern limit of the geographical area of *Sacoglottis gabonensis*. Consequently, the forests with *Aucoumea klaineana* would be located at the edge of the Cameroono-Gabonese area of the Atlantic element. Notwithstanding the presence of *Sacoglottis gabonensis* within their floristic woody, the forests of the Congolese littoral are almost with the margin of the development area of this species.

The data obtained on *Sacoglottis gabonensis* show that its duality with *Aucoumea klaineana* is not proven in the floristic

contribution of the Congolese littoral, as it is the case in its field of optimal development. In our region, *Sacoglottis gabonensis* adopts an evolving degree of sociability in an opposite way to that observed in the Cameroon-Gabonese forest, of the Nigero-Cameroon-Gabonese area of the Atlantic element. So the analysis of the ecological and structure markers of *Sacoglottis gabonensis* confirms the inexistence of true forest facies characteristic of the biafréenne forest.

References

1. Aubréville A., Principe d'une systématique des formations végétales tropicales, *Adansonia*, **5(2)**, 153-196 (1965)
2. Normand D., Forêts et bois tropicaux, Collection Que sais-je ? PUF, (1971)
3. Saint-Aubin (de) G.P., La forêt du Gabon, CTFT, Publ. N° 21, 1-208 (1963)
4. White L. et Abernethy K., Guide de la végétation de la Lopé, ECOFAC-Gabon, (1996)
5. UICN, L'atlas pour la conservation des forêts tropicales d'Afrique, UICN Gland-Suisse, (1996)
6. Doumenge C., La réserve de Conkouati: Congo, le secteur Sud-ouest, UICN, Gland-Suisse, (1992)
7. Hecketsweiler P. et Mokoko Ikonga J., La réserve de Conkouati : Congo, le secteur Sud-est, UICN, Gland-Suisse, (1991)
8. Kimpouni V., Loumeto J. et Mizingou J., Diversité floristique du faciès forestier à *Aucoumea klaineana* (Okoumé) du littoral congolais, *Acta Bot. Gallica*, **155 (3)**, 323-334 (2008a)
9. Kimpouni V., Loumeto J. et Mizingou J., Diversité du peuplement ligneux de la forêt monodominante à okoumé (*Aucoumea klaineana*) du littoral congolais, *Ann. Univ. Marien Ngouabi (N° spécial)*, **9**, 8-20 (2008b)
10. Adjanohoun E.J., Ahyi A.M.R., Ake Asi L., Baniakina J., Chibon P., Cusset G., Doulou V., Enzanza A., Eyme J., Goudote E., Keita E., Mbemba C., Mollet J., Moutsambote J.-M., Mpati J. et Sita P., Contribution aux études ethnobotaniques et floristiques en République Populaire du Congo: Médecine traditionnelle et pharmacopée, ACCT, Paris, (1988)
11. Aubréville A., Climats, forêts et désertification de l'Afrique centrale, Société d'Éditions Géographiques, Maritimes et Coloniales, Paris, (1949)
12. Dowsett R.J. et Dowsett-Lemaire F., Flore et Faune du Bassin du Kouilou (Congo) et leur exploitation, Tauraco Research Report N°4, (1991)
13. Dowsett-Lemaire F., The vegetation of the Kouilou basin in Congo, Tauraco Research, Rep. 4, (1991)
14. Hecketsweiler P., La conservation des écosystèmes forestiers du Congo, Revue UICN, Programmes pour les forêts tropicales, Gland, Suisse, et Cambridge, Royaume-Uni, (1990)
15. Samba-Kimbata M.-J., Le climat Bas-congolais, Thèse Doc. Univ. de Dijon, France, (1978)
16. Vennetier P., Atlas de la République Populaire du Congo, Ed. Jeune Afrique, (1977)
17. Nzila J.D.D., Caractéristiques physico-chimiques des sols sous une forêt secondaire à Okoumé (*Aucoumea klaineana* P.) dans la zone de Youbi (Congo), *Ann. Univ. Marien Ngouabi (N° spécial)*, **9**, 69-81 (2008)
18. Loumeto J.J., Le système litière des forêts à peuplements d'Okoumé (*Aucoumea klaineana*). Exemples de deux sites congolais : la forêt du Chaillu et la forêt du littoral, Thèse de Doctorat, Université de Paris VI, (2002)
19. Makany L., Contribution à l'étude de la végétation côtière du Congo – Brazzaville, Thèse Doc. Université de Paris (Orsay), (1963)
20. Gibert G. et Sénéchal J., L'économie forestière, 249-293, in : Revue des connaissances sur le Mayombe. Synthèse préparée pour le PNUD/UNESCO (1989)
21. Kimpouni V. et Koubouana F., Étude ethnobotanique sur les plantes médicinales et alimentaires dans et autour de la réserve de Conkouati, Rapport final, PROGECA/GEF-Congo, UICN, (1997)
22. White L.J.T., *Sacoglottis gabonensis* fruiting and the seasonal movement of elephants in the Lopé reserve, Gabon, *Journal of Tropical Ecology*, **10**, 121-125 (1994a)
23. Peters C.M., Exploitation soutenue de produits forestiers autres que le bois en forêt tropicale humide: Manuel d'initiation écologique, USAID, BSP, Washington, Programme d'appui à la biodiversité, **2**, 1- 49 (1997)
24. White L.J.T., Patterns of fruit fall phenology in the Lopé reserve, Gabon, *Journal of Tropical Ecology*, **10**, 289-312 (1994b)
25. White F., The Guineo-congolian region and its relationships to other phytochoria, *Bull. Jard. Bot. Nat. Belg.*, **49 (1/2)**, 11-55 (1979)
26. White F., La végétation de l'Afrique, Adaptation française par P. Bamps. Coll. Recherches sur les ressources naturelles végétation de l'Afrique, UNESCO, Paris, **XX**, 1-384 (1986)
27. Kimpouni V., Lejoly J. et Lisowski S., Les *Eriocaulaceae* du Congo, *Fragm. Flor. Geobot.*, **37**, 127 - 145 (1992)