

Full Length Research Paper

# Ethnobotanical and floristical study of *Alstonia boonei* De Wild. (Apocynaceae) in the Makokou region, Ogooué-Ivindo province, Gabon

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An ethnobotanical survey was conducted between May and August 2011 in the Makokou region, Ogooué Ivindo province of Gabon. The survey aimed at identifying medicinal plants used by villagers in the popular pharmacopoeia. Inventories were conducted in one village (Minkouala) in the same region, with the aim to assess the abundance of medicinal plants in the surrounding forest. A total of 38 informants distributed in four ethnic groups prescribed recipes with *Alstonia boonei* (Apocynaceae) in the treatment of 14 ailments (diseases, symptoms or physiological effects). Malaria or fever (50.63% of citations), intestinal worms (19%) and wounds (07.6%) appear to be the most cited ailments. There are ailments such as malaria, fever, or stomach disorder of which the pharmacological activity of *A. boonei* is almost established in the literature. The management inventory was conducted in the 5 000 ha of the production forest delimited in the Minkouala village, with a sampling intensity of 0.5%. Ten trees of *A. boonei* were inventoried, which gave a density of 0.4 stems/ha. The stock and the biomass of the stem barks of *A. boonei* were estimated based on parameters developed with similar studies conducted in other African countries. The exploitable stock of *A. boonei* for the Minkouala village is 1 400 trees, while the total biomass of the fresh barks to harvest in a sustainable manner is 70 000 kg, or 14 000 kg of fresh bark per year.

**Key words:** *Alstonia boonei*, popular pharmacopoeia, Makokou region, management inventories, stock, biomass, Malaria, ACP-FORENET.

## INTRODUCTION

No person ignores the primordial role of medicinal plants in the traditional medicine. They are the main component of traditional medicine and they are the source of many pharmaceutical products. Today, despite the many advances in modern medicine, there is a marked revival of interest with respect to medicine and traditional pharmacopoeia. Traditional medicinal plants have several advantages; they are affordable, easily accessible (Al-Adroey et al., 2010). The inventory of medicinal plants

remains an important task, regarding the place that they continue to occupy in the health of many people. Ethnobotanical way has been recognised as the most efficient approach which leads to the development of drugs from medicinal plants (Balick, 1990; Cotton, 1996; King and Tempesta, 1994).

The genus *Alstonia* belongs to the Apocynaceae family. It comprises about 40 species and has a pantropical distribution. *Alstonia boonei* De Wild is a large deciduous tree, up to 45 m tall and 1.2 m in diameter; bole often deeply fluted to 7 m, small buttresses present; bark greyish-green or grey, rough; slash rough-granular, ochre-yellow, exuding a copious milky latex; branches in whorls.

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The leaves are in whorls at nodes, oblanceolate, apex rounded to acuminate, lateral vein prominent almost at right angle to midrib. Inflorescence terminal, compound with 2-3 tiers of pseudo-umbels; primary peduncles 0.5-7 cm long, greyish pubescent; bracts ovate-triangular, 1-1.5 mm long, pubescent; pedicels about 5 mm long. Flowers regular, hermaphrodite, pentamerous; calyx cupular tube about 1 mm long; lobes ovate, about 1.5 mm long, spreading; corolla pale green tube up to 14 mm long; lobes slightly obliquely ovate, up to 6 mm long and wide, pubescent outside. Fruit formed by 2 pendent green follicles up to 60 cm long, longitudinally striate, dehiscing lengthways while on the tree; seeds numerous, flat, about 4 x 2 mm, with tufts of hair at each end 10 mm long. It is found in dry, peripheral, semi-evergreen Guineo-Congolian forest and transitional rainforest. Elsewhere it occurs in similar habitats and in swamp and riverine forests. *A. boonei* requires large amounts of light and colonizes gaps in the forest. It has plenty of natural regeneration in young secondary forest. Growth is rapid, and it is not uncommon for an annual increment of 1.8 m to occur in the sapling stage. It grows in a succession of crowns and should not be pruned but left to develop secondary crowns, which will later kill off the lower ones. Mature trees are often damaged by wind and decay but are fast growing and coppice readily from the base. The tree snaps easily in strong wind and therefore should not be planted near buildings (Kwaku Adotey et al., 2012; Vivien et Faure, 1985, <http://www.worldagroforestrycentre.org/sea/Products/AFDbases/af/asp/SpeciesInfo.asp?SpID=199>). *A. boonei* is logged as timber in Cameroon and Equatorial Guinea, with the minimum exploitable diameter of 60 cm. But this tree is not currently logged in Gabon. *A. boonei* is one of the most important medicinal plant species of the Makokou region. This plant is well known by local populations who designate it in different vernacular names including "Gouga" for the Baka pygmies, "Nkouka" for the Kota farmers, "Louob" for the Kwélé and "Ekouk" for the Fang.

This paper aims to discuss the traditional use of *Alstonia boonei* as a medicinal plant species in the Makokou region, to assess its abundance and to estimate the stock of stems of that tree species in the forest.

## Materials and methods

### Study area

The Ipassa Biosphere Reserve is located in North East of Gabon, in the Ogooué Ivindo province at 620 km from Libreville and at about 12 km to Makokou city. Makokou itself is the regional capital of the Ogooué-Ivindo province. The Ipassa reserve was listed as a Biosphere reserve since 30 June 1983. And since there, it is the

unique Biosphere Reserve in Gabon. The Ipassa Biosphere Reserve is composed of three main areas including: a central or core area of 10,000 hectare, a 2 km<sup>2</sup> buffer zone, and a 3.5 km<sup>2</sup> transition area. The average altitude is 520 m; the average temperature is 23.9°C while the annual rainfall varies between 1,600 and 1,800 mm.

Makokou belongs to the Guineo-congolian phytogeographical type (White, 1983). Primary forests contain many plant species of Caesalpiniaceae, Burseraceae, and Euphorbiaceae family groups. Secondary forests contain high light demand plant species such as *Pycnanthus angolensis* and *Scyphocephalum ochococoa*. Species such as *Scorodophleus zenkeri*, *Santiria trimera*, *Coula edulis*, *Anonidium mannii*, *Afrostryax lepidophyllus*, known as NTFPs (Betti, 2001, 2004) Gabon were listed among the most abundant tree species in the primary forests of the Ipassa Biosphere Reserve. The reserve hosts a large variety of Wildlife species including 129 mammals and 401 birds species (Dupuy, 2008).

The major ethnic groups, the Bantus and the Baka Pygmies live side by side outside the reserve. The Bantus include the Fang, Kwélé, and Kota. Baka Pygmies live mostly scattered in small settlements, mainly in the forest at some distance from the Bantu villages and roads. Bantus and Baka pygmies undertake many activities such as slash and burn agriculture type, hunting, fishing, gathering in the buffer and transition zones

### Ethnobotanical survey

The method used in this study which we call the "method for the popular pharmacopoeia", consists of gathering data on the popular use of medicinal plants in a given area (ex. village). Following this method, the data for this study were obtained from direct interviews with the local people conducted from 05 May to 30th August 2011 in villages settled in the periphery of the Makokou city. The survey aimed at identifying plants used in the popular pharmacopoeia among local people. The household was considered as the sample unit. In each household who accepted to answer to our questions, data were mostly recorded from adult women (mothers), because they usually knew the plants better than men and younger people. They provided useful and firsthand information on the popular use of medicinal plants. During the survey, we made enquiry "as to what ailments were treated by which plant species" rather than asking "which plants were used to treat which ailments". For each health problem cited, the name of the plants and the plant parts used were carefully recorded.

The vernacular names of the plants were recorded as

**Table 1.** Sampling parameters.

Site	Line n°	Length (Km)	Number of plots	Sampling area (ha)
A	1	2	10	5
A	2	2	10	5
B	3	2	10	5
B	4	2	10	5
B	5	1	5	2,5
B	6	1	5	2,5
Total		10	50	25

**Table 2.** List of informants.

Code_informant	Age	Gender	village	Ethnic group
Bk1	23	F	Mekob	Baka
Bk2	35	M	Mekob	Baka
Bk3	60	M	Mekob	Baka
Fg1	56	F	minkwala	Fang
Fg2	60	F	Eyameyong	Fang
Fg3	47	F	minkwala	Fang
Fg4	65	F	Endoume	Fang
Fg5	70	F	Eyameyong	Fang
Fg6	70	F	minkwala	Fang
Fg7	32	F	minkwala	Fang
Fg8	60	F	minkwala	Fang
Fg9	60	F	minkwala	Fang
Fg10	63	F	minkwala	Fang
Fg11	67	F	Eyameyong	Fang
Ko1	63	F	Lascierie	Kota
Ko2	34	F	Ntsiété	Kota
Ko3	53	F	Ntsiété	Kota
Ko5	50	F	Ntsiété	Kota
Ko6	62	F	Ntsiété	Kota
Ko7	74	F	Ntsiété	Kota
Ko8	90	F	Ntsiété	Kota
Ko10	43	F	Ntsiété	Kota
Ko11	56	F	Ntsiété	Kota
Ko12	35	F	Ntsiété	Kota
Ko15	53	F	Mbondou	Kota
Ko16	46	F	Ntsiété	Kota
Ko17	46	F	Messeb	Kota
Ko18	70	F	Lascierie	Kota
Ko4	76	M	Lascierie	Kota

**Table 2.** cont.

Ko9	32	M	Mekob	Kota
Ko13	76	M	Lascierie	Kota
Ko14	53	M	Lascierie	Kota
Ko19		M	Mekob	Kota
Kw3	47	F	Messeb	Kwélé
Kw4	39	F	Mekob	Kwélé
Kw1	49	M	Mekob	Kwélé
Kw2	75	M	Messeb	Kwélé
Kw5	40	M	Messeb	Kwélé

much as possible, and we collected the plants mentioned by the informants. The plants were identified in the herbarium of the Institut de Pharmacopée et Médecine Traditionnelle (IPHAMETRA), in Libreville (Gabon). Voucher herbal specimens are kept at the Herbarium of IPHAMETRA. The therapeutic statements were made of a specific disease, a symptom or a physiological effect. Information on the diagnosis of ailments was provided through a semi-structured interview of nurses or local health officials.

#### **Assessment of the abundance and stock of *A. boonei* in the forest**

The assessment of the abundance of *Alstonia boonei* was done in Minkouala, a village situated at 20 km from Makokou, in the road Makokou – Libreville. Minkouala village has about 2 000 inhabitants, composed mainly of the Fang ethnic group. The surrounding forest is a mixture of primary and secondary forests. It is estimated at 10 000 ha of forests, with the production forest occupying 5 000 ha. The area has already been subject to forest logging and mining activities. Villagers practice hunting, fishing, and agriculture. Cassava is considered together with ground nuts as the main crops cultivated by local villagers.

Two zones or sites of production forest were delimited in the Minkouala village, separated by the road Makokou – Libreville. Site A has 2 000 ha and site B has 3 000 ha. We used a Global Positioning System (GPS) and vegetation maps to settle our sampling plots. The sampling was systematic and stratified to 1 degree when the statistical unit is the plot. The samples or plots of 0.5 ha are distributed systematically throughout the entire population. The systematic disposal of plots allows to assume that the intensity of sampling for each stratum is proportional to its area in the forest.

In practice, sampling was carried out along straight and continuous axes or transects. These transects are oriented along a predetermined cardinal direction but are systematically arranged in such a way that they are

mostly parallel, equidistant and perpendicular to the general direction of the main road linking Makokou to Libreville.

Rectangular plots arranged along a transect are contiguous and measure 200 m in the direction of the transect (length) and 25 m in the direction perpendicular to the transect (width). This gives a surface area of 0.5 ha for each plot. The mapping activity allowed us to distinguish four main forest types including: the primary forest, the secondary forest, the swamp forest and the cultures (agricultural areas). The distance between two consecutive lines is 800 m. A total of 4 km of lines was planned per site.

Table 1 presents for each site, the lines opened, the number of plots, and the sampling area, A total of 50 plots of 0.5 ha each were inventoried in 6 lines. The two sites have a total surface area of 5 000 ha. A total of 25 ha out of that surface area was totally covered by forest inventories giving an average sampling intensity of 0.5%.

#### **Data analysis**

For analysis, we determined the number of stems in different diameter classes and the density (number of stems/ha). The total number of stems (stock) of the forest is the product of the density by the surface area.

## **RESULTS**

### **Ethnobotanical survey**

A total of 38 informants (table 2) with average age of 54.8 years old prescribed recipes with *Alstonia boonei* in the Makokou region. Those informants are settled in 8 villages and distributed as following in different ethnic groups: Kota (19 informants), Fang (11), Kwélé (5) and Baka (3). A total of 28 informants representing 73.68% were made of women. A total of 81 citations with 14 ailments (table 3) were recorded. Malaria or fever (50.63% of citations), intestinal worms (19%) and wounds

**Table 3.** Citations of *Alstonia boonei* in folk medicine in the Makokou region, Gabon.

Cod	Ailment	Name of plant	Associated plant	Plant part	Pharm-form.	Adm.
Ko14	Gonorrhoea	<i>Alstonia boonei</i>	<i>Palisota</i>	St-b	De	Or
Ko2	Malaria/fever	<i>Alstonia boonei</i>	<i>Aframomum sp</i>	St-b	Ma	Or
Ko5	Lumbalگو	<i>Dorstenia psilurus</i>	<i>Alstonia</i>	Le	De	Re
Fg9	wound	<i>Capsicum frutescens</i>	Ass. <i>Alstonia</i>	Fr	Po	Ap
Fg11	wound	<i>Capsicum frutescens</i>	Ass. <i>Alstonia</i>	Fr	Po	Ap
Ko4	wound	<i>Pterocarpus soyauxii</i>	Ass. <i>Alstonia</i>	St-b	Ra	Ap
Fg7	Malaria/fever	<i>Citrus limon</i>	Ass. <i>Alstonia</i>	Fr	De	Or
Fg10	Intestinal worms	<i>Citrus limon</i>	Ass. <i>Alstonia</i>	Fr	De	Or
Fg7	Malaria/fever	<i>Carica papaya</i>	Ass. <i>Alstonia</i>	Le	De	Or
Ko14	Gonorrhoea	<i>Palisota hisrsuta</i>	Ass. <i>Alstonia</i>	Ro	De	Or
Fg7	Malaria/fever	<i>Enanthia chlorantha</i>	Ass. <i>Alstonia</i>	St-b	De	Or
Ko2	Malaria/fever	<i>Aframomum sp</i>	Ass. <i>Alstonia</i>	St-b	Ma	Or
Kw4	Malaria/fever	<i>Capsicum frutescens</i>	Ass. <i>Alstonia</i>	Fr	Ma	Re
Bk2	Malaria/fever	<i>Capsicum frutescens</i>	Ass. <i>Alstonia</i>	Fr	Ma	Re
Kw3	Malaria/fever	<i>Capsicum frutescens</i>	Ass. <i>Alstonia</i>	Fr	Ma	Re
Kw4	Malaria/fever	<i>Capsicum frutescens</i>	Ass. <i>Alstonia</i>	Fr	Ma	Re
Ko5	Lumbalگو	<i>Alstonia boonei</i>	Ass. <i>Dorstenia</i>	St-b	De	Re
Fg9	wound	<i>Alstonia boonei</i>	<i>Capsicum</i>	St-b	Po	Ap
Fg11	wound	<i>Alstonia boonei</i>	<i>Capsicum</i>	St-b	Ra	Ap
Kw4	Malaria/fever	<i>Alstonia boonei</i>	<i>Capsicum</i>	St-b	Ma	Re
Bk2	Malaria/fever	<i>Alstonia boonei</i>	<i>Capsicum</i>	St-b	Ma	Re
Kw3	Malaria/fever	<i>Alstonia boonei</i>	<i>Capsicum</i>	St-b	Ma	Re
Fg10	Intestinal worms	<i>Alstonia boonei</i>	<i>Citrus</i>	St-b	De	Or
Fg7	Malaria/fever	<i>Alstonia boonei</i>	<i>Citrus + Enanthia + Carica</i>	St-b	De	Or
Ko4	wound	<i>Alstonia boonei</i>	<i>Pterocarpus</i>	St-b	Ra	Ap
Ko11	Malaria/fever	<i>Alstonia boonei</i>		St-b	De	Ge-ba
Fg2	Malaria/fever	<i>Alstonia boonei</i>		St-b	De	Or
Fg2	tension	<i>Alstonia boonei</i>		St-b	De	Or
Fg2	Intestinal worms	<i>Alstonia boonei</i>		St-b	De	Or
Fg10	Malaria/fever	<i>Alstonia boonei</i>		St-b	De	Or
Ko11	Malaria/fever	<i>Alstonia boonei</i>		St-b	De	Or
Ko11	Intestinal worms	<i>Alstonia boonei</i>		St-b	De	Or
Ko15	Cough	<i>Alstonia boonei</i>		St-b	De	Or
Bk1	Malaria/fever	<i>Alstonia boonei</i>		St-b	Ma	Or
Bk2	Malaria/fever	<i>Alstonia boonei</i>		St-b	Ma	Or
Bk3	Malaria/fever	<i>Alstonia boonei</i>		St-b	Ma	Or
Fg1	Intestinal worms	<i>Alstonia boonei</i>		St-b	Ma	Or
Fg3	Intestinal worms	<i>Alstonia boonei</i>		St-b	Ma	Or
Fg4	Intestinal worms	<i>Alstonia boonei</i>		St-b	Ma	Or
Fg5	Malaria/fever	<i>Alstonia boonei</i>		St-b	Ma	Or
Fg6	Malaria/fever	<i>Alstonia boonei</i>		St-b	Ma	Or

Table 3. Cont.

Fg6	Intestinal worms	<i>Alstonia boonei</i>	St-b	Ma	Or
Fg8	Intestinal worms	<i>Alstonia boonei</i>	St-b	Ma	Or
Fg8	vertige	<i>Alstonia boonei</i>	St-b	Ma	Or
Fg8	Stomach disorder	<i>Alstonia boonei</i>	St-b	Ma	Or
Fg9	Malaria/fever	<i>Alstonia boonei</i>	St-b	Ma	Or
Fg9	Intestinal worms	<i>Alstonia boonei</i>	St-b	Ma	Or
Ko1	Filaries	<i>Alstonia boonei</i>	St-b	Ma	Or
Ko2	Lactation	<i>Alstonia boonei</i>	St-b	Ma	Or
Ko2	Intestinal worms	<i>Alstonia boonei</i>	St-b	Ma	Or
Ko3	Malaria/fever	<i>Alstonia boonei</i>	St-b	Ma	Or
Ko5	Malaria/fever	<i>Alstonia boonei</i>	St-b	Ma	Or
Ko6	Malaria/fever	<i>Alstonia boonei</i>	St-b	Ma	Or
Ko7	Malaria/fever	<i>Alstonia boonei</i>	St-b	Ma	Or
Ko8	Hernia	<i>Alstonia boonei</i>	St-b	Ma	Or
Ko9	Malaria/fever	<i>Alstonia boonei</i>	St-b	Ma	Or
Ko10	Malaria/fever	<i>Alstonia boonei</i>	St-b	Ma	Or
Ko11	Lactation	<i>Alstonia boonei</i>	St-b	Ma	Or
Ko12	Malaria/fever	<i>Alstonia boonei</i>	St-b	Ma	Or
Ko13	Filaries	<i>Alstonia boonei</i>	St-b	Ma	Or
Ko15	Cough	<i>Alstonia boonei</i>	St-b	Ma	Or
Ko16	Malaria/fever	<i>Alstonia boonei</i>	St-b	Ma	Or
Ko17	Malaria/fever	<i>Alstonia boonei</i>	St-b	Ma	Or
Ko18	Intestinal worms	<i>Alstonia boonei</i>	St-b	Ma	Or
Ko19	Malaria/fever	<i>Alstonia boonei</i>	St-b	Ma	Or
Ko19	Cough	<i>Alstonia boonei</i>	St-b	Ma	Or
Kw1	Malaria/fever	<i>Alstonia boonei</i>	St-b	Ma	Or
Kw1	Intestinal worms	<i>Alstonia boonei</i>	St-b	Ma	Or
Kw2	Malaria/fever	<i>Alstonia boonei</i>	St-b	Ma	Or
Kw4	Malaria/fever	<i>Alstonia boonei</i>	St-b	Ma	Or
Kw4	Vomiting	<i>Alstonia boonei</i>	St-b	Ma	Or
Kw5	Malaria/fever	<i>Alstonia boonei</i>	St-b	Ma	Or
Fg2	Malaria/fever	<i>Alstonia boonei</i>	St-b	De	Re
Ko15	Cough	<i>Alstonia boonei</i>	St-b	De	Re
Bk1	Malaria/fever	<i>Alstonia boonei</i>	St-b	Ma	Re
Bk3	Malaria/fever	<i>Alstonia boonei</i>	St-b	Ma	Re
Fg6	Intestinal worms	<i>Alstonia boonei</i>	St-b	Ma	Re
Fg9	Malaria/fever	<i>Alstonia boonei</i>	St-b	Ma	Re
Ko10	Malaria/fever	<i>Alstonia boonei</i>	St-b	Ma	Re
Kw1	Malaria/fever	<i>Alstonia boonei</i>	St-b	Ma	Re
Kw1	Intestinal worms	<i>Alstonia boonei</i>	St-b	Ma	Re

Table 3. Legend.

**Associated plants (Ass. = Associated with):** plants which are prescribed together with other plant (s) for the same prescription. For example, to treat malaria/fever, many informants proposed to drink the decoction composed of the mixture of stem barks of *Alstonia* and fruit of *Citrus limon*.

**Plant part:** Fr = fruit; Le = leaf; Ro = root; St-b = stem bark or the bark of the stem,

**Pharmaceutical form (Pharm-form):** De = decoction; Ma = maceration (soak); Po = pounding; Ra = rapure;

**Mode of administration (Adm):** Ap = local application; Ge-ba = general bath; or = oral voice; re = rectal voice.

**Code of informant (Cod):** the letters designate the ethnic group (Bk = Baka; Ko = kota; Fg = Fang; Kw = Kwélé; the number is an arbitrary number which distinguishes the informant to other belonging to the same ethnic group.

**A citation** = one line = one informant in one recipe and one ailment in this table.

**A recipe** = One, two or many citations comprising the same plant species, the same plant part used, the same pharmaceutical form, the same mode of administration and the same ailment.

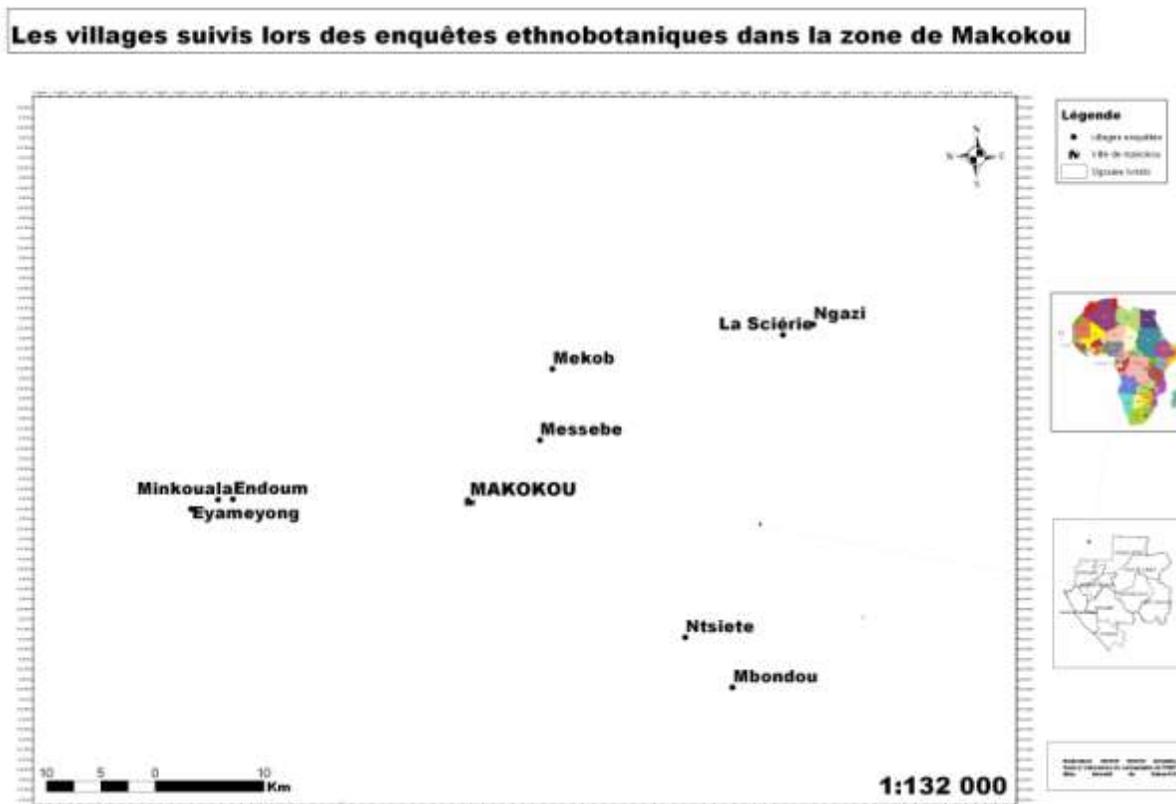


Figure 1. Map of all villages surveyed.

(07.6%) appear to be the most cited ailments. Malaria or fever is cited in all ethnic groups with a minimum of 7 citations per group. Intestinal worms are cited in three ethnic groups including Fang (10 citations), Kota (3) and Kwélé (2). Baka pygmies only cited *A. boonei* for treating malaria or fever. Stem barks are the plant parts that are largely used with 76% of citations. Maceration (68.3%) is the pharmaceutical form that is mostly used, followed by the decoction (24%). The recipes are largely administered through oral voice (70.8% of citations) and sometimes through rectal voice (20.2%). A total of six other plant species distributed in six families are used together with *A. boonei* in some recipes including: *Capsicum frutescens* (Solanaceae, 5 citations), *Citrus limon* (Rutaceae, 2), *Enantia chlorantha* (Annonaceae, 1), *Carica papaya* (Caricaceae, 1), *Pterocarpus soyauxii*

(Fabaceae, 1), *Aframomum melegueta* (Zingiberaceae, 1) and *Dorstenia psilurus* (Moraceae, 1).

### 3.2. Abundance and stock of *Alstonia boonei* in the Minkouala village

Table 4 presents for each *Alstonia boonei*'s tree identified, its diameter measured at breast height. Figure 3 illustrates the distribution of *A. boonei* trees in different diameter classes or the specific curve. Almost all diameter classes are represented, which illustrates no specific problem of regeneration.

Ten (10) trees of *Alstonia boonei* were recorded (table 3), which gives a density of 0.4 trees/ha in the two sites. Site A being the site which hosts the high number of stems (6/10). The total number of stems of *A. boonei* estimated for the 5 000 ha of the Minkouala forest is 2 000.

**Table 4.** Trees of *Alstonia boonei* counted in the Minkouala forest with their diameter measured at breast height.

Site	Line	Plot	Diameter (cm)
A	L1	P1	65
A	L1	P10	18,3
A	L2	P10	35
A	L2	P6	55
A	L2	P6	90
A	L2	P7	72
B	L4	P9	70
B	L5	P3	22,0
B	L5	P3	29,0
B	L6	P3	41,0

## Discussions

### Use of *Alstonia boonei* out of the Makokou region

*Alstonia boonei* is cited in the Makokou region for treating 14 ailments including; cough, filarities, gonorrhoea, hernia, intestinal worms, lactation failure, lombalgo, malaria/fever, stomach disorder, tension, vertige, vomiting, wound. The usages against malaria/fever are mentioned in 8 countries: Cameroon (Adjanohoun et al., 1996; Cousteix, 1961; Betti, 2001, 2003; Dijk, 1999; Titanji et al., 2008), Congo-Brazzaville (Diafouka, 1997), Ivory Coast (Zirihi Guede, 2004), Equatorial Guinea (Bitsindou, 1996), Nigeria, Senegal, Togo (Richel, 1995), Democratic Republic of Congo (Magilu et al., 1996, Terashima and Ichikawa, 2003).

The usages against intestinal worms are mentioned in four countries including Cameroon (Adjanohoun et al., 1996; Betti, 2001; Cousteix, 1961), Congo-Brazzaville (Ongoka et al., 2004), the Central African Republic and the Democratic Republic of Congo (Bitsindou, 1996).

The Mbuti and Efe hunter-gatherers based in the Ituri forest, Democratic Republic of Congo apply the white sap on snakebites and wounds, while the bark-decoction is taken for stomach disorder and malaria (Terashima and Ichikawa, 2003).

*Alstonia boonei* is used in the Bipindi-Akom II region, south Cameroon, for treating lactation failure (Dijk, 1999). Cousteix (1961) noted that *A. boonei* together with *Musanga cecropioides* were among the main plant species used by women among the Ewondo ethnic group in the Centre province of Cameroon. The Ewondo healers prescribe many daily drinks of the decoction of the stem barks of *A. boonei* to women. The same healers suggest to drink trice a day, the sap of root barks of *Musanga cecropioides* mostly when the natural milk (mother milk) does not flow enough. All these recipes are well known by the Makokou people.

*Alstonia boonei* is also mentioned against natural milk problems among the Bapundu ethnic group based in Gabon (Bourobou-Bourobou et al., 1996). The plant species is only used here, during the hours that follow the birth of the baby. *A. boonei* is also used by the Bapundu together with *Manihot esculenta* to stimulate the milk secretion and to open the galactogenic canals. *Musanga cecropioides* is recommended when the baby suffers from constipation.

### Pharmacological activity

The genus *Alstonia* in general, was considered to be not effective against Plasmodium (Wright et al., 1993). The antimalarial tests conducted by Oliver-Bever (1986) with *Alstonia boonei* were not positive. However Zirihi Guede (2004), has revealed a good activity of *A. boonei* (IC<sub>50</sub> < 4 µg/ml) against Plasmodium falciparum FcB1/Colombia. This activity can well explain the large use of the plant in the treatment of malaria among the Makokou people.

The stem bark of *A. boonei* contains antipyretic (against fever) properties (Olajide et al., 2000; Oliver-Bever, 1986, Osadebe, 2002). The antipyretic property matches with the use of *A. boonei* in the treatment of fever. *Alstonia* contains an alkaloid, the alstonine to be precise (Phillipson and O'Neill, 1987; Phillipson et al., 1987), which has amoebicidal properties. The prescriptions of *A. boonei* against abscess, hernia, backache (lumbalgo), toothache and snake bites can be explained by its analgesic (Olajide et al., 2000) or anti-inflammatory (Kweifio-Okai, 1991; Kweifio-Okai et al., 1995; Olajide et al., 2000; Rajic et al., 2000; Osadebe, 2002) properties.

The Apocynaceae family in general is characterized by a white sap (white milk). This milk may explain the large use of *A. boonei* as galactogenic (against lactation failure). If it is, this is the "doctrine of signature" which

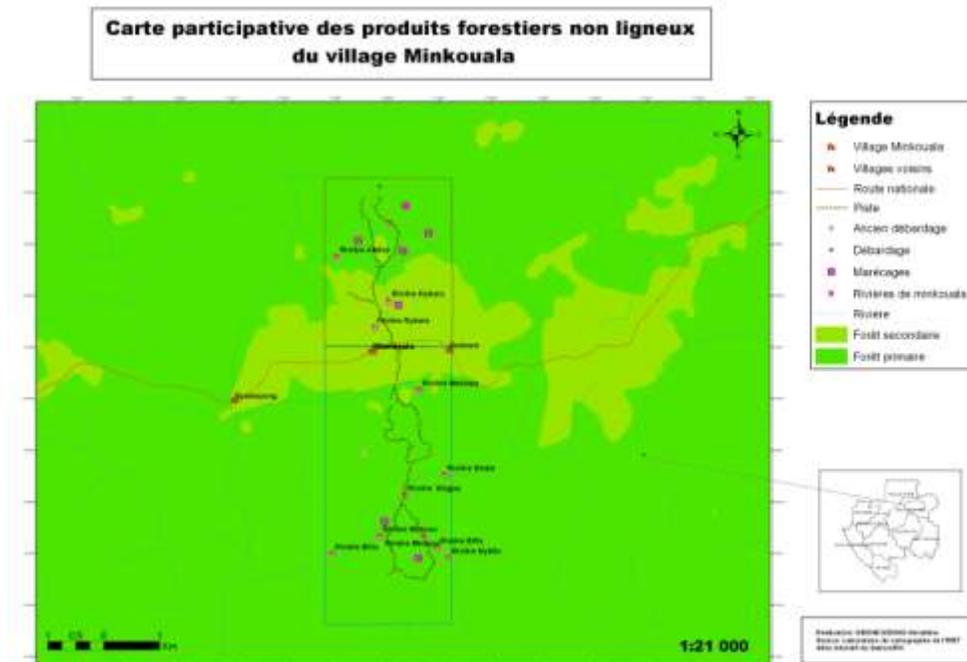


Figure 2. Map of the Village of Minkouala showing the principal road that links Makokou to Libreville.

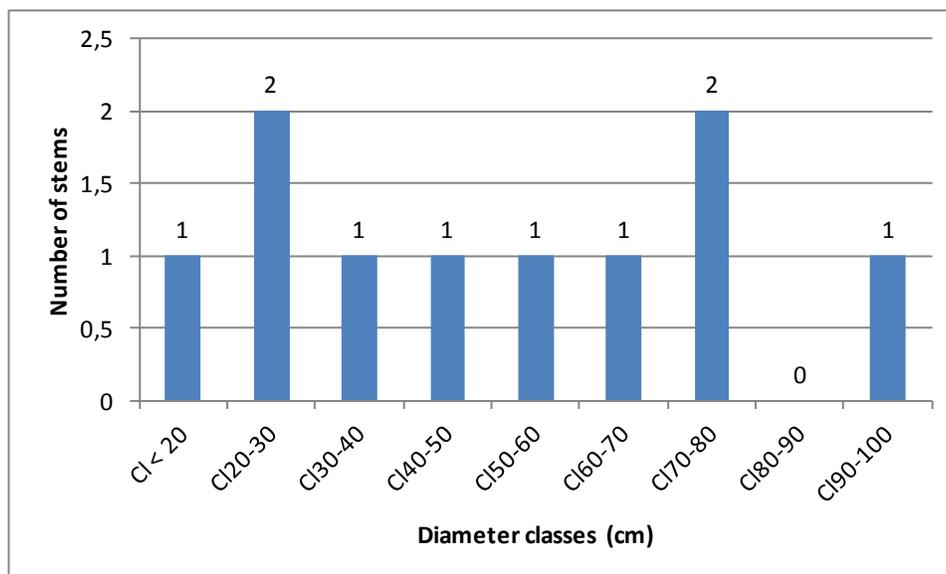


Figure 3. Distribution of *Alstonia boonei* trees per diameter classes in the Minkouala forest.

aims to link a sign of the plant to its applications in folk medicine (Pousset, 1989).

*Alstonia boonei* is largely cited against intestinal worms in the Makokou region; but the anthelmintic properties of this plant were not established (Fakae et al., 2000).

Against the backdrops of the many medicinal uses of *A. boonei*, it has been stated that phytochemicals, other than phenolics, the mineral elements, and vitamin C may

be the critical factors in the medicinal effect of the plant (Akinmoladun et al., 2007).

#### Abundance, stock, and biomass of *Alstonia boonei*

Figure 3 illustrates the distribution of *A. boonei* trees in different diameter classes or the specific curve. Almost all

diameter classes are represented, which shows no specific problem of regeneration for that tree species in the Minkouala forest. According to the Pilot Integrated Management Project (API project) which has been working in the East province of Cameroon for a long time, a plant species is said to be less represented for logging when its average density is less than 0.05 stem/ha (Forni, 1997; API, 1995). *A. boonei*'s density is 0.4 stems/ha, which shows that this plant species is not threatened in the Minkouala village. The total number of trees or the stock estimated for the 5 000 ha of the production forest delimited in the Minkouala forest is 2 000. In most of the central African countries, *A. boonei* is logged at least at 60 cm of diameter at breast high. In Gabon, the plant seems not to be solicited for its wood. No specific studies have been conducted to estimate the biomass of *A. boonei* to be harvested on a sustainable basis. We can only assimilate the plant species to other tree species for which such studies have already been conducted. If we assimilate *A. boonei* to *Prunus africana*, another medicinal plants, and for which only barks of stems of at least 30 cm of diameter at breast high (dbh) can be harvested in Cameroon (Akoa et al., 2010; Betti et al., 2011) and the Democratic Republic of Congo (Wilungula Balongelwa et al., 2011), the exploitable stock of *A. boonei* for the Minkouala village will be 1 400 trees. Studies conducted in Cameroon revealed that an exploitable stems of *Prunus africana* can yield about 50 kg of fresh bark (Betti and Ambara, 2011), when harvested in sustainable maner. This is to move the 50 kg of stem bark on the ½ opposite sides, and return at least 5 years later to move the remaining sides on the same tree, or return 10 years latter to move the same side on the same tree. If we consider these elements for *A. boonei*, the total biomass of the fresh barks to harvest for the 1400 trees estimated is 70,000 kg in 5 years or 14,000 kg per year of fresh bark.

## CONCLUSIONS

A total of 81 citations were recorded for *Alstonia boonei* in the treatment of 14 ailments by people living around the Makokou city. Malaria or Fever, intestinal worms, wounds appear to be the most important ailments treated with *Alstonia boonei* in the Makokou region. Drinking the maceration or the decoction of stem barks are the two recipes which are largely cited for *A. boonei*. Some ailments cited to be treated with *A. boonei* in the Makokou region are also known for the same plant species in other African countries. There are also ailments such as malaria, fever, or diarrhoea of which the pharmacological activity of *A. boonei* is almost established in the litterature. This leads credibility of the traditional use of *A. boonei* in the Makokou region, and of the methods used in this paper to gather data on traditional use of medicinal plants. The density of *A. boonei* is 0.4 stems/ha in the Minkouala forest, and the

exploitable stock to harvest in sustainable manner can be estimated to 1 400 trees. Further reseachs should be conducted as to better define the management parameters for *A. boonei* for its usage as a medicinal plant including: the definition of the minimum diameter of regular fructification, the best minimum diameter of exploitability, the tariff cubage, and the exact biomass of the fresh bark to harvest sustainably.

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