Phylogeny and Taxonomy of Continental African *Sabicea* (Rubiaceae)

Dissertation zur Erlangung des Doktorgrades

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This dissertation is submitted as a 'Cumulative Thesis' that includes five publications:
two published, one accepted for publication, one submitted and one in preparation for submission.

List of Publications

1- Lise Zemagho, Sigrid Liede-Schumann, Bonaventure Sonké, Steven Janssens, Olivier Lachenaud, Brecht Verstraete & Steven Dessein. **The phylogeny of the tribe Sabiceeae (Ixoroideeae-Rubiaceae) revisited, with the proposition of a new subgeneric classification for *Sabicea*** (accepted: Botanical Journal of the Linnean Society).

2- Lise A. Zemagho, Sigrid Liede-Schumann, Olivier Lachenaud, Steven Dessein & Bonaventure Sonké. **Taxonomic revision of *Sabicea* subgenus *Anisophyllae* (Ixoroideae, Rubiaceae) from Tropical Africa, with four new species** (submitted: Phytotaxa).

3- Lise A. Zemagho, Olivier Lachenaud, Steven Dessein, Sigrid Liede-Schumann & Bonaventure Sonké. **Two new *Sabicea* (Rubiaceae) species from West Central Africa: *Sabicea bullata* and *Sabicea urniformis***. Phytotaxa. 173 (4): 285–292 (2014).

4- Olivier Lachenaud & Lise Zemagho. 2015. **Two new anisophyllous species of Sabicea (Rubiaceae) from Gabon**. Candollea 70(2): 219–229 (2015).

5- Lise A. Zemagho. **Synopsis of *Sabicea* Aubl. (Rubiaceae) from Continental Africa with the inclusion of five new species** (in preparation: Plant Ecology and Evolution).

4. List of articles and declaration of own contribution

The thesis contains five research articles. Major parts of the studies was carried out in Meise Botanic Garden under the support of Prof. Dr. Bonaventure Sonké and Dr. Steven Dessein. Another part was carried out at the University of Bayreuth. Prof. Dr. Sigrid Liede-Schumann has supervised the thesis. The manuscripts were prepared and written under consideration of the comments of all coauthors.

1st publication

Lise Zemagho, Sigrid Liede-Schumann, Bonaventure Sonké, Steven Janssens, Olivier Lachenaud, Brecht Verstraete & Steven Dessein. **The phylogeny of the tribe Sabiceeae (Ixoroideeae-Rubiaceae) revisited, with the proposition of a new subgeneric classification for *Sabicea*** (accepted: Botanical Journal of the Linnean Society).

Authors' contribution: The idea and concept of the manuscript were developed by Steven Dessein and Lise Zemagho. Molecular laboratory work was done by Lise Zemagho, as well as sequence alignments. Brecht Verstraete taught to use Geneious software for alignment and editing as well as how to choose markers for the study. Different trees were checked by Steven Janssens, Steven Dessein and Lise Zemagho to ensure that there were no mistakes. Selected morphological characters were chosen under the critical remarks of Steven Dessein. Taxonomic studies were done by Lise Zemagho with the help of Bonaventure Sonké and Olivier Lachenaud. Manuscript was prepared by Lise Zemagho with support of Steven Dessein, then revised by Sigrid Liede-Schumann. The final editing was provided by Sigrid Liede-Schumann and Lise Zemagho. Sigrid Liede-Schumann is the corresponding author.

2nd publication

Lise A. Zemagho, Sigrid Liede-Schumann, Olivier Lachenaud, Steven Dessein& Bonaventure Sonké. **Taxonomic revision of *Sabicea* subgenus *Anisophyllae* (Ixoroideae, Rubiaceae) from Tropical Africa, with four new species (**submitted: Phytotaxa)

Authors' contribution: The idea and concept of the manuscript were developed by Bonaventure Sonké and Lise Zemagho. Steven Dessein and Bonaventure Sonké soon recognized *S. mapiana* and *S. sciaphilantha* as a yet undescribed species. O. Lachenaud collected additional specimens of both species allowing to better described them. Descriptions were done by Lise Zemagho and Olivier Lachenaud with support of Bonaventure Sonké. Manuscript was written by Lise Zemagho with consideration of all co-authors. Antonio

Fernandez and Hans de Vries provided illustrations for the species. Lise Zemagho is the corresponding author.

3rd publication

Lise A. Zemagho, Olivier Lachenaud, Steven Dessein, Sigrid Liede-Schumann & Bonaventure Sonké. **Two new *Sabicea* (Rubiaceae) species from West Central Africa: *Sabicea bullata* and *Sabicea urniformis.*** Phytotaxa 173 (4): 285–292 (2014).

Authors' contribution: In 2009, Steven Dessein, Bonaventure Sonké and Olivier Lachenaud collected a material of *S. bullata* during a field trip in Cameroon and recognized it as new to science. While naming the specimens of *Sabicea* and related genera at Botanical Garden Meise, some specimens came to light as new: *S. urniformis* and it was decided to publish these two new species as the first paper of my project. Descriptions were done by Lise Zemagho and Steven Dessein wrote the conservation status of species. The manuscript was written by recognizing the comments of co-authors. Antonio Fernandez provided illustrations of species. Lise Zemagho is the corresponding author.

4th publication

Olivier Lachenaud & Lise Zemagho. **Two new anisophyllous species of Sabicea (Rubiaceae) from Gabon.** Candollea 70(2): 219–229 (2015).

Authors' contribution: In 2013, the first author, collected the material of *S. mabouniensis* in the Mabounié Region (Gabon) which he had never seen before. When he brought the material to Meise Botanical Garden, it was soon recognized as a yet undescribed species. The next year, the same author collected a second undescribed species not far from the first. *S. golgothae* also in Mabounié Region. Both authors described these species as new separately due to the aberrant characters found in each. O. Lachenaud is the corresponding author.

5th publication

Lise A. Zemagho. **Synopsis of *Sabicea* Aubl. (Rubiaceae) from Continental Africa with the inclusion of five new species (in preparation for Plant Ecology and Evolution).**

Authors' contribution: The idea and concept of the manuscript were developed by Lise Zemagho. Descriptions of new species include in the manuscript were done by Lise Zemagho with help of Olivier Lachenaud and Bonaventure Sonké. Antonio Fernandez provided illustrations of new species.

Content

Publications

Summary

The widely defined tribe Sabiceeae belongs to the subfamily Ixoroideae (Rubiaceae). It comprises about 177 species in four genera: *Hekistocarpa* Hook.f., *Sabicea s.l.* (including satellite genera *Ecpoma* K.Schum., *Pseudosabicea* N.Hallé, *Schizostigma* Arn. ex. Meisn., *Stipularia* P.Beauv.), *Tamridaea* Thulin & B.Bremer, and *Virectaria* Bremek. without any synapomorphic characters to diagnose the tribe. *Sabicea* Aubl. is the richest genus inSabiceeae, distributed in Tropical Africa (c. 96 species), Tropical America (43 species) and Asia (1 species). Its representatives are scandent shrubs, woody climbers, and scramblers or twiners, found at forest edges and often abundant along forest tracks.

The revision of the whole genus in Tropical Africa has not been attempted since the World Monography by Wernham (1914), only some flora treatments and regional monographic studies are available. Furthermore, the taxonomy of *Sabicea* has been discussed controversially, mostly due to a possible combination with the closely related and morphologically very similar genera *Ecpoma*, *Pseudosabicea* and *Stipularia*. However, the decision by Khan et al. (2008) to synonymize all satellite genera under *Sabicea* following molecular results was based on few species with some misidentifications and the phylogenetic tree using both nrITS and *trnT-F* was weakly supported. As a consequence, the circumscription of Sabiceeae and the relationship between *Sabicea* and its satellite genera remained unresolved.

To resolve phylogenetic and taxonomic uncertainties among Sabiceeae and *Sabicea*, this thesis aims 1) to re-assess the phylogeny of Sabiceeae by adding more species and markers to the published matrix of Sabiceeae in a comprehensive study, 2) to clarify the relationships among *Sabicea*, *Pseudosabicea, Stipularia* and *Ecpoma* by tracing the evolution of their morphological characters, 3) to update the taxonomic treatment of the genus *Sabicea* in Continental Africa and to define the centres of diversity and endemism of the genus in Continental Africa.

Molecular work, based on nrITS and three cpDNA (*petD, rps16, trnT-F*) markers and 74 species of Sabiceeae confirms that the clade comprising *Hekistocarpa, Tamridaea* and *Virectaria* (dry fruited genera) is sister to *Sabicea s.l.* clade (fleshy fruited genus) allowing the

possibility to reinstate the tribe Virectarieae. In particular, this work reveals the monophyly of *Ecpoma* and *Stipularia* but confirms also the paraphyly of *Pseudosabicea*.

Taxonomic work is based on the study of herbarium specimens and benefits from field exploration in Cameroon and Gabon. The work was executed following the methods of classical herbarium taxonomy combined with that of phylogenetic systematic. The morphological studies show a high degree of homoplasy in the earlier envolved diagnostic characters in Sabiceeae. Only a combination of morphological characters such as growth form, anisophylly, fusion of outer bracts, inflorescence type and the number of locules per ovary allow a subgeneric classification of *Sabicea* as proposed here for the first time: *S.* subgen. *Anisophyllae*, *S.* subgen. *Sabicea*, *S.* subgen. *Stipularia* and *S.* subgen. *Stipulariopsis* delimited and newly described.

In *Sabicea* subgen. *Anisophyllae*, 15 species are recognized in which four species and two subspecies are described as new to science, while three former varieties are raised to species rank and one species previously sunk into synonymy is restored. The group has its centre of diversity in Gabon, where 10 of the 15 species occur, three of them being endemic to the country. Conservation assessment status of all taxa in this group are given using IUCN criteria.

A treatment of the other three subgenera: *S.* subgen. *Sabicea*, *S.* subgen. *Stipulariopsis*, *S.* subgen. *Stipularia* revealed sixty five species in Continental Africa of which nine are new to science. Critical notes in this thesis discuss details concerning infraspecific variation, typification, synonymization, distinguishing characters between closely related species, etc. Keys are given for the Upper Guinean, the Lower Guinean, the Congolian and the East African species. New records were done for many African countries. This part includes also a list of doubtful and excluded species.

The number of Continental African taxa recorded per 2,5° square indicates that the Guineo-Congolian Region is the centre of diversity of the genus *Sabicea*. The Lower Guinea domain harbours the highest number of species, with 42 taxa in Gabon, 35 taxa in Equatorial Guinea and 28 taxa in Cameroon. Because it also harbours from all lineages, the area is to be regarded also be the centre of origin of the genus.

Zusammenfassung

Die Tribus Sabiceeae aus der Unterfamilie Ixoroideae (Rubiaceae) umfaßt ungefähr 177 Arten in vier Gattungen: *Hekistocarpa, Sabicea s.l.* (einschl. der Satellitengattungen *Ecpoma*, *Pseudosabicea*, *Schizostigma*, *Stipularia*), *Tamridaea* und *Virectaria*. Die Tribus ist wenig präzise abgegrenzt, denn es fehlen eindeutige diagnostische Merkmale (Synapomorphien). Innerhalb der Sabiceeae ist *Sabicea* Aubl. die größte Gattung mit 96 Arten im tropischen Afrika, 43 Arten im tropischen Amerika und einer Art in Asien. *Sabicea* wird repräsentiert durch (Kletter-)Sträucher, Lianen oder Winder, die vorrangig an Waldrändern und entlang von Waldwegen anzutreffen sind.

Eine komplette Gattungsrevision für das tropische Africa ist zum letzten Mal im Rahmen der weltweiten monographischen Bearbeitung durch Wernham (1914) durchgeführt worden, und es sind nur wenige Flora-Beiträge oder regionale Abhandlungen vorhanden. Außerdem ist die Systematik von *Sabicea* oft kontrovers behandelt worden, zumeist bezüglich des Ein- oder Ausschlusses morphologisch sehr ähnlicher Gattungen wie *Ecpoma*, *Pseudosabicea* und *Stipularia*. Die Entscheidung von Khan et al. (2008) alle Satellitengattungen unter *Sabicea* zu synonymisieren erfolgte unter der Verwendung einer molekularen Phylogenie (basierend auf nrITS and *trnT-F* Datensätzen) die nur wenige Taxa und zuweilen auch falsch determinierte Proben enthielt, so daß die statistische Unterstützung entsprechend schwach war. D.h., die Abgrenzung der Sabiceeae and insbesondere die Verwandtschaft zwischen *Sabicea* und ihren Satellitengattungen blieben ungelöst.

Um die phylogenetischen und taxonomischen Unsicherheiten in den Sabiceeae und in *Sabicea* aufzulösen, verfolgte ich mit dieser Arbeit die vier Hauptziele: 1) Neuberechnung der Phylogeny von Sabiceeae unter Verwendung vieler weiterer Arten und molekulare Marker auf der Basis der bereits publizierten Matrix der Sabiceeae, 2) Aufklärung der Verwandtschaftsverhältnisse zwischen *Sabicea*, *Pseudosabicea*, *Stipularia* und *Ecpoma* durch Zurückverfolgung der Evolution ihrer morphologischen Merkmale, 3) Aktualisierung der Taxonomie der Gattung *Sabicea* in Kontinental-Afrika und Definition der Diversitäts- und Endemismuszentren von *Sabicea* im kontinentalen Afrika.

Die molekularen Untersuchungen umfaßten die Sequenzierung von nrITS and dreier cpDNAMarker (*petD, rps16, trnT-F*) für 74 Arten der Sabiceeae. Die Klade mit

Hekistocarpa, *Tamridaea* and *Virectaria* (dry fruited genera) als Schwester zur *Sabicea s.l.*-Klade (fleshy fruited genus) konnte dabei bestätigt werden, was die Wiedereinsetzung der Tribus Virectarieae möglich macht. Mit den neuen Resultaten werden insbesondere die Monophylie von *Ecpoma* und *Stipularia* dokumentiert aber auch die Paraphylie von *Pseudosabicea* bestätigt.

Der taxonomische Teil der Arbeit basiert auf dem Studium von Herbarbelegen und profitiert von Felduntersuchungen in Kamerun und Gabun. Die Durchführung folgt den Methoden der klassischen Herbarium-Taxonomie kombiniert mit der der phylogenetischen Systematik. Die morphologischen Untersuchen belegen dabei einen hohen Grad konvergenter Evolution (Homoplasie) im Bereich der früh evolvierten diagnostischen Merkmale von Sabiceeae. Deshalb erlaubt nur die Kombination von morphologischen Merkmalen wie Wuchsform, Anisophyllie, Fusion der äußeren Brakteen, Infloreszenztypen und der Anzahl der Fruchtfächer im Fruchtknoten die erstmals vorgeschlagene subgenerische Klassifikation von *Sabicea* mit vier Untergattungen: *Sabicea* subgen. *Anisophyllae*, *S.* subgen. *Sabicea*, *S.* subgen. *Stipularia* und *S.* subgen. *Stipulariopsis* werden hier abgegrenzt und neu beschrieben.

In *Sabicea* subgen. *Anisophyllae* werden 15 species und 2 Unterarten anerkannt, von denen 4 Arten und die 2 Unterarten neu beschrieben werden. Drei ehemalige Varietäten werden in den Artrang erhoben und eine früher in Synonymie verschobene Art wird wieder hergestellt. Die Untergattung hat ihr Diversitätszentrum in Gabun, wo 10 der 15 Arten vorkommen, drei von ihnen sind dort endemisch. Der Status bezüglich Artenschutz aller Taxa dieser Gruppe basierend auf den IUCN-Kriterien wird festgestellt.

Die Bearbeitungen der anderen drei Subgenera, *Sabicea* subgen. *Sabicea*, *S.* subgen. *Stipulariopsis* und *S.* subgen. *Stipularia* ergaben 65 Arten für Kontinentalfrika, wobei neun Arten neue Arten repräsentieren. Die Details bezüglich infraspezifischer Variabiliät, Typifizierung, Synonymisierung sowie der Unterscheidungsmerkmale besonders zwischen den nahverwandten Taxa werden kritisch evaluiert. Bestimmungsschlüssel für die Arten aus “Upper Guinea”, “Lower Guinea”, “Congolian Region” und “East Africa” werden vorgelegt. Für viele afrikanische Länder wurden Neufunde identifiziert und dokumentiert.

Die Anzahl der kontinentalafrikanischen Taxa pro 2,5°-Quadrant belegt, daß die Guineo-Kongolanische Region das Diversitätszentrum der Gattung *Sabicea* repräsentiert. Die Lower

Guinea-Domäne besitzt die höchste Artenzahl mit 42 Taxa in Gabun und hat 35 Taxa in Äquatorial-Guinea und 28 in Kamerun. Weil hier alle Abstammungslinien anzutreffen sind, kann die Region auch als das Entstehungszentrum für die Gattung angenommen werden.

1. General Introduction

Over the last decades, Tropical Africa has suffered to the destruction of natural ecosystems. Many species have been destroyed due to the human activities (e.g deforestation, agriculture, logging) and the demographic emergency; many others are likely to become extinct even before they are known to science (Davis et al. 1994). To overcome this problem, it is urgent need to identify and to describe species before they disappear. For centuries, taxonomists have relied on morphological characters for diagnosing and delimiting species (Kenfack 2011). However, besides surveying the morphological characters for diagnosing, it is also prudent to add various approaches expecting to yield further useful insight for a clear differentiation. In this context, molecular phylogenies in general, and species-level phylogenies in particular, can be used to uncover patterns in rainforest diversification (Plana 2004).

On the other hand, the knowledge about the distribution of biodiversity is a central prerequisite for the sustainable use and conservation (Barthlott et al. 2007). By this fact, understanding why some regions have higher levels of diversity and which factors are driving occurrence of species in a particular area is crucial for environmental management and for the development of species conservation strategies (Ndayishimiye et al. 2012). Species richness is distributed non-uniformly across the biosphere (Sechrest et al. 2002) and nature conservation is often based on the concept of biodiversity hotspots (Meyers et al. 2000). Indeed, these hotspots hosting a particularly high number of endemic species have often been interpreted as ancient forest refugia that existed during the glacial maxima (e.g. Robbrecht 1996, Sosef 1994). To address this shortcoming, comprehensive studies of plant diversity are essential.

Africa constitutes the second largest continent comprising approximately 20% of the land surface of the planet (Daniels et al. 2015). The terrestrial Afrotropical biota exhibits significant biodiversity richness and hosts 5 of the 25 global hotspots of biodiversity, including the Western Indian Ocean Islands (Meyers et al. 2000). Nevertheless, despite Africa's high biodiversity richness, the evolutionary affinities of its fauna and flora have been poorly studied in comparison to those from Europe and North America (Daniels et al. 2015). In tropical rain forest, the Rubiaceae represents one of the most diversified and largest of the families (Robbrecht 1996). This family includes the genus *Coffea* L., (coffee), which is by the far the most important economic plant within the family and the world's most important commodity after oil (Vega et al. 2003).

Many Rubiaceae's genera have been revised completely or in parts in the last decades (e.g. *Bertiera* Aubl., *Craterispermum* Benth., *Ixora* L., *Oxyanthus* D.C., *Pavetta* L., *Psychotria* L.) but many others are in need of revision at the continental scale. Among this latter group, *Sabicea* Aubl. shows an African-American-Asian disjunction (Robbrecht 1996). Many species of *Sabicea* are lianas; they are found in the forest edges and are often abundant along forest tracks. In Continental Africa, the genus occurs in West to East from Senegal to Malawi. Some species have been associated to a long term stable forest areas [e.g *S. apocynacea* is found in South Cameroon Plateau (B3), *S. bigerrica* is found in NE Gabon N of Ivindo River (B5)] providing excellent opportunities to explore a variety of questions across the phylogenetic and taxonomic delimitations of the genus as well as its geography distribution.

1. 1. Aims and scope of the study

This thesis investigates the Continental African *Sabicea* species using phylogenetic and taxonomic methods. Molecular and morphological investigations were carried out to infer the relationships among members of the tribe Sabiceeae, and to test the efficiency of diagnosing characters. Although some recent floras and regional monographic studies are available, a monograph of African *Sabicea* species has not been attempted so far, and gaps of knowledge have to be filled at least for Continental Africa (excluding Madagascar and the Gulf of Guinea islands).

Of particular interest for this thesis are the questions: Is Sabiceeae monophyletic as presently circumscribed? Which morphological diagnosing characters are useful to delimitate or characterize its members? Do *Ecpoma*, *Pseudosabicea*, *Sabicea* and *Stipularia* form one large genus *Sabicea s.l.* or do the smaller genera constitute monophyletic units? Which characters have been involved over the time? Where is the centre of diversity of the genus and how are species diversified geographically?

This thesis aims to:

- Re-assess the phylogeny of the tribe Sabiceeae and *Sabicea* as currently circumscribed

- Provide useful morphological characters for a better circumscription of the tribe Sabiceeae and *Sabicea*

- Update the taxonomic treatment and the distribution patterns of the genus in Continental Africa

1.2. Position of Sabiceeae in Rubiaceae

Rubiaceae (*Coffea* family or Madder family) is a member of the Gentianales and shares many of the features common to other families of the order, particularly basic leaf and floral morphology, the presence of colleters, and lack of internal phloem (Davis & Bridson 2007). In terms of the number of species known, the family Rubiaceae is the 4^{the} largest one in the flowering plants (Davis & Bridson 2007: 13,150 spp. in 615 genera) after the Orchidaceae (Cribb & Govaerts 2005: 25,158 spp. in ca. 830 genera), the Asteraceae (Funk et al. 2005: 23,000–30,000 spp. in 1,535–1,700 genera), and the Leguminosae (Lewis et al. 2005: 19,350 spp. in 727 genera); the family Poaceae is the fifth largest (Govaerts 2006: ca. 11,591 spp. in ca. 700 genera). Rubiaceae is usually easy to identify by the presence of simple, opposite or whorled, entire leaves, interpetiolar stipules, and an inferior ovary (Davis et al. 2009). Although the family is recognised as a monophyletic group, its size makes phylogenetic understanding difficult.

The earlier systems of classification, based on the number of ovary locules, recognised two to three subfamilies within Rubiaceae (Cinchonoideae and Coffeoideae, Schumann 1891, respectively: Cinchonoideae, Guettardoideae and Rubioideae, Verdcourt 1958). In Robbrecht's classification (1988), based on morphological and anatomical data, Rubiaceae are divided into four subfamilies (Anthirheoideae, Cinchonoideae, Ixoroideae and Rubioideae). Based on molecular phylogeny, Bremer (2009) restricted the number of subfamilies to three, excluding Robbrecht's subfamily Anthirheoideae.

Subfamily Ixoroideae was circumscribed comprising 24 tribes (Kainulainen et al. 2013) without diagnosing any synapomorphic characters because its members are highly diverse. In Ixoroideae, the tribe Sabiceeae comprises about 177 species of mainly scandent shrubs, woody climbers, scramblers or twiners. In the most recent phylogeny by Khan et al. (2008), it consists of four genera, three of which have restricted, but widely separated geographic ranges. *Hekistocarpa* and *Virectaria* are endemic African genera (Dessein et al. 2001b), *Tamridaea* occurs in Socotra and *Sabicea* is pantropical. The tribe has been understood as a complex even before molecular data came into use but was treated differently by different authors (compare Bremekamp 1966; Robbrecht 1988; Andersson 1996).

In a study of *rbcL* data from Cinchonoideae and Ixoroideae, Bremer & Thulin (1998) found Sabiceeae belonging to subfamily Ixoroideae. Furthermore, a new aberrant endemic genus from Socotra, *Tamridaea* Thulin & B.Bremer, was shown to be sister genus to *Virectaria* Bremek. and was placed in Sabiceeae together with *Sabicea* Aubl. and *Pseudosabicea* N.Hallé. However, this study did not include neither *Ecpoma* nor *Stipularia*.

Dessein et al. (2001a) published a study of *Hekistocarpa* Hook.f. and showed that it belongs in the vicinity of *Virectaria*. Their conclusions from the molecular analysis and the morphological investigation were that the emended tribe Sabiceeae sensu Bremer & Thulin (1998) could not be characterized morphologically and is therefore better treated as two distinct tribes: (1) Sabiceeae (*Sabicea* and *Pseudosabicea* and also, although not included in the analyses, *Ecpoma*, *Pentaloncha* Hook.f., and *Stipularia*) and (2) Virectarieae (including *Virectaria*, *Hekistocarpa* and *Tamridaea*). In this sense, Sabiceeae is characterized by entire stipules, medium to large flowers, valvate aestivation, berries, and small angular seeds with thickened radial walls. According to Dessein et al. (2001b: 75), it is more difficult "to diagnose the tribe Virectarieae emended to include *Hekistocarpa* and *Tamridaea*".

Robbrecht & Manen (2006) proposed to restrict Sabiceeae and Virectarieae to two subtribes: Sabiceinae (Bremek.) Robbrecht & Manen with inflorescences axillary and paired at nodes (including the genera *Ecpoma, Pseudosabicea, Sabicea, Schizostigma* and *Stipularia*) and Virectariinae with inflorescence terminal and mostly herbaceous to slightly woody (*Hekistocarpa* and *Virectaria*) or strictly woody (*Tamridaea*). Finally, based on nrITS and a single chloroplast marker (*trnT-F*) Khan et al. (2008) adopted a broad circumscription of Sabiceeae including the genera: *Hekistocarpa, Sabicea s.l.* (including *Ecpoma, Pseudosabicea, Schizostigma* and *Stipularia*), *Tamridaea* and *Virectaria*.

1.3. Early association of *Sabicea* with *Ecpoma, Pseudosabicea* and *Stipularia*: Taxonomic uncertainties

The genus *Sabicea* Aubl. is one of the very few genera of the family Rubiaceae displaying an African-Asian-American disjunction (Robbrecht 1996). It is the richest genus of the tribe Sabiceeae with representatives occurring mainly in Tropical Africa (96 species) and South America (43 species), only few representatives are found in Madagascar (6 endemic species) (Razafimandimbison & Miller 1999) and one species in Sri Lanka (Puff et al. 1988).

Species of *Sabicea* in the broad sense are easily characterized by the following combination of characters: absence of raphides, valvate corolla aestivation, axillary inflorescences and fleshy fruits with numerous small seeds (Dessein et al. 2001a) (Fig. 1).

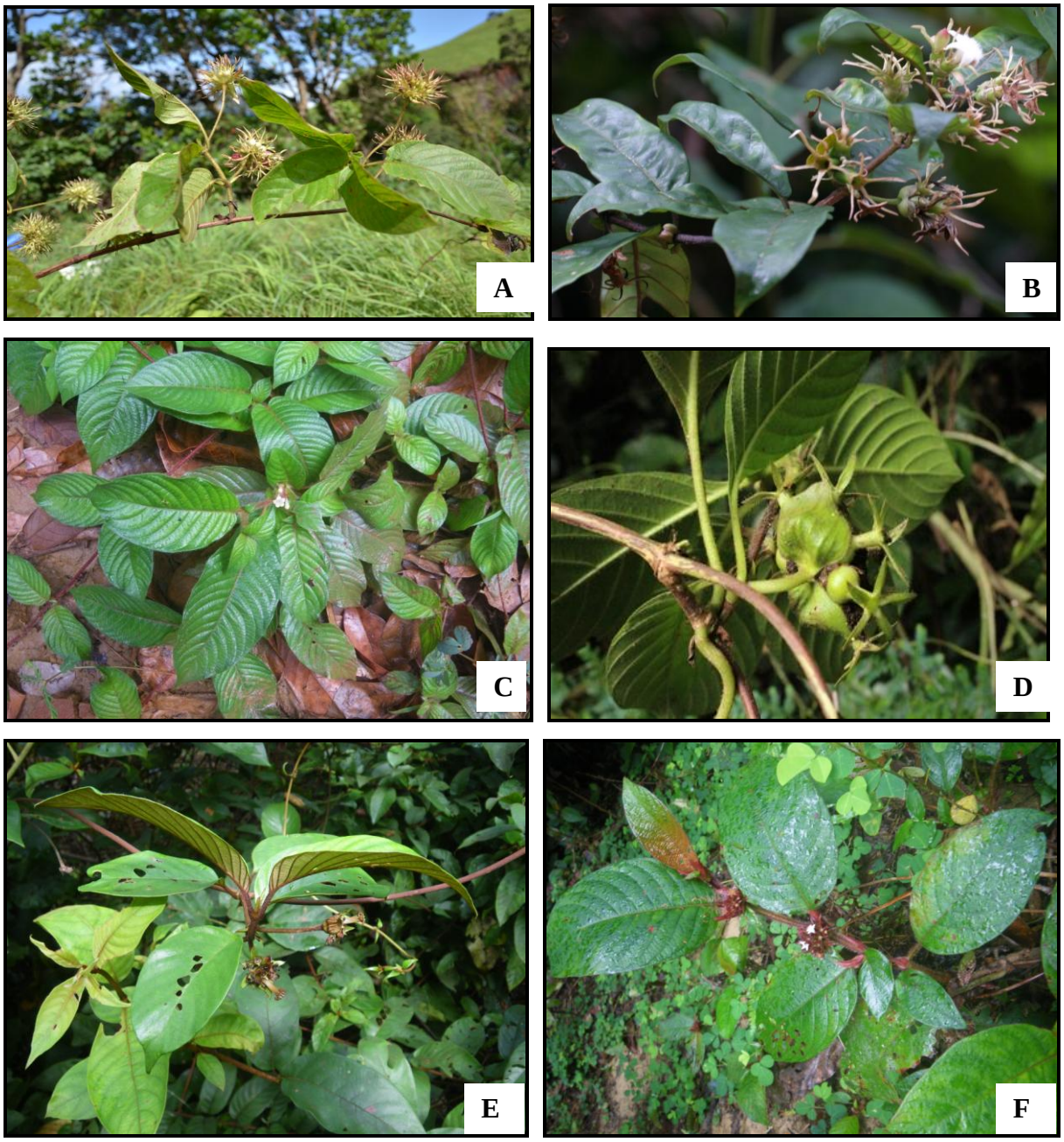

Fig. 1. Selected Continental African *Sabicea* species. A, *S. vogelii*; B, *S. duparquetiana*; C, *S. schaeferii*; D, *S. gabonica*; E, *S. capitellata*; F, *S. golgothae* [Photographs A Bidault; B, D, E Sonké; C, F Lachenaud].

The delimitation of *Sabicea* has been superficial and contentious. In the past, *Sabicea* has been regarded as a single genus (Wernham 1914; Hepper 1958) or up to four genera: *Ecpoma*, *Pseudosabicea*, *Sabicea s.str.*, *Stipularia* (Hallé 1966, 1970; Verdcourt & Bridson, 1988). The attribution of species to *Sabicea* or to one of the related genera was arbitrarily based on characters, such as an erect habit and ovary 2-locular defining *Ecpoma* K.Schum.; ovary 2-locular and scrambling or creeping habit but not twining defining *Pseudosabicea* N.Hallé; peculiar U-shaped involucral bracts and ovary 3-5-locular defining *Stipularia* P.Beauv.

Hepper (1958) was the pioneer in demonstrating the heterogeneity of diagnosing features between *Sabicea s.str*. and *Stipularia* by the use of characters including the U-shaped involucral bracts in *Sabicea* species (Fig. 2). As a consequence, he synonymized *Stipularia* under *Sabicea* and made new combinations.

Fig. 2. Morphological variation of outer bracts between *Sabicea* and a former *Stipularia.* A, *Stipularia africana* with outer bracts in U-shaped; B, *Sabicea urniformis* with outer bracts fused to half their length; C & D, *Sabicea dinklagei* and *S. capitellata* with outer bracts slightly fused. [Photographs A,C Dessein; B Lachenaud; D Sonké]

Hallé (1963) highlights the occurrence of two types of ovary within the genus, i.e. bilocular ovaries in sarmentose or creeping (never twining) species and ovary 5-locular in twining, creeping or climbing, rarely sarmentose species. Wernham (1914) had overlooked this kind of variation as quantitative and not having any value in distinguishing groups. Based on these features, Hallé (1963) described the genus *Pseudosabicea* N.Hallé (Fig. 3). Likewise, a number of Continental African species have been described or recombined to *Pseudosabicea*, for West Africa (Hepper & Keay 1963), Gabon (Hallé 1966) and East Africa (Verdcourt & Bridson 1988).

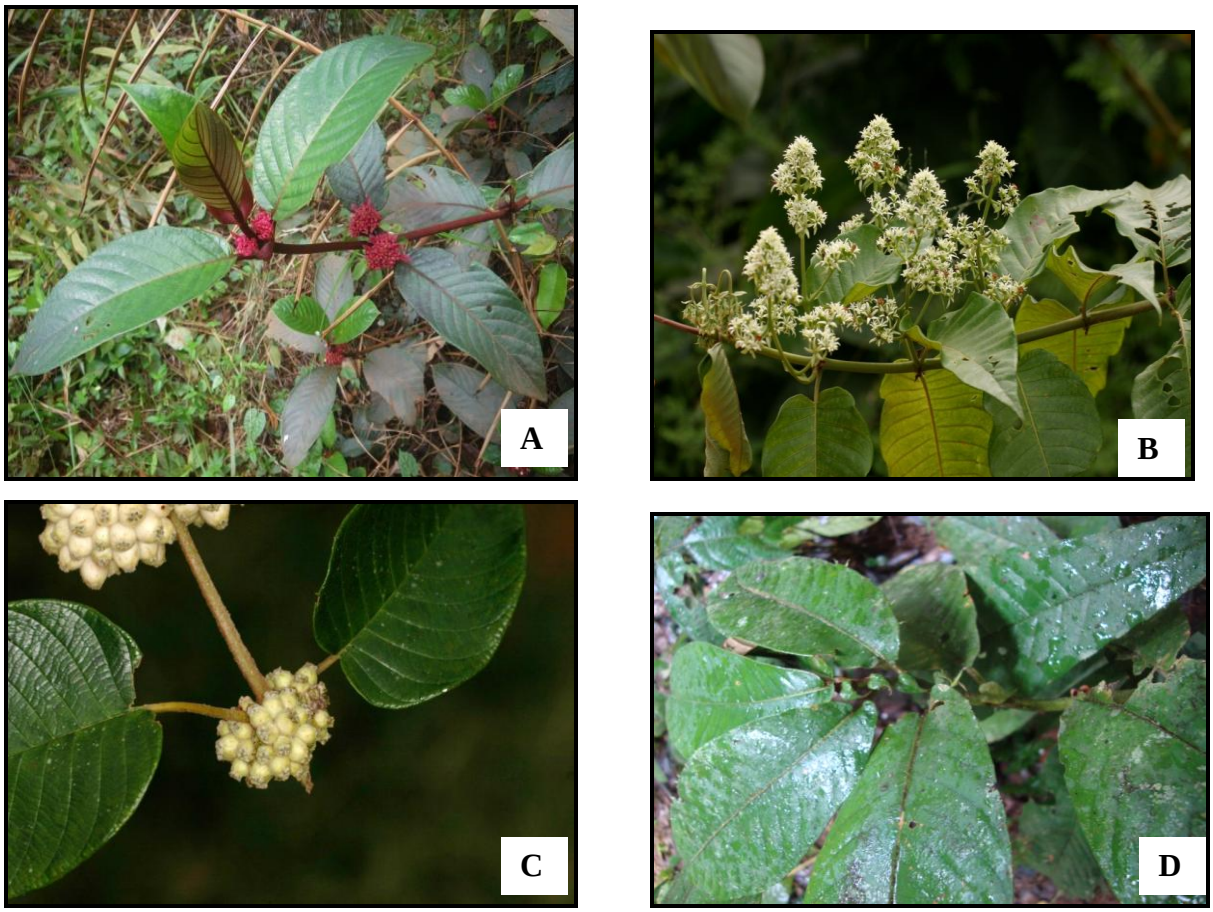

Fig. 3. Selected former *Pseudosabicea* species and sections. *P.* sect. *Floribundae* (A, *S. proselyta*, B *S. segregata*); *P.* sect. *Sphaericae* (C, *S. nobilis*); *P.* sect. *Anisophyllae* (D, *S. sciaphilantha*). [Photographs A, D Lachenaud; B, Sonké; C, Dessein]

Hallé (1963) also accepted *Ecpoma* K.Schum. previously described by Schumann (1896) as a distinct genus based on its erect habit and ovary 2-locular. He transferred *Sabicea hierniana* and *S. gigantostipula* to the latter genus (Fig. 4).

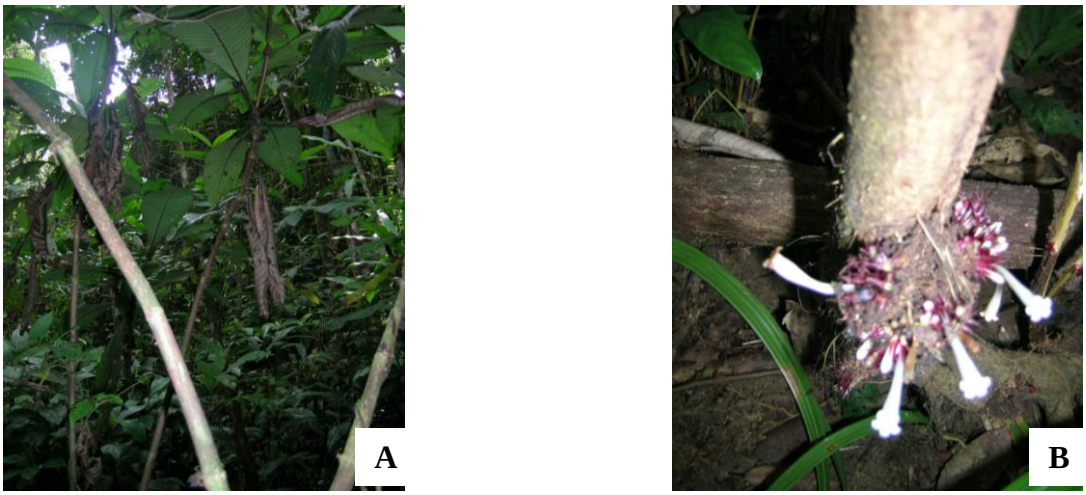

Fig. 4. A former *Ecpoma* species. *E. hierniana:* A, habit; B, inflorescence along the stem.[Photographs Sonké]

1.4. Distribution of *Sabicea* in Tropical Africa

The most complete subdivision of African phytochoria was envolved by White (1979, 1983), who described the distribution of *Diospyros* species. In Africa, he recognized fourteen phytogeographic regions, of which seven are represented in West and Central Africa. The Guinea-Congolian Region is by the far the major centre of specific endemism and shares three subcentres of endemism: The Upper Guinea, Lower Guinea and Congolian (sub) centres of endemism. The occurrence of three sub-centres of endemism within the Guineo-Congolian rain forest might suggest that these areas were most often isolated from each other during recent geological history (Pleistocene, and maybe Late Pliocene); otherwise species would have had an opportunity to spread over the whole rain forest area (Hardy 2013).

In term of phytochoria, *Sabicea* species are distributed in five of the fourteen phytochoria [Guineo-Congolia Region, Guinea-Congolia/Sudania Transition Zone, Lake Victoria Regional Mosaic, Guinea-Congolia/Zambesia Transition, Afromontane Region] (Fig. 5)

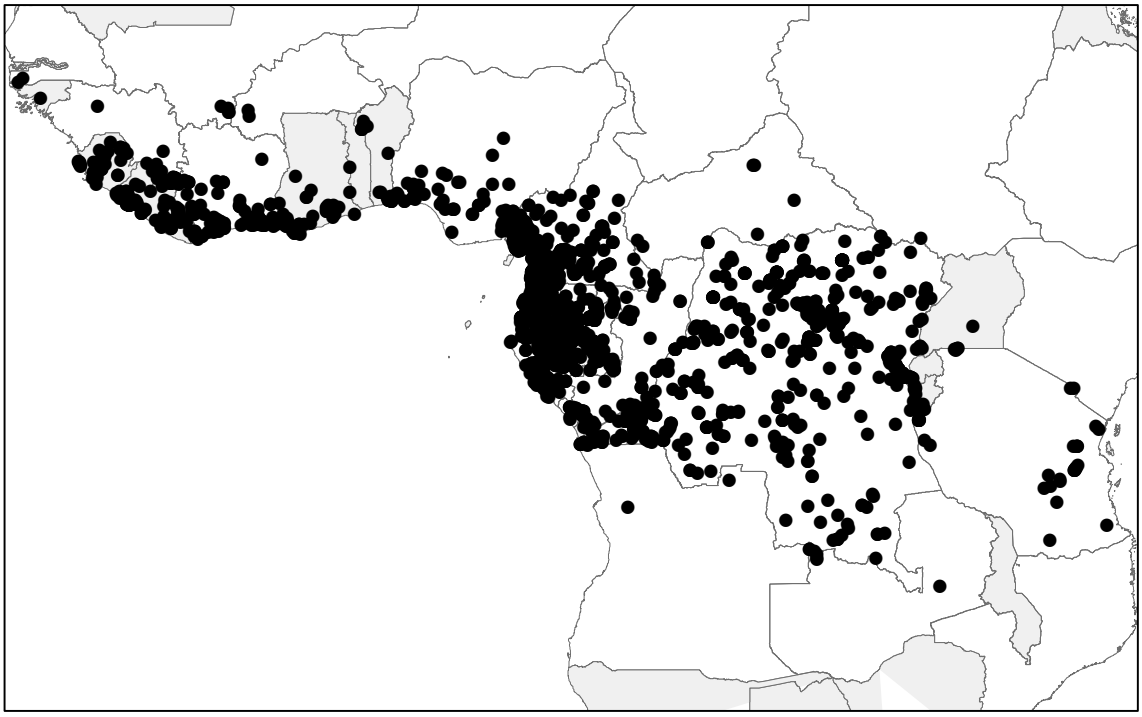

Fig 5. Distribution of *Sabicea* in Continental Africa. *Each point represents one herbarium specimen used in this study.*

Although the published scientific literature on the tribe Sabiceeae and its members provide an overview of phylogenetic, geographical, taxonomical and morphological aspects, the generic circumscription of the members is still ambiguous and debatable due to the fact that the earlier

envolved diagnostic characters for delimitating *Sabicea* overlap among related genera. Furthermore some groups have been shown to be extremely difficult to identify due to the continuous and wide range of variation of characters, which renders it difficult to describe the differences observed and to clear-cut the "state" of many character for diagnosis. To shortcoming, the taxonomic studies are needed to better circumscribe *Sabicea* and its related genera in order to revise the genus.

In Continental Africa, *Sabicea* species are concentrated in the Guineo-Congolian Region, particularly diversified in the Lower Guinea Domain. 42 taxa are found in Gabon, 37 taxa in Equatorial Guinea and 28 taxa in Cameroon. The Upper Guinea and Congolia Domains have a comparable diversity of 15 taxa. Penetration into neighbouring regions occurs from the north into the Guineo-Congolia/Sudania (transitional) Region to the south into Guineo-Congolia/Zambesian (transitional) Region. The Lower Guinea Domain exhibits the highest levels of biodiversity in Tropical Africa (White 1979, Myers et al. 2000, Kier et al. 2005). Almost Guineo-Congolian genera having a significant number of species with a centre of diversity in the Lower Guinea Domain (Lachenaud 2013), but this is also the case for some Rubiaceae rain forest genera widely distributed in Tropical Africa. Examples are *Sherbounia* (Sonké & Pauwels 2005) and *Ixora* (De Block 1998).

2. Synopsis

2.1. Methods

2.1.1 Molecular methods (Publication 1)

A total of 265 Sabiceeae accessions, representing approximately 74 species of Sabiceeae [51 species of *Sabicea* s.str., 12 species of *Pseudosabicea*, 2 species of *Stipularia*, 2 species of *Ecpoma*, 4 species of *Virectaria*, and the monotypic genera *Hekistocarpa, Schizostigma* (= *Sabicea ceylanica* Puff) and *Tamridaea*] and 3 outgroups from the tribe Mussaendeae were included in the molecular analyses.

Most DNA samples were obtained from silica gel collections, rarely, leaf samples were taken from herbarium specimens (BR, WAG). A small number of DNA samples were obtained from fresh leaf material collected from the living collections of the Meise Botanic Garden.

DNA was extracted using the 2xCTAB method (Doyle & Doyle 1987) and purified using caesium chloride/ethidium bromide gradient centrifugation. Four molecular markers, the Internal Transcribed Spacer of nrDNA (ITS), the cpDNA introns *petD* and *rps16*, and the *trnT-F* region of cpDNA (including the *trnT-L* and *trnL-F* spacers and the *trnL* intron) were sequenced. All PCR and sequencing reactions of nrITS, *trnT-F*, *petD* and *rps16* were performed using a Programmable Thermocycler Controller 100-ARNIE and products were sent to Macrogen (Seoul, South Korea) for sequencing.

2. 1.2. Phylogenetic analysis (Publication 1)

Forward and reverse sequences generated for nrITS, *petD, rps16* and *trnT-F* regions were assembled using Geneious 6.1.6 (Biomatters Ltd). Each individual base position was examined for agreement between the two strands. Consensus sequences were aligned with the plugin MAFFT implemented in Geneious 6.1.6 and the resulting alignment was edited manually.

Before analysing the concatenated data matrix, each marker was analysed separately in order to visually recognize putative phylogenetic differences between the different chloroplast datasets and then, between the cpDNA and ITS datasets. A partition homogeneity test (implemented in PAUP* 4.0b10a; Swofford 2002) was carried out to statistically detect whether the data matrices were incongruent. The best performing substitution model for Maximum Likelihood (ML) and Bayesian Inference (BI) was determined for each partition

using the Akaike Information Criterion (AIC) as implemented in jModelTest 2.1.6 (Guindon & Gascuel 2003; Darriba et al. 2012). For all partitions, the GTR+G model was suggested. Bayesian analyses of the single markers or the concatenated dataset were conducted with MrBayes 3.1 (Huelsenbeck & Ronquist 2001). Two runs of four chains (one cold, three heated), initiated from a random starting tree, were monitored for two million generations at which stationarity was reached. Every 100 generations, a tree was sampled from the chain for a total of 20,000 trees. Convergence of the runs was checked with Tracer 1.5. (Drummond & Rambaut 2007) resulting in a removal of 5,000 trees as burn-in. Geneious 6.1.6 was used to compute the 50% majority rule consensus tree. Maximum Likelihood analyses were carried out using the RAxML search algorithm (Stamatakis et al. 2005) under the GTRGAMMA approximation of rate heterogeneity for each gene (Stamatakis et al. 2006) as implemented in RAxML 7.2.8. Five hundred bootstrap trees were inferred using the RAxML rapid bootstrap algorithm to provide support values for the best-scoring ML tree. Maximum Parsimony analyses were conducted using PAUP* 4.0b10a (Swofford 2002). Heuristic searches were conducted applying tree bissection-reconnection (TBR) branch swapping on 10,000 random addition sequence replicates, with five trees held at each step. For each of the 1,000 bootstrap replicates, a heuristic search was conducted with identical settings as in the original heuristic analysis. A clade was considered well supported if the support values for both ML and MP was above 80 % and the posterior probability was between 0.95 and 1. A clade was considered well supported if the support values for both ML and MP was above 80 % and the posterior probability was above 0.95. A clade was considered moderately supported if support values for both ML and MP were above 70 % and the posterior probability between 0.90 and 0.95. A clade was considered weakly supported if support values for both ML and MP were below 70 % and the posterior probability was lower than 0.90.

2.1.3. Morphological analysis in the phylogenetic context (Publication 1)

To identify synapomorphic characters supporting monophyletic lineages, all specimens from BR, BRLU, MO, NY, UPS and WAG (herbarium acronyms according to Thiers, continuously updated) were examined, totalling 3,012 specimens. In addition, previous taxonomic works (Wernham 1914; Khan 2007) and local taxonomic treatments of Sabiceeae genera were used (Hallé 1966; Bridson & Verdcourt 1988). Eleven morphological characters, most of which have been used in the early classifications of *Sabicea s.l.*, were chosen and evaluated, then compiled into a matrix. Morphological character evolution was studied by plotting them on the phylogenetic tree based on the Bayesian topology of the combined ITS and cpDNA data

using a Maximum Parsimony approach. The "Trace Character History" option to reconstruct evolution of each character with the software package Mesquite 2.75 (Maddison & Maddison 2001).

2.1.4. Taxonomic treatment (Publications 2, 3, 4 & 5)

The taxonomic treatment is based on a revision of the material from the following herbaria: BR, BRLU, GH, P, MO, MPU, NY, UPS, WAG and YA (herbarium acronyms according to Thiers 2012, continuously updated); part of the material from K was also studied. In addition, most of the species were studied in the field in Cameroon and Gabon. Usual practices of herbarium taxonomy have been applied. Ecological and geographical data were collected from specimen labels and our field observations. Descriptive terminology follows Robbrecht (1988) and Anonymous (1962), color and other details given in the descriptions are based on living material, spirit and herbarium specimens, and from field notes. Phytogeographical considerations follow White (1979, 1993).

2.1.5. Georeferencing

Each herbarium specimen was checked for possible misidentification, and all information from the specimens' label was recorded in a database. Some records were found using online gazetteers (http://www.fallingrain.com/worlds, http://www.world gazetter.com/). New collections (mainly housed at BR) and unpublished data were also included. Any duplicates or specimens with imprecise information on sampling location were discarded. The resulting database is thus assumed to be free from both taxonomical and spatial biases. For the complete database, we only kept 2713 records with precise locations. The georeferenced specimen data were imported into ArcGIS 10.3 (ESRI, Redlands, California) geographic information software to produce distribution and richness maps.

2.1.6. Conservation assessment

The conservation status of new species and all taxa belonging to the subg. *Anisophyllae* (species, subspecies and varieties) was assessed by calculating the extent of occurrence (EOO) and the area of occupancy (AOO) using GeoCAT (Geospatial Conservation Assessment tool; Bachman et al. 2011) and applying the IUCN Red List Categories and Criteria, version 3.1 (IUCN 2012; IUCN 2013). The AOO was calculated based on a user defined grid cell of 2 km.

2.1.7. Species Richness (Publications 2 & 5)

To estimate the richness of the genus, data have been simplified to a score of presence or absence for each entity of 2,5° grid square for the subg. *Anisophyllae*, for the global Species Richness. An entity was scored as present in a grid irrespective of whether it was recorded once or numerous times from this grid, and absent if it had never been recorded from that grid. The number of taxa in each square was calculated by the extension «Count Point in Polygon» using Hawths tools implemented in ArcGIS 10.3.

2.2. Results and Discussion

2.2.1. The phylogeny of the tribe Sabiceeae (Ixoroideeae-Rubiaceae) revisited, with proposition of a new subgeneric classification for *Sabicea* (**Publication 1**).

2.2.1.1. Monophyly of Sabiceeae and *Sabicea*

The aim of the study was to re-assess the phylogeny of Sabiceeae as currently circumscribed. This includes the most comprehensive taxon sampling of the tribe to date (with 74 of 145 species). We used sequence data from the nuclear internal transcribed spacer (ITS) and three plastid markers (*petD, rps16, trnT-F*) to infer relationships among the members of the tribe and Mussaendeae's genera as outgroups. Individual analyses using Maximum Likelihood, Parsimony analysis and Bayesian approaches were conducted. Two major clades have been clearly identified: a clade comprising dry-fruited genera (*Hekistocarpa*, *Tamridaea* and *Virectaria*) and the other one comprising fleshy-fruited genera (*Sabicea* and related genera *Ecpoma*, *Pseudosabicea*, *Stipularia* and *Sabicea ceylanica*). The former thus, corresponds to the tribe Virectarieae while the latter comprises *Sabicea s.l.* We conclude that the reinstatement of Virectariae would be possible but we refrain from implementing this decision, because of the ambiguous position of *Hekistocarpa*, pending further investigation.
Within *Sabicea s.l.*, the genera *Ecpoma* and *Stipularia* were shown to be monophyletic while *Pseudosabicea* consists of two clades of which one is deeply nested in *Sabicea s. str*. [comprising sections *Floribundae* and *Sphaericae* + *Sabicea mabouniensis*) while the other one is sister to *Sabicea s.str* + *Ecpoma*. This latter group constitutes *Pseudosabicea* section *Anisophyllae* in the sense of Hallé (1970) and includes species with glomerulate and sessile inflorescences, unequally sized leaf-blades and 2-locular ovaries. The position of this clade was particularly interesting because it could be treated either as a new genus (in this case, *Sabicea* should be narrowed and paraphyletic unless *Ecpoma* and *Stipularia* are reinstated as separate genera) as well or as a subgenus (in this case, Sabiceeae sensu Khan et al. should be accepted as well as the broad circumscription of *Sabicea*). We choose to accept the circumscription of Khan et al. (2008), and four subgenera in *Sabicea* are described here for the first time.

2.2.1.2. Evolution of morphological characters in Sabiceeae

Our molecular phylogeny of Sabiceeae provides an independent hypothesis to evaluate important morphological characters of earlier classifications (Wernham 1914; Hallé 1963)

Growth form—The basal lineages within Sabiceae *s.l.* are all erect (*Hekistocarpa, Tamridaea, Virectaria*, and *Sabicea* subgen. *Stipularia*), so the erect habit is presumably ancestral in the tribe. *Sabicea s.l.* shows a remarkable range of variation in the growth habit. Sarmentose habit is found in subgen. *Anisophyllae* and in a few species of subgen. *Sabicea* (the Malagasy *S. acuminata* and *S. diversifolia* and the former *Pseudosabicea* species), presumably as a result of two independent evolutionary events. Creeping habit also evolved several times independently in subgenera *Anisophyllae* and *Sabicea*, either derived from twining or sarmentose ancestors.

Anisophylly—Unequal leaves appeared two or three times in Sabiceeae: once or possibly twice in subgen. *Sabicea* (*S. mabouniensis* from Gabon, *S. acuminata* and S. *diversifolia* from Madagascar) and once in subgen. *Anisophyllae* (Fig. 6).

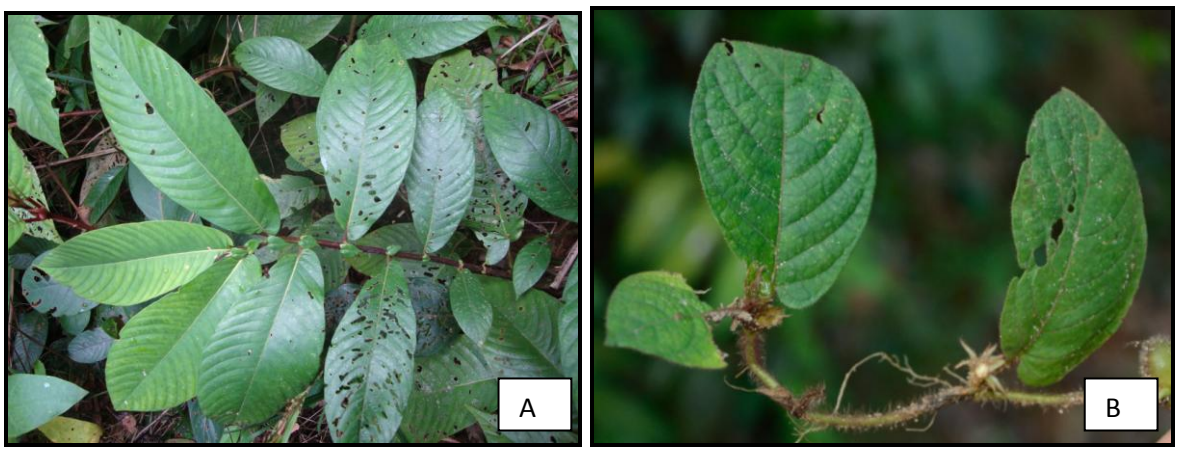

Fig. 6. Anisophylly within *Sabicea*. A, *S. sciaphilantha*; B, *S. sthenula*. [Photographs A Sonké, B Bidault].

Inflorescence type—Inflorescences in Sabiceeae are diverse; nevertheless, they can be summarized in three major types: (1) branched; (2) unbranched and sessile; (3) unbranched and pedunculate (Fig. 7). All inflorescence types occur in subgen. *Sabicea*. The inflorescences of subgen. *Stipularia* are always unbranched, but vary from sessile to pedunculate. In subgen. *Stipulariopsis* and *Anisophyllae*, the inflorescences are always unbranched and sessile (with fruits pedicellate in the former, and usually sessile in the latter) but this form can occur also in some species of subgen. *Sabicea* (e.g. *S. bullata, S. diversifolia, S. speciosa*).

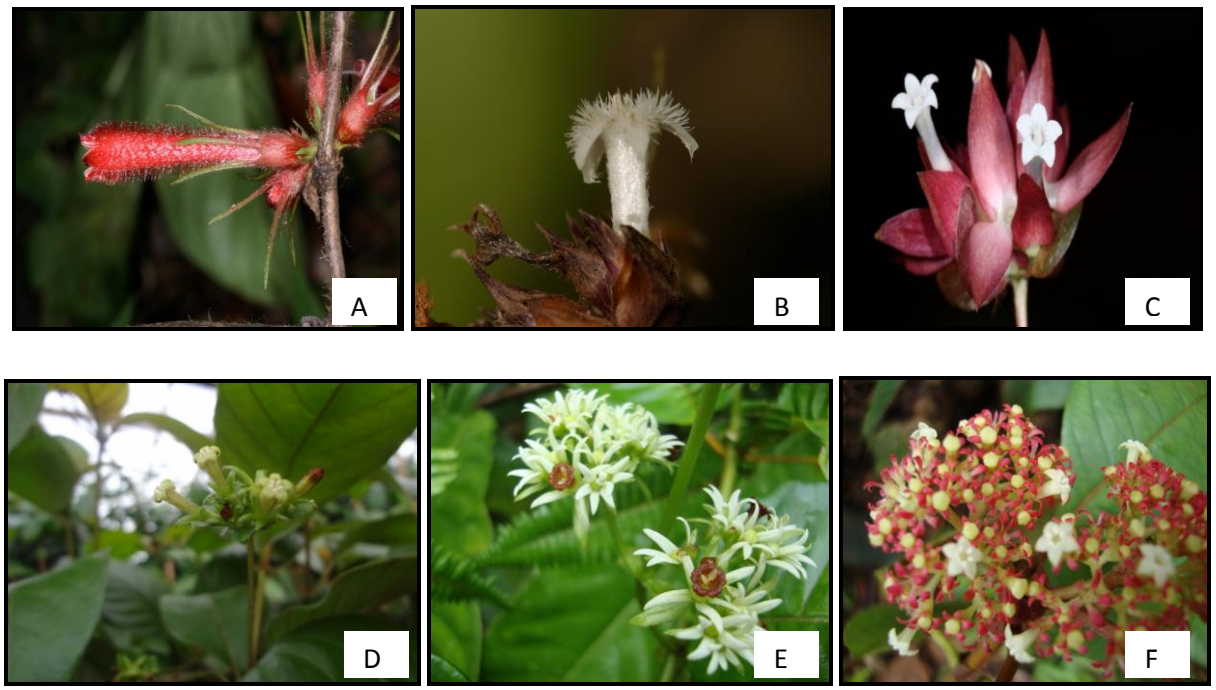

Fig. 7. Inflorescences within *Sabicea*: Unbranched and sessile. [A, *S. speciosa*; B, *S. ndjoleensis*]; unbranched and pedunculate [C, *S. calycina*; D, *S. bigerrica*]; branched [E, *S. segregata*; F, *S. proselyta*] [Phorographs A, D-F, Sonké; B, CDessein,].

Indumentum of corolla-throat—The inner indumentum (Fig. 8) consists mostly of unicellular thin-walled trichomes, which are flat and ribbon-like or sometimes moniliform (Robbrecht 1988), variable in length (short and sparse in subgenera *Stipulariopsis* and *Stipularia*). In most species of subgen. *Sabicea* (excluding *S. acuminata* and *S. diversifolia* from Madagascar), trichomes are short and sparse whereas in *S.* subgen. *Anisophyllae* trichomes are long and form a dense beard around the throat, sometimes extending to the basal part of the lobes.

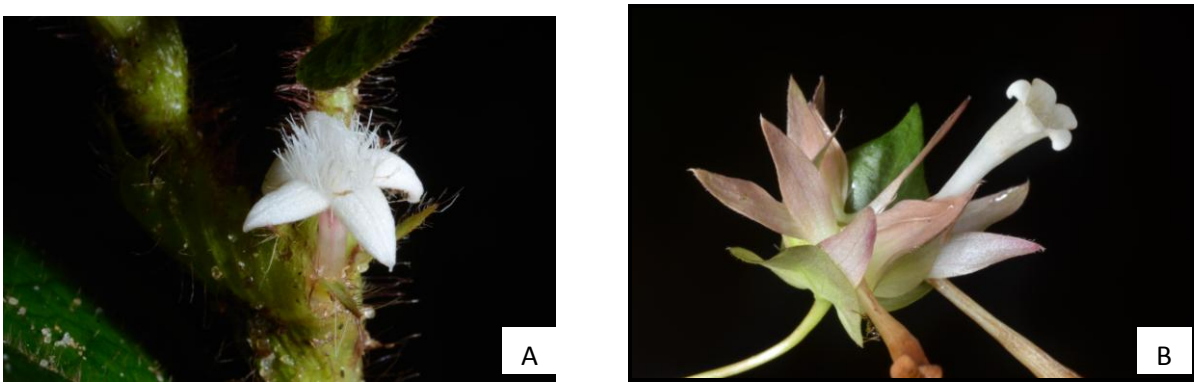

Fig. 8. Trichomes occurring around the corolla throat: long trichomes. A, *S. sthenula*; short trichomes: B, *S. calycina*. [Photographs Bidault].

2.2.1.3. Delimitation of the subgenera within *Sabicea s.l.*

Morphological comparison of each monophyletic unit in *Sabicea s.l.* allows the recognition of a combination of characters, enabling the delimitation of subgenera within *Sabicea* and to propose a key for delimitation of genera in Sabiceae and subgenera in *Sabicea*. We could clearly delimit four subgenera in *Sabicea*: subgen. *Anisophyllae* [consisting of Hallé's *Pseudosabicea* sect. *Anisophyllae*], subgen. *Stipularia* [former *Stipularia* P.Beauv], subgen. *Stipulariopsis* [former *Ecpoma* K.Schum. + *Sabicea urbaniana* and *S. xanthotricha*] and subgen. *Sabicea*.

2.2.2. Update of the taxonomic treatment of Continental African species (Publications 2, 3, 4 & 5).

2.2.2.1. Taxonomic Nomenclature

The character combination of an internal indumentum extending around the corolla throat, glomerulate and sessile inflorescences, the pseudo-alternate arrangement of leaf-blades (which is an exceptional character in Rubiaceae) occurring in *S.* subgen. *Anisophyllae*, as well as the position of this group in our phylogenetic tree were reasons to fully revise it (**Publication 2**). This publication contains a survey of the morphological characters, and keys to the species. For each species, conservation status assessment, illustrations, and distribution maps are given. The number of taxa recorded per a grid of 2,5 ° square shows that 10 of the 15 species occur in Gabon, which can therefore be regarded as centre of diversity for the subgenus. Four species are newly described (*Sabicea mapiana, S. ndjoleensis, S. parmentierae, S. sciaphilantha*), while three former varieties are raised to species rank (*S. crystallina, S. jacfelicis, S. tersifolia*) and one species previously sunk into synonymy is restored (*S. bequaertii*). Two new infraspecific taxa are also described, *Sabicea crystallina* subsp. *engongensis* and *S. sciaphilantha* subsp. *hirsuta.* The centre of diversity of subgen. *Anisophyllae* was found in Gabon where 10 species are endemics.

Publication 3. Two distinctive new species of *Sabicea* (Rubiaceae) from the Lower Guinea Region are described and illustrated which clearly belong to *Sabicea* in the sense of Hallé (1963). *Sabicea bullata* Zemagho, O.Lachenaud & Sonké is a rather isolated species, with no obvious close relatives. It is easily recognized by its cordate leaves, which are strongly bullate above(hence the specific name), and its sessile glomerulate inflorescences. Although, *S.*

leucocarpa resembles *S. bullata* in having leaves cordate at the base (but not bullate); the species further differs from *S. bullata* in pedunculate and involucrate inflorescences, white fruits, and a lowland habitat. It is restricted to the Rumpi Hills and Bakossi Mountains, in southwestern Cameroon. *Sabicea urniformis* Zemagho, O.Lachenaud & Sonké, from southern Gabon and Congo-Brazzaville, is remarkable in having discolorous leaves and an urn-shaped involucre with bracts shortly connate at the base. In general habit, *S. urniformis* also resembles *S. becquetii*, but the two species have widely separate ranges, they did not fall together in the phylogenetic tree. Morphologically, *S. becquetii* differs in its free bracts and red 2-locular ovaries. *Sabicea urniformis* is probably more closely related to *S. capitellata s.l.* Benth., also with discolorous leaves and white 5-locular ovaries, but differing in having much smaller flowers and bracts, the latter free. Detailed descriptions and botanical drawings are provided, conservation status assessed and taxonomic affinities are discussed. They are both assessed as **Least Concern** according to IUCN criteria.

Publication 4. *Sabicea golgothae* O.Lachenaud & Zemagho and *S. mabouniensis* O.Lachenaud & Zemagho, were discovered during the field work in Gabon by Olivier Lachenaud. In particular, the two species are of interest as they combine anisophylly and pedunculate inflorescences, which are until now, unusual in *Sabicea*. Both species resemble taxa of the former *Pseudosabicea* sect. *Floribundae* in having pedunculate inflorescences and 2-locular ovaries. This relationship is corroborated by our molecular analysis for *S. mabouniensis*. They also resemble representatives of *Sabicea* subgen. *Anisophyllae* in having strongly unequal leaves, 2-locular ovaries and relatively long trichomes around the corolla throat. Detailed descriptions and botanical drawings are provided. Both species are apparently endemic to the Mabounié area in West-Central Gabon, currently under exploitation prospects for mining. They are both assessed as **Critically Endangered** according to IUCN criteria. Both species support an enlarged circumscription of Sabiceeae (Hepper 1958, Khan et al. 2008, **publication 1**).

Publication 5. A synopsis of the Continental African *Sabicea* species was carried out. It includes three of the four subgenera of *Sabicea*: *S.* subgen. *Sabicea*, *S.* subgen. *Stipularia*, *S.* subgen. *Stipulariopsis*. The study supports recognition of 65 species of which five are newly described [*S. deblockiana, S. desseinii, S. liedeschumanniana, S. jongkindii, S. uniflora*], ten species are insufficiently known. Investigation of species did not reveal many problems concerning previous delimitation by Hallé (1964, 1966, 1970, 1972); Hepper (1958); Hepper & Keay (1963). However, two groups proved to be extremely difficult due to the variation of

their morphological character pattern (i.e. first order bracts, stipules, inflorescences, indumentum): *S. capitellata s.l.* and *S. venosa s.l.* For each species, ecology, chorology and distribution are given. Consideration and minor problems for these species are given as critical remarks as well as the typification and synonymization whenever appropriate. Dichotomous keys to the species of each subgenus are provided. Keys to the species are given according to African phytochoria following White (1979, 1983). Distribution maps and illustrations are shown only for new species. Distributions are characterized in terms of countries as well as phytogeographic units following White (1979). Chorology and African centres of diversity of the genus are discussed.

3. Conclusions and emerging research challenges

This thesis is the first work dedicated to the phylogenetic and taxonomic exploration of Continental African *Sabicea* species.

The phylogenetic results show that Virectarieae could be reinstate and should be separated from Sabiceeae comprising dry fruited genera in contrast to Sabiceeae comprising fleshy fruited lineages, this providing an excellent characterization for each tribe. In *Sabicea*, a subgeneric concept resulting in four subgenera is considered as the best option of handling the polymorphism of the group. However, the resolution of our phylogenetic tree is not sufficient to resolve interspecific relationships, especially in the large *Sabicea* subg. *Sabicea*. Additional markers and an increased number of taxa included in the molecular analysis are desirable in future to improve our understanding of the relationships between the species. On the other hand, the larger species number of *S.* subg. *Sabicea* and the other three subgenera give rise to the question of the character combination in *S.* subg. *Sabicea* promoting diversification and, ultimately, dispersal both to Asia and to the Americas (Smith 2001).

Sabicea shows an exceptional diversity in Continental Africa where 80 species have been identified, of which thirteen are new to science. For difficult groups morphometric analyses should be considered to improve delimitation of the species. For example, (1) Principal Coordinate Analysis (PCoA) could be used to investigate the pattern of morphological variation, and Canonical Analysis (CA) to test the cohesion of the putative groupings. (2) Fingerprinting methods should be applied to unravel the genetic structure of subspecific variation. (3) some species are still doubtful because they are only known from the type or are poorly collected and those are awaiting the description after additional material has come to light. Field work is then necessary to complete the existing material. (4) we don’t know anything about the biology of the species, their ecological requirements, and their reproductive system including pollination and dispersal agents. Again, field work is needed to collect the missing data. (5) Finally, the fossil pollen of *Sabicea* from the lower Miocene Culebra Formation of Panama (Graham 1987) could be used for dating our phylogeny.

Thus, it appears that the prior centre of diversity of the genus is located in Lower Guinea Domain (mainly Gabon, Equatorial Guinea and Cameroon) where many species are endemic or more or less restricted to this area. Therefore, the referencing of *Sabicea* species should be prioritized in the forest refuge areas there and extended to other phytochoria, so that it covers all protected areas in Tropical Africa. The result can contribute to the evaluation of protected areas and forest refuges enabling the development of conservation strategies in these regions to comprise as many endemic species as possible.

4. References of Introduction

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Publication 1

The phylogeny of the tribe Sabiceeae (Ixoroideae-Rubiaceae) revisited, with the proposition of a new subgeneric classification for *Sabicea* Aubl.

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The phylogeny of the tribe Sabiceeae (Ixoroideae-Rubiaceae) revisited, with the proposition of a new subgeneric classification for *Sabicea* Aubl.

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The tribe Sabiceeae (Ixoroideae, Rubiaceae) has undergone recent taxonomical redelimitations with the incorporation of the related genera *Ecpoma*, *Pseudosabicea* and *Stipularia* within the type genus *Sabicea*. The present study uses phylogenetic analysis coupled with morphological data to verify the relationships among members of the tribe. It includes the most comprehensive taxon sampling of the tribe to date (with 74 of 145 species) and sequence data from the nuclear internal transcribed spacer (ITS) and three plastid markers (*petD, rps16, trnT-F*) were used to infer relationships among the members of the tribe. Individual analyses using Maximum Likelihood, Parsimony analysis and Bayesian approaches reveal several supported clades: the former genus *Stipularia* is resolved as a monophyletic unit, while *Ecpoma* is monophyletic only if *Sabicea urbaniana* and *Sabicea xanthotricha* are included (corresponding to *Sabicea* subgenus *Stipulariopsis* sensu Wernham). *Pseudosabicea* is polyphyletic and falls into two well-defined clades, one corresponding to section *Anisophyllae* of Hallé (1964) and another to the remaining two sections of the genus (*Floribundae* and *Sphaericae*). Seven morphological characters are

mapped onto the phylogenetic tree to study their evolution within the group, and assess their value for the classification of *Sabicea s.l.*. Finally, our study shows that a combination of diagnostic characters should be used to differentiate each group, and we propose to recognize four subgenera within *Sabicea.*

ADDITIONAL KEYWORDS: cpDNA, *Ecpoma*, *Hekistocarpa*, morphology, nrITS, *Pseudosabicea, Sabicea, Stipularia*, *Tamridaea*, *Virectaria*.

INTRODUCTION

The tribe Sabiceeae of the subfamily Ixoroideae (Rubiaceae), was proposed for the first time by Bremekamp (1966) in the subfamily Cinchonoideae, the early morphology-based classification of Rubiaceae to accomodate *Sabicea* Aubl., which he excluded from the tribe Mussaendeae because of its simple (not bifid) stipules, axillary (not terminal) inflorescences and the very narrow (not large) testa cells. Several Rubiaceae taxonomists did not accept the Sabiceeae as a separate tribe (Verdcourt 1958; Hallé, 1961, 1963, 1966; Kirkbride, 1979, 1982; Robbrecht, 1988, 1993) and included *Sabicea*, along with supposedly related genera, in the tribes Isertieae or Mussaendeae. Andersson (1996), however, conducted a cladistic analysis using morphological characters of the tribe Isertieae *sensu* Robbrecht (1988) and ressurected the tribe Sabiceeae in which he included *Acranthera* Arn. ex Meisn. (Meisner, 1838), *Amphidasya* Standl. (Standley, 1936), *Ecpoma* K.Schum. (Schumann, 1896), *Pentaloncha* Hook.f. (Hooker, 1873a), *Pittierothamnus* Steyerm. (Steyermark, 1962), *Pseudosabicea* N.Hallé (Hallé, 1963), *Sabicea* Aubl. (Aublet, 1775), *Schizostigma* Arn. ex. Meisn. (Meisner, 1838) and *Temnopteryx* Hook.f. (Hooker, 1873a); a tenth genus included in his cladistic analysis, *Stipularia* P.Beauv. (Palisot Beauvois, 1807), was erroneously omitted from the list. He considered the tribe more closely related to members of the subfamily Ixoroideae than to the tribe Isertieae (subfamily Cinchonoideae). However, the broad taxonomic delimitation of Sabiceeae as proposed by Andersson (1996) is not supported by molecular data (Bremer & Thulin, 1998; Alejandro, Razafimandimbison & Liede-Schumann, 2005; Rydin *et al*., 2009; Khan *et al.*, 2008a; Smedmark *et al.*, 2009). On the basis of *rps16* intron sequences, Dessein *et al.* (2001a) proposed that the tribe Virectarieae, including *Hekistocarpa*, *Tamridaea* and *Virectaria* is sister to Sabiceeae. Khan *et al.* (2008a) proposed a new tribal delimitation for Sabiceeae, based on the phylogenetic signal of nrITS and cp *trnT-F* sequences and altered the generic delimitations within the tribe. Virectarieae was merged with Sabiceeae and the genera *Ecpoma*, *Pseudosabicea*, *Schizostigma* and *Stipularia* were included in *Sabicea s.l.*. As a result, the tribe Sabiceeae as broadly delimited by Khan *et al.* (2008a) included only four genera: *Hekistocarpa, Sabicea s.l., Tamridaea* and *Virectaria*. This tribal concept was adopted in later classifications (Bremer & Eriksson 2009; Kainulainen, Razafimandimbison & Bremer 2013).

The genus *Sabicea* was originally described by Aublet (1775) where he positioned two species: *S. aspera* and *S. cinerea*, the latter designated later as the type species (Standley

1921: 148). Wernham (1914) revised the genus and recognized two subgenera based mainly on the growth form: subg. *Eusabicea* with 96 species, having a twining, climbing or creeping habit, and subg. *Stipulariopsis* with nine species, having an erect habit with large leaves and stipules. He further subdivided subg. *Eusabicea* into four sections based on the type of inflorescence: sect. *Laxae* Wernham, sect. *Sessilis* Wernham, sect. *Capitatae* Wernham, and sect. *Floribundae* Wernham. Wernham (1914) accepted the closely related *Stipularia* P.Beauv. as a distinct genus, based on its peculiar involucre while Hepper (1958) synonymized *Stipularia* under *Sabicea*.

Hallé (1963) reviewed all characters used by Wernham (1914) in his classification of *Sabicea* [(1) the indumentum, especially of the leaves; (2) the nature of the inflorescence whether sessile or pedunculate, involucrate or ex-involucrate, (3) the length of the calyx lobes and their shape, (4) the shape and relative size of the corolla tube and lobes] and considered them as irrelevant for the generic classification, except for the size of the corolla tube and lobes. Instead, he emphasized on the number of ovary locules, a character largely overlooked by Wernham (1914). Hallé (1963) restricted *Sabicea* to twining or creeping species with 5-locular ovaries. He recognized *Stipularia* (with 3- to 5-locular ovaries) as a distinct genus, based of the erect habit and involucral characters. He transferred the species with 2-locular ovaries to *Ecpoma* K.Schum. (Schumann, 1896) which grouped the erect species, and the new genus *Pseudosabicea* N.Hallé, including sarmentose or creeping species. The genus *Ecpoma* had been overlooked since its description. In addition to the type species *E. apocynaceum* K.Schum., Hallé (1963) included in it five of the nine original species of *Sabicea* subg. *Stipulariopsis* (*S. bicarpellata* K.Schum., *S. cauliflora* Hiern, *S. geantha* Hiern, *S. gigantostipula* K.Schum., *S. hierniana* Wernham). *Sabicea bicarpellata* proved to be misplaced in the genus and was later transferred to *Bertiera* Aubl. (Aublet, 1775) as *B. bicarpellata* (K.Schum.) N.Hallé (Hallé, 1970). Within *Pseudosabicea*, Hallé distinguished three sections: sect. *Anisophyllae* N.Hallé (*S. batesii* Wernham, *S. mildbraedii* Wernham, *S. medusula* K.Schum. ex Wernham), sect. *Floribundae* N.Hallé (*S. floribunda* K.Schum., *S. segregata* Hiern, *S. proselyta* (N.Hallé) Razafim. *et al.*) and sect. *Sphaericae* N.Hallé (*S. arborea* K.Schum., *S. nobilis* R.D.Good, *S. pedicellata* Wernham). The transfer of *Sabicea pedicellata* to *Pseudosabicea* was in fact erroneous, since this species has a 5-locular ovary (Zemagho, pers. obs.). Several new taxa of *Pseudosabicea* were later described by Hallé (1966, 1971).

The monotypic *Schizostigma* Arn. ex. Meisn. is endemic to the forests of Southwest Sri Lanka and has often been associated with *Sabicea* and its allies. Arnott (1839) presented a good description in which he stated, "may be placed near *Sabicea*". Hiern (1877) suggested a relationship between the African genus *Pentaloncha* and *Schizostigma*, while Baillon (1880) included both *Pentaloncha* and *Temnopteryx* in *Schizostigma*, stating that they represent "sections africaines" of the genus with multiflorous inflorescences (Puff, Igersheim & Buchner, 1998 op cit.). Puff *et al.* (1998) compared *Schizostigma* and *Sabicea* and suggested that there are no character states by which the two genera can be reliably separated and that the only reason that could be brought forward in favour of keeping them as separate entities would be geographical distribution. Finally, Khan *et al.* (2008a) clearly showed that *Schizostigma* belong to *Sabicea s.l.*

Although recent phylogenetic investigations have improved our understanding of the tribe and of the systematic position of its type genus *Sabicea*, the relationships between *Sabicea s.str.* and its satellite genera are still unclear. Three questions are pertinent in this context: (1) Are Sabiceeae monophyletic as presently circumscribed? (2) Do the formal and informal characters support the phylogenetic classification? (3) Are *Ecpoma*, *Pseudosabicea* and *Stipularia* nested within *Sabicea* or should they be considered as segregate genera?.

This study presents the first analysis of morphological characters in a phylogenetic context in Sabiceeae. Within *Sabicea s.l.*, we studied the suitability of morphological characters for infrageneric classification purposes. Finding characters that support the phylogenetic classification will help to position species of which sequenceable material is not available. In addition, character evolution might give a clue to the understanding of an evolutionarily successful lineage. The aims of this study are (1) to re-assess the phylogenetic relationships within the broadly circumscribed Sabiceeae adding both additional species and further sequence data from the plastid regions *petD* and *rps16*; (2) to study the systematic value of morphological characters, which is defined here as their potential to identify monophyletic groups and to find morphological support for the major clades in *Sabicea s.l.*

MATERIAL AND METHODS

TAXON SAMPLING

We aimed at a sampling as broad as possible, including all genera of Sabiceeae *s.l.*, and as many species as possible for each genus. For both nrITS and cpDNA markers (*trnT-F, petD* and *rps16*) a total of 74 species of *Sabiceeae* were included in the study: 51 species of *Sabicea s.str.*, 12 species of *Pseudosabicea*, 2 species of *Stipularia*, 2 species of *Ecpoma*, 4 species of *Virectaria*, and the monotypic genera *Hekistocarpa, Schizostigma* (= *Sabicea ceylanica* Puff) and *Tamridaea*. Whenever possible, the type species of the genera were included, however, our efforts to isolate DNA from herbarium specimens of *Ecpoma apocynaceum* K.Schum. (the type species of *Ecpoma*) were unsuccessful. *Mussaenda erythrophylla* Schumach & Thonn., *M. arcuata* Lam. ex Poir. and *Pseudomussaenda flava* Verdc. were chosen as outgroups because Mussaendeae have been identified as sister to Sabiceeae *s.l.* (Kainulainen *et al.*, 2013) (Appendix 3). Most DNA samples were obtained from silica gel collections, rarely leaf samples were taken from herbarium specimens (BR, WAG). A small number of DNA samples were obtained from fresh leaf material collected from the living collections of the Meise Botanic Garden. We incorporated 55 previously published sequences in our dataset (31 nrITS and 24 *trnT-F*; Khan *et al.*, 2008a).

DNA EXTRACTION, AMPLIFICATION AND SEQUENCING

DNA was extracted using the 2xCTAB method (Doyle & Doyle, 1987) and purified using caesium chloride/ethidium bromide gradient centrifugation. Four molecular markers, the Internal Transcribed Spacer of nrDNA (ITS), the cpDNA introns *petD* and *rps16*, and the *trnT-F* region of cpDNA (including the *trnT-L* and *trnL-F* spacers and the *trnL* intron) were sequenced. Both amplification and sequencing was carried out using the primers listed in Table 1. Polymerase chain reactions (PCR) for nrITS, *petD, rps16* and *trnT-F* were carried out as 25-µL reactions including 10.875 µL H_2O, 2.5 µL reaction buffer (10x, 5xGC, 5xAB), 2.5 µL 25 mM $MgCL_2$, 2.5 µL 2 mM BSA, 0.25 µL of each forward and reverse primers (20µM), 0.125 µL Taq DNA polymerase (Kapa-TAQ, Dream-TAQ, PE-TAQ) and 2 µL of DNA template. PCR reactions of nrITS were run on a Thermocycler Controller 2720 with initial denaturation at 95°C for 3 min, followed by 10 cycles of 30 s at 60°C, 72°C for 1 min. 30 s, 95°C for 30 s, followed by 30 cycles of 30 s at 54°C, 72°C for 1 min, 72°C for 7 min, finishing with 10°C. All PCR and sequencing reactions of *trnT-F*, *petD* and *rps16* were

performed using a Programmable Thermocycler Controller 100-ARNIE and were carried out as follows: 96°C for 2 min.; 34 cycles at 94°C for 1 min., 50°C for 1 min., 72°C for 1 min. 30 s, and a final extension at 72°C for 10 min. PCR products were sent to Macrogen (Seoul, South Korea) for sequencing. Two hundred and forty two sequences are newly generated (76 *petD*, 77 *rps16*, 36 ITS and 53 *trnT-F*) (see Appendix 1).

Table 1. Amplification primers used in this study

Region	**Primers**	**Primers sequences (5'-3')**	**References**
nrITS	Forward (P17F) Reverse (26S–82R)	CTA CCG ATT GAA TGG TCC GGT GAA TCC CGG TTC GCT CGC CGT TAC TA	Alejandro *et al.* (2005)
PetD	Forward (petB1365F) Reverse (petD738 R)	TTG ACY CGT TTT TAT AGT TTA C AAT TTA GCY CTT AAT ACA GG	Löhne & Borsch (2004)
rps16	Forward (rps16) Reverse (rpsR2)	GTG GTA GAA AGC AAC GTG CGA CTT TCG GGA TCG AAC ATC AAT TGC AAC	Oxelman, Lidén & Berglund (1997)
trnT-F	Forward (trnL-C) Reverse (trnF-F)	CGA AAT CGG TAG ACG CTA CG AT TTG AAC TGG TGA CAC GAG	Razafimandimbison & Bremer (2002)
	Forward (trnL-A1) Reverse (trnL-I)	ACA AAT GCG ATG CTC TAA CC CC AAC TCC ATT TGT TAG AAC	

SEQUENCE ALIGNMENT

Forward and reverse sequences generated for nrITS, *petD*, *rps16* and *trnT-F* regions were assembled using Geneious 6.1.6 (Biomatters Ltd). Each individual base position was examined for agreement between the two strands. Consensus sequences were aligned with the plugin MAFFT implemented in Geneious 6.1.6 and the resulting alignment was edited manually.

PHYLOGENETIC ANALYSIS

Before analysing the concatenated data matrix, each marker was analysed separately in order to visually recognize putative phylogenetic differences between the different chloroplast datasets and then, between the cpDNA and ITS datasets. A partition homogeneity test (implemented in PAUP* 4.0b10a; Swofford, 2002) was carried out to statistically detect whether the data matrices were incongruent. The best performing substitution model for Maximum Likelihood (ML) and Bayesian Inference (BI) was determined for each partition using the Akaike Information Criterion (AIC) as implemented in jModelTest 2.1.6 (Guindon & Gascuel, 2003; Darriba *et al.,* 2012). For all partitions, the GTR+G model was suggested. Bayesian analyses of the single markers or the concatenated dataset were conducted with MrBayes 3.1 (Huelsenbeck & Ronquist, 2001; Ronquist & Huelsenbeck, 2003). Two runs of four chains (one cold, three heated), initiated from a random starting tree, were monitored for two million generations at which stationarity was reached. Every 100 generations, a tree was sampled from the chain for a total of 20,000 trees. Convergence of the runs was checked with Tracer 1.5. (Drummond & Rambaut, 2007) resulting in a removal of 5,000 trees as burn-in. Geneious 6.1.6 was used to compute the 50% majority rule consensus tree. Maximum Likelihood analyses were carried out using the RAxML search algorithm (Stamatakis, Ludwig & Meier, 2005) under the GTRGAMMA approximation of rate heterogeneity for each gene (Stamatakis, Ludwig & Meier, 2006) as implemented in RAxML 7.2.8. Five hundred bootstrap trees were inferred using the RAxML rapid bootstrap algorithm to provide support values for the best-scoring ML tree. Maximum Parsimony analyses were conducted using PAUP* 4.0b10a (Swofford, 2002). Heuristic searches were conducted applying tree bissection-reconnection (TBR) branch swapping on 10,000 random addition sequence replicates, with five trees held at each step. For each of the 1,000 bootstrap replicates, a heuristic search was conducted with identical settings as in the original heuristic analysis. A clade was considered well supported if the support values for both ML and MP was above 80 % and the posterior probability was between 0.95 and 1. A clade was considered moderately supported if support values for both ML and MP were above 50 %. A clade was considered weakly supported if the posterior probability was lower than 0.95.

MORPHOLOGICAL ANALYSIS

To identify synapomorphic characters supporting monophyletic lineages, all specimens from BR, BRLU, MO, NY, UPS and WAG (herbarium acronyms according to Thiers, continuously updated) were examined totalling 3,012 specimens. In addition, previous taxonomic works (Wernham, 1914; Khan, 2007) and local taxonomic treatments of Sabiceeae genera were used (Hallé, 1966; Bridson & Verdcourt, 1988). Eleven morphological characters, most of which had been used by Wernham (1914) or Hallé (1963) in their classifications of *Sabicea s.l.,* are choosen and evaluated here (Appendix 1), then compiled into a matrix (Appendix 2). Variability of some characters used in the analysis is illustrated in Figure 1. Morphological character evolution was studied by plotting them on the phylogenetic tree based on the Bayesian topology of the combined ITS and cpDNA data using a Maximum Parsimony approach. We used the "Trace Character History" option to reconstruct evolution of each character with the software package Mesquite 2.75 (Maddison & Maddison, 2001).

Figure 1. Variation of some morphological characters included in the phylogenetic analysis of Sabiceeae.

Anisophylly at nodes: unequal leaves: *Sabicea* aff. *aurifodinae* sp.nov. (A from OL1272)/ equal leaves: *Sabicea proselyta* (B from OL1531)-entire stipule: *Sabicea proselyta* (B' from OL1531)-Bract shape: *Sabicea bigerrica* (C* from greenhouse Meise), *Sabicea africana* (G* from BSO6239), *Sabicea urniformis* (H* from OL1532)-Inflorescence type: branched: *Sabicea proselyta* (B from OL1531)/ unbranched and pedunculate: *Sabicea bigerrica* (C from greenhouse Meise)/ unbranched and sessile:*Sabicea* aff. *aurifodinae* sp.nov.(D from BSO5962)-First order bracts in fruiting stage: not splitting *Sabicea africana* (G from BSO6239)/ splitting *Sabicea urniformis* (H from OL1532)-Fruit color: *Sabicea sp*. (E from OL1498), *Sabicea sp.* (F from BSO5004)-Indumentum corolla-throat: short trichomes: *Sabicea dinklagei* (I from BSO6109)/ long trichomes: *Sabicea* sp-OL1447 (J from OL1447). A, B, E, H, J made by O. Lachenaud; C, D, F, G, I made by B. Sonké.

RESULTS

MOLECULAR STUDY

Sequence and alignment characteristics are given in Table 2. Single gene phylogenies revealed no topological discrepancies, and all partition homogeneity tests did neither indicate conflict between the different chloroplast data sets nor between cpDNA and nrITS (P>0.02). As a result, we combined all data sets for further phylogenetic analyses. The concatenated data set consisted of 81 taxa and 491 informative characters. No topological conflict was found between the Maximum Likelihood tree, the Maximum Parsimony tree and the Bayesian consensus tree; however, support values were generally lower for the MP based phylogenetic reconstruction (Fig. 2).

Table 2. Characteristics of Sabiceeae sequences and the alignments used in the phylogenetic analyses.

Markers	nrITS	*rps16*	*petD*	*trnT-F*	chloroplast combined	nrITS +all chloroplast
Number of taxa	79	79	79	77	80	81
Range of GC contents in Sabiceeae *s.l.* sequences (%)	54	30.3	30.7	26.0	31.8	36.8
Informative characters	60	98	90	243	248	491
Aligned length in Sabiceeae *s.l.*	625	819	875	1931	2813	4318

The relationships within Sabiceeae are highly congruent with those described in previous phylogenetic studies (Alejandro *et al.*, 2005; Khan *et al.*, 2008a; Kainulainen *et al.*, 2013). The present phylogenetic analyses confirmed that the Sabiceeae as currently circumscribed is monophyletic. Several moderately to well-supported clades can be found within the tribe.

The *Hekistocarpa-Tamridaea-Virectaria* clade is resolved with moderate support (ML: 69, BI: 0.82, MP: 72) as sister to the clade containing all members of *Sabicea s.l.* (Fig.

2). *Hekistocarpa* is sister to a well-supported (ML: 99, BI: 1.0, MP: 100) *Tamridaea-Virectaria* clade. Within the highly supported (ML: 100, BI: 1.0, MP: 100) *Sabicea s.l.* clade, the highly supported *Sabicea africana-Sabicea elliptica* clade (ML: 100, BI: 1.0, MP: 100) branches off first. Next, a strongly supported clade (ML: 82, BI: 0.97, MP: 97), corresponding to *Pseudosabicea* sect. *Anisophyllae* (comprising *Sabicea aurifodinae, S. batesii, S. becquetii, S. medusula, S. mildbraedii* including var. *letestui, S. sthenula, S. sp*-SD1865 and *S. sp*-SD2149), is retrieved as sister to the rest of the group. Species previously referred to *Ecpoma* form a moderately supported clade with *Sabicea xanthotricha* and *S. urbaniana* (ML: 56, BI: 0.99, MP: 66). The *Ecpoma*-clade is sister to a large, moderately supported clade (ML: 88, BI: 0.99, MP: 58) with little internal structure, comprising all sequenced species of *Sabicea s.str.* (in the sense of Hallé 1963, 1966) as well as species of *Pseudosabicea* sect. *Sphaericae* and sect. *Floribundae*, and the monotypic *Schizostigma*. Resolution within this clade is poor, but a few supported clades can be identified. *Schizostigma* forms a moderately supported clade (ML: 70, BI: 0.90, MP: 75) with the Central African *Sabicea speciosa*. *Sabicea pilosa* and *S. urceolata* form a strongly supported clade (ML: 99, BI: 1.0, MP: 98). The two Madagascan species *S. acuminata* and *S. diversifolia* form a moderately supported clade (ML: 55, BI: 0.96, MP: 59). The Neotropical species of *Sabicea* also form a moderately supported clade (ML: 73, BI: 0.94, MP: 53) sister to a moderately supported (ML: 82, BI: 0:99, MP: 86) Continental African clade comprising *S. orientalis, S. venosa*, and S. *laxa*, as well as *S. mollis*. *Sabicea discolor* from West Tropical Africa is retrieved as moderately supported (ML: 51, BI: 0.82) sister to this alliance. The two species from São Tomé, *Sabicea exellii* and *S. ingrata*, do not form a clade; the former groups with *Sabicea rosea* from West Africa (ML: 97, BI: 1.0, MP: 93), while the position of the second in a clade of mostly Central African species receives only weak support by Bayesian analysis (BI: 0.71) and is unsupported by ML and MP analysis. Thus, *Pseudosabicea* species are resolved in two clades, the first as sister to *Ecpoma-Sabicea s.str.*, and the second as a moderately supported clade (ML: 89, BI: 1.0, MP: 68) comprising four species nested within *Sabicea s.str.* Sister to the latter clade, with moderate support (ML: 88, BI: 0.99, MP: 58) is a new species from Gabon (*Sabicea* sp.–OL1446).

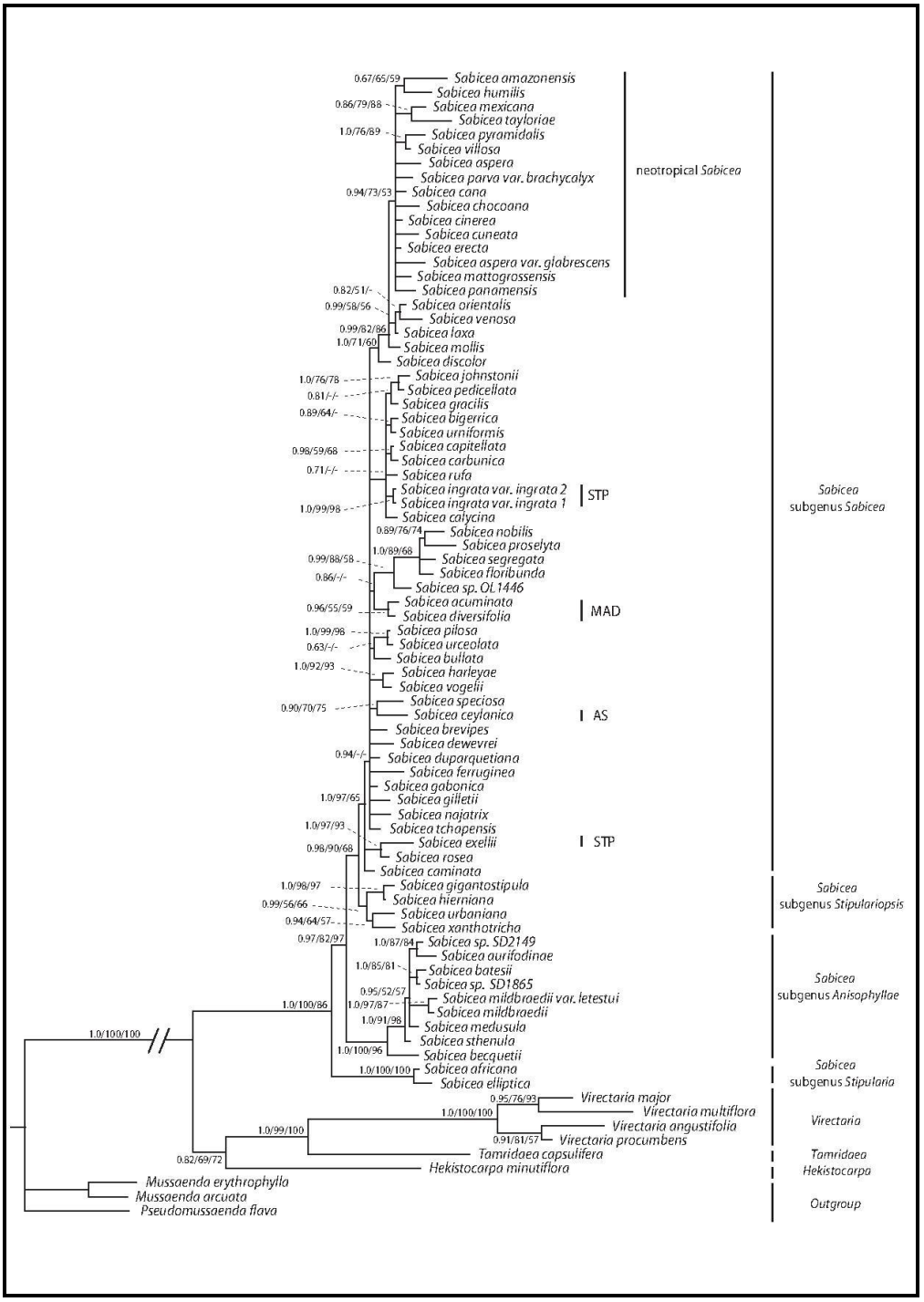

Figure 2. Strict consensus tree derived from Maximum Likelihood (ML), Maximum parsimony (MP) and Bayesian analysis (BI) of *ITS- PetD-rps16-trnT-F* data of *Sabiceeae* tribe and three outgroups *Pseudomussaenda* and *Mussaendae*. The numbers to the left represent Bayesian posterior probabilities (> 0.95), in the middle bootstrap support values (> 50%) and to the right parsimonious values. AS =Asia, MAD=Madagascar, STP=Saõ Tomé and Principe.

MORPHOLOGICAL STUDY

Patterns of character evolution of potentially taxonomically important characters are shown in Figures 3–9. The morphological comparison of monophyletic units in *Sabicea s.l.* allows to recognize them by a combination of characters (Table 3) and delimit four subgenera within *Sabicea*. Further details are given in the discussion.

Table 3. Table comparing morphological characters in the subgenera of *Sabicea s.l.* (sensu this paper)

Characters	***Sabicea* subg. *Anisophyllae***	***Sabicea* subg. *Sabicea***	***Sabicea* subg. *Stipularia***	***Sabicea* subg. *Stipulariopsis***
Growth habit	creeping or sarmentose	usually twining, sometimes creeping or sarmentose	**erect**	**erect**
Leaves	**strongly anisophyllous (except *S. becquetii* and *S. arborea*)**	isophyllous, rarely anisophyllous	isophyllous	isophyllous
Stipule type	entire or multifid	entire or multifid	entire	entire
Bracts	free usually small, not surrounding inflorescence	free or shortly connate at base, rarely (*S.urceolata*) connate for most of their length into an involucre splitting laterally in fruit	**fused for most their length into an urceolate involucre**, splitting in fruit (*S. elliptica*) or remaining intact (*S. africana*)	free and usually small (large in *S. gigantostipula*),
Inflorescence	unbranched, sessile	branched or unbranched, sessile or pedunculate	unbranched, sessile	unbranched and sessile
Indumentum of corolla-throat	**long trichomes forming a dense beard (except *S. becquetii* and *S. arborea*)**	trichomes short, or rarely long trichomes forming a dense beard (*S. acuminata*, *S. diversifolia*)	trichomes short	trichomes short
Ovary	2–locular	2–5 locular	3–5 locular	2–locular
Distribution	Central and East Africa	Pantropical	West and Central Africa	Central Africa (Lower Guinea Domain)

DISCUSSION

HEKISTOCARPA-TAMRIDAEA-VIRECTARIA CLADE

In our analysis, *Hekistocarpa*, *Tamridaea*, and *Virectaria* form a clade moderately supported, sister to *Sabicea s.l.* (Fig. 2). This is in agreement with Dessein *et al.* (2001a) and Bremer & Eriksson (2009), but in conflict with Khan *et al*. (2008a, b), who retrieved *Hekistocarpa* as sister to all other Sabiceeae genera, and Kainulainen *et al*. (2013) who retrieved *Tamridaea* and *Virectaria* as sister to the remaining Sabiceeae. The position of *Hekistocarpa* seems to be ambiguous, pending for further study. In our study, the monophyly of the *Hekistocarpa-Tamridaea-Virectaria* clade is entirely based on the *rps16* sequences and it should be confirmed by additional molecular data. Morphologically, this clade differs from *Sabicea s.l.* by the dry fruits. Fruit characters, among others (see key to the genera), can also be used to separate the three genera: fruits indehiscent or tardily splitting into two mericarps in *Hekistocarpa*, capsules with two persistent valves in *Tamridaea* and capsules with one caducous valve and the other remaining attached to the pedicel in *Virectaria* (Dessein *et al*., 2001a, b). Within this clade, the African genus *Virectaria* is fully supported as sister to *Tamridaea*, a genus endemic to Socotra, which is in agreement with previous molecular studies. The two genera are characterized by terminal inflorescences, a character not found in other members of Sabiceeae.

SYSTEMATIC VALUE OF INDIVIDUAL MORPHOLOGICAL CHARACTERS

The results from our study of morphological character evolution demonstrate that many characters used to hypothesize relationships within *Sabicea s.l.* are labile and do not delineate the genera as proposed by earlier studies. Several characters were judged as uninformative for generic and subgeneric delimitation after preliminary morphological examination, because they exhibited either very little information (e.g, pollen morphology, size and shape of the disk) or considerable intraspecific variation (external indumentum of vegetative parts, dimensions of leaves and stipules). These were excluded from further analysis.

Our Sabiceeae molecular phylogeny provides an independent hypothesis to evaluate taxonomically important morphological characters such as growth form (Fig. 3), anisophylly (Fig. 4), stipule type (Fig. 5), bracts (Fig. 6), inflorescence type (Fig. 7), corolla-throat indumentum (Fig. 8), and the number of ovary locules (Fig. 9) (see Appendices 1 and 2).

Growth form (Fig. 3)—*Sabicea s.l.* shows a remarkable range of variation in the growth habit. In the present study, we summarized the habits in four major groups: Erect shrub or herb (0); creeping (1); twining (2), i.e. with stems climbing in spiral around a support; and sarmentose (3), i.e. more or less lianescent but not climbing in spiral. In the creeping category we only included the small species (< 30 cm tall) with the stems appressed to ground or shortly ascending at the apex. There are some ambiguous cases where the stems are creeping at base and twining at apex (*S. pilosa*, *S. bullata*) or creeping at base and sarmentose at apex (*S. sp.*-SD2149); these were considered as twining or sarmentose, respectively. The basal lineages within *Sabiceae s.l.* are all erect (*Hekistocarpa, Tamridaea, Virectaria*, and *Sabicea* subg. *Stipularia*), so the erect habit is presumably ancestral in the tribe. Most species of subg. *Sabicea* are twining, and this habit presumably evolved a single time. The sarmentose habit occurs in subgenus *Anisophyllae* and in a few species of subgenus *Sabicea* (the Malagasy *S. acuminata* and *S. diversifolia* and the former *Pseudosabicea* species), presumably as a result of two independent evolutions. The creeping habit also evolved several times independently in subg. *Anisophyllae* and subg. *Sabicea*, either derived from twining or sarmentose.

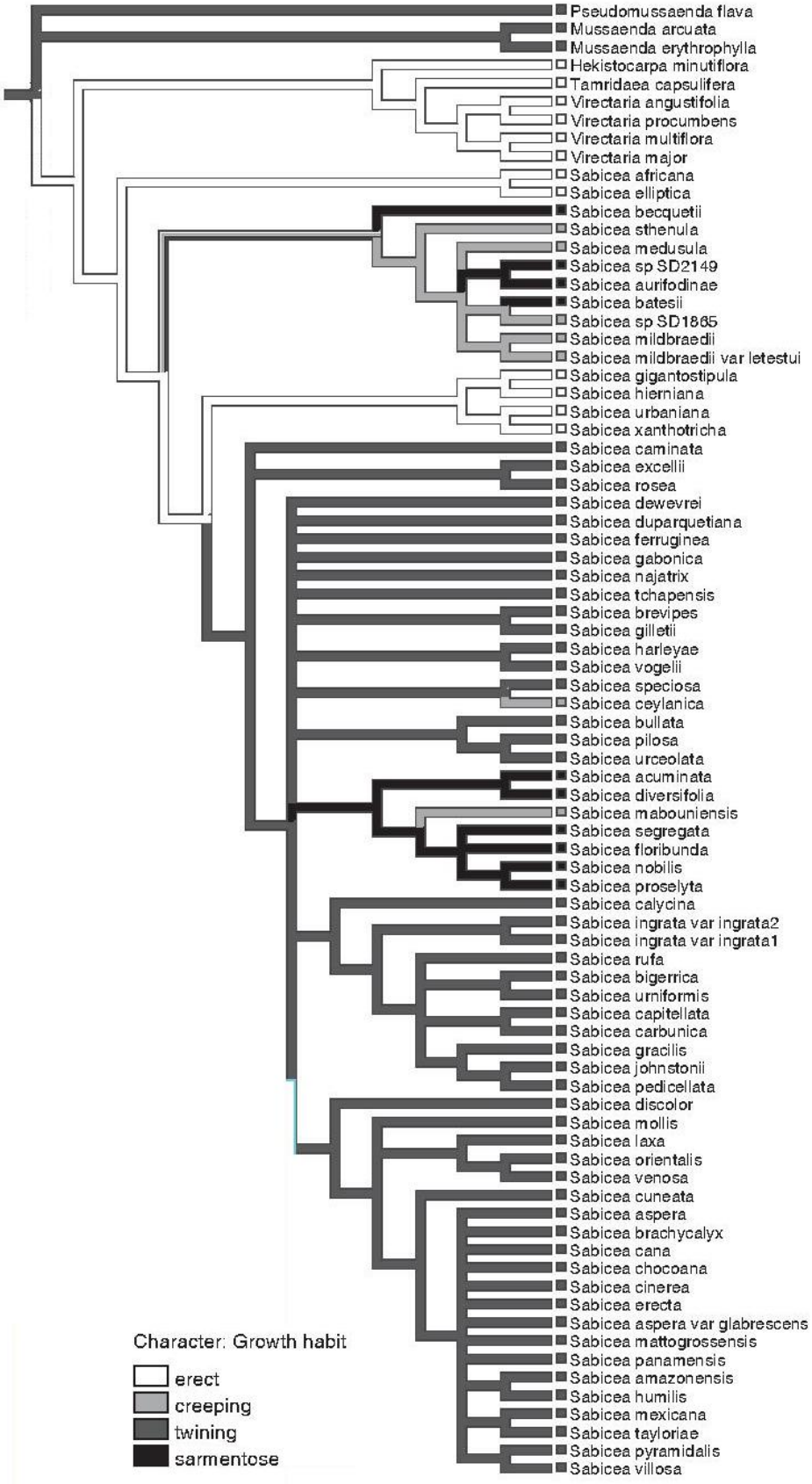

Figure 3. Evolution of growth form in Sabiceeae.

Anisophylly (Fig. 4)—Some species of *Sabicea s.l.* are anisophyllous, and Hallé (1963) used this character to diagnose *Pseudosabicea* sect. *Anisophyllae*. There is a good range of variation in the level of anisophylly: leaves slightly unequal with one about twice larger than the other (*S. tersifolia*), strongly unequal with one normally developed and the other vestigial (e.g. *S. aurifodinae*), or, at the extreme, a single leaf per node (*S. batesii*, *S. sthenula*). Our study shows that unequal leaves appeared two or three times in Sabiceeae: once or possibly twice in subg. *Sabicea* (*S. sp*.-OL1446 from Gabon, *S. acuminata* and *S. diversifolia* from Madagascar) and once in subg. *Anisophyllae*. *Sabicea becquetii* with equal or slightly unequal leaves is sister to the remainder of the *Anisophyllae* clade. This character, being homoplasic, cannot be used alone to delimit subg. *Anisophyllae*.

Figure 4. Evolution of anisophylly in Sabiceeae.

Stipule type (Fig. 5)—Stipules are often useful in distinguishing Rubiaceae genera (Gentry, 1993). The stipules in Sabiceeae are interpetiolar and persistent; in *Sabicea* subg. *Anisophyllae* they are often connate with the base of the petioles. They vary in shape from entire or shortly bidentate at apex, to multifid (divided in many segments). Multifid stipules are found in some (but not all) species of *Sabicea* subg. *Anisophyllae,* but also in the Malagasy taxa *S. acuminata* and *S. diversifolia*. Consequently, this character has to be considered homoplasic.

Figure 5. Evolution of stipule type in Sabiceeae.

Bracts (Fig. 6)—The genus *Stipularia* has been separated from *Sabicea* (e.g. Hallé, 1966) based on its peculiar urn-shaped involucre surrounding the inflorescence. This involucre consists of 2–4 bracts that are fused for most of their length, and either split in fruit (*S. elliptica*) or remain intact (*S. africana*). However, as pointed out by Hepper (1958), the bracts of *Sabicea s.str.* show considerable variation: they can be free and inconspicuous (e.g. *S. exellii*), free and conspicuously surrounding the inflorescence (e.g. *S. capitellata*) or shortly fused at the base (*S. dewevrei*, *S. urniformis*; in the latter species the bracts split in fruit); an exception is *S. urceolata* that has bracts fused for most of their length and splitting in fruit, thus much resembling the involucre of *Stipularia*. This character, therefore, is also homoplasic. In subg. *Anisophyllae* bracts are free, usually small and inconspicuous (in *Sabicea sp.*-SD2149, they are larger and enclose the flowers when young, but not the whole inflorescence). In subg. *Stipulariopsis*, bracts are free and very small, except in *S. gigantostipula*, which has 2 large free bracts surrounding the inflorescence.

Figure 6. Evolution of the bracts in Sabiceeae.

Inflorescence type (Fig. 7)—In the present study, we summarized inflorescences of Sabiceeae in three major types: (1) branched; (2) unbranched and sessile; (3) unbranched and pedunculate. Our study shows that all inflorescence types occur in subg. *Sabicea*. The

inflorescences of subg. *Stipularia* are always unbranched, but vary from sessile to pedunculate. In subg. *Stipulariopsis* and *Anisophyllae*, the inflorescences are always unbranched and sessile (with fruits pedicellate in the former, and usually sessile in the latter). Unbranched and sessile inflorescences are also found in some species of subg. *Sabicea* (e.g. *S. bullata*, *S. diversifolia*, *S. speciosa*), hence, this character is homoplasic as well.

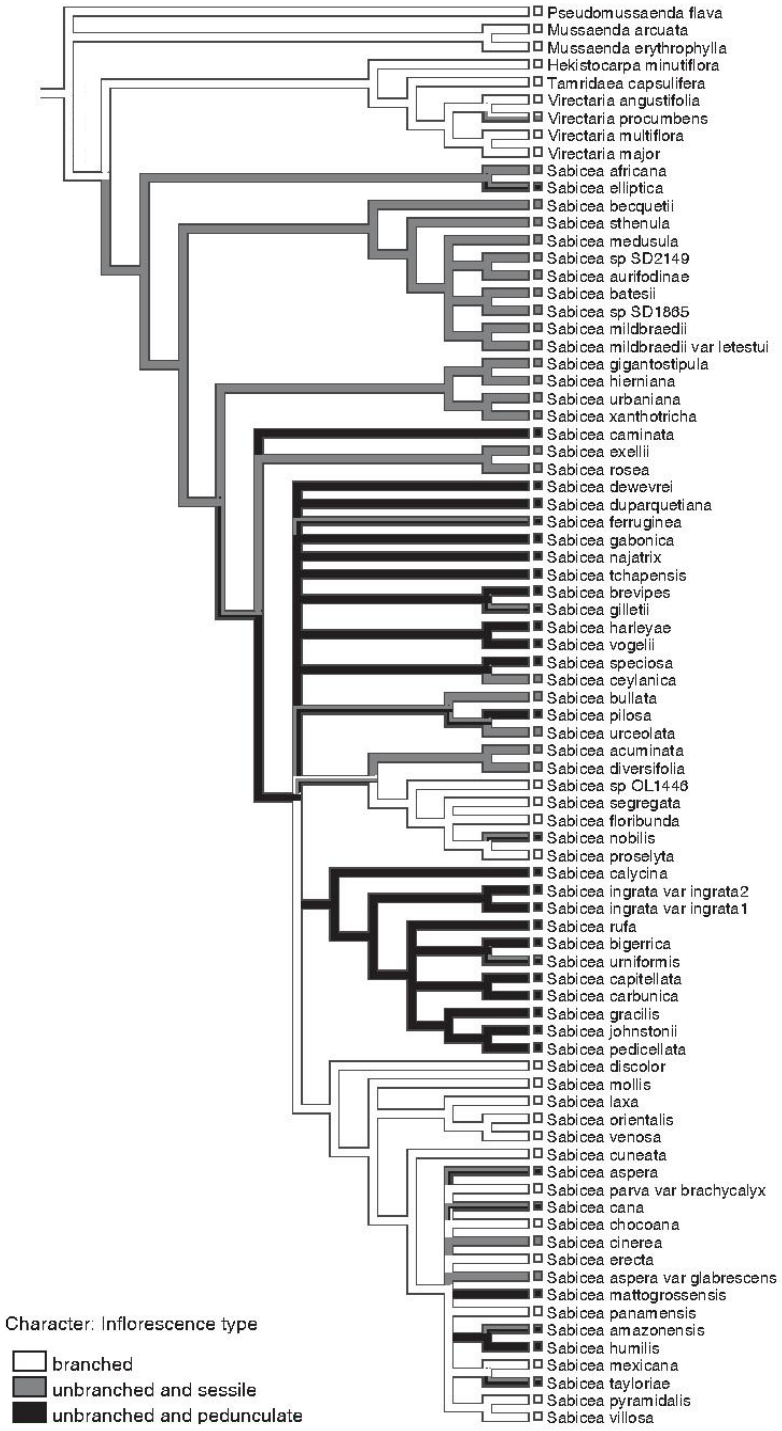

Figure 7. Evolution of inflorescence type in Sabiceeae.

Indumentum of corolla-throat (Fig. 8)—An important character that has been overlooked in the discussion of Sabiceeae is the nature of the internal indumentum. Verdcourt (1958) examined the trichomes of many Rubiaceae genera and distinguished two groups: the internal indumentum (inside the corolla tube) and the external indumentum (other plant organs). While Verdcourt (1958) considered the trichome structure of external indumentum as a useful secondary character, the systematic importance of the inner indumentum has not been extensively discussed in the literature. The inner indumentum mostly consists of unicellular thin-walled trichomes, which are flat and ribbon-like or sometimes moniliform (Robbrecht, 1988). In *Sabicea*, the internal indumentum consists of thin white multicellular trichomes of variable length. Of particular systematic value are the trichomes occuring around the corolla throat, which are short (c. 0.5 mm) and sparse in the subgenera *Stipulariopsis* and *Stipularia*, and in most species of subg. *Sabicea*. In subg. *Anisophyllae* (except for *S. becquetii*) these trichomes are long (1–2 mm) and form a dense beard around the throat, sometimes extending to the basal part of the lobes. However, the two Madagascan species (*S. acuminata* and *S. diversifolia*) also display a long and dense corolla throat indumentum, so this character appears to be homoplasic.

Figure 8. Evolution of indumentum corolla-throat in Sabiceeae.

Number of ovary locules (Fig. 9)—Hallé (1963) considered the number of ovary locules as an useful character to separate *Ecpoma* and *Pseudosabicea* (2-locular) from *Sabicea* (5-locular), while Wernham (1914) judged this character as quantitative, and therefore of little taxonomic significance. In subg. *Sabicea*, most species are 5-locular, however, the former *Pseudosabicea*

species nested in *Sabicea* and also one new species from Gabon (*Sabicea sp*.-OL1446) are bilocular, and so are the members of subg. *Stipulariopsis* and subg. *Anisophyllae*. Therefore, this character seems to be homoplasic.

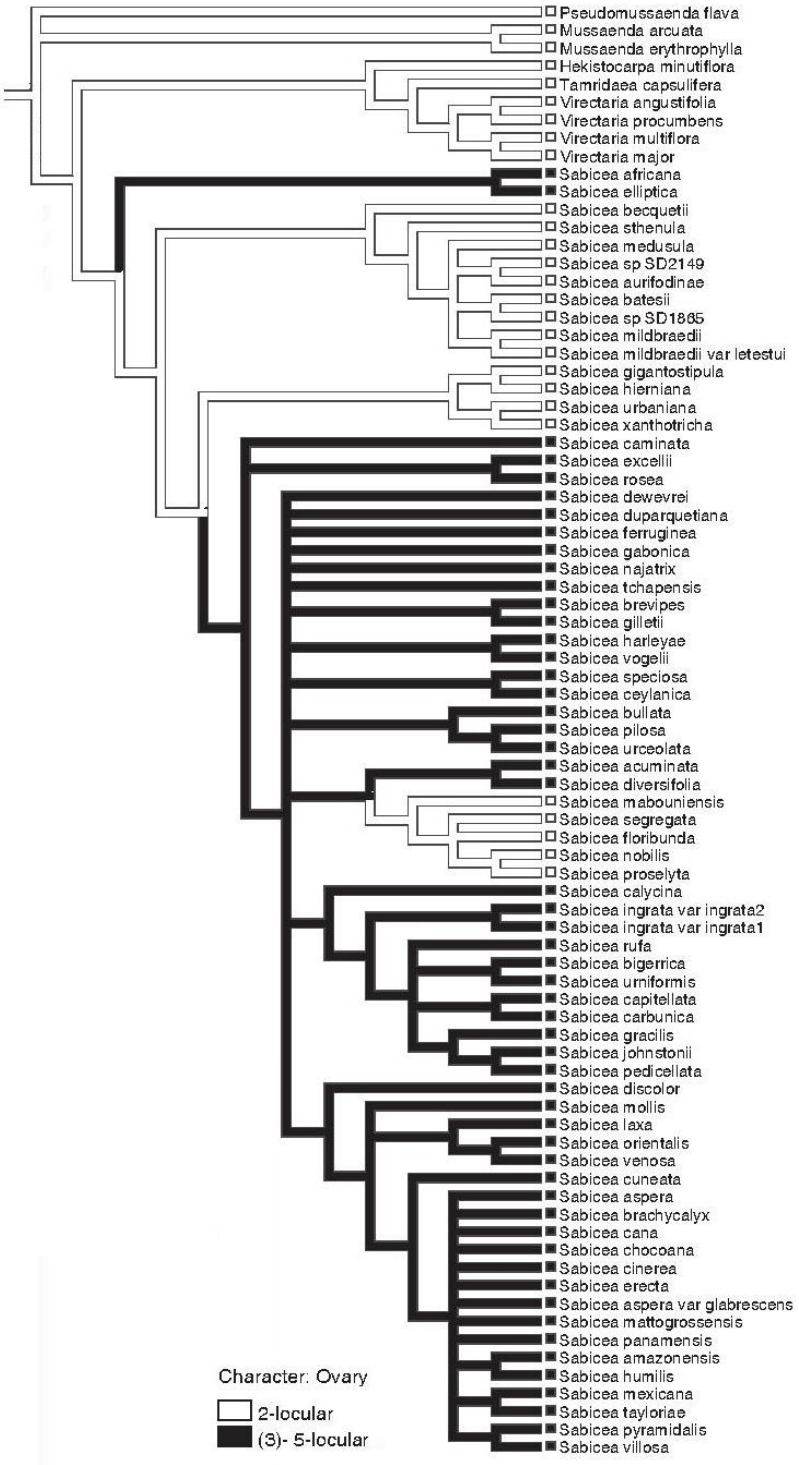

Figure 9. Evolution of ovary in Sabiceeae.

NEW SUBGENERIC CLASSIFICATION FOR *SABICEA S.L.*

The synonymization of *Ecpoma, Pseudosabicea* and *Stipularia* under *Sabicea* as proposed by Khan *et al.* (2008a) is accepted in the present study. However, Khan *et al.* (2008a) did not propose a new subgeneric classification for *Sabicea s.l.*, indicating that a better sampling was needed for taxa previously placed in *Ecpoma*, *Pseudosabicea*, and *Stipularia*. With the sampling currently presented, several moderately to well-supported clades can be identified within *Sabicea s.l.*, allowing us to propose a new subgeneric classification (see key to the subgenera). We choosed to use subgenera instead of sections as four well supported lineages were found within *Sabicea s.l.*.Moreover, although, additional studies are needed to delimitate monophyletic groups within *Sabicea* sensu Hallé, some previous sections could be clearly found within this latter (sections. *Floribundae, Laxae, Sphaericae*).

The first clade branching off consists of *S. africana* and *S. elliptica* and is highly supported. This clade is characterised by the erect habit, and the peculiar urceolate involucre surrounding the inflorescences. On account of the latter character, both species were previously referred to the separate genus *Stipularia* (Palisot-Beauvois 1807; Hallé 1963, 1966). Since the clade is sister to the rest of *Sabicea s.l.*, the generic status of *Stipularia* could be retained. However, since none of its diagnostic characters is synapomorphic (the erect habit also occurs in subg. *Stipulariopsis*, and the urceolate involucre in *S. urceolata*), we agree with Hepper (1958) and Khan *et al.* (2008a) to include *Stipularia* in *Sabicea*.

A second well-supported lineage within *Sabicea s.l.* corresponds to *Pseudosabicea* sect. *Anisophyllae* (Hallé, 1963). This group is well supported and comprises six described species and one variety (Table 4), as well as two still undescribed taxa (*S. sp.*-SD1865, *S. sp.*-SD2149). Hallé (1963) characterized section *Anisophyllae* by anisophyllous nodes combined with sessile inflorescences. However, both characters are also found in the two Madagascan species of subg. *Sabicea*, which differ by their 5-locular ovaries. The present study shows that this clade lacks a unique synapomorphy and that it can only be circumscribed by a combination of characters, i.e. bilocular ovaries, and inflorescences constantly unbranched and sessile. Species of this group also usually show strong anisophylly and long trichomes in the corolla-throat. However, *Sabicea becquetii* (and *S. arborea*, not sequenced here and morphologically similar) are aberrant in having leaves equal or only slightly unequal and a corolla throat with short trichomes. A case could be made for placing them in a separate

subgenus (especially if we consider the basal position of *S. becquetii* in the group), but due to lack of sequence data for *S. arborea*, we refrain from doing so at this moment (Table 4).

Table 4. Subgeneric composition and name changes in *Sabicea*. An asterisk (*) denotes species included in the present study. Type species are marked in bold.

Pseudosabicea **sect. *Anisophyllae* N.Hallé**	***Sabicea*** **subg. *Anisophyllae* (N.Hallé) Zemagho, Sonké, Dessein & Liede**
Pseudosabicea arborea (K.Schum.) N.Hallé	*Sabicea arborea* K.Schum.
*Pseudosabicea aurifodinae** N.Hallé	*Sabicea aurifodinae* (N.Hallé) Razafim., B.Bremer, Liede & Saleh A.Khan
*Pseudosabicea batesii** (Wernham) N.Hallé	*Sabicea batesii* Wernham
*Pseudosabicea becquetii** N.Hallé	*Sabicea becquetii* (N.Hallé) Razafim., B.Bremer, Liede & Saleh A.Khan
*Pseudosabicea medusula** (K.Schum. ex Wernham) N.Hallé	*Sabicea medusula* (K.Schum) Wernham
*Pseudosabicea mildbraedii** (Wernham) N.Hallé	*Sabicea mildbraedii* Wernham
*Pseudosabicea sthenula** N. Hallé	*Sabicea sthenula* (N.Hallé) Razafim., B.Bremer, Liede & Saleh A.Khan
Ecpoma **K.Schum.**	***Sabicea*** **subg. *Stipulariopsis* Wernham**
Ecpoma apocynaceum K. Schum.	*Sabicea apocynacea* (K.Schum.) Razafim., B.Bremer, Liede & Saleh A.Khan
Ecpoma cauliflorum (Hiern) N.Hallé	*Sabicea cauliflora* Hiern
Ecpoma geanthum (Hiern) N.Hallé	*Sabicea geantha* Hiern
*Ecpoma gigantostipulum** (K. Schum.) N.Hallé	*Sabicea gigantostipula* K.Schum.
*Ecpoma hiernianum** (Wernham) N.Hallé & F.Hallé	*Sabicea hierniana* Wernham
Sabicea subgen. Stipulariopsis **Wernham**	
*Sabicea urbaniana** Wernham	*Sabicea urbaniana* Wernham
*Sabicea xanthotricha** Wernham	*Sabicea xanthotricha* Wernham
Stipularia **P. Beauv.**	***Sabicea*** **subg. *Stipularia* (P.Beauv.) Zemagho, Sonké, Dessein & Liede**
Stipularia africana* P.Beauv.	*Sabicea africana* (P. Beauv.) Hepper
*Stipularia elliptica** Schweinf. ex Hiern	*Sabicea elliptica* (Schweinf. ex Hiern) Hepper
Stipularia mollis Wernham	*Sabicea lanata* Hepper
Sabicea **Aublet**	***Sabicea*** **subg. *Sabicea***
43 spp. New World	43 spp. New World
ca. 75 spp. Old World	ca. 75 spp. Old World
Schizostigma **Arn. ex Meisn.**	

*Schizostigma hirsutum** Arn. ex Meisn.	*Sabicea ceylanica* Puff
***Pseudosabicea* N. Hallé sect. *Sphaericae* N.Hallé**	
*Pseudosabicea nobilis** (R.D.Good) N.Hallé	*Sabicea nobilis* R.D. Good
***Pseudosabicea* N. Hallé sect. *Floribundae* Wernh. ex. N.Hallé**	
*Pseudosabicea floribunda** (K. Schum.) N.Hallé	*Sabicea floribunda* K.Schum.
*Pseudosabicea proselyta** N.Hallé	*Sabicea proselyta* (N. Hallé) Razafim., B. Bremer, Liede & Saleh A.Khan
Pseudosabicea sanguinosa N.Hallé	*Sabicea sanguinosa* (N.Hallé) Razafim., B.Bremer, Liede & Saleh A.Khan
*Pseudosabicea segregata** (Hiern) N.Hallé	*Sabicea segregata* Hiern

A third moderately well-supported lineage within *Sabicea s.l.* groups the former *Ecpoma* species (*E. gigantostipulum* and *E. hiernianum*) together with *Sabicea urbaniana* and *S. xanthotricha*. The latter two species were not included in *Ecpoma* by Hallé (1963) presumably because he had not seen the material. This clade is mophologically homogeneous and can be characterized by the erect habit, bilocular ovaries, and unbranched sessile inflorescences with free (and usually small) bracts. It could be retained as a genus, but this would render *Sabicea* paraphyletic, unless subg. *Anisophyllae* is also elevated to generic level. This group largely corresponds with Wernham's (1914) subgenus *Stipulariopsis*, so this subgenus is here reinstated. Two aberrant species placed in this subgenus by Wernham have already been excluded from *Sabicea*: *S. bicarpellata* K.Schum. is a *Bertiera* (Hallé, 1970), while the Neotropical *S. umbrosa* Wernh. is now placed in *Amphidasya* (Standley, 1936). Following Art. 11 of the International Code of Botanical Nomenclature, the name *Stipulariopsis* has priority over *Ecpoma* at the infrageneric rank, because the latter was described as a genus.

The fourth clade comprises all species of *Sabicea s.str.*, plus *Schizostigma, Pseudosabicea* sect. *Floribundae,* and *Sabicea nobilis* (the type species of the genus *Pseudosabicea* and of sect. *Sphaericae*). Despite the generally low resolution, the three latter groups are deeply and unambiguously nested in this clade (Table 4). Therefore, we propose to recognize this large group as *Sabicea* subg. *Sabicea*. This name is choosed instead of subg. *Eusabicea* to respect the rule of priority of the International Code of Botanical Nomenclature. It comprises approximately 75 species in the Old World and 43 species in the New World (Khan, 2007). With the deeper nodes unresolved or only weakly supported, the relationships

within this subgenus remain unclear and will be subject of further phylogenetic studies including more taxa and/or characters.

TAXONOMIC TREATMENT

TRIBE SABICEEAE Bremek., Rec. Trav. Bot. Neerl. 31: 253 (1934), emend. L. Andersson (1996: 157). Type: *Sabicea* Aubl.
Virectarieae Verdc., Kew Bull. 30: 366 (1975). Type: *Virectaria* Bremek.

Plants annual or perennial, herbaceous to woody, erect to variously climbing or creeping. Raphides absent. Stipules persistent, interpetiolar, sometimes ± extensively fused to petiole, entire to ± deeply laciniate. Inflorescences axillary or terminal, branched or not, sessile or pedunculate. Flowers (4-)5-(-6) merous, heterostylous or homostylous. Corolla tube cylindrical to narrowly funnel-shaped, 3–35 mm long, ± villose inside; lobes reduplicate or truly valvate, glabrous to villose inside. Ovary 2–5-locular. Placentas elliptic or oblong, rarely cordate, attached throughout their length or rarely peltate (and then the stipe usually attached above middle), each with numerous ovules. Fruits fleshy and indehiscent, dry and indehiscent or capsular with two valves. Seeds numerous, angular; exotesta cells without secondary thickening in outer tangential wall, radial walls distinctly thickened, at least in lower part, inner tangential wall with distinct secondary thickening in the shape of bands or an even sheet perforated by minute pores. Pollen grains 3–4-colporate or 3–4 (5)-pororate

KEY TO THE GENERA OF THE TRIBE SABICEEAE

1. Inflorescences terminal; ovary 2-locular; fruits dry, capsular and 2-valved.....2

– Inflorescences axillary; ovary 2- to 5-locular; fruits dry or fleshy, indehiscent or tardily splitting into 2 mericarps 3

2. Capsules with two valves remaining attached to the pedicel; corolla tube much longer than lobes, the latter unequally 3-lobed at apex; corolla aestivation reduplicate valvate; anthers included; style with two filiform lobes..... *Tamridaea*

– Capsules with one valve caducous and the other remaining attached to the pedicel; corolla tube not or only slightly longer than lobes, the latter entire; corolla aestivation valvate, anthers long-exserted; style linear, without stigmatic branches ..... *Virectaria*

3. Fruits dry, indehiscent or tardily splitting into 2 mericarps; inflorescence scorpioid; corolla aestivation reduplicate valvate .....*Hekistocarpa*

– Fruits fleshy, indehiscent; inflorescence not scorpioid; corolla aestivation truly valvate .....*Sabicea*

DIVERSITY AND GEOGRAPHICAL DISTRIBUTION OF THE TRIBE SABICEEAE

The tribe Sabiceeae is most diverse in Tropical Africa and presumably has its origin there. The genera *Hekistocarpa* and *Virectaria* are both African endemics. *Virectaria* is essentially Guineo-Congolian with penetration in Zambezian region, and has its centre of diversity in the Lower Guinea subcentre of endemism (Dessein *et al.*, 2001b; phytochoria according to White 1979). *Hekistocarpa* is a monospecific genus with a limited distribution in Lower Guinea, from Nigeria to northern Congo-Brazzaville. The monospecific *Tamridaea* is endemic to Socotra island. Only *Sabicea*, by far the largest genus, has a broad distribution across the tropics, with its main center of diversity in tropical Africa (especially Lower Guinea) and an important secondary centre in tropical America; it also includes a few representatives in Madagascar and a single species in Sri Lanka.

DESCRIPTION OF *SABICEA* Aubl.

Sabicea Aubl. Hist. Pl. Guiane Francoise 1: 192, t. 75. Jun-Dec 1775 – Lectotype: *S. cinerea* Aubl., designated by Standley (1921: 148).
≡ *Schwenkfelda* Schreb. (Gen. Pl. 1: 123. 1789) ≡ *Schwenkfeldia* Willd. (Sp. Pl. 4 [post Reichardianum quinta]: 982. 1798) – Illegitimate replacement name for *Sabicea*.

Plants perennial, woody or, more rarely, herbaceous, usually lianescent, more rarely erect or creeping, sometimes anisophyllous. Stipules persistent, interpetiolar, free or rarely connate with
the petioles at base, entire to deeply laciniate. Inflorescences axillary, branched or not, sessile to
pedunculate. Bracts conspicuous or not, often surrounding the inflorescence, free to shortly

connate, or rarely connate for most of their length. Flowers (4-)5(-6)-merous, heterostylous. Calyx campanulate to infundibuliform, usually green, lobes antrorse to reflexed, usually lanceolate, subulate to subulate-setaceous or setaceous. Corolla white to pale green or occasionally bright red; tube cylindrical or narrowly infundibuliform, 3–22 mm long, villose inside in the upper part; lobes valvate, • } triangular, (sub-) acute at apex, glabrous to villose inside. Stamens ([4–]5[–10]) per flower, included to fully exserted; anthers dorsifixed near the middle by very short free part of filament, linear to narrowly oblong, acute to rounded at base and
apex. Pollen grains colporate to pororate, apertures 3 or 4, exine surface minutely reticulate, released as monads. Style glabrous, included or exserted, divided into 2–5 linear to broadly spathulate stigmatic lobes. Ovary 2- to 5-locular with axile placentation and numerous ovules per
locule. Fruits fleshy, indehiscent and bacciform, white, red, purple or black when mature, globose
to ellipsoid or more rarely fusiform. Seeds numerous and very small, variously angular, usually
with parallel striations or more rarely reticulate; exotesta cells variable in shape, with few to many rounded pits, radial wall with verrucose thickenings.

Number of species: c. 150 species (c. 96 confined to the African mainland, 43 to the Neotropics,
six to Madagascar, three to Sao Tome and Principe, and one to Sri Lanka).

KEY TO THE SUBGENERA OF *SABICEA*

1. Erect herbs or shrubs 2

– Plants twining, creeping or sarmentose (never erect).....3

2. Outer bracts fused into an urn-shaped involucre; ovary 3- to 5-locular; calyx lobes shorter than tube or at most equalling it; leaves strongly discolorous with dense felt of whitish trichomes beneath ..... Subg. *Stipularia*

– All bracts free, usually small; ovary 2-locular; calyx lobes much longer than tube; leaves green on both sides ..... Subg. *Stipulariopsis*

3. Ovary 5-locular; plants usually twining, rarely creeping or sarmentose.....Subg. *Sabicea*

– Ovary 2-locular; plants sarmentose or creeping, never twining.....4

4. Inflorescences sessile, unbranched; corolla-throat with long trichomes (except *S. becquetii*); leaves usually anisophyllous ..... Subg. *Anisophyllae*

– Inflorescences pedunculate (sessile in flowering stage in *S. nobilis*), usually branched; corolla-throat with short trichomes; leaves usually not anisophyllous .....Subg. *Sabicea*

DESCRIPTION OF THE SUBGENERA

1. *SABICEA* AUBL. SUBG. ***SABICEA***

= *Paiva* Vell., Fl. Flum.: 104. 7 Sep-28 Nov 1829 (‘1825’) – Type: *P. verticillata* Vell. (= Sabicea villosa Willd. ex Schult.).

= *Pseudosabicea* N.Hallé, Adansonia ser 2, 3: 170. 1963 – Type: *P. mitisphaera* N.Hallé (= *Sabicea nobilis* R.Good).

= *Pseudosabicea* sect. *Floribundae* N.Hallé, syn. nov. (1963: 172) – Type: *Pseudosabicea floribunda* (K.Schum.) N.Halle (≡ *Sabicea floribunda* K.Schum.).

= Pseudosabicea sect. Sphaericae N.Halle(1963: 170) – Type: *Pseudosabicea mitisphaera* N.Hallé (= *Sabicea nobilis* R.D.Good), nom. illeg. acc. to ICBN, Art. 22.2.

= Schizostigma Arn. ex Meisn., Pl. Vasc. Gen. 1: 164; 2: 115. 1838 – Type: *S. hirsutum* Arn. ex
Meisn. (≡ Sabicea ceylanica Puff).

Lianas, usually twining, sometimes creeping or sarmentose. Stipules interpetiolar, persistent, erect to reflexed, usually entire (but multifid in Madagascan species). Nodes with two opposite
leaves, leaf blades usually equal in size (sometimes strongly unequal), symmetrical to markedly
asymmetrical at base, discolorous or not. Inflorescences axillary, 1-2 per node, branched or not,
sessile or pedunculate, 1- to many-flowered. Bracts surrounding the inflorescence or not, usually
free, sometimes shortly connate at base (rarely connate for most of the length forming an involucre splitting laterally at fruiting stage in S. urceolata). Corolla with tube 5–25 (30) mm; corolla throat inside with short multicellular trichomes (long in Madagascan species). Ovary 2–5
locular.

2. *SABICEA* AUBL. SUBG. ***ANISOPHYLLAE*** ZEMAGHO, SONKÉ, DESSEIN & LIEDE **COMB. & STAT. NOV**

Pseudosabicea sect. *Anisophyllae* N.Halle, Adansonia, ser. 2,3: 170 (1963). – Lectotype (designated here): *Sabicea mildbraedii* Wernham

Sarmentose shrubs or creeping herbs. Stipules interpetiolar, persistent, erect to reflexed, usually shortly connate to the base of the petioles, entire to multifid. Nodes usually with 2 strongly unequal leaves, or sometimes with a single leaf opposed to a stipule; rarely with 2 subequal leaves. Leaf blades usually asymmetric at base, strongly discolorous, the lower side covered with a dense felt of white to buff woolly trichomes. Inflorescences axillary, sessile, unbranched, usually many-flowered, one or two per node, on leafy or leafless stems. Bracts and bracteoles free and usually small, not enclosing the inflorescence, sometimes enclosing the flowers when young. Corolla with tube 3–11 mm long, throat usually densely pubescent with long multicellular trichomes sometimes extending up to the base of the corolla lobes (trichomes shorter in *S. becquetii*). Ovary 2-locular.

Notes: Hallé (1963) did not choose a type species for *Pseudosabicea* sect. *Anisophyllae* among the three species he originally placed in that section (*S. batesii, S. medusula, S. mildbraedii*). The latter species is here chosen as lectotype since it is the most widespread, and its characters are well representative of the group.

3. *SABICEA* AUBL. SUBG. *STIPULARIA* (P.BEAUV.) ZEMAGHO, SONKE,

DESSEIN & LIEDE COMB. & STAT. NOV.

= Stipularia P.Beauv., Fl. Owar. 2: 26. 1807 – Type: S. africana P.Beauv. (≡ Sabicea africana (P.

Beauv.) Hepper).

Erect shrubs, usually branched at base. Stipules interpetiolar, persistent, erect, entire. Nodes with two opposite leaves, leaf blades equal in size, symmetrical at base, strongly discolorous

(the lower side covered with a dense felt of white to buff woolly trichomes). Inflorescences axillary, sessile or subsessile, 1–2 per node, unbranched, and many-flowered. Involucre deeply urceolate and surrounding the inflorescence, reddish, formed by the fusion of 2–4 bracts, remaining intact or splitting in the fruiting stage. Corolla tube 25–30 mm long; corolla throat with short multicellular trichomes. Ovary 3–5 locular.

4. ***SABICEA*** AUBL. SUBG. ***STIPULARIOPSIS*** WERNHAM (1914: 27).

Lectotype (designated here): Sabicea hierniana Wernham (1914: 29).

Ecpoma K.Schum., Bot Jahrb. Syst. 23; 430 (1896), syn. nov. – Type: E. apocynaceum

K.Schum. (1896: 430).Erect shrubs or herbs, usually single-stemmed or more rarely ramose. Stipules interpetiolar, persistent, erect, entire. Nodes with two opposite leaves, leaf blades equal in size, symmetrical at base, green on both sides. Inflorescence axillary, 2 per node, sessile, unbranched, usually many-flowered. Bracts usually small, rarely (*S. gigantostipula*) two large free bracts surrounding the inflorescence and resembling stipules. Corolla tube 15–20 mm long; corolla throat with short multicellular trichomes. Ovary 2-locular.

Notes: Wernham (1914) did not choose a type species for subgen. *Stipulariopsis*. *Sabicea hierniana* is here chosen as lectotype, since it is the most widespread species and its characters are well representative of the group.

CONCLUSION

Based on nrITS and three chloroplasts markers (*petD, rps16* and *trnT-F*), the tribe Sabiceeae is revisited and found to comprise four genera: *Hekistocarpa*, *Sabicea*, *Tamridaea* and *Virectaria*. Our results show that *Hekistocarpa-Tamridaea-Virectaria* is sister to *Sabicea s.l.* and that therefore, re-establishment of Virectariae for the dry-fruited genera in contrast to Sabiceeae comprising taxa with fleshy fruits could be a valid option.

In *Sabicea s.l.*, a subgeneric concept is considered the best option to reflect the polymorphism of the group, resulting in four new subgenera: *Sabicea* subg. *Stipularia* (corresponding to the former genus *Stipularia*), *S.* subg. *Stipulariopsis* (including all former *Ecpoma* species, *S.*

urbaniana and *S. xanthotricha*), *S.* subg. *Anisophyllae* (previously *Pseudosabicea* sect. *Anisophyllae*) and the large *Sabicea* subg. *Sabicea* (including all the remaining species). The larger species number of *S.* subg. *Sabicea* and the other three subgenera raise the question as to the character combination in *S*. subg. *Sabicea* promoting diversification and, ultimately, dispersal both Asia and the Americas.

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APPENDICES

Appendix 1. Morphological characters used for optimisation

Characters and characters states

1 -Growth habit: erect (0) creeping (1) twining (2) sarmentose (3)

2- Anisophylly: leaves equal to subequal (0), leaves strongly unequal (1)

3- Stipule size: less than 15 mm high (0) more than 16 mm (1)

4- Stipule type: entire to bidentate (0), multifid (1)

5- Bracts: free to shortly connate (0), fused and urceolate, splitting in fruiting stage (1), fused and urceolate, not splitting in fruiting stage (2)

6- Inflorescence type: branched (0), unbranched and sessile (1), unbranched and pedunculate (2)

7- Calyx-lobes length: shorter than 3 mm long (0) between 4-9 mm long (1) longer than 13 mm long (2)

8- Corolla-throat indumentum: short trichomes (0) long trichomes (1)

9-Ovary: 2-locular (0), (3-) 5-locular (1)

10- Pedicels length in fruit: sessile (0) between 0.5-4 mm (1) more than 5 mm (2)

11-Fruit-color: white (0), purple to black (1), red (2), yellow (3), fruits dry and brown (4)

Appendix 2. Morphological matrix for Sabiceeae and out-groups

	Taxa\characters	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	*Mussaenda arcuata*	2	0	0	0	0	0	0	0	0	?	3
2	*Mussaenda erythrophylla*	2	0	0	0	0	0	1&2	0	0	?	3
3	*Pseudomussaenda flava*	2	0	0	0	0	0	0&1	0	0	0	4
4	*Hekistocarpa minutiflora*	0	0	0	0	0	0	0	0	0	0	4
5	*Sabicea acuminata*	3	1	0	1	0	1	1	1	1	0	0
6	*Sabicea africana*	0	0	1	0	2	1	0	0	1	0	2
7	*Sabicea amazonensis*	2	0	0	0	0	1&2	1	0	1	0	2
8	*Sabicea aspera*	2	0	0	0	0	1&2	0	0	1	1	1
9	*Sabicea aspera var. glabrescens*	2	0	0	0	0	1	0	0	1	1	1
10	*Sabicea aurifodinae*	3	1	0&1	0	0	1	0&1	1	0	0	?
11	*Sabicea batesii*	3	1	0&1	0	0	1	0	1	0	0	?
12	*Sabicea becquetii*	3	0	0	0	0	1	1	0	0	0	2
13	*Sabicea bigerrica*	2	0	0	0	0	2	1	0	1	2	0
14	*Sabicea brevipes*	2	0	0	0	0	2	2	0	1	0	2
15	*Sabicea bullata*	2	0	0	0	0	1	1	0	1	0	2
16	*Sabicea calycina*	2	0	0	0	0	2	2	0	1	2	1
17	*Sabicea caminata*	2	0	0	0	0	2	0	0	1	0	0
18	*Sabicea cana*	2	0	0	0	0	1&2	0	0	1	1	1
19	*Sabicea capitellata*	2	0	0	0	0	2	0&1	0	1	0	0
20	*Sabicea carbunica*	2	0	0	0	0	2	0	0	1	0	2
21	*Sabicea ceylanica*	1	0	0	0	0	1	1	0	1	2	0
22	*Sabicea chocoana*	2	0	0	0	0	0	0	0	1	1&2	1
23	*Sabicea cinerea*	2	0	0	0	0	1	1	0	1	0	2
24	*Sabicea cuneata*	2	0	0	0	0	0	1	0	1	1&2	?
25	*Sabicea dewevrei*	2	0	0&1	0	0	2	0	0	1	0	2
26	*Sabicea discolor*	2	0	0	0	0	0	0	0	1	2	0
27	*Sabicea diversifolia*	3	1	0	1	0	1	1	1	1	0	2
28	*Sabicea duparquetiana*	2	0	0	0	0	2	1&2	0	1	0	2
29	*Sabicea elliptica*	0	0	0&1	0	1	1&2	0	0	1	0	2
30	*Sabicea erecta*	2	0	0	0	0	0	1	0	1	1	?
31	*Sabicea exellii*	2	0	0	0	0	1	0	0	1	1	1
32	*Sabicea ferruginea*	2	0	1	0	0	1&2	2	0	1	2	2
33	*Sabicea floribunda*	3	0	0	0	0	0	0	0	0	1	0

34	*Sabicea gabonica*	2	0	0	0	0	2	2	0	1	1	2
35	*Sabicea gigantostipula*	0	0	1	0	0	1	2	0	0	1	1
36	*Sabicea gilletii*	2	0	0	0	0	1&2	2	0	1	1	2
37	*Sabicea gracilis*	2	0	0	0	0	2	1	0	1	2	0
38	*Sabicea harleyae*	2	0	0	0	0	2	2	0	1	2	2
39	*Sabicea hierniana*	0	0	1	0	0	1	1&2	0	0	1	1
40	*Sabicea humilis*	2	0	0	0	0	2	1	0	1	1	?
41	*Sabicea ingrata var. ingrata1*	2	0	0	0	0	2	1	0	1	0	0
42	*Sabicea ingrata var. ingrata2*	2	0	0	0	0	2	1	0	1	0	0
43	*Sabicea johnstonii*	2	0	0	0	0	2	1	0	1	2	0
44	*Sabicea laxa*	2	0	0	0	0	0	0	0	1	1	0
45	*Sabicea mattogrossensis*	2	0	0	0	0	2	2	0	1	2	1
46	*Sabicea medusula*	1	1	0	0	0	1	1	1	0	0	2
47	*Sabicea mexicana*	2	0	0	0	0	0	1	0	1	2	1
48	*Sabicea mildbraedii*	1	1	0	1	0	1	0	1	0	0	2
49	*Sabicea mildbraedii var. letestui*	1	1	0	1	0	1	0	1	0	0	?
50	*Sabicea mollis*	2	0	0	0	0	0	0&1	0	1	1	0
51	*Sabicea najatrix*	2	0	0	0	0	2	1	0	1	0	2
52	*Sabicea nobilis*	3	0	1	0	0	1&2	0	0	0	1	0
53	*Sabicea orientalis*	2	0	0	0	0	0	1	0	1	1	0
54	*Sabicea panamensis*	2	0	0	0	0	0	1	0	1	2	2
55	*Sabicea parva var. brachycalyx*	2	0	0	0	0	0	0	0	1	0	2
56	*Sabicea pedicellata*	2	0	0	0	0	2	0	0	1	2	0
57	*Sabicea pilosa*	2	0	0	0	0	2	2	0	1	0	2
58	*Sabicea proselyta*	3	0	0	0	0	0	0	0	0	1	0
59	*Sabicea pyramidalis*	2	0	0	0	0	0	0	0	1	2	1
60	*Sabicea rosea*	2	0	0	0	0	1	1	0	1	1	2
61	*Sabicea rufa*	2	0	0	0	0	2	0	0	1	0	0
62	*Sabicea segregata*	3	0	0	0	0	0	1	0	0	1	1
63	*Sabicea speciosa*	2	0	0	0	0	2	2	0	1	1	2
64	*Sabicea sthenula*	1	1	0	1	0	1	1	1	0	0	?
65	*Sabicea tayloriae*	2	0	0	0	0	1&2	1	0	1	0	1
66	*Sabicea tchapensis*	2	0	0	0	0	2	2	0	1	1	2
67	*Sabicea urbaniana*	0	0	1	0	0	1	2	0	0	1	?
68	*Sabicea urceolata*	2	0	0	0	1	1	0	0	1	0	2
69	*Sabicea urniformis*	2	0	0	0	1	1&2	1	0	1	0	0
70	*Sabicea venosa*	2	0	0	0	0	0	1	0	1	1	0

71	*Sabicea villosa*	2	0	0	0	0	0	1	0	1	1	1
72	*Sabicea vogelii*	2	0	0	0	0	2	2	0	1	2	2
73	*Sabicea xanthotricha*	0	0	1	0	0	1	2	0	0	1	?
74	*Sabicea sp.nov.-SD1865*	1	1	0&1	1	0	1	1	1	0	0	?
75	*Sabicea sp.nov-SD2149*	3	1	0	0	0	1	1	1	0	0	?
76	*Sabicea sp.nov-OL1446*	1	1	0&1	0	0	0	1	0	0	1	?
77	*Tamridaea capsulifera*	0	0	0	0	0	0	1	0	0	2	4
78	*Virectaria angustifolia*	0	0	0	0	0	0	0	0	0	1	4
79	*Virectaria major*	0	0	0	0	0	0	1	0	0	0	4
80	*Virectaria multiflora*	0	0	0	0	0	0	0&1	0	0	0	4
81	*Virectaria procumbens*	0	0	0	0	0	0&1	0	0	0	1	4

Appendix 3. Species, vouchers and GenBank accession numbers

Species	**Voucher**	**Country**	**ITS**	**petD**	**rps16**	**trnT-F region**
Outgroup						
Mussaenda arcuata Poir	*Bremer 3080* (UPS)	Tanzania	AJ846860	– – –	FM204721	AJ847380
Mussaenda erythrophylla Schum. & Thonn.	*Alejandro 129* (USTH)	Philippines	AJ846858	– – –	FJ884628	AJ847372
Pseudomussaenda flava Verdc.	*Bidgood 8030* (BR)	Ethiopia	AJ846877	JQ958026	FM204729	AJ847385
Hekistocarpa						
H. minutiflora Hook.f.	*Sonke 5603* (BR)	Cameroon	LN878254	LN878092	LN878213	LN878285
Sabicea* subgen. *Anisophyllae						
Sabicea aurifodinae (N.Hallé) Razafim., B.Bremer, Liede & Saleh A.Khan	*Wieringa 5026* (WAG)	Gabon	AM409046	LN878025	LN878150	AM409162
Sabicea batesii Wernh.	*Valkenburg 2569*	Gabon	AM409048	LN878026	LN878151	AM409139

Species	**Voucher**	**Country**	**ITS**	**petD**	**rps16**	**trnT-F region**
	(WAG)					
Sabicea becquetii (N.Hallé) Razafim., B.Bremer, Liede & Saleh A.Khan	*Reekmans 11116* (K)	Burundi	AM409050	LN878027	LN878152	AM409138
Sabicea medusula K. Schum. ex Wernh.	*Van Andel 3555* (WAG)	Cameroon	AM409047	LN878028	LN878153	AM409163
Sabicea mildbraedii var. *letestui* N.Hallé	*Dessein 1909* (BR)	Gabon	LN878219	LN878029	LN878154	LN878257
Sabicea mildbraedii Wernh.	*Wieringa 5032* (BR)	Gabon	AM409051	LN878030	LN878155	AM409137
Sabicea sp.nov1	*Dessein 2149* (BR)	Gabon	LN878220	LN878031	LN878156	LN878258
Sabicea sp.nov2	*Dessein 1865* (BR)	Gabon	LN878221	LN878032	LN878157	LN878259
Sabicea sthenula (N.Hallé) Razafim., B.Bremer, Liede & Saleh A.Khan	*Dessein 18294* (BR)	Gabon	LN878222	LN878033	LN878158	LN878260
Sabicea* subgen. *Sabicea						
Sabicea acuminata Baker	*Luckow 4448* (BR)	Madagascar	LN878255	LN878034	LN878159	LN878261
Sabicea amazonensis Wernh.	*Campbell P22037* (MO)	Brazil	AM409007	– – –	– – –	AM409157
Sabicea aspera Aubl.	*Andersson 2003* (NY)	French Guiana	AM409008	LN878035	– – –	AM409143
Sabicea aspera var. *glabrescens*	*Gillespie 825* (NY)	Guyana	AM409024	– – –	– – –	AM409147
Sabicea bigerrica N.Hallé	*Dessein 2498* (BR)	Gabon	LN878223	LN878036	LN878160	– – –
Sabicea brevipes Wernh.	*Jongkind 2793*	Ghana	AM409178	LN878094	LN878216	AM409178

Species	**Voucher**	**Country**	**ITS**	**petD**	**rps16**	**trnT-F region**
	*(*WAG)					
Sabicea bullata Zemagho, O.Lachenaud & Sonké	*Dessein 2572* (BR)	Cameroon	LN878224	LN878037	LN878161	LN878262
Sabicea calycina Benth.	*Dessein 3147* (BR)	Cameroon	LN878225	LN878038	LN878162	LN878263
Sabicea caminata N.Hallé	*De Wilde 10311* *(*WAG)	Gabon	AM409010	LN878039	– – –	AM409118
Sabicea capitellata Benth.	*Carvalho 3201* (BR)	Cameroon	LN878226	LN878040	LN878163	LN878264
Sabicea carbunica N.Hallé	*Wieringa 5151* (UPS)	Gabon	LN878227	LN878041	LN878164	– – –
Sabicea ceylanica Puff.	*Iwarsson 576* (UPS)	Sri Lanka	AM409057	LN878093	LN878214	AM409168
Sabicea chocoana C.M. Taylor	*Delprete 6342* (NY)	Colombia	AM409013	LN878042	LN878165	AM409144
Sabicea cinerea Aubl.	*Andersson 1903* (MO)	French Guinea	AM409014	– – –	– – –	AM409120
Sabicea cuneata Rusby	*Solomon 17654* (NY)	Bolivia	LN878228	LN878043	LN878166	– – –
Sabicea dewevrei De Wild. & T.Durand	*Lemaire 1393* (BR)	Republic of the Congo	AM409016	LN878095	LN878215	AM409121
Sabicea discolor Stapf	*Jongkind 4880* *(*WAG)	Cote d'Ivoire	AM409018	LN878044	– – –	AM409145
Sabicea diversifolia Pers.	*De Block 901* (BR)	Madagascar	LN878229	LN878045	LN878167	LN878265

Species	**Voucher**	**Country**	**ITS**	**petD**	**rps16**	**trnT-F region**
Sabicea duparquetiana Baill. ex Wernh.	*Dessein 1725* (BR)	Gabon	LN878230	LN878046	LN878168	LN878266
Sabicea erecta Rusby	*Nee 43237* (MO)	Bolivia	LN878231	LN878047	LN878169	– – –
Sabicea exellii G.Taylor	*Joffroy 188* (BRLU)	Sao Tome and Principe	AM409020	LN878048	– – –	AM409124
Sabicea ferruginea Benth.	*Jongkind 5683* (WAG)	Liberia	AM409021	LN878049	LN878170	AM409125
Sabicea gabonica Hutch.	*Van Andel 3417* (WAG)	Cameroon	AM409019	LN878050	LN878171	AM409123
Sabicea floribunda K.Schum.	*Wieringa 5440* (WAG)	Gabon	LN878232	LN878051	LN878172	LN878267
Sabicea gilletii De Wild.	*Lejoly 82/903* (BR)	Democratic Republic of the Congo	AM409023	LN878052	LN878173	AM409154
Sabicea gracilis Wernh.	*Dessein 1418* (BR)	Cameroon	LN878233	LN878053	LN878174	– – –
Sabicea harleyae Hepper	*Jongkind 4867* (WAG)	Cote d'Ivoire	AM409025	LN878054	LN878175	AM409152
Sabicea humilis S.Moore	*Malme 2684*	Brazil	AM409026	LN878055	– – –	AM409148
Sabicea ingrata var. *ingrata*1K. Schum	*Joffroy 150* (BR)	Sao Tome and Principe	LN878234	LN878056	LN878176	LN878268
Sabicea ingrata var. *ingrata* 2 K. Schum	*Ogonovsky 10*	Sao Tome and Principe	AM409027	LN878057	LN878177	AM409149
Sabicea johnstonii K.Schum. ex Wernh.	*Boyekoli Ebale Congo 2010*	Gabon	LN878235	LN878058	LN878178	LN878269

Species	**Voucher**	**Country**	**ITS**	**petD**	**rps16**	**trnT-F region**
	Expedition 847 (BR)					
Sabicea laxa Wernh.	*Lachenaud 867* (BR)	Cameroon	LN878236	LN878059	LN878179	LN878270
Sabicea longipetiolata De Wild.	*Boyekoli Ebale Congo 2010 Expedition 640* (BR)	Gabon	LN878237	LN878060	LN878180	LN878271
Sabicea mattogrossensis Wernh.	*Beck 9986* (NY)	Bolivia	AM409029	– – –	LN878181	AM409127
Sabicea mexicana Wernh.	*Hahn 639* (NY)	Mexico	AM409030	LN878061	LN878182	AM409153
Sabicea mollis K. Schum. ex Wernh.	*Dessein 2258* (BR)	Gabon	LN878238	LN878062	LN878183	LN878272
Sabicea najatrix N. Hallé	*Wieringa 4653* (WAG)	Gabon	AM409031	LN878063	LN878184	AM409128
Sabicea nobilis (R.D.Good) Razafim., B.Bremer, Liede & Saleh A.Khan	*Wieringa 7673* (WAG)	Gabon	LN878239	LN878064	LN878185	LN878273
Sabicea orientalis Wernh.	*Mhoro 443* (UPS)	Tanzania	AM409032	LN878065	LN878186	AM409155
Sabicea panamensis Wernh.	*Harling 26896* (S)	Ecuador	AM409033	LN878066	LN878187	AM409156
Sabicea parva var. *brachycalyx*	*Beck 10056* (NY)	Bolivia	LN878240	LN878067	LN878188	– – –
Sabicea pedicellata (Wernh.) N.Hallé	*Sonké 5567* (BRLU)	Cameroon	LN878241	LN878068	LN878189	LN878274

Species	**Voucher**	**Country**	**ITS**	**petD**	**rps16**	**trnT-F region**
Sabicea pilosa Hiern	*Dessein 2814* (BR)	Gabon	LN878242	LN878069	LN878190	LN878275
Sabicea proselyta (N.Hallé) Razafim., B.Bremer, Liede & Saleh A.Khan	*Van Valkenburg 2646* (WAG)	Gabon	AM409053	LN878070	LN878191	AM409166
Sabicea pyramidalis L. Andersson	*Burnham 1455* (F)	Ecuador	AM409034	LN878071	LN878192	AM409129
Sabicea rosea Hoyle	*Jongkind 10096* (WAG)	Liberia	LN878243	LN878072	LN878193	LN878276
Sabicea rufa Wernh.	*Sonké 5082* (BR)	Cameroon	LN878244	LN878073	LN878194	– – –
Sabicea segregata Hiern	*Wieringa 5025* (WAG)	Gabon	AM409054	LN878074	LN878195	AM409164
Sabicea speciosa K.Schum.	*Van Meer 1623* (WAG)	Nigeria	AM409037	LN878075	LN878196	AM409131
Sabicea tayloriae Rusby ex. Liede, Meve & S.A.Khan	*Nee 46014* (MO)	Bolivia	– – –	LN878076	LN878197	LN878277
Sabicea tchapensis K.Krause	*Dessein 3017* (BR)	Cameroon	LN878245	LN878077	LN878198	LN878278
Sabicea urceolata Hepper	*Dessein 1803* (BR)	Gabon	LN878246	LN878078	LN878199	LN878279
Sabicea urniformis Zemagho, O.Lachenaud & Sonké	*Wieringa 5584* (WAG)	Gabon	LN878247	LN878079	LN878200	LN878280
Sabicea venosa Benth.	*Sonke 2797* (WAG)	Central African Republic	AM409041	LN878096	LN878218	AM409134

Species	**Voucher**	**Country**	**ITS**	**petD**	**rps16**	**trnT-F region**
Sabicea villosa Willd. ex. Roem. & Schult.	*Delprete 5102* (NY)	Costa Rica	AM409042	LN878080	LN878201	AM409160
Sabicea vogelii Benth.	*Jongkind 4859* (WAG)	Cote d'Ivoire	AM409044	LN878081	LN878202	AM409136
Sabicea sp. nov3.	*Lachenaud 1446* (BRLU)	Gabon	LN878249	LN878082	LN878203	LN878286
Sabicea* subgen. *Stipularia						
Sabicea africana P. Beauv.	*Dessein 1824* (BR)	Gabon	LN878250	LN878083	LN878204	LN878281
Sabicea elliptica Schweinf. ex Hiern	*Lisowski 56663* (BR)	Congo	AM409058	LN878084	LN878205	AM409169
Sabicea* subgen. *Stipulariopsis						
Sabicea gigantostipula K.Schum.	*Dessein 1650* (BR)	Cameroon	LN878251	LN878085	LN878206	LN878282
Sabicea hierniana Wernh.	*Dessein 1955* (BR)	Gabon	LN878252	LN878086	LN878207	LN878283
Sabicea urbaniana Wernh.	*Chatrou 488* (BR)	Cameroon	LN878253	LN878087	LN878208	LN878284
Sabicea xanthotricha Wernh.	*Sonke 1082* (BR)	Cameroon	AM409045	LN878088	LN878209	AM409151
Tamridaea						
Tamridaea capsulifera	*Miller 10087* (UPS)	Yemen	AM409170	LN878089	LN878210	AM409059
Virectaria						
Virectaria angustifolia (Hiern.) Bremek.	*Lisowski 56663*	Republic of the	LN878256	LN878097	LN878217	LN878287

Species	**Voucher**	**Country**	**ITS**	**petD**	**rps16**	**trnT-F region**
	(BR)	Congo				
Virectaria multiflora (Sm.) Bremek.	*Leeuwenberg 2295* (UPS)	Cote d'Ivoire	AM409060	LN878090	LN878211	AM409171
Virectaria major (K.Schum.) Verdc	*Lejoly 2934* (BRLU)	Democratic Republic of the Congo	AM981282	– – –	– – –	AM982741
Virectaria procumbens (Sm.) Bremek.	*Adams 453* (UPS)	Liberia	AM409061	LN878091	LN878212	AM409172

Publication 2

Taxonomic revision of *Sabicea* subgenus *Anisophyllae* (Ixoroideae, Rubiaceae) from Tropical Africa, with four new species.

(submitted: Phytotaxa)

Taxonomic revision of *Sabicea* subgenus *Anisophyllae* (Ixoroideae, Rubiaceae) from Tropical Africa, with four new species

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Abstract

A taxonomic revision of *Sabicea* subgenus *Anisophyllae* (Rubiaceae), a group restricted to Eastern Nigeria, Central and East Africa, is presented here. This work, based on a study of herbarium specimens and field observations in Cameroon and Gabon, includes a survey of the morphological features of the group, a key to the species, descriptions of all the taxa, and IUCN conservation status assessments. Fifteen species are recognised, four of which are described as new (*Sabicea mapiana, S. ndjoleensis, S. parmentierae, S. sciaphilantha*), while three former varieties are raised to species rank (*S. crystallina*, *S. jacfelicis*, *S. tersifolia*) and one species previously sunk into synonymy is restored (*S. bequaertii*). Two new infraspecific taxa are also described, *Sabicea crystallina* subsp. *engongensis* and *S. sciaphilantha* subsp. *hirsuta*. The group has its center of diversity in Gabon, where 10 of the 15 species occur, three of them being endemic to the country.

Abstract (French)

Une révision taxonomique du genre *Sabicea*, sous-genre *Anisophyllae* (Rubiaceae), un groupe restreint à l'Est du Nigeria, à l'Afrique centrale et orientale, est ici présentée. Ce travail, fondé sur l'examen des spécimens d'herbier et sur des observations de terrain au Cameroun et au Gabon, comprend un aperçu des caractères morphologiques du groupe, une clé des espèces, des descriptions de tous les taxons, et des évaluations de leur statut de conservation selon les critères de l'UICN. Quinze espèces sont reconnues, dont quatre sont décrites comme nouvelles (*Sabicea mapiana, S. ndjoleensis, S. parmentierae, S. sciaphilantha*), tandis que trois variétés sont élevées au rang spécifique (*S. crystallina*, *S. jacfelicis, S. tersifolia*) et une espèce anciennement mise en synonymie est rétablie (*S. bequaertii*). Deux nouveaux taxons infraspécifiques sont également décrits, *Sabicea crystallina* subsp. *engongensis* et *S. sciaphilantha* subsp. *hirsuta*. Le centre de diversité du groupe se trouve au Gabon, où 10 des 15 espèces sont présentes, trois d'entre elles étant endémiques du pays.

Keys words: Conservation status, Guineo-Congolian Region, IUCN Red List Categories and Criteria, Lower Guinea, taxonomy, Rubiaceae, *Sabicea*, tropical African flora

Running title: Taxonomic revision of *Sabicea* subgenus *Anisophyllae* (Rubiaceae)

Introduction

The genus *Sabicea* Aublet (1775: 192) includes ca. 145 species as currently circumscribed (Govaerts *et al.* 2013). The genus belongs to the tribe Sabiceeae in the subfamily Ixoroideae (Rubiaceae), and differs from the three other genera included in this group, *Hekistocarpa* Hook.f. (1873: 1151), *Tamridaea* Thulin & B.Bremer (1998: 85) and *Virectaria* Bremek. (1952: 21), in having fleshy instead of dry fruits (Dessein *et al.* 2001a & b), with *Virectaria* been the sister group of *Sabicea* (s.l.). The genus is distributed mostly in tropical America (43 species) and tropical Africa (c. 82 species) (Khan *et al.* 2008), with a few representatives in Madagascar (6 species) (Razafimandimbison & Miller, 1999) and a single species, previously included in the monotypic genus *Schizostigma* Arn. ex. Meisn. (1838: 164), occuring in Sri Lanka (Puff *et al*. 1998). *Sabicea* species are mostly lianas, although some are creeping herbs

or small erect shrubs. They are usually found in forest edge habitats, where they are often abundant.

The delimitation of the genus has much changed over the years, particularly concerning the African representatives, which have been regarded as forming either a single genus (Hepper, 1958; Khan *et al.* 2008), or up to four different genera (Hallé 1963, Dessein *et al.* 2001a, b), namely *Sabicea*, *Stipularia* P.Beauv. (1807: 26), *Ecpoma* K.Schum. (1896: 430) and *Pseudosabicea* N.Hallé (1963: 1970). In his monograph of the genus, Wernham (1914) adopted a broad concept of *Sabicea*, recognising only *Stipularia* as a separate genus on account of its peculiar involucre (he did not mention the genus *Ecpoma*). Later, Hepper (1958) included *Stipularia* in *Sabicea*, thus recognising one genus only. In contrast, Hallé (1963) adopted a narrow delimitation of the genus, restricting *Sabicea* to twining species with 5-locular ovaries. He reinstated *Stipularia* (also with 3- to 5-locular ovaries) on account of its erect habit and particular involucre, and transferred species with 2-locular ovaries to *Ecpoma* and the new genus *Pseudosabicea* (the former erect, the latter creeping or sarmentose). Within *Pseudosabicea*, he recognised three sections: sect. *Anisophyllae* N.Hallé (1963: 170) with unequal leaves and unbranched inflorescence, sect. *Sphaericae* N.Hallé (1963: 170) with equal leaves and unbranched inflorescence, and sect. *Floribundae* N.Hallé (1963: 172) with equal leaves and ramose inflorescence. He later added several new taxa to the genus *Pseudosabicea* (Hallé 1964, 1966, 1971), amounting to a total of 13 species.

Recent phylogenetic studies within Sabiceeae (Khan *et al.* 2008; Zemagho *et al*. submitted) have shown that the generic divisions between *Sabicea* and its satellite genera are untenable, mostly because *Pseudosabicea* consists of two different lineages. One of them, which includes the type species of the genus and of sect. *Sphaericae*, as well as the members of sect. *Floribundae*, is nested in *Sabicea* s.str. The other lineage has a more basal position in the group, and includes the species of sect. *Anisophyllae*. As a result, a broad concept of *Sabicea* has been adopted, including *Ecpoma*, *Pseudosabicea*, *Stipularia*, and *Schizostigma* as synonyms (Khan *et al.* 2008).

An analysis of morphological data, combined with one nuclear ribosomal (ITS) and three plastid (*petD*, *rsp16*, *trnT-F*) markers allowed us to propose a new infrageneric classification of *Sabicea* s.l. (Zemagho *et al.* submitted). Four monophyletic groups, supported by both plastid and nuclear data, were identified and treated as subgenera: subg. *Stipularia* (corresponding to the former genus *Stipularia*); subg. *Stipulariopsis* (corresponding to the

former genus *Ecpoma*); subg. *Sabicea* (including *Sabicea* sensu Hallé, *Schizostigma*, *Pseudosabicea* sect. *Floribundae*, and the type species of *Pseudosabicea* sect. *Sphaericae*); and subg. *Anisophyllae*, which is the subject of the present revision.

Sabicea subg. *Anisophyllae* corresponds to Hallé's (1963) *Pseudosabicea* sect. *Anisophyllae*, with the addition of *S. arborea* K.Schum. (1899: 58). The latter species was placed by Hallé (1963) in *Pseudosabicea* sect. *Sphaericae*, because it has equal leaves; however, it is clearly related to *S. becquetii* (N.Hallé) Razafim., B. Bremer, Liede & Khan (Hallé 1964: 400; Khan *et al*. 2008: 14), placed in sect. *Anisophyllae* by Hallé (1964).

Species of subg. *Anisophyllae* can be recognised by the combination of the following characters: sarmentose or creeping habit (i.e. neither twining nor erect), sessile glomerulate inflorescences and bilocular ovaries (Zemagho *et al.* submitted). Other *Sabicea* species with bilocular ovaries differ either in being erect shrubs with larger stipules and corollas (subg. *Stipulariopsis*) or in having the inflorescences pedunculate (*S. floribunda*, *S. proselyta*, *S. sanguinosa*, *S. segregata* and *S. nobilis* of subg. *Sabicea*; in the last species the inflorescences may be sessile in flower but are always distinctly pedunculate in fruit).

The subg. *Anisophyllae* includes two well-distinct groups, which could perhaps be treated as separate subgenera: the *becquetii* group (including *S. arborea*, *S. becquetii*, *S. bequaertii* and *S. tersifolia*) and the *batesii* group (including the remaining species). Species of the *becquetii* group have equal to moderately unequal leaves, short and sparse hairs in the corolla throat, and reticulate seeds, while species of the *batesii* group are strongly anisophyllous, with a dense beard of long hairs closing the corolla throat, and seeds with parallel striations (due to an elongation of the testa cells). Molecular analyses (Zemagho *et al.* submitted) suggest these two groups are sister to each other, but only one species of the *becquetii* group could be sequenced.

The redefinition of subg. *Anisophyllae*, the fact that several new taxa belonging to this group were collected in recent years, and the evidence that some of the species limits needed reappraisal, were the reasons to undertake a full revision of this group, which is presented here.

Material and methods

This study is based on a revision of the material from the following herbaria: BR, BRLU, GH, P, MO, MPU, NY, UPS, WAG and YA (acronyms according to Thiers, 2014); part of the material from K was also studied. In addition, most of the species were studied in the field in Cameroon and Gabon. Normal practices of herbarium taxonomy have been applied. All specimens cited were seen by the authors and mainly by LZ, OL and BS. The abbreviations s.loc., s.d., s.coll. and s.n. were used when the locality, date, collector, or collecting number were unknown, respectively. Each specimen was databased, and, if possible georeferenced using the online gazetteer (http://www.fallingrain.com/worlds, http://www.world gazetter.com/) or specimen labels. The georeferenced specimen data were imported into ArcMap 10.3 (ESRI, Redlands, California) geographic information software to produce distribution and richness maps. Ecological and geographical data were collected from specimen labels and field observations. Descriptive terminology follows Robbrecht (1988) and Anonymous (1962) while color and other details given in the descriptions are based on living material, spirit and herbarium specimens, and data derived from field notes. Phytogeographical considerations follow White (1979, 1993) but we simplify his '(sub)centres of endemism' into Domain and Region. The conservation status of species was assessed by calculating the extent of occurrence (EOO) and the area of occupancy (AOO) using GeoCAT (Geospatial Conservation Assessment tool; Bachman *et al.* 2011) and applying the IUCN Red List Categories and Criteria, version 3.1 (IUCN 2012; IUCN 2013). The AOO was calculated based on a user defined grid cell of 2 km.

Morphology

Habit

The species of subg. *Anisophyllae* show much variation in habit. However, none of them, are twining, which is the common condition in *Sabicea* s.l.

The low growing species are creeping herbs; some have the stems completely appressed to the ground or ascend only at the very apex (*Sabicea mapiana, S. sthenula*), while others develop ascending lateral stems on which the flowers are borne (*S. medusula, S. mildbraedii, S. parmentierae*). The distinction between these two groups is not always clear-cut. The lateral

stems, when present, are typically arcuate, i.e. more or less erect at base and usually horizontal at apex.

The more robust species (*S. aurifodinae, S. batesii, S. crystallina, S. jacfelicis, S. ndjoleensis, S. sciaphilantha*) are sarmentose woody lianas, reaching up to 5 m in height and occasionally forming dense tangles. Their older stems are frequently creeping at base, apparently because they fall to the ground due to their weight and begin to develop roots. As in the smaller species, the lateral stems are more or less arcuate.

Species of the *becquetii* group (*S. arborea, S. becquetii, S. bequaertii, S. tersifolia*) are variously described as shrubs or lianas by the collectors. Although we do not have field experience of these species, they appear to be +/- scrambling and sarmentose plants resting on other vegetation, rather than true self-standing shrubs (a habit which in *Sabicea* seems restricted to the subgenera *Stipularia* and *Stipulariopsis*).

Leaves and stipules

The arrangement of leaves and stipules shows considerable variation within the group, with many species being anisophyllous (Fig. 1). The following cases can be distinguished:

(1) Anisophylly absent or weak, i.e. leaves opposited at nodes, not or only slightly unequal, with two free interpetiolar stipules (*S. arborea, S. becquetii, S. bequaertii*).

(2) Moderate anisophylly, i.e. leaves paired at nodes with one of them up to three times as large as the other one, with two free interpetiolar stipules (*S. tersifolia*).

(3) Strong anisophylly, i.e. nodes with one normal and one vestigial leaf, and two interpetiolar stipules. This is the most common situation in the group, occuring in *S. aurifodinae, S. crystallina, S. jacfelicis, S. medusula, S. mildbraedii* (except some variants, see below), *S. ndjoleensis, S. parmentierae* and *S. sciaphilantha*. The stipules are more or less connate at the base with the reduced leaf, and more shortly so with the petiole of the normal leaf, forming an asymmetrical sheath which extends on the stem below the insertion of the leaves, and often bears a chevron-like marking at base (Fig. 2B). This structure is called “système spathiforme” by Hallé (1966: 201).

FIGURE 1. Anisophylly in *Sabicea* subg. *Anisophyllae*. A, *S. crystallina* subsp. *crystallina* (Crystal Mountains, Gabon, plant not collected). B, *S. sciaphilantha* subsp. *sciaphilantha* (*Sonké & Ikabanga 5992*); C, *S. sthenula* (*Bidault et al. 1340)*. Photos: J.-P. Vande Weghe (A), B. Sonké (B), E. Bidault (C).

4) Extreme anisophylly, i.e. a single leaf per node opposed to a stipule (*S. batesii*, *S. mapiana*, *S. sthenula*) the latter more or less connate with the petiole at the base. This pseudo-alternate arrangement of leaves is exceptional in Rubiaceae, where opposite leaves are the rule. It is evidently derived from the previous case by disappearance of the vestigial leaf and fusion of the stipules.

The two latter cases may occasionally be found in the same species: *S. mildbraedii* normally has two stipules and two strongly unequal leaves per node, but a few specimens of var. *glabrescens* show extreme anisophylly with a single leaf per node.

The blades (discounting the vestigial ones) are petiolate, elliptic to obovate, more or less acuminate at apex, and vary much in size, from 3 to over 30 cm long. The leaf base is often asymmetrical, with the distal side inserted above the proximal one. This character is correlated to anisophylly: species with strong to extreme anisophylly have asymmetrical leaf bases, while those not or moderately anisophyllous have symmetrical leaf bases.

All species of the group have strongly discolorous leaves, with the upper side green (or sometimes whitish in the very young stage) and the lower side buff to whitish, persistently covered with a dense felt of woolly indumentum (see under the indumentum section for more details).

The stipules (Fig. 2) are persistent, 5–23 mm long and 1.5–16 mm wide, erect to reflexed. They vary from narrowly to broadly ovate in outline, and from entire to multifid, in the latter case with the segments are triangular to linear (Fig. 2C, D).

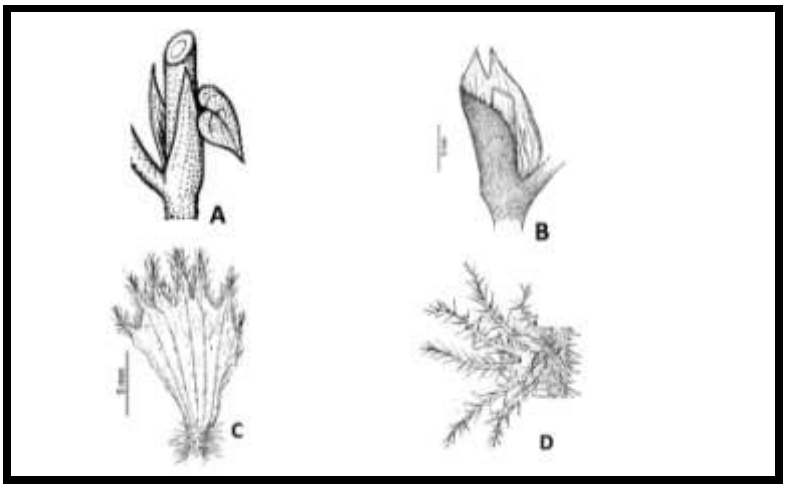

FIGURE 2. Stipules. A, *Sabicea aurifodinae*; B, *S. batesii*; C, *S. sthenula*; D, *S. parmentierae*.

Indumentum

As noted by Wernham (1914), *Sabicea* is a "hairy genus", and this is especially the case in subg. *Anisophyllae*. The indumentum of *Sabicea* species is very complex, with different types of hairs occuring on different organs, and frequently intermingled together. Since this indumentum often provides useful characters for specific delimitation, it is necessary to describe it in some detail.

Verdcourt (1958) distinguished two main types of indumentum in Rubiaceae: the internal indumentum, occuring on the inside of the corolla, style and stamens, and the external indumentum occurring on all other organs (vegetative parts, inflorescences, bracts, calyces, and exterior of the corolla). In *Sabicea*, the external indumentum consists of usually multicellular hairs, which can be classified in four types (Fig. 3):

(1) Woolly hairs (Fig. 3D, E, F) are very thin and curly, usually appressed and often forming a dense felt. They cover the lower surface of the leaves in all species of subg. *Anisophyllae,* and can also be present on the stems, petioles, and on the exterior of the stipules, bracts, calyx and corolla.

(2) Stiff hairs (Fig. 3A, F) are +/- straight, rigid and cylindrical, with rather thick walls. They are equivalent to the "cylindrical type" of multicellular hairs recognised by Robbrecht (1988), and to the "incompletely septate hairs" of Verdcourt (1958: 222), a term criticised by Robbrecht since the septae are actually complete. In subg. *Anisophyllae*, such hairs may occur on the leaves (both sides), stems, exterior of stipules and bracts, calyx (both sides) and exterior of corolla; they are frequently intermingled with woolly hairs.

(3) Silky hairs (Fig. 3G, H) resemble the previous type, but are softer and have thin walls. They are found inside the bracts and the stipules (at least at their base) in most species of the subgenus. They may also occur on the ovary, calyces, and exterior of the corolla.

(4) Uncinate hairs (Fig. 3C) are short, rigid and curved, often more or less hook-like. In subg. *Anisophyllae* they are always found in association with longer stiff or silky hairs. They occur frequently on the upper side of the leaf nerves, more rarely on the stems (*S. medusula*, *S. sthenula*).

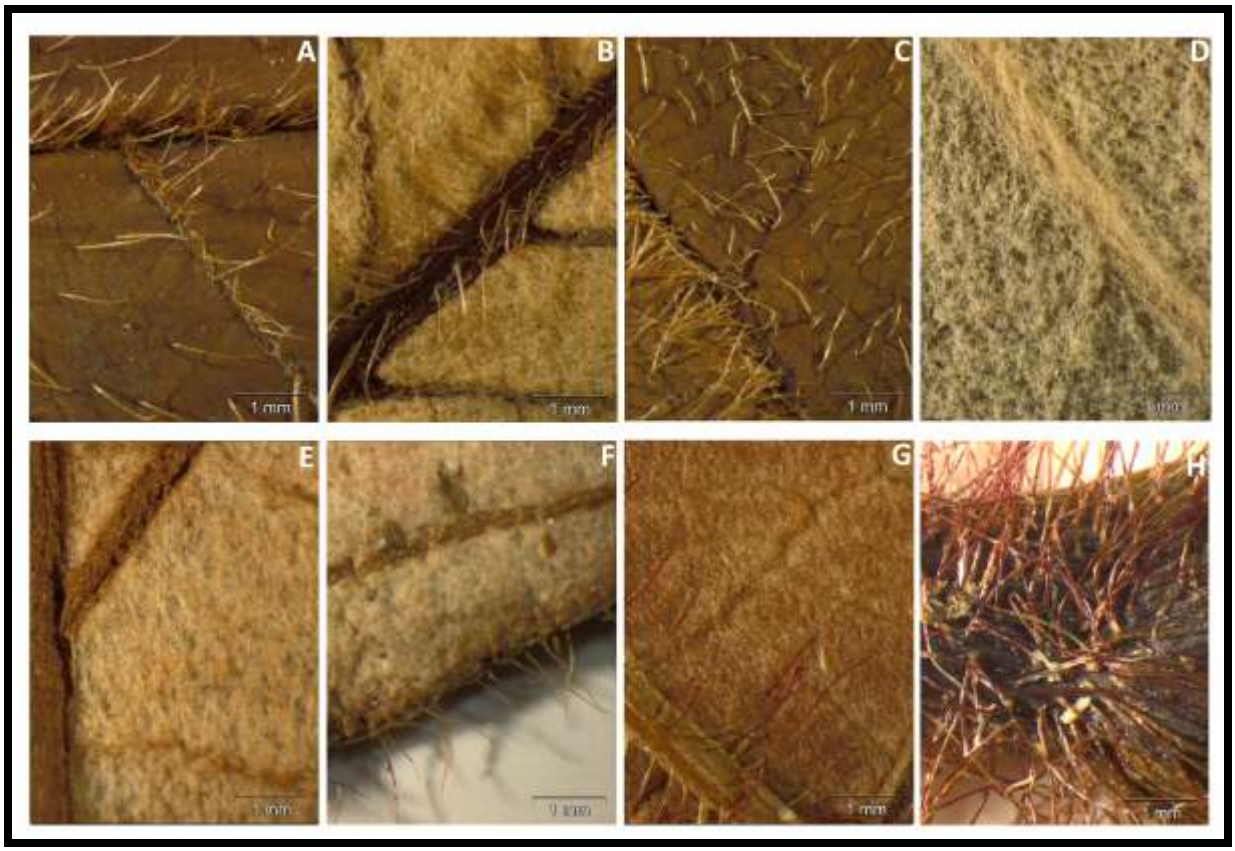

FIGURE 3. Leaf and stem indumentum in *Sabicea* subg. *Anisophyllae*. A, *S. parmentierae*, upper side of leaf (*Hallé & Villiers 5048*); B, same species, lower side (*J. & A. Raynal 9732)*; C, *Sabicea becquetii*, upper side of leaf *(Lewalle 2556*); D, same species, lower side (*Lewalle 170)*; E, *Sabicea batesii*, lower side of leaf (*Sonké 3143)*; F, *S. mapiana*, lower side of leaf (*Lachenaud et al. 1447)*; G, *S. sciaphilantha* subsp. *hirsuta*, lower side of leaf (*Nguema et al. 277)*; H, *S.* aff. *sciaphilantha*, stem (*Issembé 259)*.

Occasional intermediate forms may occur between stiff and silky, or stiff and uncinate hairs. In the rest of the text we use the term "felted" for an indumentum consisting of woolly hairs, and "villose" for an indumentum of non-woolly hairs (stiff or silky, sometimes with shorter uncinate hairs present as well); "hairy" can refer to either type.

The anthers and style of *Sabicea* species are glabrous, and the internal indumentum is therefore restricted to the interior of the corolla. Although Verdcourt (1958) and Robbrecht (1988) reported the internal corolla indumentum to be constantly unicellular in Rubiaceae, in *Sabicea* it is usually multicellular, as illustrated by Hallé (1966: see e.g. Pl. 44, 45, 46). The internal indumentum of subg. *Anisophyllae* consists of cylindrical hairs inside the corolla tube, and moniliform hairs (showing apparent constrictions, see e.g. Fig. 27D) in the corolla throat, sometimes extending onto the base of the lobes. In most species of the subgenus, these moniliform hairs are long (0.8-2 mm) and form a very dense white beard protruding from the

corolla throat (Fig 4). Species of the *becquetii* group, however, have short (< 0.5 mm long) and sparse hairs in the throat.

The distribution of the indumentum inside the corolla tube varies between species, and often even within a single species according to flower morph. The tube can be villose in the whole upper half, or glabrous except for a narrow ring of hairs (sometimes broken into distinct patches) around mid-height, or villose near the apex and with a separate ring of hairs around mid-height. The base of the tube is always glabrous.

Inflorescence, bracts and bracteoles

All species of subg. *Anisophyllae* have sessile inflorescences forming dense axillary clusters (Fig. 4). The inflorescences are single, or more rarely paired, at nodes; they are borne on young leafy stems (in most species) or on older leafless stems and in the axils of the lower leaves (in *S. aurifodinae, S. crystallina, S. jacfelicis, S. ndjoleensis* and *S. sciaphilantha*). Species with pseudoalternate leaves have the inflorescences opposed to the leaf, and either intrastipular, i.e. borne inside the stipule (*S. mapiana*, *S. sthenula*) or extrastipular, arising by piercing the base of the stipule (*S. batesii*).

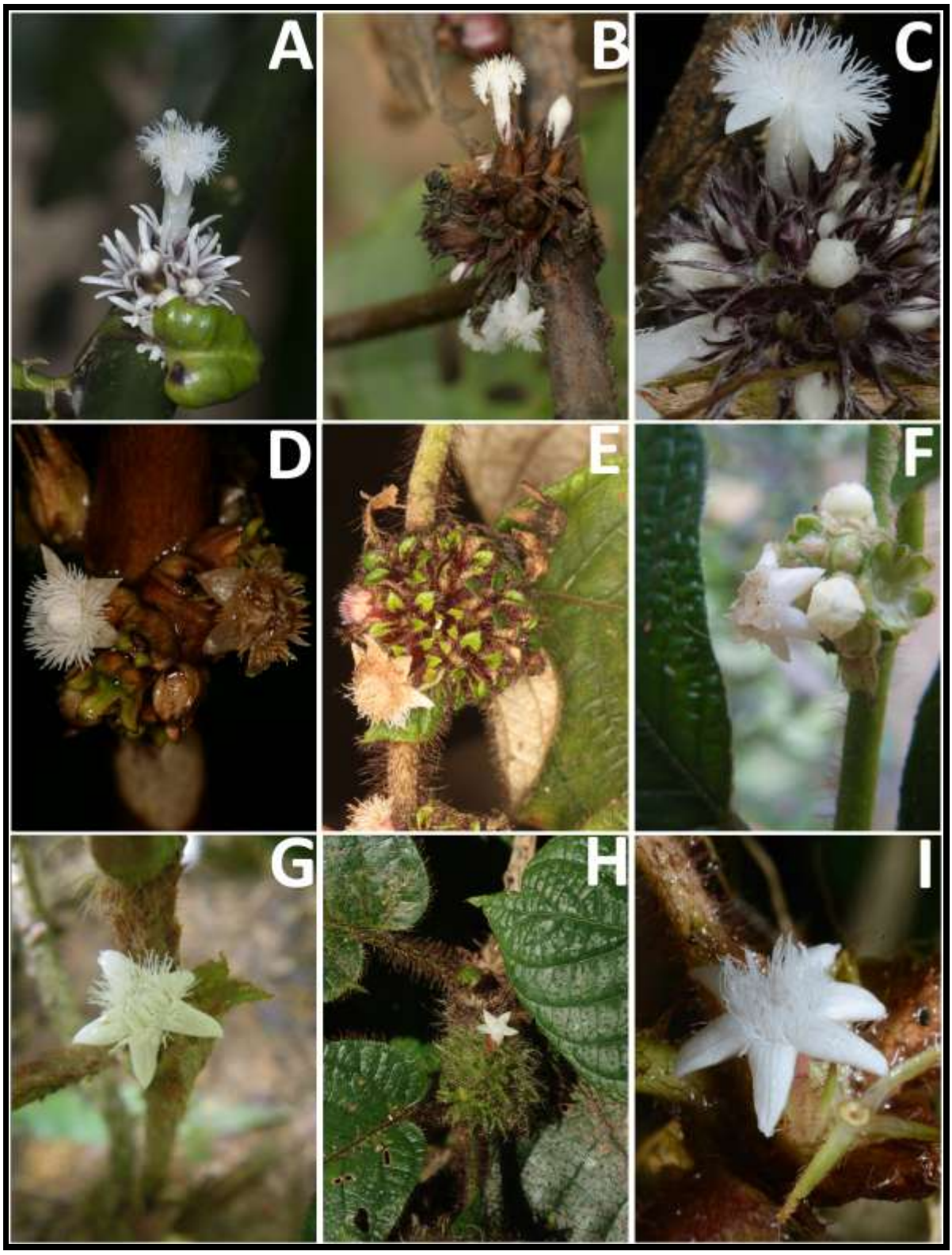

FIGURE 4. Variation in inflorescences. A, *Sabicea crystallina* subsp. *crystallina* (Crystal Mountains, Gabon, plant not collected); B, *S. ndjoleensis* (*Dessein et al. 2149*); C, *S. sciaphilantha* subsp. *sciaphilantha* (*Bidault et al. 1328*); D, *S. batesii* (*Dessein et al. 1746*); E, *S. parmentierae* (*Stévart et al. 4309*); F, *S. mildbraedii* var. *letestui* (*Lachenaud et al.1329)*; G, *S. mapiana* (*Lachenaud 1477*); H, *S. medusula* (*Droissart 1873*); I, *S. sthenula* (*Bidault et al.1490)*. Photos: J.-P. Vande Weghe (A), S. Dessein (B, D), E. Bidault (C, I), T. Stévart (E), O. Lachenaud (F–G), V. Droissart (H).

The bracts and bracteoles (sometimes not clearly distinct from each other) are usually short and +/- hidden between the flowers; their arrangement is often difficult to see, due to the extreme congestion of the inflorescence. In some species however, the bracts are more developed and conspicuously surrounding the inflorescence (*S. becquetii, S. bequaertii*). *S. ndjoleensis* is remarkable for its spathaceous bracts completely enclosing the flower buds, and later splitting. The bracts vary from glabrous to densely hairy outside, while the inside is provided with long silky hairs, sometimes restricted to the base.

Flowers

The flowers are sessile, actinomorphic, 5-merous (rarely 6-merous) and heterostylous.

The calyx is frequently discolorous, buff to whitish outside and green inside; but it can also be entirely green (*S. sthenula* and most specimens of *S. medusula*), dark purple (*S. ndjoleensis, S. sciaphilantha*) or with a purplish tube and white lobes (*S. aurifodinae, S. crystallina*). The calyx tube varies in length from 0.5 to 4 mm long, and the lobes from 0.5 to 8 mm. The shape, size and indumentum of the calyx lobes are important characters in the subgenus: they vary from short and rounded (e.g. *S. jacfelicis*) to long and linear (e.g. *S. medusula*). The outside of the calyx is often covered with woolly hairs, sometimes with sparser stiff or silky hairs as well, while the inside is either glabrous or villose. Tiny colleters (usually visible only from the inside) frequently occur between the calyx lobes.

The corolla is entirely white, or more rarely (*S. medusula, S. parmentierae, S. sthenula*) with a pink tube and white lobes. The tube is cylindric to narrowly funnel-shaped, varying in length from 3.5 mm (*S. mildbraedii*) to 13 mm (*S. bequaertii, S. tersifolia*); the lobes are triangular and shorter than the tube, up to 6 mm long in *S. bequaertii*. The exterior of the corolla is often hairy, with various types of hairs according to the species; but it can also be glabrous. Inside of the corolla is more or less villose, often densely bearded in the throat (for more details see the indumentum section).

The stamens, alternate with the corolla lobes, are always included in long-styled flowers, and usually exserted in short-styled flowers; however, in *S. medusula* and *S. sthenula*, both morphs have included stamens, though at different levels. The anthers are narrow, 1–2 mm long, and do not vary much between species.

The style is glabrous, included in short-styled flowers and +/- exserted (though sometimes hidden among the dense hairs of the corolla throat) in long-styled flowers. The apex is bifid, and stigmatic lobes vary in shape from narrowly cylindrical to broad and flattened.

The ovary is constantly 2-locular in subg. *Anisophyllae*, which is unusual in the genus (most other *Sabicea* species have a 5-locular ovary) and is overtopped by a short cylindrical glabrous disk. The ovary is usually hairy, either with woolly or stiff hairs or both; more rarely it is glabrous (e.g. *S. aurifodinae*).

The placentas, each with numerous ovules, are T-shaped in cross section. In tangential section, the placentas appear elliptic or oblong (*S. aurifodinae*) or very slightly cordiform in shape (*S. mildbraedii*); in the latter case, the apical part becomes 2-partite and attached to the septum above c. 0.2 mm long (*S. mildbraedii*, *S. ndjoleensis*).

Fruits and seeds

The fruit is a berry, usually ellipsoid and crowned by the persistent calyx. The fruits are most commonly seen immature and green, but in some species at least they turn red to purple at maturity. They vary from glabrous to densely hairy (with either woolly or stiff hairs, or a mixture of both) (Fig. 5).

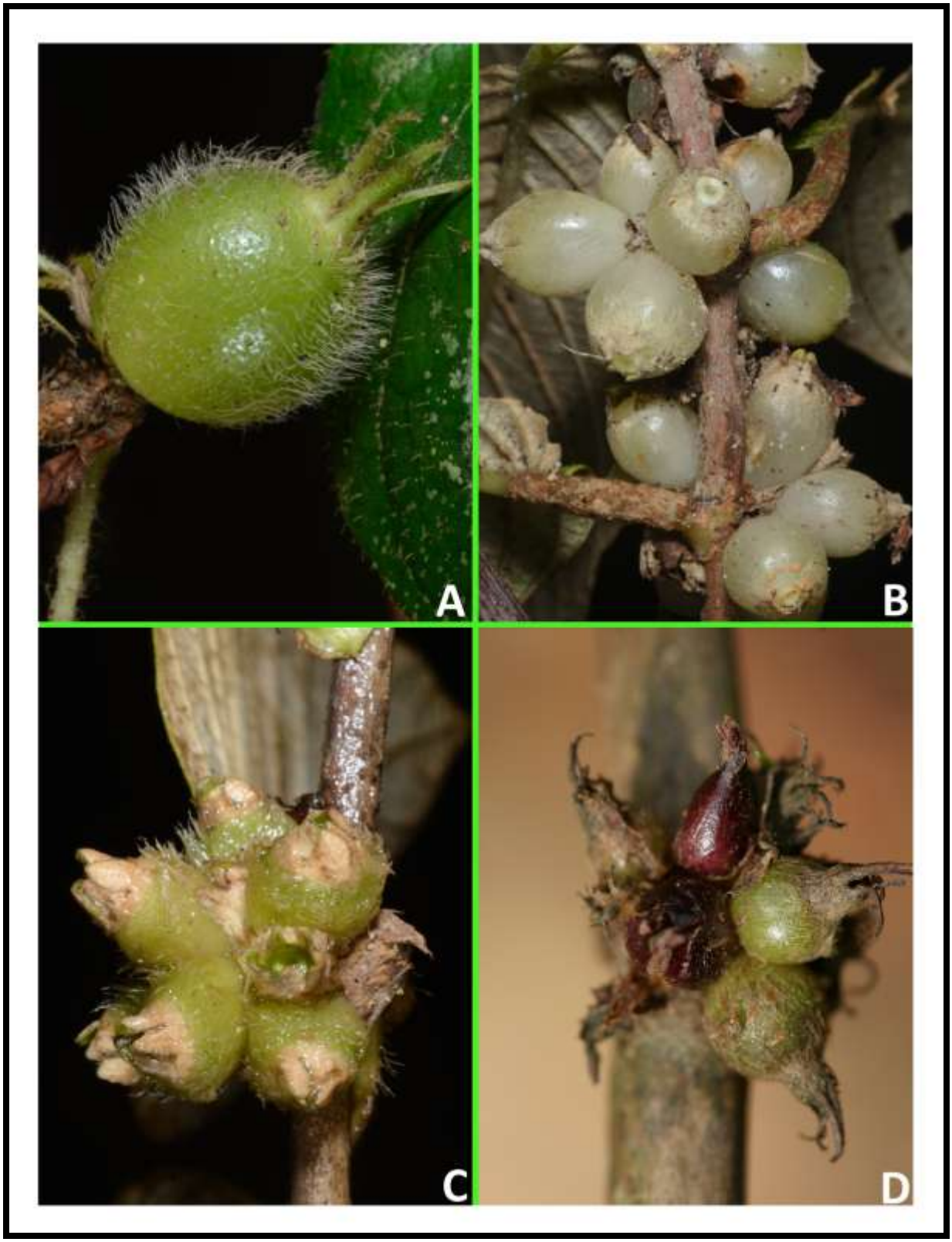

FIGURE 5. Variation in infructescences. A, *Sabicea sthenula* (*Bidault et al. 1495)*; B, *S. mildbraedii* var. *glabrescens (Bidault et al. 1900)*; C, *S.mildbraedii*, intermediate between vars. *letestui* & *glabrescens* (*Bidault et al. 1485*); D, *S. ndjoleensis* (*Dessein et al. 2149*).

The seeds are numerous, small and polygonal (Fig. 6). Most species have the seeds with parallel striations, due to an elongation of the testa cells. In *S. becquetii* and related species, however, the seeds are reticulate with testa cells not markedly elongated.

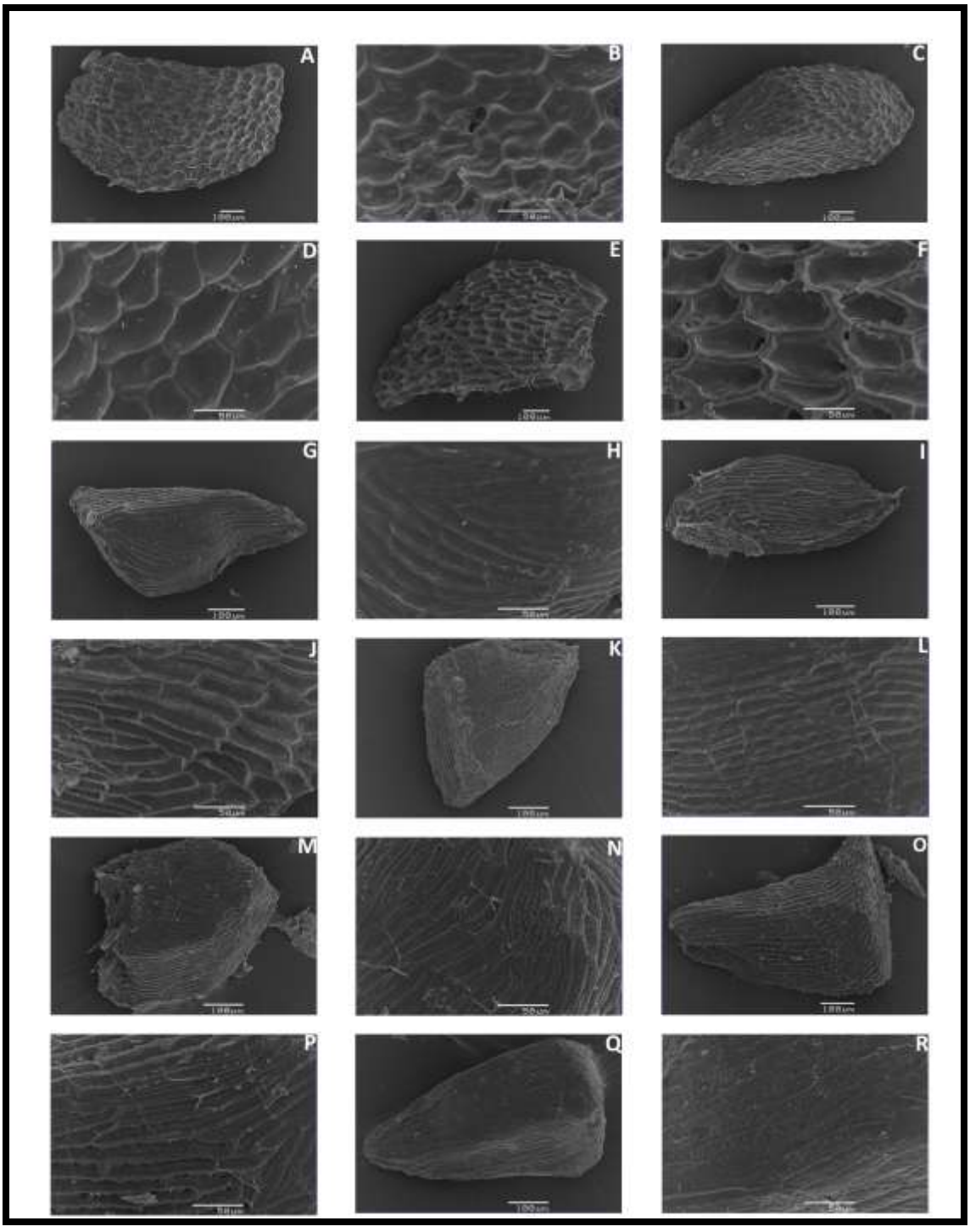

FIGURE 6. Variation of seed-coat in *Sabicea* subg. *Anisophyllae.* A–B, *Sabicea becquetii* (*Becquet 115*); C–D, *S. bequaertii* (*Troupin 12423*); E–F, *S. tersifolia* (*Lotter 1486*); G–H, *S. aurifodinae (Wieringa 5026*); I–J, *S. jacfelicis* (*Letouzey 9280*); K–L, *S. medusula* (*Letouzey 8469*); M–N, *S. mildbraedii* var. *glabrescens* (*Binot & Lejoly 147*); O–P, *S. sthenula* (*Cheek 11557*); Q–R, *S. sciaphilantha* subsp. *sciaphilantha* (*Sonké & Ikabanga 6182*).

Ecology

Like other members of the genus *Sabicea*, species of subg. *Anisophyllae* usually grow on forest edges, in sunny or half-shaded places. They are especially common in regrowth vegetation along forest tracks, on the banks of forest streams, and on forest-savanna boundaries; they may also occur in small natural gaps in the forest. They are usually gregarious, sometimes forming very dense thickets (particularly *S. batesii*) and they evidently play an important role in forest reconstitution. Most species occur in lowland or mid-altitude habitats (below 1200 m), but the three eastern species (*S. arborea, S. becquetii, S. bequaertii*) occur at high altitudes only, from 1300 to 2400 m.

The reproductive biology of subg. *Anisophyllae* is hardly known. The flowers of most species are probably pollinated by insects, and those of *S. jacfelicis* are reported to be much visited by bees (according to specimen *J.J. de Wilde 8155*). The fruits are likely to be dispersed by birds, but no observations of dispersal have been made in the field. Most species evidently reproduce vegetatively to a large extent.

Distribution

Species of subg. *Anisophyllae* occur mostly in the Guineo-Congolian Regional Centre of Endemism and have their centre of diversity in Lower Guinea Domain (phytochoria according to White 1979, 1983) (Fig. 7). Gabon is by far the richest country with 10 species, of which three are endemic (*S. aurifodinae, S. mapiana, S. ndjoleensis*); next comes Cameroon with five species. Three species are found in the Congolia subcentre of endemism: *S. medusula, S. mildbraedii*, and *S. tersifolia*, the latter being endemic to this domain. One species occurs in the Lake Victoria Regional Mosaic (*S. becquetii*, endemic to Burundi) and the last two belonging to the Guinea Congolia/Zambesia transition zone and Somalia-Masai Regional Centre of Endemism respectively: *S. bequaertii* occuring in the Congo-Nile dorsal, and *S. arborea* in the Eastern Arc Mountains of Tanzania (Table 1)

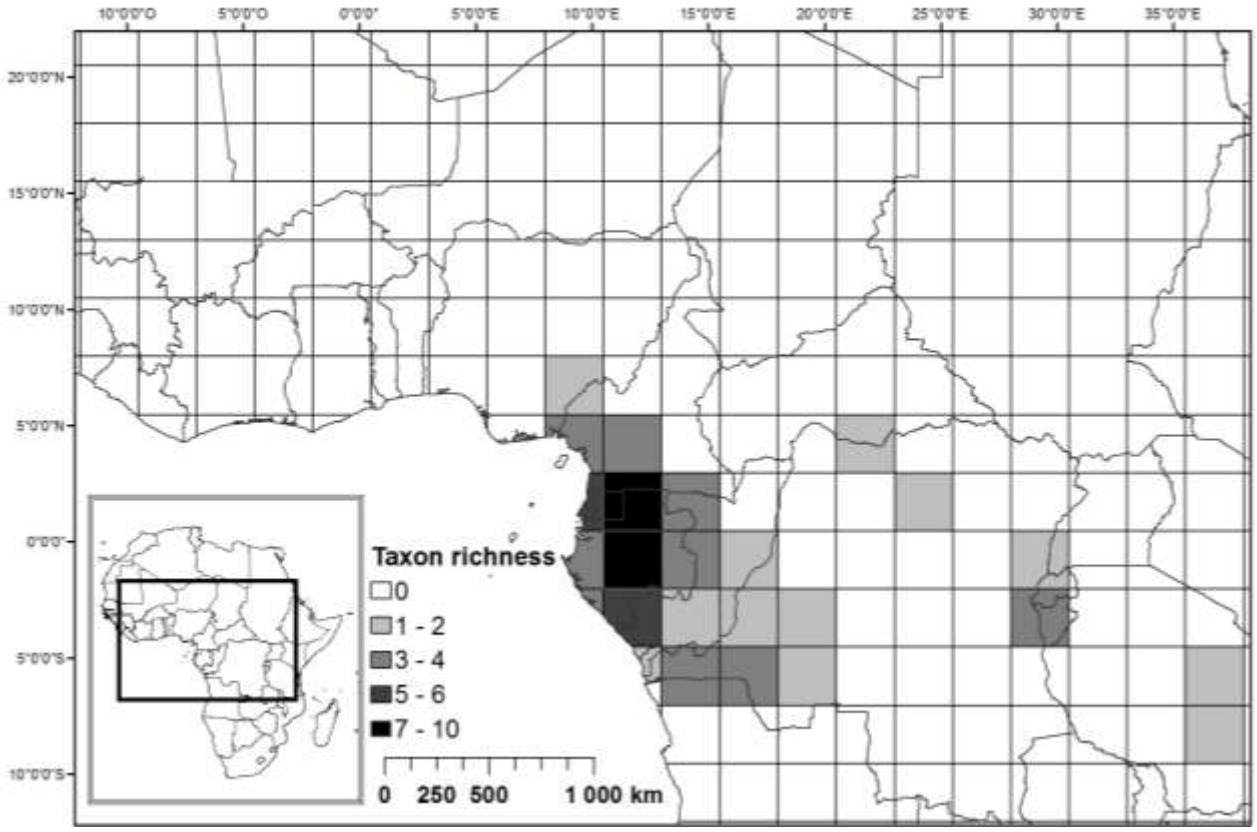

FIGURE 7. Distribution of species richness in *Sabicea* subg. *Anisophyllae* (grid cells 2.5° x 2.5°).

Table 1. Chorology of *Sabicea* subgenus *Anisophyllae*. Species endemic to one region or domain are in **bold**.

Guineo-Congolian	Upper Guinea Domain	Species
	Lower Guinea Domain	***S. aurifodinae***
		S. batesii
		S. crystallina
		S. jacfelicis
		S. medusula
		S. mildbraedii
		S. ndjoleensis
		S. mapiana
		S. parmentierae
		S. sciaphilantha
		S. sthenula
	Congolia Domain	*S. medusula*
		S. mildbraedii
		S. tersifolia
Lake Victoria Regional Mosaic		***S. becquetii***
Guinea Congolia/Zambesia transition zone		***S. bequaertii***
Somalia-Masai Region		***S. arborea***

Uses

No human uses are reported for the group, except for *S. mildbraedii* var. *mildbraedii*, of which the very hairy leaves are used as toothbrush in Gabon and Republic of Congo (according to specimens *Walters & Kandinia 2082* and *Babet s.n.*). Although several species of *Sabicea* have edible fruits, it is not known whether edible fruits occur in subg. *Anisophyllae*.

Although apparently not yet used to this purpose, the low creeping species (*S. mildbraedii, S. medusula, S. sthenula*) could prove useful as soil-covering plants, while the larger species (e.g. *S. batesii* and *S. sciaphilantha*), which like to grow on slopes, could be used to stabilize roadside embankments.

Taxonomic treatment

This chapter includes a key to the species, and a complete treatment for each species (morphological description, distribution, habitat and ecology, phenology, affinities, notes if necessary, conservation status, and a citation of the specimens examined). The species are arranged in alphabetical order. When a species includes infraspecific taxa, the distribution, ecology and phenology are described separately under each taxon. The specimens are cited in alphabetical order of country, collector and number. The two Congos are distinguished as Republic of Congo (Congo-Brazzaville) and DR Congo (Democratic Republic of Congo).

Sabicea* Aubl. subgenus *Anisophyllae (N.Hallé) Zemagho, Sonké, Dessein & Liede

Pseudosabicea sect. *Anisophyllae* N.Hallé, Adansonia 3: 170 (1963)

Type: ***Sabicea mildbraedii*** Wernham.

Sarmentose lianas or creeping herbs, with stems usually rooting at base. Nodes usually with opposite leaves (often strongly unequal) and two interpetiolar stipules, but sometimes with a single leaf opposed to a stipule. Leaves frequently asymmetric at base, always strongly discolorous, the lower side densely felted with buff or whitish woolly hairs. Stipules persistent, erect or reflexed, entire to multifid, often +/- connate with the petioles at base, villose inside at least at the base. Inflorescences axillary (or leaf-opposed in species with a single leaf per node), sessile and densely glomerulate. Bracts and bracteoles free or shortly connate, inconspicuous to +/- surrounding the inflorescence. Flowers 5-merous, usually heterostylous. Calyx tube 0.5–4 mm long, the lobes variable in shape, erect to patent. Corolla tube white or pink, cylindrical or narrowly funnel-shaped, 3.5–13 mm long; corolla lobes always white, triangular or elliptic; corolla throat often densely bearded with long multicellular hairs. Ovary 2-locular. Fruits sessile or subsessile, usually green, but turning red at maturity in some species at least.

Key to the species

1. Leaves equal to moderately unequal (the large one up to 3 times as large as the smaller one), symmetrical at base; corolla throat with hairs rather short and sparse, not forming a dense beard; seed surface reticulate. DR Congo to Tanzania.....2

– Leaves strongly unequal with one of them vestigial, or sometimes a single leaf per node; leaf base +/- asymmetrical; corolla throat entirely closed by a dense beard of long moniliform hairs; seed surface with parallel striations. Cameroon to DR Congo 5

2. Calyx lobes 3–8 mm long; leaves usually villose above, rarely glabrescent; bracts 7–20 x 3–8 mm long, free ..... *S. becquetii* (Burundi)

– Calyx lobes < 1.5 mm long; leaves glabrous above, or with short woolly hairs in the young stage only; bracts < 10 mm long 3

3. Calyx with patent lobes and inside of tube glabrous; leaves markedly unequal; lowland to mid-altitude species, 470–1270 m a.s.l ..... *S. tersifolia* (DR Congo)

– Calyx with erect lobes and inside of tube densely villose; leaves not or slightly unequal; montane species, 1600–2400 m a.s.l 4

4. Bracts conspicuously surrounding the inflorescence, the outer pair shortly connate at base; corolla with long silky hairs outside, tube (6.5–) 9–13 mm; calyx tube mostly glabrous outside.....*S. bequaertii* (DR Congo, Rwanda, Uganda)

– Bracts inconspicuous, free; corolla with short woolly hairs outside (sometimes with longer silky hairs at apex of lobes only), tube 4–6 mm; calyx entirely covered with woolly hairs outside ..... *S. arborea* (Tanzania)

5. Nodes with a single leaf opposed to a stipule 6

– Nodes with two strongly unequal leaves (one sometimes extremely reduced) and two stipules +/- connate with the smaller leaf.....9

6. Corolla with pink tube and white lobes; stems villose, lacking woolly hairs; calyx lobes long and narrow (4–6 x 0.5–1 mm), green on both sides; low creeping plant .....

.....*S. sthenula* (Cameroon, Gabon, Republic of Congo)

– Corolla entirely white; stems densely felted with woolly hairs, sometimes with stiff hairs present as well; calyx lobes shorter (< 4.5 mm) and usually broader, densely white- or buff-felted outside.....7

7. Plant very low and creeping, < 10 cm high; calyx lobes narrowly triangular, 3–4.5 mm long; inflorescences borne inside the stipules ..... *S. mapiana* (Gabon)

– Plant more or less ascending; calyx lobes shorter and broader, 1–2.5 mm long.....8

8. Robust plant to 2.5 m tall, with large leaves (11.2–) 16.5–26 x (4.5–) 5.2–9 cm; calyx with tube 2–2.5 mm and lobes 1.7–2.5 mm; inflorescences arising through an hole at the base of the stipule; ovary with long stiff hairs at base .....

.....*S. batesii* (Cameroon, Equatorial Guinea, Gabon)

– Plant smaller, to 0.5(–0.8) m tall, with leaves 4.5–12.5 x 2–7 cm; calyx smaller, with tube 0.5–1.5 mm and lobes 1–1.8 mm; inflorescences arising inside the stipule; ovary with short woolly hairs only.....

.....*S. mildbraedii* var. *glabrescens*, variant (Gabon to DR Congo)

9. Inflorescences axillary on young leafy stems; low plants, rarely to 1 m high; corolla often (but not always) with pink tube.....10

– Inflorescences on old leafless stems or in the axils of the lowest leaves; robust plants, often more than 1 m high; corolla entirely white 12

10. Stipules entire or shortly bidentate; calyx lobes linear and narrow, 3–5.5 x 0.3–0.5 mm, the inside often with short and long hairs intermingled; corolla with pink tube and white lobes; anthers always included ..... *S. medusula* (Nigeria to DR Congo)

– Stipules multifid (rarely a few of them entire in *S. mildbraedii*); calyx lobes broader and/or shorter ([1]), the inside glabrous or with hairs of +/- equal length; anthers exserted in short-styled flowers.....11

11. Calyx lobes spathulate with narrow basal part and enlarged apex, the former with very dense stiff hairs inside, the latter much less hairy; corolla with pink tube 6.5–7 mm long, and white lobes 3–5 mm long .....

.....*S. parmentierae* (Cameroon, Equatorial Guinea, Gabon)

– Calyx lobes without clearly differentiated base and apex, glabrous to sparsely villose inside; corolla entirely white and smaller, tube 3.5–4.5 mm long, lobes 1.5-3 mm long

..... *S. mildbraedii* (Gabon to DR Congo)

12. Corolla tube short, c.4 mm long; calyx lobes short and broad, 1–2 mm long; stipules entire or 2-3-fid ..... *S. jacfelicis* (Cameroon, N Gabon)

– Corolla tube 7–11 mm long; calyx lobes narrowly elliptic to narrowly ovate, 2–6 mm long; stipules always entire 13

13. Calyx lobes dark purple, rather thick and canaliculate on the inner side; stems usually densely hairy (rarely glabrous in *S. sciaphilantha* subsp. *sciaphilantha*).....14

– Calyx lobes whitish, thin and usually flat (sometimes weakly canaliculate in *S. aurifodinae*); stems glabrous, or with very sparse hairs near apex 15

14. Bracts large, spathaceous and completely enclosing the flowers when young; calyx lobes pubescent outside, glabrous or with appressed silky hairs inside.....

.....*S. ndjoleensis* (C Gabon)

– Bracts small, not spathaceous and hidden between the flowers; calyx lobes glabrous outside and with +/- stiff hairs inside.....

.....*S. sciaphilantha* (Equatorial Guinea, Gabon, Republic of Congo)

15. Calyx lobes gradually narrowed to the apex, usually hairy inside, remaining +/- erect after anthesis; bracts entirely villose inside, with long silky hairs, the lower ones spathaceous and partly surrounding the inflorescence when young .....

.....*S. aurifodinae* (SW Gabon)

– Calyx lobes of same width throughout or slightly enlarged near apex, glabrous inside and divergent after anthesis; bracts inside with stiff hairs at the base and glabrous at the apex, not spathaceous and not surrounding the inflorescence.....

.....*S. crystallina* (Equatorial Guinea, N Gabon)

([1]), If stipules multifid and calyx lobes long and narrow, see intermediates between *S. medusula* and *S. sthenula* (discussed under the latter species).

Description of the species

1. *Sabicea arborea* K. Schum. (1899: 58)

Pseudosabicea arborea K.Schum.(1899: 58) Hallé (1964: 397).
Type:—TANZANIA. Uluguru Mts., Ngluwenu, alt. 1500–1700 m, *Stuhlmann 8775* (holotype B†); Neotype (designated by Hallé 1964: 398):—Tanzania, bezirk Morogoro: Uluguru-Gebirge, Nordwestseite, Lupanga, alt. 2100 m, 12 November 1932, *H.J. Schlieben 2970* (neotype BR!, isoneotypes GH!, P!).

Shrub or liana, probably sarmentose, up to 2 m high; stems 1–3 mm thick, densely white-felted in the young stage, later glabrescent. Leaves opposite, equal in size; petiole 0.5–1 cm long, densely white-felted and sometimes also with stiff hairs on the upper side; leaf blade elliptic, 3.9–8 x 1.8–3.3 cm, symmetrical, acute or obtuse at base, acuminate at apex, coriaceous, strongly discolorous; upper side green, in the young stage sparsely felted, soon becoming glabrous; lower side buff to whitish, densely felted with woolly hairs; secondary nerves 10–15 on each side of midrib. Stipules paired at nodes, free and interpetiolar, ovate, entire, acute or obtuse at apex, 5.5–6 x 4–4.5 mm, erect or reflexed, glabrous or sparsely felted on both surfaces, and inside with c.1 mm long silky hairs at base. Inflorescences axillary on leafy stems, 1 (–2) per node, sessile, densely glomerulate, many-flowered, 1.2–1.8 cm in diameter. Bracts free, not clearly surrounding the inflorescence, ovate, entire and acute at apex, slightly concave, 7–7.5 x 3–4 mm, outside sparsely white-felted, inside glabrous, the base with long silky hairs on both surfaces; bracteoles narrowly ovate to broadly elliptic, 2–5 x 0.7–1.5 mm, with indumentum similar to the bracts. Flowers 5-merous, sessile,

heterostylous. Calyx with cylindrical tube c.1.2 mm long and erect triangular lobes 0.5–1.5 mm long, outside densely white-felted, inside densely villose with silky hairs directed upwards and c.1 mm long. Corolla white, with cylindrical tube 4–6 x 1.2 mm and narrowly elliptic lobes 2–3.5 x 1–1.2 mm; outside of corolla densely felted with short woolly hairs, the apex of lobes sometimes also provided with silky hairs c.1.5 mm long; throat and upper part of tube inside sparsely hairy with short hairs c.0.4 mm long. Flower buds nearly cylindrical, only slightly enlarged at apex. Stamens either included, subsessile and attached in the upper part of the tube with their apex almost reaching throat (long-styled flowers) or fully exserted on very short filaments (short-styled flowers); anthers c. 1.5 x 0.3 mm. Ovary 2-locular; densely white-felted, and also with stiff hairs c.1 mm long near the base. Disk cylindrical, c. 0.3 mm, glabrous. Style bifid, glabrous, either 5 mm long and just reaching throat (long-styled flowers) or c.4 mm and included (short-styled flowers); stigmas 1–1.5 mm long, narrowly cylindrical. Fruits and seeds unknown.

Distribution:—Somalia-Masai Regional Centre of endemism. *Sabicea arborea* is endemic to the Uluguru and Nguru mountains in Tanzania (Fig. 8).

Habitat and ecology:—This species grows in montane rain forest, 1600–2200 m in altitude.

Phenology:—Flowering from November to February.

Affinities:—*Sabicea arborea* is closely related to *S. bequaertii* and *S. tersifolia*, both of which were previously considered conspecific (Hallé 1964, Verdcourt & Bridson, 1988) but are different enough to be awarded specific status; also related to this group is *S. becquetii*. The differences between these four species are summarised in Table 2.

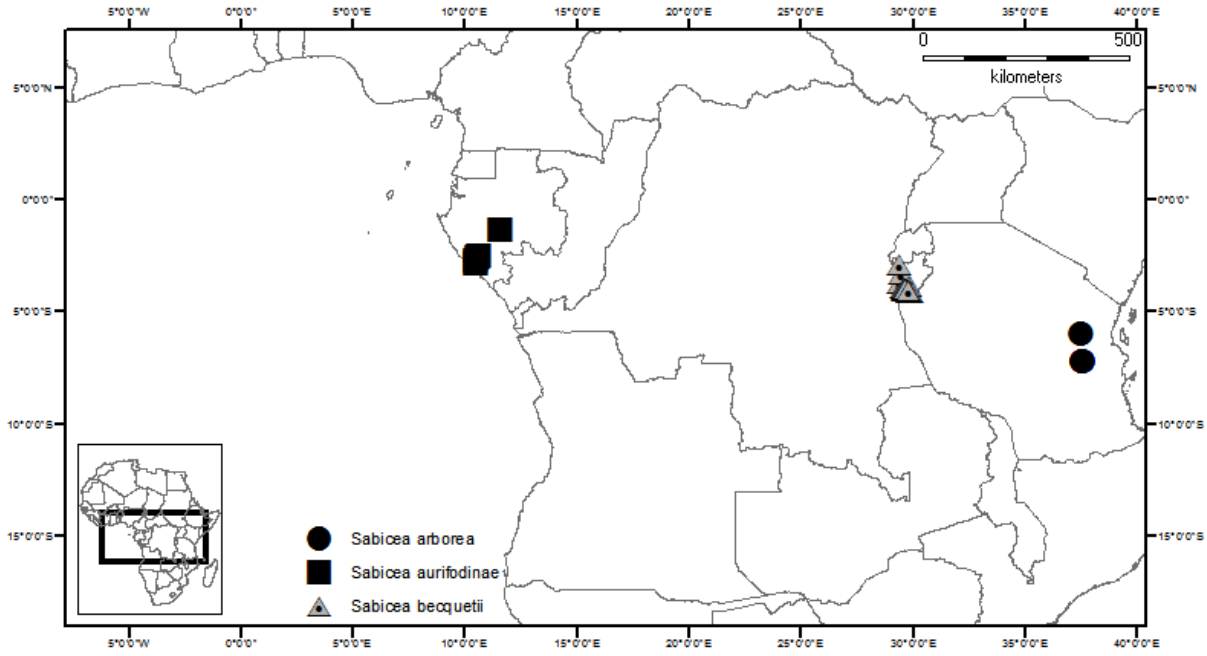

FIGURE 8. Distribution of *Sabicea arborea*, *S. aurifodinae* and *S. becquetii*.

TABLE 2. Distinguishing characters between *Sabicea arborea*, *S. becquetii*, *S. bequaertii* and *S. tersifolia*

Characters	***S. arborea***	***S. becquetii***	***S. bequaertii***	***S. tersifolia***
Leaves	equal	slightly unequal to subequal	equal or nearly so	**markedly unequal** (one up to 3 times as large as the other)
Upper side of leaf blade	glabrous (or sparsely felted in the young stage)	**villose, rarely glabrescent**	glabrous (or sparsely felted in the young stage)	glabrous (or very sparsely felted in the young stage)
Bracts	inconspicuous and +/- hidden among the flowers, free	conspicuously surrounding the inflorescence, free	conspicuously surrounding the inflorescence, **the outher pair shortly connate**	inconspicuous and +/- hidden among the flowers, free
Size of outer bracts	7–7.5 x 3–4 mm	**7–20 x 3–8 mm**	7–10 x 5–7 mm	3–4 x 1–2.5 mm
Bract indumentum (outside)	sparsely felted	densely felted and sparsely villose	glabrous at base, felted or villose at apex	densely felted
Bract indumentum (inside)	villose at base only	villose all over	villose nearly all over	villose at base only
Length of calyx tube	c.1.2 mm	c.0.7 mm	2–2.5 mm	c.1 mm
Calyx lobes	0.5–1.5 mm, erect	**3–8 mm**, patent	0.5–1.3 mm, erect	1–1.5 mm, patent
Calyx indumentum (outside)	densely white-felted all over	densely white-felted all over **and sparsely villose with stiff hairs**	**tube nearly glabrous**, the lobes villose with silky hairs	densely white-felted all over
Calyx indumentum (inside)	densely villose	glabrous or nearly so	densely villose	glabrous
Length of corolla tube	**4–6 mm**	8.5–11 mm	(6.5–) 9–13 mm	10–13 x 1.2–2 mm
Corolla indumentum (outside)	densely white-felted, the apex of the lobes sometimes villose	white-felted, with longer silky hairs also present (at least at the apex of the lobes)	villose with long silky hairs	densely white-felted
Anthers of short-styled flowers	fully exserted	mostly included with only the tips exserted	half-exserted	fully included
Altitude	1600–2200 m	1300–2200 m	1600–2400 m	**470–1270 m**
Distribution	Tanzania	Burundi	DR Congo (Kivu), Rwanda, Uganda	DR Congo

Notes:—The habit of *S. arborea*, which is variously described as a shrub, climber or scrambling herb, needs further study on the field (see also the discussion of morphological characters in the group). It was originally described as a tree, but this is evidently erroneous.
A collection from the Udzungwa Mountains in Tanzania, *Luke et al. 6904* (BR, K) closely resembles *S. arborea*, but differs in having long stiff hairs on the stems and both sides of the leaves (in addition to short woolly hairs) and slightly larger bracts. This specimen unfortunately lacks flowers. Better material is needed to decide its status; it is likely to represent a new taxon.

Conservation status:— IUCN Red List Category: **Endangered [EN B1ab(i,ii,iii,iv,v)+ 2ab(i, ii, iii,iv,v)].** The extent of occurrence is estimated as 0.286 km^2 and the area of occupancy as 8.000 km^2, both within the limit for Critically Endangered under criteria B1 and B2. The species is known from only two locations, within the limit for Endangered under the conditions B1a and B2a. The Eastern Arc mountain forests of Tanzania, where it occurs, are threatened by deforestation for agriculture and charcoal production, so a decline in the extent of occurrence, area of occupancy, extent and quality of habitat, number of locations and number of individuals can be predicted. Therefore, *S. arborea* qualifies for Endangered status under the conditions B1ab(i,ii,ii,iv,v) and B2ab(i,ii,ii,iv,v).

Additional specimens examined:—**TANZANIA**. Morningside to Bondua Peak, Uluguru Mts above Morogoro, montane rain forest on the W slope of Mt. Palata at 1600–1800 m, 28 February 1982, *A. Borhidi, J.B. Hall & O. Hedberg 82262* (MO, UPS); Uluguru, Bunduki, 27 January 1935, *E.A. Bruce 668* (K, MO); Uluguru Mountains, 26 December 1931, *B.D. Burtt 3472* (K); Uluguru Mountains, 22 January 1976, *Cribb & Grey-Wilson 10351* (K); Kanemba F.R., 8 December 1995, *Kisena & Mmari 1655* (K); Nguru Mts, above Divue headwater, 6 km SSE Maskati Mission, 12 February 1991, *Manktelow, Pocs & Swenson 91347* (BR, K, MO, UPS); summit of Lupanga, Uluguru Mountains, 23 December 1933, *Michelmore 854* (K)

2. *Sabicea aurifodinae* (N.Hallé) Razafim., B. Bremer, Liede & S.A.Khan (Khan et al. 2008: 14) (Fig. 9)

Pseudosabicea aurifodinae N.Hallé (1966: 201).

Type:—GABON. Moubigou 2, au bout de la route de Massima vers Moumba, 21 May 1963, *N.Hallé* & *G.Cours 6137* (holotype P!; isotype, BR!).

Sarmentose liana up to 3 m high, with stems rooting at base; stems 2–10 mm thick, glabrous or with very sparse woolly hairs near apex. Leaves opposite, strongly unequal with one of them much reduced; reduced leaf subsessile, with leaf blade 0.4–0.6 x 0.15–0.3 cm; normal leaf with petiole 0.5–2.5 cm long, glabrous or sparsely villose with stiff hairs 1–1.5 mm long; leaf blade elliptic, 11.7–29 x 5–15.7 cm, asymmetrical at base with proximal side obtuse to subcordate and distal side cuneate inserted 2–10 mm higher, acuminate at apex, papery to slightly coriaceous, strongly discolorous; upper side green, glabrous or with sparse stiff hairs 2–2.5 mm long; lower side white to buff, densely felted with woolly hairs (sparser on nerves); secondary nerves 12–21 on each side on midrib. Stipules paired at nodes, interpetiolar and connate at base with the petioles into a sheath 3–8 mm long, the free part elliptic to narrowly ovate, entire and acute at apex, 9–17 x 2.5–3 mm, erect to patent, outside glabrous or with very sparse woolly hairs, inside glabrous except the basal part with stiff hairs c.1.5 mm long. Inflorescences on old leafless stems near the ground, 1–2 per node, sessile and densely glomerulate, many-flowered, 1.3–3.5 cm in diameter. Bracts and bracteoles not clearly distinct from each other, ± hidden between the flowers or the lower ones partly surrounding them in the young stage, the outer ones broadly ovate, concave and +/- spathaceous, 3–6.5 x 2.5–3 mm, the inner ones narrower, 5–6 x 1.2–1.8 mm, outside glabrous or sparsely felted, inside densely villose on the whole surface with soft silky hairs c.1.2 mm long. Flowers 5-merous, subsessile, heterostylous. Calyx with purplish tube and white lobes; calyx tube 1–2 mm long, outside glabrous or with short woolly hairs, inside glabrous; calyx lobes narrowly ovate and gradually narrowed to an acute apex, thin, flat or faintly channeled on the inner side, erect or slightly bending outwards at apex, 3.5–5 x 0.5–0.7 mm, outside glabrous or sparsely felted, inside villose with short appressed hairs or rarely glabrescent. Corolla white, with tube narrow and almost cylindrical, 8.5–11 x 1–1.5 mm long, and lobes triangular, c. 2 x 1.3 mm; outside of corolla glabrous to densely felted on the lobes and upper part of tube, the apex of the lobes sometimes also villose with silky hairs c.1 mm long; throat and base of lobes inside densely bearded with c.1 mm long white moniliform hairs; inside of tube with a

ring of hairs around mid-height, and either villose from the throat down to the insertion of the stamens (long-styled flowers) or glabrous in the upper part (short-styled flowers). Flower buds with apex ovoid and slightly enlarged. Stamens either half-exserted, on filaments c.1 mm long attached c.1.5 mm below throat (long-styled flowers) or fully exserted (short-styled flowers); anthers c. 1.2–2 x 0.5 mm long. Ovary 2-locular, glabrous or sparsely felted. Disk cylindrical, c.0.2 mm, glabrous. Style bifid, glabrous, either c.10 mm long and exserted (long-styled flowers) or c.9 mm long and included (short-styled flowers); stigmas c.1.5 mm long, narrowly elliptic. Fruits green (probably not fully mature), obovoid with persistent calyx, 10 x 15 mm when fresh, 6–11 x 4–6 mm when dry, glabrous or with short and very sparse woolly hairs. Seeds pale brown, polygonal, c. 0.6 x 0.3 mm, the surface with dense faint parallel striations.

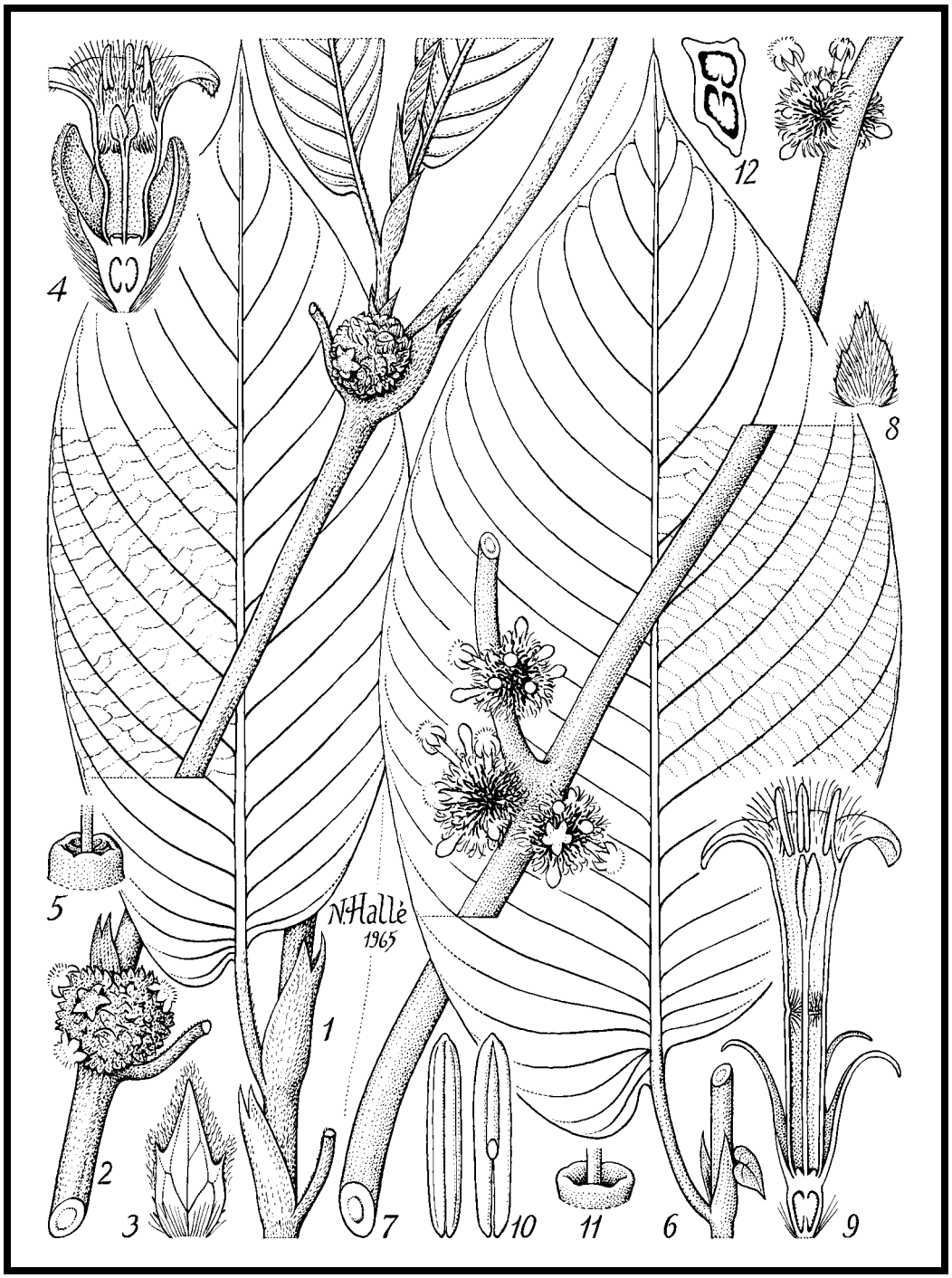

FIGURE 9. *Sabicea batesii*. 1, portion of stem with one leaf and stipules; 2, flowering stem; 3, bract; 4, section of short-styled flower; 5, disk. *Sabicea aurifodinae;* 6, portion of stem with two unequal leaves and stipules; 7, flowering stem; 8, bract; 9, section of short-styled flower; 10, anthers, seen from front (left) and back (right); 11, disk; 12, cross section of ovary. From *N. Hallé 2125* (1–5) & *N. Hallé 6137* (6–12). Drawing by N. Hallé, reprinted from Hallé (1966: 203).

Distribution:—Lower Guinea subcentre of endemism. *S. aurifodinae* is apparently endemic to southwest Gabon, where it occurs in the Doudou Mts and the western part of the Chaillu massif (Fig. 8). It could possibly be expected in Republic of Congo.

TABLE 3. Distinguishing characters between *Sabicea aurifodinae, S. crystallina, S. ndjoleensis* and *S. sciaphilantha*

Characters	***S. aurifodinae***	***S. crystallina***	***S. ndjoleensis***	***S. sciaphilantha***
Stems	glabrous or nearly so	glabrous or nearly so	densely hairy	densely hairy, rarely glabrous
Stipule length	9–17 mm	5–23 mm	5–8 mm	10–24 mm
Bracts	hidden between the flowers or partly surrounding them when young, +/- spathaceous and concave, 3–6.5 x 2.5–3 mm	inconspicuous and hidden between the flowers, flat, not spathaceous, 1.5–3.5 x 0.7–1.5 mm	**completely enclosing the flowers in bud,** spathaceous and concave, **6–9 x 5–6 mm**	inconspicuous and hidden between the flowers, not spathaceous, 2–3 x 0.5–1 mm
Bract indumentum (inside)	villose all over, with silky hairs	**villose in the lower half only, with stiff hairs**	villose all over, with silky hairs	villose all over, with silky hairs
Calyx tube	1–2 mm	0.5–1.3 mm	1.5–4 mm	0.7–1.2mm
Calyx lobes (colour)	white	white	dark purple	dark purple
Calyx lobes (size)	3.5–5 x 0.5–0.7 mm	2.5–5.5 x 0.3–1.2 mm	3–6 x 0.3–0.7 mm	2–4.5 x 0.2–0.5 mm
Calyx lobes (shape)	narrowly ovate and gradually narrowed to the apex, thin, flat or faintly channeled inside	lnarrowly ovate or narrowly elliptic, **broader near apex or of same width throughout**, thin and flat	narrowly ovate and gradually narrowed to the apex, rather thick and ± channelled inside	narrowly ovate and gradually narrowed to the apex, rather thick and markedly channeled inside
Calyx lobes (position)	erect or bending outwards at apex	patent to oblique, divergent from each other	erect or bending outwards at apex	erect to oblique, often bending outwards at apex
Indumentum of calyx lobes (outside)	glabrous or sparsely felted	glabrous or villose only on margin (subsp. *crystallina*) sparsely villose and felted (subsp. *engongensis*)	densely felted	glabrous
Indumentum of calyx lobes (inside)	shortly villose with appressed hairs, or sometimes glabrous	always glabrous	glabrous to densely villose with appressed hairs	**densely villose with +/- stiff hairs**
Distribution	south Gabon (Doudou Mts, Chaillu Massif)	Equatorial Guinea, NW Gabon (Crystal Mts)	central Gabon (around Ndjolé)	Equatorial Guinea to Republic of Congo

Habit and ecology:—Forest edges in half-shade, particularly along roads; 140–650 m in altitude.

Phenology:—Flowers in May and October: fruits (probably not mature) in April–May and November.

Affinities:—*Sabicea aurifodinae* is closely related to *S. crystallina, S. ndjoleensis* and *S. sciaphilantha*. All these species are robust sarmentose lianas, with leaves in strongly unequal pairs, entire stipules, a long corolla tube, and inflorescences mostly on the older stems below the leaves. The differences between them are given in Table 3.

Notes:—The species is here regarded as monotypic; we consider *Pseudosabicea aurifodinae* var. *crystallina* N.Hallé (1971: 316) to represent a separate species, *Sabicea crystallina*.

Part of the material cited under *P. aurifodinae* in the Checklist of Gabonese Vascular Plants (Sosef *et al.* 2006) belongs to either *Sabicea crystallina* (*A.M. Louis 116, G. Walters 505 & G. Walters 553*) or *S. sciaphilantha* (*F.J. Breteler 14850, F. Hallé 4537, D.W. Thomas 6460*).

Hallé (1966) describes the calyx of *S. aurifodinae* as glabrous and uses this character in his key to the species. The indumentum of the calyx (and also of the exterior of corolla) is in fact quite variable in *S. aurifodinae*, and even on the type specimen some calyces are sparsely villose on the inside of the lobes.

Conservation status:—IUCN Red List Category: **Vulnerable [VU D2].** The extent of occurrence is estimated as 1410.124 km^2 and the area of occupancy as 20 km^2, both within the limit for Endangered under criteria B1 and B2. The species is known from five subpopulations (two of which are in the Moukalaba Doudou National Park) corresponding to four locations in the sense of IUCN. The areas where it occurs are sparsely populated, and the species apparently favours secondary habitats such as roadsides, so there is no evidence of an immediate threat. Nevertheless, due to its restricted range and small number of locations, the species qualifies for Vulnerable status under criterion D2.

Additional specimens examined:—GABON. Nyanga: Doudou Mountains, Chantier SNF–Bakker, 29 November 2003, *C.C.H. Jongkind et al. 5825* (BR, WAG); Chantier CEB, c. 65 km SSW of Doussala, 17 May 1985, *J.M. Reitsma et al. 1011* (MO, WAG); Eastern slopes of Doudou-mountains, 20 April 1987, *J.M. Reitsma et al. 3366* (MO, WAG); forestry concession of Bakker, 6 km N of Igotchi, 29 October 2003, *J.J. Wieringa et al. 5026* (MO, WAG).

3. *Sabicea batesii* Wernham (1914: 53) (Fig. 9).

Pseudosabicea batesii (Wernham) N.Hallé (1963: 170).
Lectotype (designated here):—CAMEROON. Bipindi ("Bipinde"), 1911, *G. Zenker 4070* (lectotype BR!; isolectotypes BM!, E, G, GOET, P!, S, WU).

Sarmentose liana 1–2.5 m high, with stems ascending and arcuate, rooting at base; stems 3–7 mm thick, densely felted with buff woolly hairs, at length becoming glabrescent. Leaves single at each node and opposed to a stipule; petiole 0.7–3 (–4) cm long, densely felted all around and villose on the upper side with stiff hairs c.1.5 mm long; leaf blade elliptic, (11.2–) 16.5–26 x (4.5–) 5.2–11.2 cm, asymmetrical at base with proximal side subcordate to rounded and distal side obtuse inserted 2–10 mm higher, acuminate at apex, coriaceous and strongly discolorous; upper side green, villose on the midrib and sometimes sparsely so on the lamina, with stiff hairs 1–2 mm long; lower side buff (purplish when young), densely felted with woolly hairs; 10–18 secondary nerves on each side of midrib. Stipules solitary and leaf-opposed (but those of flowering nodes often splitting), shortly connate to the petiole, ovate, (9–) 12–20 x (3–) 7–12 mm, divided in 2–3 usually short segments 1–4(–8) mm long, outside densely felted with buff woolly hairs, inside villose with 2–3 mm long silky hairs forming a triangular area near the base. Inflorescences on leafy stems, opposite to the leaf and initially arising by piercing the base of the stipule which later splits or falls as the inflorescence develops, 1(–2) per node, sessile, glomerulate, 1–3 cm in diameter. Bracts buff, +/- enclosing the flowers when young, broadly ovate, concave, entire, acute to obtuse at apex, 6–7.5 x 3–6 mm, outside densely felted all over and villose at base with long silky hairs 1.5–3 mm, inside glabrous except for long silky hairs at base; bracteoles narrowly ovate to oblong, minutely toothed, 4–5 x 1–2.5 mm, with same indumentum as the bracts. Flowers 5(–6)-merous, sessile, heterostylous. Calyx buff outside and pale green inside; calyx tube 2–2.5 mm long, outside densely felted, inside glabrous; lobes narrowly elliptic to narrowly triangular, 1.7–2.5 x 1–1.6 mm, outside densely felted and sometimes villose on the margin, inside sparsely villose with short appressed hairs; one tiny colleter between each pair of calyx lobes. Corolla entirely white, with tube nearly cylindrical, c. 4.5 x 2 mm, and lobes triangular, 2–3 x 1.2–1.8 mm; outside of corolla tube glabrous, the lobes with dense felt of woolly hairs intermingled with stiff hairs c. 1 mm long; throat and base of lobes inside densely bearded with c.1 mm long white moniliform hairs; inside of tube either villose in the whole upper half (long-styled flowers) or only near the throat and with a separate ring of hairs around the middle (short-

styled flowers). Flower buds with apex broader than long and markedly enlarged. Stamens either included, subsessile and attached around the upper 1/3rd of the tube (long-styled flowers) or exserted with filaments exceeding throat by c.1 mm (short-styled flowers); anthers 1.2 x 0.4 mm long. Ovary 2-locular, with long silky and short woolly hairs intermingled. Disk cylindrical, c.0.3 mm, glabrous. Style bifid, glabrous, either c.6 mm long and exserted (long-styled flowers) or c.3.5 mm long and included (short-styled flowers); stigmas 1–1.2 mm long, broadly elliptic and +/- flattened. Fruits greenish white to pale brown, ellipsoid or obovoid with persistent calyx, 5–7 x 4–6.5 mm when dry, sessile, usually with long silky and short woolly hairs intermingled, rarely with short woolly hairs only. Seeds pale brown, polygonal, c. 0.6 x 0.3 mm, the surface with dense faint parallel striations.

Distribution:—Lower Guinea subcentre of endemism. The species occurs in Cameroon where it is apparently very local and in Equatorial Guinea, and Gabon where it is widespread and locally abundant (Fig. 10).

Habitat and ecology:—Forest edges in half-shade, especially along roads and streams (which are probably the original habitat); 30–1000 m in altitude. The species is particularly abundant in high rainfall areas (Cristal and Chaillu Mts in Gabon) where it is locally dominant in roadside vegetation, forming dense thickets.

Phenology:—Flowering probably throughout the year, recorded in all months except July and September; fruits in March, May and November–January.

Affinities:—*Sabicea batesii* is unique in the genus in having the inflorescences borne outside the stipule, arising through an hole at its base; unfortunately, this character can only be seen on young inflorescences, since they later break up the stipule while expanding. The species is further unusual (in the genus, and in Rubiaceae as a whole) in having pseudo-alternate leaves opposed to a stipule, a character shared with *S. sthenula, S. mapiana,* and some variants of *S. mildbraedii* var. *glabrescens*. The differences between these four species are summarised in Table 4; the latter two species are especially similar to *S. batesii*, but are less robust plants and have the inflorescences borne inside the stipules.

There is also a similarity of habit between *S. batesii* and other tall sarmentose species (*S. aurifodinae, S. crystallina, S. jacfelicis, S. ndjoleensis* and *S. sciaphilantha*) but all these have the leaves in unequal pairs, and inflorescences mostly borne on older stems below the leaves; with the exception of *S. jacfelicis*, they also have a much longer corolla than *S. batesii*.

Table 4. Distinguishing characters between *Sabicea batesii*, *S. mapiana*, *S. mildbraedii* var. *glabrescens* and *S. sthenula*

Characters	***S. batesii***	***S. mapiana***	***S. mildbraedii* var. *glabrescens***	***S. sthenula***
Habit	**Sarmentose liana to 2.5 m**	Very low and creeping	Low and creeping at base, to 50 cm	Very low and creeping
Indumentum of stems	short woolly hairs only	short woolly and long stiff hairs intermingled	short woolly hairs, sometimes also with long stiff hairs	long silky hairs
Stipule shape	2- to 3-fid	5- to 10-fid	2- to 5-fid	5- to 14-fid
Leaves (cm)	(11.2–)16.5–26 x (4.5–) 5.2–9	5.8–15.5 x 3.2–8	4.5–12.5 x 2–7	4.2–12 x 2.4–8.5
Inflorescence	**many-flowered, extrastipular**	few-flowered, intrastipular	usually few-flowered, intrastipular	few-flowered, intrastipular
Calyx lobes	narrowly elliptic to triangular, 1.7–2.5 x 1–1.6 mm	narrowly triangular, 3–4.5 x 0.6–1.3 mm	short and broadly elliptic, 1–1.8 x 0.7–1.2 mm	**broadly elliptic, 4–6 x 0.5–1 mm**
Exterior of calyx	buff, densely felted	buff, densely felted	buff or whitish, densely felted	**green, not or very sparsely felted**
Indumentum of ovary	long stiff and short woolly hairs intermingled (the stiff hairs sometimes caducous in fruit)	long stiff and short uncinate hairs intermingled	**short woolly hairs only**	long stiff hairs
Corolla	entirely white	entirely white	entirely white	**tube pink, lobes white**
Anthers of short-styled flowers	exserted	included	exserted	included

Notes:—The description of *S. batesii* (Wernham 1914) is based on two syntypes, *Zenker 4070* and *Bates 536*. The former is better distributed in herbaria, and is therefore chosen as lectotype.

The stipules of *S. batesii*, described as entire (Wernham 1914), are in fact 2- to 3-fid, usually shortly so. However, damaged stipules can appear entire at apex.

The collection *N. Hallé & G. Cours 5945*, without flowers or fruits, was cited with doubt under *S. batesii* in the Flore du Gabon (Hallé 1966: 204) and later considered as probably belonging to *Pseudosabicea aurifodinae* var. *crystallina* (Hallé 1971: 317). This specimen is much too hairy for either *S. batesii* or *S. crystallina*, and also differs from the former in having the leaves in unequal pairs; it is rather referrable to *S. sciaphilantha* subsp. *hirsuta*.

A collection from Equatorial Guinea, *Lisowski M-1400* (BRLU), resembles *S. batesii* in having pseudoalternate leaves and inflorescences borne outside the stipule, but has smaller leaves and more hairy calyx lobes. This specimen lacks good flowers and better material from the same area is needed to decide its status; it could possibly be a hybrid between *S. batesii* and *S. parmentierae*.

Conservation status:—IUCN Red List Category: **Least Concern [LC]**. The extent of occurrence is estimated as 189,585.529 km^2 and the area of occupancy as 128.000 km^2 based on herbarium records. The latter feature falls within the limit for Endangered under criterion B2, but is obviously much underestimated, since we observed the species to be common and widespread along many roads in the central part of Gabon. The species is known from more than 10 localities, occurs mostly in sparsely populated areas, and is actually favoured by small-scale forest clearance due to its preference for open habitats; it is therefore not threatened.

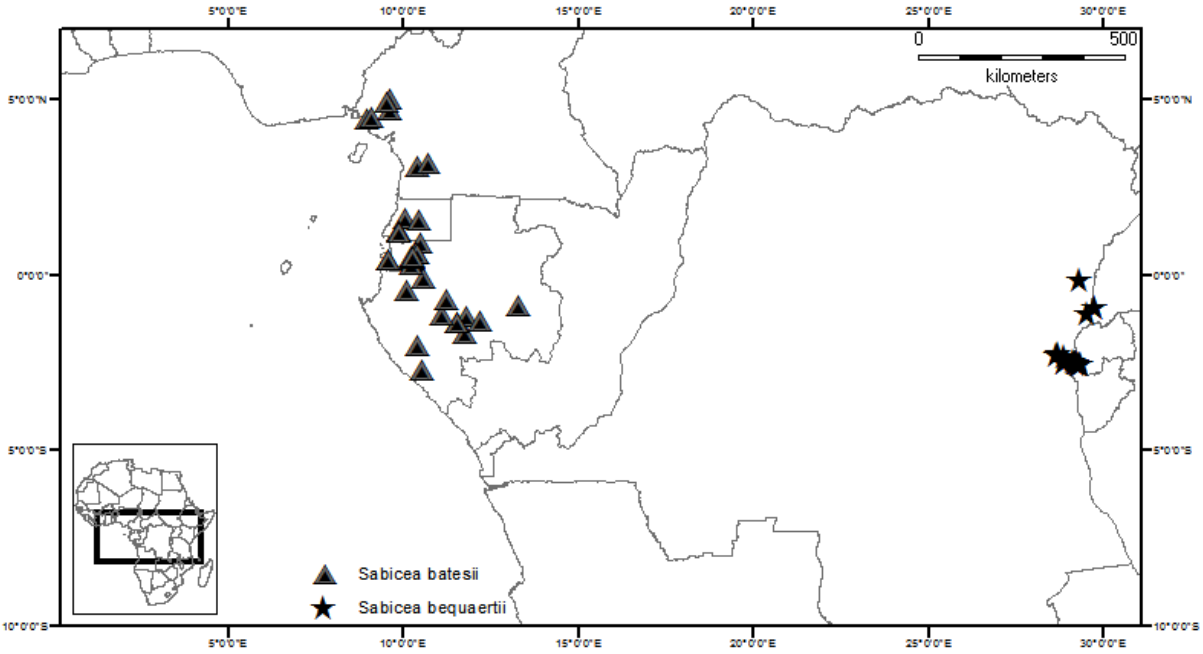

FIGURE 10. Distribution of *Sabicea batesii* and *S. bequaertii*.

Additional specimens examined:—**CAMEROON**. Bakossi Mountains 1–8 km NNE of Menyum Village, 22–30 May 1987, *C. Doumenge 597* (BR, MO); Mokoko Forest Reserve, Ekombe–Mofako, 03 June 1994, *D. Pouakouyou & M. Etuge 33* (MO); près Mokoko River Forest Reserve 40 km NW de Muyuka, 31 May 1976, *B. Satabié 290* (BR, P); Mokoko Forest Reserve, 01 May 1995, *B. Sonké 1079* (BR); Bakossi forest between Nyandong and Molongo, 18 February 1987, *D.W. Thomas 6695* (MO); road 5 km north of Mekalat (to Lolodorf), 11 March 1997, *van Gemerden 80* (SCA, YA). **EQUATORIAL GUINEA**. Rio Mbambala, campement Shimmer km 16 (entre Rio Muni et Monte Mitra), 22 August 1997, *N. Nguema & J. Lejoly 13* (BRLU, P); inselberg de Bicurga, près du village de Bicurga, 24 May 2002, *I. Parmentier & P. Esono 3398* (BRLU); SO du Parc National de Monte Alén, entre la station Ecofac de Mosumo et Monte Boracho, 12 February 2001, *B. Senterre & D. Ngomo 279,1* (BRLU); 4 km N de Mitong, 12 December 2003, *B. Sonké & P. Esono 3143* (BR, BRLU, MO). **GABON.** Mfoa, 85 mi. E of Gabon, October 1896, *G.L. Bates 536* (BM!, G!, K!, P!); 8 km S.S.W. of the hydroelectric power station in the Mbé river at Kinguélé, 28 August 1978, *F.J. Breteler & J.J.F.E. de Wilde 352* (BR, P, MO, WAG); Crystal Mountains, 3 km NE of Kinguélé. Road from Kinguélé to Tchimbélé, 11 September 1994, *F.J. Breteler et al. 12809* (WAG); Barrage de Kinguélé, downstream of the hydroelectric power station, 19 November 1986, *J.J.F.E. de Wilde et al. 8834* (BR MO, P, WAG); Monts de Cristal, inselberg Milobo, 10 km N Mbé Akélayong, 50 km W Medouneu, 03 December 2001, *J. Degreef 245* (BR); Monts de Crystal, Kinguéle, 07 february 2008, *S. Dessein et al. 1746* (BR, LBV, WAG); Doudou Mountains National Park, c. 8 km S of Peny, 16 February 2008, *S. Dessein et al. 1911* (BR); Mouyanama falls, at base of Mt Songou, 22 February 2008, *S. Dessein et al. 2076* (BR); Boussimbi village, at base of Mt Iboundji, 04 Mars 2008, *S. Dessein et al. 2376* (BR); km 18 à l'E de Libreville, 28 January 1961, *N. Hallé 930* (P); km 18 de Libreville, 02 April 1963, *N. Hallé 1528* (P); Abanga, chantier CEFA, 01 June 1963, *N. Hallé 2125* (BR, P); chutes de Kinguélé, rivière Mbei, 15 January 1968, *N. Hallé & J.F. Villiers 4440* (P); Mont Mvélakéné, 6 km SW Méla, 14 February 1968, *N. Hallé & J.F. Villiers 5258* (P); Moumba

côté ouest, environs d'Etéké, 19 May 1963, *N. Hallé & G. Cours 6049* (P); Moubigou 2, 21 May 1963, *N. Hallé & G. Cours 6140* (P); Piste du Lac Azingo, +/- 10 km au NE du lac et 30 km au NW de Lambaréné, 26 October 2014, *O. Lachenaud et al. 2081* (BR, BRLU, LBV, MO, WAG); Monts de Crystal, Kinguélé, 13 April 2006, *M.E. Leal et al. 1100* (BR); Dibouka, 21 November 2004, *A.C.Ley & Yedy 75* (WAG); Waka National Park. c. 10 km SE of Oghoubi Camp, 20 March 2007, *M. Sosef et al. 2455* (WAG); Concession Bordamur, SE of Ndjolé, 26 February 2009, *T. Stévart et al. 3074* (BR); Doudou Mountains, Igotchi, 21 November 2003, *J.L.C.H. van Valkenburg et al. 2569* (BR, MO, WAG); Crystal mountains, 1½ km SW of Tchimbélé, along side of an old road, 22 December 1989, *J.J. Wieringa 275* (BR, MO, WAG); Crystal Mountains, 14 km on the road from Kinguélé to Tchimbélé (=57 on SEEG road), 13 November 2004, *J.J. Wieringa et al. 5410* (MO, WAG).

4. *Sabicea becquetii* N.Hallé (1964: 400) Razafim., B. Bremer, Liede & S.A.Khan (Khan et al. 2008: 14) (Fig. 11).

Pseudosabicea becquetii N.Hallé (1964: 400).

Type:—BURUNDI. Bururi, chefferie Ararawe, 1,600 m, September 1932, *A. Becquet 115* (holotype BR!; isotypes BR!, P!).

Scrambling shrub or liana, often sarmentose and up 3 m high, but sometimes much lower and prostrate; stems 2–4 mm thick, with sparse felt of wolly hairs often intermingled with long patent hairs 1.5–2 mm long. Leaves opposite, slightly unequal to subequal; petiole 0.1–2.5 cm long, densely felted all around and villose with long stiff hairs on the upper side; leaf blade elliptic, 3.7–14 x 1.8–6.8 cm, +/- symmetrical, acute to obtuse at base, acuminate at apex, strongly discolorous; upper side green, sparsely villose or rarely glabrescent, with stiff hairs 0.5–1 mm long, in the young stage sometimes intermingled with sparse woolly hairs; lower side whitish, densely felted and sometimes also with long stiff hairs on the midrib; secondary nerves 7–17 on each side of midrib. Stipules paired at nodes, free and interpetiolar, ovate to suborbicular, acute or obtuse, entire or shortly bilobed at apex, 5–10 x 4–12 mm, initially erect but soon reflexed, outside densely felted and sparsely villose at least on the margin, inside glabrous except for the base with short stiff hairs c.0.5 mm long. Inflorescences axillary on leafy stems, one per node, sessile, densely glomerulate, 1–2.5 cm in diameter, with 5–20 flowers. Bracts whitish outside and green inside, free, in 2 main pairs (sometimes with additional smaller bracts), elliptic to narrowly ovate, entire, acute to obtuse at apex, patent, 7–20 x 3–8 mm, outside densely white-felted and also sparsely villose with stiff hairs 1.2–2 mm long, inside villose with stiff hairs 1–1.5 mm long sometimes intermingled with very sparse woolly hairs; bracteoles narrowly ovate, entire and acute at apex, 5.5–7 x 1–1.5 mm, outside with same indumentum as the bracts, inside glabrous except for short hairs c.0.5 mm long at

the base. Flowers sessile, 5-merous, heterostylous. Calyx tube c. 0.7 mm, outside densely white-felted and sparsely villose with long stiff hairs, inside glabrous; calyx lobes elliptic and acute, patent, 3–8 x 0.5–1 mm, outside densely white-felted and sparsely villose with stiff hairs, inside glabrous or very sparsely villose; 1–2 tiny colleters between every pair of calyx lobes. Corolla white to pinkish white, with cylindrical tube 8.5–11 x 1.5–2 mm and triangular lobes 3–4 x 1.5–2.3 mm; outside of corolla hairy (except the glabrous base of the tube) with intermingled short woolly and long silky hairs, the latter sometimes restricted to the apex of the lobes; throat and upper half of tube inside sparsely hairy with short multicellular hairs c. 0.5 mm long. Flower buds nearly cylindrical and only slightly enlarged at apex. Stamens either included, subsessile and attached around the middle of the tube (long-styled flowers) or with their tips exserted, on filaments c.1 mm long attached near the throat (short-styled flowers); anthers 2 x 0.4 mm. Ovary 2-locular, with long silky and short woolly hairs intermingled. Disk cylindrical, c. 0.6 mm long, glabrous. Style bifid, glabrous, either c.13 mm long and exserted (long-styled flowers) or c.6 mm long and included (short-styled flowers); stigmas 3 mm long (long-styled flowers) or 1.2 mm long (short-styled flowers), narrowly elliptic and +/- flattened. Fruits red, with flesh also red, ellipsoid with persistent calyx, 5–7 x 4.5–5 mm when dry, sparsely hairy with long silky and short woolly hairs intermingled (the latter +/- caducous), sessile. Seeds brown, polygonal, c. 0.8 x 0.5 mm, reticulate.

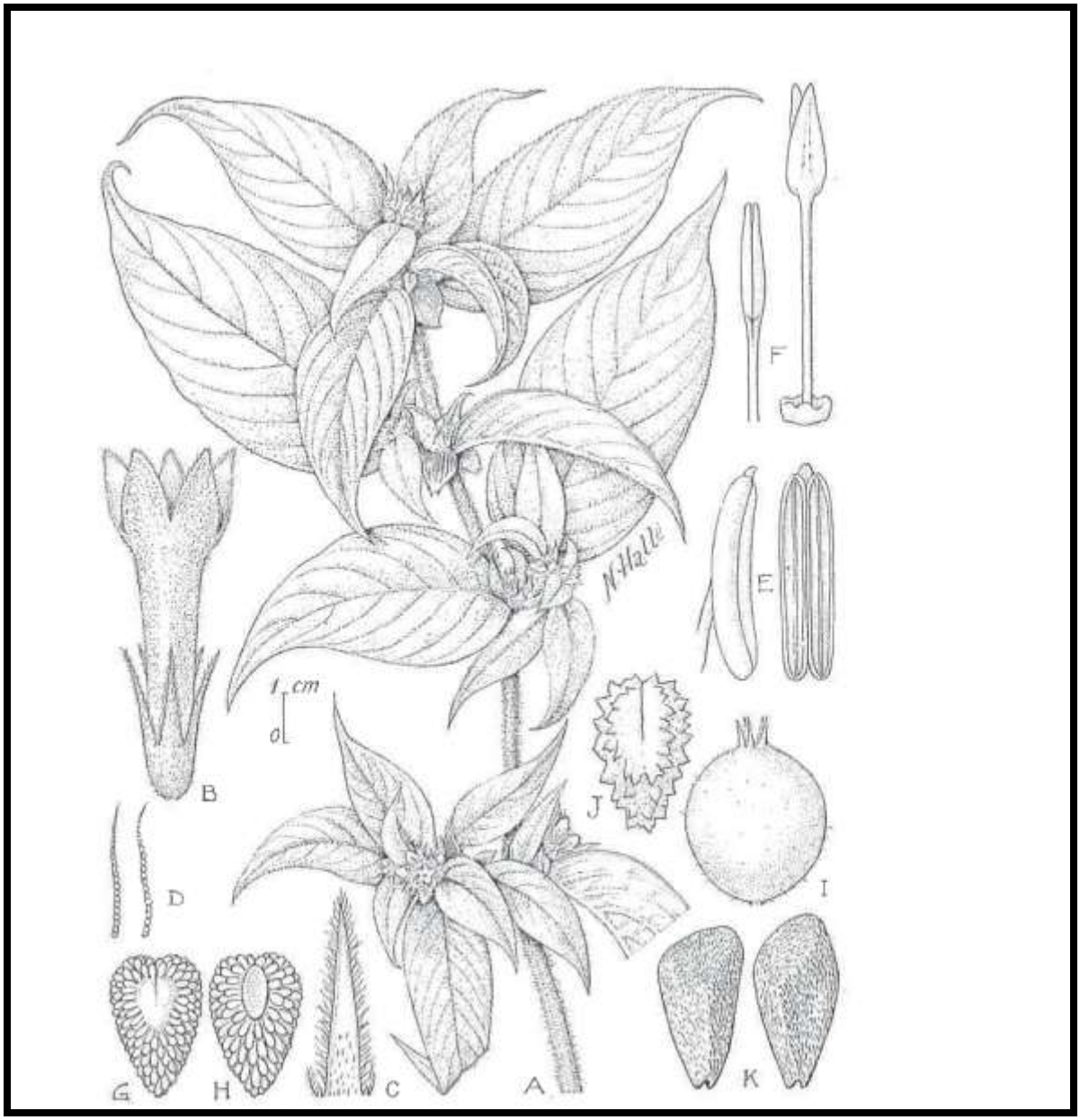

FIGURE 11. *Sabicea becquetii*. A, flowering stem; B, flower; C, calyx lobe viewed from inside; D, hairs from the corolla throat; E, anthers; F, style; G–H, placenta with ovules; I, fruit; J, placenta, the ovules removed; K, seeds. All details from *Becquet 115*. Drawing by N. Hallé, reprinted from Hallé (1964: 401).

Distribution:—Lake Victoria Regional Mosaic. Endemic to Burundi, where locally abundant (Fig. 8).

Habitat and ecology:—Savannas and gallery forests; 1300–2200 m in altitude.

Phenology:—Flowers collected in March, May, and all months from August to January, probably all year round. Fruits in March–May, July and October.

Affinities:—*Sabicea becquetii* resembles *S. arborea* and *S. bequaertii*, but has much longer calyx lobes. It also differs in having the leaves usually villose on the upper side (rarely glabrescent, e.g. in *Bouharmont 13179*) and the bracts generally larger; see Table 2 for a summary of differences. Furthermore, it has a different range, the other two species being not known from Burundi.

Notes:—The habit of the species seems to be quite variable according to collectors' notes, and needs further study on the field. It is apparently not a free-standing shrub, but rather a scrambling plant, somewhat intermediate between a shrub and liana (S. Ntore, pers. comm.).

The seeds of *S. becquetii*, which have been described as smooth (Hallé, 1964), are in fact conspicuously reticulate (Fig. 6).

Conservation status:—IUCN Red List Category: **Vulnerable [VU B1ab(i,ii,iii,iv,v) + 2ab(i,ii,iii,iv,v)].** The extent of occurrence is estimated as 3868.579 km^2 and the area of occupancy as 80 km^2, both within the limit for Endangered under criteria B1 and B2. Based on herbarium records, the species is known from 15 subpopulations, but 7 of these are likely to be extinct, and many others are threatened; only two are in protected areas (the Bururi Forest Reserve and Kinoso Nature Reserve, both of which are very small in extent). The species occurs in a densely populated region, where clearance of its habitat for agriculture represents the main threat; a decline in the extent of occurrence, area of occupancy, extent and quality of the habitat, number of locations and number of individuals can therefore be assumed. It qualifies as Vulnerable under conditions B1ab(i,ii,iii,iv,v) and B2ab(i,ii,iii,iv,v), and is likely to become Endangered in the near future.

Additional specimens examined:—**BURUNDI**. Munini (Mashuha, préfecture de Bururi), source de la Sikuvyaye, 22 September 1974, *P. Auquier 4195* (BR); Entre Bujumbura et Bugarama, 02 March 1980, *J. Bouharmont 13179* (BR); Rushubi, 02 January 1966, *J. Lewalle 170* (BR); Route entre Bururi et Makamba, 21 November 1966, *J. Lewalle 1306* (BR, MO); Kayanza: Route de Butara près de Ndora, 17 December 1967, *J. Lewalle 2556* (BR, MO); Kumuyange, 29 May 1971, *J. Lewalle 5830* (BR); Honga, 14 October 1971, *J. Lewalle 6229* (BR, MO); Buta, Bururi, 24 April 1953, *G. Michel 4446* (BR); Source du Nil, Bututsi, 5 March 1955, *G. Michel 4686* (BR); Makamba, 29 October 1980, *P. Ndabaneze 1272* (BR); Centre provincial de Makamba, à côté de l'école primaire, 20 December 2007, *F. Niyongabo 44* (BR); Réserve Naturelle Forestière de Bururi, 25 June 2004, *F. Niyongabo 58* (BR); Réserve Naturelle de Kinoso, 24 December 2007, *F. Niyongabo 62* (BR); Réserve forestière de Bururi, 28 July 2014, *S. Ntore 777* (BR); Nördlich von Mukayagoro, 07 March 1926, *A. Peter 38402* (BR, WAG); Munini, 22 September 1974, *J. Rammeloo 4756* (BR); Vallée Sikuvyaye, 28 August 1971, *M. Reekmans 934* (BR); Honga, 14 October 1972, *M. Reekmans 1062* (BR, MO); Vallée Siguvyaye, 20 September 1974, *M. Reekmans 3577* (BR); Vallée Siguvyaye, 31 December 1974, *M. Reekmans 4054* (BR, GH); Kwitaba, 19 October 1977, *M.*

Reekmans 6532 (BR, P, MO); Kwitaba, 15 December 1977, *M. Reekmans 6824* (BR, MO); Vyanda-Kigwena, 06 May 1982, *M. Reekmans 11116* (BR, MO, UPS, WAG).

5. *Sabicea bequaertii* De Wild. (De Wildeman 1924: 229).

Pseudosabicea arborea subsp. *bequaertii* (De Wild.) Verdc. (Verdcourt 1976: 183). Type:—DR Congo. Kabango, 3 November 1914, *Bequaert 6178* (holotype BR!; isotype BR!).

Sarmentose shrub or liana, up to 5 m, with alternate branching; stems 1.5–3.5 mm thick, densely white-felted in the young stage, later glabrescent. Leaves opposite, equal to slightly unequal; petiole 0.5–1.5 cm, covered all around with a soon caducous felt of woolly hairs, and persistently villose on the upper side with stiff hairs c.1 mm long; leaf blade elliptic, 3–11 x 1.5–4.6 cm, symmetrical, acute at base, acuminate at apex, papery to slightly coriaceous, strongly discolorous; upper side green, sparsely white-felted in the young stage, soon becoming glabrous; lower side whitish to buff, densely felted with woolly hairs; secondary nerves 9–15 on each side of midrib. Stipules paired at nodes, free and interpetiolar, ovate to triangular, entire, acute to obtuse at apex, 4–8 x 2.5–5.5 mm, erect, outside glabrous or sparsely felted on margins, inside glabrous except the base with stiff hairs c.1 mm long. Inflorescences axillary on leafy stems, one per node, sessile, densely glomerulate, 0.6–1.5 cm in diameter, few- to many-flowered. Bracts conspicuous and surrounding the inflorescence; outer pair of bracts shortly connate at base, ovate, concave, entire, acute and +/- bending outwards at apex, 7–10 x 5–7 mm, outside glabrous at base and +/- felted towards the apex, inside almost entirely villose with silky hairs c. 1.2 mm long; inner bracts spathaceous, concave, +/- bilobed, 4.5–8 x 3–5 mm, outside glabrous at base and hairy at apex with a mixture of short woolly and long silky hairs, inside almost entirely villose with long silky hairs; bracteoles narrowly obovate to narrowly elliptic, free, acute, 3–5 x 0.8–1.8 mm, with indumentum similar to the inner bracts. Flowers, 5-merous, sessile, heterostylous. Calyx tube cylindrical, 2–2.5 mm long, outside mostly glabrous (or very sparsely villose) with the base white-felted, inside densely villose with silky hairs directed upwards and 0.8–1.5 mm long; calyx lobes 0.5–1.3 mm long, triangular to linear, acute at apex, erect, outside villose with erect silky hairs c.1 mm long, inside villose like the tube. Corolla entirely white, with narrowly cylindrical tube (6.5–) 9–13 x 1–2 mm and triangular lobes 4–6 x 1.2–2.5 mm; outside of corolla densely villose with appressed silky hairs 0.5–1.2 mm long on the lobes and

upper half of tube, the base of the tube glabrous; throat and upper part of tube inside sparsely hairy with short hairs c.0.2 mm long; inside of lobes densely papillose. Flower buds only slightly enlarged at apex. Stamens either included, subsessile and attached slightly above the middle of the tube (long-styled flowers) or half-exserted with the apex bending outwards, subsessile and attached in the upper part of the tube (short-styled flowers); anthers c. 2 x 0.4 mm. Disk cylindrical, glabrous, c. 0.5 mm long. Ovary 2-locular, densely white-felted all over, and villose near the base with stiff hairs c.1 mm long. Style bifid, glabrous, either 11–14 mm long and exserted (long-styled flowers) or c.9 mm long and included (short-styled flowers); stigmas 2–2.5 mm long, narrowly cylindrical. Fruits red, ellipsoid with persistent calyx, 6 x 4.5 mm when dry, sessile, sparsely hairy with long stiff and short woolly hairs intermingled. Seeds dark brown, polygonal, c.1 x 0.7 mm, reticulate.

Distribution:— Guinea-Congolia/Zambesia transition zone. Restricted to the highlands of eastern DR Congo (Kivu), Rwanda (Nyungwe forest) and Uganda (Fig. 10); apparently frequent to common in its limited range.

Habitat and ecology:—The species usually grows in montane forest and on wet banks of roads, 1600–2400 m in altitude. Only the type specimen is noted as having been collected in "steppe à *Acanthus*", which might be an error.

Phenology:—Flowers in January–May and July–September; fruits in February and July.

Affinities:—*Sabicea bequaertii* has been treated by recent authors either as a synonym (Hallé 1964) or subspecies (Verdcourt 1976: 183; Verdcourt & Bridson 1988: 455) of *S. arborea*. The two taxa are certainly closely related, and are probably vicariants occuring in different mountain ranges. However, the differences between them (see Table 2) seem amply sufficient to treat them as separate species.

Notes:—*S. bequaertii* is not to be confused with *S. becquetii*, which is closely related and has a confusingly similar name.

Conservation status:—IUCN Red List Category: **Vulnerable [VU B1ab(i,ii,ii,iv,v) + B2ab(i,ii,ii,iv,v)].** The extent of occurrence is estimated as 17196,970 km^2 and the area of occupancy as 60 km^2, respectively within the limits for Vulnerable and Endangered under criteria B1 and B2. The species is known from 12 subpopulations representing 7 locations. Most of the subpopulations occur in protected areas (Nyungwe National Park in Rwanda,

Kahuzi-Biega N.P. in DR Congo, and Bwindi-Impenetrable N.P. in Uganda). However, in view of the high population pressure and political instability of the region, a decline in the extent of occurence, area of occupation, habitat extent and quality, number of locations and number of individuals can be expected, and the species qualifies for Vulnerable status under the conditions B1ab(i,ii,ii,iv,v) and B2ab(i,ii,ii,iv,v).

Additional specimens examined:—**DR CONGO**. Lwamisole, 15 June 1949, *F.L. Hendrickx 5953* (BR); Kahusi, 11 March 1959, *A. Léonard 3422* (BR); Kahusi, 28 April 1959, *A. Léonard 3989* (BR); Route Bukavu–Astrida, 23 July 1959, *A. Léonard 5106* (BR, P); Kivu, 29 km au S de Butembo, 14 April 1973, *S. Lisowski 17605* (BR); Route Kalongi vers 52 km de Bukavu, 13 July 1972, *J. Ntakiyimana 270* (BR); Réserve du Kahusi-Biega, Km 21,5 route Kavumu-Walikale, 19 March 1957, *R. Pierlot 1509* (BR). **RWANDA**. Forêt de Nyungwe, km 120, 19 January 1971, *G. Bouxin 34* (BR); Forêt de Nyungwe au km 101, bord du marais Kamaranzovu, 26 January 1971, *G. Bouxin 187* (BR); Forêt de Nyungwe, route Butare–Cyangugu, sentier au km 100, 20 August 1959, *G. Bouxin & M. Radoux 695* (BR); Forêt de Nyungwe, environs de Busozo, 20 May 1971, *G. Bouxin 826* (BR); Forêt de Nyungwe, environs du Kamiranzovu, 15 September 1971, *G. Bouxin 1140* (BR); Environ de Rangiro, piste vers le mont Ruheru, 07 February 1980, *D. Bridson 334* (BR, WAG); Kamiranjovu, 17 March 1956, *A.R. Christiaensen 1399* (BR); Territoire de Shangugu, 14 February 1958, *G. Michel 5111* (BR); Km 99, route Butare–Cyangugu; forêt de Rugege, 10 May 1973, *C. Nuyt 98* (BR); Forêt de Rugege, km 104 route Astrida–Bukavu, 28 February 1957, *R. Pierlot 1490* (BR); Rutovu, km 62 de la route Astrida–Shangugu, 14 April 1958, *M. Reynders 296* (BR); Route Bukavu–Astrida, environs d'Uwinka, colline Kwinzira, 06 March 1959, *G. Troupin 9805* (BR); Bukavu, vers km 93, environ d'Uwinka, colline Bunyangurube, 08 January 1960, *G. Troupin 11506* (BR); Route Bukavu–Astrida, environs d'Uwinka; colline Lutoyi, 07 Juy 1960, *G. Troupin 12423* (BR). **UGANDA**. Kayonza forest, Kigezi, October 1940, *Eggeling 4172* (K); Marambo, Kayonza, Kigezi, March 1947, *Purseglove 2387* (K).

6- *Sabicea crystallina* (N.Hallé) Zemagho, O.Lachenaud & Sonké, *comb & stat. nov.*

Basionym: *Pseudosabicea aurifodinae* var. *crystallina* N.Hallé, Adansonia, sér. 2, 11: 316 (1971).

Type:—GABON. Rivière Balakabo, sous-affluent de la haute Noya, 18 km WSW de Méla, Monts de Cristal, 20 January 1968, *N. Hallé & J.F. Villiers 5428* (holotype P!).

Sarmentose liana up to 2 m high, forming dense tangles; stems 2–6 mm thick, glabrous or very sparsely villose with stiff hairs c.1.5 mm long. Leaves opposite, strongly unequal with one of them much reduced; reduced leaf with petiole 0–0.2 cm long and leaf blade 0.4–1 x 0.2–0.7 cm; normal leaf with petiole 0.9–3 cm long, glabrous or sparsely villose like the stems; leaf blade elliptic to slightly obovate, 8.5–26 x 3.4–11.4 cm, asymmetrical at base with

proximal side obtuse to subcordate and distal side acute to obtuse inserted up to 8 mm higher, papyraceous to coriaceous, strongly discolorous; upper side green, glabrous or sparsely villose with stiff hairs 1–2 mm long; lower side white to pale buff, densely felted with woolly hairs; secondary nerves 10–19 on each side of the midrib. Stipules paired at nodes, interpetiolar and connate at base with the petioles into a sheath 3–8 mm long, the free part narrowly ovate, entire, acute at apex, 5–23 x 1.2–5 mm, erect to patent, glabrous outside or very sparsely ciliate on the margin, glabrous inside except the base with stiff hairs c.1.5 mm long. Inflorescences on older stems below the leaves, or sometimes in the axils of the lowest leaves, 1–2 per node, sessile, glomerulate, 1–1.7 cm in diameter, with 5–15 flowers. Bracts and bracteoles ± hidden between the flowers and not enclosing them; bracts triangular, acute, 1.5–3.5 x 0.7–1.5 mm, outside glabrous or sparsely felted and sometimes villose on margin, inside densely villose with long stiff hairs in the lower half and glabrous in the upper half; bracteoles narrowly ovate, entire or shortly toothed, acute to obtuse at apex, 1.5–6.5 x 0.5–1 mm, with same indumentum as the bracts. Flowers 5-merous, sessile or with short pedicel up to 1 mm; only long-styled flowers seen. Calyx with purplish tube and white lobes; tube 0.5–1.3 mm, outside glabrous or sparsely villose, inside glabrous; lobes narrowly elliptic to narrowly ovate, +/- of the same width throughout or slightly broadening near the apex, acute to rounded, 2.5–5.5 x 0.3–1.2 mm, thin and flat (not channelled), patent to oblique and divergent from each other, outside glabrous to hairy (see descriptions of subspecies), inside glabrous; 1–4 minute colleters usually present between every pair of lobes. Corolla entirely white, with tube narrow and almost cylindrical, 8–11 x 1–2 mm, lobes triangular, 2–2.5 x 1.2–1.5 mm; outside of corolla tube always glabrous, the lobes either glabrous or villose with stiff hairs c. 1 mm long; throat and base of lobes inside densely bearded with white moniliform hairs c.1 mm long; inside of tube hairy in upper part down to the base of the anthers, and with 5 patches of hairs around the middle of the tube. Flower buds with apex ovoid and slightly enlarged. Stamens included or with their tips slightly exserted, attached above the upper third of the tube, on filaments c. 1.5 mm long; anthers c. 1.5 x 0.5 mm. Ovary 2-locular, glabrous or very sparsely villose with stiff hairs. Disk cylindrical, c. 0.3 mm long, glabrous. Style bifid, glabrous, c. 12 mm long and exserted; stigmas c. 1 mm long, broadly elliptic and +/- flattened. Fruits green (probably not mature), obovoid with persistent calyx, c. 5 x 3.5 mm when dry, subsessile or with short pedicel to 1.5 mm long. Seeds brown, polygonal with truncate apex, c. 0.5 x 0.3 mm, the surface with dense faint parallel striations.

Affinities:—*Sabicea crystallina* resembles *S. aurifodinae*, and was originally described as a variety of it (Hallé 1971). The differences between them are slight, but the two taxa have a different facies and separate ranges, and we feel they are better treated as separate species. *S. sciaphilantha* and *S. ndjoleensis* also belong to the same group; the differences between all four species are shown in Table 3.

Notes:—Only two specimens with open flowers are known (one from subsp. *crystallina* and one from subsp. *engongensis*); both are of the longistylous form.

Hallé (1971: 317) regarded as probably belonging to this taxon the specimen *N.Hallé & G.Cours 5945*, which he had earlier referred with doubt to *S. batesii* (Hallé 1966: 204). This specimen, although lacking flowers or fruits, is far too hairy for both species, and rather seems to represent *S. sciaphilantha* subsp. *hirsuta*.

Conservation status:—IUCN Red List Category: **Near-Threatened [NT].** The extent of occurrence is estimated as 5,259.358 km^2 and the area of occupancy as 40 km^2, respectively within the limits for Vulnerable and Endangered under criteria B1 and B2. The species is known from 9 subpopulations representing 7 locations, within the limit for Vulnerable under the conditions B1a and B2a. However, there is no evidence of a decline in either extent of occurrence, area of occupancy, extent or quality of habitat, number of locations or number of individuals. The species occurs in a sparsely populated area, and is adaptable to some degree of habitat degradation due to its preference for open habitats. Five of its subpopulations are situated in national parks (Monte Alén N.P. in Equatorial Guinea, and Monts de Cristal N.P. in Gabon). Nevertheless, in view of its small range, it seems appropriate to treat it as Near-threatened.

Key to the subspecies

1. Calyx glabrous or with very sparse hairs on margin; corolla outside glabrous or nearly so ..... *S. crystallina* subsp. *crystallina*

– Calyx hairy outside; corolla outside with long stiff hairs on the lobes ....*S. crystallina* subsp. *engongensis*

6a. Sabicea crystallina subsp. ***crystallina***.

Stems, petioles and upper side of leaf blade glabrous or sparsely villose. Stipules 5–23 x 1.2–5 mm. Bracts c. 1.5 x 1.5 mm, bracteoles 1.5–3 x 0.2–0.5 mm. Calyx tube glabrous outside; calyx lobes 2–4.5 x 0.3–1 mm, glabrous or sparsely villose on the margin only. Corolla glabrous outside or sometimes with very sparse stiff hairs near the apex of the lobes.

Distribution:—Lower Guinea subcentre of endemism: Restricted to Equatorial Guinea and northwestern Gabon (Cristal Mountains and their foothills) (Fig. 12).

Habit and ecology:—Open areas in wet evergreen forest; 60–550 m in altitude.

Phenology:—Flowers in November and December; immature fruits from November to April.

Notes:—The specimen *N.Hallé 2368* (P) from Abanga, Gabon, probably belongs here but lacks flowers and fruits, and cannot be identified with certainty.

Conservation status:—IUCN Red List Category: **Near-Threatened [NT].** The extent of occurrence is estimated as 3037.849 km^2 and the area of occupancy at 36 km^2, respectively within the limit for Vulnerable and Endangered under criteria B1 and B2. The taxon is known from 8 subpopulations representing 6 locations. Four of the subpopulations are situated in national parks (Monte Alén N.P. in Equatorial Guinea, and Monts de Cristal N.P. in Gabon). The situation of *S. crystallina* subsp. *crystallina* is thus very comparable to that of the species as a whole, and the taxon is assessed to be Near-threatened for the same reasons.

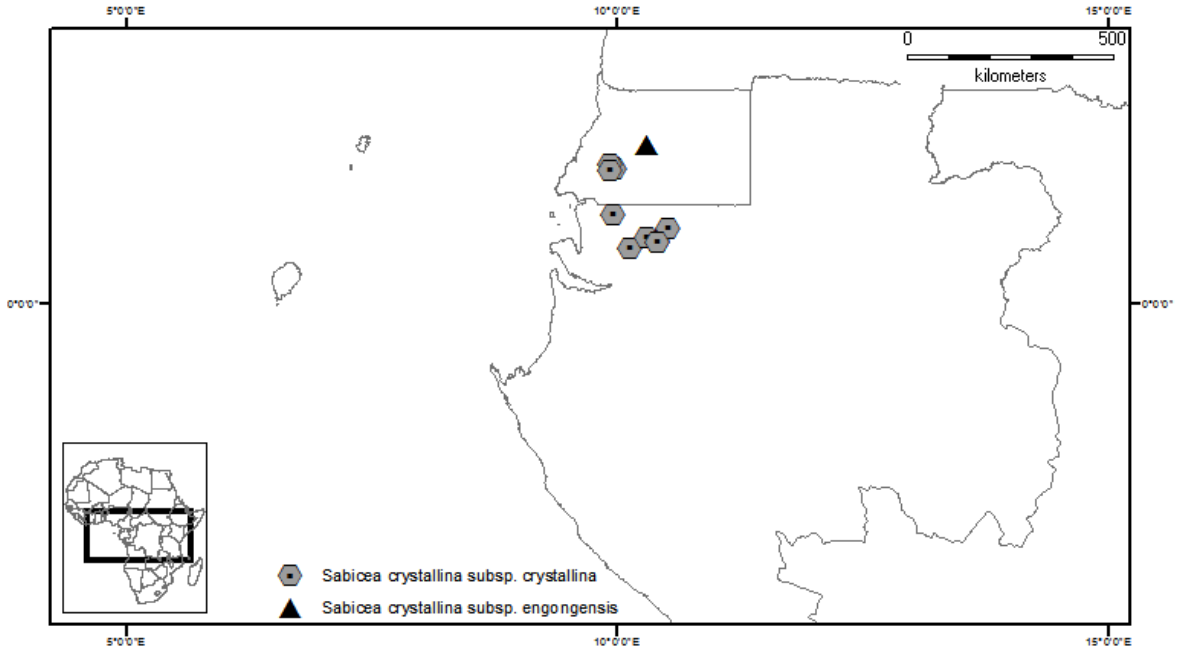

FIGURE 12. Distribution of *Sabicea crystallina* subsp. *crystallina* and *S. crystallina* subsp. *engongensis.*

Additional specimens examined:—**EQUATORIAL GUINEA**. De Sendje à Ongamnsok, 19 February 2001, *J. Lejoly 01/16* (BRLU); Region continentale: Monte Mitra, 30 November 1997, *C. Obama 341* (BRLU, WAG); 19 km au N de Mitong, 15 December 2003, *B. Sonké & P. Esono 3192* (BR). **GABON**. South of Tchimbélé dam, 06 February 2008, *S. Dessein et al. 1721* (BR, WAG); Nkan, Monts de Cristal, 31 January 1968, *N. Hallé & J.F. Villiers 4794* (P); 5 km sur la route forestière, 1 km droite direction Libreville sur la route Asok–Kougoulou, 17 November 1982, *A.M. Louis 116* (WAG); Tchimbélé dam, monts de Cristal, road N of dam., 0.4 km N of dam, 12 November 2000, *G. Walters et al. 505* (BR, MO, WAG); Estuaire: Ekorado Village, Mitemboni River, 26 April 2001, *G. Walters et al. 553* (BR, MO, WAG); Crystal Mountains, Tchimbélé, ½ km SE of dam, 19 December 1989, *J.J. Wieringa 253* (MO, WAG).

6b. *Sabicea crystallina* subsp. ***engongensis*** Zemagho, O.Lachenaud & Sonké, *subsp. nov.*(Fig. 13).

Type:—EQUATORIAL GUINEA. Parc national de Monte Alen, dalle rocheuse d'Engong, 5 km à l'Ouest du village d'Engong, 11 May 2002, *I. Parmentier & P. Esono 2732* (holotype BRLU!).

Stems, petioles and upper side of leaf blade glabrous. Stipules 13–20 x 2–4 mm. Bracts 3–3.5 x 0.7–1.2 mm, bracteoles 4–6.5 x 0.5–1 mm. Calyx tube glabrous or sparsely villose outside; calyx lobes 3–5.5 x 0.8–1.2 mm, slightly widening at the apex, outside hairy with sparse woolly hairs all over and stiff hairs c. 0.8 mm long mostly on the margin. Corolla tube glabrous outside, the lobes densely villose with stiff hairs c. 1 mm long.

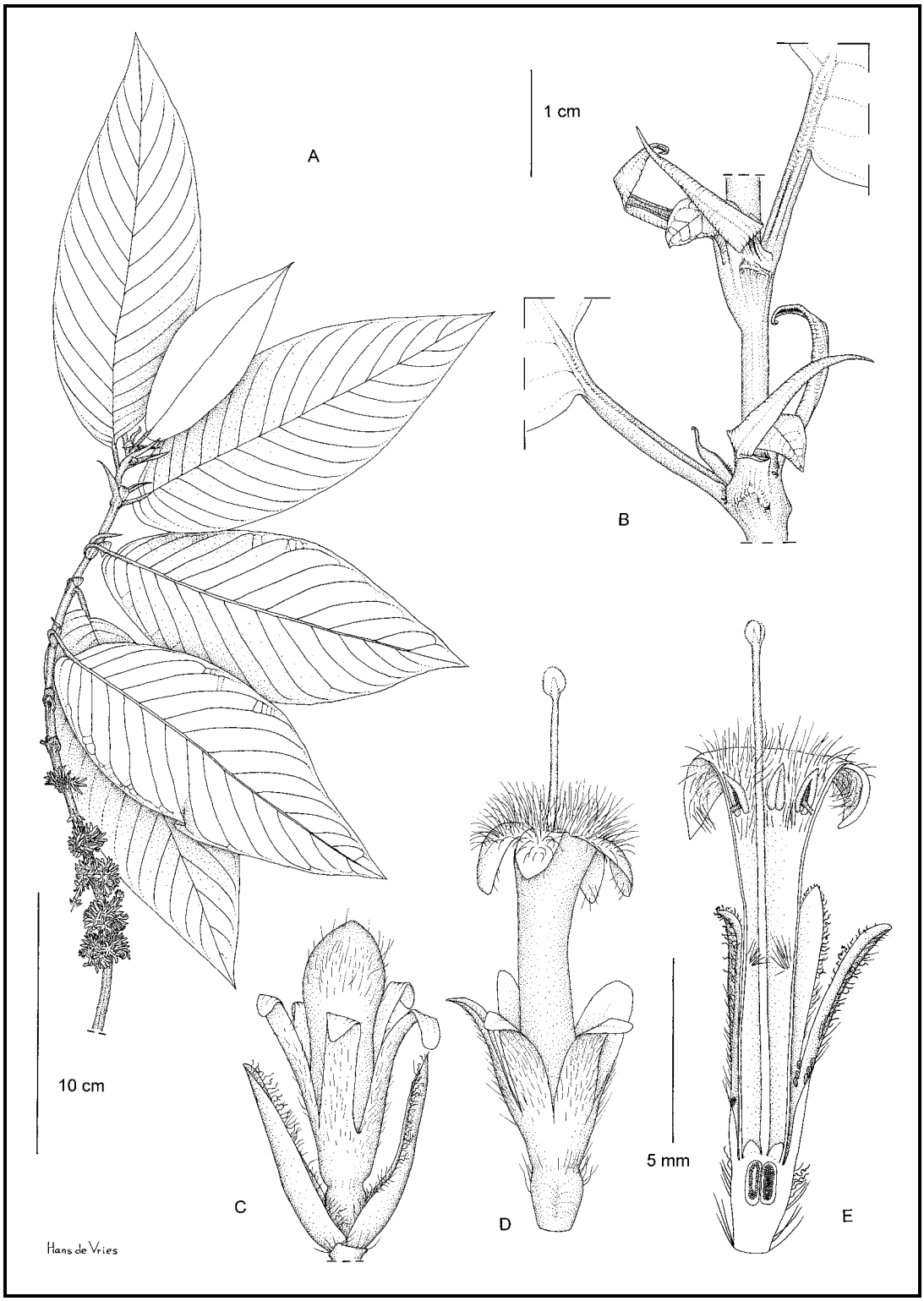

FIGURE 13. *Sabicea crystallina* subsp. *engongensis*. A, flowering branch; B, detail of stem with two successive nodes showing the stipules, reduced leaves and base of normal leaves; C, flower bud with two bracteoles; D, flower; E, section of flower. From *Parmentier & Esono 2732* (A, C–E), *Parmentier & Nguema 110* (B). Drawing by Hans De Vries.

Etymology:—The name of the subspecies derives from its only known locality, the Engong rock slab in Equatorial Guinea.

Distribution:—Lower Guinea subcentre of endemism. Endemic to Equatorial Guinea and known from a single rocky outcrop in the Monte Alén National Park (Fig. 12). This area is particularly rich in rare species; other endemics include *Torenia mannii* Skan (Linderniaceae) and a new species of *Pauridiantha* (Rubiaceae).

Habit and ecology:—Low shrubby formations ("manteau arbustif") on rocky outcrops, c.1100 m in altitude.

Conservation status:—IUCN Red List Category: **Vulnerable** [**VU D2**]. This taxon is known from a single subpopulation, therefore its extent of occurence is not calculable. Its area of occupancy is estimated as 4 km^2, within the limit for Critically Endangered under criterion B2. Its only location is in the Monte Alén National Park, and does not seem currently threatened by human activities, so there is no evidence of a decline. However, due to its extremely limited range, the taxon is vulnerable to any stochastic event, and qualifies for Vulnerable under criterion D2.

Phenology:—Flowering in May.

Notes:—This taxon differs from *Sabicea crystallina* subsp. *crystallina* mostly in the indumentum of the calyx and corolla. Only the type bears flowers; a second collection from the type locality, *Parmentier & Nguema 110*, lacks flowers and fruits.

Additional specimens examined:—EQUATORIAL GUINEA. Parc national de Monte Alen, dalle rocheuse d'Engong, 5 km à l'Ouest du village d'Engong, 2 July 1999, *I. Parmentier & N. Nguema 110* (BRLU).

7. *Sabicea jacfelicis* (N. Hallé) Zemagho, O.Lachenaud & Sonké, *comb. & stat. nov.* (Fig. 14).

Basionym: *Pseudosabicea mildbraedii* (Wernham) N.Hallé var. *jacfelicis* N.Hallé, Flore du Gabon 12: 208 (1996).

Type—GABON. km 25 Makokou, piste du Bouéni, 12 February 1961, *N.Hallé 1143* (holotype P!; isotypes BR!, P!).

Scrambling sarmentose liana 1.5–5 m high; twigs 1–3 mm thick, in the young stage densely white-felted and sparsely villose with stiff hairs c. 1.5 mm long, at length becoming glabrescent. Leaves opposite, strongly unequal with one of them much reduced; reduced leaf

sessile, 0.4–2 x 0.3–1.2 cm; normal leaf with petiole 0.5–1.2 cm long, in the young stage densely white-felted all over and villose on the upper side with stiff hairs c. 0.7 mm long; leaf blade narrowly elliptic, 3.3–16 x 1.5–6.5 cm, strongly asymmetrical at base with proximal side rounded to subcordate and distal side cuneate to rounded inserted 3–5 mm higher, acuminate at apex, coriaceous, strongly discolorous; upper side green, usually sparsely villose all over (rarely on the midrib only) with short scabrid stiff hairs 0.5(–1) mm long; lower side whitish, densely felted with woolly hairs, sometimes with sparse stiff hairs 1–1.5 mm long present as well; 10–16 secondary nerves on each side of midrib. Stipules paired at nodes, interpetiolar and connate at base with the petioles into a sheath 2–3 mm long, the free part narrowly ovate, entire or shortly 2–3-fid, 7–14 x 1–2 mm, the lobes when present 1–4 mm long, glabrous outside, ciliate on the margin with short woolly and long stiff hairs intermingled, glabrous inside except for the base with long stiff hairs. Inflorescences on old leafless stems or more rarely in the axils of the lower leaves, 1–2 per node, sessile, densely glomerulate, many-flowered, 0.6–1 cm in diameter. Bracts and bracteoles numerous and not clearly distinct from each other, ± hidden between the flowers and not enclosing them, the outer ones elliptic to. narrowly ovate, acute at apex, 2.3–3.5 x 0.5–1 mm, the inner ones elliptic, c.1.5 x 0.2 mm, outside glabrous or sparsely felted, inside villose near the base with stiff hairs c.1 mm long. Flowers 5-merous, heterostylous, subsessile, the minute pedicel (< 0.5 mm) with dense long stiff hairs c.1 mm long. Calyx green (probably white outside); calyx tube 0.8–1 mm long, densely white-felted outside, glabrous inside; calyx lobes broadly elliptic to suborbicular, rounded at apex, 1–2 x 0.7–1.3 mm, densely white-felted outside, glabrous or sparsely villose with short appressed hairs c.0.3 mm long inside. Corolla white, with tube cylindrical to slightly funnel-shaped, 4 x 1–1.5 mm, and lobes triangular, 1–2 x 0.7–1 mm; outside of corolla glabrous, or rarely with a few woolly hairs at the very apex of the lobes; throat and base of lobes inside densely bearded with white moniliform hairs 0.8–1 mm long; inside of tube either villose from the throat down to the insertion of the stamens (long-styled flowers) or glabrous except a ring of hairs around the insertion of the stamens (short-styled flowers). Flower buds with apex ovoid and enlarged. Stamens either included with filaments 0.5–0.8 mm long attached slightly above the middle of the tube (long-styled flowers) or completely exserted, with filaments of same length and attached just below throat (short-styled flowers); anthers 1–1.2 x 0.3 mm. Ovary 2-locular, glabrous to densely white-felted. Disk cylindrical, c. 0.5 mm, glabrous. Style bifid, glabrous, either 5.5 mm long and exserted (long-styled flowers) or 4 mm long and included, almost reaching the throat (short-

styled flowers); stigmas 0.8–1 mm long, +/- cylindrical with thickened apex. Fruits pale purplish-white to blackish, obovoid with persistent calyx, 7 x 5 mm when fresh, glabrous, subsessile. Seeds pale brown, polygonal, c. 0.6 x 0.3 mm, the surface with dense parallel striations.

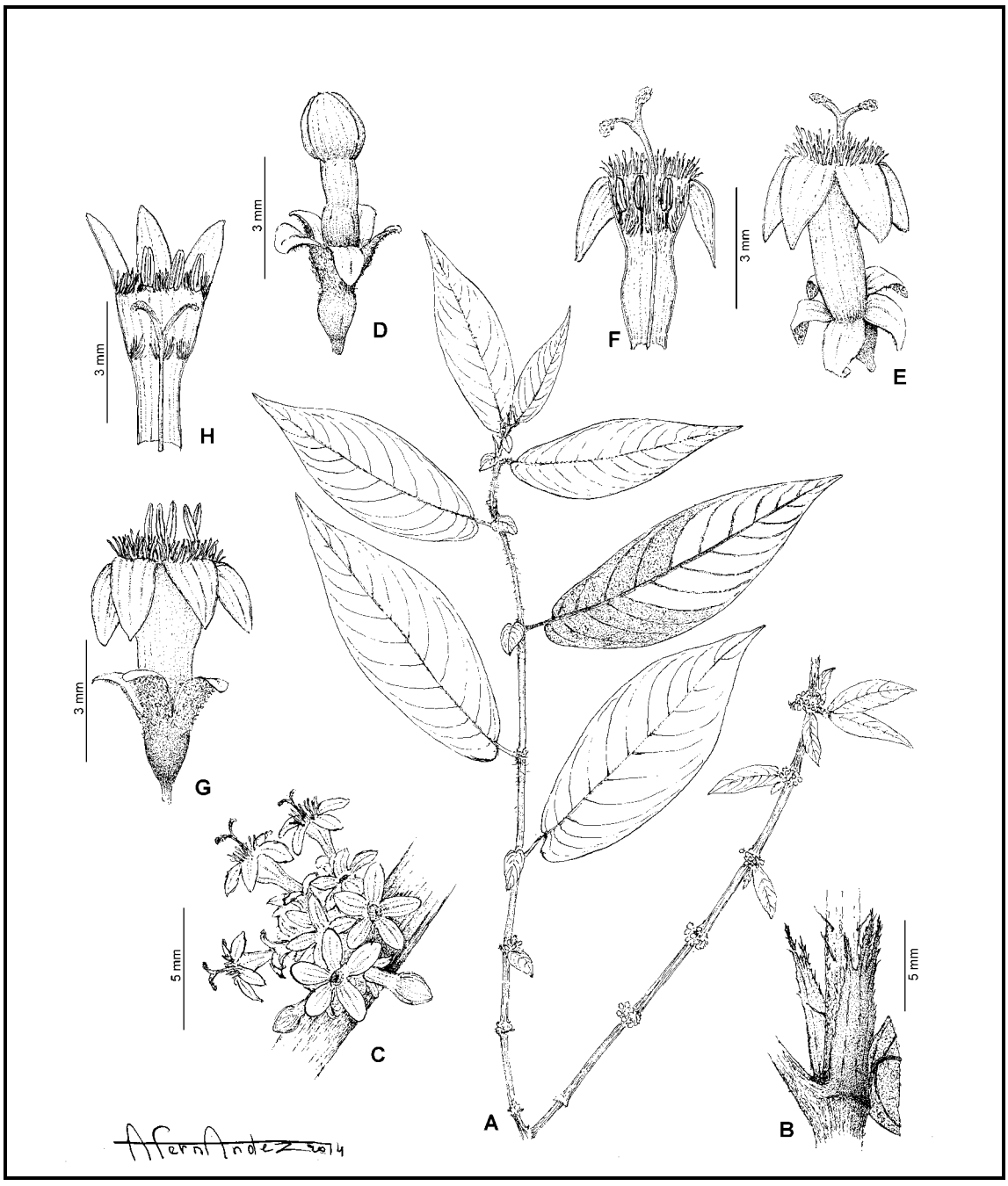

FIGURE 14. *Sabicea jacfelicis.* A, flowering stem; B, detail of a node showing the stipules; C, inflorescence; D, flower bud; E, long-styled flower; F, section of long-styled flower (calyx and ovary removed); G, short-styled flower; H, section of short-styled flower (calyx and ovary removed). From *Letouzey 3876* (A), *Letouzey 9280* (B–F), *de Wilde 8155* (G–H). Drawing by Antonio Fernandez.

Distribution:—Lower Guinea subcentre of endemism. *Sabicea jacfelicis* occurs in southern Cameroon and north-eastern Gabon (Fig. 15), where it is locally common. It is likely to occur in Equatorial Guinea as well.

Habitat and ecology:—The species is apparently partial to riparian forest edges, c. 470 m in altitude.

Phenology:—Flowering in April, June and October; fruiting in February, April and August

Affinities:—*Sabicea jacfelicis* was originally described as a variety of *Sabicea mildbraedii* (Hallé 1966) but differs considerably from that species in the taller habit, the inflorescences borne on leafless stems or in the axils of the lower leaves, and the glabrous corolla or nearly so (the leaves are also usually narrower, but this character is not absolutely diagnostic). These characters justify its treatment as a species of its own. The ranges of the two taxa are separate, *S. jacfelicis* being more northern.

From other lianescent species with inflorescences on the old stems (*S. aurifodinae, S. crystallina, S. ndjoleensis* and *S. sciaphilantha), S. jacfelicis* differs in the shorter calyx lobes and especially by the much shorter corolla tube.

Notes:—The specimen *N.Hallé 2865* is atypical because its leaves are glabrous above (except for the midrib; all other collections show sparse scabrid hairs on the lamina.

Conservation status:—IUCN Red List Category: IUCN Red List Category: **Vunerable [VU B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v)].** The extent of occurrence is estimated as 52,102.260 km^2 and the area of occupancy as 36 km^2, the latter value being within the limit for Endangered under criterion B2. The species is known from 7 subpopulations representing 6 locations. Two of these locations are potentially threatened by the construction of dams (around Nyabessan in Cameroon, and Makokou in Gabon) and one by a mining project (Bélinga, Gabon). Therefore, a decline in the extent of occurrence, area of occupancy, extent and quality of habitat, number of locations and number of individuals can be projected. The species qualifies as Vulnerable under conditions B1ab(i,ii,iii,iv,v) and B2ab(i,ii,iii,iv,v), and would become Endangered if any of the locations is lost.

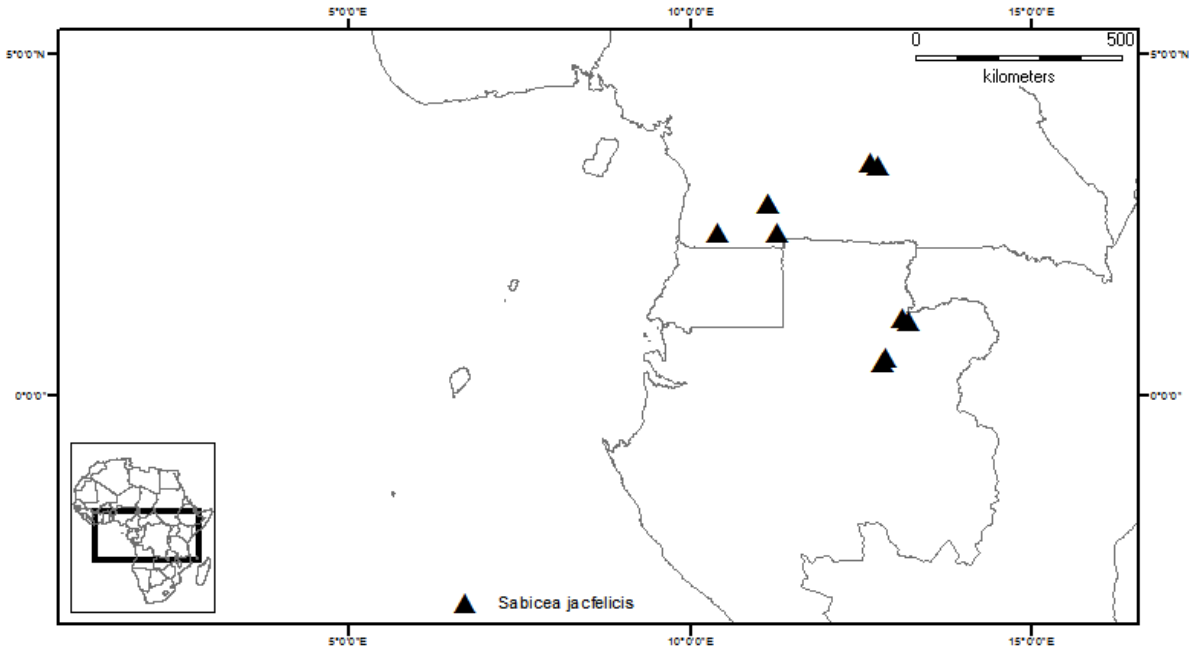

FIGURE 15. Distribution of *Sabicea jacfelicis.*

Additional specimens examined:—**CAMEROON**. East Province: between Somalomo and Milon, 69 km SE of Akonolinga, 18 june 1981, *J.N. Asonganyi 311* (BR, P); Station du Cacaoyer de N'Koemvone, 14 km on the road from Ebolowa to Ambam, 28 August 1974, *J.J.F.E. de Wilde 7442* (BR); Station du Cacaoyer de N'Koemvone, 14 km on the road from Ebolowa to Ambam, 8 April 1975, *J.J.F.E. de Wilde 8155* (BR, MO, P, WAG, YA); Ambam, bords du Ntem, April 1940, *H. Jacques-Félix 5128* (BR, P); Somalomo, 17 April 1961, *R. Letouzey 3876* (BR, MO, P); rives de la Biwome près Nyabessan, 8 April 1968, *R. Letouzey 9280* (BR, P). **GABON.** Ivindo National Park, Ivindo River downstream from Ipassa, 9 March 2008, *S. Dessein et al. 2463* (BR, LBV); Bélinga, 28 October 1964, *N. Hallé 2865* (P); Bélinga, 22 June 1966, *N. Hallé 3976* (P).

8. *Sabicea mapiana* Zemagho, O.Lachenaud & Sonké, *sp. nov.* (Fig. 16).

Type:—GABON. Mabounié, piste du nord-est, 17 November 2013, *O.Lachenaud et al. 1447* (holotype BR!; isotypes BRLU!, LBV!, MO!, P!, WAG!).

Low herb < 10 cm high, with stems entirely creeping or ascending only at the apex; stems densely felted with woolly hairs and sparsely villose with stiff patent hairs 1.5–3 mm long. Leaves single at each node and opposed to a stipule; petiole 1–4.5 cm long, with same indumentum as the stems; leaf blade elliptic, 5.8–15.5 x 3.2–8 cm, ± asymmetrical at base with proximal side rounded to cordate and distal side acute to subcordate inserted up to 5 mm higher, acuminate, papyraceous to coriaceous, strongly discolorous; upper side dark green, rather sparsely villose with stiff hairs 1–2 mm long; lower side pinkish-white, densely felted

with woolly hairs; 7–13 secondary nerves on each side of midrib. Stipules solitary and leaf-opposed, green, narrowly elliptic to broadly ovate, 10–22 x 6–15 mm, multifid with 5–10 lobes 1.5–4 mm long, erect, sparsely felted to nearly glabrous outside, villose on the margin with stiff hairs c.1 mm long, glabrous inside except the base with dense silky hairs c.3 mm long. Inflorescences on leafy stems, one per node, opposite to the leaf and ± surrounded by the stipule, sessile, glomerulate, with few flowers (c.7). Bract solitary, opposed to the stipule and ± enclosing the inflorescence, spathaceous and concave, acute or shortly 2- to 3-dentate at apex, 7–10 x 6 mm, densely felted outside, villose on margin, glabrous inside except the base with silky hairs c.2 mm long; bracteoles narrowly ovate, entire to shortly dentate, 4–11 x 1–3 mm, with same indumentum as the bracts. Flowers 5-merous, sessile; only short-styled flowers seen. Calyx buff outside, green inside; calyx tube 1.5–2 mm long, densely felted outside, glabrous inside; calyx lobes narrowly triangular, acute at apex, channelled inside, erect to patent, 3–4.5 x 0.6–1.3 mm, densely felted outside, villose with stiff hairs on the margin, sparsely villose with short appressed hairs in the central area inside; one minute colleter between every pair of lobes. Corolla entirely white, with tube narrowly funnel-shaped, 6 x 1–2 mm, and lobes triangular, 2–2.5 x 1–1.3 mm; outside of corolla tube glabrous or sparsely villose in upper part, the lobes densely hairy with stiff hairs c.1 mm long intermingled with a shorter dense felt of woolly hairs; throat and base of lobes inside densely bearded with white moniliform hairs 1–1.5 mm long; inside of tube villose in the upper 1.5 mm down to the base of the anthers, and with a separate ring of hairs slightly above mid-height. Stamens included, with filaments c.1 mm long attached slightly above the middle of the tube, the anther tips almost reaching throat; anthers 1.2–1.5 x 0.6 mm. Ovary 2-locular, densely villose with stiff hairs c.2 mm long intermingled with short uncinate hairs. Disk cylindrical, c.0.3 mm long, glabrous. Style bifid, glabrous, 4.5–5 mm long and included; stigmas 1–1.5 mm long, elliptic and slightly flattened. Fruits green (probably not fully mature), obovoid with persistent calyx, 7–9 x 4–7 mm when dry, densely villose, subsessile. Seeds brown, polygonal, c. 0.6 x 0.4 mm, the surface with dense parallel striations.

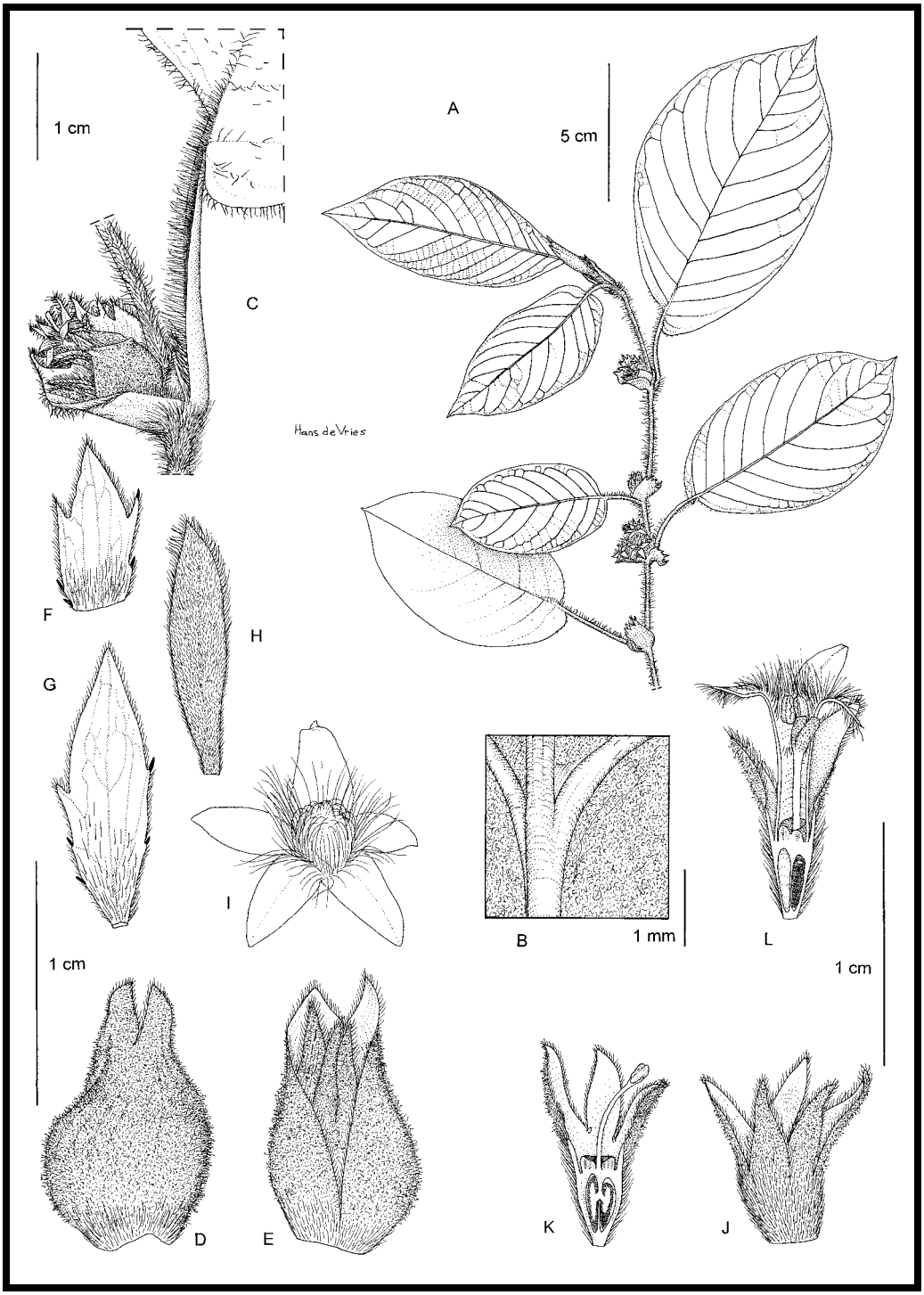

FIGURE 16. *Sabicea mapiana*. A, flowering stem; B, detail of lower side of leaf; C, detail of a node with inflorescence, stipule enclosing it, and base of leaf; D, bract seen from outside; E, bract enclosing a very young inflorescence, seen from inside; F and G, bracteoles (inside); H, bracteole (outside); I, corolla seen from above; J, calyx and ovary; K, section through calyx and ovary (corolla removed); L, section of short-styled flower. All details from *Lachenaud et al. 1447*. Drawing by Hans De Vries.

Etymology:—The species is named after Dr. Jeannette Mapi-Sonké, for her constant encouragement and advice to the first and last authors.

Distribution:—Lower Guinea subcentre of endemism. Apparently endemic to southwest Gabon, where only known from the Doudou Mts, and the Mabounié region east of Lambaréné (Fig. 17). Possibly more widespread, but evidently uncommon.

Habitat and ecology: —The species was always encountered along forest roads, where it locally forms patches covering the ground.

Phenology:—Flowering in November; fruits (probably immature) in February and May.

Affinities:—This species resembles *S. batesii, S. sthenula*, and some variants of *S. mildbraedii* var. *glabrescens* in having pseudoalternate leaves opposed to a stipule; the differences between the four species are shown in Table 4. The species is best separated from *S. batesii* by the much lower creeping habit, the inflorescences borne inside the stipules, and the presence of stiff hairs on the stems; and from *S. sthenula* by the entirely white corolla, the usually shorter calyx lobes with dense woolly indumentum outside, and the presence of dense woolly hairs on the stems. Since *S. mapiana* is morphologically intermediate between these two species, it might have arisen through ancient hybridisation between them.

Notes:—Only the type collection bears flowers, which are of the brevistylous form. The species is likely to be heterostylous, as usual in the genus.

Conservation status:—IUCN Red List Category: **Endangered [EN B1ab(i,ii,iii,iv,v) +B2ab(i,ii,iii,iv,v)].** The extent of occurrence is estimated as 222.656 km^2 and the area of occupancy as 12 km^2, both within the limit for Endangered under the criteria B1 and B2 respectively. The species is known from three subpopulations, representing two locations. One of these locations (the Mabounié area, with two subpopulations) is potentially at risk from a mining project. Therefore, a decrease in the extent of occurrence, area of occupancy, extent and quality of the habitat, number of locations and number of individuals can be projected, and the species qualifies for Endangered under the conditions B1ab(i,ii,iii,iv,v) and B2ab(i,ii,iii,iv,v).

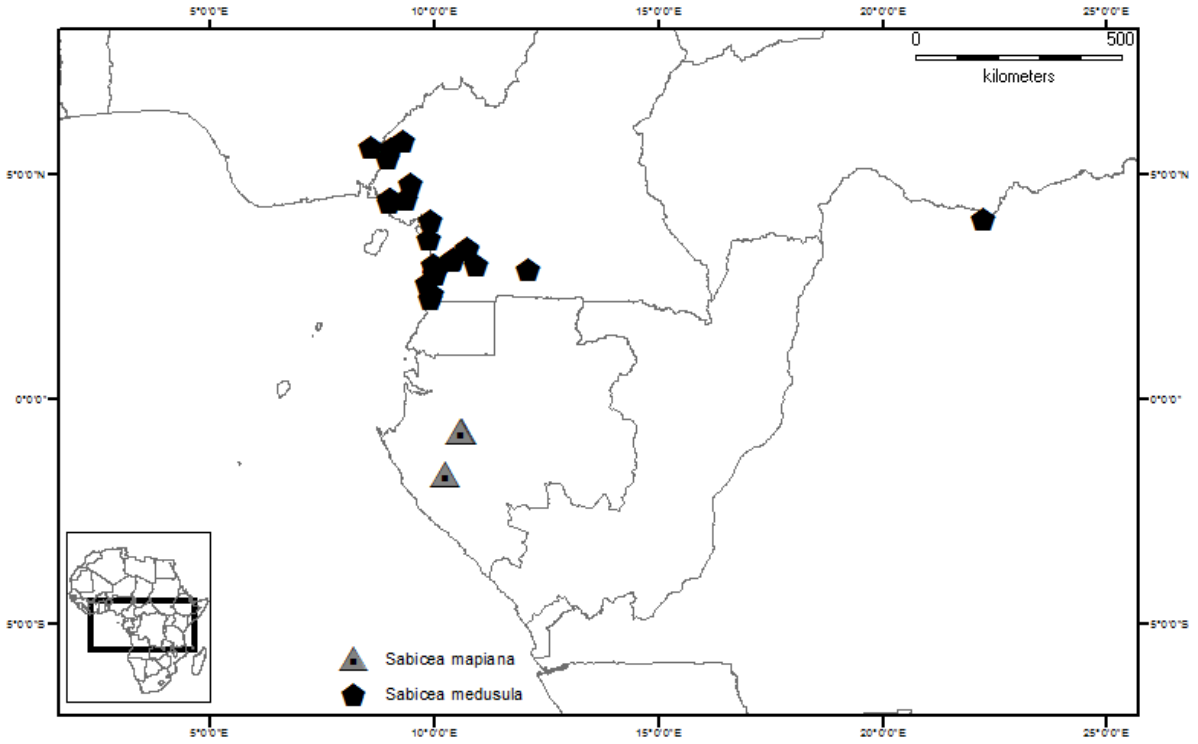

FIGURE 17. Distribution of *Sabicea mapiana* and *S. medusula*.

Additional specimens examined:—**GABON**. Foot of Doudou Mountains, 25–35 km W of Mandji, 15 February 2008, *S. Dessein et al. 1865* (BR, WAG, MO); Mabounié, forest, east of the mine; 2 May 2012, *T. Stévart et al. 4130* (MO).

9. *Sabicea medusula* K. Schum. ex Wernham (1914: 44) (Fig. 18).

Pseudosabicea medusula (K. Schum. ex Wernham) N.Hallé (1963: 170).

Lectotype (**designated here)**:—CAMEROON. Bipindi ("Bipinde"), 1912, *G. Zenker 4414* (lectotype BR!; isolectotypes E, G, GOET, MO, WU).

Low creeping rhizomatous herb up to 30 cm high, with flowering stems ascending and arcuate; stems 1.5–2 mm thick, villose with stiff patent reddish hairs 2–2.5 mm long intermingled with short and sparse curly hairs. Leaves opposite and strongly unequal with one of them much reduced; reduced leaf with petiole 0–0.3 cm and leaf blade 0.4–0.9 x 0.1–0.4 cm; normal leaf with petiole 0.7–3.5 cm long, with same indumentum as the stems; leaf blade elliptic to obovate, 5–18.8 x 2.8–7.5 cm, asymmetrical at base with proximal side cordate to obtuse and distal side acute to cordate inserted 2–5 mm higher, acuminate at apex, papery, strongly discolorous; upper side green, sparsely villose with stiff hairs 1–2 mm long

intermingled with shorter +/- uncinate hairs on the nerves; lower side buff to whitish, densely felted with woolly hairs and also sparsely villose (sometimes only on the midrib) with stiff hairs 1–2 mm long; secondary nerves 9–15 on each side of midrib. Stipules paired at nodes, interpetiolar, connate at base with the reduced leaf and very shortly with the petiole of the normal leaf, the free part triangular or narrowly ovate, entire or shortly bidentate, acute at apex, 7–15 x 1.5–4 mm, erect to reflexed, outside sparsely villose at least on the margin and sometimes with sparse woolly hairs also present in the young stage, inside glabrous except the base with c.2 mm long silky hairs. Inflorescences axillary on leafy stems, one per node in the axil of the reduced leaf, sessile and densely glomerulate, 1–2 cm in diameter, many-flowered. Bracts and bracteoles ± hidden between the flowers and not enclosing them; bracts 2–4, ovate to broadly elliptiv, shortly connate at base, acute at apex, 4–5 x 1–2.5 mm, outside glabrous or sparsely villose, villose on the margin, inside densely villose with long silky hairs at base and glabrous at apex; bracteoles broadly elliptic, entire and acute at apex, 6–6.5 x 0.2–0.5 mm, with same indumentum as the bracts. Flowers 5-merous, sessile, heterostylous. Calyx green; calyx tube cylindrical, c.1 mm long, villose outside, glabrous inside; calyx lobes linear to very narrowly spathulate, acute at apex, +/- channelled and gradually bending outwards, 3–5.5 x 0.3–0.5 mm, glabrescent to densely white-felted outside, villose on the margin with stiff hairs 2–2.5 mm long, inside villose with sparse long stiff hairs often intermingled with short and denser stiff hairs. Corolla with dark pink to reddish tube and white lobes; tube cylindrical or narrowly infundibuliform, 5–6 x 1–2 mm; lobes triangular, 1.5–2 x 1–1.5 mm; outside of corolla tube glabrous, the lobes villose with stiff hairs c.1 mm long; throat densely bearded with white moniliform hairs c.0.8 mm long; inside of tube either villose at the very apex and with a separate ring of hairs at the insertion of the stamens (long-styled flowers) or sparsely villose from the throat down to the base of the anthers and with 5 small tufts of hairs slightly below the middle (short-styled flowers). Flower buds nearly cylindrical with apex only slightly enlarged. Stamens always included and subsessile, attached either around the middle of the tube (long-styled flowers) or in the upper part of the tube with their apex almost reaching throat (short-styled flowers); anthers c. 1.3 x 0.3 mm. Ovary 2-locular, densely villose with stiff hairs c.2 mm long directed upwards. Disk cylindrical, c. 0.3 mm long, glabrous. Style bifid, glabrous, either c.6.5 mm long and very shortly exserted, +/- hidden among the hairs of the corolla throat (long-styled flowers) or c. 3 mm long and included (short-styled flowers); stigmas c.1.3 mm long, broadly elliptic and +/- flattened. Fruits red or whitish (when immature?), ellipsoid with persistent calyx, c. 10 x 9 mm when fresh, 7–9 x 6–

6.5 mm when dry, densely villose with patent hairs c. 2 mm long. Seeds pale brown, polygonal with truncate apex, c.0.6 x 0.3 mm, the surface with dense parallel striations.

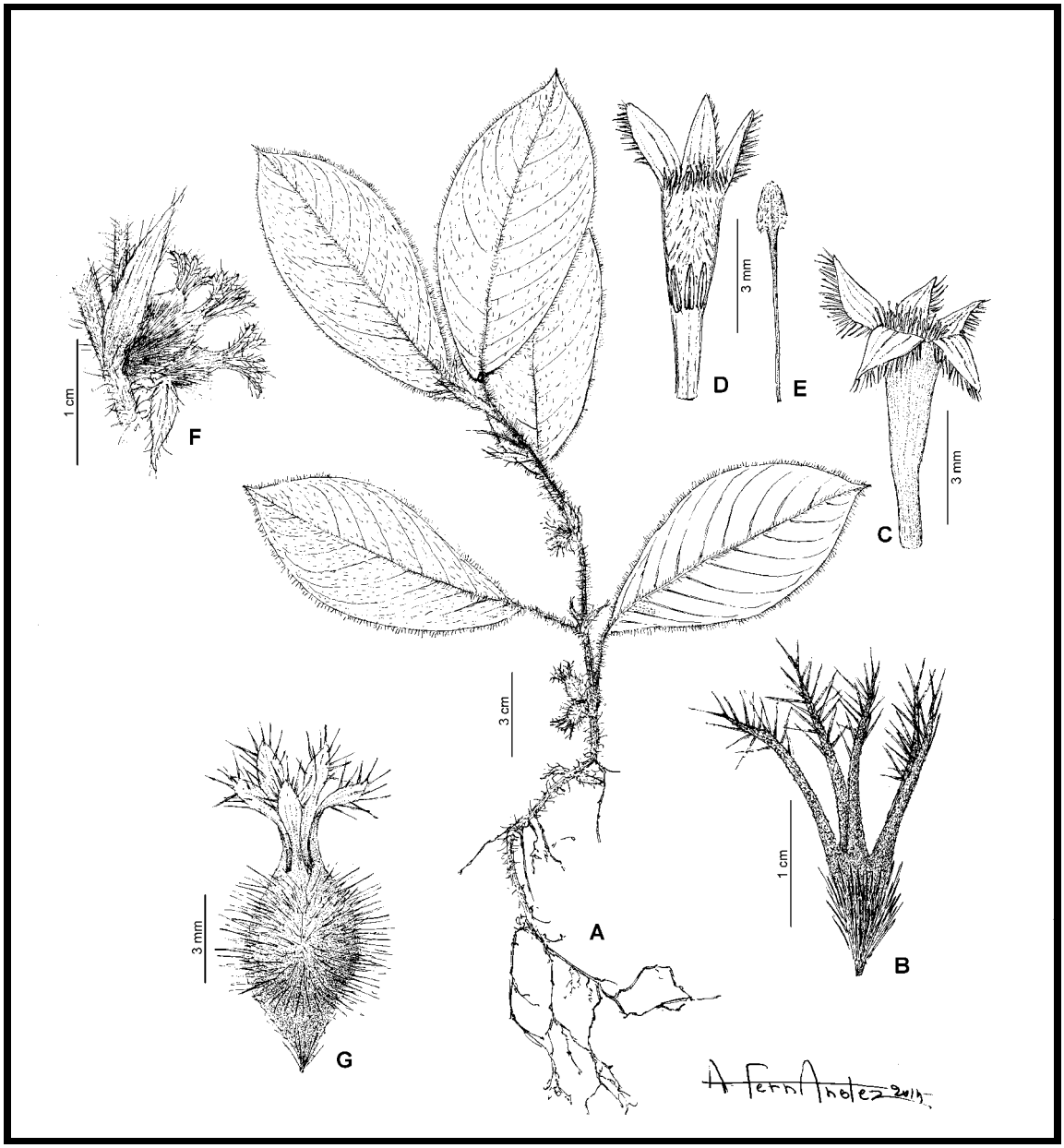

FIGURE 18. *Sabicea medusula.* A, fruiting stem; B, calyx and ovary; C, long-styled flower (calyx and ovary removed); D, section of long-styled flower (style, calyx and ovary removed); E, style; F, detail of a node with infructescence, reduced leaf and stipules; G, fruit; H, detail of a calyx lobe, side view. From *Sonké 1115* (A, F–G) and *Sonké 3978* (B–E, H). Drawing by Antonio Fernandez.

Distribution:—Lower Guinea and Congolia subcentres of endemism. The species is common in its main range covering the Atlantic regions of Cameroon and extreme south-eastern Nigeria (Cross River National Park); an apparently isolated and very disjunct population occurs in northern DR Congo, on the lower Uele river (Fig. 17).

Habitat and ecology:—Degraded areas in forest, usually growing in half-shade and often covering the ground on paths; also along forest streams (which are probably the original habitat) and sometimes in cocoa plantations; 0–580 m in altitude.

Phenology:—Flowers in January, May–July, September and November; fruits in February–March, May–September and November.

Affinities:—*Sabicea medusula* closely resembles *S. parmentierae* and *S. sthenula* in the low habit, and the corolla with a pink tube and white lobes. Another similar species, though with an entirely white corolla, is *S. mildbraedii*. The differences between these four species are shown in Table 5.

Notes:—Wernham's description of *S. medusula* is based on two syntypes, *Zenker 2095* and *4414*. The latter specimen is more complete and agrees better with the description; therefore we choose it as lectotype.

The indumentum of the calyx lobes is somewhat variable in *S. medusula*: the exterior varies from densely white-felted to green and nearly glabrous; the interior typically bears long stiff hairs intermingled with denser shorter ones, but sometimes only the long hairs are present.

The only collection of *S. medusula* from DR Congo, despite being geographically very remote from the others, does not show any differences. The specimen from Nigeria was seen on photograph only, but the identification makes no doubt.

S. medusula and *S. sthenula* are normally quite distinct species, but several collections showing intermediate characters between them have been noted; they are discussed under *S. sthenula*. A record of *S. medusula* from Republic of Congo (Lachenaud 2009) refers to one such intermediate.

Sonké & Nguembou 3757 (BR, WAG), from the Ngowayang massif in Cameroon, probably belongs to *S. medusula* but has unusually broad (1.2 mm) +/- spathulate calyx lobes. In this character it resembles *S. parmentierae*, but differs from that species in the entire stipules, the nearly cylindrical flower buds, and the presence of short stiff hairs (together with longer ones) on the inside of the calyx.

TABLE 5. Distinguishing characters between *Sabicea parmentierae, S. medusula, S. mildbraedii* and *S. sthenula*.

Characters	***S. parmentierae***	***S. medusula***	***S. mildbraedii***	***S. sthenula***
Phyllotaxy	2 unequal leaves and 2 stipules per node	2 unequal leaves and 2 stipules per node	2 unequal leaves and 2 stipules per node (rarely a single leaf opposed to a stipule in var. *glabrescens*)	**1 leaf and 1 stipule per node, opposed to each other**
Stipule shape	multifid with linear lobes	**entire or shortly bidentate**	multifid with triangular to linear lobes (rarely entire)	multifid with broad triangular lobes
Secondary nerves	7–12	9–15	9–15	6–9
Bracts and bracteoles	inconspicuous and hidden between the flowers, 4–7 mm	inconspicuous and hidden between the flowers, 4–6.5 mm	inconspicuous and hidden between the flowers, 2.5–5 mm	**conspicuous, 6–10 mm, the outer bract +/- surrounding the inflorescence**
Bract indumentum (inside)	**entirely villose**	villose at the base only	villose at the base only	villose at the base only
Shape of calyx lobes	**spathulate with narrow basal part and enlarged apex**	linear or very slightly spathulate, without differentiated basal part	variable (elliptic, triangular, narrowly ovate or slightly spathulate) without differentiated basal part	broadly elliptic and gradually narrowing to the apex
Size of calyx lobes	3.5–4.5 x (0.5–)1–1.5 mm	3–5.5 x 0.3–0.5 mm	**1–3.5 x 0.5–1.5 mm**	4–6 x 0.5–1 mm
Indumentum of calyx lobes (outside)	densely white-felted and sparsely sillose with stiff hairs	white-felted or not, sparsely villose with stiff hairs	densely white-felted, with stiff hairs often present as well	villose with soft silky hairs (woolly hairs absent or very sparse)
Indumentum of calyx lobes (inside)	**long stiff hairs very dense at base**, scarcer or absent at apex	**sparse long stiff hairs,often mixed with dense shorter ones**	glabrous or with sparse appressed hairs	glabrous or with sparse appressed hairs
Corolla color	tube red to pink, lobes white	tube pink, lobes white	**entirely white**	tube pink, lobes white
Corolla tube length	6.5–7 mm	5–6 mm	**3.5–4.5 mm**	7–7.5 mm
Corolla lobes	**3–5 x 1.5–4 mm**	1.5–2 x 1–1.5 mm	1.5–3 x 1–2 mm	2–3 x 0.8–1.2 mm
Corolla indumentum (outside)	lobes densely villose, tube glabrous	lobes densely villlose, tube glabrous	lobes villose to densely felted, tube glabrous	lobes and **upper part of tube villose**
Flower buds	strongly enlarged at apex	nearly cylindrical	nearly cylindrical to strongly enlarged at apex	nearly cylindrical
Stamens of short-styled flowers	exserted	included	exserted	included
Distribution	south Cameroon to NW Gabon	Nigeria to DR Congo	central Gabon to DR Congo	Cameroon to Republic of Congo

S. medusula has been recorded from Gabon (Hallé 1971) but the specimen, *N.Hallé & Villiers 5048*, actually represents *S. parmentierae*. Two other Gabonese collections, *Sosef et al. 2669* (WAG) and *Dessein et al. 2264* (BR, LBV) may represent *S. medusula* but are too poor for positive identification.

Conservation status:—IUCN Red List Category: **Least Concern [LC].** The extent of occurrence is estimated as 294,201.236 km^2 and the area of occupancy as 92 km^2; the latter value falls under the limit for Endangered under criterion B2. However, the species is known from more than 10 locations including three national parks (Cross River in Nigeria, Korup and Campo-Ma'an in Cameroon), is locally common and adapts well to some degree of habitat degradation. Therefore, it is not currently threatened.

Additional specimens examined:—CAMEROON. 12 km from Kribi, Lolodorf road, 14 January 1969, *J.J. Bos 3648* (BR, MO, P, UPS, WAG); 19 May 1969, *J.J. Bos 4573* (WAG); Mamfe 'Overside', 17 March 1955, *D.E. Coombe 198* (BR, P); 28 km on the road from Ebolowa to Lolodorf, 25 July 1975, *J.J.F.E. de Wilde 8385* (BR, MO, P, WAG, YA); Mokoko Forest Reserve, Barombi, 25 May 1994, *P. Tchouto 1220* (MO); Dikome, 03 May 1994, *N. Ekema et al. 870* (MO); Campo-Ma'an area, Bongola, Along the Bongola river, 29 January 2000, *M. Elad et al. 1226* (WAG); sud-ouest de Nko'Adjap (± 20km est de Campo), 16 May 2009, *O. Lachenaud et al. 782* (BR, WAG, YA); Km 29 route Campo-Kribi, 17 May 2009, *O. Lachenaud et al. 825* (BR, YA); Littoral: 28 km NE of Douala, along road to Edéa, 18 August 1965, *A.J.M. Leeuwenberg 6418* (BR, MO, P, WAG, YA); Près de la rivière Fon, à 12 km à l'est de Kamelon (5 km SE de Sangmelima), 24 November 1966, *R. Letouzey 8469* (BR, P); Entre Ogurang et Babong, 45 km SW Mamfe, 28 May 1975, *R. Letouzey 13661* (BR, MO, P); Southwest: Kumba– Mamfe road baduma mile 20, 01 July 1987, *J. Nemba et al. 579* (BR); Ekombe-Mofako, 03 June 1994, *D. Pouakouyou & M. Etuge 57b* (MO); Mokoko F.R., 02 May 1994, *B. Sonké 1115* (BR, WAG); Ngoyang, 15 September 2005, *B. Sonké & K.C. Nguembou 3882* (BR, BRLU); 3 km W Ngovayang, 17 September 2005, *B. Sonké & K.C. Nguembou 3978* (BR, BRLU); Lambi: Massif de Ngovayang, 20 February 2008, *B. Sonké 4645* (BR); Nkolembonda: Mont des Eléphants, 15 March 2008, *B. Sonké & M. Simo 4706* (BR); Lake Tissongo, 24-29 June 1986, *D.W. Thomas 6167* (MO, P); Steep hillside 5 kms due west of Esukutang village, 29 May 1988, *D.W. Thomas et al. 7985* (MO); Elephant Mont, 10 June 2001, *T.R. van Andel et al. 3555* (SCA, WAG, YA); South Province: Bipindi, 01 July 1900, *G. Zenker 2095* (E, G, K, MO, P, S, WAG, WU). **DR CONGO**. Bas-Uele, 17 July 1935, *A. Dewulf 644* (BR). **NIGERIA**. Oban Group F.R., Itankpini area, 5 August 1865, *Daramola FHI 56390* (FHI).

10. *Sabicea mildbraedii* Wernham (1914: 53).

Type:—DR CONGO. Kimuenza, 17 km au S de Leopoldville, *Mildbraed 3664* (holotype B†; lectotype HBG, designated by Hallé, 1964: 399).

Pseudosabicea mildbraedii (Wernham) N.Hallé (1963: 170).

Creeping and often +/- straggling herb 20–60 (–100) cm high, with lateral stems ascending and +/- arcuate; stems 1–3 mm thick, usually with long stiff and short woolly hairs intermingled, but sometimes with short woolly hairs only. Leaves usually opposite and strongly unequal (rarely a single leaf per node opposed to a stipule in var. *glabrescens*); reduced leaf with petiole 0–0.3 cm and leaf blade 0.4–1.4 x 0.2–1 cm; normal leaf with petiole 0.3–3.2 cm long, with same indumentum as the stems; leaf blade elliptic, (3.1–) 4.2–14.5 x 1.8–7.5 cm, usually slightly asymmetrical at base with proximal side acute to subcordate and distal side acute to rounded inserted 0–5 mm higher, acuminate at apex, papery to coriaceous, strongly discolorous; upper side green, usually villose with stiff hairs 0.5–1.5 mm long, more rarely glabrous, or sometimes sparsely felted in the young stage; lower side whitish, densely felted with woolly hairs, often with stiff hairs present as well; secondary nerves 9–15 on each side of midrib. Stipules usually paired at nodes and interpetiolar (rarely solitary and opposed to the leaf in var. *glabrescens*), connate at base with the reduced leaf and very shortly with the petiole of the normal leaf, erect to patent, ovate to elliptic, 6–20 x 1.5–7 mm, usually multifid (rarely a few of them entire), divided for up to half of their length into 2–7 linear to narrowly triangular segments 1–10 mm long, outside glabrescent to variously hairy (with woolly, or stiff hairs, or both), inside glabrous except the base with long silky hairs. Inflorescences axillary on leafy stems, one per node, in the axil of the reduced leaf, sessile, densely glomerulate, 0.7–1.6 cm in diameter, many-flowered. Bracts and bracteoles short and hidden between the flowers; bracts few, free or very shortly connate at base, ovate, entire or irregularly dentate, acute at apex, 3–5 x 2.5–5 mm, outside hairy with either with short woolly or long silky hairs, villose on the margins, inside glabrous except the base with long silky hairs; bracteoles elliptic to narrowly ovate, entire to shortly dentate, acute at apex, 2.5–5 x 0.7–2 mm, with indumentum similar to the bracts. Flowers 5-merous, sessile, heterostylous. Calyx whitish outside and green inside; calyx tube 0.5–1.5 mm, hairy outside with either short woolly or long stiff hairs, inside glabrous; calyx lobes rather variable in shape, narrowly triangular (sometimes almost linear) to broadly elliptic or even slightly spathulate, acute to rounded at apex, 1–3.5 x 0.5–1.5 mm, outside densely white-felted and

often sparsely villose as well, inside glabrous or sparsely villose with short appressed stiff hairs; one tiny colleter between each pair of calyx lobes. Corolla entirely white; tube cylindrical or narrowly funnel-shaped, 3.5–4.5 x 1–2 mm; lobes triangular, 1.5–3 x 1–2 mm; outside of corolla tube glabrous, the lobes with a dense felt of woolly hairs often intermingled with long stiff hairs; throat densely bearded with white moniliform hairs c.1 mm long; inside of tube either villose in the whole upper half (usually in long-styled flowers) or villose at the apex and with a separate ring of hairs around the upper third (short-styled flowers, rarely in long-styled flowers as well). Flower buds usually nearly cylindrical, rarely strongly enlarged at apex. Stamens either included, subsessile and attached between the middle and the upper 1/4th of the tube, with their apex almost reaching throat (long-styled flowers) or exserted to sub-exserted, on filaments 0.5–1 mm long attached near the throat (short-styled flowers); anthers 1–1.2 x c.0.3 mm. Ovary 2-locular, variously hairy with either long stiff hairs, or a dense felt of woolly hairs, or a mixture of both. Disk cylindrical, 0.5–1 mm long, glabrous. Style bifid, glabrous, either c. 6 mm long and exserted (long-styled flowers) or c. 3 mm long and included (short styled-flowers); stigmas 1–1.2 mm long, elliptic and slightly flattened. Fruits green to whitish, becoming red at maturity (at least in var. *mildbraedii*), ellipsoid or ovoid with persistent calyx, c. 9 x 7 mm when fresh, 4.5–7 x 2.5–6 mm when dry, variously hairy with either long stiff or short woolly hairs, sessile or with very short pedicels to 1 mm long. Seeds pale brown, polygonal, c.0.6 x 0.4 mm, the surface with dense parallel striations.

Affinities:—In general habit, *Sabicea mildbraedii* resembles *S. medusula, S. parmentierae* and *S. sthenula*; it differs from these species in the smaller and entirely white corolla, and in the shape and indumentum of the calyx lobes (see Table 5).

S. mildbraedii also shows a resemblance to *Sabicea jacfelicis*, but differs in the smaller habit, the inflorescences borne on young leafy stems, and the corolla lobes densely hairy outside.

The variants of *S. mildbraedii* var. *glabrescens* with pseudoalternate leaves can also be mistaken for *S. batesii* or *S. mapiana*, from which they differ mostly in their shorter calyx; see Table 4 for differences between these species.

Notes:—*S. mildbraedii* is the most widespread and variable species in the group, and might actually consist of more than one species. The current taxonomic treatment is tentative and recognises three varieties: var. *glabrescens*, var. *letestui* and var. *mildbraedii*. We have not recognised the var. *dubia* of Hallé (1966) which in our opinion is just a robust extreme of var. *mildbraedii*. On the other hand, his var. *jacfelicis* is different enough from the rest to be

treated as a separate species, *Sabicea jacfelicis*; as a result *S. mildbraedii* no longer occurs in Cameroon.

Sabicea mildbraedii normally has two stipules and two strongly unequal leaves per node, but occasional variants with a single leaf opposed to a stipule, the reduced leaf being completely absent, have been noted in var. *glabrescens* (*Moungazi 1536* from Gabon, *Bouquet 1907* and *Lejoly 86/366* from Republic of Congo).

There is a great level of polymorphism in var. *mildbraedii* concerning the shape of the calyx lobes. Some specimens, e.g. *Bequaert 7546*, have broad and slightly spathulate calyx lobes, while at the other extreme is *Champluvier 5029* with very narrow calyx lobes resembling *S. medusula*. Various types of intermediates occur between these two forms.

Some collections from Gabon are difficult to name varietally. *Dessein et al. 1987* (BR, LBV), from the Doudou Mts, resembles var. *letestui* (the only one recorded in its range) but has unusually narrow calyx lobes. *Bidault et al. 1485* (BRLU, MO) from the Mabounié region resembles var. *glabrescens*, but has long stiff hairs on the ovary and fruits; since it comes from a region where the ranges of var. *glabrescens* and var. *letestui* closely approach each other, it may well be a hybrid between them. *Sonké et al. 6186* (BRLU, MO) from the same area comes very close to var. *mildbraedii*, but since the latter is not recorded from west Gabon and the material is imperfect, more collections are needed to decide on its status.

Conservation status:—IUCN Red List Category: **Least Concern [LC].** The extent of occurrence is estimated as 458,004.337 km^2 and the area of occupancy as 372 km^2. The latter value falls within the limit for Endangered under criterion B2, but is obviously underestimated, *S. mildbraedii* being a fairly ubiquitous forest edge species in some parts of its range (e.g. southeast Gabon). The species is known from more than 10 locations, is usually common where it occurs, and benefits from some degree of forest degradation due to its preference for open habitats. It is not therefore threatened.

Key to the varieties:

1. Ovary and fruit with short woolly hairs .....

.....*S. mildbraedii* var. *glabrescens* (Gabon to DR Congo)

– Ovary and fruit with long stiff hairs.....2

2. Calyx lobes broad and rounded, usually slightly bending inwards at apex; calyx patent after anthesis (but eventually becoming +/- erect on the fruit.....

.....*S. mildbraedii* var. *letestui* (SW Gabon)

– Calyx lobes acute, erect or bending outwards at apex; calyx remaining erect after anthesis.....*S. mildbraedii* var. *mildbraedii* (SE Gabon to DR Congo)

10a. *Sabicea mildbraedii* var. ***glabrescens*** Wernham

(1914: 53) (Fig. 19).

Type:—DR CONGO. Environs de Kisantu, s.d., *Gillet 3520* (holotype BR!).

Stems densely white-felted, sometimes with appressed to patent long stiff hairs present as well. Leaves, upper side glabrous to sparsely villose, and in the young stage sometimes sparsely white-felted; lower side densely felted, without any stiff hairs. Stipules outside glabrescent to densely white-felted and sometimes villose on the margin. Calyx tube erect, with densely white-felted outside; calyx lobes shortly elliptic, acute to rounded at apex, erect or usually bending outwards, 1–1.8 x 0.7–1.2 mm, outside densely white-felted and sometimes shortly villose (stiff hairs c.0.3 mm long) on the margin, inside glabrous or sparsely villose with short appressed hairs near the apex. Corolla lobes densely white-felted outside, and sometimes villose near the apex. Ovary and fruit densely white-felted.

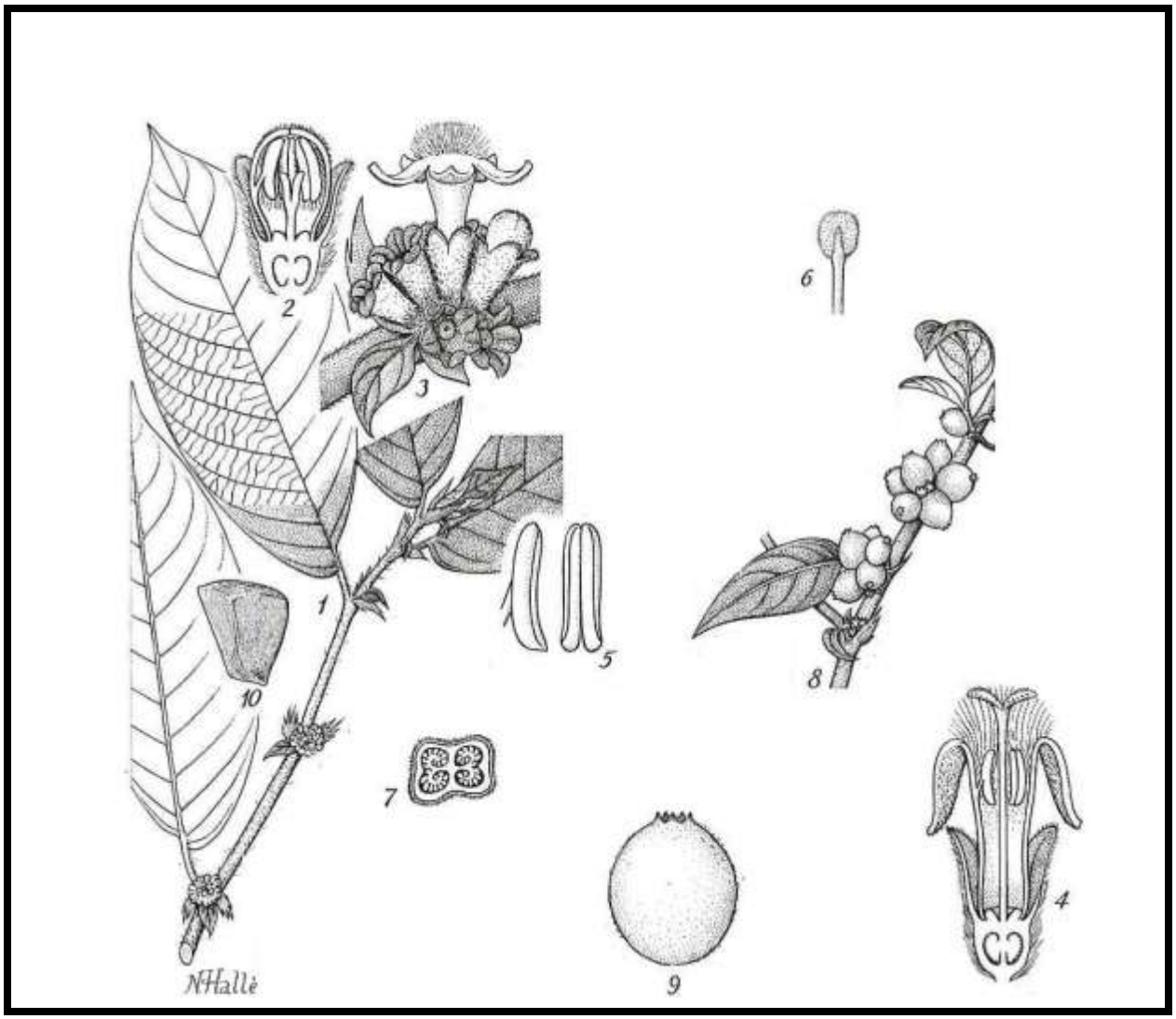

FIGURE 19. *Sabicea mildbraedii* var. *glabrescens.* 1, flowering stem; 2, section of a flower bud; 3, inflorescence; 4, section of long-styled flower; 5, anthers; 6, stigma viewed from outside; 7, cross section of the ovary; 8; portion of fruiting stem; 9, fruit; 10, seed. From *N. Hallé 1896* (1), *N. Hallé 1661 and 1662* (2–10). Drawing by N. Hallé, reprinted from Hallé (1966: 207).

Distribution:—Lower Guinea and Congolia subcentres of endemism. This variety occurs in central Gabon, Republic of Congo and DR Congo (Fig. 20). Its range partly overlaps with that of var. *mildbraedii* in the two latter countries.

Habitat and ecology:—Forest-savanna boundaries and young stages of forest regrowth, especially on roadsides; 230–320 m in altitude.

Phenology:—Flowers in March–April, July and November–December; fruits in January and November.

Notes:—A collection from the Lastoursville area in Gabon, *Van der Maesen et al. 5726* (BR, P, WAG) resembles this taxon but is unusually robust (said to reach 1.5 m high) and has a remarkably dense white indumentum on the upper side of young leaves. More collections from the same area are necessary to decide its status.

Conservation status:—IUCN Red List Category: **Least Concern [LC].** The extent of occurrence is estimated as 281,278.242 km^2 and the area of occupancy as 108 km^2, the latter value being within the limit for Endangered under criterion B2. However, the taxon is known from more than 10 locations including three national parks (Odzala in Republic of Congo, Lopé and Ivindo in Gabon), occurs mostly in sparsely populated areas, is locally common, and is likely to benefit from forest degradation due to its preference for open habitats. It is not therefore threatened.

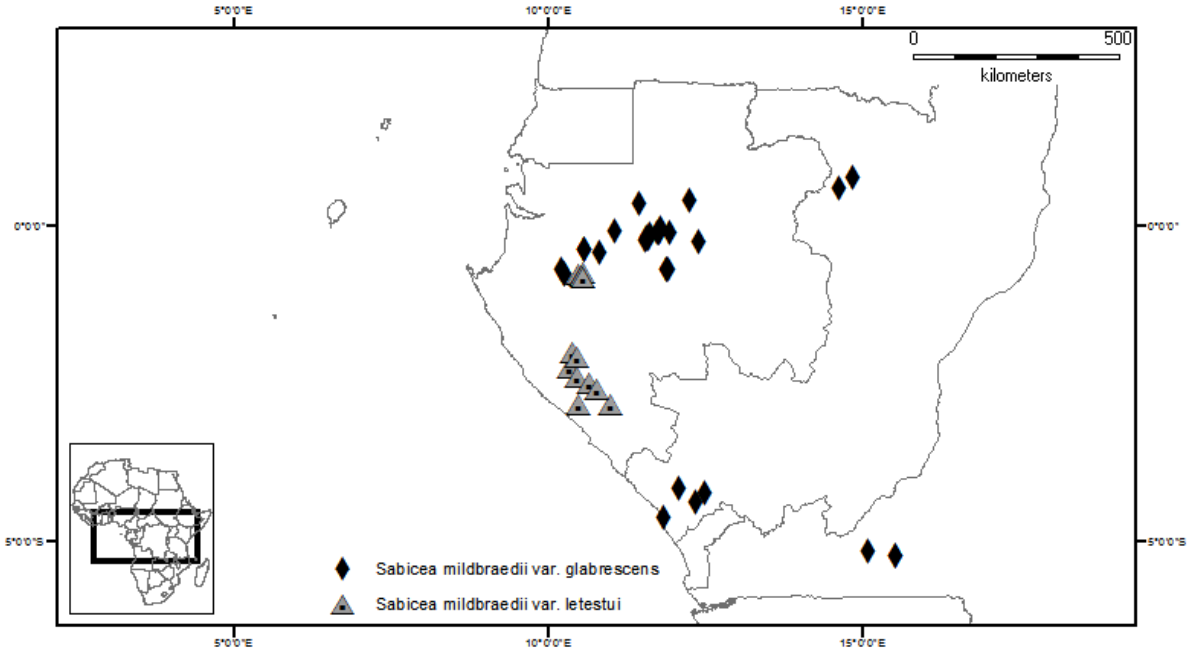

FIGURE 20. Distribution of *Sabicea mildbraedii* var. *glabrescens* and *S. mildbraedii* var. *letestui.*

Additional specimens examined:—**DR CONGO.** Mpese, 01 June 1947, *H. Callens 8* (BR); Mpese, December 1949, *H. Callens 2152* (BR) **GABON**. Lopé Reserve, 4 July 1986, *M.P.T. Alers & A. Blom 86* (MO, WAG); 1–5 km E of Lambaréné airstrip along road to Mouila, 10 Mars 1999, *L. Andersson & A. Nilsson 2344* (BR); Sud de Lambaréné, entre 5 et 10 km depuis la ville, entre l'Ogooué et la route de Fougamou, 0°45'4.3" S 10°15'43" E, 10 April 2015, *E. Bidault et al.* 1900 (MO); Aschouka (Lopé), île Nzangui, 28 January 1998, *A. Binot & J. Lejoly 147* (BRLU); Makande surroundings, c. 65 km SSW of Booué, Makande Camp, 22 February 1999, *F.J. Breteler et al. 15174* (LBV, WAG); South of the Ogooué River, 0°06.6'S 11°45.1'E, 24 December 1996, *J.J.F.E. de Wilde & de Wilde-Bakhuizen 11813* (BR, LBV, SEGC, WAG); Lopé, près de la station Ecofac, 9 November 1993, *M.M. Dhetchuvi 1169* (BRLU); Chantier CGPPO, 80 km de Ndjolé, vers Lalara, 13 June 1971, *G. Gilles 401*

(P); Ogooué, Booué, 30 July 1966, *N.Hallé & Le Thomas 213* (P); 10 km SW de Ndjolé, 14 April 1963, *N. Hallé 1661* (BR, P); Ayem, 10 km SW de Ndjolé, 16 April 1963, *N. Hallé 1662* (P); Ayem, SW de Ndjolé, 27 April 1963, *N. Hallé 1896* (P); Km 23 Alembe-Ayem Road, near Ogooue R, right bank, 1 November 1982, *A.J.M. Leeuwenberg & A.M.Louis 12415* (BR, MO, WAG); Forêt des Abeilles. Station de la Makandé, 11 July 1993, *J. Lejoly 93/67* (BRLU); 12 July 1993, *J. Lejoly 93/88* (BRLU); Ogooué-Ivindo: Near Achouka, 10 November 1983, *A.M. Louis et al. 577* (BR, WAG); Mintome, 31 March 2003, *R. Mboma et al. 98* (WAG); Ivindo National Park: route Langoué, 08 April 2004, *A. Moungazi 1536* (BR, MO, P, WAG); Mont de Casque ca. 20 km Km. NW of Booué, 16 May 1987, *J.M. Reitsma et al. 3394* (MO, WAG, NY); sud de Lambaréné, zone entre l'Ogooué, le lac Ezanga, et la route de Lambaréné à Fougamou, 0°45'04"S 10°15'43"E, 12 April 2015, *Sylvafrica 10* (MO); Lopé-Okanda Reserve, Grand-Débardage Trail, 2 November 2000, *G. Walters et al. 499A* (BR, LBV, MO); Lope reserve, 14 January 1993, *L.J.T. White 692* (MO, WAG); Lopé-Okanda Reserve, 26 September 1990, *L.J.T White [series 2] 141* (MO). . **REPUBLIC OF CONGO**. Mayombe, gorge de la Loukoula, à 5/6 km de Les Saras, 01 February 1965, *A. Bouquet 1907* (P); forêt du cirque de Diosso, 28 January 1966, *C. Farron 4830* (P); Parc National d'Odzala, transect Tombi km 14.9, 17 January 1996, *J. Lejoly 96/50* (BRLU); Parc National d'Odzala, de Mbanza vers Edibabanza, 28 January 1996, *J. Lejoly 96/316* (BRLU); Mayombe, Mvouti, forêt de Masseka vers le col du Bamba, 22 November 1986, *J. Lejoly 96/366* (BR); Kouilou, Kakamoeka, 11 October 1990, *S. Lisowski B-8011* (BR); Littoral congolais, 20 November 1962, *L. Makany 452* (BR).

10b. *Sabicea mildbraedii* var**. *letestui*** (N. Hallé) Zemagho, O.Lachenaud & Sonké, *comb. nov.* (Fig. 21).

Basionym: *Pseudosabicea mildbraedii* (Wernham) N.Hallé var. *letestui* N.Hallé, Flore du Gabon 12: 206 (1966).

Type:—GABON. Tchibanga, galerie près de la Nyanga, *Le Testu 1933* (holotype P!; isotype BR!).

Stems sparsely villose with long patent hairs c. 2 mm long, intermingled in the young stage with a dense caducous felt of appressed woolly hairs. Leaves: upper side sparsely villose with appressed stiff hairs 1–1.5 mm long, and sometimes sparse woolly hairs also present in the very young stage; lower side densely white-felted and sparsely villose with long stiff hairs. Stipules villose outside at least on the margins, sometimes with sparse woolly hairs present as well. Calyx initially +/- erect, becoming patent and bowl-shaped after anthesis, and +/- erect again on the fruit; calyx tube densely white-felted outside; calyx lobes broadly ovate to elliptic, rounded and often slightly hooded at apex, 1.3–2 x 1.2–1.5 mm, outside densely white-felted and often willose on the margin, inside glabrous. Corolla lobes outside densely white-felted and sometimes with sparse long stiff hairs near the apex. Ovary and fruits densely villose at least in the upper half, with stiff hairs c.1.5 mm, initially directed upwards and later patent.

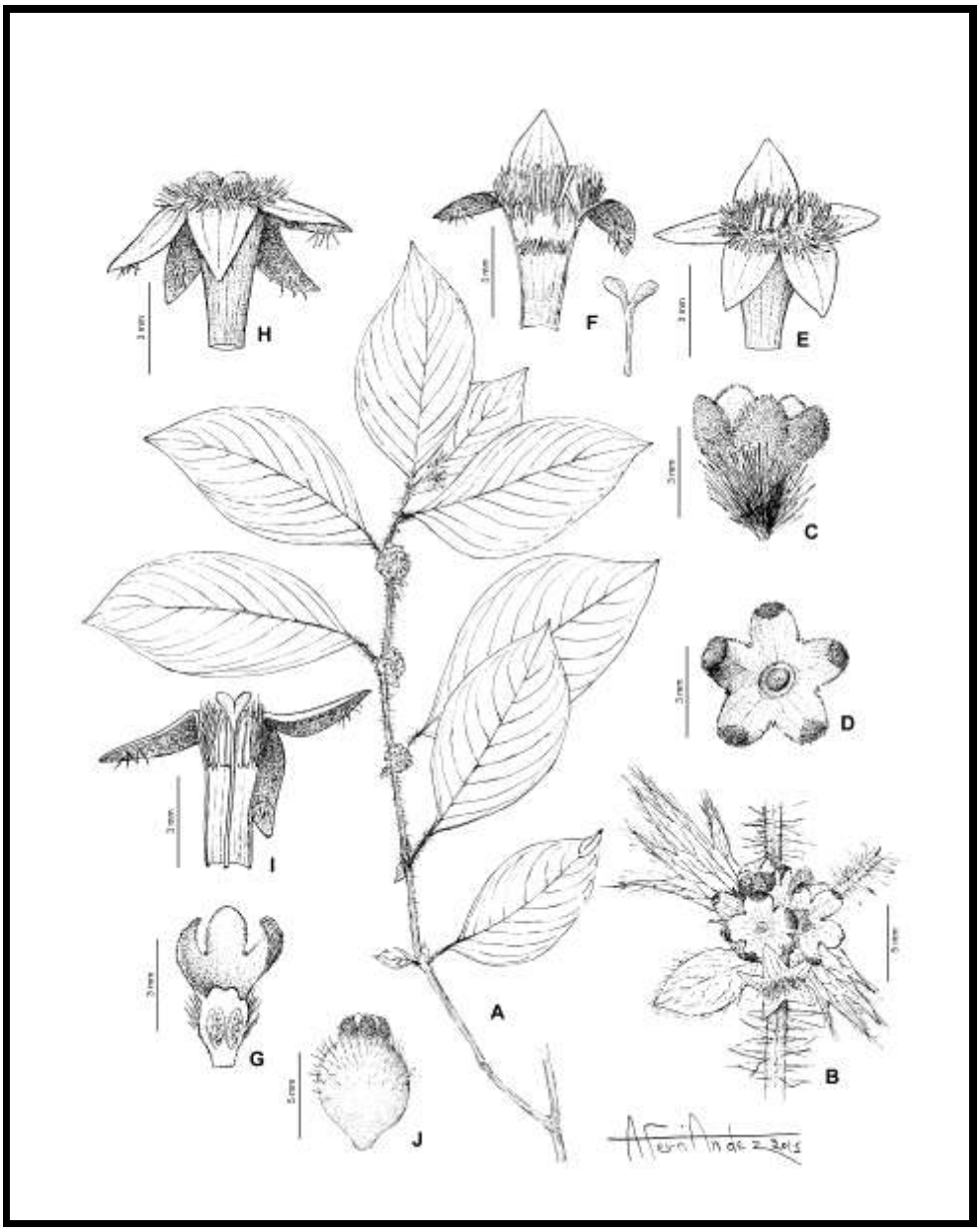

FIGURE 21. *Sabicea mildbraedii* var. *letestui.* A, flowering stem; B, detail of node with inflorescence, stipules and reduced leaf; C, calyx, lateral view; D, calyx, viewed from above; E, short-styled flower (calyx and ovary removed); F section of short-styled flower, with style; G, section of calyx and ovary; H, long-styled flower (calyx and ovary removed); I, section of long-styled flower (calyx and ovary removed); J, fruit. From *Wieringa et al. 3032* (A, E-F), *Reitsma et al. 957* (B), *Arends et al. 693* (C–D), *Lachenaud et al. 1329* (G-I), *Sonké & Ikabanga 6191* (J). Drawing by Antonio Fernandez.

Distribution:—Lower Guinea subcentre of endemism. This variety is apparently endemic to southwest Gabon, where locally abundant (Fig. 20); it might also occur in adjacent Republic of Congo. Its range closely approaches that of var. *glabrescens* in the Lambaréné region, although the two varieties have never been found together.

Habitat and ecology:—Forest edges in half-shade, frequently along roads or on the borders with savanna; 100–250 m in altitude.

Conservation status:—IUCN Red List Category: **Least Concern [LC].** The extent of occurrence is estimated as 9,420.131 km^2 and the area of occupancy as 48 km^2, respectively within the threshold for Vulnerable and Endangered under criteria B1 and B2. The taxon is known from 12 subpopulations representing 9 locations, including one protected area (Moukalaba Doudou National Park) and thus would qualify for Vulnerable status under subcriterion B1a. However, being a common species of secondary habitats in its range, it is not threatened at present.

Phenology:—Flowers in February, April–May and October–December; immature fruits in February and September–October.

Additional specimens examined:—**GABON**. Eastern foothills of the Doudou mountain, 08 December 1984, *J.C. Arends, A.M. Louis & J.J.F.E. de Wilde 693* (BR, MO, WAG); Mabounié, 45 km SW of Lambaréné, 13 November 2013, *E. Bidault et al. 1267* (BRLU); Nyanga: Doussala, 26 September 2000, *H.P. Bourobou et al. 279* (BR, MO, P, WAG); Doudou Mountains National Park, c.8 km S of Peny, 16 February 2008, *S. Dessein et al. 1909* (BR, WAG); Mabounié, 12 November 2013, *O. Lachenaud et al. 1329* (BRLU, LBV, MO); chantier CEB, Doussala, c. 25 km SSW of Doussala, 16 May 1985, *J.M. Reitsma et al. 957* (BR, MO, WAG); Mabounié, 12 October 2012, *B. Sonké & D. Ikabanga 5992* (BRLU); Mabounié, 45 km SW of Lambaréné, 5 February 2013, *B. Sonké et al. 6191* (BRLU); Monts Doudou, au Sud-Ouest du village Moukoualou, qui se trouve à 6 km Sud de Mourindi (Brigade de Faune de Moukalaba), 21 March 2000, *M. Sosef et al. 910* (MO, P, WAG); forestry concession of Bakker, 6 km N of Igotchi, 29 October 2003, *J.J. Wieringa et al. 5032* (BR, MO, WAG); old logging road leading southwards of CBG chantier Peni, 18 April 2005, *J.L.C.H. van Valkenburg et al. 3108* (BR).

10c. *Sabicea mildbraedii* var. *mildbraedii* (Fig. 22).

Lectotype (designated by Hallé, 1964: 399):—DR CONGO. Kimuenza, region de Léopolville, *Mildbraed 3664* (holotype B†; isotype HBG!).

Sabicea dubia Wernham (1914:53) Type:—DR CONGO. Madibi, *A. Sapin s.n* (holo-, BR!)

Pseudosabicea mildbraedii (Wernham) N.Hallé var. *dubia* (Wernham) N.Hallé (1964:400).

Stems villose with stiff, patent and often reddish hairs c. 2 mm long, intermingled on young stems with a dense white felt of appressed woolly hairs. Leaves, upper side villose with stiff hairs only, never felted; lower side densely white-felted and sparsely villose at least on the base of the midrib. Stipules outside densely villose to very sparsely felted. Calyx tube densely villose outside; calyx lobes rather variable in shape, narrowly triangular (sometimes almost linear) to broadly elliptic or even slightly spathulate, acute and often bending outwards at

apex, 1.5–3.5 x 0.5–1.5 mm, outside densely white-felted and villose at least on the margin, inside glabrous or sparsely villose with short appressed stiff hairs. Corolla lobes outside villose with stiff hairs 0.7–1.5 mm long intermingled with a short felt of woolly hairs. Ovary and fruit densely villose with stiff hairs 1.5–2 mm long, initially directed upwards, then patent in fruit.

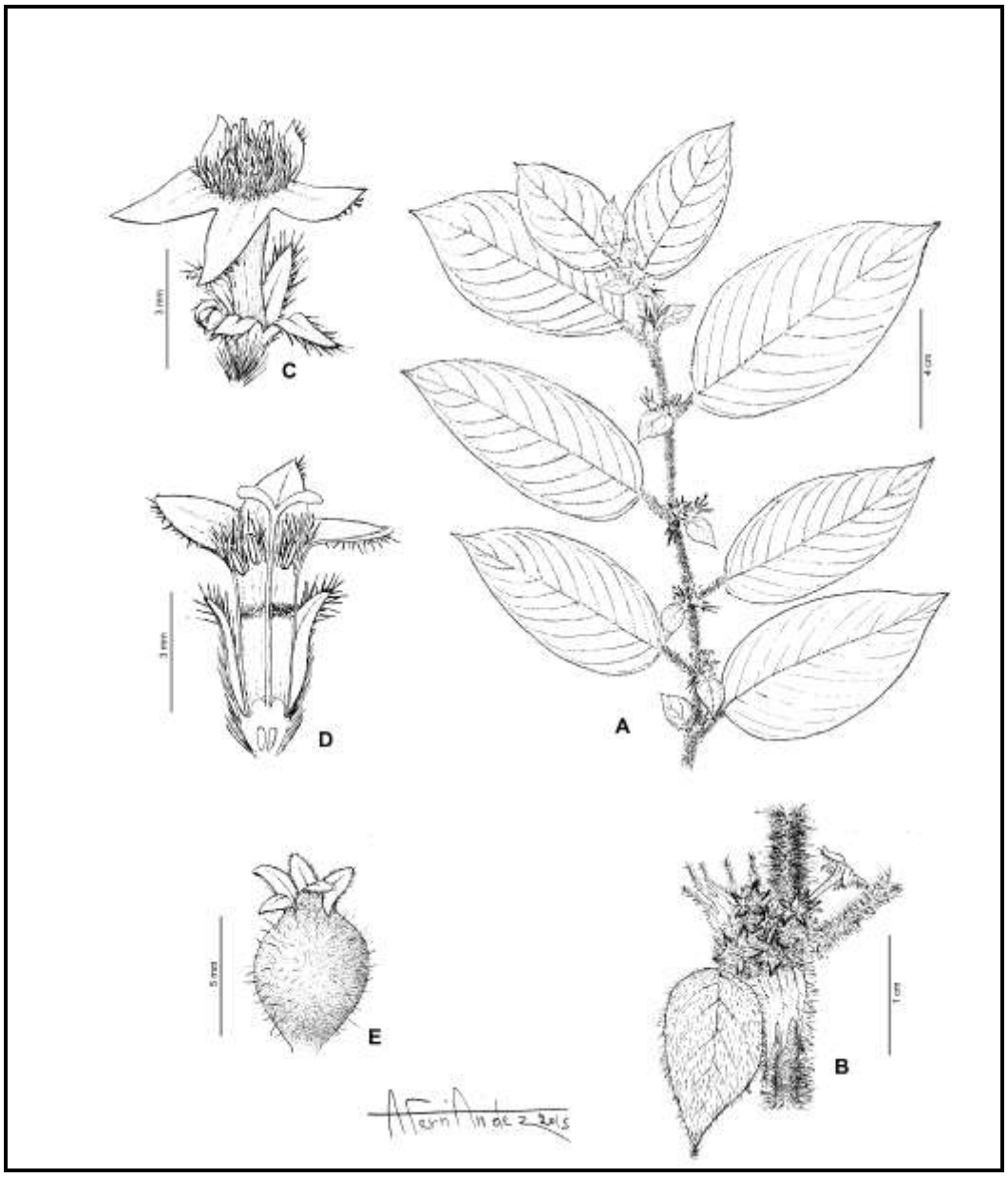

FIGURE 22. *Sabicea mildbraedii* var. *mildbraedii*. A, flowering stem; B, detail of a node with inflorescence, stipules and reduced leaf; C, short-styled flower; D, section of long-styled flower; E, fruit. From *Breteler 6248* (A), *Walters & Kandinia 2082* (B), *Nkunga 6255* (C), *Robyns 4199* (D), *Walters & Niangadouma 1221* (E). Drawn by Antonio Fernandez.

Distribution:—Lower Guinea and Congolia subcentres of endemism. Common and widespread from southeast Gabon to southwestern DR Congo (Fig. 23), partly overlapping with the range of var. *glabrescens*.

Habitat and ecology:—Forest-savanna boundaries, young forest regrowth (e.g. along roads and in fallow fields) and woodland; 300–1050 m in altitude.

Phenology:—Flowers collected in all months except July; fruits in January, March and September.

Conservation status:—IUCN Red List Category: **Least Concern [LC]**. The extent of occurrence is estimated as 244,782.911 km^2 and the area of occupancy as 216 km^2. The latter value falls within the limit for Endangered under criterion B2. However, the taxon is known from more than 10 locations, is usually common, and is favoured by human activities due to its preference for open habitats. It is not therefore threatened.

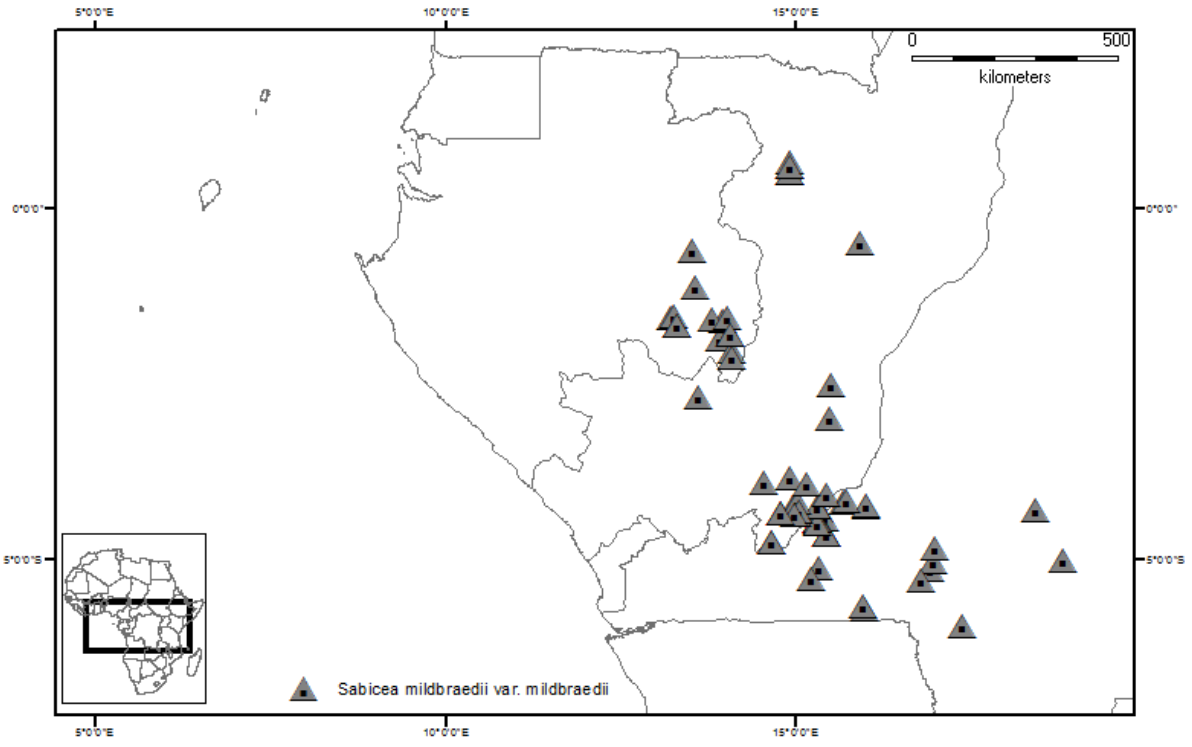

FIGURE 23. Distribution of *Sabicea mildbraedii* var. *mildbraedii*.

Additional specimens examined:—**DR CONGO.** Léo-Kalina "Raquette", 15 January 1940, *A. Becquet 1021* (BR); Léopoldville [=Kinshasa], 14 April 1915, *J. Bequaert 7316* (BR); 07 May 1915, *J. Bequaert 7546* (BR); Lac de "Ma Vallée", Zone Kimwenza, 26 August 1966, *H. Breyne 204* (BR, WAG); Nsele - Menkao, zone Maluku, 20 March 1975, *H. Breyne 2363* (BR); entre Dembo et le Kwango, October 1900, *R.P. Butaye 1487* (BR); Environs de Lemfu, October 1903, *R.P. Butaye s.n.* (BR); Kapana, 21 February 1950, *H. Callens 2365* (BR); Kimuenza-Lovanium, 09 November 1955, *A. Carlier 28* (BR); Sanda, Territoire Kasangulu, 21 April 1960, *P. Compère 1964* (BR); Kenge - Kwango, 03 March 1956, *R. Devred 2647* (BR); 40 km SW Kenge vers Popokabaka, 09 May 1948, *P. Duvigneaud 8545* (BRLU); Entre Kwango-Wamba, village de Pandi à 25 km est de Dinga, 14 August 1944, *R. Germain 2802* (BR); Kimuenza, April 1900, *J. Gillet 775* (BR); Kimuenza, 10 October 1900, *J. Gillet 1623* (BR); Léo II, 5 January 1947, *E. Jans 14* (BR); Kinshasa, mont Amba, pic du mont, près du monastère des Norbertins, 04 June 1974, *A. Lawalrée 18323* (BR); Plateau Batéké (zone de Maluku) près de Mutiene, sur les rives de la Bombo, 09 December 1982, *J. Lejoly 82/722* (BR, BRLU, WAG); Miabi (territoire Bakwanga), 21 November 1956, *L. Liben 1972* (BR, P); environ 30 km au SW de Kinshasa. Bord du lac Ma Vallée, 14 April 1979, *S. Lisowski 52155* (BR); Région de Kinshasa, plateau de Batéké, route Menkao-Mutiene, près du pont sur la Bombo, 09 December 1982, *S. Lisowski 85841* (BR); Environs de Kinshasa, zone de Kimuenza, bord du lac de "Ma Vallée", 12 December 1982, *S. Lisowski 86156* (BR, WAG); Région de Kinshasa, plateau de Batéké, route Menkao-Mutiene, près du pont sur la Bombo, 09 December 1982, *S. Lisowski 86617* (BR, WAG); Kikwit/Erco, 21 November 1990, *B. Masens 503* (BR, BRLU, MO, WAG); Manenga, Territoire Kimbanseke, 06 December 1979, *Nkunga 6255* (BR); Kingana, territoire Popokabaka, 26 November 1958, *L. Pauwels 714* (BR);); Kimvula, territoire Popokabaka, 06 January 1959, *L. Pauwels 1118* (BR); Kimvula, 18 June 1959, *L. Pauwels 3318* (BR); Kimuenza Lovanium, Territoire Binza, 21 January 1957, *W. Robyns 4199* (BR); Madibi, April 2007, *A. Sapin s.n.* (BR); Sanda, 26 November 1908, *H. Vanderyst s.n* (BR.); Sanda, April 1925, *H. Vanderyst 14648* (BR). **GABON**. just outside W of Kelé on road towards Franceville, 03 March 1999, *L. Andersson & A. Nilsson 2302* (BR); 6 km Moanda -Franceville, 01 September 1970, *F.J. Breteler 6248* (BR, P, WAG); near Okondja, 'Route de Falaises', 06 October 1997, *F.J. Breteler & M.E. Leal 14221* (WAG); Plateau Batéké, 37 km E of Franceville, 07 December 1989, *J.J.F.E. de Wilde et al. 9973* (BR, WAG); Kessala village, 29 February 2008, *S. Dessein et al. 2195* (BR); SSE of Moanda, near Mandjaye, 26 November 1992, *J.J. Dibata 1098* (MO, UPS, US, WAG); Route Moanda-Mounana, km 8, piste à gauche 1 km, 05 November 1984, *A.M. Louis 1637* (MO, WAG); c.70 km S of Okondja on road to Franceville, 02 November 2005, *M. Sosef et al. 2195* (WAG); Batéké Plateau, Station of the Projet de Protection des Gorilles, 21 November 2001, *G. Walters et al. 900* (BR, MO, WAG); Plateaux Batéké National Park. Mpassa river drainage; 6 km from Projet Protection des Gorilles, Along Mpassa river, 03 March 2003, *G. Walters & R. Niangadouma 1221* (MO, WAG); Batéké Plateaux, Ekouyi Mbouma village, 09 December 2007, *G. Walters & G. Kandinia 2082* (BR, MO). **REPUBLIC OF CONGO**. Mayama, 26 November 1930, *Babet s.n.* (P); Malengo, 19 August 1964, *A. Bouquet 399* (P); Parc National d'Odzala, savane à env. 10 km du Camp Mboko, sur piste vers Mbomo, 05 December 1994, *D. Champluvier 5029* (BR, WAG); Brazzaville, January 1904, *A.J.B. Chevalier 11381* (P); Gompaka, 5 August 1912, *A.J.B. Chevalier 27707* (P); route Brazzaville–Kinkala, km 37, recû forestier de Kingoye, 05 December 1962, *B. de Néré 35* (MPU, P); Cataractes, route Brazzaville à Kinkala, piste à gauche du village de Tonkama km 38, 14 December 1962, *B. de Néré 128* (P); Cataractes, à 42 km, route Brazzaville–Kinkala, piste à gauche après Tonkama, 20 December 1962, *B. de Néré 216* (MPU); plateau des Cataractes, région de Boko, 04 August 1963, *B. de Néré 298* (MPU, P); same locality and

date, *B. de Néré 373* (MPU); plateau des Cataractes, route Brazzaville-Kinkala, km 30, forêt de Kubola, 09 June 1960, *B. Descoings 5740* (MPU, P); Bassin de l'Alima-Likouala, région de Makoua, à 11 km sur la route d'Etoumbi, 12 June 1961, *B. Descoings 7344* (MPU, P); Plateau des Cataractes, à 20 km de Kibossi sur la route de Brazaville, 17 December 1962, *B. Descoings 9668* (BR, MPU, P); Plateau Batéké, ancien village sur le bord des falaises de Douvres, 26 November 1962, *B. Descoings 9841* (MPU); région de Kindamba, entre Meya et Loukakou, piste des grottes de Meya, 7 February 1963, *B. Descoings 11393* (P); Yakatopema (Moukouma), new MPD camp, 28 January 2009, *E. Kami 4084* (BR); Parc National d'Odzala, environ 1 km à l'est du Camp Ikouélé, 21 June 1995, *Kouka 154* (BRLU); Vers Mpika (35 km au NNW de Brazzaville), 08 November 1987, *J. Lejoly 87/095* (BR); Parc National d'Odzala, piste de Mbomo vers le camp caravati km 17, 12 December 1990, *J. Lejoly & J.M. Moutsamboté 328* (BRLU); Parc National d'Odzala, piste de Mbomo vers le camp caravati km 17, 12 December 1990, *J. Lejoly & J.M. Moutsamboté 350* (BRLU); Parc National d'Odzala, entre le Camp Ikouélé et le camp Mboko, 8 December 1993, *J. Lejoly 93/450* (BRLU); Cataractes, km 56, près du village Yanga, 06 January 1989, *S. Lisowski B-5359* (BR); Parc National d'Odzala, près du campement du layon N'Tombi, 12 February 1994, *S. Lisowski C-802* (BRLU); Parc National d'Odzala, environ 2 km à l'ouest du Camp Mboko, 3 February 1994, *S. Lisowski C-917* (BRLU); piste Brazzaville–Kinkala, km 40, 15 January 1955, *Prévost 95* (P); Bafuru plateau, Léfini Animal Reserve, grassland on lower slopes of Léfini ravine, 12 October 1991, *D.W. Thomas & Harris 8597* (MO); Pool, Réserve de Chasse de Léfini, banks of the Léfini river near its confluence with the Louna river, c.20 km upstream from Mbouanbé, 24 October 1991, *D.W. Thomas et al. 8713* (MO, WAG); région de Fort-Rousset [=Owando], 17 February 1958, *Trochain 10858* (P).

11. *Sabicea ndjoleensis* Zemagho, O.Lachenaud & Sonké, *sp. nov.* (Fig. 24).

Type:—GABON. Moyen Ogooué, c. 10 km NNW of Ndjolé, on BSO forestry road, 276 m, 0°05'16.2"S 10°44'43.5"E, 26 February 2008, *S. Dessein et al. 2149* (holotype BR; isotypes LBV, MO, P, WAG).

Scrambling lianescent shrub, up to 1.5 m high but usually lower, with stems ± trailing and rooting at base; stems 2–5 mm thick, in the young stage densely felted with buff woolly hairs intermingled with longer stiff hairs c. 2 mm long, at length becoming ± glabrescent. Leaves opposite, strongly unequal with one of them much reduced; reduced leaf with petiole 0.1–0.2 cm and leaf blade 0.4–0.8 x 0.2–0.6 cm; normal leaf with petiole 0.8–3.5 mm, with same indumentum as the stems; leaf blade elliptic to slightly obovate, (8–) 10–24.5 x (3) 3.8–10 cm, strongly asymmetrical at base with proximal side rounded to subcordate and distal side truncate to obtuse inserted 1–6 mm higher, acuminate at apex, slightly coriaceous to papery, strongly discolorous; upper side dark green, sparsely villose with stiff hairs 0.7–2.5 mm long, intermingled with shorter woolly hairs on the midrib; lower side buff or greyish, densely felted with woolly hairs; secondary nerves 11–21 on each side of midrib. Stipules paired at

nodes, interpetiolar and connate at base with the petioles into a sheath 4–7 mm long, the free part narrowly triangular, entire, 5–8 x 1.5–3 mm, +/- erect, outside glabrous or with very sparse woolly hairs near the base and sometimes sparsely ciliate on the margin, inside glabrous except the base with silky hairs c. 1.5 mm long. Inflorescences on older stems below the leaves or more rarely in the axils of the lower leaves, 1–2 per node, sessile, densely glomerulate, 1.7–3 cm in diameter, many-flowered. Bracts and bracteoles numerous and not clearly distinct from each other, dark purple, spathaceous and completely enclosing the flowers when young, concave at base, +/- bifid or more rarely entire and acute at apex, the outer ones larger, 6–9 x 5–6 mm, the innermost c. 4 x 1.2 mm, outside sparsely felted (at length becoming glabrescent), inside densely villose all over with silky hairs c. 2 mm long. Flowers 5-merous, sessile, heterostylous. Calyx dark purple; calyx tube 1.5–4 mm long, outside densely felted and sometimes villose with appressed silky hairs, inside glabrous or villose in upper half; calyx lobes linear to elliptic, acute at apex, rather thick and ± concave on the inner side, erect with the apex often +/- bending outwards, 3–6 x 0.3–0.7 mm outside densely felted, inside glabrous to densely villose with appressed silky hairs c.1 mm long; one minute colleter between every pair of lobes. Corolla entirely white, with tube narrow and almost cylindrical, 8.5–11 x 1.5–2 mm, and lobes triangular, 2.3–4 x 1.2–1.8 mm; outside of corolla lobes and upper half of tube densely villose with long appressed silky hairs, the lower half of tube glabrous; throat and base of lobes inside densely bearded with white moniliform hairs c. 1 mm long; inside of tube with 5 patches of hairs slightly above mid-height, the upper part either villose from the throat down to the base of the anthers (long-styled flowers) or glabrous (short-styled flowers). Flower buds with ovoid and slightly enlarged apex. Stamens either included, subsessile and attached around the upper $1/4^{th}$ of the tube (long-styled flowers) or half-exserted, subsessile and attached just below throat (short-styled flowers); anthers c. 2 x 0.3 mm long. Ovary 2-locular, densely villose with appressed silky hairs c. 1.5 mm long. Disk cylindrical, c. 0.2 mm, glabrous. Style bifid, glabrous, either 11–12 mm long and exserted (long-styled flowers) or c.5 mm long and included (short-styled flowers); stigmas 1.2–1.7 mm long, narrowly elliptic. Fruits green to purple, only known in the very young stage.

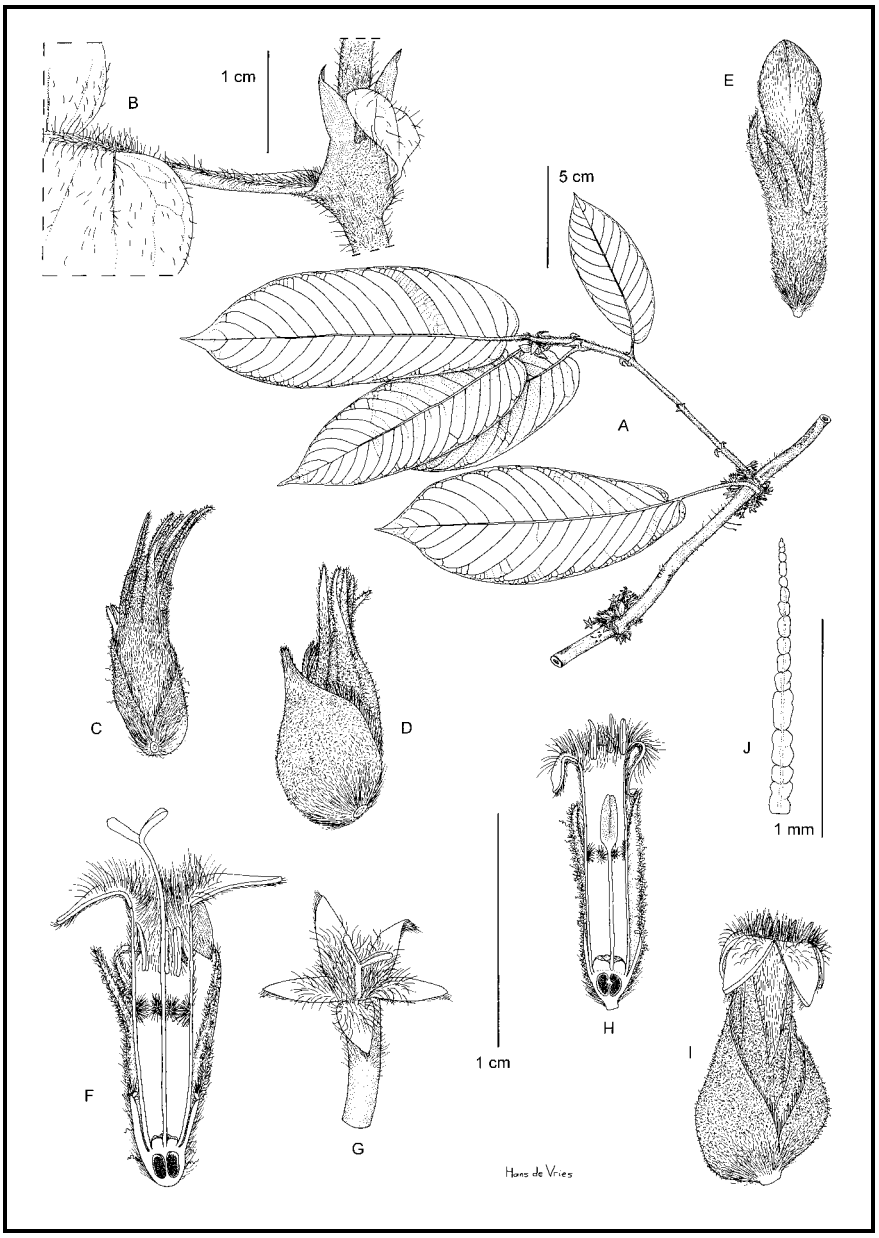

FIGURE 24. *Sabicea ndjoleensis*. A, flowering stem; B, node with stipules, reduced leaf and base of normal leaf; C, calyx surrounded by one bract seen from inside; D, portion of inflorescence with two calyces, surrounded by a bract seen from outside; E, flower bud; F, section of long-styled flower; G, long-styled flower (calyx and ovary removed); H, section of short-styled flower; I, portion of inflorescence with a short-styled flower and surrounding bract; J, detail of a hair from the corolla throat. From *Dessein et al. 2149* (A–B, E, H–J) and *Breteler & Jongkind 10452* (C–D, F–G). Drawn by Hans De Vries.

Etymology:—The species name derives from the town of Ndjolé (Gabon) in the vicinity of which the species occurs.

Distribution:—Lower Guinea subcentre of endemism. Endemic to the hills north of Ndjolé in central Gabon (Fig. 25), where locally not rare. This area is home to several other endemic species, such as *Combretum ndjoleense* Jongkind (Combretaceae), *Dactyladenia ndjoleensis*

Breteler and *Magnistipula devriesii* Breteler (Chrysobalanaceae) and *Tarenna ogoouensis* Degreef (Rubiaceae).

Habitat and ecology:—Half-shaded areas in lowland forest, frequently on the banks of forest tracks.

Phenology:—Flowering in November and February-March; immature fruits in February.

Affinities:—*Sabicea ndjoleensis* is near *S. aurifodinae*, *S. crystallina* and *S. sciaphilantha*. All these species are robust sarmentose plants, with leaves in unequal pairs, entire stipules, a long corolla tube, and inflorescences mostly on the older stems. The differences between them are shown in Table 3. *S. ndjoleensis* is best separated from its relatives by the large spathaceous bracts, completely enclosing the young flowers.

Notes:—A collection from Gabon showing similarities to both *S. ndjoleensis* and *S. sciaphilantha* is discussed under the latter species.

Conservation status:—IUCN Red List Category: **Critically Endangered** [**CR B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v)**]. The extent of occurrence is estimated as 0.456 km^2 and the area of occupancy as 8.000 km^2, both within the limit for Critically Endangered under criteria B1 and B2. The species is known from a single location, which is not protected. Forest exploitation is ongoing in the area (though currently on a limited scale) and the development of a manganese mining project a little further north is likely to bring increased human pressure on the region. A decline in the extent of occurrence, area of occupancy, extent and quality of habitat, number of locations and number of individuals is therefore expected, and the species qualifies as Critically Endangered under the conditions B1ab(i,ii,iii,iv,v) and B2ab(i,ii,iii,iv,v).

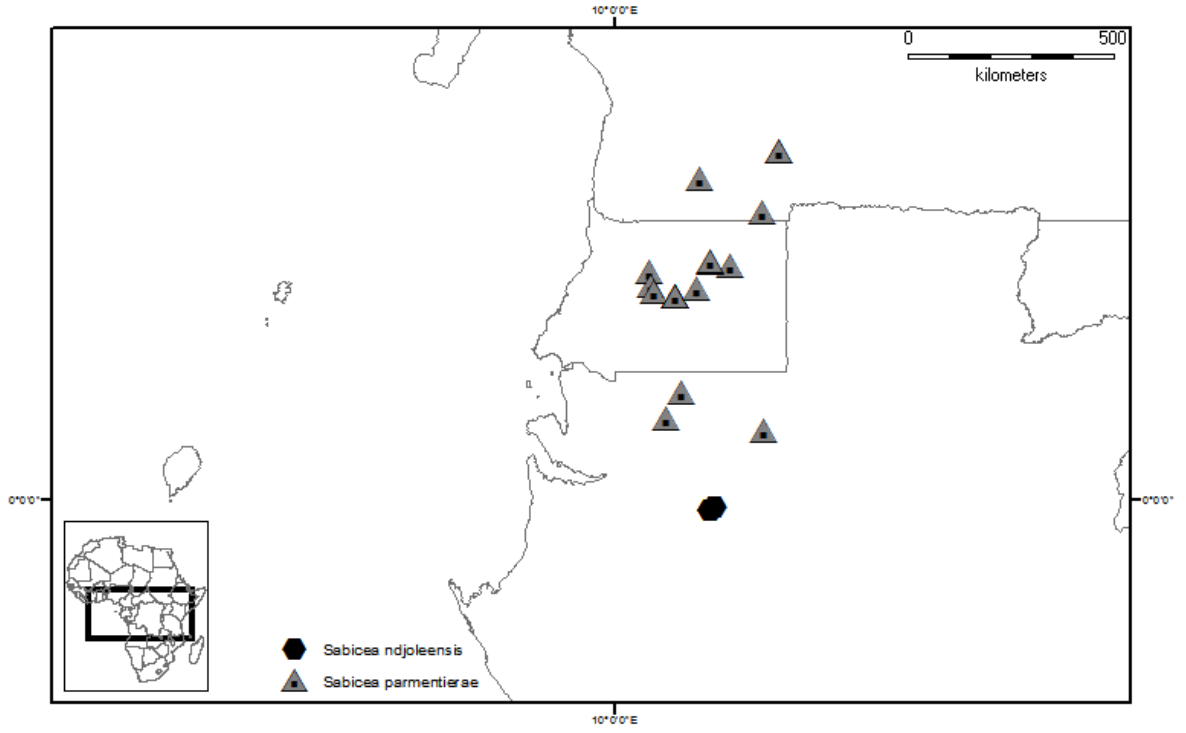

FIGURE 25. Distribution of *Sabicea ndjoleensis* and *S. parmentierae.*

Additional specimens examined:—**GABON**. Moyen Ogooué, about 10 km NNW of Ndjolé, 16 March 1996, *F.J. Breteler 13492* (WAG), 5–15 km NNW of Ndjolé, November 1991, *F.J. Breteler & C.C.H. Jongkind 10452* (BR, WAG); same locality, 15 November 1991, *F.J. Breteler & C.C.H. Jongkind 10501* (WAG).

12. *Sabicea parmentierae* Zemagho, O.Lachenaud & Sonké, *sp. nov.* (Fig. 26).

Type:—CAMEROON. Bidjap, 32 km E Nyabesan, 07 March 1963, *J. & A. Raynal 10282* (holotype P!; isotype YA!).

Low creeping rhizomatous herb 10–20 cm high, with flowering stems ascending and arcuate; stems 1–2 mm thick, persistently villose with stiff patent purplish hairs c.3 mm long, and also sparsely white-felted on young stems. Leaves opposite, strongly unequal with one of them much reduced; reduced leaf with petiole 0.1–0.3 cm long and leaf blade 0.4–0.8 x 0.2–0.4 cm; normal leaf with petiole 0.5–3.8 cm, with same indumentum as the stems; leaf blade elliptic to slightly obovate, 3.4–15.3 x 1.5–6.4 cm, strongly asymmetrical at base with proximal side rounded to subcordate and distal side acute to subcordate inserted 2–7 mm higher, gradually

acuminate at apex, papery, strongly discolorous; upper side green, sparsely to densely villose with stiff hairs c.1 mm long, and shorter uncinate hairs also present on the nerves; lower side white or pinkish-buff, densely felted with woolly hairs, and villose on the nerves (sometimes sparsely so on the lamina as well) with stiff hairs 1–1.5 mm long; secondary nerves 7–12 on each side of midrib. Stipules paired at nodes, interpetiolar, connate at base with the reduced leaf and very shortly with the petiole of the normal leaf, erect to patent, 4–16 x 1.5–4 mm, deeply divided (for ½ to ¾ of their length) into 3–7 linear segments 2–9 mm long, sparsely villose outside with stiff hairs 1–1.5 mm long (sometimes restricted to the margin) and sparse woolly hairs sometimes present as well, glabrous inside except the base with stiff hairs c.3 mm long. Inflorescences axillary on leafy stems, one per node, sessile, densely glomerulate, many-flowered, 0.9–1.8 cm in diameter. Bracts and bracteoles ± hidden between the flowers, not enclosing them; bracts elliptic, entire or shortly dentate, acute at apex, c. 4 x 1.5 mm, villose on both sides with stiff hairs c.1 mm long; bracteoles narrowly ovate to linear, 2–7 x 0.2–1.5 mm, with same indumentum as the bracts. Flowers 5-merous, sessile, heterostylous. Calyx white outside and green with purple hairs inside; calyx tube c. 1.5 mm long, villose with long stiff hairs outside, glabrous inside; calyx lobes spathulate, sometimes narrowly so, the apex acute or obtuse and conspicuously bending outwards, 3.5–4.5 x (0.5–)1–1.5 mm, outside densely white-felted and sparsely villose with stiff hairs 0.7–2 mm long, inside villose with long stiff hairs only, very dense on the narrow basal part and sparse or absent on the enlarged upper part. Corolla with red to pinkish tube and white lobes; tube 6.5–7 x 1–1.5 mm, narrowly infundibuliform, ± widening near the apex; lobes triangular, 3–5 x 1.5–4 mm; outside of corolla tube glabrous, the lobes densely villose with stiff hairs 0.7–2 mm long intermingled with short woolly hairs; throat and base of lobes inside densely bearded with white moniliform hairs 1.5–2 mm long; inside of tube either villose in the upper 2 mm down to the base of the anthers (long-styled flowers) or villose in the upper 1 mm and with 5 patches of short hairs c. 2.5 mm below the throat (short-styled flowers). Flower buds with apex broader than long and strongly enlarged. Stamens either included, subsessile and attached c.2 mm below throat (long-styled flowers) or exserted and +/- hidden between the hairs of the corolla throat, with filaments c. 1.5 mm long attached 2.5 mm below throat (short-styled flowers); anthers 1.5–2 x 0.4 mm long. Ovary 2-locular, densely hirsute. Disk cylindrical, c.0.3 mm long, glabrous. Style bifid, glabrous, either 8.5 mm long and exserted but ± hidden between the long hairs of the corolla-throat (long-styled flowers) or 6 mm long and included (short-styled flowers); stigmas c. 1.5 mm long, broadly elliptic and +/- flattened.

Fruits (probably not fully mature) green, ellipsoid with persistent calyx, 5–6 x 4.5–5 mm when dry, densely villose with long hairs c.2 mm long, subsessile. Seeds brown, polygonal, c. 0.4 x 0.3 mm, the surface with dense parallel striations.

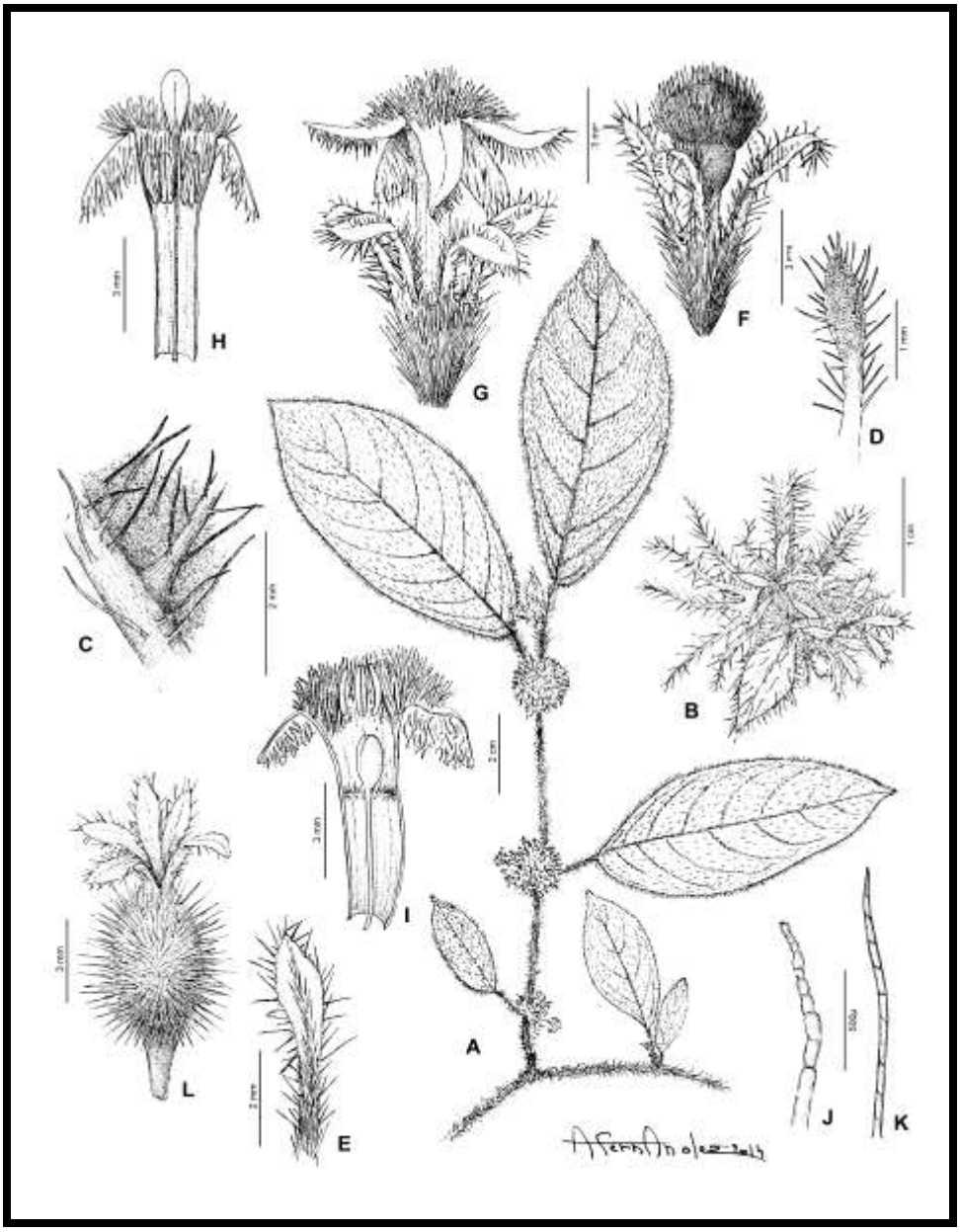

FIGURE 26. *Sabicea parmentierae.* A, flowering stem; B, node with inflorescence, stipules and reduced leaf; C, portion of midrib and lateral nerve below with detail of indumentum; D, detail of a calyx lobe, outside; E, detail of a calyx lobe, inside; F, flower bud; G, long-styled flower; H, section of long-styled flower (calyx and ovary removed); I, section of short-styled flower; J, detail of a hair from the corolla throat; K, detail of a hair from the outside of a corolla lobe; L, fruit. From *N.Hallé & Villiers 5048* (A, F–G), *Letouzey 10177* (B–C, J–K), *Lejoly 94/216* (D–E, L), *J. & A. Raynal 10282* (H–I). Drawing by Antonio Fernandez.

Etymology:—The species is named after Dr Ingrid Parmentier, formerly of the University of Brussels, specialist of the inselberg flora and one of its collectors.

Distribution:—Lower Guinea subcentre of endemism. *S. parmentierae* occurs in the extreme south of Cameroon, Equatorial Guinea, and the Crystal Mountains in northern Gabon (Fig. 25).

Habitat and ecology:—Half-shaded places in forest, usually along streams, in low thickets on inselbergs, or along forest tracks; 490–1110 m in altitude.

Phenology:—Flowering in February–March, May and August–November; fruiting in January, March, May and October.

Affinities:—*Sabicea parmentierae* is best recognised by the spathulate calyx lobes, consisting of a narrow erect base and an enlarged apex bending outwards; the basal part bears very dense stiff hairs inside, while the apex is much less hairy. It is closely related to *S. medusula* and *S. sthenula*, sharing with them a low habit and a pink corolla tube; but these two species have narrower calyx lobes, shorter corolla lobes, and nearly cylindrical flower buds (those of *S. parmentierae* are strongly enlarged at apex). *S. parmentierae* may also resembles *S. mildbraedii*, which has a shorter and entirely white corolla, and calyx lobes glabrous to sparsely hairy inside, variable in shape but not differentiated into base and apex; the ranges of the two species also differ. The differences between the four species are summarised in Table 5.

Notes:—One of the first collections of *S. parmentierae*, *N.Hallé & Villiers 5048* from Gabon, was referred to *S. medusula* by Hallé (1971). So far we have seen no authentic material of *S. medusula* from Gabon, although the species may well occur in the country.

Although this species is well characterised, some collections showing intermediate characters with *S. medusula* and *S. batesii* have been noted; they are discussed under these two species.

Conservation status:—IUCN Red List Category: **Near-Threatened [NT].** The extent of occurrence is estimated as 20,538.703 km^2, slightly above the limit for Vulnerable under criterion B1, and the area of occupancy as 52km^2, below the threshold for Endangered under criterion B2. The species is known from 13 subpopulations representing 12 locations, which is above the limit for Vulnerable under the condition B2a. It occurs in two protected areas (Monte Alén National Park and the Monumento Natural de Piedra Bere, both in Equatorial Guinea). In view of its small range, and preference for inselbergs which are a vulnerable habitat, the species can be classified as near-threatened.

Additional specimens examined:—**CAMEROON**. South Province: Rocher d'Akoakas (± 35 km SE d'Ebolowa), 06 May 2009, *O. Lachenaud et al. 600* (BR); Colline Nkondo près Enyantoum, 20 km SW d'Ambam, 19 March 1970, *R. Letouzey 10177* (BR, P, WAG); Akoakas, 27 km SE Ebolowa, 15 February 1963, *J. & A. Raynal 9732* (P). **EQUATORIAL GUINEA**. Parc National de Monte Alén, transect de Monte Chocolate, 10 October 1994, *J. Lejoly 94/216* (BRLU); Région d'Anisok au dessus du village Nzuamayong, Inselberg Akuom, 11 September 1997, *S. Lisowski M-678* (BRLU); Région d'Anisok au dessus du village Nzuamayong, 11 September 1997, *S. Lisowski M-705* (BRLU); Région d'Anisok, environs de Temelon, près du village Ayene, 10 September 1997, *S. Lisowski M-761* (BRLU); Montagne près de Bikurga, 23 September 1997, *S. Lisowski M-1389, M-1465, M-1467* & *M-1472* (all BRLU); Entre Nsuameyong et inselberg Akuom, 16 January 1998, *C. Obama & J. Lejoly 447* (BRLU); Parc National de Monte Alén, dalle rocheuse d'Engong, 5 km à l'ouest du village d'Engong, 2 July 1999, *I. Parmentier & P. Nguema 107* (BRLU); Parc National de Monte Alén, dalle rocheuse de Monte Alén, 15 May 2002, *I. Parmentier & P. Esono 3082* (BRLU); inselberg de Bicurga, 24 May 2002, *I Parmentier & P. Esono 3148* (BRLU); Monte Alén, 9 August 2001, *B. Sonké et al. 2482* (BR, BRLU). **GABON**. Akoga, 8 February 1968, *N. Hallé & J.F. Villiers 5048* (P); Rougier Logging Concession, Haut Abanga, east of Ndjolé, 18 February 2012, *T. Stévart et al. 4309* (LBV); besides access road to hydroelectric facility at Tchimbélé, 17 November 2002, *J.S. Strijk 364* (WAG).

13. *Sabicea sciaphilantha* Zemagho, O.Lachenaud & Sonké, *sp.nov.* (Fig. 27).

Type:—GABON. Mabounié, 11 October 2012, *B. Sonké & D. Ikabanga 5957* (holo-, MO!; iso-, BRLU, LBV, WAG).

Scrambling lianescent shrub, 0.4–1.5 m high, with stems ± arcuate, trailing and rooting at base; stems 2–5 mm thick, usually with short woolly and long stiff hairs intermingled, more rarely glabrous. Leaves opposite, strongly unequal with one of them much reduced; reduced leaf subsessile, 0.7–4 x 0.3–2.4 cm; normal leaf with petiole 0.6–2.4 cm long, glabrous or with same indumentum as the stems; leaf blade elliptic to obovate, (8.5) 10–36 x 2.7–11.4 cm, ± asymmetrical at base with proximal side cordate to rounded (rarely cuneate) and distal side rounded to cuneate inserted up to 3 mm higher, acuminate at apex, papery to slightly coriaceous, strongly discolorous; upper side green, glabrous or villose on the midrib (rarely also on the lamina in subsp. *hirsuta*) with stiff hairs c.3 mm long; lower side buff or pinkish-grey, densely felted with woolly hairs and sometimes villose on the midrib; secondary nerves 13–30 on each side of the midrib. Stipules paired at nodes, interpetiolar and connate at base with the petioles into a sheath 3–6 mm long, the free part narrowly ovate to elliptic, entire, acute at apex, 10–24 x 2.5–6.5 mm, erect to patent, outside glabrous or sparsely felted near the base, inside glabrous except the base with long silky hairs. Inflorescences on older stems below the leaves, or rarely in the axils of the lower leaves, 1–2 per node, sessile, densely glomerulate, (0.5–)1–2 cm in diameter, usually many-flowered, exceptionally 1-flowered.

Bracts and bracteoles numerous and not clearly distinct from each other, dark purple, ± hidden between the flowers and not enclosing them, narrowly triangular, acute at apex, 2–3 x 0.5–1 mm, glabrous or sparsely villose outside, densely villose inside with long silky hairs all over. Flowers 5-merous, sessile, heterostylous. Calyx dark purple; calyx tube 0.7–1.2 mm, glabrous to densely villose outside, glabrous inside; calyx lobes linear, acute, rather thick and markedly channeled on the inside, erect to oblique and ± bending outwards at apex, 2–4.5 x 0.2–0.5 mm, glabrous outside, densely villose with stiff erect hairs on the margin and inside; 1–2 minute colleters between every pair of lobes. Corolla entirely white, with tube narrow and cylindrical, 7–10 x 1–2 mm, and lobes triangular, 1.5–3 mm long; outside of corolla glabrous to densely villose with stiff hairs on the lobes and upper part of tube (the base of the tube always glabrous); throat and base of lobes inside densely bearded with white moniliform hairs c. 1 mm long; inside of tube either villose from the throat down to the base of the anthers and with 5 patches of hairs c.1 mm lower (long-styled flowers) or glabrous in the upper part and with a ring of hairs around mid-height (short-styled flowers). Flower buds with apex shortly ovoid and slightly enlarged. Stamens either included, with filaments c. 0.7 mm long attached 3.5 mm below the throat (long-styled flowers) or exserted for most of their length, subsessile and attached near the throat (short-styled flowers); anthers 1.5–1.8 x 0.5 mm long. Ovary 2-locular, glabrous to villose with stiff appressed hairs c.2 mm long. Disk cylindrical, c. 0.3 mm high, glabrous. Style bifid, glabrous, either 11–11.5 mm long and exserted (long-styled flowers) or 7.5 mm long and included (short-styled flowers); stigmas 2–2.5 mm long, obovate and ± flattened. Fruits burgundy red, ovoid with persistent calyx, c. 7 x 6 mm when dry, glabrous or sparsely villose, sessile. Seeds pale brown, polygonal, c. 0.5 x 0.3 mm, the surface with dense faint parallel striations.

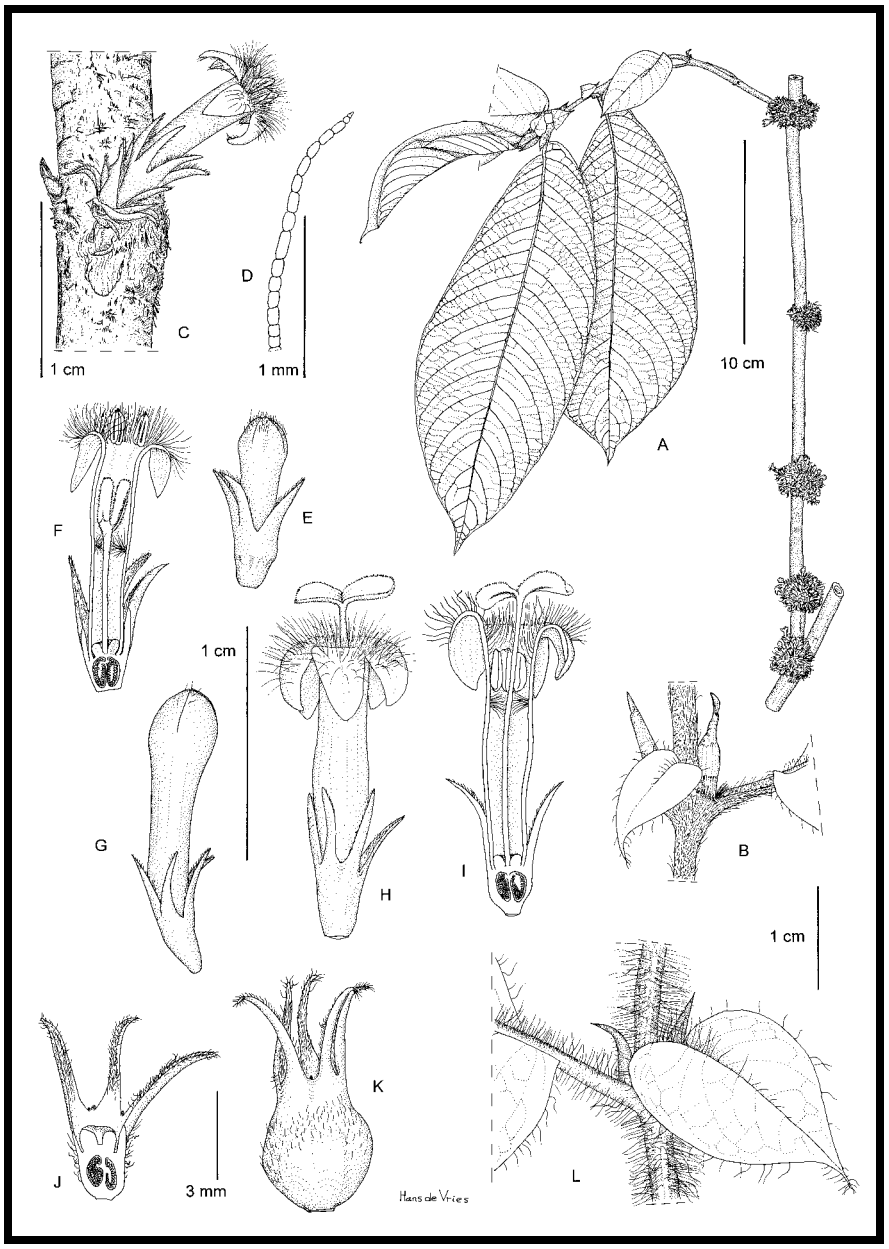

FIGURE 27. *Sabicea sciaphilantha* subsp. *sciaphilantha* (A–K) & subsp. *hirsuta* (L). A, flowering stem; B, node with stipules, reduced leaf and base of normal leaf; C, detail of inflorescence with one short-styled flower; D, detail of a hair from the corolla throat; E, flower bud; F, section of short-styled flower; G, flower bud; H, long-styled flower; I, section of long-styled flower; J, section of calyx and ovary; K, fruit; L, node with stipules, reduced leaf and base of normal leaf. From *Sonké & Ikabanga 5957* (A), *Lachenaud et al. 1375* (B), *Lachenaud et al. 1272* (C–F), *Bidault et al. 1303* (G–I), *Lachenaud et al. 1289* (J–K), *Breteler et al. 14850* (L). Drawing by Hans De Vries.

Etymology:—The specific name, *sciaphilantha*, literally means "shade-loving flower", an allusion to the fact that the flowers are usually borne in shade near the base of the plant, while the leaves are exposed to the light.

Affinities:—*Sabicea sciaphilantha* closely resembles *S. ndjoleensis*, *S. aurifodinae* and *S. crystallina*. All four species are robust sarmentose plants, with leaves in unequal pairs, entire

stipules, a long corolla tube, and inflorescences borne on the older stems, usually below the leaves. The differences between them are shown in Table 3.

Notes:—Part of the material cited under *Pseudosabicea aurifodinae* in the Checklist of Gabonese Vascular Plants (Sosef *et al.* 2006) actually belongs to *Sabicea sciaphilantha* (subsp. *hirsuta*: *F.J. Breteler 14850, F. Hallé 4537;* subsp. *sciaphilantha*: *D.W. Thomas 6460*).

Issembé 259 (WAG) from Mboumi, south of Ndjolé in Gabon, much resembles *S. sciaphilantha* subsp. *hirsuta* in general habit and indumentum, but has larger bracts reminiscent of *S. ndjoleensis* (though slightly smaller). It differs from both species in the calyx lobes, which are broadly elliptic, +/- flat, and glabrous outside apart from woolly hairs on the margin. More collections from the same area are needed to decide its status.

Conservation status:—IUCN Red List Category: **Vulnerable [VU B2ab(i,ii,iii,iv,v)].** The extent of occurrence is estimated as 51,744.709 km^2 and the area of occupancy as 72 km^2, the latter value being within the limit for Endangered under criterion B2. The species is known from 16 subpopulations representing 7 locations, including three protected areas (Lopé National Park in Gabon, Altos de Nsork National Park in Equatorial Guinea, and the Dimonika Biosphere Reserve in Congo). One of the locations at least (Mabounié, in Gabon) is potentially at risk from a mining project. A decline in the extent of occurrence, area of occupancy, extent and quality of habitat, number of locations and number of individuals can therefore be expected, and the species qualifies for Vulnerable status under the conditions B2ab (i,ii,iii,iv,v).

Key to the subspecies

1. Stems glabrous or with appressed hairs, corolla glabrous to sparsely pubescent outside.....
.....*S. sciaphilantha* subsp. *sciaphilantha*

– Stems with long patent hairs, corolla densely pubescent outside.....
..... *S. sciaphilantha* subsp. *hirsuta*

13a. *Sabicea sciaphilantha* subsp. ***hirsuta*** Zemagho, O.Lachenaud & Sonké, *subsp. nov*. (Fig. 27 L)

Type:—GABON. Makandé, 0°41'S 11°54'E, 22 November 1993, *M.M. Dhetchuvi 1401* (holo-, BRLU!).

Stems and petioles villose with patent stiff hairs 3–4 mm long intermingled with sparse to dense appressed woolly hairs. Calyx tube glabrous to densely villose outside. Corolla densely villose outside except the base of the tube. Ovary glabrous to villose.

Etymology:—The subspecific epithet refers to the long-hairy stems.

Distribution:—Lower Guinea subcentre of endemism. This taxon occurs sparsely in Equatorial Guinea, central Gabon, and southwest Republic of Congo (Fig. 28).

Habitat and ecology: —Primary and secondary forest, often along tracks; up to 900 m in altitude.

Phenology:—Flowering in October–November; immature fruits in January.

Notes:—The only collection from Equatorial Guinea (*Nguema et al. 277*), as well as one from Republic of Congo (*F.Hallé 1626*) and two Gabonese specimens (*Breteler et al 14850*, *N.Hallé & Cours 5945*) are vegetative only. They are referred to this taxon on account of the typical stem indumentum. The latter collection was initially referred with doubt to *S. batesii* (Hallé 1966: 204) and later thought to belong to *Pseudosabicea aurifodinae* var. *crystallina* (Hallé 1971: 317) but differs from both *S. batesii* and *S. crystallina* in being much more hairy. This specimen shows curious hairy galls on the stems, which at first sight could be taken for inflorescences.

Conservation status:—IUCN Red List Category: **Vulnerable [VU D2].** The extent of occurrence is estimated as 26,999.427 km^2 and the area of occupancy as 32 km^2; the latter value falls within the threshold for Endangered under criterion B2. The taxon is known from six subpopulations representing five locations; three of these locations are protected areas (Lopé National Park in Gabon, Altos de Nsork National Park in Equatorial Guinea, and the Dimonika Biosphere Reserve in Congo). The areas where it occurs are sparsely populated and the taxon seems relatively adaptable to secondary habitats, so there is no evidence of an

immediate threat. However, due to the small number of known locations, the taxon qualifies for Vulnerable status under criterion D2.

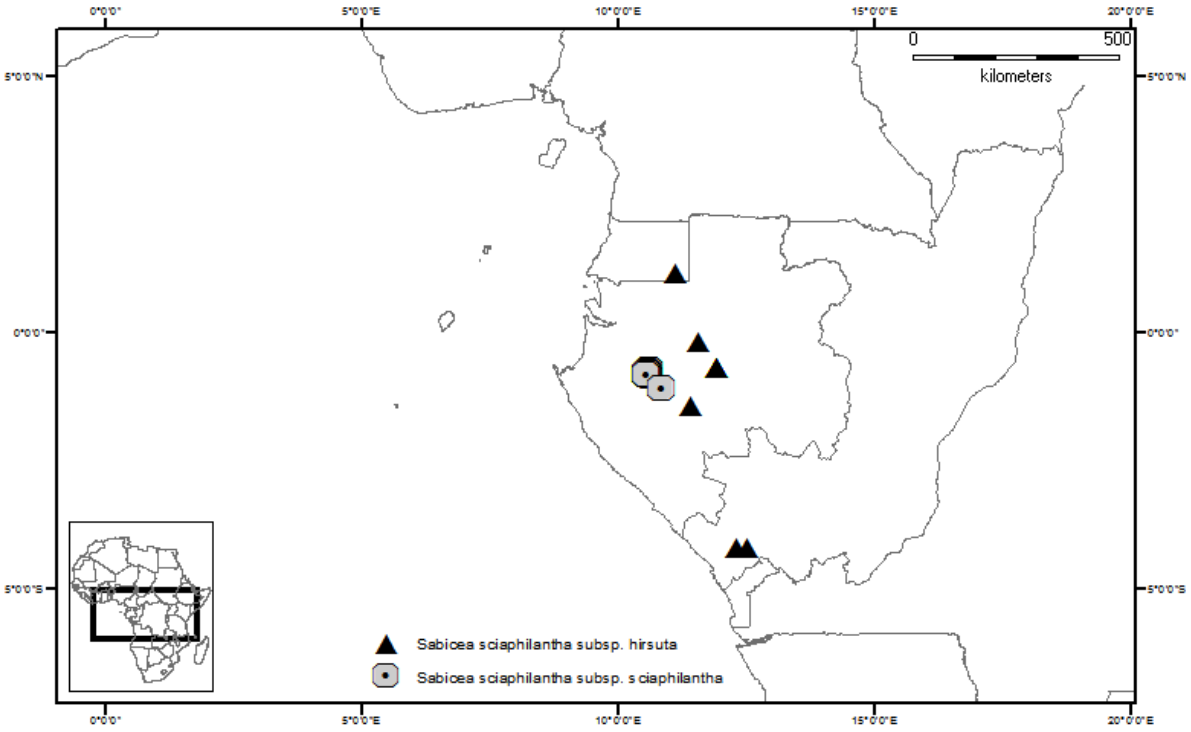

FIGURE 28. Distribution of *Sabicea sciaphilantha* (subsp. *sciaphilantha* and subsp. *hirsuta*).

Additional specimens examined:—EQUATORIAL GUINEA. Parc national de Nsork, Obamicu, 7 August 1998, *N. Nguema et al. 277* (BRLU). **GABON**. Makande surroundings, about 65 km SSW of Booué, 30 January 1999, *F.J. Breteler et al. 14850* (WAG); Makandé, 30 November 1993, *M.M. Dhetchuvi 1532* (BRLU); Région de la "Forêt des Abeilles", campement rivière Makandé (2 km en amont de son embouchure dans l'Offoué), 14 January 1999, *F. Hallé 4537* (WAG); Ovala, env. d'Etéké, carrière micaschiste des recherches filoniennes, c. 900 m, 16 May 1963, *N.Hallé & G. Cours 5945* (P); Réserve de Lopé-Okanda, 26 October 1990, *L.J.T. White [series 2] 170* (MO). **REPUBLIC OF CONGO**. Dimonika, chemin de la "tour des physiciens", 1986, *H. de Foresta 813* (P); Col des Bambas, 13 April 1969, *F. Hallé 1626* (P).

13b. *Sabicea sciaphilantha* subsp. ***sciaphilantha*** (Fig. 27 A–K).

Stems and petioles sometimes glabrous, or usually appressed-hairy with stiff hairs c.1.5 mm long intermingled with a dense felt of woolly hairs. Calyx tube glabrous or very sparsely villose outside. Corolla outside glabrous, or sparsely villose on the lobes and upper half of the tube. Ovary glabrous to very sparsely villose.

Distribution:—Lower Guinea subcentre of endemism. Endemic to Gabon and apparently restricted to the lower Ngounié basin, where locally common (Fig. 28).

Habitat and ecology:—Half-shaded areas along forest streams, small forest gaps on slopes, and also frequently on the banks of forest tracks; 40–100 m in altitude.

Phenology:—Flowering in May–June and October–November; fruits in February.

Notes:—Two specimens, *Sonké & Ikabanga 5980* and *Thomas & Wilks 6440*, differ from the rest in having glabrous stems, in which character they resemble *S. aurifodinae*. Their calyces, however, are perfectly typical for *S. sciaphilantha*.

Conservation status:—IUCN Red List Category: **Endangered [EN B1ab(i,ii,iii,iv,v)+2ab (i,ii,iii,iv,v)].** The extent of occurrence is estimated as 202.568 km^2 and the area of occupancy as 40 km^2, both within the limit for Endangered under criteria B1 and B2 respectively. The taxon is known from 10 subpopulations representing two locations, none of which is protected. The Mabounié region, where all but one subpopulations occur, is potentially at risk from a mining project. A decline in the extent of occurrence, area of occupancy, extent and quality of habitat, number of locations and number of individuals can therefore be expected, and the taxon qualifies for Endangered status under the conditions B1ab(i,ii,iii,iv,v) and B2ab(i,ii,iii,iv,v).

Additional specimens examined:—**GABON**. Mabounié, 45 km SW de Lambaréné, près de la rivière Ngounié, 9 October 2012, *E. Bidault et al. 722* (BRLU, MO), Zone de Mabounié, à 45 km au sud-ouest de Lambaréné, rive nord de la rivière Ngounié, 14 November 2013, *E. Bidault et al. 1303* (BRLU, MO), Zone de Mabounié, à 45 km au sud-ouest de Lambaréné, rive nord de la rivière Ngounié, 16 November 2013, *E. Bidault et al. 1328* (BRLU, MO); Zone de Mabounié, à 45 km au sud-ouest de Lambaréné, rive nord de la rivière Ngounié, 21 June 2014, *E. Bidault et al. 1642* (BRLU, MO); Mabounié, entre camp et débarcadère, 10 November 2013, *O. Lachenaud et al. 1272* (BRLU, LBV, MO); Mabounié, Golgotha, 11 November 2013, *O. Lachenaud et al. 1289* (BRLU, LBV, MO); Mabounié, entre camp et débarcadère, 14 November 2013, *O. Lachenaud et al. 1375* (BRLU); Mabounié, 11 October 2012, *B. Sonké & D. Ikabanga 5962* (BRLU, MO); Mabounié, le long de la rivière Ngounié, 12 October 2012, *B. Sonké & D. Ikabanga 5980* (BRLU, MO); Mabounié, 13 October 2012,

B. Sonké & D. Ikabanga 6002 (BRLU, MO); Mabounié, 14 October 2012, *B. Sonké & D. Ikabanga 6020* (BRLU, MO); Mabounié, Golgotha, 3 February 2013, *B. Sonké et al. 6182* (BRLU, MO); Komi, near Sindara, 17 June 1986, *D.W. Thomas & C. Wilks 6460* (MO, P).

14. *Sabicea sthenula* (N. Hallé) Razafim., B. Bremer, Liede & S.A.Khan (Khan et al. 2008: 14) (Fig. 29).

Pseudosabicea sthenula N. Hallé (1966: 208).

Type:—GABON. Mboundou, SE of Makokou, 27 February 1961, *N. Hallé 1339* (holotype P! isotype BR!)

Low creeping herb < 10 cm high, with stems closely appressed to the ground or sometimes shortly ascending at apex, 1–1.5 mm thick, villose with patent or slightly reflexed c. 2 mm long silky purplish hairs, sometimes intermingled with much shorter uncinate hairs. Leaves single at each node; petiole 0.5–8.7 cm, with indumentum similar to the stems; leaf blade elliptic, 4.2–12 x 2.4–8.5 cm, cordate to obtuse and +/- asymmetrical at base with the distal side inserted 0-4 mm above the proximal side, acute or shortly acuminate at apex, papery, strongly discolorous; upper side green, sparsely villose with stiff and +/- appressed hairs c. 1 mm long, intermingled with short uncinate hairs on nerves; lower side buff to whitish, densely felted with woolly hairs all over, and villose on the midrib with stiff hairs c.2 mm long; secondary nerves 6–9 on each side of midrib. Stipules solitary and leaf-opposed, pale green to reddish, erect, broadly ovate and multifid, 8–15 x 6.5–16 mm, divided for 1/3 to 2/3 of their length into 5–14 narrowly triangular segments 1–7 mm long, sparsely villose to nearly glabrous outside, villose on the margin, glabrous inside except the base with silky hairs c.2 mm long. Inflorescences on leafy stems, one per node, opposed to the leaf and +/- surrounded by the stipule, sessile, densely glomerulate, with 3–10 flowers. Bract solitary, opposed to the stipule and +/- surrounding the inflorescence when young, narrowly ovate, entire and acute at apex, 6–10 x 2.5–3 mm, sparsely villose outside and densely so on the margin, glabrous inside except for long hairs near the base; bracteoles narrowly ovate, entire and acute at apex, 7–9 x 1 mm, with same indumentum as the bracts. Flowers 5- or rarely 6-merous, sessile, heterostylous. Calyx pale green on both sides; calyx tube 1–1.5 mm long, outside glabrous or sparsely villose, inside glabrous; calyx lobes narrowly ovate and gradually narrowing to the acute apex, slightly channelled on the inside, erect to patent, 4–6 x 0.5–1 mm, villose on the margin with silky hairs c. 1.5 mm long, outside glabrescent or sparsely villose (sometimes with very sparse woolly hairs present as well), inside glabrous or sparsely villose with

appressed silky hairs in the central part; one tiny colleter between each pair of calyx lobes. Corolla with pink tube and white lobes; tube narrow and almost cylindrical, 7–7.5 x 1–1.3 mm; lobes narrowly triangular, 2–3 x 0.8–1.2 mm; outside of corolla villose on the lobes and upper 1/4th of the tube, with +/- stiff hairs c.1 mm long intermingled with short and very sparse woolly hairs, the base of the tube glabrous; throat densely bearded with white moniliform hairs c.1 mm long; inside of tube either sparsely villose from the throat down to the base of the anthers (long-styled flowers) or villose down to the insertion of the stamens and with a separate ring of short hairs slightly above mid-height (short-styled flowers). Flower buds nearly cylindrical, only slightly enlarged at apex. Stamens always included and subsessile, attached either near the middle of the tube (long-styled flowers) or around the upper 1/5th of the tube, with their apices almost reaching throat (short-styled flowers); anthers c. 1.3 x 0.3 mm. Ovary 2-locular, densely villose with silky hairs c.2 mm long. Disk cylindrical, c. 0.5 mm long, glabrous. Style bifid, glabrous, either c. 8 mm long and slightly exserted but +/- hidden between the hairs of the corolla-throat (long-styled flowers) or c. 5 mm and included (short-styled flowers); stigmas 1–1.3 mm long, narrowly elliptic and +/- flattened. Fruits (probably not fully mature) green, ovoid with persistent calyx, 5–9 x 3.5–6 mm when dry, densely villose. Seeds pale brown, narrowly polygonal, c. 0.8 x 0.3 mm, the surface with dense parallel striations.

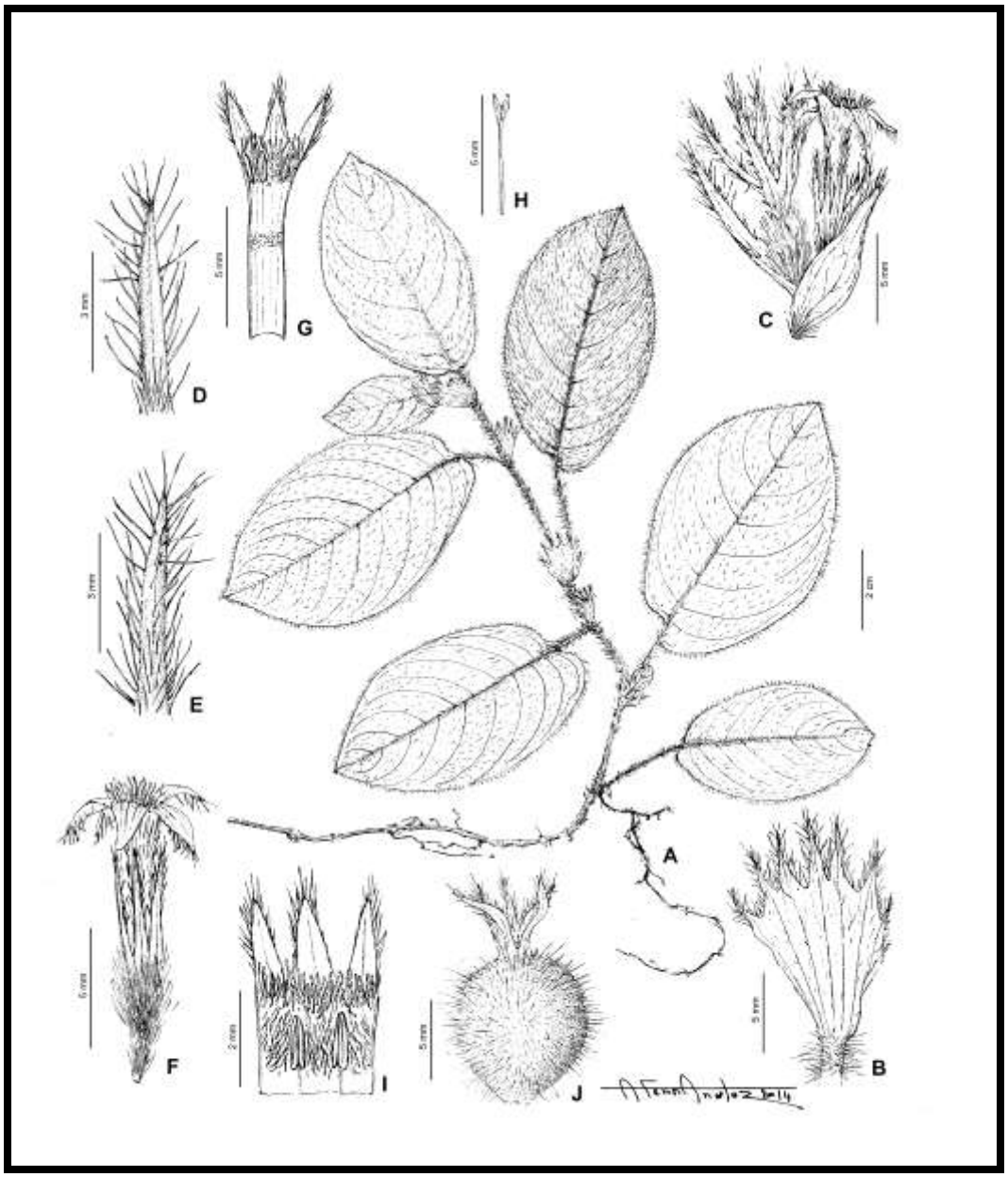

FIGURE 29. *Sabicea sthenula*. A, flowering stem; B, stipule, C, inflorescence; D, detail of calyx lobe, inside; E, detail of calyx lobe, outside; F, short-styled flower; G, section of short-styled flower (calyx, ovary and style removed); H, style; I, detail of the lobes and upper part of corolla tube inside; J, fruit. From *N.Hallé 1339* (A), *Breteler et al. 8821* (B–C, F–I), *Wieringa et al. 4132* (D–E). Drawing by Antonio Fernandez.

Distribution:—Lower Guinea subcentre of endemism. The species is rare in Cameroon, common and widespread in Gabon, and rare in southwest Republic of Congo (Fig. 30).

Habitat and ecology:—Half-shaded places in forest, along forest streams (which are probably the original habitat) and in degraded areas, often covering the ground on shaded roadsides; 140–720 m in altitude.

Phenology:—Flowers in January–April and October–November; fruits in February–May and October–November.

Affinities:—*Sabicea sthenula* closely resembles *S. medusula* in the very low habit, corolla with a pink tube and white lobes, and long and narrow calyx lobes. In the two former characters it also resembles *S. parmentierae*. The differences between these species are summarised in Table 5.

S. sthenula also resembles *S. mapiana* which has a similar low creeping habit and pseudoalternate leaves. The latter species differs in its entirely white corolla, and shorter calyx lobes covered by a dense felt of buff woolly hairs outside (see Table 4).

Notes:—Although *S. sthenula* and *S. medusula* are normally quite distinct species, several collections showing intermediate characters have been noted. Two specimens, *J. & A. Raynal 10184* from Cameroon and *A.M.Louis et al. 2563* from Gabon, have multifid stipules like *S. sthenula*, but show leaves in unequal pairs, stiff hairs on the lamina beneath, and linear calyx lobes as in *S. medusula*. Another collection from Gabon, *Dauby et al. 1746*, is closely similar to the preceding, but with leaves solitary at each node. Finally, *Lejoly 96/680* from Republic of Congo has entire stipules leaves in unequal pairs like *S. medusula*, but the calyx lobes rather match *S. sthenula*. The status of these intermediates is at present unclear, since the material is not homogeneous and some of the collections are poor. More field observations would be necessary to solve this issue.

Conservation status:—IUCN Red List Category: **Least Concern [LC].** The extent of occurrence is estimated as 136,324.007 km^2, and the area of occupancy as 56.000 km^2, the latter value being within the limit for Endangered under criterion B2. The species is known from 12 locations, including one protected area (the Dimonika Biosphere Reserve in Congo). Most of its range is sparsely populated, and due to its preference for open habitats, the species benefits from small-scale forest clearance. It is also very likely to be more widespread than records suggest, as it is neglected by collectors due to its low size. It is therefore not threatened at present.

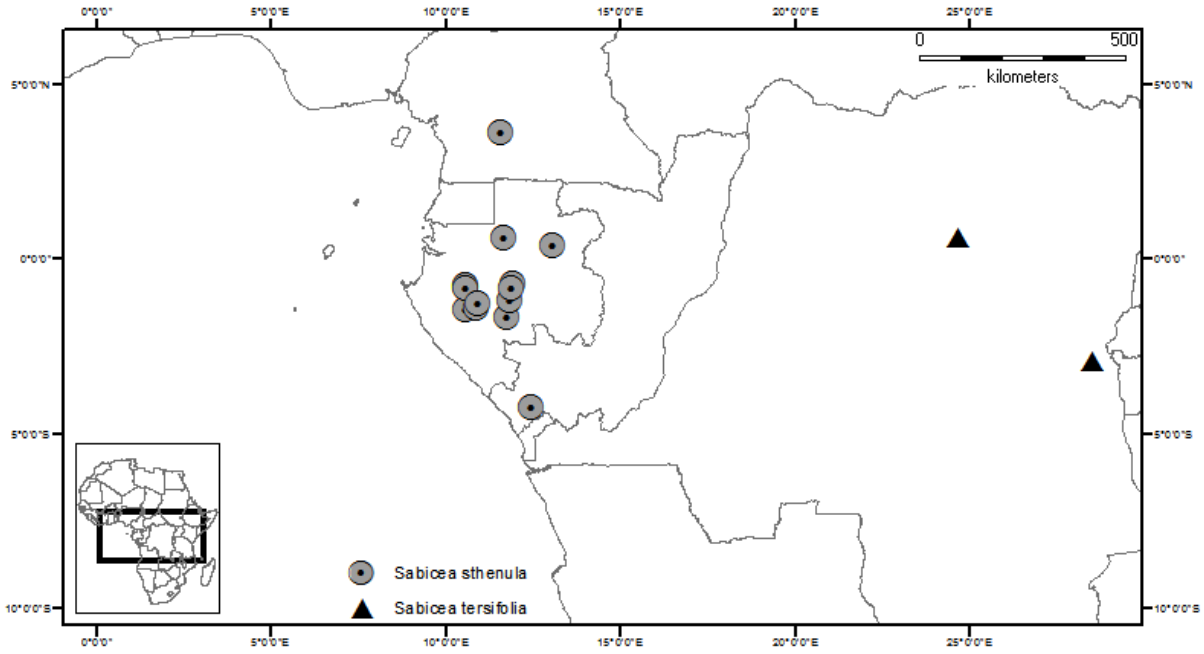

FIGURE 30. Distribution of *Sabicea sthenula* and *S. tersifolia.*

Additional specimens examined:—CAMEROON. Central province: Mefou proposed National Park, Ndanan 1, 09 March 2004, *M. Cheek et al. 11557* (BR, P). **GABON.** 5–10 km E of Saint Germain, E of Okano River, 19 April 1988, *F.J. Breteler et al. 8821* (BR, LBV, MO, P, WAG); Makande surroundings, about 65 km SSW of Booué, 02 March 1999, *F.J. Breteler 15282* (BR, WAG); Zone de Mabounié, 45 km SW Lambaréné, 16 November 2013, *E. Bidault et al. 1340* (BRLU); Foothills of Koumounabouali massive, NE of Bemboudié, 14 February 2008, *S. Dessein et al. 1829* (BR, K, LBV, MO, WAG); Mouyanama falls, at base of Mt Songou, 23 February 2008, *S. Dessein et al. 2112* (BR, LBV, WAG); Base of Mt Iboundji, path to waterfalls, 03 March 2008, *S. Dessein et al. 2342* (BR, LBV); Mboundou, SE de Makokou, 27 February 1961, *N. Hallé 1378* (BR, P); route Mimongo à Mbigou, 22 May 1963, *N. Hallé & G. Cours 6160* (P); Mabounié, 18 November 2013, *O. Lachenaud et al. 1468* (BRLU, LBV, MO); IFL logging concession, along Waka river, 10 November 2009, *T. Stévart et al. 3304* (BR); Mabounié, 12 October 2012, *B. Sonké & D. Ikabanga 5974* (BRLU); Ogooué-Lolo: Forêt des Abeilles, 11 km WSW of Gongué forestry camp, 13 January 2001, *J.J. Wieringa et al. 4132* (BR, MO, WAG); upper Waka area, 8 km on a forestry road heading SE from IFL forestry camp, 30 March 2004, *J.J. Wieringa et al. 5154* (BR, WAG). **REPUBLIC OF CONGO**. Dimonika, 30 April 1986, *H. de Foresta* 976 (P).

Specimens intermediates between *S. sthenula* and *S. medusula*:—CAMEROON. Tom, 12 km E Nyabesan, 04 March 1963, *J. & A. Raynal 10184* (P). **GABON.** CFAD Rougier Ivindo, Ouest du Parc National de l'Ivindo, zone tampon, 16 March 2009, *G. Dauby et al. 1746* (BRLU, MO); Koumameyong, November 1987, *A.M. Louis et al. 2563* (BR). **REPUBLIC OF CONGO**. Grand escarpement d'Odzala, entre le Belvédère et le camp du daman, 24 November 1996, *J. Lejoly 96/680* (BR).

15. *Sabicea tersifolia* (N.Hallé) Zemagho, O.Lachenaud & Sonké, *comb. & stat. nov.* (Fig. 31).

Basionym: *Pseudosabicea arborea* var. *tersifolia* N.Hallé, *Bulletin du Jardin Botanique de l'État à Bruxelles* 34: 398 (1964).

Type:—**DR CONGO**. en aval de Yanonghe, 9 March 1940, *Germain 249* (holotype, BR!; isotypes, BR!, P!).

Liana or shrub, probably sarmentose, up to 2 m high; stems 2–6 mm thick, densely white-felted in the young stage, later glabrescent. Leaves opposite, moderately unequal; reduced leaf with petiole 0.3–0.6 cm long and leaf blade 3.5–8.5 x 2.2–4.3 cm; normal leaf with petiole 0.6–1.5 cm long, densely white-felted; leaf blade elliptic, 8–17 x 4–8.2 cm, +/- symmetrical, obtuse or acute at base, acute or acuminate at apex, coriaceous and strongly discolorous; upper side green, glabrous or with very sparse woolly hairs in the young stage; lower side whitish, densely felted with woolly hairs; secondary nerves 8–18 on each side of midrib. Stipules paired at nodes, free and interpetiolar, ovate, entire, acute at apex, 6 x 5–6 mm, erect, outside glabrescent, inside glabrous except the base with silky hairs c.2 mm long. Inflorescences axillary on leafy stems, 1–2 per node, sessile, densely glomerulate, 0.7–1 cm in diameter, few-flowered. Bracts and bracteoles very small and hidden between the flowers; bracts elliptic, shortly dentate, shortly connate at base, 3–4 x 1–2.5 mm, outside densely felted, inside glabrous except the base with long silky hairs; bracteoles narrowly elliptic and irregularly dentate, c.2 x 1 mm, with same indumentum as the bracts. Flowers 5-merous, sessile; only brevistylous flowers seen. Calyx tube c.1 mm, densely white-felted outside, glabrous inside; calyx lobes triangular, patent and acute at apex, 1–1.5 mm long, densely white-felted outside, glabrous inside; one minute colleter between each pair of calyx lobes. Corolla white, with tube narrow and cylindrical 10–13 x 1.2–2 mm, +/- curved at base, and lobes triangular, 2–3 x 1.2–2 mm; outside of corolla densely white-felted except the very base of the tube; throat, base of lobes and upper 2/3 of tube inside with sparse hairs 0.25–0.5 mm long. Flower buds nearly cylindrical, only slightly enlarged at apex. Stamens included, subsessile with their apex just reaching throat; anthers c. 2 x 0.4 mm. Ovary 2-locular, densely white-felted. Style bifid, glabrous, c. 4 mm long, included; stigmas c. 1 mm long, narrowly cylindrical. Fruits red, subglobose to ellipsoid with persistent calyx, c. 6 x 6 mm when fresh, c.4 x 3.5 mm when dry, densely white-felted in the young stage covered with woolly hairs when young, sessile. Seeds numerous, brown, polygonal, c.0.7 x 0.7 mm, reticulate.

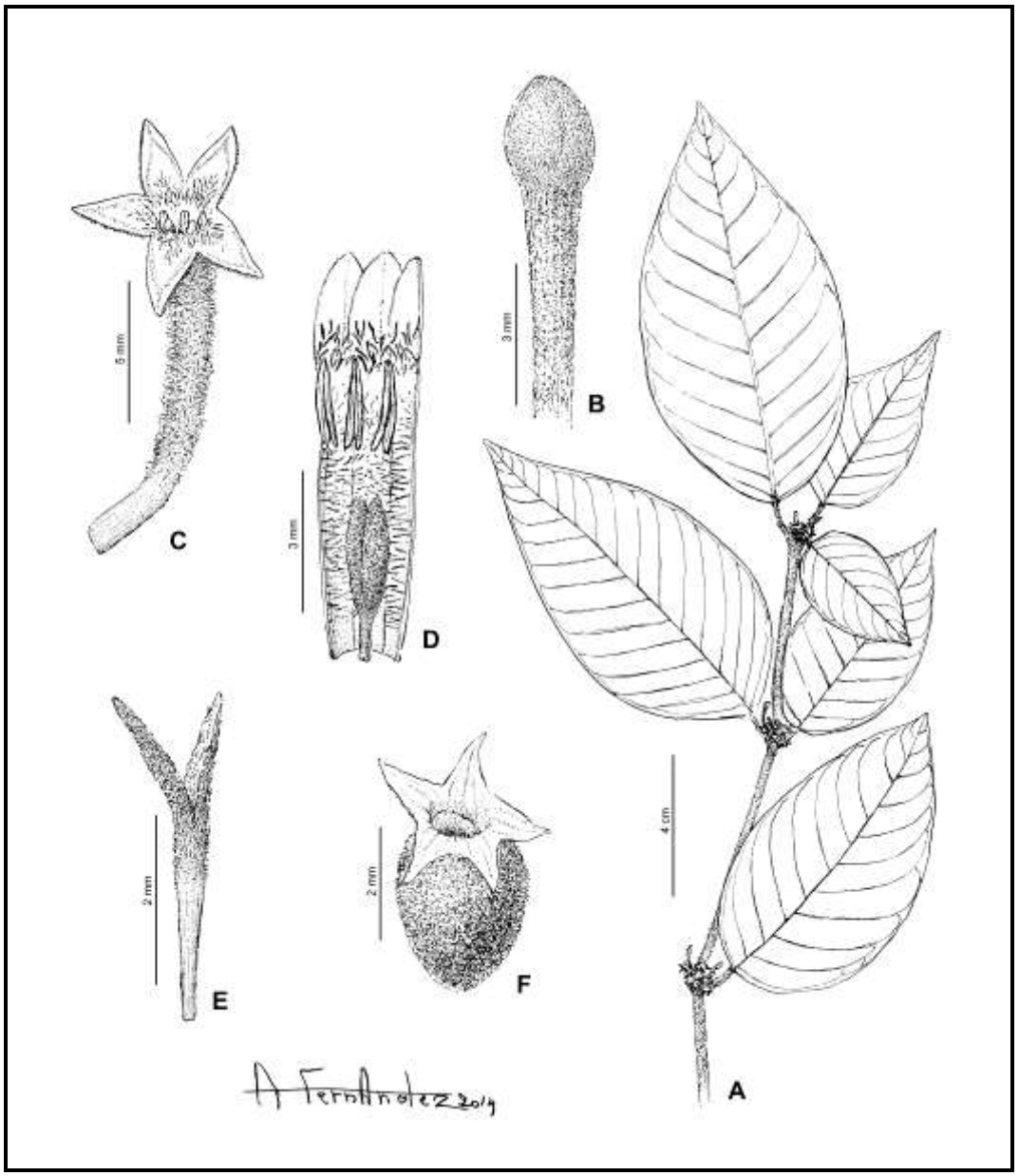

FIGURE 31. *Sabicea tersifolia*. A, flowering stem; B, flower bud; C, flower (calyx and ovary removed); D, section of flower (calyx and ovary removed); E, style; F, immature fruit. All details from *Germain 249*. Drawing by Antonio Fernandez

Distribution:—Congolia subcentre of endemism. Endemic to DR Congo, occuring from the Yangambi region east to the foothills of the Congo-Nile dorsal (Fig. 30). Apparently a rare species, collected only three times.

Habitat and ecology:—A heliophilous species growing along rivers and on grassland/forest margins, 470–1270 m in altitude.

Phenology:—Flowers in March and July; fruits in March (immature) and August (mature).

Affinities:—*Sabicea tersifolia* is closely related to *S. arborea*, and was originally described as a variety of it, but shows enough differences (see Table 2) to be recognised as a separate species. It also has a different ecology from *S. arborea*, being found at lower altitudes.

Notes:—The habit of the species needs further study in the field; two collections are recorded as lianas (*Germain 249* and *Lebrun 5674*) and one as a shrub (*Lotter 1486*). See also the Morphology chapter.

The two flowering collections (*Germain 249* and *Lebrun 5674*) are both of the brevistylous form. The species is likely to be heterostylous, as usual in the genus.

Conservation status:—IUCN Red List Category: **Endangered** [**EN B2ab(i,ii,iii,iv)**]. The species is known from three locations, only two of which could be georeferenced (the third , "Urega", being too imprecise). The extent of occurrence is therefore not calculable, while the area of occupancy is estimated as 8 km^2, within the limit for Critically Endangered under criterion B2. None of the localities are protected, and deforestation for agriculture (and also for mining in the eastern part of its range) represents a clear threat to the species. A decline in the area of occupancy, extent and quality of habitat, number of locations and number of individuals can therefore be projected, and the species qualifies for Endangered status under the conditions B2ab(ii,iii,iv,v).

Additional specimens examined:—DR Congo. South Kivu Province, 2°55.040'S-28°29.870'E, 18 August 2008, *Lotter 1486* (BR); Urega (Maniema), July 1932, *Lebrun 5674* (BR, P).

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Publication 3

Two new *Sabicea* (Rubiaceae) species from West Central Africa: *Sabicea bullata* and *Sabicea urniformis*.

Phytotaxa. 173 (4): 285–292 (2014).

Two new *Sabicea* (Rubiaceae) species from West Central Africa: *Sabicea bullata* and *Sabicea urniformis*

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Abstract

Two distinctive new species of *Sabicea* (Rubiaceae) from the Lower Guinea region are described and illustrated. *Sabicea bullata* is easily recognized by its cordate leaves, which are strongly bullate above, and its sessile glomerulate inflorescences. It is restricted to the Rumpi Hills and Bakossi Mountains, in southwestern Cameroon. *Sabicea urniformis*, from southern Gabon and Congo-Brazzaville, is remarkable in having discolorous leaves and an urn-shaped involucre with bracts shortly connate at the base.

Detailed descriptions and botanical drawings are provided, conservation status assessed and taxonomic affinities discussed.

Key words: Conservation status, Lower Guinea, Rumpi Hills, IUCN Red List Categories

Introduction

Sabicea Aublet (1775: 192) is a large genus of the Rubiaceae family and includes ca. 145 species (Govaerts *et al.* 2013). The two main centers of diversity are tropical Africa (ca.

85 species) and South America (ca. 54 species) (Khan *et al*. 2008); the genus also occurs in Madagascar (6 spp.) (Razafimandimbison & Miller, 1999) and Sri Lanka (1 sp.) (Khan *et al*. 2008).

The delimitation of *Sabicea*, especially in Africa, has been controversial. Hallé (1963, 1966) regarded *Sabicea* to consist only of species with twining habit and 5-locular ovaries, and separated the genera *Stipularia* Palisot-Beauvois (1807: 26), *Ecpoma* Schumann (1896: 430) and *Pseudosabicea* N. Hallé (1963: 170), which have a non-twining habit and (except in *Stipularia*) 2-locular ovaries. Based on phylogenetic data, Khan *et al*. (2008) united these satellite genera with *Sabicea*. This largely follows the earlier treatments of Wernham (1914, who however kept *Stipularia* distinct) and Hepper (1958). *Sabicea* in the broad sense is easily characterized by the following combination of characters: absence of raphides, valvate corolla aestivation, axillary inflorescences and fleshy fruits with numerous small seeds (Dessein *et al.* 2001, Khan *et al.* 2008).

The genus *Sabicea* s.l. belongs to tribe Sabiceeae. Based on nrITS and *trn*T-F sequence data, Khan *et al.* (2008) also included in this group the genera *Hekistocarpa* Hooker (1873: 1151), *Tamridaea* Bremer & Thulin (1998: 85) and *Virectaria* Bremekamp (1952: 21), although this broad circumscription of Sabiceeae s.l. is not supported by any morphological synapomorphy. Dessein *et al.* (2001) treated these three genera as a separate tribe, Virectarieae, a position supported by *rps*16 intron sequences.

In Africa, *Sabicea s.l.* is most diverse in the Lower and Upper Guinean Domains, with only few species in the Congolian Domain and in the other African phytoregions of White (1979). Although valuable regional treatments have been provided by Hepper & Keay (1963) for West Africa, Hallé (1966) for Gabon and Verdcourt & Bridson (1988) for East Africa, recent collections have resulted in the discovery of new species, which calls for a continental revision of the genus, presently under way. In this paper two of these new species are described, *S. bullata* from southwestern Cameroon and *S. urniformis* from southern Gabon and Congo-Brazzaville. These two species belong to *Sabicea* in the narrower sense of Hallé (1963, 1966).

Material and methods

Herbarium material of *Sabicea* was consulted at BR, BRLU, GH, MO, NY, UPS, WAG and YA (herbarium acronyms according to Thiers 2010). Descriptive terminology follows Robbrecht (1988) and Anonymous (1962). All specimens seen are cited. Measurements, colours and other details given in the descriptions are based on living material, spirit and herbarium specimens, and data derived from field notes. Phytogeographical terminology follows White (1979). The distribution map was made with DIVA-GIS 7.5.0 (Hijmans *et al.* 2001), using georeferenced specimen data derived from the labels or available literature. The conservation status of the new species was assessed by calculating the extent of occurrence (EOO) and the area of occupancy (AOO) using GeoCAT (Bachman *et al.* 2011) and applying the IUCN Red List Categories and Criteria, version 3.1 (IUCN 2012; IUCN 2013). The AOO was calculated based on a user defined grid cell of 2 km.

Taxonomic treatment

Sabicea urniformis Zemagho, O. Lachenaud & Sonké, *sp. nov.* (Fig. 1)

Type:—GABON. Ogooué – Maritime: Rabi, in rainforest, near camp, 01°55'S 09°50'E, 24 March 2004, *Breteler et al. 9427* (holotype BR; isotypes LBV, WAG).

Creeping and twining liana; stems up to 5 m long; 2–3 mm thick; twigs hirsute with long (ca. 2 mm) patent hairs intermingled with short appressed woolly hairs. *Stipules* persistent, entire, reflexed (rarely erect), ovate to sub-orbicular, acute at the top, 5–10 × 3–6 mm, glabrous on adaxial surface, hirsute on the abaxial surface. *Leaves* opposite, equal; petioles 0.2–3 cm long, with same indumentum as the twigs; blades elliptic, 3–15.8 × 1.6–7.4 cm, upper side darkish green, densely to sparsely villose with straight hairs, lower side grey white to pale buff, with a dense felt of short woolly hairs (sometimes sparser) intermingled with sparser, long stiff hairs; base obtuse, rarely acute; apex acuminate; secondary nerves 9–17 on each side of the mid-vein, distinctly bullate above in life. *Inflorescences* capitate and involucrate, 9–14 flowered, sessile or shortly (to 0.4 cm) pedunculate; involucre narrowly urn-shaped at anthesis, patent and star-like in fruit, consisting of at least two pairs of bracts; bracts green, ovate to narrowly

ovate, apex acute, densely villose on both sides with straight hairs, sometimes intermingled with woolly hairs on outer side; the outer pair (11–)14–30 × 6–13 mm, shortly connate at base at anthesis, splitting in fruit; the inner pairs slightly smaller and free. *Flowers* 5-merous, sessile. Calyx tube ca. 1 mm long; lobes narrowly triangular to linear, 3–5 mm long, apex acute, densely covered with long silky hairs. Corolla white, tube 15–20 mm long, lobes 2–3 mm long, covered with long appressed silky hairs outside, shortly pubescent in upper half inside. Stamens half-exserted (short-styled flowers) or included (long-styled flowers); anthers 1.25–1.5 mm long, base glabrous, apex pubescent. Ovary 5-locular; style 5-lobed, included, ca. 12 mm long (short-styled flowers) or exserted, 17–19 mm long (long-styled flowers). Fruits sessile, ovoid to obovoid, 17 × 15 mm in vivo, hirsute, white with flesh also white, topped with persistent calyx. Seeds, numerous, not mature.

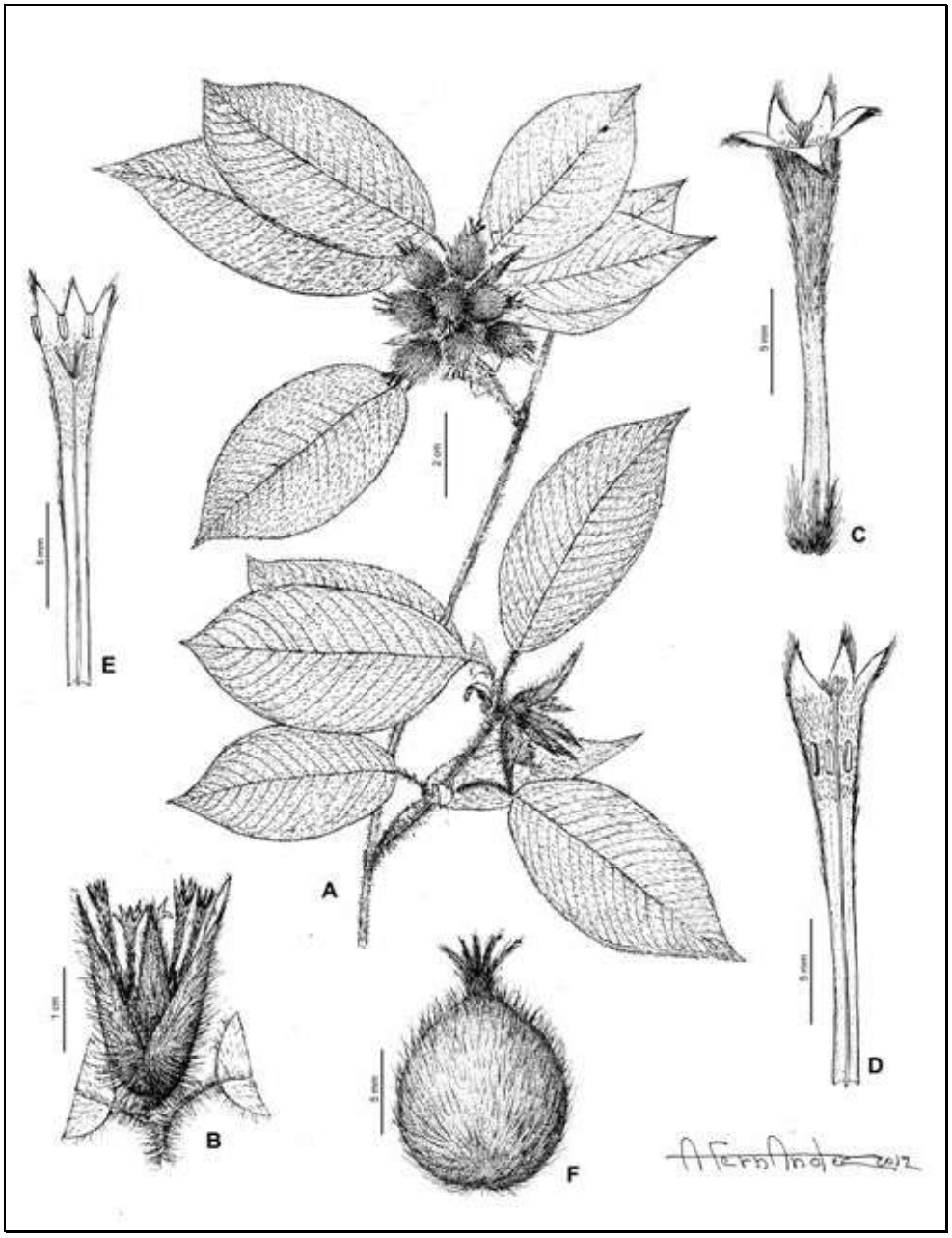

FIGURE 1. *Sabicea urniformis*. A. Fruiting twig. B. Inflorescence. C. Long-styled flower. D. Section of long-styled flower. E. Section of short-styled flower. F. Fruit. A & C, *Breteler et al. 9427*; B, *J.M. & B. Reitsma 3571*; D-F, *Wieringa & Haegens 2390.*

Distribution and Ecology:—*Sabicea urniformis* is known from southwest Gabon, where it is locally common, and adjacent Congo-Brazzaville (Fig. 2). It grows in forest edges and in secondary forest.

Phenology:—Probably flowering and fruiting the whole year round.

TABLE 1. Distinguishing characters between *Sabicea becquetii*, *S. capitellata*, *S. urceolata* and *S. urniformis*.

	S. becquetii	***S. capitellata***	***S. urceolata***	***S. urniformis***
Leaves	discolorous	discolorous	green on both sides	discolorous
Involucre shape	hemispherical	hemispherical	narrowly urceolate	narrowly urceolate in flower, patent and star-like in fruit
Bracts	free	free	almost entirely connate, splitting down one side in fruit	shortly connate at base, splitting in fruit
Corolla tube	9–11 mm	7–8 mm	ca. 25 mm	15–20 mm
Ovary	2-locular	5-locular	5-locular	5-locular
Fruit colour	red	white	red	white
Distribution	Burundi	Cameroon to D.R. Congo	Nigeria to Gabon	Gabon and Republic of Congo (Brazzaville)

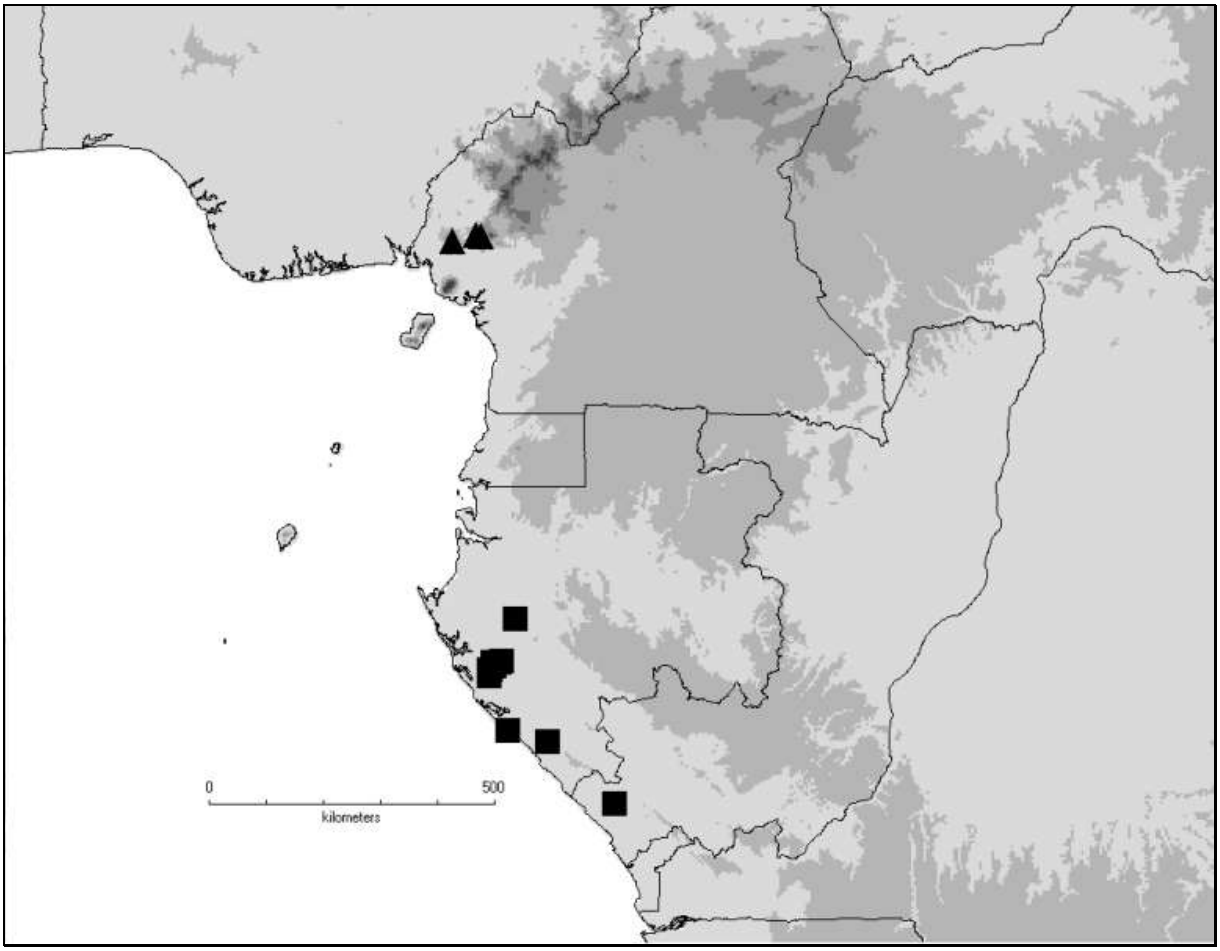

FIGURE 2. Distribution of *Sabicea bullata (*▲) and *Sabicea urniformis (*■*)*

Notes:—This plant was first recognized as new species by N. Hallé, as indicated on the specimen *Dowsett-Lemaire 1434*. *Sabicea urniformis* is remarkable in its involucre, of which the two outer bracts are shortly connate into a narrow urn-shaped structure at anthesis (hence the specific name) before splitting and becoming patent in fruit. This is unusual in *Sabicea,* where most species have free bracts. In this character *S. urniformis* superficially resembles *S. urceolata* Hepper (1958: 293), but the latter has bracts almost entirely connate, red fruits, and the leaves are green on both sides.

In general habit, *S. urniformis* also resembles *S. becquetii* N.Hallé (1964: 400) Razafim., Bremer, Liede & Khan (2008: 20), but the two species have widely separate ranges and are presumably not related; *S. becquetii* differs in its free bracts and red 2-locular fruits. *Sabicea urniformis* is probably more closely related to *S. capitellata* Benth. (Hooker 1849:

398) s.l., also with discolorous leaves and white 5-locular fruits, but differing in having much smaller flowers and bracts, the latter free. Differences between all these species are summarized in Table 1.

Conservation status:—Under Criterion B, *Sabicea urniformis* qualifies for vulnerable based on the Extent of Occurrence (14981.96 km^2) and endangered based on Area of Occupancy (44 km^2, grid cell size 2 km). However, there is no clear threat for the species at present. Forests are relatively well managed in the area where the species is found, and in addition *S. urniformis*, like most of its congeners, is a forest edge species, relatively adaptable to habitat degradation. Therefore the species is for now considered as Least Concern.

Paratypes:—**REPUBLIC OF CONGO (BRAZZAVILLE)**. Kouilou: Mayombe à Béna, 20 December 1990, *Dowsett-Lemaire 1434* (BR); Béna, *Lisowski B-7164* (BR).

GABON. Rabi Kounga site 2 S, 1 June 2002, *Bouroubou et al. 681* (MO); between Rabi-Kounga and Yeno, 16 May 1992, *Breteler et al. 11478* (LBV, WAG); Rabi-Kounga, 9 July 1998, *Breteler et al. 14362* (BR, LBV, WAG); concession de Rabi-Shell, entre Rabi et Toucan, 23 January 2010, *Dauby et al. 2108* (BRLU); Nyanga, Gamba, 12.4 km from Gamba airport in SE direction; 30 November 1994, *J.J.F.E. de Wilde* & *de Wilde-Bakhuizen 11259* (WAG); concession Maurel & Prom près du Lac Ezanga, 22 November 2013, *Lachenaud et al. 1532* (BR, BRLU, LBV, MO, P, WAG); road between Rabi and Eshira, 22 January 1988, *J.M.* & *B. Reitsma 3571* (LBV, WAG); Rabi-Kounga, southside, 09 October 1991, *Schoenmaker 2* (LBV, WAG); Nyanga, Mayumba, ca. 20 km along the road to Ndindi, 31 March 2001, *Tabak* & *van Os 235* (WAG); Ogooué-Maritime: Rabi, 4,5 km on road to Divangui, roadside, 4 March 1994, *Wieringa & Haegens 2390* (LBV, WAG); Ngounié, 52 km road Mandji to Yeno, 19 January 2005, *Wieringa et al. 5584* (WAG).

Sabicea bullata Zemagho, O.Lachenaud & Sonké, *sp. nov.* (Fig. 3)

Type:—CAMEROON. Rumpi Hills near Dikome Balue, 1417 m, 4°54'53.7'' N 09°14'32.3'' E, 18 April 2009, *Dessein et al. 2572* (holotype BR; isotype YA).

Creeping or twining liana; stems up to 3 m long; 0.5-3 mm thick; twigs hirsute with long straight hairs (1-2 mm long); only the twining stems are flowering. *Stipules* persistent, entire,

ovate to sub-orbicular, acute at the top, 8–12 × 8–10 mm, glabrous on adaxial surface, hirsute on the abaxial surface. *Leaves* opposite, equal; petioles 0.5–4.5 cm long, hirsute (hairs c. 2 mm long); blades elliptic, 4.8–11 × 2.8–6.5 cm, green on both surfaces (the young leaves tinged purple below), hirsute on both surfaces, margins ciliate (hairs 0.7-1 mm long), strongly bullate in vivo (not always visible when dry); base cordate; apex acuminate; secondary nerves 10–15 on each side of the mid-vein. *Inflorescences* solitary at the nodes, glomerulate, 3–5-flowered, sessile; bracts green, broadly ovate to narrowly ovate, apex acute, hirsute on both surfaces; 5–7 × 2–6 mm, free, rather inconspicuous and not clearly forming an involucre, consisting of one basal pair and one pair below each flower . *Flowers* 5-merous, sessile; only longistylous flowers known. Calyx green, tube ca. 1 mm long, lobes ovate to narrowly ovate, 7–9 × 4–5 mm, apex acute, hirsute outside, glabrous inside except near base. Corolla white, tube 12–15 mm long, lobes 2–3 mm long, appressed-pubescent outside, pubescent inside above the insertion of the stamens. Stamens included, inserted near the middle of the tube, anthers ca. 2 mm long, base and apex glabrous. Ovary 5-locular; style 5-lobed, exserted, stigmas ca. 2 mm long (long-styled flowers). Fruits sessile, ovoid, 7 × 5 mm (probably larger when fully mature), hirsute, red, topped with green persistent calyx. Seeds, numerous, not mature.

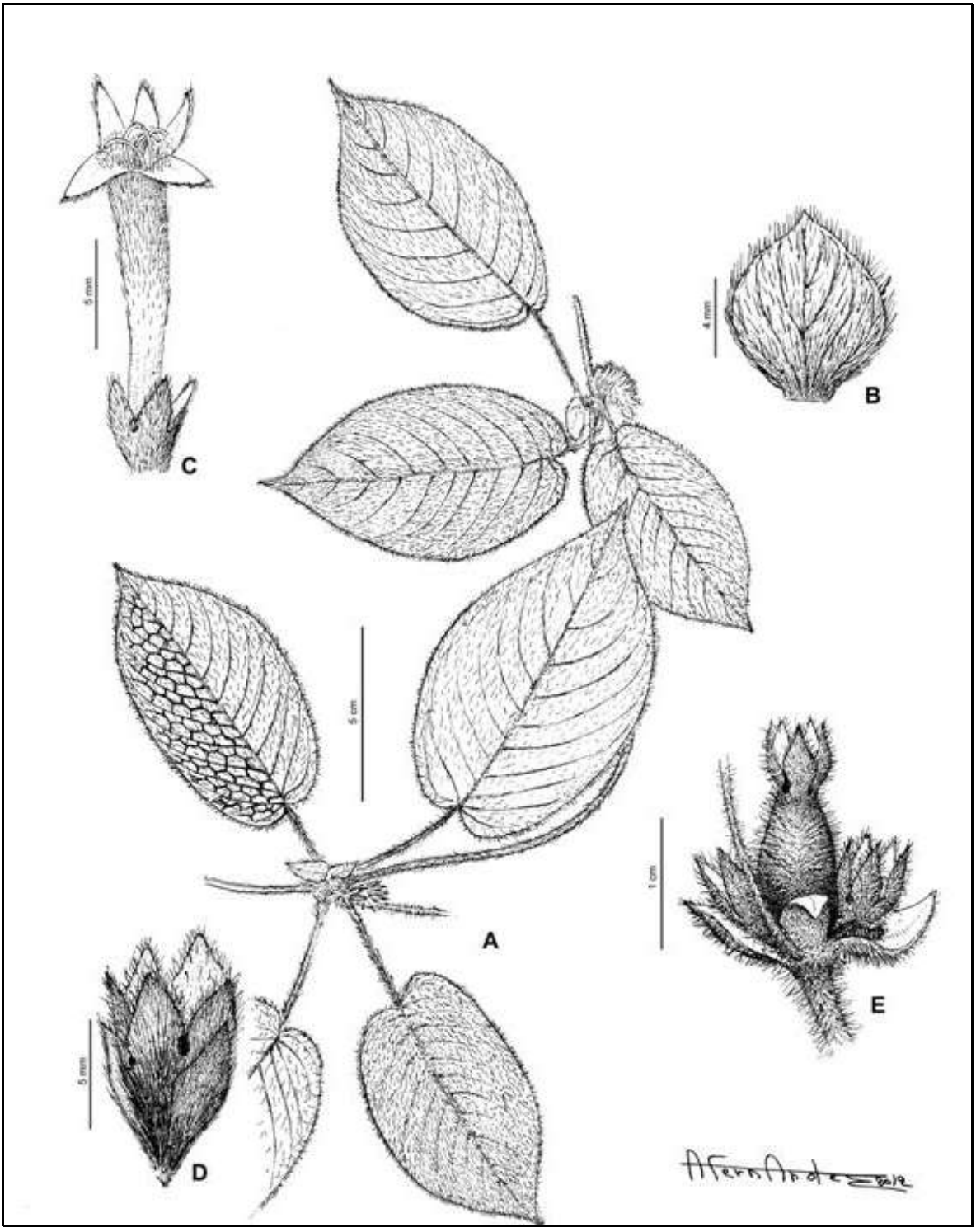

FIGURE 3. *Sabicea bullata*. A. Habit. B. Bract C. Long-styled flower. D. Calyx with 2 bracteoles. E. Infrutescence with bracts and two stipules. A-B & D-E, *Dessein et al. 2572*; C, *Etuge 4061*.

Distribution and Ecology:—*Sabicea bullata* is endemic to the western Cameroon highlands (Rumpi Hills and Bakossi Mountains) (Fig. 2). It occurs in submontane forest, 1000–1417 m

a.s.l. The species is relatively light demanding, occurring mostly in edges and treefall gaps, and avoiding dark undergrowth. It is locally very abundant and can cover the ground on forest paths. It is generally encountered as a sterile creeper; only the twining stems bear flowers, which explains the rarity of collections.

Phenology:—Flowers: January. Mature fruits: April.

Notes:—The species was already recognized as new (as *Sabicea* sp. A) by Cheek *et al.* (2004). This is a rather isolated species, with no obvious close relatives. The leaves of *Sabicea bullata*, which are cordate at base and strongly bullate in life (hence the specific name), make the species easily recognizable even when sterile. The leaves of *Sabicea. leucocarpa* Krause (1917: 357) Mildbraed (1922: 91) are also cordate at the base, but not bullate; the species further differs from *Sabicea bullata* in pedunculate and involucrate inflorescences, white fruits, and lowland habitat. Although only one flowering collection is known, the species is presumably heterostylous, as usual in the genus.

Conservation status:—The species is known from four collections only, all from western Cameroon. The thresholds for Endangered under Criterion B are met for Extent of Occurrence (123.89 km^2) and Area of Occupancy (12 km^2, grid cell size 2 km). It is difficult, however, to define a clear threat for the species at present. Although there are clear signs of forest degradation in both the Bakossi Mountains and the Rumpi Hills, it is not obvious at present how this will influence the survival of *Sabicea bullata*. Indeed, most *Sabicea* species, including this one, survive well in degraded forests. Therefore the species is for now considered as Least Concern.

Paratypes:—**CAMEROUN**: Bakossi Mountains 1–8 km NNE of Meyum Village, 20–30 May 1987, *Doumenge 474* (MO, YA); Kodmin, 21 January 1998, *Etuge et al.* 4061 (MO, YA); Rumpi Hills near Dikome Balue, 1204 m, 21 April 2009, *Dessein et al.* 2651 (BR, K, MO, YA).

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Publication 4

Two new anisophyllous species of Sabicea (Rubiaceae) from Gabon

Candollea 70(2): 219–229 (2015).

Two new anisophyllous species of Sabicea Aubl. (Rubiaceae) from Gabon

Olivier Lachenaud & Lise Zemagho

Abstract

LACHENAUD, O. & L. ZEMAGHO (2015). Two new anisophyllous species of Sabicea Aubl. (Rubiaceae) from Gabon. *Candollea* 70: 219-229. In English, English and French abstracts. DOI: http://dx.doi.org/10.15553/c2015v702a7

Two new *Rubiaceae* species, *Sabicea golgothae* O. Lachenaud & Zemagho and *Sabicea mabouniensis* O. Lachenaud & Zemagho, are described and illustrated. These two species are very similar to each other, and differ from all their congeners by the combination of strong anisophylly and pedunculate inflorescences. Their position in the genus is discussed. Both species are apparently endemic to the Mabounié area in West-Central Gabon, currently under exploitation prospects for mining. They are both assessed as "Critically Endangered" according to IUCN Categories and Criteria.

Résumé

LACHENAUD, O. & L. ZEMAGHO (2015). Deux nouvelles espèces anisophylles du genre Sabicea Aubl. (Rubiaceae) décrites du Gabon. *Candollea* 70: 219-229. En anglais, résumés anglais et français. DOI: http://dx.doi.org/10.15553/c2015v702a7

Deux nouvelles espèces de *Rubiaceae*, *Sabicea golgothae* O. Lachenaud & Zemagho et *Sabicea mabouniensis* O. Lachenaud & Zemagho, sont décrites et illustrées. Ces deux espèces sont très semblables entre elles, et diffèrent de tous leurs congénères par le fait qu'elles présentent à la fois une anisophyllie très marquée et des inflorescences pédonculées. Leur position au sein du genre est discutée. Les deux espèces paraissent endémiques de la région de Mabounié dans le centre-ouest du Gabon, qui fait l'objet d'un projet d'exploitation minière. Toutes deux sont évaluées comme «En Danger Critique d'Extinction» selon les Catégories et les Critères de l'UICN.

Keywords

RUBIACEAE – *Sabicea* – Gabon – Mabounié – Anisophylly – New species – Taxonomy – Conservation status

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Introduction

Gabon, a country situated on the Atlantic coast of Central Africa, is well-known for its rich flora counting many national endemics. Sosef et al. (2006) reported 4710 species of vascular plants in the country, of which 508 (c. 11%) are only known from Gabon. These numbers are approximate since the flora of Gabon, and of Central Africa in general, is still imperfectly known. Some species previously considered endemic to Gabon have since then been discovered in neighbouring countries, such as Congo-Brazzaville (Lachenaud, 2009). On the other hand, additional Gabonese endemics are described every year (e.g. Sosef et al., 2007; Bissiengou & Sosef, 2008; Janssens et al., 2010; Ntore et al., 2010; Breteler, 2011; Fischer & Lachenaud, 2013; Lachenaud et al., 2013; Lye, 2014), often from recent collections made in previously little-known or even unexplored areas.

The Mabounié region, situated east of Lambaréné on the lower course of the Ngounié river, was one such area completely unknown to botanists until recently. Plant collections made in this area between 2011 and 2014, as part of an environmental impact assessment for a mining project, resulted in the discovery of several new species. Among these are the two remarkable species of *Sabicea* Aubl. *(Rubiaceae: Sabiceeae),* which are described here.

The genus *Sabicea*, in the broad sense, includes c. 145 species (Govaerts et al., 2013) which are distributed mostly in tropical Africa and South America, with a few species in Madagascar and one in Sri Lanka. They are usually small twining lianas or creepers occurring in forest edges, and are often abundant along forest tracks. The genus is characterised by axillary inflorescences, valvate corolla aestivation, soft fleshy fruits with numerous small seeds, and absence of raphides (Dessein et al., 2001; Khan et al., 2008).

The African species of *Sabicea* have not been revised as a whole since Wernham's (1914) worldwide monograph of the genus, although a new revision is underway by LZ. Valuable local treatments have been published for West Africa (Hepper, 1963), Gabon (Hallé, 1966) and East Africa (Verdcourt & Bridson, 1988). The African species of *Sabicea* s.l. are morphologically quite diverse, and some have been placed in the segregate genera *Pseudosabicea* N. Hallé, *Ecpoma* K. Schum. and *Stipularia* P. Beauv. (Hallé, 1963, 1966), while other authors have included them in a more broadly circumscribed *Sabicea* (e.g. Hepper, 1958, 1963). The main characters used for generic segregation were the habit, and the number of ovary locules: *Sabicea* s.str. included only twining plants with 5-locular ovaries, *Pseudosabicea* was characterised by 2-locular ovaries and a sarmentose or creeping (but not twining) habit, while *Ecpoma* and *Stipularia* both comprise erect plants, with 2-locular ovaries in the case of the former, and 3- to 5-locular ovaries combined with a peculiar urn-shaped involucre, in the latter. Based on molecular evidence, Khan et al. (2008) proposed a broad circumscription for *Sabicea* including all the segregate genera, a position which is followed here.

The genus *Sabicea* is particularly well-represented in Gabon, with c. 45 species according to our analysis. The "Flore du Gabon" (Hallé, 1966) only lists 20 species of *Sabicea* s.s. and 33 when the segregate genera are included, but several additions have been made in subsequent literature (Hallé, 1971; Walters et al., 2011; Zemagho et al., 2014) and a number of species, most of them discovered in recent years, are currently under description. Gabon is therefore the main center of species diversity of the genus (the second richest country being Cameroon with c. 36 species) and *Sabicea* is among the ten most species rich genera in the Gabonese flora.

The two species described here, *Sabicea golgothae* O. Lachenaud & Zemagho and *S. mabouniensis* O. Lachenaud & Zemagho, appear to be morphologically closely-related, and according to our current knowledge, are both endemic to the Mabounié area. They correspond well with the general characteristics of the genus, but differ from all other species described so far (Wernham, 1914; Hepper, 1963; Hallé, 1966, 1971; Khan, 2007; Zemagho et al., 2014) by the combination of a strong anisophylly and pedunculate inflorescences. Their morphological affinities and conservation status are discussed below.

Material and methods

The descriptions are based on the study of living material, herbarium specimens, and material preserved in spirit. The following herbaria were consulted, but did not yield additional collections of the species: BR, BRLU, LBV, MPU, P, WAG and YA.

A preliminary risk of extinction assessment was made using the IUCN Red List Categories and Criteria (IUCN, 2012). The extent of occurrence (EOO) and area of occupancy (AOO) were calculated using GeoCAT (Geospatial Conservation Assessment tool; Bachman et al., 2011) with a cell size of 2 km^2. The number of 'locations' (as defined by IUCN, 2012) was calculated with regard to the kind of threats, such that a single location may encompass more than one adjacent subpopulation.

Taxonomy

Sabicea golgothae O. Lachenaud & Zemagho, **spec. nova** (Fig. 1A-D, 2, 3).

Habitu reptante, foliis valde anisophyllis, ovarioque biloculare Sabicea mabouniensis O. Lachenaud & Zemagho, S. medusula K. Schum. ex Wernham, S. mildbraedii Wernham et S. sthenula (N. Hallé) Razafim. et al. similis est. A S. mabouniensi differt foliis basi acutis vel obtusis (nec cordatis) et valde discoloribus

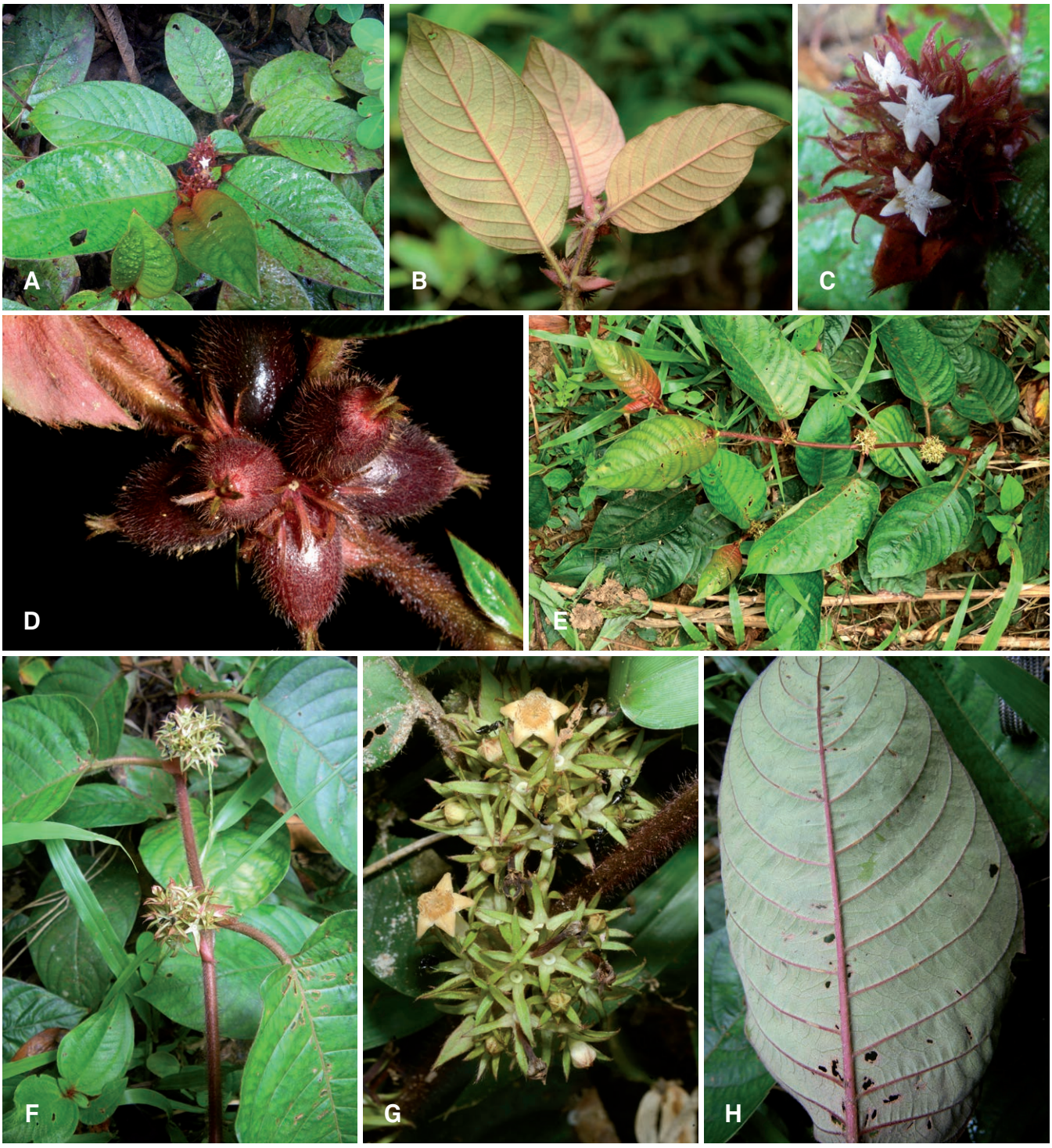

Fig. 1. – *Sabicea golgothae* O. Lachenaud & Zemagho. **A.** Habit; **B.** Underside of leaves; **C.** Inflorescence; **D.** Fruits. Sabicea mabouniensis O. Lachenaud & Zemagho. **E.** Habit; **F.** Detail of stem with inflorescences; **G.** Inflorescences; **H.** Underside of leaf.
[**A-D:** *Lachenaud et al. 2116;* **E-H:** *Lachenaud et al. 1446*]
[Photos: **A, C, F, H:** O. Lachenaud; **B, D, E, G:** E. Bidault]

Fig. 2. – *Sabicea golgothae* O. Lachenaud & Zemagho. **A.** Habit; **B.** Node with stipules and reduced leaf; **C.** Detail of lower leaf surface; **D.** Inflorescence; **E-F.** Bracts; **G.** Flower; **H.** Longitudinal section of flower; **I.** Mature fruit; **J.** Cross-section of fruit. [*Lachenaud et al. 2116*, BRLU] [Drawing: Antonio Fernandez]

indumento subtus lamina obscurante, pedunculis brevioribus (0.2-0.5 nec 0.8-2 cm), calyce rubro (nec viride), corollaque omnino alba fauce longiore barbata; ab alteris speciebus inflorescentiis breviter pedunculatis (nec sessilibus), calyce rubro, fructibusque maioribus distinguitur.

Typus: Gabon. Moyen-Ogooué: Mabounié, 0°46'31"S 10°32'30"E, 2.XI.2014, *Lachenaud, Bidault & Lissambou 2116* (holo-: BRLU!; iso-: BR!, G!, LBV!, MO!, P!, WAG!).

Low creeping *herb*, 5-15 cm high, with stems rooting at base; stems villous, with indumentum consisting of c. 2 mm long, pinkish, patent hairs, intermingled with much shorter uncinate hairs. *Leaves* opposite, highly unequal especially on upper nodes, often appearing alternate at first sight; reduced leaf with petiole 0-1 cm and lamina lanceolate to elliptic, 1.2-6.3 × 0.3-2.9 cm; normal leaf with petiole 1.2-3.2(-5.5) cm long, with similar indumentum to the twigs, and lamina (5.8-)8-13.8 × (2.2-)3.7-6.5 cm, elliptic, acute to obtuse and often asymmetrical at base, acuminate at apex, papery and strongly discolorous; upper side green, with appressed stiff hairs very sparse on the lamina and denser on nerves, where they are intermingled with shorter crisped hairs; lower side pinkish-buff, with dense persistent felt of woolly hairs (becoming sparser but still visible on old leaves), intermingled with long stiff appressed hairs on the nerves and on the margin; nerves slightly bullate above, pinkish beneath, the laterals 9-12, ascending and almost reaching the margin; tertiary veins densely reticulate and contrasting below. *Stipules* wine red, 2 per node, interpetiolar, erect to patent, 12-23 × 3.5-10.5 mm, broadly ovate and slightly falcate, acute, entire or with 1-2 short lateral teeth, slightly veined, sparsely hairy outside with +/- appressed hairs 0.3-1 mm long, glabrous inside. *Inflorescences* axillary, solitary at each node and borne in the axil of the reduced leaf, densely glomerulate to very shortly cymose, 1.3-1.7 cm long; peduncle very short and usually hidden by the stipules, 0.2-0.5 cm long, with same indumentum as the stems; flowering part 1.2-1.4 × 1.7-2.3 cm; ramifications not or hardly distinct, < 0.1 cm. *Bracts* wine red, numerous, decreasing in size from the base to the apex of the inflorescence, not clearly forming an involucre, entire or shortly dentate, sparsely appressed-hairy outside, glabrous or with very sparse short hairs near the apex inside; lower pair of bracts broadly ovate, shortly connate at base for c. 1 mm and acute at apex, 11-11.5 × 5-7 mm; upper bracts lanceolate, free, acute, 6-11 × 0.5-2.5 mm, resembling the calyx lobes. *Flowers* (4-)5-merous; pedicels very short, < 1 mm long, densely hairy. *Calyx* wine red, with short tube c. 1 mm; lobes acute, narrowly lanceolate, erect to oblique at anthesis and +/- bending outwards at apex, 5-6 × 0.6-1 mm, sparsely hairy outside with hairs 0.5-1.5 mm long, glabrous inside except short sparse hairs near their apex, alternating with short colleters at their base. *Corolla* pale buff in bud, pure white at anthesis and later fading to brown; tube narrow and almost cylindrical, 6 × 1.5 mm; lobes triangular, patent, 2 mm long; outside of corolla with short, c. 0.5 mm long stiff hairs on lobes and upper 1/4th of tube, otherwise glabrous; inside of corolla with a dense beard of (0.7-)1-1.2 mm long moniliform hairs in throat and upper part of tube, and a separate ring of shorter hairs inside the tube just above mid-height. *Stamens* included, inserted c. 1.5 mm below throat of corolla tube; anthers subsessile, c. 1 × 0.3 mm, shortly apiculate. *Ovary* c. 2 mm long, densely covered with

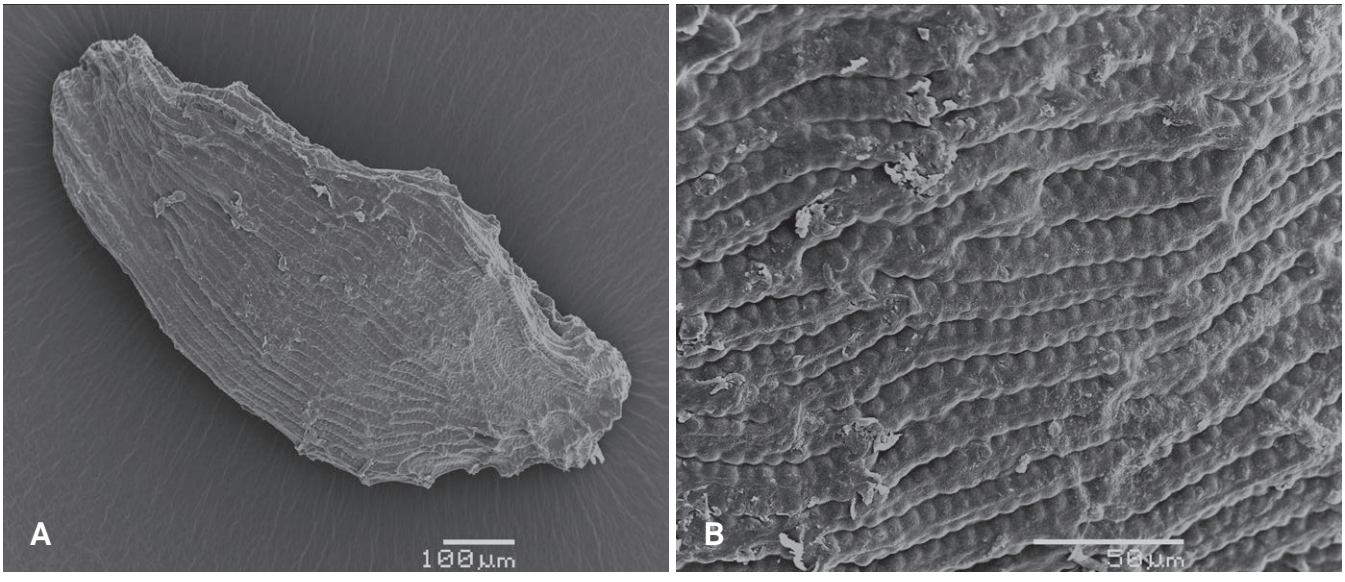

Fig. 3. – Seed of *Sabicea golgothae* O. Lachenaud & Zemagho, viewed in electron microscopy. **A.** Entire seed; **B.** Detail of seed surface. [Photos: Iris van der Beeten]

long appressed stiff hairs, 2-locular in cross-section. *Disk* shortly cylindrical, c. 0.5 mm, glabrous. *Style* bifid, included, about equalling the anthers, glabrous, 5.5 mm long including the 1.5 mm long stigmas, these dorsally compressed and rounded at apex. *Fruits* dark purple outside, with purple flesh, ovoid, with persistent calyx, 12-17 × 8-11 mm in life, villous with patent hairs 1-2 mm long, very shortly pedicellate (pedicel c. 1 mm long). *Seeds* numerous, dark brown, polygonal, c. 1 × 0.5 mm, the surface with dense parallel striations.

Etymology. – The species is named after Golgotha Hill in the Mabounié region, where it was first discovered, and in the vicinity of which all known subpopulations occur.

Distribution and ecology. – *Sabicea golgothae* is apparently endemic to the Mabounié region in West-Central Gabon (Fig. 4), where it is known from three very close sites. The new species grows in half-shaded forest edges along tracks, where it locally forms dense populations.

Conservation status. – The EOO of *S. golgothae* is estimated as 0.608 km^2 and the AOO as 12 km^2, respectively within the thresholds for "Critically Endangered" and "Endangered" under Criteria B1 and B2. The species is known from three subpopulations (in addition to the two subpopulations from which specimens were taken, a third was observed at 0°46'09"S 10°32'07"E) which represent a single location in the sense of IUCN, and all three occur in the mining concession. One of these subpopulations is at least under immediate threat in the mining project. A decline in the EOO, AOO, extent of habitat and quality, number of subpopulations and number of individuals can therefore be predicted. *Sabicea golgothae* should thus be assigned a preliminary status of "Critically Endangered" [CR B1ab(i,ii,iii,iv,v)].

Notes. – *Sabicea golgothae* is very close to *S. mabouniensis* described below. Both species also resemble *S. medusula* K. Schum. ex Wernham, *S. mildbraedii* Wernham, and *S. sthenula* (N. Hallé) Razafim. et al. All these species have in common a low creeping habit, strong anisophylly (in *S. sthenula* and some rare variants of *S. mildbraedii*, the anisophylly is even extreme, with a single leaf per node) and a 2-locular ovary. The major differences between them are summarised in Table 1.

Sabicea medusula, *S. mildbraedii* and *S. sthenula* all differ from *S. golgothae* in having truly sessile inflorescences, and a green to whitish calyx. In *S. golgothae* the peduncle, although short, is always present, and the calyx is wine red; the fruits are also conspicuously larger than in the three other species.

From *S. mabouniensis*, *S. golgothae* can be distinguished by its acute to obtuse (not cordate) leaf bases, strongly discolorous leaves (with the indumentum completely obscuring the under surface, except on old leaves), more condensed inflorescences with shorter peduncles, the deep wine red colour of its bracts and calyces, and its entirely white corollas with longer hairs in the throat. These differences are slight, but appear to be constant in the subpopulations we have seen. Since the two taxa occur in the same area, only a few kilometers away from each other, and without apparent habitat discontinuity or barriers to dispersal, it seems appropriate to treat them as separate species rather than subspecies. The apparent difference in the internal indumentum of the corolla tube between *S. golgothae* (two separate rings of hairs) and *S. mabouniensis* (a single continuous ring) may not be significant, since we have found other *Sabicea* species (e.g. *S. mildbraedii*) to be variable in this respect.

The flowers of *S. golgothae*, with their anthers and style at same level, appear to be isostylous. This would be exceptional in a genus where distyly is otherwise the rule. However, since only the type collection bears open flowers, more material would be needed to confirm this character.

Paratypus. – **Gabon. Moyen-Ogooué:** Mabounié, Golgotha, 0°45'55"S 10°32'49"E, 31.X.2014, *Lachenaud, Bidault & Lissambou 2106* (BR, BRLU, LBV, MO).

Sabicea mabouniensis O. Lachenaud & Zemagho, **spec. nova** (Fig. 1E-H, 5).

Habitu reptante, foliis valde anisophyllis, ovarioque biloculare Sabicea golgothae O. Lachenaud & Zemagho, S. medusula K. Schum. ex Wernham, S. mildbraedii Wernham et S. sthenula (N. Hallé) Razafim. et al. similis est; sed a primo differt foliis basi cordatis indumento subtus laxiore, pedunculis longioribus (0.8–2 nec 0.2–0.5 cm), calyce viride (nec rubro), corolla lobis intus ochraceo-luteis et fauce breviore barbata; ab alteris speciebus inflorescentiis pedunculatis, foliis indumento subtus laxiore et lamina non obscurante, corollaeque lobis intus ochraceo-luteis (nec albis) conspicue distinguitur.

Typus: Gabon. Moyen-Ogooué: Mabounié, piste du nord-est, 0°43'00"S 10°35'53"E, 17.XI.2013, *Lachenaud, Stévart, Ikabanga, Issembé, Boupoya & Kaparidi 1446* (holo-: BR!; iso-: BRLU!, LBV!, MO!, P!, WAG!).

Low creeping *herb*, with stems rooting at base; stems villous with indumentum consisting of 1.5-2 mm long, pinkish, patent hairs, intermingled with much shorter uncinate hairs. *Leaves* opposite, strongly unequal especially on upper nodes, often appearing alternate at first sight; reduced leaf with petiole 0-1.3 cm and lamina lanceolate to elliptic, 1.1-3.6 × 0.3-2.6 cm; normal leaf with petiole 2-4 cm long, with similar indumentum to the twigs, and lamina 7-13.2 × 4.2-7.3 cm, elliptic, subcordate and asymmetrical at base,

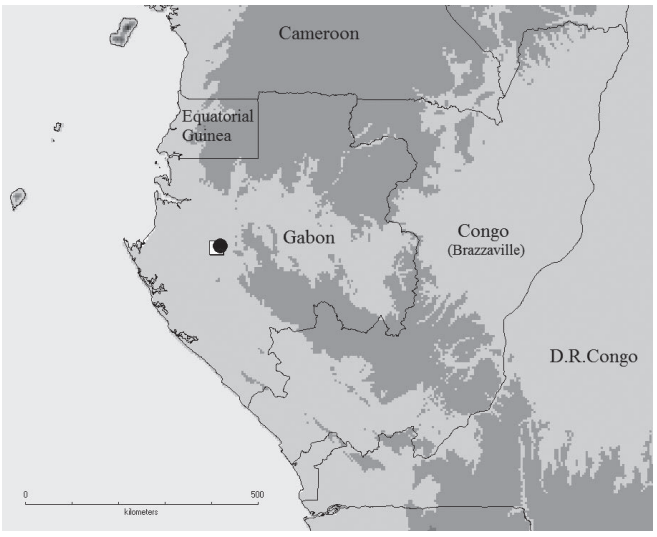

Fig. 4. – Distribution of *Sabicea golgothae* O. Lachenaud & Zemagho (white square) and *S. mabouniensis* O. Lachenaud & Zemagho (circle).

acuminate at apex, papery and slightly discolorous; upper side green, with appressed stiff hairs very sparse on the lamina and denser on nerves, where they are intermingled with shorter crisped hairs; lower side pale green, with short and rather sparse pinkish-white woolly hairs, intermingled with longer hairs on the nerves; nerves slightly bullate above, pinkish beneath, the laterals 9-12, ascending and almost reaching the margin; tertiary veins densely reticulate and slightly contrasting below. *Stipules* pinkish-green, 2 per node, interpetiolar, erect, 12-18 × 6-9 mm, broadly ovate and slightly falcate, acute, entire or shortly bidentate, faintly veined, sparsely hairy outside with appressed hairs c. 1 mm long, glabrous inside. *Inflorescences* axillary, usually in opposite pairs but sometimes only one developing per node, dense contracted cymes (often appearing falsely umbellate), 1.8-4 cm long; peduncle 0.8-2 cm long, with similar indumentum to the twigs; flowering part 1-2 × 1.4-2.7 cm; ramifications short, < 0.4(-1) cm. *Bracts* pale green, numerous, decreasing in size from the base to the apex of the inflorescence, not clearly forming an involucre, free or shortly connate at base for c. 1.5 mm, entire, rather densely appressed-hairy outside and sparsely so inside; lower bracts broadly ovate, acute, 10-13 × 3-6 mm; upper bracts narrowly lanceolate, c. 8 × 1.2 mm, resembling the calyx lobes. *Flowers* 5-merous, pedicels 1-2 mm long, densely hairy. *Calyx* pale green (the apex of lobes often pinkish), with tube very short, c. 0.5 mm; lobes acute, narrowly lanceolate, +/- patent at anthesis, 5-6 × 0.6 mm, densely hairy outside and sparsely so inside, alternating with short colleters at their base. *Corolla* with white, narrow and almost cylindrical tube, 6 × 1-1.5 mm; lobes pale ochre-yellow inside, triangular, patent, 1.3-1.7 mm long; outside of corolla with short, c. 0.5 mm long appressed hairs on lobes and upper 1/5th of tube, otherwise glabrous; inside of corolla sparsely hairy in upper half of tube and more densely so around the throat, with rather short moniliform hairs c. 0.5 mm long. *Stamens* included with apex almost reaching throat; anthers sessile, 1.3 × 0.5 mm, shortly apiculate. *Ovary* c. 2 mm long, densely appressed-hairy, 2-locular. *Disk* shortly cylindrical, c. 0.3 mm, glabrous. *Style* bifid, included, reaching about the mid-height of anthers, glabrous, 5 mm long including the 1.5 mm long stigmas, these dorsally compressed and rounded at apex. *Fruits* unknown.

Distribution and ecology. – *Sabicea mabouniensis* is known from a single site in the Mabounié area, in West-Central Gabon (Fig. 4). It is apparently a very rare species: although the area has been relatively well-prospected in recent years, no other sites were found. The species grows on a sunny forest edge along a track, a common habitat for species of the genus. It occurs there alongside another new species of *Sabicea (Lachenaud et al. 1447);* the latter is not strictly endemic to the region, and will be described elsewhere.

Conservation status. – The new species is known from a single subpopulation, representing a single location, and occurs in a mining concession. The AOO of *S. mabouniensis* is estimated at 4 km^2, within the threshold for Critically Endangered status under Criterion B2 (the EOO is not calculable). It is thus extremely susceptible to any threat, the most important of which is deforestation for mining. Although the area where it occurs is not to be immediately affected by the mining project, we anticipate that this pressure will increase in the future. A decline in the AOO, extent and quality of habitat, number of subpopulations and number of individuals can therefore be expected, and the species should thus be assigned a preliminary status of "Critically Endangered" [CR B2ab(ii,iii,iv,v)].

Notes. – *Sabicea mabouniensis* is morphologically very close to *S. golgothae*, also described in this article (see under that species for more details). It also superficially resembles other low anisophyllous species *(S. medusula, S. mildbraedii* and *S. sthenula)* but is quite easily separated by the pedunculate inflorescences, the weakly discolorous leaves with hairs not obscuring the under surface (vs. strongly discolorous with a dense felt of woolly hairs obscuring the under surface), and the corolla with short hairs in the throat and lobes ochre-yellow inside (vs. corolla long-bearded in the throat and with the lobes entirely white) (Table 1).

Only short-styled flowers have been observed in *S. mabouniensis*. Due to the rarity of the material, it is not possible to determine whether the species is heterostylous, as usual in the genus.

Fig. 5. – *Sabicea mabouniensis* O. Lachenaud & Zemagho. **A.** Habit; **B.** Detail of lower leaf surface; **C-D.** Bracts; **E.** Node with two stipules, one reduced leaf, one petiole (p) and base of an inflorescence (i); **F-G.** Different views of inflorescence; **H.** Disk and base of calyx, seen from above; **I.** Flower; **J.** Longitudinal section of flower; **K.** Corolla lobe, seen from outside. [*Lachenaud et al. 1446*, BR & BRLU] [Drawing: Hans de Vries]

Discussion

Position of the new species in the genus, and evolution of anisophylly in Sabicea

The discovery of these two species is particularly interesting, because they are apparently not closely related to other anisophyllous *Sabicea*. Within *Sabicea*, anisophylly was previously recorded in two different groups: (1) A pair of closely related Malagasy species, *S. acuminata* Benth. and *S. diversifolia* Pers. – these are sarmentose shrubs with 5-locular ovaries, multifid stipules and sessile inflorescences, thus quite different from the two new species described here. (2) Another group of Central African species (hereafter referred to as the *S. mildbraedii* group) include *S. aurifodinae* (N. Hallé) Razafim. et al., *S. batesii* Wernham, *S. medusula*, *S. mildbraedii*, *S. sthenula*, and several undescribed related species. The habit in this group varies from sarmentose *(S. aurifodinae, S. batesii)* to creeping *(S. medusula, S. mildbraedii, S. sthenula),* and the stipules from entire to multifid. The ovary is always 2-locular and the inflorescences are sessile. The creeping species of this group are thus very similar to *S. golgothae* and *S. mabouniensis*, although these two have the inflorescences pedunculate (very shortly so in *S. golgothae*).

Species of the latter group were previously included in *Pseudosabicea* due to their 2-locular ovaries, and our two novelties would also have belonged to that genus in the classification of Hallé (1963, 1966). However, molecular studies (Khan et al., 2008) showed *Pseudosabicea* to be a polyphyletic assemblage of two distinct clades. The first clade forms one of the basal lineages in *Sabicea* s.l. and includes the anisophyllous species of the *S. mildbraedii* group, while the second clade is deeply nested in *Sabicea* and includes species with the leaves in equal pairs, namely *S. nobilis* Good (the type species of *Pseudosabicea*), *S. floribunda* K. Schum., *S. proselyta* (N. Hallé) Razafim. et al., *S. segregata* Hiern, and also, based on morphology, *S. sanguinosa* (N. Hallé) Razafim. et al.

Molecular studies based on *ITS, petD, rps16* and *trnT-F* sequences (Zemagho et al., unpubl. data) showed, surprisingly, that *S. mabouniensis* is not closely related to the *S. mildbraedii* group, but rather placed it as sister to the *S. nobilis* clade with moderate support. This is an unexpected result, since although species of the latter group have 2-locular ovaries and usually pedunculate inflorescences like *S. mabouniensis*, they are otherwise quite different in their sarmentose habit and leaves arranged in equal pairs. Unfortunately, due to its recent discovery *S. golgothae* could not be included in this molecular study.

Table 1. – Differences between *Sabicea golgothae* O. Lachenaud & Zemagho, *S. mabouniensis* O. Lachenaud & Zemagho and other low creeping anisophyllous species.

Characters	*S. golgothae*	*S. mabouniensis*	*S. medusula*	*S. mildbraedii*	*S. sthenula*
Phyllotaxy	nodes with 2 unequal leaves and 2 stipules	nodes with 2 unequal leaves and 2 stipules	nodes with 2 unequal leaves and 2 stipules	nodes with 2 unequal leaves and 2 stipules (rarely a single leaf opposed to a stipule)	**nodes with 1 leaf and 1 stipule opposed to each other**
Stipule shape	entire or with 1-2 short lateral teeth	entire or shortly bidentate	entire or shortly bidentate	multifid with 2-7 lobes (very rarely entire)	multifid with 5-14 lobes
Leaf base	acute to obtuse	subcordate	obtuse to subcordate	acute to subcordate	cordate to obtuse
Leaf underside	strongly discolorous, with dense felt of buff hairs obscuring the lower surface	**weakly discolorous, hairs sparse on adult leaves and not obscuring the lower surface**	strongly discolorous, with dense felt of buff/ whitish hairs obscuring the lower surface	strongly discolorous, with dense felt of buff/ whitish hairs obscuring the lower surface	strongly discolorous, with dense felt of buff/ whitish hairs obscuring the lower surface
Inflorescence	shortly pedunculate (peduncle 0.2-0.5 cm), not or hardly branched	rather long pedunculate (peduncle 0.8-2 cm), usually branched	sessile, unbranched	sessile, unbranched	sessile, unbranched
Colour of calyx	**wine red on both sides**	pale green on both sides (often tinged pinkish at apex)	green, or sometimes whitish outside	whitish outside and green inside	pale green on both sides
Calyx lobes	5-6 mm, lanceolate	5-6 mm, lanceolate	3–5.5 mm, linear to very narrowly spathulate	**1-3.5 mm**, broadly elliptic to lanceolate	4–6 mm, lanceolate
Colour of corolla	tube and lobes white	tube white, **lobes ochre-yellow inside**	tube pink, lobes white	tube and lobes white	tube pink, lobes white
Corolla tube length	6 mm	6 mm	5–6 mm	**3.5-4.5 mm**	7-7.5 mm
Hairs in corolla throat	long: (0.7-)1-1.2 mm	**short: c. 0.5 mm**	long: c. 0.8 mm	long: c. 1 mm	long: c.1 mm
Fruits	dark purple, 12-17 × 8-11 mm in vivo	not known	red or whitish, c. 10 × 9 mm in vivo	green to red, c. 9 × 7 mm in vivo	green, 5–9 × 3.5-6 mm when dry

It appears, therefore, that anisophylly and the number of ovary locules are both homoplasic characters within *Sabicea* s.l. This supports an enlarged circumscription of *Sabicea* as proposed by Hepper (1958, 1963) and Khan et al. (2008).

Endemism in West-Central Gabon

Both *S. mabouniensis* and *S. golgothae* are apparently endemic to the Mabounié region in West-Central Gabon. They have never been found elsewhere, despite being easy to collect and to identify; and while it is possible that additional sites will be found in the future, both species must be very rare.

Their distribution is not easy to understand in terms of current chorological concepts, since the region where they occur lies at the border of the Coastal and Central areas recognised by Caballé (1978) in his classification of Gabonese forests. However, analyses of available vegetation inventories (Stévart, unpubl. data) suggest there may be an overlooked center of endemism in West-Central Gabon, an area roughly delimited by Ndjolé (NE), Lambaréné (NW), La Lopé (E) and Rabi (SW). Examples of species endemic to this area and relatively widespread within it are *Craterispermum* sp. nov. (*Rubiaceae*, species under description by H. Taedoumg & P. De Block), *Diospyros rabiensis* Breteler *(Ebenaceae), Synsepalum fleuryanum* A. Chev. *(Sapotaceae)* and *Whitfieldia letestui* Benoist *(Acanthaceae)*. This area also includes a number of endemics with narrower ranges, to which *Sabicea golgothae* and *S. mabouniensis* presumably belong. Further studies on the distribution patterns of Gabonese endemic plants are ongoing, and should give us a better understanding of the subject.

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Publication 5

Synopsis of *Sabicea* Aubl. (Rubiaceae) from Continental Africa with the inclusion of five new species

(in preparation: Plant Ecology and Evolution).

Synopsis of the genus *Sabicea* (Rubiaceae) in Continental Africa including five new species

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Abstract

Background and aims—The delimitation of *Sabicea* and related genera was controversially due to their closely diagnosing morphologicgal characters. Molecular phylogenetic works allow to regongize *Sabicea* and the closely genera as single genus therefore the taxonomic revision is needed.

Methods—A detailed of morphological study was performed on all herbarium material using the classical methods of nomenclature.About 4000 herbarium specimens kept in BR, BRLU, GH, MO, NY, P, UPS, WAG, YA, and a part of material from BM and K were seen for the study.

Keys results—Taxonomic keys of each subgenera and keys for the Upper Guinean, the Lower Guinean, the Congolian and the East African species are given. Sixty three species are recognized. Detailed examination of the specimens revealed five novelties: *S. deblockiana* from Cameroon and Gabon, and *S. desseinii* from Cameroon, *S. jongkindii* from Liberia and S. Ghana, *S. liedeschumanniana* from Equatorial Guinea, *S. uniflora* from Gabon. *S. brunnea* is reinstated as separate species from *S. capitellata*. Thirteen species are synonymized. Lectotypification is made for *S. brunnea, S. gigantostipula, S. rufa.* Eight species are treated as insufficiently known.

Keys words—*Sabicea,* Rubiaceae, new species, lectotypification

INTRODUCTION

According to the World Checklist of Rubiaceae (Govaerts et al. 2013), *Sabicea* Aubl. comprises about 145 species distributed in Tropical Africa (96 species) with few representatives in Madagascar, in Tropical America (43 species) and one species in Sri Lanka (Asia). Species of *Sabicea* in the broad sense are easily characterised by the following combination of characters: absence of raphides, valvate corolla aestivation, axillary inflorescences and fleshy fruits with numerous small seeds (Dessein et al. 2001).

In Continental Africa, the greatest centre of diversity of the genus is located in Lower Guinea Domain following White (1979, 1993). *Sabicea* species are mostly lianas and representatives are found in the forest edges and are often abundant along forest tracks.

This study is a part of an intensive work focusing on the phylogenetic and taxonomic studies of the genus in Continental Africa. The revision of the whole material in main herbaria and the recent field works in some African countries (mainly Cameroon, Equatorial Guinea, Gabon) allow to resolve taxonomic problems within the genus and to find some new records. This examination has also led to increase the knowledge about the pattern of diversity in the genus and to discover novelties (Zemagho et al. 2014; Lachenaud & Zemagho 2015; Zemagho et al. submitted). On the other hand, the recent phylogenetic studies (Khan et al. 2008; Zemagho et al. accepted) of the tribe Sabiceeae show that *Sabicea* and related genera should be considered as a single genus, in which four subgenera are clearly identified. In this fact, Continental African species become morphologically more diverse than species from South America and Madagascar. This reconsideration of *Sabicea* as a single genus is a reason to study the whole genus and its diversity in Continental Africa.

1- Taxonomic history

The genus

Sabicea was established in 1775 by Aublet in which he positioned two species: *Sabicea cinerea* Aubl. and *S. aspera* Aubl.; both are scrambling plants. Swartz added the Jamaican species in 1778, *S. hirta* and Ruiz and Pavon in the same year a Peruvian species *S. umbellata*. Schreber in 1789 in his "Genera Plantarum" remplaced the Aublet's name by *Schwenkfelda* but this name was not valide due to the rules of taxonomical nomenclature. In 1805, Persoon added the first Tropical African species, *S. diversifolia* from Madagascar and in 1818,

Humbold, Bonpland and Kunth published a fifth species of the genus, *S. hirsuta*. From 1829 to 1913, thirty nine additional species were described in which twenty eight were found in Continental Africa. Wernham (1914) consolidated the early taxonomic work in his "Monograph of *Sabicea*" where more than sixty additional species were described, amounting the total number of species to one hundred and five.

In Continental Africa, Hallé (1963) revised the generic concept of *Sabicea* (see infrageneric classification) and published many new species from Gabon (Hallé 1963, 1964, 1966, 1971). Likewise, he discussed also the affinities of species with some from other phytochoria regions. Subsequently, many other regional floras were produced for West Africa (Hepper & Keay 1963), Gabon (Hallé 1966) and East Africa (Verdcourt & Bridson 1988).

Infrageneric classification

The first attempt to divide the genus was done by Wernham (1914) who recognised two subgenera according to some morphological grounds: subgen. *Eusabicea* Wernh. with *S. aspera* as a type species and comprising 96 species and subgen. *Stipulariopsis* Wernh. comprising only 9 species. No type species has been chosen for this latter. He divided again the former subgen. in four sections based on the type of inflorescence: (1) sect. *Capitate* in which the inflorescence is surrounded by a bracts, free or fused; (2) sect. *Floribundae* including species which inflorescence diffuse and compound and partial inflorescence with more or less conspicuous bracts; (3) sect. *Laxae* included the species more or less lax at maturity and (4) sect. *Sessile* included the species on which the branches of inflorescence, the peduncle and pedicels are all suppressed or almost so (the flowers are disposed in dense axillary clusters). However, he omitted to typify each section (Table 1).

Table 1. Composition of various sections of *Sabicea* in Continental Africa (Wernham, 1914). Madagascan and São Tomean species are omitted.

Subgenera	Sections	Species
Eusabicea	*Capitate*	*S. barteri, S. brachiata, S. brevipes, S. calycina, S. capitellata, S. composita, S. cruciata, S. dewevrei, S. dinklagei, S. duparquetiana, S. fulva, S. geophiloides, S. gigantea, S. gilletii S. gracilis, S. jonhstonii, S. lanuginosa, S. laurentii, S. pedicellata, S. pilosa, S. schaeferi, S. rufa, S. robbii, S. talbotii, S. tchapensis, S. trigemina*
	Floribundae	*S. floribunda, S. segregata*
	Laxae	*S. angolensis, S. cameroonensis, S. dewildemanniana, S. discolor, S. entebbensis, S. laxa, S. longepetiolata, S. mollis, S. parviflora, S. pseudocapitellata, S. schumanniana, S. smithii, S. vogelii, S. venosa*
	Sessile	*S. arborea, S. batesii, S. bracteolata, S. dubia, S. medusula, S. mildbraedii, S. speciosa, S. speciossissima*
Stipulariopsis		*S. cauliflora, S. geantha, S. gigantostipula, S. hierniana, S. stipularioides, S. urbaniana, S. xanthotricha*

Hallé (1963) reviewed the diagnotic characters of *Sabicea* and considered them as a little taxonomic value except the length of the corolla tube. He added a new character, the number of ovary locules which has been overlooked by Wernham (1914). Then, Hallé (1963) used other additional characters (habit, placenta shape and consistence of fruit) to segregate the new genus *Pseudosabicea* N.Hallé. At the same time, he confirmed the generic status of *Ecpoma* previously described by Schumman (1891) (table 2). *Pseudosabicea* N.Hallé with *P. nobilis* as type species was divided in three sections based on the type of inflorescence: (1) sect. *Anisophyllae* includes species with congested inflorescence and unequal leaves in size; (2) sect. *Floribundae* includes species with inflorescence in lax or becoming lax and equal leaves in size; (3) sect. *Sphaericae* included species with congested inflorescence and equal leaves.

Table 2. Distinguished characters between *Ecpoma, Pseudosabicea* and *Sabicea* sensu Hallé (1963).

Characters	*Ecpoma*	*Pseudosabicea*	*Sabicea*
Growth form	shrubs not slender or treelets up to 4 m high	creeping or climbing, both not slender and volubile	liana usually slender and volubile, rarely ± shrubs
Anisophylly	absent	± accentuated or rare	present
Ovary	2-locular	2 (3)-locular	(4) 5-locular
Mash	uncolored	uncolored	fleshy and juicy
Fruit axis	not accrescent	not fleshy-accrescent	fleshy-accrescent
Placentas	rounded and ± cordate, peltate	oblong, fleshy and peltate	narrow, slender and sessile

The genus *Stipularia* P.Beauv. was described by Palisot Beauvois (1807) based on its peculiar campanulate involucral bracts surrounding the flowers. The status of the genus was accepted by various authors (Wernham 1914, Hallé 1966, Dessein et al. 2001). However, Hepper (1958) studying the variation of the involucral bracts in *Sabicea* species showed that there is no consistent characters which convince to clearly separate *Stipularia* from *Sabicea*. As a consequence, he synonymized *Stipularia* under *Sabicea*

Sabicea had been regarded as a single genus or up to four genera (*Ecpoma, Pseudosabicea, Sabicea, Stipularia*). Based on nrITS and cp *trnT-F*, Khan et al. (2008) provided the first insight between these four genera. Their results favor the broadly circumscription of the genus and related genera into a single genus *Sabicea* s.l.. However the study reveals some incongruences: *Ecpoma, Pseudosabicea* and *Stipularia* were assigned as polyphyletic units and neither *Sabicea*'s subgenera sensu Wernham (1914), nor *Sabicea* sensu Hallé (1963) were not found in their phylogeny. On revisiting the phylogeny of Sabiceeae with additional markers and species (*petD* and *rps16*) in combination with morphology (eleven morphological characters); Zemagho et al. (accepted) proved that *Ecpoma* and *Stipularia* form a monophyletic clades within *Sabicea* s.l. However, all characters previously used by authors to separate *Sabicea* and allied have been considered to be homoplasic, therefore they accepted the previous conclusion and divided the genus in four subgenera rather to reinstate *Ecpoma* and *Stipularia*: subgen. *Anisophyllae* [Hallé's *Pseudosabicea* section *Anisophyllae*],

subgen. *Sabicea* [*Sabicea* sensu Hallé + *Pseudosabicea* sect *Floribundae* + *Pseudosabicea* sect. *Sphaericae*], subgen. *Stipularia* [remaining *Stipularia* species] and subgen. *Stipulariopsis* [remaining *Ecpoma* K.Schum.+ *Sabicea urbaniana* and *S. xanthotricha*].

MATERIAL AND METHODS

Identification of more than 3500 herbarium specimens of *Sabicea* was carried out from different herbaria: BR, BRLU, GH, MO, NY, P, UPS, WAG, YA, and a part of material from BM and K (acronyms follow Thiers 2010).

Two groups proved to be extremely difficult in the genus due to the variation of their morphological charcaters (i.e. first order bracts, stipules, inflorescences, indumentum): *S. capitellata* s.l. and S. *venosa* s.l. The investigation of other species did not reveals many problems concerning some previous delimitations. This work aims to present the synopsis of *Sabicea s.s.*, for each species, ecology, chorology and distribution are given. If necessary, critical remarks are given, as well as the typification whenever appropriate. Dichotomous keys to the species of each subgenera are provided. Distribution are are given according to the countries and according to White (1979, 1983, 1993). The chorological divisions follow White's (1993) phytogeographical system, simplifying " regional (sub)centre of endemism" and other " into "Region". The term "Domain" is used as well for the subcentres recognized by White (1979) in the Guineo-Congolian Region.

2- Global distribution of Continental African species

(1) Most Continental African *Sabicea* are endemic species and show a distribution restricted to one phytochorion or within the Guineo-Congolian Region to one of its three domains (table 1):

(a) Guineo-Congolia wide taxa are found in all three domains distinguished by White (Upper Guinea, Lower Guinea and Congolia).

(b) Lower Guinean endemics: 42 taxa

(c) Upper Guinean endemics: 12 taxa

(d) Congolia endemics: 2 taxa (*S. gilletii*, *S. goossensi*)

(e) Guinea-Congolia Region: *S. calycina*

(f) Linking elements of Lower Guinea and Congolian Domains: 5 taxa

(g) Upper and Lower Guinean species not penetrating in Congolian domain: 2 taxa

(2) Afromontane endemics: 2 taxa (*S. arborea*, *S. bequaertii*)

(3) Lake Victoria Regional Mosaic endemic: *S. becquetii*

(4) Four taxa are found in the transition zone of Sudanian and Guineo-Congolian Region

(5) One species is found in the transition zone of Zambesian and Guineo-Congolian Region

(6) Four species are wide distributed in at least two phytochoria:

(a) *S. africana* is found to the Guinea Congolia, Sudania (Central African Republic) and Zambezia (Angola) Regions

(b) *S. dinklagei* is distributed to the Lower and Congolia Domains, Zambesia and Sudanian Regions.

(c) *S. orientalis* is distributed to the Lower and Congolia Domains, Lake Victoria Regional Mosaic, Sudanian and Afromontane Regions.

(d) *S. venosa* is probably the most widespread species in the genus and it is distributed in the Guineo-Congolia, Zambesia and Sudanian Regions.

Table 3. Chorology of *Sabicea*. In bold, novelties recognized here.

Distribution	species
Widespread elements in Continental Africa	*S. africana, S. dinklagei, S. orientalis, S. venosa*
Guineo-Congolia Region	*S. calycina*
Linking elements of Lower Guinea and Congolia Domain	*S. capitellata, S. dewevrei, S. ferruginea, S. longepetiolata, S. segregata*
Linking elements of Upper Guinea and Lower Guinea Domains	*S. geophiloides, S. schumanniana*
Upper Guinea Domain	*S. bracteolata, S. cordata, S. discolor, S. ferruginea, S. globulifera, S. harleyae,* ***S. jongkindii,*** *S. liberica, S. multibracteata, S. rosea, S. solitaria, S. vogelii*
Lower Guinea Domain	*S. apocynacea, S. bigerrica, S. brunnea, S. bullata ,S. cauliflora,* ***S. deblockiana, S. desseinii,*** *S. duparquetiana var. robbianella, S. duparquetiana var. duparquetiana, S. duparquetiana var. trigemina ,S. fulva var. clipeolaria, S. fulvovenosa, S. gabonica, S. gigantostipula, S. gogothae, S. gracilis, S. hierniana, S. laxa, S. leucocarpa,* ***S. liedeschumanniana,*** *S. mabouniensis, S. najatrix, S. neglecta, S. nobilis, S. pedicellata, S. pilosa, S. proselyta, S. rufa, S. sanguinosa, S. tchapensis,* ***S. uniflora,*** *S. urbaniana, S. urniformis, S. urcolata, S. xanthotricha*
Congolia Domain	S. *gilletii, S. goossensi*
Lake Victoria Regional Mosaic endemic	*S. becquetii*
Afromontane Region	*S. arborea, S. bequaertii*
Linking elements of Transition zone Sudania/Guineo-Congolian Regions	*S. brevipes, S. elliptica, S. floribunda, S. fulva*
Linking elements of Transition zone Zambezia/Guineo-Congolian Regions	*S. johnstonii*

3- Generic distribution; African centres of *Sabicea* diversity

In Africa, *Sabicea* is concentrated in the Guineo-Congolian Region and slightly Zanzibar-Inhambane Region and the Guineo-Congolia/Sudania (transitional) Region. The figure 1 showing the number of African species recorded per 2°50' square clearly indicates the existence of three centres of species diversity, in decreasing order of importance (maximum number of species per 2°50' square given in square brackets):

(i) the Lower Guinea Domain [42];

(ii) the Congolia Domain [15];

(iii) the Upper Guinea Domain [14].

The Lower Guinea Domain has the highest species diversity with as 42 species per 2°50 square. The high species diversity of the Lower Guinea Domain was already highlight by De Block (1998) and Sonké (1999). This may in part be explained by the great habitat diversity of this part of the Guineo-Congolian Region. This part combines coastal, lowland and montane habitats because of the presence of Cameroon Mountain. Many squares along the coast from Nigeria to Gabon have high species richness that exceeds 25 species. Clearly, the western parts of Cameroon, Equatorial Guinea and Gabon form a centre of high diversification for *Sabicea.*

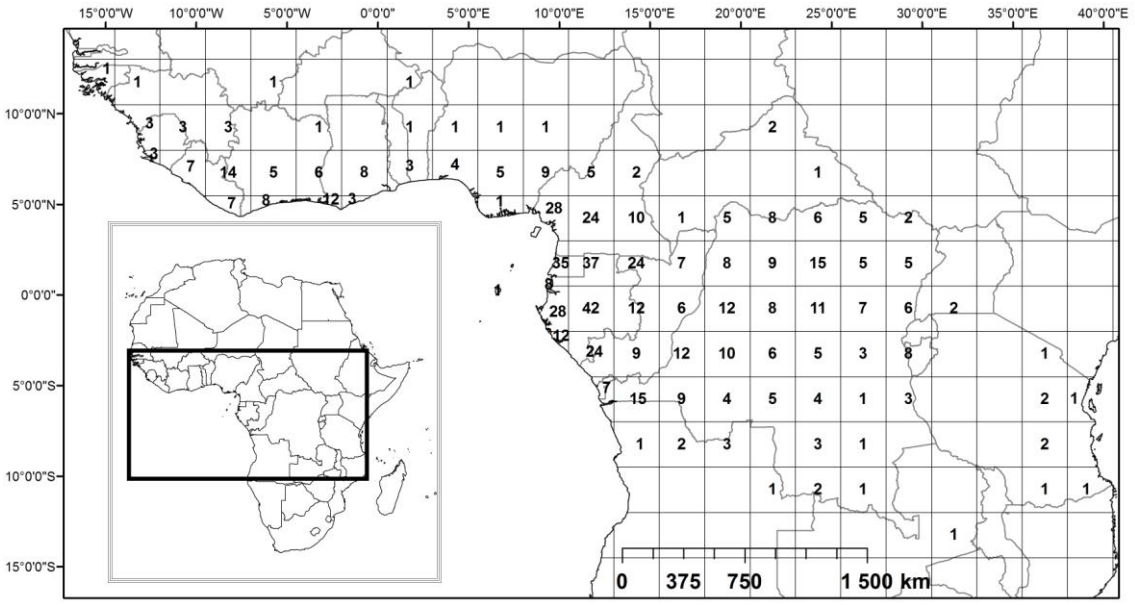

Figure 1. Number of species recorded per 2.50.

Keys to subgenera of *Sabicea* (adapted from Zemagho et al. accepted)

1. Erect herbs or shrubs 2

– Plants twining, creeping or sarmentose, never erect 3

2. Bracts fused into an U-shaped involucre, ovary 3-to 5-locular; calyx lobes shorter than tube or at most equalling it; leaves strongly discolorous with dense felt of whitish hairs beneath ..... Subg. *Stipularia*

– Bracts free, usually small; ovary 2-locular; calyx lobes much longer than tubes; leaves green on both sides ..... Subg. *Stipulariopsis*

3. Ovary 5-locular ..... Subg. *Sabicea*

– Ovary 2-locular 4

4. Inflorescence sessile, unbranched; corolla-throat with long long trichomes (except on *S. becquetii* group), leaves usually anisophyllous or almost so ..... Subg. *Anisophyllae*

– Inflorescence pedunculate (sessile in flowering stage in S. nobilis); corolla-throat with trichomes, leaves usually not anisophyllous ..... Subg. *Sabicea*

Sabicea* Subg. *Stipularia (P.Beauv.) Zemagho, Sonké, Dessein & Liede

Stipularia P. Beauv., Fl. Oware 2: 26. 1810.

Type species: *Sabicea africana* (P.Beauv) Hepper, Kew Bull. 13: 292. 1958.

Erect shrubs, usually branched at base. Nodes with two opposite leaves, equal in size, symmetrical at base, strongly discolorous (the lower side covered with a dense felt of white to buff woolly trichomes). Stipules interpetiolar, persistent, erect, entire. Inflorescences axillary, 1–2 per node, axillary, unbranched, sessile or subsessile and many-flowered. Involucre deeply urceolate and surrounding the inflorescence, reddish, formed by the fusion of 2–4 bracts, remaining intact or splitting in the fruiting stage. Corolla tube 2.5–3 cm long; corolla throat with short multicellular trichomes. Ovary 3–5 locular.

Keys to the species

1. Stipules 19–45 mm long, 14–35 mm broad; involucre, 2.1–3.5 cm high, comprising by the fusion of 4 lobes, foliceaous, glabrous externally sometimes with short appressed trichomes externally; involucre always reddish; leaf-blades oblong (15.6) 22.5–36 x 6.2–12.8 cm long; inflorescence sessile .....***S. africana*** (Widespread in Tropical Africa)

– Stipules 7–15 mm long, 2–5 mm broad; involucre, 1.2–3.2 cm high, comprising by the fusion of 2-3 lobes, covered with dense felt of woolly trichomes, sometimes intermingled with short trichomes, denser later; involucre becoming whitish when dry; leaf-blades 5.5–13.2 x 2.6–5.8 cm long; inflorescence shortly pedunculate (c. 4 mm long) .....***S. elliptica*** (to include *S. lanata*) (widespread in Tropical Africa)

Sabicea **Subgenus** ***Stipulariopsis*** Wernham (1914: 27)

Type species: ***Sabicea hierniana*** Wernham (1914: 29)

Ecpoma K.Schum., Bot Jahrb. Syst. 23; 430 (1896). – Type: *E. apocynaceum* K.Schum. (1896: 430)

Erect shrubs or herbs, usually single-stemmed or more rarely ramose. Nodes with two opposite leaves, equal in size, symmetrical at base, green on both sides. Stipules interpetiolar, persistent, erect, entire. Inflorescence axillary, 2 per node, unbranched and sessile, usually many-flowered. Bracts usually very small, rarely (*S. gigantostipula*) two large free bracts surrounding the inflorescence and resembling stipules. Corolla tube 1.5–2 cm long; corolla throat with short multicellular trichomes. Ovary 2-locular.

Keys to the species

1. Vegetative parts (stems, leaf-blades, midrib and nerves, petioles, outer surface of stipules) densely villose with long straight trichomes (c. 1.5 mm long); calyx lobes hirsute with long straight stiffs (2–3.5 mm long) intermingled with short uncinate trichomes (c. 0.2 mm long), ciliate on the margin with the same trichomes .....

S. urbaniana (Southwestern Cameroon, Gabon)

– Vegetative parts (stems, leaves blades, midrib and secondary nerves, outer surface of leaves) glabrous or with appressed trichomes (0.2–1 mm long); calyx lobes with short appressed trichomes on both sides or glabrous 2

2. Leaf-blades papyraceous, slightly bullate on lower surface; midrib and secondary nerves not prominent on lower surface .....***S. xanthotricha*** (Southwestern Cameroon)

– Leaf-blades coriaceous, not bullate on the lower surface; midrib and secondary nerves more prominent on lower surface.....3

3. Leaves very large, more than 50 cm long; inflorescence with two bracts apparent stipules up to 70 mm long and 40 mm broad; .....

.....***S. gigantostipula*** (Southwestern Cameroon, Equatorial Guinea)

– Leaves not exceeding 40 cm long and 30 cm broad; inflorescence with bracts hidden between flowers and not clearly apparent; if so, shortly connate at the base; 4

4. Stipules longitudinally plicate with prominent parallel ribs; green or brown; nerves tinged purplish below; calyx lobes narrowly elliptic, 5–15 mm long; erect shrub, occasionally ramose .....***S. hierniana*** (Cameroon)

– Stipules not plicate longitudinally without prominent parallel ribs; purple or dark red; nerves green below; calyx lobes linear subulate to filiform or setaceous; erect shrub (never ramose).....5

5. Leaf-blades elliptic to obovate, conspicuous hairy on both sides; young parts and petiole sparsely pubescent; stipules with appressed trichomes outside becoming glabrous at the length; calyx lobes more than 7 mm long with silky trichomes externally.....***S. cauliflora*** (Gabon, São-Tomé and Principle)

– Leaves narrowly elliptic to elliptic; glabrous on both surfaces, young parts and petiole glabrous or almost so; stipules always glabrous outside; calyx lobes 4–7 mm long, glabrous .....***S. apocynacea*** (to include *S. geantha*) (Cameroon, Equatorial Guinea)

Keys to Continental African *Sabicea* Subg. *Sabicea*

Pseudosabicea sect. *Floribundae* N.Hallé (1963: 172). – Type: *Pseudosabicea floribunda* (K.Schum.) N.Hallé = *Sabicea floribunda* K.Schum.

Pseudosabicea sect. *Sphaericae* N.Hallé (1963: 170). – Type: *Pseudosabicea mitisphaera* N.Hallé = *Sabicea nobilis* R.D.Good.

Plants usually twining, sometimes creeping or sarmentose. Nodes with two opposite leaves, usually equal in size (but sometimes strongly unequal), symmetrical to markedly asymmetrical at base, discolorous or not. Stipules interpetiolar, persistent, erect to reflexed, usually entire (but multifid in Madagascan species). Inflorescences axillary, 1–2 per node, branched or not, sessile or pedunculate, 1- to many-flowered. Bracts surrounding the inflorescence or not, usually free, sometimes shortly connate at base, rarely (*S. urceolata*)

connate for most of their length into an involucre splitting laterally in the fruiting stage. Corolla tube variable in size; corolla throat inside with short multicellular trichomes (long in Madagascan species). Ovary 2–5 locular.

Keys to the groups

1. Ovary 2-locular; scrambling lianescent shrub, rarely low creeper, never twining... **Group A**

– Ovary 5-locular, twining, creeping or climbing, rarely sarmentose.....**Group B**

Group A: Species with ovary bilocular [restricted in Central Africa]

1. Inflorescence glomerulate; flowers in dense clusters, sessile; outer surface of bracts and lower side of leaves covered with dense felt of woolly trichomes.....

.....***S. nobilis*** (Cameroon, Gabon)

– Inflorescence paniculate or in cymes compound never glomerulate, flowers pedicellate; outer surface of bracts and lower side of the leaves covered with straight trichomes (never woolly) 2

2. Low creeping herb, leaf-blades strongly anisophyllous and discolorous.....3

– Scrambling lianescent shrub, leaf-blades isophyllous and green on both sides.....4

3. Leaf with base subcordate; inflorescences 1.8–4 cm, with ramifications usually short but distinct; bracts and calyces pale green (the apex often pinkish); peduncle 0.8–2 cm, well exceeding the stipules; internal of corolla-throat and entire upper half of tube with rather short hairs, c.0.5 mm long.....***S. mabouniensis*** (West-Central Gabon)

– Leaf with base acute to obtuse; inflorescences 1.3–1.7 cm with ramifications not or hardly distinct; peduncle 0.2–0.5 cm, usually hidden by the stipules; bracts and calyces wine red; internal of corolla-throat with long hairs 0.7–1.2 mm around the throat + a separate ring of shorter hairs around mid-height .....***S. golgothae*** (West-Central Gabon)

4. One bract at the base of the peduncle; bracts and bracteoles elliptic to lanceolate, 8–10 mm (20 mm) ..... ***S. floribunda*** (Cameroon, Equatorial Guinea, Gabon, RD Congo)

– Two bracts, opposite, on the apex of peduncle; bracts and bracteoles suborbicular or subdeltate to broadly ovate, 4–7 mm 5

5. Bracts and calyx-lobes pale green to green; inflorescences paniculate; peduncle long (20–60 mm long); calyx lobes more than 4 mm long; glabrous to sparsely puberulent inside; fruits purple to dark at maturity.....

.....***S. segregata*** (Cameroon, Equatorial Guinea, Gabon, RD Congo)

– Bracts and calyx-lobes pink to red; inflorescences ± in contracted cymes in flowering stage, more open later; peduncle short (3–20 mm long); calyx lobes short, not exceeding 3 mm long; densely puberulent to hirsute inside; fruits white 6

6. Vegetative parts (stems, leaves, petiole, stipules) hirsute with long straight trichomes (2–4 mm long); stipules wide at base, acute to ± attenuate at the apex, 12–15 mm long; inflorescence villose on axes; calyx lobes lanceolate to oblong, 2.5–5 x 1–1.8 mm long, pilose and ciliate on margin ..... ***S. sanguinosa*** (Gabon)

– Vegetative parts (stems, leaves, petiole, stipules) with short appressed trichomes (c. 0.5 mm long); stipules subdetatoid, c. 3 times more large than the stems; 8–12 mm long; inflorescence hirsute on axes; calyx elliptic, 1.5–3 x 0.4–8 mm, puberulent .....

..... ***S. proselyta*** (Cameroon, Equatorial Guinea, Gabon)

Group B: Species with ovary 5-locular

Keys to the groups of Lower Guinea and Congolia Domains [Lower Guinea and Congolia Domains of the Guineo Congolian Region]

1. Inflorescence branched; bracts generally reduced, not enclosing the flowers, variable in size and shape, stipules reflexed ..... **Keys 1 (*S. venosa* group)**

– Inflorescence unbranched; bracts wide and enclosing the flowers, stipules erect 2

2. Leaf discolorous, with felted of woolly buff on abaxial surface, fruits white, two pairs of bracts, opposite and decussate ..... **Keys 2 (*S. capitellata* group)**

– Leaf with the same color on both sides, fruits variable in color; bracts free or fused, variable in number and size..... **Keys 3**

Keys 1: *S. venosa* group

1. Corolla red attractive, inflorescences on leafless stem or on the base of old stems ***S. speciosa***

– Corolla white or greyish, inflorescences on the young stems 2

3. Leaves whitish on the lower side, covered with dense hairs felted 3

– Leaves green on both sides 4

4. Fruits white..... ***S. orientalis*** (to include *S. cameroonensis*)

– Fruits black..... ***S. goossensii***

5. Calyx-lobes short (+/- 0.5 mm) ; inflorescences lax; corolla white with long tube (+/- 15 mm) ..... ***S. laxa***

– Calyx-lobes long (>1.5 mm) ; inflorescences generally quite dense; corolla shorter, significantly bent 6

6. Corolla greenish with straight tube, 7-10 mm long .....

.....***S. venosa*** (s.l., incl. *S.affinis, S. amomi, S. mollis*)

– Corolla whitish, with tube bent, 12-15 mm de long 7

7. Stems and leaves with trichomes hirsute ..... ***S. congensis***

– Stems and leaves with appressed trichomes ..... ***S. schumanniana***

Keys 2: *S. capitellata* group

1. First order bracts in U-shaped ..... ***S. urceolata***

– First order bracts free or shortly fused at the base 2

2. Leaves green on both surfaces ..... ***S. bigerrica***

– Leaves discolorous (never green on both sides)..... 3

3. Stipules relatively wide (8–15 x 5–9 mm) and erect.....4

– Stipules short (< 5 mm), mostly reflexed (with sometimes an exception in *S. capitellata*) 6

4. Secondary nerves 16–19 pairs, prominent, calyx-lobes short (< 1 mm long) hidden in flowering stage .....***S. liedeschumanniana***

– Secondary nerves 9–12 pairs, not prominent; calyx lobes longer, triangular to linear, 5–6 mm long, clearly up to the bracts 5

5. Involucral bracts fused at least on half their length, patent and star-like in fruit, 10–13 x 9–11 mm.....***S. urniformis***

– Bracts free, <7–10 x 3–4 mm..... ***S. deblockiana***

6. Flowers and fruits pedicellate 7

– Flowers and fruits sessile or almost so.....8

7. Outer surface of the stipules with long straight hairs; calyx lobes short (4–12 mm).....

.....***S. pedicellata***

– Outer surface of the stipules with felt of woolly buff; calyx lobes long (15–20 mm)

.....***S. johnstonii***

8. Bracts green on both sides..... ***S. gracilis***

– Bracts discolorous 9

9. Calyx lobes short (+/-0.5 mm) ..... ***S. rufa***

– Calyx lobes long (1.5–5 mm).....10

10. Stipules elliptic to oblong 6–9 x 2–4 mm, erect; calyces hidden by the involucre ***S. brunnea***

– Stipules suborbicular 3–6 x 5–6 mm, erect to reflexed; calyces up to the involucre.....

.....***S. capitellata* s.l**.

Keys to the species (Keys 3)

1. Inflorescences 1-flowered 2

– Infloresences few to many-flowered 3

2- Calyx lobes 1-2 mm wide, pubescent or thinly pilose ..... ***Sabicea geophiloides***

– Calyx lobes elliptic, 3.5–5 x 1.2–2 mm, glabrous ..... ***Sabicea uniflora***

3. Corolla red attractive, tube long (21–28 x 2–3 mm), inflorescence on the leafless stems .....***S. speciosa***

– Corolla white or green, tube +/- short (tube de 7–15 mm); inflorescences on leafy stems 4

4. Leaves cordate on the base and strongly bullate, fruits ovoid, inflorescences glomerulate and sessile.....***S. bullata***

– Leaves not cordate on the base and never bullate, fruits globose, inflorescences variable 5

5. Calyx with 3 sepals broadly elliptic (foliaceous), fruit red, becoming dark at the maturity ..... ***S. calycina***

– Calyx with 5 sepals, variable in shape, fruits white or red, never dark at maturity 6

6. Low creeper (< 10 cm), leaf-blades subcordate, fruits white or yellow; inflorescences with 2 bracts ..... ***S. leucocarpa***

– Creeping or climbing, up to several meters long with stems sometimes tending to twine up into the canopy; leaves acute at the base 7

7. Inflorescence surrounded by a sginle pair of free bracts; bracts suborbicular; bracteoles absent 8

– Inflorescence surrounded by at least two pairs of bracts (if not, bracts developed, not clearly distinct to the bracts) 10

8. First order bracts free, suborbicular to (sub) ovate, 22–26 x 19–20 mm; calyx with lobes long and linear (>8 mm) up to the tube, plant with appressed hairs..... ***S. gabonica***

– First order bracts shortly fused at the base on about 5–6 mm from the axis, narrowly ovate,12–22 x 19–27 mm, calyx-lobes triangular 2–3 mm, clearly shorter than the tube, plant glabrous to hirsute 9

9. Inflorescences on leafless nodes or on the old stems; peduncle shorter 6–15 mm long bracts and calyces purplish; outer surface of stipules with long appressed hairs; ovary and fruits hirsute ..... ***S. najatrix***

– Inflorescences on leafy stems; peduncle 8–52 mm long, bracts and calyces greenish; outer surface of the stipules glabrous; ovary and fruits glabrous ..... ***S. dewevrei***

10. Calyces and bracts red or dark-purple; stems and leaves hirsute 11

– Calyces and bracts green (occasionally slightly purplish) 12

11. Calyx with short tube 2–4 mm long, corolla tube 22–23 x 1–2 mm..... ***S. desseinii***

– Calyx with long tube 6–8 mm long, corolla tube 24–28 x 2–3 mm.....***S. pilosa***

12. Bracts wide, ovate (12–22 m); bracteoles absent; leaves and stems hirsute (montane species) 13

– Bracts small (c. 6 mm), usually +/- connate (concave) at the base; each flower surrounding by a pair of bracteoles (lowland species) 14

13. Involucral bracts villose .....***S. gilletii*** (restricted in RD-Congo)

– Involucral bracts puberulent..... ***S. tchapensis*** (Lower Guinea Domain)

14. Inflorescence (sub) sessile, corolla with tube 10–15 mm long; stems and leaves glabrous or with appressed hairs .....***S. fulva***

– Inflorescence clearly pedunculate 15

15. Calyx with lobes lanceolate > 5 mm long, corolla-tube +/- 10 mm, fruits red at maturity, large involucral bracts connate and naviculate capitula large (>1.5 cm de diameter)..... ***S. duparquetiana***

– Calyx with lobes elliptic, shorter < 3 mm long, corolla tube +/-6 mm, fruits white with fleshy purplish, capitula shorter <1(–1.5) cm in diameter ***S. dinklagei***

Keys to the species of Upper Guinea Domain [Upper Guinea Domain of the Guineo Congolian Region]

1. Calyx with 3 lobes, foliaceous; fruits red becoming dark at the maturity ..... ***S. calycina***

– Calyx with 5 lobes, diverse in shape and size, fruits red (never dark)..... 2

2. Inflorescences clustered each with 10–15 involucral bracts free from each other; white tinged pink; the outermost pair narrower than the rest (10–15 x 4–10 mm), flat, calyx with white tube and white tinged pink lobes..... ***S. multibracteata***

– Inflorescences clustered, each with 2–8 involucral bracts; pale green to green; the outermost pair ovate c. 2 –4 x 2–6 mm, slightly fused and connate at the base; calyx with tube and lobes red.....3

3. Prostrate herb, rooting along the stems, stems slender, inflorescence solitary on leafy stems, each with 4 involucral bracts.....***S. geophiloides***

– Creeping or climbing, up to several meters long with stems robust, becoming woody at the age sometimes tending to twine up into canopy, inflorescence many-flowered, on leafless stems, each with 2 bracts.....4

4. Inflorescences on leafless stems or on the base of old stems, sessile; calyx lobes broadly elliptic to deltate, corolla dark red with long tube (21–28 x 2–3 mm) .....***S. speciosa***

– Inflorescences on leafy stems or on flowering nodes, clearly pedunculate; calyx lobes broadly elliptic to deltate; corolla white to white-greenish; tube +/-short (tube de 7–15 mm 5

5. Leaves strongly discolorous.....***S. ferruginea***

– Leaves green on both sides.....6

6. Inflorescences many-flowered (more than10 flowers); corolla tube red 7

– Inflorescences uni- or few-flowered (less than 5 flowers); corolla tube white.....10

7. Peduncle 3–14 cm long, flowers and fruits pedicellate.....8

– Peduncle ≤ 5 mm long, flowers and fruits sessile 9

8. Stipules erect, narrowly elliptic, 6–10 mm long, 1–3 mm wide; vegetative parts with short appressed trichomes (c. 0.2 mm long), more longer and denser on secondary nerves and midrib (c. 2 mm long) ..... ***S. harleyae***

– Stipules reflexed, suborbicular to broadly ovate, 11–16 mm long, 10–12 mm wide; vegetative parts villose with long straight trichomes (c. 2 mm long) ..... ***S. vogelii***

9. Leaf subcordate to cordate at the base; calyx lobes 4–7 mm long, involucral bracts over to 2.5 cm wide, broader than longer; involucral bracts villose ..... ***S. brevipes***

– Leaf acute at the base, calyx-lobes 8.5–11 mm long, involucral bracts not exceeding 1.5 cm, longer than wide; involucral bracts puberulent ..... ***S. tchapensis***

10. Calyx with long lobes, 9–21 x 0.2–1.5 mm long 11

– Calyx with short lobes, 1–1.2 x 1.2–3 mm long, ... ***S. rosea***

11. Fruits fusiform; calyx-lobes linear ..... ***S. jongkindii***

– Fruits globose; calyx-lobes oblong to narrowly ovate 12

12. First order bracts, free, ovate c. 1.8 x 1.5 cm ..... ***S. solitaria***

– First order bracts, slightly fused at the base 13

13. Leaf-base subcordate to cordate ..... ***S. cordata***

TAXONOMIC TREATMENT

This synopsis focuses on three subgenera: *Sabicea* (58 spp.), *Stipularia* (3 spp.) and *Stipulariopsis* (5 spp.). Subgenus *Anisophyllae* has been treated separately (Zemagho et al. in review) and then, will not included here.

1. *Sabicea africana* (P.Beauv) Hepper, Kew Bull. 13: 292 (1958). —Type: Nigeria, *Palisot de Beauvois s.n.* (holo-: G; iso-: P).

Stipularia africana P. Beauv. Fl. Ow. 2: 26 (1810 [1807]); F.T.A.: 80 (1877); F. Pellegrin, Fl. Mayombe 3: 9 (1938); F.Hallé, Adansonia 1: 266 (1961); N.Hallé, Fl. du Gabon 12: 158 (1966).

Ecology: This taxon grows along the riverine forest, in swampy areas and it was found between 0–860 m elevation.

Chorology and distribution: Widespread in Continental Africa: Angola, Benin, Cameroon, Central African Republic, Republic of Congo, Equatorial Guinea, Gabon, Ghana, Ivory Coast, Liberia, Nigeria, DR Congo, Sierra Leone.

Representative specimens examined: **Angola:** 70 Km N Capaia, Lake Carumbo Camp Site near Luele River, 07°45'10"S 19°57'23"E, 03 May 2011, *F.M. Crawford FC812* (BR).

Benin: Dogla, 6°36'N 2°32'E, 10 Jul. 2001, *A. Akoègninou 4946* (WAG); Hozin, c. 6°31'N 2°33'E, 12 Aug. 2000, *V. Adjakidjè 3728* (WAG); Mèridjonou, 6°30'N 2°42'E, 18 Dec. 1999, *V. Adjakidjè, P. Agbani & H. Yédomonhan 3244* (WAG).

Cameroon: 8 km Mbakaou-Tibati, 6.22'N 12.46'E, 30 Jun. 1972, *A.J.M. Leeuwenberg 10068* (BR, MO, UPS); 8 km Est de l'embouchure de la Sanaga, c.4°46'N 13°10'E, 5 Jan.1974, *R. Letouzey 12584* (WAG); 99 km route Sangmélina-Yaoundé, 15 Dec. 1986, *S. Lisowski B-3623* (BR).

Central African Republic: Manovo-Gounda-St. Floris National Park; WWF Inter. Elephant Cons. Project, 9.3 km S of Koumbala, Pende confluence on Pende Creek, 15 May 1984, *J. M. Fay 6647* (MO); Région de Yalinga, Haut Oubangui, 95 km NW de Yalinga, près de Cirengambo, dans la Haute-Kotto, 17 June 1921, *G. Le Testu 2830* (MO).

DR Congo: Plateau Batéké, station forestière de Kinzono, 2°9'27.40"S 14°0'26.05"E, 30 Jan. 1987, *F. Billiet & B. Jadin 4001* (BR); Stanley-Pool, 4°12'S 15°33'E, 15 Feb. 1891, *Demeuse 186* (BR); 528 km Kikwit, amont pont Kwilu, 5°2'S 18° 48'E, 10 Jun. 1992, *Masens Da & Musa Yung 731* (BR).

Equatorial Guinea (Rio de Muni): Région continentale, Etembue (Réserve de Ndote), 1º17'N 9º25'E, 18 Aug. 1997, *F. Eneme & J. Lejoly 80* (BRLU); Ndote Nord, environs du

village Jandye, 29 Aug. 1997, *S. Lisowski M-33* (BRLU); Rio de Muni, au S de Bata, au S du fleuve Ekuka, 20 Sep. 1997, *S. Lisowski M-1623* (BRLU).

Gabon: Mondah forest, east of road Liberville-Cap Estérias, 0º34'25.3"N 9º 20'48.6"E, 13 Mar. 2008, S. *Dessein, O. Lachenaud, S. Janssens, Y. Issembe & T. Nzabi 2525* (BR); Batéké plateau, Mpassa river watershed, 4.2 km N of station of the Projet de Protection des Gorilles, 02º04'45"S 014º03'47"E, 21 Nov. 2001, *G. Walters, A. Bradley & G.N. Essouma 984* (BR, MO); Mondah Forest. 25 km N of Libreville, 0°35'N 9°21'E, 16 Apr. 2006, *G.M. Walters, C. Davidson, S.R. Christoph & J.P. van de Weghe 1640* (WAG).

Ghana: Half Assinie, 23 Nov. 1974, *A.A. Enti FE 1371* (BR, MO); Near Mpataba, 5°06.5'N 2°35.5'W, 01 Mar. 1995, *C.C.H. Jongkind, D.K. Abbiw 2080* (MO, WAG); Along the Takoradi-Elubo Highway, 5°15.4'N 2°44.3'W, 16 Mar. 1996, *M. Merello, H. Schmidt, J. Amposah, A. Welsing & K. Baah 1459* (WAG, MO).

Ivory Coast: Abouabou, c.5°17'N3°54'W, 12 Oct. 1949, *J.G. Adam 6471* (MO); Abidjan, Irho. Port Bouet, 5°15'N3°58'W, 28 May 1970, *J. de Koning 658* (BR, WAG); Moussou savanna, back of Grand Bassam, E.S.E of Abidjan, 5°14'N 3°45'W, 10 October 1959, *F.R. Fosberg 40428* (MO).

Liberia: Buchanan, 5°53'N10°03'W, 23 Dec. 1969, *J.G. Adam 25402* (MO); Grand Cape Mount Co: Jabrocca, c.6°48'N 11°12'W, 25 Dec. 1947, *J.J.T Baldwin 10850* (MO, WAG); Grand Cape Mount, south-east of lake Piso, 6º38.1'N 11º 08.5'W, 27 Feb. 2013, *C.C.H. Jongkind 11723* (WAG).

Nigeria: Province Benin- District Iyekuselu, 22 Feb. 1961, *J.A. Emwiogbon 44288* (BR); Lagos state, c. 20 km Ikorodu - Epe road, 2 km E of Parafa, 6°38'N 3°47'E, 17 Mar. 1977, *A.J.M. Leeuwenberg 11223* (BR, WAG); Irele-Ajagba road, 17 Nov. 1981, *Olorunfemi, Binuyo & Babagbemi OBB430* (MO).

Congo (Brazzaville): Likouala department, close to the edge of Nsassa forest, 2 km W of Epena, Lac Télé Community Reserve, 1°21'54"N 17°26'06"E, 12 May 2008, *E. Kami 4001* (BR); Likouala department, close to the edge of Nsassa forest, 2 km W of Epena; Cataractes, route Brazzaville - Kinkala, km 50 Yanga, c. 4°23'S 14°58'E, 5 Dec. 1962, *De Néré 61* (BR, MO, WAG); Kouilou, Bena, 08 Oct. 1990, *S. Lisowski B-7182* (BR).

Sierra Leone: Newton. Peninsula, c.7°22'N 12°22'W, 03 Mar. 1964, *J.K. Morton SL930* (MO); s.l., Dec., *E.G.F. Scott 4077* (GH).

Zimbabwe: s.l., *H. Vanderyst s.n.* (BR); s.l., 18 Sep.1892, *F. Demeuse s.n.* (BR).

2. *Sabicea apocynacea* (K.Schum.) Razafim., B.Bremer, Liede & Saleh A.Khan, Taxon 57: 14 (2008). — Type: Cameroon, near Lolodorf, *Staudt 208* (holo-: K, photo).

Ecpoma apocynaceum K.Schum., Bot. Jahrb. Syst. 23: 430 (1896); Hallé, Adansonia 3: 173 (1963)

Sabicea geantha (Hiern) N.Hallé Hiern, D.Olivier & auct. suc. (eds.), Fl Trop. Afr. 3: 78 (1877), Wernham, Monogr. *Sabicea*: 29 (1914), **syn. nov.** — Type: Gabon, Sierra del Cristal, 0°30'N 10°30'E, 1862, *G. Mann* 1728 (holo-: K; iso-: P WAG).

Ecpoma geanthum Hallé, Adansonia 3: 173 (1963); Hallé, Fl. du Gabon 12, Rubiaceae 1: 221 (1966).

Ecology: This taxon occurs in atlantic littoral forest, mountain primary forest, secondary forest border and it was found between 120–1100 m elevation.

Chorology and distribution: Lower Guinea Domain: Cameroon, Equatorial Guinea, Gabon

Notes: 1. *Sabicea geantha* has been treated at the specific rank by Hiern (1877) with a single specimen from Gabon (*Mann 1728*). Wernham (1914) recognised this taxon as having a remarkable glabroussness of the stipules, petioles and leaves. Detail comparison between *S. apocynacea* and the specimen *Mann 1748* shows that only the shape of leaf is different between both species (the former is elliptic whereas the latter is lanceolate). We found the shape of the leave as not reliable and therefore, we synonymized *S. geantha* under *S. apocynacea.*

2. Both *S. apocynacea* and *S. geantha* have not previously been reported in Equatorial Guinea.

Representative specimens examined: **Cameroon:** N'Koemvone, ca. 15 km S of Ebolowa, 2°49'N 11°08'E, 04 Mar. 1964, *W.J.J.O de Wilde et B.E.E. & Wilde-Duyfjes 2049*. (BR, WAG); South, Bibondi, 03°20'15N 10°39'37E, 22 Jan. 2005, *B. Sonké 3739* (BR, MO); Campo-Ma'an area, Bifa, Path to the National Park, 2°39.4'N 10°17.0'E, 12 Oct. 2001, *G.P Tchouto Mbatchou 3302* (WAG).

Equatorial Guinea: Parc National de Monte Alen, dalle rocheuse d'Engong, 5 km à l'ouest du village d'Engong, 1º37'N 10º18'E, 11 May 2002, *I. Parmentier & P. Esono 2897* (BR).

Gabon: Monts de Cristal, Mbe National Park, in between rocks below Mt. Mbilan ridge, 0°28.3'N 10°15.3'E, 08 Apr. 2005, *M.E. Leal, D. Nguema Ekomo, E. Mounoumoulossi. & P. Bissiemou 536* (WAG); Estuaire, Crystal mountains, 82300 m on transect G, 0º28'N 10º14'E, 08 Aug. 2001, *N.S. Nguema Miyono 1890* (BR, WAG).

3. *Sabicea bigerrica* N.Hallé in Fl. du Gabon 12: 192 (1966). — Type: Gabon. Makokou, *Hallé 1079* (holo-: P).

Chorology and distribution: Lower Guinea Domain: endemic to Gabon.

Ecology: This taxon occurs in secondary forest edge, secondary thicket near river and it was found between 389–730 m elevation.

Note: Morphologically, *Sabicea bigerrica* resembles *Sabicea gracilis* and *S. rufa*. These species belong to *S. capitellata* group with inflorescences capitulate. The pattern of pubescence on different vegetative parts, the size and the shape of the leaves are the most common features in these species. Characters that can be used to distinguish the three species are: leaves color (greenish on both sides in *S bigerrica* vs weakly to strongly discolorous in *S. gracilis* and S. *rufa*), the robussness of the stem in *S. bigerrica* (vs slender in both *S. gracilis* and *S. rufa*), the prominence of secondary nerves in *S. rufa* (not prominent in *S. bigerrica* and *S. gracilis*), the first order bracts (connate in *S. bigerrica* vs not connate and naviculate in *S. gracilis* and *S. rufa*). Futhermore these species are geographically separated: *S. bigerrica* is restricted to Gabon, while *S. rufa* in Cameroon and *S. gracilis* in Cameroon and Equatorial Guinea.

Representative specimens examined. Gabon: Km 6 Moanda - Franceville, 1°33'S 13°15'E, 10 September 1970, *F.J. Breteler 6398* (BR, MO, WAG); Ipassa station, c.10 km from Makokou, 0º30'42.1"N 12º48'18.5"E, 09 Mar. 2008, *S. Dessein, O. Lachenaud, S. Janssens, Y. Issembe & T. Nzabi 2498* (BR), forêt des Abeilles, 25 km S du confluent Ogooue-Ivindo, c.0°21'S 12°10'E, 11 May 1984, *C.M. Wilks 940* (WAG).

4. *Sabicea bracteolata* Wernham in Monogr. *Sabicea*: 73 (1914). — Type: French Guinea: Labé, *Chevalier 12390* (holo-: P; iso-: K, WAG).

Chorology and distribution: Upper Guinea Domain: Guinea, Ghana.

Ecology: This taxon occurs in open places of high forest.

Representative specimens examined: **Ghana:** Ankasa Forest Reserve, 06 Oct 1973, *A.A. Enti R1164* (BR, MO, WAG).

Note: This species is newly recorded from Ghana.

5. *Sabicea brevipes* Wernham in Monogr. *Sabicea*: 58 (1914). — Type: Togo. *Kersting 146* (lecto-: Hbb. Berol., Brux, **designed here**).

Chorology and distribution: Linking elements of transition zone Sudania/Guineo-Congolian Regions: Benin, Burkina Faso, Ghana, Mali, Nigeria, Togo.

Ecology: This taxon occurs in many ranges of habitats: high and riverine forests, savannahs, secondary regrowth and it was found between 350–650 m elevation.

Notes: 1- This taxon was described as restricted to woodland from Ghana eastwards to Nigeria. During this study, some specimens from Burkina Faso (*Geerling & Bokdam 1217*) and others from Mali (e.g. *Demange 2827*, *Demange 3312*, *Adam 15057*) fall in the same range than this taxon. Accordinly the geographic distribution is extending to these countries.

2- In the protologue, Wernham described this taxon with five syntypes from Togo: *Baumann 256, Kersting 146, Büttner 73, Büttner 749, E. & M. Laurent* but did not choose any type. The name is here lectotypified.

Representative specimens examined: **Benin:** Goro, 8°56'N 2°32'E, 07 Apr. 1999, *A. Akoègninou, P. Agbani & H. Yédomonhan 2260* (BR, WAG); Koussoukouango, 10°10'N 1°12' E, 2 Oct. 2000, *A. Akoegninou 3507* (WAG); Kotiakou, 4 km S. de Tanguiéta, Est de la route auprès d'une petite rivière, 10°36'N 1°17'E, 17 May 1999, *W.J. van der Burg, A. Akoègninou, J.P. Essou & P. Agbani 1481* (WAG).

Burkina Faso: Bobo-Dioulasso, 4°36'W 11°08'N, 09 October 1967, *C. Geerling & L.J. Bokdam 1217* (BR, WAG); Daramandougou, 16 Feb. 1978, *Toutain 2465* (P).

Ghana: Kpeve Agricultural Station, 09 May 1950, Darko 567 (MO); Volta region, walking east from Dadiasi, 8º13'N 0º35'E, 21 May 1996, *C.C.H. Jongkind & C.M.J. Nieuwenhuis 2793* (BR,WAG), Road in Volta River Forest Reserve, 6°11'N 0°01'E, Oct. 1951, *J.K. Morton 6069* (WAG).

Ivory Coast: Releve 48; Champ de riz, 500 m W of Gouléako, 5°51'N 7°25'W, 24 June 1984, *A. de Rouw 56* (WAG); Bouale, Boka de Titiekio, 21 Feb. 1951, *G. Roberty 13919* (MO).

Mali: Kaboila, 11°13N5°38'E, 15 Sep. 1958, *J.G. Adam 15057* (P); Fabolasso, 07 December 1955, *Demange 259* (P); Sikasso, galerie du Farako supérieure, 28 km sud (route de C.I.), 11°2'N 5°35'E, 03 Jul. 1967, *Demange 2827* (P); Kadoudougou, 14 km S.W. de Sikasso, galerie de Thalweg, 11°18'N 5°58'E, 06 Nov. 1966, *Demange 3312* (P).

Nigeria: Nyanya (Benue Plateau State, Keffi District), 8°51'N 7°52'E, 21 May 1973, *V.E. Eimunjeze, J.K. Adebusuyi & S. Macauley 66470* (MO, WAG); In the college compound Ogori/Magongo T.T.C. (Kwara State, Lokoja District), 7°27'N 6°11'E, 5 May 1978, M.O Soladoye, B.O Daramola & Ihe 323 (MO, WAG); At the hills around Ogori town, 10 May 1978, *M.O Soladoye, B.O Daramola & Ihe BO402* (MO).

Togo: Near Palimé, Missahohe, 6°57'N 0°36'E, 05 Nov. 1971, *F.J. Breteler 7264* (BR, WAG).

6. *Sabicea brunnea* Wernham in Monogr. *Sabicea*: 65 (1914). — Type: Cameroon, *Winkler 1027* (lecto-: BM; isolecto-: K, **designed here**).

Chorology and distribution: Lower Guinea Domain: S. Nigeria and Cameroon.

Ecology: This taxon occurs in edge of high forest, secondary forest, in secondary growth by roadside through high forest, open areas and it was found between 0–100 m elevation.

Notes: In Monograph of *Sabicea*, Wernham (1914: 65) described *S. brunnea* and *S. capitellata* without affinities with other *Sabicea* species. Govaerts et al. (2012) synonymized *S. brunnea* under *S. capitellata* with not apparent grounds. Although, both possess the same type of indumentum on their inflorescence and other morpholgical similarities, the first order bracts can be clearly segregate these species: *S. capitellata*: small free bracts and stipules narrowly elliptic whereas *S. brunnea*: large bracts, shortly fused at the base and stipules suborbicular.

Representative specimens examined: **Cameroon:** Littoral-Wouri division, 40 km E of Douala on highway to Edéa, on steep embankment on S side of road, c. 03º56'58"N 10º00'16"E, 30 Nov. 1994, *R.E. Gereau, E. Jato & E. Sarabe 5608* (MO, WAG); Province Southwest. Along road near path around approximately the SW half of Ejagham lake, approximately 3 km S of Eyumojock, Ejagham Forest Reserve, 05º45'N 08º59'E, 17 Dec. 1986, *S. D. Manning 1240* (BR, MO); Littoral province, Sanaga Maritime, lac Tissongo, 3º35'21.6"N 9º54'24"E, 27 Jan. 2009, *B. Sonké 5213* (BR, BRLU).

Nigeria: South Eastern State, district Ikom. Near Ajasso village, 22 Feb. 1973, *Latilo & Oguntayo 67667* (WAG); Okumi and Ikom, *Holland 262* (BM, K)

7. *Sabicea bullata* Zemagho, O.Lachenaud & Sonké, Phytotaxa 173 (4): 289 (2014). — Type: Cameroon. Rumpi Hills near Dikome Balue, *Dessein et al. 2572* (holo-: BR; iso-: YA).

Chorology and distribution: Lower Guinea Domain: endemic to the western Cameroon highlands.

Ecology: This taxon occurs in submontane forest and it is found at 1000–1417 m elevation

Notes: *Sabicea bullata* is one rare species in the genus having the upper side of leaves strongly bullate which is an uncommon character in the genus.

Representative specimens examined: **Cameroon**: Bakossi Mountains 1–8 km NNE of Meyum Village, 5°01'N 9°38'E, 20–30 May 1987, *C. Doumenge 474* (MO, YA); Kodmin, 4°59'N 9°42'E, 21 Jan. 1998, *M. Etuge 4061* (MO, YA); Rumpi Hills near Dikome Balue, 4°54'28.5"N 9°14'54.2"E, 21 Apr. 2009, *S. Dessein, O. Lachenaud, B. Lemaire, B. Sonké & H. Taedoumg 2651* (BR, K, MO, YA).

8. *Sabicea calycina* Bentham in W.J. Hooker, Fl. Niger: 399 (1849); Hiern, Fl.Trop. Afr. 3: 76 (1877); Wernham, Monogr. *Sabicea*: 63 (1914); F.W.T.A. 2 ed.2: 1972 (1963); Hallé, Fl.

du Gabon 12, Rubiaceae 1: 186 (1966); D.Bridson & B.Verdcourt, Fl. Trop. East Afr., Rubiaceae (part 2): 472 (1988). — Type: Equatorial Guinea. Bioko, *Vogel 35* (holo-: K).

Sabicea calycina var *hirsutiflora* Wernham, Monogr. *Sabicea*: 64 (1964). — Type: Nigeria, Inter Ibadan et Abeokuta. Yorubaland, 15 Mar. 1899, *Schlechter 13024* (holo-: BM).

Sabicea barteri Wernham, Monogr. *Sabicea*: 64 (1964).— Type: Nigeria, Old Calabar, *Bater 1248* (holo-: K).

Chorology and distribution: Guinea-Congolian Domain: Benin, Cameroon, Republic of Congo,, Equatorial Guinea, Gabon, Ghana, Ivory Coast, Liberia, Nigeria, DR Congo.

Ecology: This taxon occurs in primary and secondary vegetations, submontane forest, mixed evergreen and semi-deciduous forest with semi-deciduous elements predominant (i.e *Lophira alata*, *Coula edulis* and *Saccoglottis gabonensis*), coastal forest, secondary bush, roadsides, savannahs, open swamps at margin along road and it was found between 20–1000 m elevation.

Note: *Sabicea calycina* is one of the most widespread species in *Sabicea*. It is a very distinct species in the genus with its long puberulous to glabrous peduncles and heads of flowers with large foliaceous calyx-lobes (only 3 in contrast to 5(–6) in the rest of the genus). The pattern of pubescence in this taxon is highly variable. Some specimens possess spreading trichomes on branchets while others are clearly glabrous particularly those from Ivory Coast and Ghana.

Representative specimens examined: **Benin:** Ouémé, Akpro-Missérété, Hozin, c. 6º31'N 2º33'E, 12 Aug. 2000, *V. Adjakidjè 3724* (WAG); Ouémé, Ifangni, Ifangni, 6º40.63'N 2º42.70'E, 18 Dec. 2000, *V. Adjakidjè 4177* (WAG); Zou, Zogbodomé, ilot forestier de la Lama, c. 6º57'N 2º05'E, 13 Aug. 2001, *V. Adjakidjè 4816* (WAG).

Cameroon: Manengole, Nkongsamba-Douala km 13, 4º52'N 9º53'E, 21 Dec. 1967, *P. Bamps 1497* (BR); Sud-est de Nko'adjap (+/- 20 km est de Campo), 2°22.229'N 9°57.483'E, 15 May 2009, *O. Lachenaud, B. Lemaire, M. Simo & B. Sonké 758* (BR); path from Fabe-Mundemba road to Makeke camp, 05º00'N 08º55'E, 29 Aug. 1986, *S.D. Manning 93* (BR, MO).

Republic of Congo: Province Kouilou, Punga, 12º20'E 4º20'S, 17 Jun. 1949, *R. Dechamps 13043* (BR, MO).

DR Congo: Mandindi (Banalia), 1°43'N 25°29'E, 11 Dec. 1913, *Bequaert 1447* (WAG); Km 40, route de Kisangani à Bengamisa juste avant le pont sur la Lindi, 0º 51'N 25º 12'E, 28 Nov. 1976, *J. Lejoly 644* (BRLU); Dima; 3°17'S 17°29'E. 15 Jan. 1915, *H. Vanderyst 5111* (BR).

Equatorial Guinea: Centro Sur: Mosumo, cataratas del Laña, 1°43'37''N 10°04'39''E, 09 Jul. 1999, *Aedo & al. 5159* (BR); Malabo-Luba, road km 40, 3°32'N 8°36'E, 27 Jul. 1986, *M.F. de*

Carvalho 2515 (BR, NY, UPS, WAG); Littoral: Río Campo, cerca de Bongoro, 2°8'N 9°54'E, 20 Mar. 2000, *R. Pérez Viso 2186* (BR).

Gabon: Province Estuaire: forêt de Mondah on road Libreville-Cap Esterias, ca.0º33'N 9º22'E, 26 Feb.1999, *L. Andersson & A. Nilsson* 2276 (BR); 20 road-km SE of Igotchi-Mouenda, Bakker timber concession; lowland forest, c. 3°00'S 10°36'E, 12 May 1997, *G.D. McPherson 17034* (MO, WAG); Inselberg in Bordamur concession area, some 9 km from WWF station, on right hand side of logging road leading into forest interior, c. 1°04'N 11°43'E, 25 Oct. 2002, *J.S. Strijk 313* (WAG).

Ghana: Eastern Oda district: Esen Epem Forest Reserve, approximately 100 km NE of Accra on Accra-Oda road, 05º50'37"N 00º49'46"E, 22 Jun. 1995, *D.K. Harder, D. Abbiw, J. Amponsah & A. Welsing 2972* (WAG, MO); Eastern, Atewa Range Forest Reserve, 06º16'N 00º32'W, 22 May 1974, *C.C.H. Jongkind, D.K. Abbiw, & C.M.J. Nieuwenhui 1516* (BR, MO, UPS, WAG).

Ivory Coast: Guiglo, N'guisankro (Baoulé camp) 8 km S of Zagné, then 11 km on track in direction east to forest. N of border between Forêt classé and Parc National Tai, 6º08'N 7º25'W, 05 May 1990, *P. Albers 87* (WAG); Sassandra, 4°57'0.00"N 6°4'60.00"W, 22 Aug. 1956, *J.J.F.E. de Wilde 326* (WAG); MAN Coffee Research Station, c.7°33'N 7°52'W, 24 Jan. 1984, F.*N. Hepper & J. Maley 7756* (WAG).

Liberia: Tchien District, Cess River, Aug. 1947, *J.J.T Baldwin 9021* (WAG).

Nigeria: At Ibillo (Bendel State, Auchi District), 7°26'N 6°05'E, 09 May 1978, *B.O. Daramola, M.O. Soladoye & Ihe BO387* (WAG), Osumanre East Forest Reserve, Oseakwa. By the side of Ulasi river. East-Central State, Ihiala District, c. 5°50'N 6°50'E, 04 May 1972, *J.A. Emwiogbon* & *Onyeachusim 149* (WAG); I.I.T.A , District Ibadan, 4º45'N 3º55'E, 06 Jul. 1972, *P. Wit 2232* (WAG).

Sierra Leone: s.l., 20 Oct. 1914, *N.W. Thomas 3783* (GH).

9. *Sabicea capitellata* Benth., W.J. Hooker, Fl. Niger: 398 (1849); Wernham, Monogr. *Sabicea*: 65 (1914); Hallé, Fl. du Gabon 12: 188 (1966). — Type: Equatorial Guinea. Bioko, *Vogel 88* (holo-: K).

Sabicea trichochlamys K. Schum, Bot. Jahrb 33: 338 (1903). — Type: Cameroon. Bipindi, 1896, *Zenker 1141* (holo-: P).

Sabicea talbotii Wernh., Cat. Talb. Niger (1913); Wernham, Monogr. *Sabicea*: 66 (1914). — Type: Nigeria. Oban, 1912, *Talbot 2032* (holo-: BM), **syn.nov**.

Sabicea carbunica N.Hallé, Fl. du Gabon 12: 190 (1966). — Type: Region d'Ayem, *Hallé 1999* (lecto-: P; isolecto-: WAG, **designated here**), **syn.nov.**

Ecology: This taxon occurs in mature forest along footpath, gallery, secondary and atlantic Biafran forests, roadside and it is found between 20–1300 m elevation.

Chorology and distribution: Lower and Congolia Domains: S. Nigeria, Cameroon, Equatorial Guinea, Gabon, DR Congo.

Notes: This taxon is extremely variable as regards the length of the leaf-blades, the length of peduncle, the fusion of the first order bracts, the pubescence of floral and vegetative parts.

1- Wernham (1914) separated *S. capitellata* from *S. talbotii* by the lacking of felt indumentum on the leaves and the inner side of involucral bracts bearded (vs glabrous in *S. capitellata*) Our investigation of more than 100 herbarium specimens of *Sabicea capitellata* do not show differences between both species, these patterns are variable as leaves of some specimens from N. Cameroon (Adamaoua Region) are not felted on the lower side (e.g. *Leeuwenberg 8894*). Therefore, we synonymized *S. talbotii* under *S. capitellata*.

2- This taxon resembles *S. capitellata* with morphological features, and its flowers enclosed by the capitule, however, some characters can be used to distinguish these species: the lower side of leaves glabrous except on the midrib and secondary nerves prominent, reddish to purplish on the lower side in *Sabicea carbunica*, the length of calyx lobes (3–6 x 0.5–1 mm for *S. capitellata* in vs 2–2.5 x 0.8–1 mm for *S. carbunica*).

3. Hallé (1966: 191) cited two speciemns: *Hallé 1999* and *Hallé 1942* as type. We have to choose one of these specimens as a lectotype. *Hallé 1999* is here designated as lectotype.

Representative specimens examined: **Cameroon:** Km 12 Foumban - Foumbot road, 5°43'N 10°50'E, 15 Dec. 1971, *A.J.M. Leeuwenberg 8894* (BR, MO, WAG); South, Bibondi, 03°20'15"N 10°39'37"E, 22 Jan. 2005, *B. Sonké 3727* (BR, BRLU, MO); Campo-Ma'an area, Bibabimvoto, Forest around the Bongola river, 2°15.5'N 9°52.7'E, 29 Jan. 2000, *G.P. Tchouto Mbatchou, M. Elad, C. Balogue, Mamia & Nlongbouvo 2469* (BR).

Equatorial Guinea: Bioko: Malabo - Riaba, estrada km 20, c.3°42'N 8°54'E, 17 Dec. 1986, *M.F. de Carvalho 2804* (BR); Région continentale. Réserve de Ndote Engong (Sofoge layon 10), 1º22'N 9º36'E, 12 Aug. 1998, *J. Lejoly & Elad 98/169* (BRLU); Rio Muni, Littoral, Bitica, 13 Aug. 2001, *B. Sonké 2533* (BR, BRLU).

Gabon: 11 km on the road from Asok to the hydroelectric power station in the Tchimbélé river, 0°40'N 10°23'E, 18 Aug. 1978, *F.J. Breteler & J.J.F.E. de Wilde 65* (WAG); Belinga, vers l'embarcadère, 1°05'N 13°12'E, s.d., *N. Hallé 2867* (BR); along road at Bordamur, c. 1°05'N 11°74'E, s.d, *J.T.A.G. Raymakers 130* (BR).

Nigeria: South-East State, Ikom District. Near Ajasso Village, 22 Feb. 1973, *M.G. Latilo 67667* (WAG).

RD. Congo: Mpese (Zone: Madimba), 29 Aug. 1979, *H. Breyne 3773* (BR); Bassin de la Nsele, 4°14'S 15°33'E, 15 Oct.1900, *R.P. Butaye 1459* (BR); Université Lovanium,

Léopoldville-zone annexe, 4°19'S 15°19'E, 23 Aug. 1963, *C. Evrard 6552* (BR, MO); Environs d'Eala, 0°3'N 18°19'E, 15 Aug. 1930, *J.P.A. Lebrun 1046* (BR).

10. *Sabicea cauliflora* Hiern in D.Oliver & auct. suc. (eds); F.T.A. 3: 77 (1877); Wernham, Monogr. *Sabicea*: 28 (1914). — Type: São-Tomé, *Mann s.n.* (holo-: K; isolecto-: P).

Ecpoma cauliflora (Hiern) N.Hallé, Adansonia, n.s.: 173 (1963); Hallé, Fl. du Gabon 12: 222 (1966).

Ecology: This taxon occurs in primary montane forest and it was found at about 1300 m elevation.

Chorology and distribution: Lower Guinea Domain: São-Tome and Principe.

Note: Hallé (1966: 224) cited *Sabicea cauliflora* to occur in Gabon and listed the specimen *Hallé 931* (P) which was unfortunately sterile. Robbrecht (1996: 567), considered this taxon as endemic to São-Tomé. A part the specimen *Hallé 931*, we did not find any other Gabonese specimens falling within the range of *S. cauliflora* and therefore, the citation of Hallé (1966) seems doubtful. Moreover, the presence of this species in Gabon and São-Tomé causes a curious gap which is uncommon in the genus. In this fact, we refrain to consider this species as distributed in Gabon.

11. *Sabicea cordata* Hutch. & Dalziel (1931: 106)

Distribution: Upper Guinea Domain: Ivory Coast.

Ecology: This taxon grows in gallery forest, secondary vegetation, roadside, in fringing forest.

Representative specimens examined Ivory Coast: Guiglo, Taï, 7º27'N 5º52'W, 23 Aug. 2002, *A. Bakayoko & P. Martin 160* (WAG); Louga, near Sassandra river, c. 5°03'N 6°13'W, 25 Jan. 1975, *J. de Koning 5204* (WAG); Near Gansé, in gallery forest of river Comoé, 8°37'N 3°55'W, 10 Aug. 1967, *C. Geerling & L.J. Bokdam 665* (BR, MO, WAG); Tainso, Wenchi District, 1935, *C. Vigne 3537* (MO).

12- *Sabicea deblockiana* Zemagho, Sonké & O.Lachenaud, *sp.nov.* — Type: Gabon. Ogooué-Maritime, Rabi, 0.7 km ESE of Shell-camp, 1º57.0'S 9º53.2'E, 26 Sep. 1994, *J.J. Wieringa 2790* (Holo-: BR; iso-: WAG, Figure 1).

Creeping shrub or small liana, 1–2 m high, 1–4 mm thick. Young stems covered with silky trichomes (trichomes 0.5–1 mm long, red). Internodes (2.4) 4.1–15 (16.7) cm long, 2–4 mm

thick. Stipules interpetiolar, erect (rarely reflexed), entire occasionnally echancrate at the apex, ovate, 8–10 x 4–10 mm long, glabrous on the adaxial surface, densely pubescent with appressed trichomes (≤1 mm long) on the abaxial surface, sparser trichomes on margins, apex acute to narrowly acuminate. Leaves with petioles 0.4–1.7 mm long with the same trichomes as on the stems; leaf-blades ± papery, elliptic or oblong to sub ovate, (3.4) 4.3–14.9 x (1.4) 2.2–6.7 (8.9) cm; upper surface (including secondary nerves), dark green, with sparser long straight trichomes (c. 1 mm long, appressed); midrib covered with appressed long trichomes (trichomes 1–2 mm long); lower surface (including secondary nerves) covered with buff tomentum intermingled with long straight trichomes (trichomes 1–2 mm long, brown), midrib, densely pubescent with ± erecto-patent trichomes (trichomes 1–3 mm long, brown), whitish, base obtuse to cordate, apex acuminate. 9–12 secondary nerves at each side on mid-vein, ± prominent. Inflorescence 2 per node, capitate and involucrate, c. 31 flowered, sessile to pedunculate (0–4 mm long) with the same trichomes as on the stems; involucre consisting of two pairs the bracts, not fused at the base; the outer pairs, cordate, 7–10 mm, the inner pairs, narrowly elliptic, 10 x 3 mm long, internally densely pubescent at the base with long straight trichomes, less pubescent at the apex with soft, weak trichomes (trichomes c. 1 mm long), externally glabrous except near the base, ciliate on margin; apex acute to acuminate rarely mucronate (acumen up 5 mm high). Flowers 5- numerous, 9–11 mm long, sessile to subsessile (pedicels 0–4 mm long). Calyx, green, tube campanulate, 1–3 x 0.5–1 mm, externally pilose, internally glabrous; lobes 5-(6), linear or narrowly elliptic, 3–7 x 0.2–0.5 mm, externally covered with silky trichomes, internally glabrous, cilate on margin. Corolla greenish-white, tube 8–9 x 1–2 mm externally with sparser trichomes, densely on the upper part, glabrous on the lower part, internally with soft white trichomes on the upper part extending over the throat, glabrous on the lower part; lobes 1–2 x 0.8–1 mm, internally glabrous, externally puberulent to pubescent. Stamens exserted (short styled flowers), near the corolla throat, anthers, narrowly elliptic, c. 1 mm long, brown. Ovary 2- locular. Style 5-lobed, included (short styled flowers), c. 6 mm long, base glabrous, apex with soft trichomes, white. Fruits, ovoid, 4–11 x 6–11 mm diam., pale green with some purple red lines and tiny spots when immature, purple when mature, pubescent with soft trichomes. Calyx persistent. Many small numerous seeds.

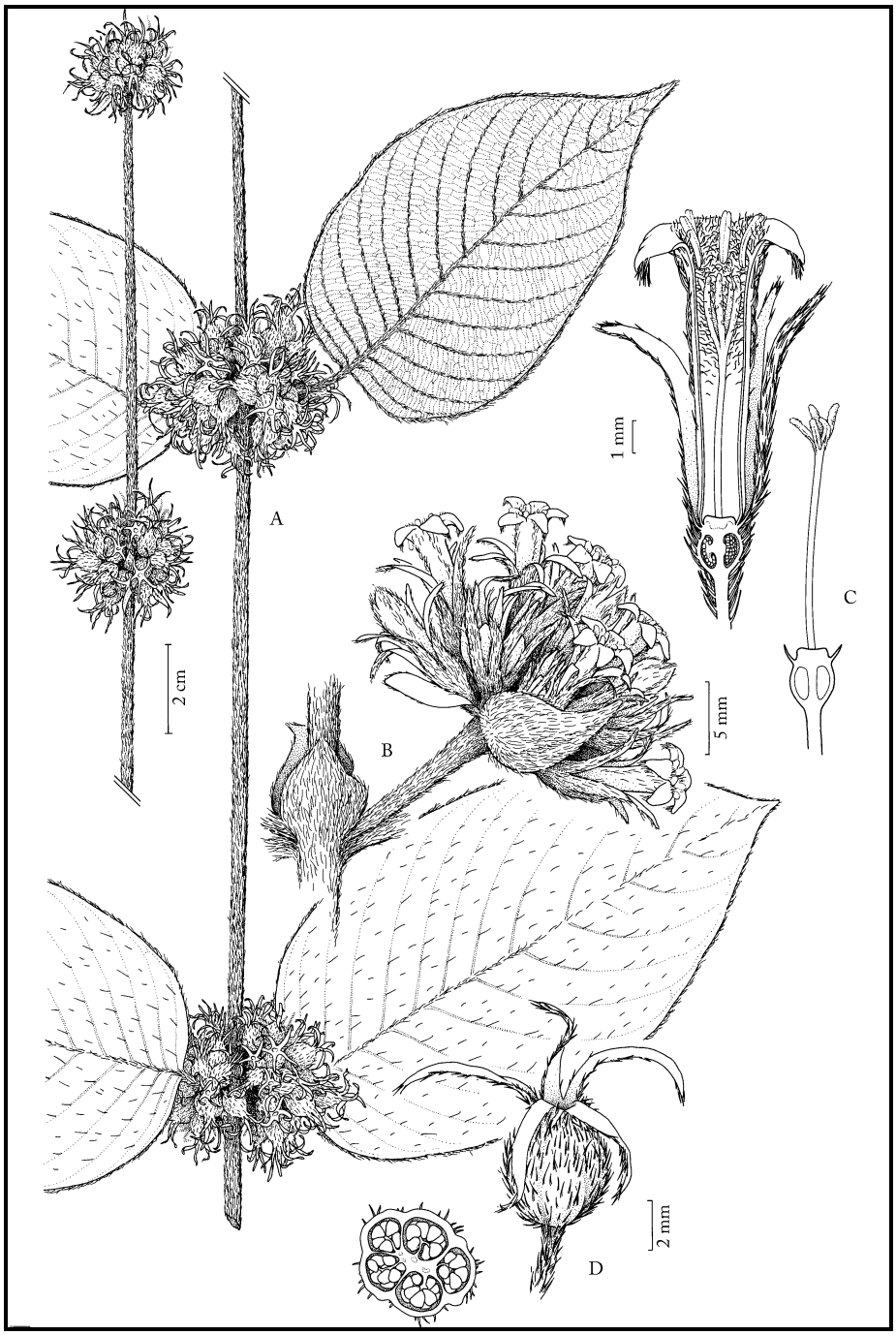

Figure 2. *Sabicea deblockiana***.** A, Fruiting twigs; B, Inflorescence; C, Style. D, Fruits. A & C from *Van Nek 127*; C & D from *J.J. Wieringa 2790*.

Etymology: The specific epithet honours Dr. Petra DeBlock, of the Botanic Garden Meise (Belgium), who is an internationally recognized taxonomist, specialist of the Tropical Africa and Madagascar and mostly of the Rubidaceae family.

Phenology: Flowering: November

Chorology and Distribution: Lower Guinea Domain: Cameroon, Gabon (Fig. 3)

Ecology: This species grows along an old sand track, secondary forest, primary forest and it was found between 40–300 m elevation.

Notes: *S. deblockiana* belongs to *S. capitellata* group with its inflorescences capitate (details comparison in Table 4).

Representative specimens examined: Cameroon: Nyong et Sanaga, Ntem - Kribi-Mbam, Mékoassi (24 km SW Ambam), 3 km N village, 21 Feb. 1963, *J. & A. Raynal 9978* (P).

Gabon: Between Mouila and Yeno, about 34 km on road from Mouila, 1°45'S 11°20'E, 08 Sep. 1986, *F.J. Breteler, R.H.M.J. Lemmens & T. Nzabi 8093* (WAG, MO); Ogooué-Maritime, Pechoud road southwards, 1º56.6'S 9º53.0'E, 27 Oct.1990, *F.I. van Nek 127* (BR, WAG)

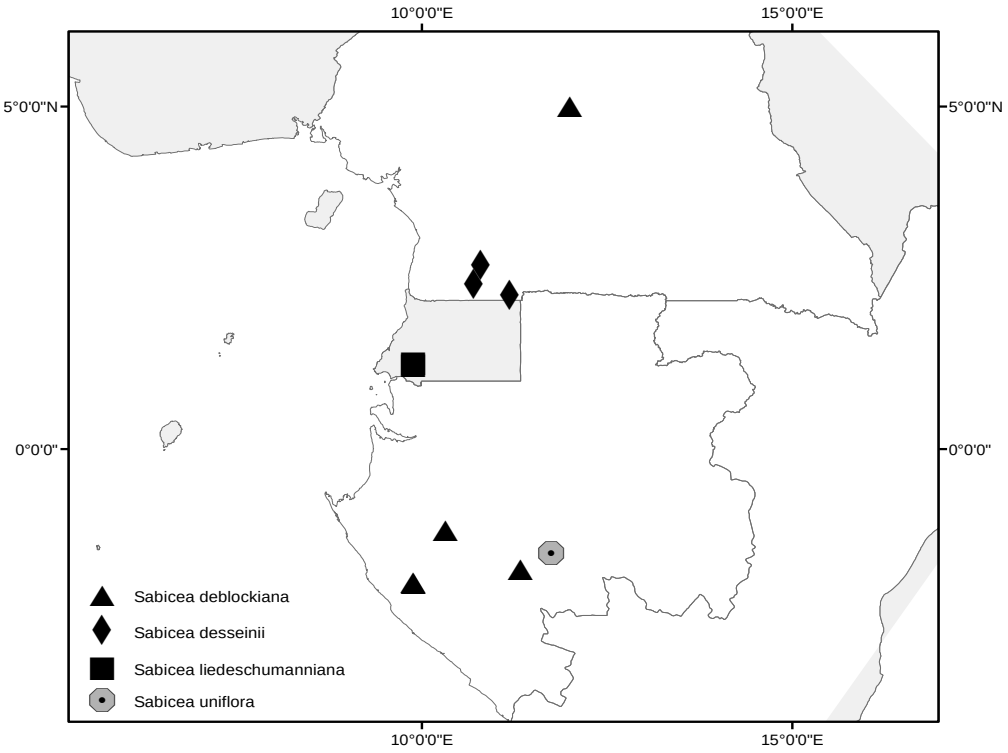

Figure 3. Distribution of *S. deblockiana, S. desseinii, S. liedeschumanniana* and *S.uniflora.*

Table 4. Distinguished characters between *S. deblockiana*, *S. liedeschumanniana* and relatives.

Characters	*S. bigerrica*	*S. capitellata* s.l	***S. deblockiana***	*S. gracilis*	***S. liedeschumanniana***	*S. jonhstonii*	*S. pedicellata*	*S. rufa*	*S. urniformis*
Stipule shape	ovate	suborbicular	ovate	ovate to cordiform	cordate to cordiform	(sub)-ovate	ovate	ovate	ovate to sub-orbicular
Stipule size(mm)	3–4.8 x 2–3.5	3–5 wide	8–10 x 4–10	4–8 x 3–6	**14 –16 x 6–10**	4–7 x 4–5	5–6 x 3–5	3–5 x 4–8	5–10 × 3–6
Leaf-blades	**green on both sides**	discolorous	discolorous	discolorous	discolorous	discolorous	discolorous	discolorous	discolorous
Secondary nerves	not prominent	not prominent	not prominent	not prominent	**prominent, 16–19 secondary nerves**	not prominent	not prominent	not prominent	not prominent
Involucre shape	hemispherical	hemispherical	hemispherical	hemispherical	**narrowly urceolate in flower, patent and star-like in fruit**	hemispherical	hemispherical	hemispherical	narrowly urceolate in flower, patent and star-like in fruit
Bracts	free from each other	free from each other	free from each other	free from each other	**shortly connate at base, splitting in fruit**	free from each other	free from each other	free from each other	shortly connate at base, splitting in fruit
Inflorescences	many-flowered	few-flowered	many-flowered	8–12flowerd	many-flowered (c. 30 flowers)	many-flowered	14–28flowered	3–9 flowered	9–14 flowered
Calyx-lobes (mm)	4–7 x 0.4–1.5	3–6 x 0.5–1	3–7 x 0.2–0.5	2–5 x 0.1-0.9	1–2 x 1	4–12 x 0.2–1	c. 2	1–1.5	3–5
Corolla-tube (mm)	7–9	7–10	8–9 x 1–2	8x1	c. 8	6–9 x 1–1.2	7–9 x 1–2	6–9	15–20
Corolla-lobes (mm)			1–2 x 0.8–1	1–1.4 x 0.2	2 x 1	1.3–2 x 0.8–1		2–1 x 0.5–1	2–3

13. *Sabicea desseinii* Zemagho, Sonké & O.Lachenaud, ***sp nov.*** − Type: **Cameroon**: Près Bidjap, piste pygmée d'Akom 11,75 km W. Ambam, 30 Nov. 1979, *R. Letouzey 15288* (holo-: BR; iso-: P, Figure 4).

Small liana, stems up to 3 m high, c. 2 mm thick. Young stems with silky trichomes (trichomes c. 2 mm long). Stipules interpetiolar, entire, erect, narrowly ovate, 5–11 x 2–6 mm, ± glabrous on the adaxial surface, silky trichomes on the abaxial surface, ciliate on the margin

(trichomes 1–2 mm long), base cordate, apex acuminate to mucronate (acumen 12–19 mm high). Leaves with petioles (5) 11–21 (25) mm long, hirsute with long straight trichomes (c. 2 mm long). Leaf-blades, elliptic to narrowly elliptic, 4.9–11.2 x 2.7–6.2 cm, upper surface, green, puberulent with short appressed trichomes (trichomes ≤0.2 mm long) sometimes sparsely pubescent; lower surface, green, pubescent to densely pubescent with long straight trichomes (trichomes 1–2 mm long); midrib and secondary nerves, white-red, sparsely pubescent. 4–10 secondary nerves at each side on the mid-vein. Inflorescence 2, on the leafless node, glomerulate and involucrate, 4–8 flowered, pedunculate, 3–5 mm long, hirsute with long straight hairs; involucre consisting of two pairs of bracts; bracts free, red, the outer pairs, sub-cordate, 7–9 x 4–9 mm, base cordate, apex acuminate, the inner pairs, broadly elliptic, 7 x 4 mm, externally with long appressed trichomes (trichomes 1–3 mm long), internally pubescent, ciliate on margin. Calyx red, tube, 4–5 mm long, externally with silky trichomes, internally glabrous; lobes linear, 8–20 x 0.2–1 mm, silky trichomes on both surfaces. Corolla white, tube, c. 22–23 x 1–2 mm long, externally pubescent to ± glabrous, lobes, triangular, 2–4 x 1–2 mm, externally with long appressed trichomes extending over the margin, internally with buff tomentum, corolla throat glabrous. Stamens included (long styled flower) in the middle of the corolla throat. Ovary 5-locular, style 5 lobed, mi-exserted, c. 27 mm long, base glabrous, apex with buff indumentum. Fruits (sub) ovoid , 7–8 x 15–16 mm diam. when dry, red, topped with persistent calyx. Small numerous seeds.

Note: 1. The leaves are slightly anisophyllous in *Parmentier 1758.*

2. Details comparison in Table 5

Etymology: This species is named after Dr. Steven Dessein, who made a major contribution to the knowledge of African Rubiaceae and for the facilies offers by the Botanic Garden Meise to carry out the *Sabicea* projet.

Chorology and distribution: Lower Guinea Domain: endemic to Cameroon (Fig. 3).

Ecology: This taxon grows in secondary bushes, secondary forest and it is found at 532 m elevation.

Representative specimens examined:**Cameroon.** Mékomengona (17 km SW Ambam), au N du village, 20 Feb. 1963, *J. & A. Raynal 9859* (P), South province: Bindem: 3 Km NE de Bindem, 2º41'26.90"N 10º 47'31.49"E, 21 Jul. 2008, *B. Sonké 5004* (BR).

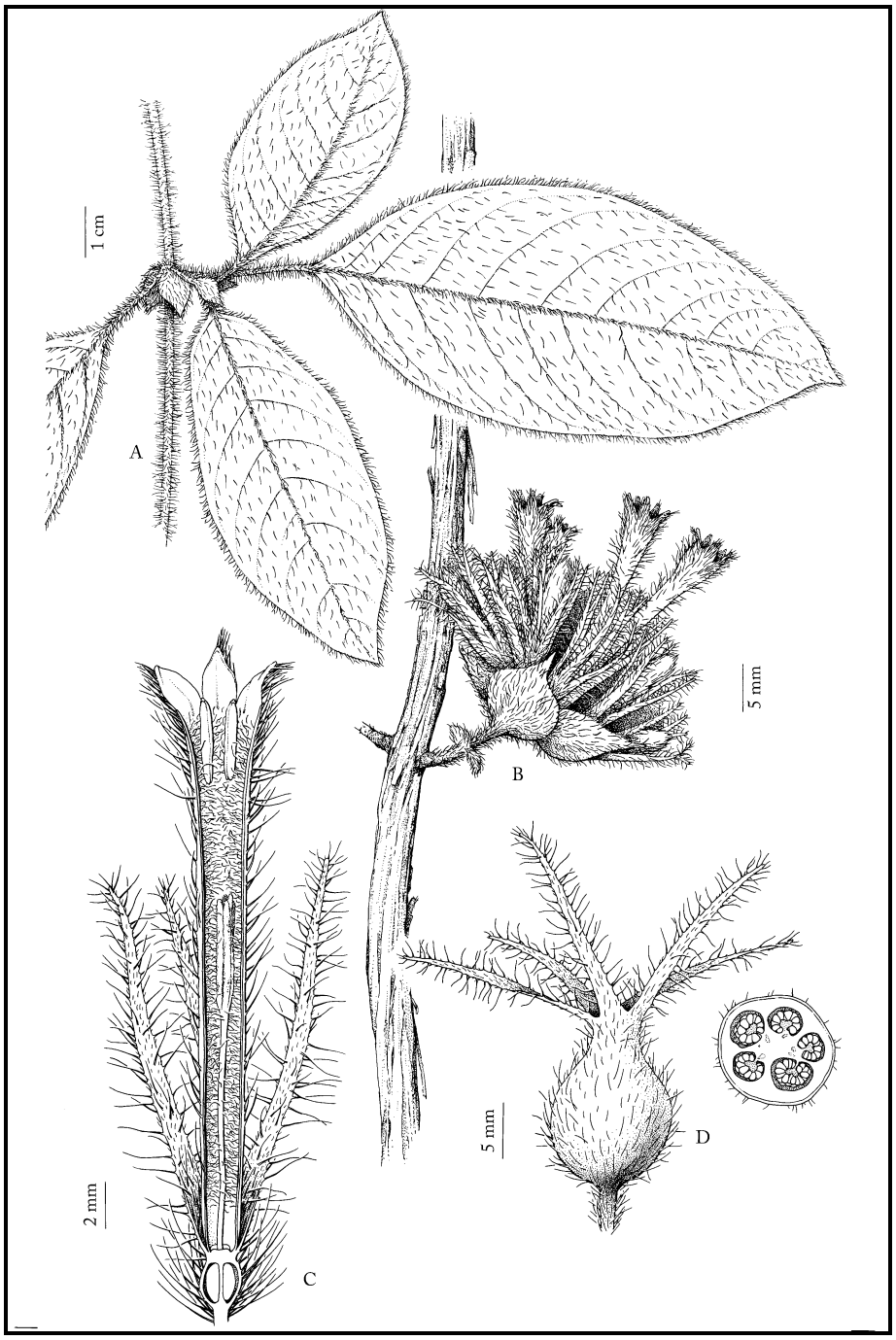

Figure 4. *Sabicea desseinii*: A, Habit ; B, Flowering stem; C, Section of short-styled flower; D; Fruits. From *R. Letouzey 15288.*

Table 5. Distinguished characters between *S. desseinii, S. multibracteata, S. pilosa, S. speciosa.*

Characters	***S. desseinii***	*S. multibracteata*	*S. pilosa*	*S. speciosa*
Stipule size	narrowly ovate, 5–11 x 2–6 mm		ovate to subtriangular, 4–6 x 6–9 mm	ovate to cordiform, 9–16 x 7–13 mm
Bract color	red	white tinged pink	green	red
Bracts	Two pairs free bracts, the outer most , sub cordate,7–9 x 4–9 mm	10–15 involucral bracts free from each other; the outermost pair narrower than the rest,10–15 x 4–10 mm	two pairs, the outermost shortly connate, (sub-) ovate 12–16 x 4–9 mm	Two small bracts, cordate to cordiform c. 2 x 2 mm
Inflorescence	pedunculate, 3-5 mm long	pedunculate, c. 8 mm long	pedunculate, 5-28 mm	**sessile**
Calyx tube	**2–4 mm**	c. 2 mm	6–8 mm	5–8 mm
Calyx lobes (mm)	8–20 x 0.2–1	**14–18x 1–1.5**	13–15 x 3–4	7–17 x 0.2–5
Corolla color	red	**white**	red	red
Corolla tube	**22–23 x 1–2 mm**	20–22 x 1–2 mm	24–28 x 2–3 mm	21–28 x 2–3 mm
Corolla-lobes (mm)	2–4 x 1–2	c. 4	1–4	3–5
Distribution	endemic to Cameroon	Liberia and Ghana	Cameroon, Equatorial Guinea, Gabon	Cameroon, Ghana, Nigeria, DR Congo

14. *Sabicea dewevrei* De Wild & T.Durand, Ann. Mus. Congo Belge, Bot., III, 1: 112 (1901); Wernham, Monogr. *Sabicea*: 71 (1914); Hallé, Fl. du Gabon 12: 185 (1966); D.Bridson & B.Verdcourt, Fl. Trop. East. Africa, Rubiaceae (part 2) 473: (1988) —Type: DR Congo "Zaire", orientale, Waboundou [Wabundu, Ponthierville], *Dewevre 1143* (holo-: BR).

Sabicea dewevrei var. *latifolia* De Wild., Muss. Em. Laurent 1: 276 (1906). — Type: DR Congo. Isangi. Ifuta. *E. & M. Laurent s.n.* (holo-: BR).

Sabicea dewevrei var. *glabra* Wernh., Monogr. *Sabicea*: 42 (1914). — Type: DR Congo. Irumu. *Mildbraed 2823* (Hb. Berol.).

Sabicea gigantea Wernh., Monogr. *Sabicea*: 71 (1914). — Type: Congo. *Sapin s.n.* (holo-: BR), **syn. nov.**

Distribution: Lower and Congolia Domains: Congo (Brazzaville), Gabon, DR Congo, Uganda.

Ecology: This species grows in the primary and secondary forests, open and swamp areas, savannahs, forested rive bank and it is found between 365–1460 m elevation.

Notes: 1. This taxon resembles *S. najatrix* with its large bracts surrounding almost the whole inflorescence, the calyx up to the corolla tube. The differences between these species are: the peduncle length (8–52 mm in *S. dewevrei* vs 6–15 mm in *S. najatrix*), the pubescence of outer surface of the stipules (glabrous in *S. dewevrei* vs long appressed trichomes somewhat ± clinate, densely pubescent near the base with the base with the same trichomes in *S. najatrix*), pubescence of ovary and calyces (glabrous in *S. dewevrei* vs ciliate in *S. najatrix*).

2. In the protologue, Wernham separated *S. dewevrei* from *S. gigantea* based on the growth form, the almost glabroussness of *S. gigantea*. *S. dewevrei* is variable in pubescence and its indumentum falls in the same range of *S. gigantea* which is poorly collected. During our investigations, we did not find other morphological characters to separate both species . Therefore, we synonymized *S. gigantea* under *S. dewevrei*.

3. Wernham (1914) described *Sabicea gigantea* as "grand arbre des forêts" which is probably an error as most *Sabicea* species are lianas with few shrubs and erects.

Representative specimens examined: **Congo (Brazzaville):** Niari; Mayombe au col de Bamba, 08 Dec. 1990, *F. Dowsett-Lemaire 1393* (BR); Col de Bamba, (Mayombe), 08 Dec. 1990, *I.F. La Croix 5034* (MO). **Gabon**: Mouyanama falls, at base of mount Songou, 1º38'58.3"S 11º45'19.7"E, 22 Feb. 2008, *S. Dessein, O. Lachenaud, S. Janssens, Y. Issembe & T. Nzabi 2059* (BR); Moumba Côté Ouest, c.1°15'S 11°35'E, 19 May 1963, *N. Hallé 6071* (WAG). **RD-Congo**: Km 3 ancienne route Buta (Haut-Zaïre), 0°31'45'N 25°12'E, 28 Jun. 1987, *A.K. Apema 139* (BR); Orientale, Ituri, Lodjo, near AGK mining camp, 2º03.12'N 30º00.22'E, 25 Jan. 2011, *B. Bytebier 3349* (BR); Rivière Mwanzangoma (territoire Dibaya), 5°49'S 22°41'E, 09 Jan. 1957, *L. Liben 2234* (BR).

15. *Sabicea dinklagei* K.Schum.,Bot. Jahrb. Sysr. 23: 428 (1896); Wernham, Monogr. *Sabicea*: 170 (1914); Hallé, Fl. du Gabon 12: 169: (1966); D.Bridson & B.Verdcourt,Fl. East Trop. Africa, Rubiaceae (part 2): 472 (1988). — Type: Cameroon, Greet Batanga, *Dinklage 1124* (B†).

Sabicea laurentii De Wild., Miss Laur.1: 276 (1906); Wernham, Monogr. *Sabicea* 70 (1914). — Type: RD-Congo. Eala, 26 May 1905, *Laurent 902* (holo-: BR).

Sabicea homblei De Wild., Bull. Bot. Etat Bruxelles 5: 32 (1915). — Type: DR Congo. Plateau de la Manika (environs de Katentania), 15 Nov. 1912, *Homblé 804* (holo- : BR).

Sabicea laurentii var. *angustifolia* De Wild. in Pl. Bequaert 2: 233 (1923). — Type: DR Congo. Walikale - Lubutu, 15 Jan. 1915, *Bequaert 6626* (holo-: BR).

Sabicea caminata N.Hallé, Fl. du Gabon 12: 172 (1966). — Type: Gabon. Makokou, 06 Feb. 1961, *Hallé 1101* (holo-: P; iso-: BR,), **syn. nov.**

Chorology and distribution: Widespread in Continental Africa: Angola, Cameroon, Republic of Congo; Equatorial Guinea, Gabon, Malawi, RD-Congo, Uganda, Zambia

Ecology: This taxon grows in the wide range of habitats such as primary and secondary forests, savannahs.

Note: When describing *S. caminata*, Hallé (1966: 172) used the peduncle length, the fusion of first order bracts as well as the size of calyx tube to distinguish it from *S. dinklagei*. This latter possesses the first order bracts fused at the base, not connate and not naviculate at the apex while *S. caminata* possesses the first order bracts fused at base, connate and naviculate. An examination of more than 150 herbarium specimens did not allow us to correctly segregate these two species as the peduncle lenght is variable is both species as well as the fusion of the first order bracts and this is more accurate in infrutescence when the fruits split the fused bracts. Moreover, many transitional features exist on both species mainly concerning the fusion of first order bracts. In this fact, it is difficult to clearly distinguish these species. Therefore, we synonymized *S. caminata* under *S. dinklagei*.

Representative specimens examined: **Angola**: Distrito Bié, 12°34'19.06"S 17°40'7.99"E, 02 Oct. 1965, *R. Monteiro E Murta 1788* (BR).

Cameroon: Bitye, 3°01'N 12°21'E, 1916, *G.L. Bates 1133* (MO, NY); S bank of Lobé river, SE of Grand Batanga ferry, 2°52'N 9°54'E, 11 Oct. 1969, *J.J. Bos 5470* (BR, MO, WAG); Station du Cacaoyer de N'koemvone - about 14 km on the road from Ebolowa to Ambam, 2°49'N 11°08'E, 28 Nov. 1974, *J.J.F.E. de Wilde 7758* (BR, MO, WAG).

Republic of Congo: Massif du Chaillu, route Komono-Mossendjo, km 59, près du village Kibouma, 08 Jan. 1989, *S. Lisowski B-5342* (BR).

DR Congo: Eala, 0°3'N 18°19'E, 07 Apr. 1932, *A.C. Baland 1419* (BR); Kasayi, Muetshi, 4°41'S 22°39'E, 15 Nov. 1982, *P. Casier 439* (BR); Plateau de la Manika (environs de Katentania), 9°30'S 25°30'E, 12 Nov. 1912, *Homblé 804* (BR).

Equatorial Guinea: Région continentale, Pradera de Baga, 1º19'N 9º33'E, 19 Jun. 1999, *F. Eneme 360* (BR, WAG); Parc National de Monte Alen, transect de Monte Alen, 1º39'N 10º18'E, 04 Oct. 1994, *J. Lejoly 94/161*(BRLU); Parc National de Monte Alen, 5 km au NO d'Engong, 1º37'N 10º18'E, 03 Jan. 1999, *J. Lejoly 99/112* (BRLU).

Gabon: About 43 km E of Mouila, along road under construction, leading to Yeno, 1°40'S 11°20'E, 02 Dec. 1984, *J.C. Arends, A.M. Louis & J.J.F.E. de Wilde 582* (BR, WAG); Near Sablière, ca. 4 km N of Libreville, 0°31'N 9°22'E, 16 Apr. 1985, *J.M. & B. Reitsma 793* (WAG); Rabi-3, near WSW 3, 1°56.6'S 9°52.5'E, 13 Dec. 1990, *F.I. van Nek 499A* (WAG).

Malawi: North Province, Mzimba District, Mzuzu, road to Lunyangwa river waterworks, by streamlet, 23 Jan. 1973, *J. Pawek 6409* (MO); Mzuzu, Lunyangwa waterworks, 25 Mar. 1973, *J. Pawek 6510* (UPS, MO); Northern region, Mufinga hills, above Chisenga, 20 Oct. 1986, *F. Dowsett-Lemaire 377* (BR).

Zambia: District Samfya, 11°21'43.28"S 29°33'4.93"E, 30 Sep.1953, *D.B. Fanshawe 322* (BR); Central Kanona district, Kundalila falls picnic area, 13 km S of Serenje-Mpika highway, 13º09'16"S 30º42'07"E, 22 Nov. 1993, *D.K. Harder, M.C. Merello & C. Nkhoma 2097* (MO, WAG); Track to old Boma gardens, Abercorn, 07 Feb. 1955, H.M. Richards 4355 (BR); Chisali district, Shiwa Ngandu, Below Rest House, 19 Jan. 1959, 11°19'44.07"S, 31°46'53.05"E, *H.M. Richards 10755* (BR).

16. *Sabicea discolor* Stapf., J. Linn. Soc., Bot. 37: 105 (1905); Wernham, Monogr. of *Sabicea*: 34 (1914); D.Bridson & B.Verdcourt, Fl. Trop. East Africa, Rubiaceae (part 2): 470: (1988). — Type: Tanzania, Uluguru Mts., *Goetze 209* (lecto-: K).

Sabicea discolor var. *laxothyrsa* Wernham in Monogr. of *Sabicea*: 35 (1914).

Ecology: This taxon grows in montane forest, along road in secondary forest, patch of disturbed forest in agricultural area, forest edge, secondary vegetation and it is found between 20–1000 m elevation.

Chorology and distribution: Upper Guinea Domain: Ghana, Guinea, Ivory Coast, Liberia, Sierra Leone.

Representative specimens examined. Ghana: Western Region, Ankasa River Forest Reserve, c. 5°17'N 2°35'W, 28 Jun. 1966, *A.A. Enti 35577* (WAG); About 8 miles from Princess Town, 4°54'N 2°05'W, 28 Mar. 1954, *J.K. Morton 344* (WAG); Akwapim, 6°15'N 0°15'W, Mar. 1900, *C.W. Murphy 679* (WAG); s.l., 6°41'N 1°37'W, 2 May 1956, *L. Piening 2356* (BR).

Guinea: Macenta, Sérédou, c. 8°23'N 9°17'W, 25 March 1949, *J.G. Adam 4042* (MO, WAG); West of the Nimba mountain, 7°42.86'N 8°25.89'W, 07 July 2012, *C.C.H. Jongkind 11416* (WAG); near Yomou, Plot CU9, 7°40'N 9°14'W, 16 February 2012, *E.L.A.N. Simons, C.C.H. Jongkind, C.H. Bosch, D.M. Mulbah, D Bilivogui & J.B. Balamou 877* (BR, WAG).

Ivory Coast: Forêt du Yapo, 16 km NW of Azaguié-Ahoua, 5º43'N 4º06'W, 21 May 1975, *H.J. Beentje 295* (BR, WAG); along the road starting 40 km from San Pedro to Grand Béréby, c. 4°41'N 6°57'W, 23 March 1970, *J. de Koning 256* (BR, WAG); .C Scio, Pinhou, Lobykro à 5km, bloc 28 parcelle 141 de la Sodefor. sur hectare, 6°50'N 7°42'W, 24 Aug. 2001, *L. Nusbaumer, L. Gautier, A. Bakayoko, P. Martin & D. Kouamé LN576* (MO, WAG).

Liberia: Nimba, 7°32'N 8°32'W, 5 Feb. 1965, *J.G. Adam 20859* (MO, UPS, WAG); Gola National Forest, NE of Bomi hills, 6°55'58.00"N, 10°45'44.00"W, 28 Apr. 1966, *J.J. Bos 1930* (BR, WAG); Grand Bassam, c. 5°53'N 10°03'W, 02 May 1898, *M.J. Dinklage 1903* (WAG).

Sierra Leone: Njala, c. 8°07'N 12°05'W, 27 Sep.1926, *F.C. Deighton 2125* (WAG); Mayaso, c. 8°57'N 11°50'W, 6 Aug. 1914, *N.W. Thomas 1381* (WAG); Yonibana, c. 8°26'N 12°14'W, 11 Nov. 1914, *N.W. Thomas 5240* (WAG).

17. *Sabicea duparquetiana* Baill. ex Wernham, Monogr. *Sabicea*: 69 (1914); Hallé, Fl. du Gabon 12: 173 (1966). — Type: Gabon, *Duparquet s.n.* (holo-: P).

Sabicea robbii Wernham, Monogr. *Sabicea*: 69 (1914); Hallé, Fl. du Gabon 12, Rubiaceae 1: 173 (1966). — Type: Nigeria. Old Calabar, *Robb s.n*. (holo-: BM).

Sabicea duparquetiana var. *impexalla* N.Hallé Hallé in Fl. du Gabon 12: 177 (1966)—Type: Gabon. Tchombié, Dec. 1922, *Pobéguin 152* (holo-: P; iso-: WAG).

Ecology: This taxon grows in rainforest, exploited forest, along the track in secondary forest and it was found between 59–600 m elevation.

Chorology and distribution: Lower Guinea Domain: Equatorial Guinea, Gabon, Nigeria.

Note: 1. In the World Check-list of Rubiceae (Govaerts et al., 2012), *S. duparquetiana* var. *robbianella* is uncorrectly placed under synonymy of *S. duparquetiana* var. *duparquetiana*. An examination of herbarium material led to recognise the var. *robbianella* as distinct from var. *duparquetiana* by having the first order bracts strongly naviculate at the apex, the nervation on the lower side of the leaves is not prominent and the stems and petioles are slender.

2. *S. trigemina* is known from only a type and single collection *Zenker 1821* (P) from Cameroon, our study of this type and comparison with specimens of *S. duparquetiana* and those of *S. dinklagei* show that these species is intermediate between *S. duparquetiana* and *S. dinklagei* by having robust stems and the first order bracts not naviculate at the apex but the diagnosing characters lack to consider it at the specific rank but it should perhaps been treated as a variety of *S. duparquetiana.* Other collections of this species may help to clarify its position.

17a. *Sabicea duparquetiana var. duparquetiana* Monogr. *Sabicea*: 69 (1914).

Ecology: This species grows in high exploited forest, forested roadside, along the track in primary and secondary forest and it was found between 59–600 m elevation.

Chorology and distribution: Lower Guinea Domain: Nigeria, Equatorial Guinea, Gabon

Representative specimens examined: **Equatorial Guinea:** 4 km N de Mitong, 01 13'N 09 53'E, 12 Dec. 2003, *B. Sonké 3141* (BR, BRLU, MO); 8 km N de Mitong, 01 14'N 09 57'E, *B. Sonké 3158* (BR, BRLU, MO).

Gabon: Rabi, ± 1°55'S. 9°50'E, 26 Mar. 1990, *F.J. Breteler, C.C.H. Jongkind, J.J. Wieringa, Moussavou 9522* (WAG); c.10 km NNW of Ndjolé, on BSO forestry road, 0º05'16.2"S 10º44'43.5"E, 26 Feb. 2008, *S. Dessein, O. Lachenaud, S. Janssens, Y. Issembe* & *T. Nzabi 2152* (BR); Along road, ca. 4 km N of Libreville, 0°31'N 9°25'E, 13 Mar. 1985, *J.M.* & *B. Reitsma 648* (MO, NY, WAG).

17b- *Sabicea duparquetiana var. robbianella* N.Hallé,Fl. du Gabon 12, Rubiaceae 1: 176 (1966). — Type: Gabon. Dabilila, région de Tchibanga, *Le Testu 1457* (holo-: P).

Ecology: This taxon grows in secondary forest edge, sunny forest edge along track, forested roadside, secondary regrowth and it is found between 40–400 m elevation.

Chorology and distribution: Lower Guinea Domain: endemic to Gabon.

Representative specimens examined: Gabon: Nyanga, plus de 41 km de Tchibanga, 3º04.6'S 10º44.1'E, 21 Oct. 2009, *P. Bissiengou 415* (WAG); Doudou mountains, about 55 km along exploitation track in a WNW direction from Doussala, 2°13'S 10°13'E, 17 Nov. 1986, *J.J. de Wilde, J.C. Arends & J. de Bruijn 9003* (BR, WAG); Ogooué-Maritime, Rabi, 4½ km on road to Divangui, 1º54.1'S 9º54.5'E, 04 Mar. 1994, *J.J. Wieringa 2388* (WAG).

17c. *Sabicea duparquetiana var. trigemina* Zemagho, Sonké & O.Lachenaud ***var. nov***. — Type: Cameroon**:** Bipindi, 1898, *G.A. Zenker 1821* (holo-: BM; iso-: HBG, P, WAG).

Sabicea trigemina in Bot. Jahrb. Syst. 48: 408 (1912).

Ecology: Forest

Chorology and distribution: Lower Guinea Domain: endemic to S.Cameroon.

Note: This taxon is only known from the type species.

18. *Sabicea elliptica* (Schweinf. ex Hiern) Hepper, Kew Bull 13: 292 (1958)—Type: Sudan Republic. Niamniam-land, *Schweinfurth 3721* (lecto-: K).

Stipularia elliptica Schweinf. ex Hiern in Fl. Trop. Afr. 3: 80 (1877).

Sabicea lanata Hepper in Kew Bull 13: 293 (1958). — T ype: DR Congo: Boyeka, *Nanna 62* (K syn), **syn. nov.**

Stipularia mollis Wernham in Journ. Bot. 56: 310 (1918).

Ecology: This taxon grows in shallow water by forested riverbank, mature forest, secondary forest mostly around river or swamp areas and it was found between 330–350 m elevation.

Chorology and distribution: Guineo-Congolia and Guineo-Congolia/Sudania (transitional) Regions: Cameroon, Central African Republic, Republic of Congo , Nigeria, DR Congo, Sudan.

Note: When we were studying the specimens from MO, we came to the same conclusion with Hepper (1958) that the status of *S. lanata* is doubtful and therefore, we placed it as synonymy under *S. elliptica.*

Representative specimens examined: **Cameroon:** Eastern province, west bank of the Sangha river, from old village site to opposite Ndakan, 02º21'N 16º08'E, 16 Apr. 1988, *J. David, J. Harris & J.M. Fay 520* (BR, GH, MO, WAG); Rive de la Kadei entre Mindorou et Dongongo (40 km SSE de Batouri), c.4°07'N 14°38'E, 25 Apr. 1962, *R. Letouzey 4875* (BR); Rive du Dja près Ndongo, à 40 km WNW de Moloundou, 18 Mar. 1973, *R. Letouzey 12147* (BR).

Central African Republic: Dzanga-Sangha Reserve. Kenié stream, 40 km South Lidjombo, 2°21'N 16°09'E, 10 Sep. 1988, *D. J. Harris & J. M. Fay* 1096 (MO); Près rivière Kudu, 6 km N Moroubas, dans la circonscription de la Waka, c.6°11'N 20°13'E, 30 Jun.1923, *C. Tisserant 1151* (BR).

Republic of Congo: Moba, Louamé saline, Parc National d'Odzala, 00º48.50'N 15º03.56'E, 19 Dec. 1995, *F. Maesels FM35* (BR).

Nigeria: Aboh Forest Reserve, 16 Aug. 1978, Ekwuno, Fagbemi, Csanyinlusi PFO 242 (MO); Osumanre East Forest Reserve, Oseakwa. By the edge of Ulasa river, Oseakwa. East-Central State, Ihiala District, c. 5°50'N 6°50'E, 6 May 1972, *J.A. Emwiogbon 190* (WAG).

DR Congo: Village Batiabongena: Haut-Zaïre le long de la rivière Tshopo à Masako, Berge gauche. Km 14 ancienne route Buta, 0°35'45"N 25°15'45"E, 03 Mar. 1987, *A.K. Apema 244* (BR); Rives Makusa, 4°22'N 27°56'E, 24 Jun. 1937, *P.A.M. De Graer 844* (BR, MO); Lukolela, 1°3'30"S 17°11'00"E, 11 Jul. 1906, *L. Pynaert 245* (BR).

19. *Sabicea ferruginea* (G.Don) Benth in W.J. Hooker, Fl. Niger: 397 (1849); Wernham in Monogr. *Sabicea*: 60 (1914). — Type: Sierra Leone. Southern Province, Bonthe. Bagru River, 1861, *Mann 862* (holo-: K; iso-: P, WAG).

Cepahelis ferruginea G.Don in Gen. Syst 3: 605 (1834).

Sabicea lasiocalyx Stapf. in J. Linn. Soc., Bot. 37: 106 (1896). — Type: Liberia. Sinoe Basin. Monrovia, Kakatown, April 1914, *Whyte s.n.* (holo-: K; iso- WAG).

Sabicea ferruginea var. *lasiocalyx* (Stapf.) Wernham, Monogr. *Sabicea*: 60 (1914).

Ecology: This taxon grows in primary or disturbed primary rain forest, secondary vegetation and it was found between 20–1100 m elevation.

Chorology and distribution: Upper Guinea Domain: Ghana, Guinea, Ivory Coast, Liberia, Sierra Leone.

Notes: The peduncle length of this species is variable according to the geographic distribution. The specimens form Ghana have inflorescences sessile while the others from Liberia have inflorescences pedunculate.

Representative specimens examined: **Ghana**: 25 km N of Cape Coast. Central Region, Cape Coast, Mfoum, c. 5°22' N 1°25'W, 18 Nov. 1967, *J.B. Hall 37143* (WAG); Eastern Region, Kibi, Atewa Range Forest Reserve, c. 6°10'N 0°33'W, 25 Nov. 1971, *J.B. Hall 43245* (WAG); Western Region, Daboase, Subri River Forest Reserve, c. 5°19'N 1°45'W, 2 Jan. 1975, *J.B. Hall 45120* (WAG).

Guinea: Koloumba, Mts Mimba, 25 Jul. 1949, *J.G. Adam 5781* (MO); Nzérékoré, Nimba mountains, plot PERS25, near upper pumping station on road up mountain from camp, 7º40.60'N 8º22.48'W, 13 Jul. 2008, *Nimba Botanic Team PD1337* (WAG).

Ivory Coast: Forêt classée de Soubré, Plantation Sodepalm, 5º40'N 6º20'W, 20 Feb. 1969, *P.R.J. Bamps* 2081 (BR, WAG); Forêt de Téké, c. 5°38'N 4°02'W, 28 Sep. 1956, J.J.F.E. de Wilde 564 (WAG); c. 19 km SW of Kpata-Abidou, c. 5°05'N 5°50'W, 09 May 1975, *W.J. van der Burg 233* (WAG).

Liberia: Western Province, Vonjama District, Zigida, 8°02'N 9°29'W, 25 Oct. 1947, *J.J.T Baldwin 9988* (MO, WAG); Grand Cape mount, north of lake Piso, 6º48.20'N 11º17.30'W, 22 Jul. 2004, *C.C.H. Jongkind 6059* (BR, WAG); Putu hills, east range, 5º38.5'N 8º10.6'W, 25 Jan. 2010, *C.C.H. Jongkind 9243* (BR, WAG).

20. *Sabicea floribunda* K.Schum. in Bot. Jahrb. Syst. 23 : 428. (1897); Wernham in Monogr. *Sabicea*: 72 (1914). — Type: Cameroon, Lolodorf, *Staudt 1* (holo-: P).

Pseudosabicea floribunda (K.Schum.) N.Hallé in Adansonia, n.s., 3: 172 (1963); in Fl. du Gabon 12: 214 (1966).

Sabicea floribunda var. *paucinervis* Wernham in Monogr. *Sabicea*: 73 (1914). — Type: Kamerun, Gross-Batanga, 2°51'N 9°53'E, 24 October 1891, M.J. Dinklage 1391 (WAG).

Ecology: This taxon grows in old secondary forest edge, coastal forest, swamp areas, roadside and it found between 10–1250 m elevation.

Chorology and distribution: Lower Guinea and Congolia Domains. S. Nigeria, Cameroon, Congo (Brazzaville), Equatorial Guinea, Gabon, DR Congo.

Representative specimens examined: **Cameroon:** 45 km on the road from Kribi to Campo, 2°35'N 9°50'E, 03 Dec. 1974, *J.J.F.E. de Wilde 7784A* (BR, WAG); Nkamouna, 03 16'06''N 13 50'55''E, 11 Jun. 2004, *B. Sonké 3481* (BR, BRLU, MO); 2.7 from Lolabé village, 2°41'N 9°51'E, 4 Aug. 2001, *T.R. van Andel 3827* (WAG).

Republic of Congo : s.l, Oct. 1952, *R.G.A. Germain 8116* (WAG); Sangha, West slope of Mt. Nabema, c. 1°51'N 13°58'E, 15 Nov.1991, *D.W. Thomas 8892* (MO, WAG).

Equatorial Guinea: Littoral, route d'exploitation chantier Semge vers le premier pont sur Mitemelé, Côté route, 01°05'N 010°10'E, 13 Jul. 1988, *J.J. Dibata 451* (BR); Région continentale, Route de Nco vers Misobong au niveau de la grande cascade, 09 Jan. 1998, *Nguema & J. Lejoly 206* (BRLU); 8 km N de Mitong, 01°14'N 09°57'E, 13 Dec. 2003, *B. Sonké 3157* (BR, BRLU, MO).

Gabon: Province Estuaire: forêt de Mondah on road Libreville - Cap Esterias, ca. 0º33'N 9º22'E, 26 Feb.1999, *L. Andersson & A. Nilsson 2577* (BR); Parc National de Waka. Près du Camp Oghoubi, au Nord-E, 1°04'S 11°11'E, 24 Jun. 2006, J. *Mayombo, B. Nziengui, E.M. Mamadou & J. Boussengui-Nongo 1559* (MO, WAG); Crystal Mountains, Tchimbélé. 0.5 km S of dam, 0°37'N 10°24'E, 19 Mar. 1990, *J.J. Wieringa 720* (WAG).

DR Congo: Orientale, Ituri, Lodjo, near AGK mining camp, 2º03.23'N 29º59.85'E, *B. Bytebier 3343* (BR); Kimuenza, 4°28'S 15°17'E, 15 Oct. 1900, *J. Gillet 1749* (BR); Yangambi, 0°46'N 24°27'E, 03 Jul. 1958, *A. Leonard 759* (BR).

21. *Sabicea fulva* Wernham, Monogr. *Sabicea* 66: (1914); Hallé in Fl. du Gabon 12, Rubiaceae 1: 177 (1966). — Type: S. Cameroon. Lomie; 26 May 1911, *Mildbraed 5424* (holo-: HBG; iso-: P).

Ecology: This taxon grows in forest near river, bushes, in primary forest with a few steams, along forest-exploited track, a secondary regrowth and it was found between 250–1000 m elevation.

Chorology and distribution: Lower Guinea Domain: Cameroon, Central African Republic, Republic of Congo, Equatorial Guinea, Gabon, Nigeria.

Note: This taxon is newly reported from Congo (Brazzaville) and Equatorial Guinea.

Representative specimens examined: **Republic of Congo**: Route de Makala avant Kuilila, 16 Nov. 1978, *G. Cusset 592* (P); Sounda (Pointe-Noire), 22 Jan. 1966, *C. Farro. 4849* (P); Au km 20 de la route de Sounda, ancien chantier forestier Siko (Pointe-Noire), 08 Feb. 1966, *C. Farron 5011* (P).

Equatorial Guinea: Région continentale, Ngong Mocomo, vers inselberg Acoak Banga, 1º4'N 11º11'E, 08 Aug. 1998, *J. Lejoly & Elad 98/15* (BRLU); Région continentale, Réserve de Ndote Engong (Sofoge layon 10), *J. Lejoly & Elad 98/168* (BRLU); Región continental, Monte Alén, 31 Aug. 1998, *Ngomo & Ndong 492* (BRLU).

Gabon: Foot of Doudou Mountains, 25-35 km W of Mandji, 1º44'42.0"S 10º12'9.2"E, 15 Feb. 2008, *S. Dessein, O. Lachenaud, S. Janssens, Y. Issembe & T. Nzabi 1864* (BR); Makandé, débardage Héron, Forêt près de la station, 0º41'S 11º54'E, 20 Nov. 1993, *M.M. Dhetchuvi 1371* (BRLU); About 40 km SW of Ndendé, 2°36'S 11°13'E, 02 Dec. 1983, *A.M. Louis, F.J. Breteler & J. de Bruijn 1091* (BR, MO, P, WAG).

Nigeria: Soki-Ikom Forest Reserve, High forest, by the roadside between Boki and Ikom, 04 October 1977, *J.A. Emwiogbon & Osanyinlusi s.n.* (MO).

21a. *Sabicea fulva* var. *clipeolaria* N.Hallé, Fl. du Gabon 12: 180 (1966). — Type: Gabon. Liyanga, region de Lastoursville, *Le Testu 7690* (holo-: P ; iso-: BR, WAG).

Ecology: unkown.

Chorology and distribution: Lower Guinea Domain. endemic to Gabon.

Note: Taxon known only from the type.

22. *Sabicea fulvovenosa* R.D.Good in J. Bot. 61: 68 (1923). — Type: Cabinda. Caio - Rio Lufo - Hombe region, 05 Feb. 1919, *J. Gossweiler 7887* (holo-: BM).

Ecology: unknown.

Chorology and distribution: Endemic to Cabinda.

Representative specimens examined: Cabinda. s.l., *Gossweiler 7027* (BM).

23. *Sabicea gabonica* (Hiern) Hepper, Kew Bull 13: 292 (1958); F.T.W.A. 2 eds (2): 172 (1963); Hallé, Fl. du Gabon 12: 180 (1966). — Type: Gabon. Riv. Gabon, *Mann 933* (holo-: K).

Stipularia gabonica Hiern, D.Oliver & auct. suc. (eds), Fl. Trop. Afr. 3 80 (1877)

Stipularia efulenensis Hutch., Bull. Misc. Inform. Kew 1908: 291 (1908). — Type: French Cameroon. Efulen, *Bates 439* (holo-: K).

Sabicea efulenensis (Hutch) Hepper, Kew Bull. 13: 292 (1958); Hallé in Fl. du Gabon 12: 181 (1966).

Ecology: This taxon grows in forest vegetation, sunny forest edge, atlantic biafran forest, plantation in secondary forest and it was found between 60–850 m elevation.

Chorology and distribution: Lower Guinea Domain: Cameroon, Equatorial Guinea, Gabon, Nigeria, DR Congo.

Note: This taxon is newly recorded in Equatorial Guinea and DR Congo.

Representative specimens examined: **Cameroon:** 15 km from Kribi, Bidou III, Ebolowa road, 2°52'N 10°02'E, 27 Oct. 1969, *J.J. Bos 5711* (BR, WAG); Massif du Mbam Minkom à l'est de Nkolakié (20-25 km NW de Yaoundé), 3°57'41.8"N 11°22'15.1"E, 27 May 2009, *O. Lachenaud, H. Taedoumg & G.A.T. Tiam 866* (BR); 13 km à l'est d'Akonéthé (3 km au sud d'Olonou), 2º46'N 12º02'E, 16 Dec. 1986, *J. Lejoly 86/1057* (BR, BRLU).

Equatorial Guinea: Région continentale, Parc National de Monte Alen, 1°37'N 10°18'E, 23 Aug. 1997, *D. Ngomo 270* (BRLU); Centro Sur, Achimelan, km 23 de la carretera de Kogo, 1°41'N 9°49'E, 05 Jul. 2000, *R. Pérez Viso 3318* (BR); 6 km N de Mitong, 01°15'N 09°53'E, 12 Dec. 2003, *B. Sonké 3150* (BR, BRLU, MO).

Gabon: Province Moyen-Ogooué: along road between Nzorbang and Lambaréné, 0°37'S 10°11'E, 09 Mar. 1999, *L. Andersson & A. Nilsson 2341* (BR); Foot of Doudou mountains, 25-35 km W of Mandji, 1º40'47.0"S 10º13'49.9"E, 15 Feb. 2008, *S. Dessein, O. Lachenaud, S. Janssens, Y. Issembe & T. Nzabi 1869* (BR); Gaboon River, c. 0°25'N 9°27'E, Jul. 1861, *G. Mann 933* (WAG).

DR Congo: Lac Yandja (Isangi), 0°42'N 24°17'E, 30 Nov. 1951, *R. Germain 7237* (BR); Yabahondo (rive gauche du Lomami-territoire Isangi), 0°42'N 23°58'E, 15 Oct. 1952, *R. Germain 8107* (BR), Lileko, entre Yangambi et Basoko, À l'embouchure de la Losaye, 0°57'N 24°10'E, 28 Sep. 1938, *J.P. Louis 11376* (BR).

24. *Sabicea geophiloides* Wernham, Cat. Talb. Niger: 41 (1913); Wernham, Monogr. *Sabicea*: 60 (1914). — Type: Nigeria. Oban, 1911, *Talbot 255* (holo-: BM).

Ecology: This taxon occurs in open areas in high forest and it was found at 150 m elevation.

Distribution: Upper and Lower Guinea Domain. Ghana, Benin, Ivory Coast, S. Nigeria, Cameroon.

Representative specimens examined: **Ghana:** Pokoase, groove, 12 Apr. 1972, *J.B. Hall & Lock 43466* (MO, WAG).

Ivory Coast: Zagné, c. 6°13'N 7°29'W, 24 May 2002, *A. Bakayoko 142* (WAG).

Nigeria: Olokemeji Forest Reserve, 32 km W of Ibadan, 14 Jun. 1981, *A.H. Gentry & G.E. Pilz 32678* (MO); ca 20 miles SE of Ibadan, c.7°08'N 3°50'E, 10 May 1966, *C.L.M. van Eijnatten 1485* (WAG); Western province, Ikirun, ± 60 miles [c.95 km] NE of Ibadan, 15 Jun. 1966, *C.L.M. van Eijnatten 1617* (WAG).

25. *Sabicea gigantostipula* K.Schum., Bot. Jahrb. Syst. 33: 337 (1903); Wernham, Monogr. *Sabicea*: 27 (1914). — Type: Cameroon. Bipinde, *Zenker 2474* (lecto-: BR; isolecto-: P, **lectotype designed here**).

Ecpoma gigantostipula (K.Schum.) N.Hallé , Adansonia s.n., 3: 173 (1963).

Ecology: This taxon occurs in young secondary forest, shaded track in degraded forest, Mature rainforest, Atlantic biafran lowland forest with Caesalpinioideae, *Calpocalyx heitzii*, *Sacoglottis gabonensis* and *Terminalia superba*, in *Raphia* swamp and it was found at 34–920 m elevation.

Chorology and distribution: Lower Guinea Domain: Cameroon, Equatorial Guinea, S. Nigeria.

Note: 1. This species is newly recorded from Equatorial Guinea.

2. Schumann used four syntypes to describe this taxon: *Talbot 259* form S.Nigeria and *Büsgen 541*, *Ledermann 595*, *Zenker 2474*, *Dinklage 1011* from Cameroon and did not choose any the type specimen. During the present study, I have seen *Zenker 2474* (BR, P) and *Dinklage 1011* (P). *Zenker 2474* is in more than one herbarium and was choosen as lectotype.

Representative specimens examined: **Cameroon:** About 5 km from Kribi, Ebolowa road, 2°55'N 9°56'E, 21 Nov. 1968, *J.J. Bos 3348* (BR, MO); Etinde, Njonji. Path from CDC plantations towards summit, 4°08'N 9°01'E, *S. Cable , T. Holden, M. Seifert & S. Williams 159* (MO, WAG); South, W Ngoyang, 03º21'01.06"N 10º43'15.08"E, 18 Sep. 2005, *B. Sonké 4004* (BR, MO).

Equatorial Guinea: De Sendje à Ongamnsok, 1º22'N 9º58'E, 19 Feb. 2001, *J. Lejoly 01/45* (BRLU); Route de Nco vers Misobong au niveau de la grande cascade, 09 Jan. 1998, *Nguema & J. Lejoly 175* (BRLU); Parc National de Monte Alén, 3.7 km à l'ouest d'Aconangui, 1°46'37.18"N 10°14'38.09"E, 22 Jun. 2003, *B. Senterre & D. Obiang 3891* (BRLU).

Nigeria: Cross River National Park. Oban Hills. Forest ca. 10 km ESE of Neghe, 08 Feb. 1995, *K. Schmitt & T.O. Ibiang 366* (MO).

26. *Sabicea gilletii* De Wild., Ann. Mus. Congo Belge, Bot. V, 1: 78 (1903); Wernham, Monogr. *Sabicea*: 58 (1914). — Type: DR Congo. environs de Kimuenza, 15 Jan. 1901, *Gillet 1911* (holo-: BR).

Ecology: This taxon occurs in savannahs, secondary regrowth, primary and degraded forests, swampy areas and it was found at 470 m elevation.

Chorology and distribution: Congolia Domain. Endemic to DR Congo.

Note: *Sabicea gilletii* strongly resembles *S. brevipes*. I have some doubt that both species are different. Because of the geographic range, I choosed to maintain as separate. *S. gilletii* is restricted to Congolia Domain (DR Congo) while *S. brevipes* occurs in Upper Guinea Domain (Benin, Burkina Faso, Ghana, Mali, Nigeria, Togo).

Representative specimens examined: **DR Congo:** Route Bita-Inkiene km 2, Territoire: Maluku, 27 Nov. 1970, *H. Breyne 986* (BR); Panzi, 7°13'S 17°58'E, 06 Feb. 1952, *H.S.J. Callens 3118* (BR); Village de la Romée (Yanonghe), 0°35'N 24°47'E, 07 Dec. 1948, *R. Germain 4541* (BR).

27. *Sabicea globulifera* Hutch. & Dalziel, Fl. W. Trop. Afr. 2: 106 (1931). — Type: Guinea. Monts Nimba [Nimba N.E., lisière à 1600 m], c.7°35'N-8°28'W, Feb. 1942, *Schnell 409* (holo-: P).

Ecology: This species occurs in highlands and it was found at 1600 m elevation.

Chorology and distribution: Upper Guinea Domain: Endemic to Guinea.

Representative specimens examined: **Guinea**: Monts Nimba [Nimba N.E., lisière à 1600 m], c.7°35'N-8°28'W, Feb. 1942, Schnell 285 (P)

28. *Sabicea golgothae* Lachenaud & Zemagho**,** Candollea 70: 220 (2015). **—** Type: Gabon, Mabounié, 0°46'31"S 10°32'30"E, 2 Nov. 2014, *Lachenaud, Bidault & Lissambou 2116* (holo-: BRLU; iso-: BR, G, LBV, MO, P, WAG).

Ecology: The species grows in half-shaded forest edges along tracks, where it locally forms dense populations.

Chorology and distribution: Lower Guinea Domain: Endemic to West-Central Gabon

Additional specimens examined. Gabon, Mabounié, Golgotha, 0°45'55"S 10°32'49"E, 31 October 2014, *Lachenaud, Bidault & Lissambou 2106* (BR, BRLU, LBV, MO).

29. *Sabicea goossensi* De Wild., Pl. Bequaert 2: 231 (1923).— Type: DR Congo. Ganda Sundi, 25 Jul. 1919, *Goossens 1121* (holo-: BR).

Ecology: This taxon occurs in savannahs, secondary regrowth and it was found between 350–480 m elevation.

Chorology and distribution: Congolia Domain. Endemic to RD Congo.

Note: 1. De Wildemann (1923) published this taxon as *Sabicea goossensi* but in the World Check-list of Rubiaceae, Govaerts et al. (2012) erroneously wrote *Sabicea goossensii*.

2. *Sabicea goossensi* is related to *S. orientalis* and *Sabicea venosa* s.l. but differs by its long straight trichomes covering vegetative and floral parts, the calyx-lobes are longer than a tube.

Representative specimens examined. DR Congo: Kinanga (route Kimpese - Kitobola), 5°27'S 13°22'E, 25 Nov. 1959, *P. Compere 855* (BR); Temvo (Mayombe), 5°29'S 13°3'E, 11 Feb. 1919, *F. Vermoesen 1458* (BR).

30. *Sabicea gracilis* Wernham, Monogr. *Sabicea*: 60 (1914). — Type: Cameroon. Efulen, *Bates 398* (holo-: BM).

Sabicea gracilis var. *gracilis.*

Sabicea gracilis var. *microcalyx* RD. Good, J. Bot. 64 (suppl. 2): 7 (1926).

Ecology: This species occurs in degraded evergreen forest, in lowland and it was found between 80–118 m elevation.

Chorology and distribution: Lower Guinea Domain: Cameroon, Equatorial Guinea (reported to occur in Cabinda by Govaerts et al).

Representative specimens examined: **Cameroon**: From base camp to Gwap village (short route), 3º 10'57.4"N 10º 16'45.1"E, 08 Mar. 2007, *S. Dessein & B. Sonké 1417* (BR); Mémel II, 03°10'N 10°24'E, 01 Mar. 2004, *B. Sonké 3237* (BR, BRLU, MO); South province, Océan: Bifa, 2º 42'27.9"N 10º15'32.60"E, 16 Oct. 2008, *B. Sonké 5119* (BR).

Equatorial Guinea: Rio Muni, Centre-Sud, Ayaguening (Akonangui), 01 Aug. 2001, *B. Sonké 2522* (BRLU).

31. *Sabicea harleyae* Hepper, Kew Bull. 13: 292 (1958). — Type: Liberia. Ganta, 13 May 1939, *Harley 1167* (holo-: K; iso-: WAG).

Ecology: This taxon occurs in secondary forest at roadside, disturbed riverbank forest, devastated logged out forest, in high forest, on roadside and it was found between 426–900 m elevation.

Chorology and distribution: Upper Guinea Domain: Guinea, Ivory Coast, Liberia, Sierra Leone.

Note: Although *S. harleyae* and *S. vogelii* share the same geographical distribution, these species morphologically have some differences which can allowed to easily distinguish them: the shape and size of the stipules (broadly ovate 11–16 x 10–12 mm in *S. vogelii* vs narrowly elliptic 6–10 x 1–1.2 mm in *S. harleyae*); the length of the corolla tube (10–11 x 2 mm in *S. vogelii* vs 12–13 x 1–2 mm in *S. harleyae*). The type of indumentum is also different in both cases: in *S. harleyae*, the trichomes are short (c. 0.2 mm long) and appressed mainly on the lower side of the leaves, stipules, bracts while in *S. vogelii*, leaves, stipules, midrib, bracts are villose with long straight trichomes, erect to patent (1–2 mm long).

Representative specimens examined: **Guinea:** Administratif centre: Nzérékoré, Village: Zouèpo (Mount Nimba), c. 7°42'N 8°24'W, 21 May 1949, *J.G. Adam 5177* (MO, WAG); Nzérékoré, Nimba mountains, along road from Seringbara to Zouguépo, 7º39.0'N 8º27.2'W, 20 Jun. 2007, *C.C.H. Jongkind 7755* (WAG); Nzérékoré, near bridge south-west of Zabia, 7º40.9'N 9º14.5'W, 30 Apr. 2011, *C.C.H. Jongkind 10495* (BR, WAG).

Ivory Coast: Tiapleu, c. 7°25'N 8°14'W, 7 Mar. 1968, *L. Aké Assi 9986* (WAG); Guiglo-Zagné, 7º29'N 6º13'W, 24 May 2002, *A. Bakayoko & P. Martin 142* (WAG); Danané, Forêt Classé de Tiapleu, 7º21.4'N 8º07.8'W, 31 Mar. 2000, *C.C.H. Jongkind 4867* (WAG).

Liberia: Nimba, 7°32'N 8°32'W, 5 Feb. 1965, *J.G. Adam 20845* (UPS, WAG); Nimba, east of the Nimba mountains, 7º25.55'N 8º29.13'W, 12 Apr. 2010, *C.C.H. Jongkind 9634* (BR, WAG); Gola National Forest, Bomi hills, 6°55'58.00"N 10°45'44.00"W, 22 Jul. 1965, *P.P.C. van Meer 24* (WAG).

Sierra Leone: Kambui Hills, c. 7°50'N 11°15'W, 24 May 1960, *T.S. Bakshi 186* (WAG).

32- *Sabicea hierniana* Wernham, Monogr. *Sabicea*: 29 (1914); F. Pellegrin, Fl. du Mayombe 3: 9 (1938); F. Hallé, Adansonia 1: 271–273 (1961). — Type: Gabon. Gaboon river, 1861, *Mann 918 (*lecto-: K; isolecto-: P, by H. Hallé, 1966).

Ecpoma hierniana (Wernh.) N.Hallé & F.Hallé, Adansonia s..n. 3: 173 (1963).

Ecology: This taxon occurs in lowland rainforest, swampy bottomland in forest, mature forest and it was found between 70–1200 m elevation.

Chorology and distribution: Lower Guinea Domain: Equatorial Guinea, Gabon.

Note: This taxon is newly recorded in Equatorial Guinea.

Representative specimens examined: **Equatorial Guinea:** Ayee (Sofoge), 1°06'N 9°44'E, 13 Sep. 2001, *Esono & Ndong 318* (BRLU); Parc National de Monte Alen, dalle rocheuse d'Engong, 5 km à l'ouest du village d'Engong, 1º37'N10º18'E, 01 May 2002, I. *Parmentier & P. Esono 2896* (BRLU); Littoral, Engong, 1º26'N 9º32'E, 14 Aug. 2001, *B. Sonké 2544* (BR).

Gabon: Monts de Cristal, 12-15 km N.E. of Asok, 0°49'N 10°26'E, 18 Aug. 1978, *F.J. Breteler & J.J.F.E. de Wilde 119* (BR, MO, WAG); Doudou Mts, ca 40 km N.N.W. of Doussala on track towards Bongo, c. 2°10'S 10°20'E, 23 Mar. 1988, *J.J.F.E. de Wilde & C.C.H. Jongkind 9519* (WAG); 13 km NNW of Ndjolé, on BSO forestry road, 0º05'01.2" S 10º45'16.7"E, 26 Feb. 2008, *S. Dessein, O. Lachenaud, S. Janssens, Y. Issembe & T. Nzabi 2177* (BR).

33. *Sabicea johnstonii* K.Schum. ex Wernham, Monogr. *Sabicea*: 66 (1914); F.W.T.A. 2 eds (2): 174 (1963); Hallé, Fl. du Gabon 12, Rubiaceae 1: 191 (1966). — Type: Sud Nigeria, Cross River, *Johnston s.n.* (holo-: BM).

Ecology: This species occurs in secondary regrowth in forest edge, in open places, roadside, in formerly cleared area in forest, swamp areas and it was found between 200–1900 m elevation.

Chorology and distribution: Cameroon, Gabon, Nigeria, DR Congo, Zambia.

Note: This taxon is newly recorded in Cameroon.

Representative specimens examined: **Cameroon:** 2 km S of Kribi, roadside at bridge, c. 2°55'N 9°54'E, 11 Oct. 1968, *J.J. Bos 3052* (WAG); Near Pygmee village between Kienke river and km 7 on Kribi-Ebolowa road, 2°56'N 9°59'E, 17 Oct. 1969, *J.J. Bos 5533* (WAG); c. 40 km SSW. of Eséka, S. of Badjob, c. 3°32'N 10°34'E, 9 Nov. 1964, *W.J.J.O., J.J.F.E. de Wilde & B.E.E. de Wilde-Duyfjes 3812* (BR, MO, WAG).

Gabon: Makokou, piste du Bouéni, c. 0°30'N 13°00'E, 11 Feb. 1961, N. Hallé 1133 (WAG); 50 km on the road Mbigou to Malinga, 2°07.1'S 12°08.4'E, 8 Dec. 2001, *J.J. Wieringa 4652* (WAG).

Nigeria: Iyila-Ibene agricultural farm, 28 Feb. 1966, J.*O. Ariwaodo 1126* (BR).

DR Congo: Province Orientale. District de l'Ituri. Territoire de Mambasa. Réserve de Faune à Okapis. Localité Babukeli à 6 km d'Epulu, 1º25'N 28º35'E, 06 Sep. 2000, *Amsini 342* (BR); Turole, Bunyakiri, territoire Kalehe, 2°5'S 28°34'E, 01 Jan.1958, R. Gutzwiller 2493 (BR); Km 58, route de Kisangani vers Ubundu (rive gauche), 0º05'N 25º16'E, 06 Apr. 1977, *J. Lejoly 1284* (BR, BRLU, WAG).

Zambia: s.l., 15 Jul. 1911, A. Boone 92 (BR); Old Anwchi, 23 Sep. 1998, *P. Holland 90* (BR).

34. *Sabicea jongkindii* Zemagho, Sonké & O.Lachenaud, ***sp. nov.*** — Type:Liberia. Sapo NP, buffer zone, near rapids in Sinoe River, 5°20.1'N 8°48.2'W, 23 Nov. 2002, *C.C.H. Jongkind, F. Blyden et al. 5349* (holo-: WAG, Figure 5).

Small liana, stems with short, soft, unicellar and long straight trichomes, patent; internodes 1.4–5.3 cm long, 1–3 mm thick. Stipules, interpetiolar, persistent, erect (rarely bidentate at apex), cordate to cordiform, 1–1.5 x 1–1.5 mm, puberulent with the same trichomes as on twigs on outer surface; glabrous except on the base. Leaves opposite with petioles 0.4–1.8 mm long with the same trichomes as on twigs. Leaf-blades oblong 1.9–5.6 x 0.5–3.8 cm, cuneate to obtuse at base, sub acute at apex; upper surface sparsely puberulent with short appressed trichomes (c. 0.1 mm long), longer and more dense on nerves on both surfaces; Inflorescence 1 (rarely 2)-flowered, solitary; peduncle 3–6 mm long with short unicellular trichomes. Bracts 2 pairs, outer pair slightly fused at base, narrowly ovate 1.2 x 1 mm, short unicellular trichomes outside, glabrous with only trichomes at base inside. Calyx green, tube campanulate, 3–11 x 2–4 mm, sparsely puberulent outside (trichomes c. 0.1 mm), pilose inside with short appressed trichomes (c. 0.5 mm long, brown); lobes with colleters on the sinus, (3) 7–11 x 0.2 mm, sparsely puberulent outside, glabrous inside. Corolla red, tube c.16–19 mm covered with silky to velvety trichomes (c. 0.5 mm long, red) outside, glabrous on lower part with cluster of buff, unicellular, erect in the middle and sparsely soft unicellular hairs in upper part and reaching over the throat; lobes triangular 3 x 2 mm, with appressed trichomes outside, glabrous inside. Stamens mi-exserted, with apex reaching throat; anthers sessile, 3 x 0.8 mm, shortly apiculate. Ovary with 5 locular, glabrous. Style (short-styled) included in the middle of tube, 12–17 mm long, 5-lobed, stigmas c. 4 mm long, white. Disk cylindrical, 0.4 x 2 mm, glabrous. Fruits fusiform, 7–17 x 6–9 mm when dry, sparsely pubescent. Calyx persistent. Small numerous seeds.

Etymology: This species is named after Carel Jongkind who collected the type specimen.

Ecology: Forest

Chorology and distribution: Upper Guinea: Liberia, Ghana (Fig. 6).

Note: The fruits of *Sabicea* species are generally (sub-) globose or (sub-) ovoid. Fusiform fruits are found in *S. jongkindii* and *S. rosea* with is an uncommon character in the genus (Table 5).

Representative specimens examined: **Liberia**: Sinoe Co. Butaw, 17 Mar. 1948, *J.T. Baldwin 11486* (MO), s.l., *C. Jongkind 12457* (WAG).

Ghana: Ankasa Forest Reserve, 06 Oct. 1973, *A.A. Enti R1164* (BR, MO, WAG).

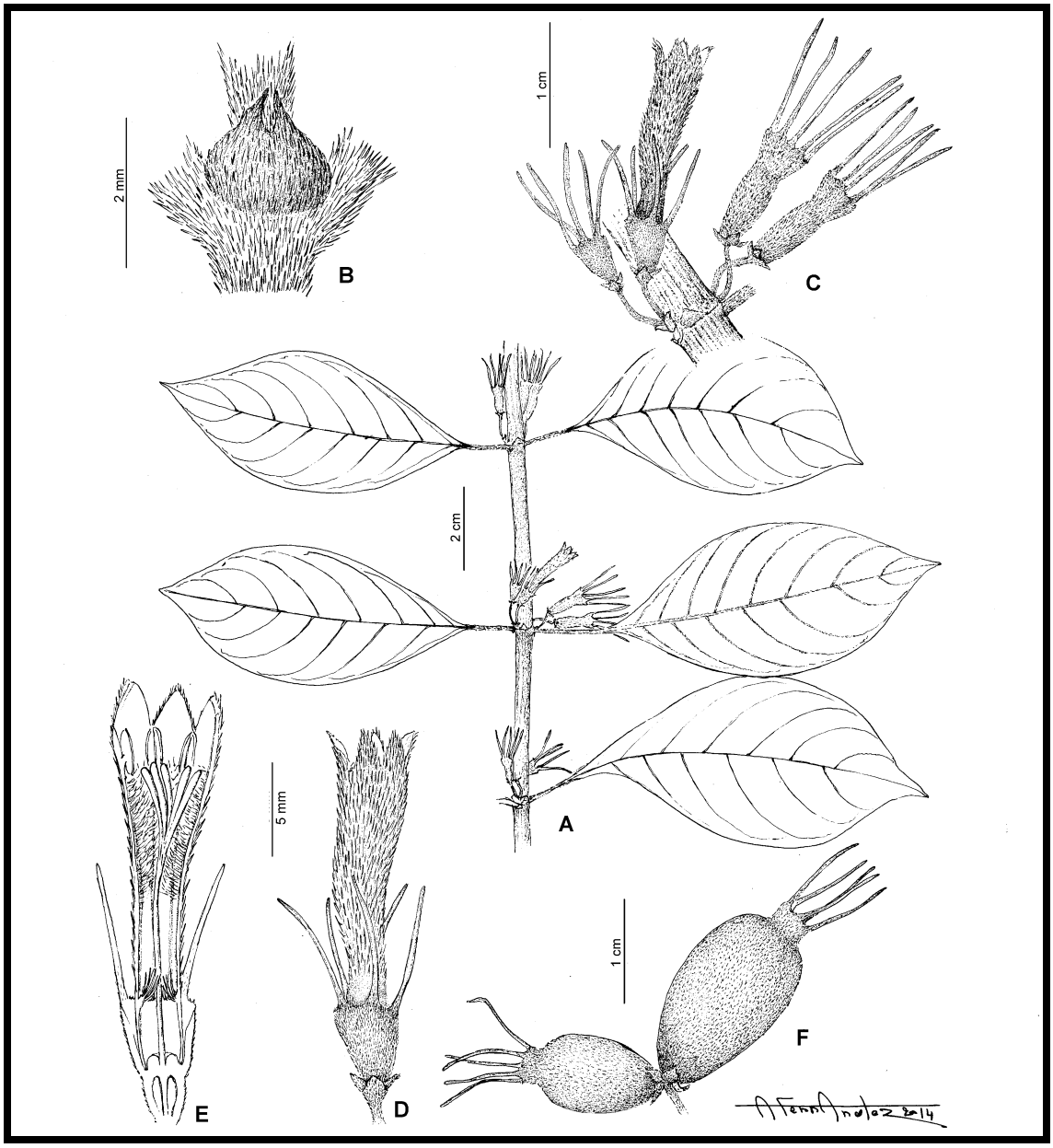

Figure 5. *Sabicea jongkindii:* A, flowering stem; B, Stipules; C, Inflorescence; D, flower; E, Section of short-styled flower; F, fruits. From *Jongkind 5349.*

Table 6. Distinguished characters *between S. cordata, S. jongkindii* and *S. rosea.*

Characters	*S. cordata*	***S. jongkindii***	*S. rosea*
Stipules	Ovate, **5–7 x 3–7 mm**	cordate, occasionally echancrate on apex, 1–– 1.5 x 1–1.5 mm	triangular to deltate, 1.2–4 x 0.2-3mm
Inflorescence	1-3 flowered	1-flowered	1-flowered
Calyx lobes (mm)	narrowly ovate, (5) 8–21 x 1–2	**linear, (3) 7–11 x 0.2**	linear, 1–1.2 x 3
Corolla tube (mm)	-	**16–19**	25
Corolla lobes (mm)		3 x 2	2 x 1–2
Indumentum calyx-lobes (inside)	Sparsely to densely pubescent (trichomes, clinate, c. 0.5 mm long)	glabrous	minutely puberulous
Fruit	(sub-) globose	fusiform	fusiform

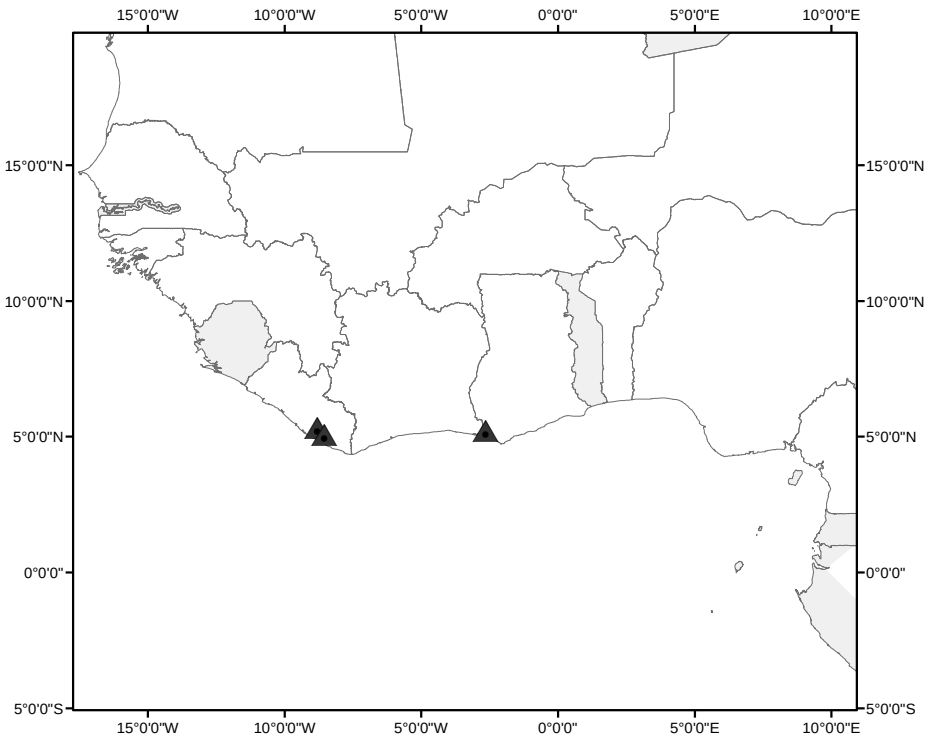

Figure 6. Distribution of *Sabicea jongkindii*.

35. *Sabicea laxa* Wernham, Monogr. *Sabicea*: 33 (1914). — Type: Cameroon. Bipindi, 1912, *Zenker 4567* (holo-: BM).

Ecology: This taxon occurs along the forestry road, in secondary forest and it was found between 550–800 m elevation.

Chorology and distribution: Lower Guinea Domain: Cameroon, Equatorial Guinea, Gabon.

Notes: 1. This species is newly recorded from Equatorial Guinea and Gabon.

2. This taxon belongs to *Sabicea venosa* group and it is brieftly distinguished from the others members by its short calyx-lobes (+/- 0.5 mm long), inflorescence lax, corolla white, long (+/- 15 mm long).

Representative specimens examined: **Cameroon:** Province Centre, Massif du Mbam Minkom à l'est de Nkolakié (20-25 km NW de Yaoundé), 3°57'41.8"N 11°22'15.1"E, 27 May 2009, *O. Lachenaud, H. Taedoumg & G.A.T. Tiam 687* (BR); Central province, Kolakié et environs, c. 3º58'N 11º23'E, 07 Jun. 2003, K.C. Nguembou & Djuikouo 778 (BR, BRLU, WAG); Bipinde, 4°28'N 9°04'E, 01 Jul. 1911, *G.A. Zenker 4020* (BR, P).

Equatorial Guinea: Bata - Niefang: Estrada km 35. Fabrica de madera de Adjape de zona de Comayá, ya descrita en cuaderno de campo, c. 1°51'N 10°03'E, 01 Aug. 1994, *M.F. de Carvalho 5618* (BR, BRLU, WAG).

Gabon: Chantier Rougier-Océan, ca. 20 km NE of Oveng, 0°44'N 11°23'E, 11 May 1986, *J.M. & B. Reitsma 2256* (WAG); Woleu-Ntem, along road in Bordamur concession area, near Assok Beghe, 1º02.3'N 11º41.4'E, 02 Oct. 2002, *J.S. Strijk 22* (WAG); Woleu-Ntem, logged-over forest along logging road in Bordamur concession area, some 19 km from the WWF-station, 1º08.00'N 11º47.00'E, 07 Oct.2002, *J.S. Strijk 501* (WAG).

36. *Sabicea leucocarpa* (K.Krause) Mildbraed, Wiss. Erg. Zweit Deut. Zentr.-Afr. Exped. 1910–1911, Bot. 2: 91 (1922). — Type: Cameroon. Südkameruner Waldgebiet, 01 July 1910, J. Mildbraed 5707 (holo: HBG; iso: BR, P).

Geophila leucocarpa K.Krause, Bot. Jahrb. Syst. 54: 357 (1917).

Ecology: This taxon was found between 700–942 m elevation.

Chorology and distribution: Lower Guinea Domain: endemic to S. Cameroon.

Representative specimens examined: **Cameroon:** Nkolemana, près Mebomezoa, 12 km SE Ngomedzap, à 45 km au SSW de Mbalmayo, 27 Jun. 1972, *R. Letouzey 11390* (BR); Entre Abat et Bayis, 20 km WNW Nguti, 12 Jun. 1975, *R. Letouzey 13802* (BR)

37. *Sabicea liberica* Hepper, Kew Bull. 13: 293: (1958). — Type: Liberia. Moanda, *Linder 1380* (holo-: WAG).

Ecology: unknown.

Chorology and distribution: Upper Guinea Domain: endemic to Liberia.

Representative specimens examined: **Liberia**: Eastern Province. Tchien District. Bahtown, on Cess River, c. 6°26'N 8°37'W, 11 Aug. 1947, *J. J.T. Baldwin 8030* (WAG); near Bomi Hills forest camp, c. 6°54'N 10°45'W, 11 Feb. 1969, *J.W.A. Jansen 1478* (WAG); Moala, c. 6°42'N 10°41'W, 4 Nov. 1926, *D.H. Linder 1380* (WAG).

38. *Sabicea liedeschumanniana* Zemagho ***sp.nov.*** − Type: Equatorial Guinea (Rio de Muni). Moyen Orient. 4 km de Mitong, 12 December 2003, *Sonké & Esono 3139* (holo-: BR,; iso-: BRLU, MO, Figure 7).

Creeping shrub, pubescent with long appressed trichomes (c. 1 mm long) when young, glabrous when old. Stipules interpetiolar, erected, ovate, 9–16 x 6–10 mm diam., glabrous on the adaxial surface(except near the base), woolly trichomes with long straight appressed trichomes on abaxial surface (trichomes ≤ 1 mm long), eciliate on margin. Leaves with petioles 12–29 mm long, pubescent with long appressed trichomes (c. 1 mm long). Leaf-blades, elliptic, 10.7–14.1 x 5.2–6.7 mm long, upper surface, ± glabrous, midrib and secondary nerves sparsely pubescent, green; lower surface, woolly trichomes rarely with straight trichomes, midrib and secondary nerves covered with silky trichomes (c. 1 mm long), base obtuse, apex acute to acuminate (acumen c. 2 mm high). 16–19 secondary nerves at each side on mid-vein, prominent. Floral buds, triangular, densely pubescent. Inflorescence, 7–13 mm long pedunculate, capitate, probably involucrate in budding and flowering (splitting in fruiting), c. 30 flowered, sessile; involucre consisting of two pairs of bracts; the outer pairs, fused at the base to nearly 1/3 their length covering the calyx tube, patent and star-like in fruit, ovate to sub ovate, 15 x 11 mm, the inner pairs, elliptic, 13 x 6 mm, externally with buff tomentum spreading with short appressed trichomes (≤ 1 mm long), internally glabrous with only straight trichomes near the base, apex acute. Flowers 5- numerous, pedicellate, 0–3 mm long, densely pubescent to pilose (trichomes 1–2 mm long). Calyx tube, campanulate, ≤ 1 mm long, externally with silky trichomes, internally glabrous; lobes 5, triangular to orbicular, ≤ 1 mm long. Corolla white, tube c. 8 mm long, externally densely pubescent, internally with buff tomentum extending over the throat, lobes 5, 2 x 1 mm long, internally glabrous, externally densely pubescent. Stamens included (long styled flowers) in the lower part of

corolla tube, anthers 1.5–2 mm long. Ovary 5 locular, style 5 lobed, exserted (long styled flowers), 6–7 mm long, base and apex glabrous. Fruits, ovoid, pedicellate (0–4 mm long), 6 x 5 mm in vivo, c. 5 x 3 mm when dry, green when immature, pubescent with persistent calyx.

Etymology: This species is named in honour of Prof. Dr. Sigrid Liede-Schumann, to whom I'm indebted for the assistance and facilities offered by her Laboratory.

Phenology: Flowering: December and fruiting around the same period.

Ecology: unknown.

Chorology and distribution: Lower Guinea Domain: endemic to Equatorial Guinea (Fig. 3).

Notes: See under ***S.*** *deblockiana* (Table 4).

Representative specimens examined: Equatorial Guinea. 6 km de Mitong, 12 December 2003, *Sonké & Esono 3152* (BR, BRLU, MO).

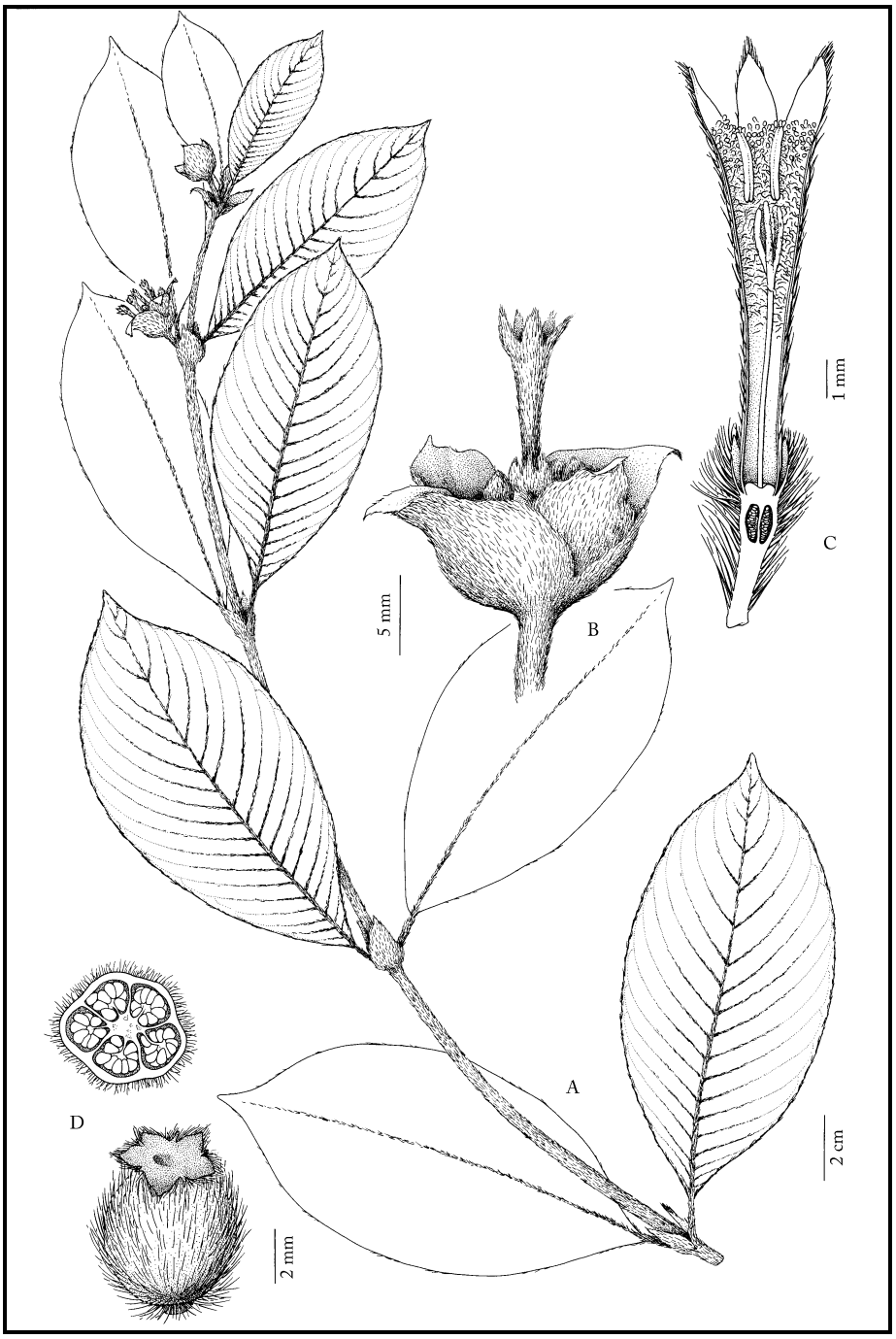

Figure 7. *Sabicea liedeschumanniana*: A, Flowering stem; B, Inflorescence; C, Section of short-styled flower; D, Fruit. From *Sonké 3139.*

39. *Sabicea longepetiolata* De Wild., Ann. Mus. Congo Belge, Bot. V, 1: 78 (1903); Wernham in Monogr. *Sabicea*: 34 (1914); Hallé, Fl. du Gabon 12: 198 (1966). — Type: RD Congo. Kimuenza, *Gillet 2179* (holo-: BR).

Ecology: This species occurs in young secondary forest with *Musanga cecropioides*, in *Gilbertiodendron* forest, in primary forest and it was found between 365–470 m elevation.

Chorology and distribution: Lower and Congolia Domains: Gabon and RD Congo.

Representative specimens examined: **Gabon:** Masenguelani (60 SE de Lopé), 0°30'S 11°55'E, 30 Jan. 1998, *A. Binot & J. Lejoly 215* (BRLU); Along road at Bordemur, c. 1°05'N 11°74'E, 12 Dec. 2001, *J.T.A.G. Raymakers 113* (WAG); Alongside forestry road, Chantier Rougier-Océan, ca 20 km NE of Oveng, 0°44'N 11°23'E, 11 May 1986, *J.M. Reitsma 2256* (WAG).

DR Congo: Yangambi, 0°46'N 24°27'E, 20 Aug. 1948, *R. Germain 977* (BR); Kimuenza, 4°28'S 15°17'E, 15 May 1901, *J. Gillet 2179* (BR); Lukoléla, 1°3'30"S 17°11'00"E, 13 Dec. 1903, *J. Kriekels s.n* (BR).

40. *Sabicea mabouniensis* O.Lachenaud & Zemagho, Candollea 70: 224 (2015). — Type: Gabon, Mabounié, piste du nord-est, *Lachenaud, et al., 1446* (holo-: BR; iso-: BRLU, L, LBV, MO, P).

Ecology: This taxon is found growing on a sunny forest edge along a track.

Chorology and distribution: Lower Guinea Domain: endemic to West-Central Gabon.

This species is known just from the type specimen.

41. *Sabicea multibracteata* J.B.Hall, Bull Jard. Bot. Natl. Belg. 50: 249 (1980). — Type: Liberia. Putu District, near Kanweake, 26 Mar. 1962, *De Wilde & Voorhoeve 3648* (holo-: K, iso-: WAG).

Ecology: This taxon grows in secondary forest, roadside and it was found at 40 m elevation.

Distribution: Upper Guinea Domain: Ghana, Ivory Coast, Liberia.

Representative specimens examined: **Ghana**: Ankasa River Forest Reserve, 5°17'N 2°35'W, 09 Jan. 1967, *J.B. Hall & Enti 36306* (WAG); Atewa Range Forest Reserve, 6°00'N 0°36'W, 19 Jan. 1974, *J.B. Hall 44754* (WAG); Simpa, 5°06'N 2°06'W, Feb. 1933, *C. Vigne 2807* (WAG).

Ivory Coast: Between Gabo and Gaour, 4°53'N 6°38'W, 24 Feb. 1955, *L. Aké Assi 2830* (WAG); between Podoué and Guirou, 4°43'N 7°22'W, 11 Aug. 1962, *J.L. Guillaumet 1233* (WAG); Near Lamé, 40 km E of Abidjan, 06 Nov. 1958, *A.J.M. Leeuwenberg 1898* (BR, WAG).

Liberia: Dugbe HummingBird site (ca. 20 km South of Sapo National Park, ca. 50 km East of Greenville, north of the road from Dubge to Tuzon, 25 Mar. 2014, B. Senterre 7026 (K)

42. *Sabicea najatrix* N.Hallé in Fl. du Gabon 12: 182 (1966). — Type: Gabon. Tchibanga, *Le Testu 1898* (holo-: P; iso-; BM, BR).

Ecology: This taxon grows in old forest, secondary regrowth, primary high forest, secondary vegetation along the road and it was found between 100–700 m elevation.

Chorology and distribution: Lower Guinea Domain: Cameroon, Equatorial Guinea, Gabon.

Note: This taxon is newly recorded from Cameroon, Equatorial Guinea and DR Congo.

Representative specimens examined: **Cameroon:** 13 km à l'est d'Akonéthé (3 km sud d'Olonou), 2º46'N 12º02'E, 16 Dec. 1986, *J. Lejoly 86/1017* (BR, BRLU); On hill facing the village of N'kolandom I, 2°48'N 11°10'E, 28 Oct. 1974, *J.J.F.E. de Wilde 7655* (BR, WAG).

Equatorial Guinea: Parc National de Monte Alen, transect de Monte Chocolate, 1º39'N 10º19'E, 14 Jul. 1995, *J. Lejoly 95/1152* (BRLU).

Gabon: Ogooué-Ivindo, nord-est du parc de la Lopé, 25 km du carrefour qui mène à l'ancien Booué Bac, 0º11.76'S 11º50.96'E, 06 March 2010, *P. Bissiengou 1055* (WAG); Ogooué-Lolo, Makande surroundings, c. 65 km SSW of Booué, c. 0º41'S 11º55'E, 05 Feb. 1999, *F.J. Breteler 14928* (BR, WAG); Nyanga, Doudou mountains, chantier SFN-Bakker, 2º53.6'S 10º30.7'E, 25 Nov. 2003, *C.C.H. Jongkind 5777* (BR, WAG).

RD-Congo: Maduda-Nkai-Mbaku, Zone: Tshela, 11 Nov. 1982, *H. Breyne 4511* (BR).

43. *Sabicea neglecta* Hepper, Kew Bull. 14: 225 (1960). — Type: E. Nigeria: Calabar Prov., Oban group Forest Reserve, May 1952, *E. Ujor* in FHI 30836 (holo-: K).

Ecology: This taxon grows in roadside.

Chorology and distribution: Lower Guinea Domain: endemic to E. Nigeria.

Representative specimens examined: **Nigeria**: Near mile 74, Calabar-Mamfe road, Province Calabar, District Ikpai, 26 February 1964, *Onyeachusim & Latilo 54214* (BR).

Note: This taxon at first sight looks like *S. cordata* but the several flowered inflorescence serve to distinguish easily these two species. It is also near *S. speciosa* but this is cauliflorous and possesses corolla reddish to purplish.

44. *Sabicea nobilis* R.D.Good, J. Bot. 61: 86 (1923). — Type: Gabon. Makokou, *Hallé 1129* (holo-: P).

Pseudosabicea nobilis (R.D.Good) N.Hallé in Fl. du Gabon 17, Rubiaceae: 2 (1970).

Pseudosabicea mitisphaera N.Hallé in Adansonia 3: 170 (1963); in Fl. du Gabon 12: 210 (1966).

Ecology: This taxon grows in secondary forest along forestry road, secondary regrowth, along exploitation road in primary forest and it was found between 250–800 m elevation.

Chorology and distribution: Lower Guinea Domain: Cameroon, Gabon.

Note: The congested and felted inflorescence in addition to ovary bilocular are characters sharing with the members of Subgen. *Anisophyllae* and this taxon. However, this taxon differs by its fruits with pedicel.

Representative specimens examined: Cameroon: Nkamouna, 03 16'06"N 13 50'55"E, 11 Jun. 2004, *B. Sonké 3480* (BR, BRLU, MO); Nkamouna, 03 15' 30"N13 49' 16"E, 15 Jun. 2004, *B. Sonké 3525* (BR, BRLU).

Gabon: Moukabo, about 25 km E of Mouila, on the road to Yeno, 1°50'S 11°10'E, 27 Nov. 1984, *J.C. Arends, A.M. Louis & J.J.F.E. de Wilde 468* (BR, WAG); Monts Doudou, W. of Doussala and Rés. de Faune de Moukalaba, c. 2°15'S 10°20'E, 4 Dec. 1984, *J.C. Arends, J.J.F.E de Wilde & A.M. Louis 607* (WAG); Ogooué River, Booué, c. 0°06'S 11°56'E, 31 Jul. 1966, *N. Hallé & A. Le Thomas 268* (WAG).

45. *Sabicea orientalis* Wernham, Monogr. *Sabicea*: 31 (1914); T.T.L.C.: 532 (1949); Verdc., Kew Bull. 14: 348 (1960); Bridson & Verdcourt, Fl. Trop. East. Afr., Rubiaceae (part 2): 470 (1988). — Type: Tanzania, Uluguru Mts, *Goetze 209* (lecto-: K).

Sabicea cameroonensis Wernham, Monogr. *Sabicea*: 64 (1914). — Type: Cameroon. Molundu, 22 Mar. 1911, *Mildbraed 4711* (holo-: BM), **syn. nov.**

Ecology: This taxon grows in woodland, secondary forest, in primary and partly secondary submontane rain forest, swamp forest, coastal forest and thicket regenerating after cultivation, patches of natural forest present, montane forest, grassland area with few *Erytrina abyssinica*, *Acacia polycantha* and *Cordia africana* and it was found between 300–1200 m elevation.

Chorology and distribution: Burundi, Cameroon, Central African Republic, Gabon, DR Congo, Tanzania, Uganda.

Representative specimens examined: **Burundi:** Rumonge, route Bururi - territoire: Bururi, 3°59'S 29°26'E, 07 Mar. 1971, *J. Lewalle 5266* (MO, WAG); Bubanza,Territoire: Bubanza, 3°05'S 29°24'E, 30 Jan. 1972, *M. Reekmans 1470* (BR, MO); Kitwe, province Bururi, 4º00'S 29º30'E, 13 Dec. 1977, *M. Reekmans 6718* (BR, MO, WAG).

Cameroon: 5 km N. of Betaré Oya, near fish pond, c. 5°38'N 14°06'E, 04 Feb.1966, *A.J.M. Leeuwenberg 7735* (WAG); Alat-Makay, 02º51'N 13º20'E, 19 Mar. 2002, *C. K. Nguembou 339* (BRLU); Bissombo, 3º20'N 12º34'E, 27 Feb.2004, *C. K. Nguembou & Djuikouo 1028* (BRLU).

Central African Republic: **Central African Republic**: Plant of the Manovo-Gounda-St. Floris National Park. WWF Inter. Elephant Cons. Project. 14.5 S of Koumbala- Pende confluence on Pende Creek. 8º19'N 21º15'E, 14 May 1984, *J.M. Fay 6632* (MO); Sangha-Mbaere, 45 km S of Lidjombo, Ndakan gorilla study area M trail, 02º21'N 016º10'E, 17 May 1990, *J. Harris 2350* (BR, MO), Mokpoto, 10 km S de Bangui, 04°16'N 018°31'E, 12 June 2003, B. Sonké & D. Beina 3002 (MO); Mokpoto, 10 km S de Bangui, 04°16'N 018°31'E, 12 June 2003, B. Sonké & D. Beina 3006 (MO); Ngotto, 5 km W de Ngottoa, 03°57'N 017°20'E, 14 June 2003, *B. Sonké & D. Beina 3097* (MO)

Gabon: 10 km along the road from Lalara to Makokou and than a forest exploitation road following the Okano river on its left bank upstream for about 31 km, 08 Sep. 1978, *F.J. Breteler & J.J.F.E. de Wilde 495* (BR, MO, WAG); Woleu-Ntem. behind the WWf-station, at entrance to Bordamur concession area, 08 Oct. 2002, *J.S. Strijk 56* (WAG).

DR Congo: Doruma, 4°43'N 27°41'E, 07 Apr. 1933, *P.A.M. De Graer 8* (BR); Kisangani, 500 m au SE de Kabondo, 0º30'N 25º14'E, 30 Apr. 1977, *J. Lejoly 1415* (BR, BRLU); Sambili, (Bas-Uélé), à 1 km sur la route de Bangassou, 04º30'N 23º42'E, 07 July 1978, *J. Lejoly 4019B* (BR, BRLU).

Tanzania: Bunduki, Uluguru mountains, c.7°10'S 37°40'E, 29 Mar. 1969, *M. Batty 144* (BR); T4. Kigoma district, Kasye forest, 5º41'S 29º55'E, 17 Mar. 1994, *G.S. Bidgood, F. Mbago & K. Vollesen 2774* (BR, WAG); Kagera: Bukoba rural district, T1. Minziro Forest Reserve. Bulembe hill slope, 01º00'53"S 031º37'15"E, 18 Nov. 1999, *G. Gobbo, D. Sitoni, G. Simon, G. Mwiga & P. Maganga 541* (BR, MO).

46. *Sabicea pedicellata* Wernham, Cat. Talb. Niger: 42 (1913). — Type: Nigeria. S.Nigeria, Oban, 1912, *Talbot 1367* (holo-: BM).

Pseudosabicea pedicellata (Wernham) N.Hallé, Adansonia 3: 172 (1963).

Sabicea lanuginosa **syn. nov.**

Ecology: This taxon occurs in forest edge, in secondary regrowth, roadside and it was found between 100–680 m elevation.

Chorology and distribution: Lower Guinea Domain: S. Nigeria, Cameroon, Gabon.

Note: 1. *Sabicea pedicellata* resembles *S. johnstonii*. However, tey can be distinguished with theindumentum on abaxial surface of stipule (long appressed trichomes (c. 1 mm) in *S. johnstonii* vs felted buff in *pedicellata*), the dimension of bracts (8–12 x 7–8 mm in *S.*

johnstonii vs 4 x 4 mm in *S. pedicellata*), length of calyx lobes (4–12 x 0.2–1 mm in *S. johnstonii*).

2. Hallé (1963) erroneously classified *S. pedicellata* [*P. pedicellata*] in his *Pseudosabicea* sect. *Sphaericae*. This species should be removed in this section because of its ovary 5-locular in contrast to the members of this section with ovary bilocular. Based on molecular and morphological evidences, *S. pedicellata* should belong to species with capitulate inflorescence.

3. *S. lanuginosa* was described by Wernham (1914) without affinities with some species. Hallé (1966) keys out *S. lanuginosa* based on its yound leaves araneo-lanuginose on lower surface, bracts not subulate and not acute. The examination of herbarium material *Hagerup 808* (P), Keay & *Savory FHI22451* (P) coincide with some collection of *S. pedicellata* from Cameroon (*Sonké 5567, Sonké 5573*). According to the rules of taxonomical nomenclature, we synonymized *S. lanuginosa* under *S. pedicellata* .

Representative specimens examined: **Cameroon**: Mundemba Fabe Road, Ndian Division, 07 February 1988, *J. Nemba & P. Mambo 721* (MO); Sud-Ouest: sanctuaire Mbanyang Mbo, Nguti, 5º20'39.50"N 9º31'11.60"E, 06 April 2011, *B. Sonké 5567* (BR); Sud-Ouest: sanctuaire Mbanyang Mbo, Nguti, 5º20'39.50"N 9º31'11.60"E, 09 April 2011, *B. Sonké 5573* (BR). **Gabon:** Km 15 Moanda - Mbinda, 1°37'S 13°8'E, 15 September 1970, *F.J. Breteler 6461* (BR, MO, WAG); Ogooué-Lolo, Bambidie, ca. 30 km of Lastoursville, c. 0º40'S 13º00'E, 01 May 1992, *F.J. Breteler 11219* (BR; WAG); Ogooué-Lolo, near Bambidie. E of Lastoursville, c. 0º42'S 12º59'E, 10 October 1994, *F.J. Breteler 13190* (BR, WAG).

Nigeria: Oban Group Forest Reserve near Orem village on Calabar-Mamfe road, South Eastern State, District Oban, 5°24'5.00"N 8°25'6.00"E, 08 March 1973, *M.G. Latilo & Oguntayo 70542* (WAG).

47. *Sabicea pilosa* Hiern, D. Oliver & auct. suc. (eds.), Fl. Trop. Afr. 3: 76 (1877); Wernham,Monogr. *Sabicea*: 61 (1914); F.W.T.A. 2 ed. 2: 172 (1963); Hallé, Fl. du Gabon 12, Rubiaceae 1: 166 (1966). — Type: Gabon, baie de l'île de Corisco, *Mann 1866* (holo-: P).

Ecology: This taxon occurs in Atlantic biafran lowland forest with Caesalpinioideae, *Calpocalyx heitzii*, *Sacoglottis gabonensis* and *Terminalia superba*, in high riverbank, edge of riverine forest, primary and secondary forests, in forest along a track and it was found between 40–1000 m elevation.

Chorology and distribution: Lower Guinea Domain: Cameroon, Equatorial Guinea, Gabon.

Critical remarks: In the World Check-list of Rubiaceae (Goaverts et al. 2013), this taxon is incorrectly reported from Upper and Lower Guinea Domains (Ivory Coast, Cameroon, Equatorial Guineam Gabon). This confusion is probably due to its resemblance with *S. speciosa* occuring from Togo to DR Congo. Specific characters used to distinguish *S. speciosa* from *S. pilosa* are: peduncle length (sessile in *S. speciosa* vs 5–28 mm in *S. pilosa*), bracts (small, c. 2x 2 mm, free in *S. speciosa* vs wide, 7–9 x 15–16 mm, shorlty connate and ± naviculate in *S. pilosa*), shape of calyx lobes (conspicuously subulate or setaceous in *S. speciosa* vs (narrowly) elliptic in *S. pilosa*).

Representative specimens examined: **Cameroon:** Ekombe-Mofako, Mokoko Forest Reserve, 4°29'N 9°06'E, 23 Apr. 1994, *J.M. Acworth 212* (MO); Bifa (piste zur la route Kribi-Ebolowa). À 5 km au SE de Zingui. Campement à 2 h de marche à l'ESE du village, 02º42.242'N 010º15.884'E, 14 Apr. 2007, *V. Droissart & M. Simo 376* (BRLU); South Province, Ocean, c. 10 km south of Mekalat. Between Mekalat and Lolodorf, c. 3º07'N 10º45'E, 07 Apr. 1996, *A.S. Mutsaers 34* (WAG).

Equatorial Guinea: Region continentale, 1°24.0'N 9°56.5'E, 26 May 1999, *E.F. Eneme 175* (BRLU, WAG); Région continentale. Ngoma (10 km SE de Etembue), layon 25, 1º14'N 9º29'E, 12 Aug. 1988, *J. Lejoly et Elad 98/146* (BRLU); Litoral: Rio Campo, cerca de Bongoro, 2°8'N 9°54'E, 30 Mar. 2000, *R. Pérez Viso 2190* (BR).

Gabon: About 42 km E of Mouila, along road under construction towards Yeno, 1°40'S 11°20'E, 01 December 1984, *J.C. Arends, A.M. Louis & J.J.F.E. de Wilde 575* (WAG); Forêt des Abeilles; station de la Makande, 0º41'S 11º54'E, 23 Jul. 1993, *J. Lejoly 95/255* (BRLU); Sentier botanique de Tchimbélé, 0º37'301"N10º24'402"E, 20 Jun. 2001, *T. Stévart 874* (BRLU).

48. *Sabicea proselyta* (N.Hallé) Razafim., B. Bremer, Liede & Khan, Taxon 57: 14 (2008)

Pseudosabicea proselyta N.Hallé in Adansonia 3: 172 (1963); Hallé, Fl. du Gabon 12: 213 (1966). — Type: Gabon, *Hallé 748* (holo-: P).

Ecology: This taxon occurs in sunny edge of forest stream, degraded forest, secondary regrowth, roadside, exploitated high forest and it was found between 40–1080 m elevation.

Chorology and distribution: Lower Guinea Domain: Cameroon, Equatorial Guinea, Gabon

Note: This taxon is newly recorded from Cameroon and Equatorial Guinea.

Representative specimens examined: **Cameroon**: Station du Cacaoyer de N'koemvone, about 14 km on the road from Ebolowa to Ambam, 2°49'N 11°08'E, 28 Nov. 1974, *J.J.F.E. de Wilde 7762* (BR, MO, WAG); Campo Ma'an area, Onoyong, in the National Park, 2°32.7'N 10°40.8'E, 20 Mar. 2001, *G.P. Tchouto Mbatchou, M. Elad & A. Nnangah 93* (WAG).

Equatorial Guinea: Région continentale, entre Nsuamayong et inselberg Akuom, 1º49'N 10º54'E, 23 Jan. 1998, *Obama et Lejoly 656* (BRLU); (Rio Muni), Parc National de Monte Alen, dalle rocheuse d'Engong, 5 km à l'ouest du village d'Engong, 1º37'N 10º18'E, 12 May 2002, I. *Parmentier & P. Esono 2780* (BRLU); Parc National de Monte Alen-transect de Monte Chocolate, 1º46'N 10º16'E, 08 Jan. 1998, *Van Reeth 141* (BRLU).

Gabon: km N of Tchimbélé on former road to Asok, 0°38'18.1"N 10°24'35.6"E, 06 Feb. 2008, *S. Dessein 1741* (BR); Km 43 Mouila–Yéno, c.1°40'S 11°20'E, 21 Feb. 2008, *S. Dessein 2028* (BR); c.10 km NNW of Ndjolé, on BSO forestry road, 0º05'16.2"S 10º44'43.5"E, 26 Feb. 2008, *S. Dessein, O. Lachenaud, S. Janssens, Y. Issembe & T. Nzabi 2150* (BR).

49. *Sabicea rosea* Hoyle, Bull. Misc. Inform. Kew 1935: 264 (1935). — Type: Ghana. Boinsu, *Vigne 3190* (holo-: K; iso-: WAG).

Ecology: This taxon occurs in primary and secondary forests, in open areas and along a track in the forest, in river bank and it was found between 100–650 m elevation.

Distribution: Upper Guinea Domain: Ghana, Guinea, Ivory Coast, Liberia, Nigeria.

Representative specimens examined: **Ghana:** Ankasa forest reserve, c.5°13'N 2°39'W, 04 Feb. 1921, *A.A. Enti 42659* (MO, WAG); Kibi, Atewa Range Forest Reserve, 6°10'N 0°36'W, 4 Apr 1969, *J.B. Hall & A.A. Enti 39458* (WAG); s.l., 4°52'N 2°14'W, Feb. 1934, *F.R. Irvine 2376* (MO, WAG).

Guinea: Kabiata, 13 May 1949, *J.G. Adam 5043* (MO).

Ivory Coast: Yapo, c. 6°04'N 4°05'W, 22 Dec. 1955, *L. Aké Assi 3889* (WAG); 23 km NW of Sassandra, 4°59'N 6°17'W, 28 Oct. 1968, *F.J. Breteler 5831* (WAG); Forêt du Téké, c. 5°34'N 4°02'W, 11 Mar. 1964, *R.A.A. Oldeman 1008* (BR, WAG).

Liberia: SW LAMCO Hq. Camp. Nimba, 7°28'N 8°35'W, 2 Dec. 1964, *P. Adames 803* (BR, WAG); Grand Gedeh county, Putuh road south of Zwedru, 5°38'16.8"N 8°7'40.2"W, 16 Jan. 1967, *J.J. Bos 2875* (BR, WAG); Along the road from Tchien to Sinoe, c. 5 miles S. of Tchien, c. 6°00'N 8°10'W, 18 Jan. 1969, *J.W.A. Jansen 1243* (WAG).

Nigeria: Lagos, 6°27'N 3°23'E, 1946, *W.H. Batten-Poole 1* (WAG).

50. *Sabicea rufa* Wernham in Monogr. *Sabicea*: 63 (1914). — Type: Cameroon. Bipindi, 1898, *Zenker 1818* (lecto-: BM; isolecto-: G, P, **designated here**).

Ecology: This taxon occurs in riverine forest edge, secondary shrubland, Atlantic Biafran forest with Caesalpiniaceae, savannahs and it was found between 29–110 m elevation.

Chorology and distribution: Lower Guinea Domain: Cameroon, Equatorial Guinea, Gabon.

Note: Wernham (1914) used seven syntypes: *Zenker 1818, Mildbraed 5619, Dinklage 1063, 1153, 1211, 1363* from Cameroon and *Soyaux 16* from Gabon to describe this species. *Zenker 1818* is choosen as type specimen.

Representative specimens examined: **Cameroon**: About 6 km S of Kribi, 2°53'N 9°54'E, 22 Aug. 1969, *J.J. Bos 5241* (BR, MO, WAG); Bifa (piste sur la route Kribi - Ebolowa), 5 km au SE de Zingui, 2º42.672'N 010º15.277'E, 12 Apr. 2007, *V. Droissart & M. Simo 326* (BRLU); Littoral province, Sanaga Maritime: lac Tissongo, 3º35'21.6"N 9º4'24"E, 27 Jan. 2009, *B. Sonké 5212* (BR, BRLU).

Equatorial Guinea: Région continentale. Ngoma (10 km SE de Etembue), layon 25, 1º14'N 9º29'E, 12 Aug. 1998, *J. Lejoly et Elad 98/117* (BRLU); Estuaire du Rio Muni, village Mayang, au bord de la rivière Mitong, 1°09'N 9°56'E, 14 Sep. 1957, *S. Lisowski M-816* (BRLU); Estuaire du Rio Muni, village Mayang, au bord de la rivière Mitong, 1°09'N 9°56'E, 15 Sep. 1997, *S. Lisowski M-891* (BRLU).

51. *Sabicea sanguinosa* (N.Hallé) Razafim., B.Bremer, Liede & Khan, Taxon 57: 14 (2008). — Type: Gabon. Petit Bam Bam, *N. Hallé & Le Thomas 573* (holo-: P; iso-: K, MO, WAG).

Pseudosabicea sanguinosa N.Hallé,Adansonia, ser 2, 11: 313 (1971).

Ecology: This taxon grows in exploitated forest, swamp areas, savannahs and it was found at 150 m elevation.

Chorology and distribution: Lower Guinea Domain: endemic to Gabon.

Representative specimens examined: **Gabon:** Eastern part of the Presidential Reserve Wonga-Wongué, c. 100 km S of Libreville, c. 0°30'S 9°40'E, 28 Feb. 1983, *J.J.F.E. de Wilde, J.C. Arends, A.M. Louis, J.J. Karper & F. Bouman 815* (BR, WAG); ca 10 km au SSE de Batanga, 0°23.70'S 9°20.80'E, 21 May 2001, *M.S.M. Sosef 1613* (WAG); Nyonyie, Transect M2, 0°3.4'S 9°23.0'E, 15 Jul. 1990, *C.M. Wilks 2252* (WAG).

52. *Sabicea schaeferi* Wernham, Monogr. *Sabicea*: 59 (1914). — Type: Cameroon. Bare, *Schaefer 76* (Hb Berol).

Ecology: Forest

Chorology and distribution: Lower Guinea Domain: Cameroon and Gabon.

Note: This taxon is newly recorded in Gabon.

Representative specimens examined: Gabon: *Lachenaud 1544* (BRLU)

53. *Sabicea schumanniana* Büttner in Verh. Bot. Vereins Prov. Brand. 31: 76 (1889); Wernham in Monogr. *Sabicea*: 42 (1914); Hallé, Fl. du Gabon 12, Rubiaceae 1: 196 (1966). — Type: Congo. Type: *Büttner 447* (B†). *Dewevre 287* (BR) designed by Hallé as reference

Sabicea congensis Wernham, Journ. Bot. 56: 309 (1918); Hallé, Fl. du Gabon 12, Rubiaceae 1: 195 (1966). — Type: Congo ex-belge, *Nannan 93* (holo- : BR), **syn. nov.**

Sabicea dewildemaniana Wernham, Monogr. *Sabicea*: 42 (1914). — Type: DR Congo. Bas Congo. *Cabra 93* (holo-: BR), **syn. nov**.

Ecology: This taxon occurs in sunny forested river bank, riparian forest and it was found between 375–660 m elevation.

Chorology and distribution: Upper and Lower Domains: Cameroon, Central African Republic, Congo (Brazzaville), Gabon, Ivory Coast, RD Congo.

Note: This taxon is closely related to *S. schumanniana* from which it differs by its indumentum, the laxer venation of the leaves and large bracts.

Representative specimens examined: **Cameroon:** Near Meyo Ntem on bank of river Ntem, District of Mann, 21 Jan. 1978, *A. Koufani 98* (BR); Km 5, Ngolbang - Mvoutessi, vallée de la rivière Awout, 3º18'N 11º47'E, 17 Dec.1986, *J. Lejoly 86/1135* (BR, BRLU);. Riverbank of Ntem river, west of Ntemasi, 2º20'20"N 10º35'40"E, 11 Feb. 2001, *T. van Andel 3209* (YA, WAG).

Congo-Brazzaville: Forêt du Mayombe, 07 Jan. 1977, I. Bitsindou (BR); Ngandju Sedec (rive française), 09 Jun. 1919, *F. Vermoesen 2747* (BR).

Gabon: Ivindo National Park, Ivindo river downstream from Ipassa, 0º28'55.6"N 12º48'38.4"E, 09 Mar. 2008, *S. Dessein, O. Lachenaud, S. Janssens, Y. Issembe & T. Nzabi 2457* (BR); , Loango National Park, downstream from debarcader at Rabi village, along the Rembo, 1º54'23"S 9º35'04"E, 10 May 2005, *D.J. Harris 8536* (WAG); Tchibanga, c. 2°50'S 11°00'E, Nov. 1907, *G.M.P.C. Le Testu 1253* (WAG).

Ivory Coast: Chemin forestier. Adiopodoumé, 5°20'N 4°09'W, 10 November 1997, *J. Munzinger 8* (BR); Guiglo, relevé 24, 500 m W of Gouléako, 11 Aug. 1983, *A. de Rouw 42* (WAG); Tabou, along the road Tabou-Beriby, 25 Sep.1972, *J. van Doorn 203* (WAG).

DR Congo: Le long du Ruki près d'Eala, 0°05'N 18°16'E, 21 Aug. 1936, G. Coûteaux 73 (BR); Chinganga, 5°4'S 12°32'E, 23 Aug.1895, *A. Dewevre 287* (BR); Près village Boyeka (Équateur), 0°3'N 18°20'E, 28 Aug. 1914, *Nannan 93* (BR).

54. *Sabicea segregata* Hiern in D.Oliver & auct. suc. (Eds.), Fl. Trop. Afr. 3: 77 (1877); Wernham, Monogr. *Sabicea*: 72 (1914). — Type: Gabon. *Mann s.n.* (holo-: K; iso-: P).

Pseudosabicea segregata (Hiern) N.Hallé, Adansonia 3: 172 (1963); Hallé, Fl. du Gabon 12: 218 (1966).

Sabicea henningsiana Büttner ,Verh. Bot. Brand. 31: 79 (1889).

Ecology: This species occurs on roasdside, coastal and secondary forests, secondary regrowth, forest edge, atlantic biafran forest with Caesalpiniaceae and it was found between 10–1080 m elevation.

Chorology and distribution: Lower Guinea Domain: Cameroon, Equatorial Guinea, Republic of Congo, Gabon.

Note: This species is newly recorded from Equatorial Guinea, Republic of Congo.

Representative specimens examined: **Cameroon:** Campo-Ma'an area, Ebodje, along the beach, 2°33.8'N 9°49.6'E, 20 Feb. 2002, *M. Elad, G.P. Tchouto Mbatchou, J. Nganwui & Ondoua 1367* (WAG); Campo-Ma'an area, Mvini, Bigan, Along Transect 7, 2°19.3'N 10°08.4'E, 16 Feb. 2002, *G.P. Tchouto Mbatchou, M. Elad, C. Balogue, J. Nganwui Ondoa & Tamokendu 2524* (WAG); Bipinde, s.c., *G.A. Zenker s.n* (BR).

Congo (Brazzaville): Route de Dimonika à Pounga, 4°16' S 12°26' E, 24 Nov. 1978, *G.H.J. Cusset 520* (MO, WAG); Near Koulila (Mayombe), c.4°14'S 12°25'E, 06 Dec. 1990, *I.F. La Croix 5005* (MO); Kouilou, Kakamoeka, 11 Oct.1990, *S. Lisowski B-8005* (BR).

Equatorial Guinea: Bata - Nasanga: Estrada km 14, c.1°59'N 9°51'E, 17 Oct. 1991, *M.F. de Carvalho 4890* (WAG); Parc National de Monte Alen, dalle rocheuse d'Engong, 5 km à l'ouest du village d'Engong, 1º37'N 10º18'E, 12 May 2002, *I. Parmentier & P. Esono 2781* (BRLU); 4 km N de Mitong, 1°13'N 9° 53'E, 12 Oct. 2003, *B. Sonké 3138* (BR, BRLU, MO).

Gabon: Mintoume, 00º24'422"N 012º15'033"E, 05 Feb. 2005, *Boupoya & Mbazza 185* (BRLU); Gamba, ca. 2º46'S 10º2'E, 24 Sep. 1975, *F.J. Breteler & R.A. van Raalte 5675* (BR); Foot of Doudou mountains, 25-35 km W of Mandji, 1º44'42.0"S 10º12'59.2"E, 15 Feb. 2008, *S. Dessein, O. Lachenaud, S. Janssens, Y. Issembe & T. Nzabi 1862* (BR).

55. *Sabicea solitaria* J.B.Hall in Bull. Bot. Natl. Belg. 50: 253 (1980). — Type: Ivory Coast: forêt de Yapo, 5°48'N 4°10'W, 25 Aug. 2009, *L. Aké Assi 3122* (Hholo-: K; iso-: WAG).

Ecology: This taxon occurs in damp forest.

Distribution: Upper Guinea Domain: Ghana, Ivory Coast.

Representative specimens examined: **Ghana**: 1 mile (c. 1.5 km) N of Ankasa Forest Reserve, c.5°13'N 2°39'W, 05 Apr. 1968, *J.B. Hall & Enti GC38431* (BR, WAG).

56. *Sabicea speciosa* K.Schum., Bot. Jahrb. Syst. 23: 429 (1896); Wernham, Monogr. *Sabicea*: 44 (1914). — Type: Cameroon. Bipindi, 4°28'N 9°04'E, 1896, *G.A. Zenker 1816* (holo-: P).

Ecology: This taxon occurs in secondary and high forests, shaded track in degraded forest and it was found between 120–749 m elevation.

Chorology and distribution: Guineo-Congolian Region: Cameroon, Ghana, Nigeria, DR Congo.

Note: See *Sabicea pilosa.*

Representative specimens examined: **Cameroon:** Eseka - rivière Nyong km 12, 3º38'N 10º45'E, 06 Oct. 1967, P. Bamps 1315 (BR); Bakossi region, near Bangone, on road to Bambele, 4°49'14.8"N 9°34'13.1"E, 25 Mar. 2009, *S. Dessein, O. Lachenaud, B. Lemaire, B. Sonké & H. Taedoumg 2763* (BR); Parc National Deng Deng, 5º12'51.26"N 13º26'44.80"E, 21 Jul. 2011, *B. Sonké, H. Taedoumg, L. Zemagho & N. Kamdem 5833* (BR). **Ghana**: Ankasa F.R., c.5°13'N 2°39'W, 17 Apr. 1981, *D.K. Abbiw 131* (MO).

Nigeria: Oban Group Forest Reserve, West Block of pillar 139, 5°13'N 8°22'E, 08 May 1971, *P.P.C. van Meer 1519* (WAG); Near Awi village, 18 miles N of Calabar, 5°15'N 8°22'E, 14 May 1971, *P.P.C. van Meer 1623* (WAG).

DR Congo: Forêt de Kibiya, Bolobo, 15 Dec. 1951, *H.C. Flamigni 10351* (BR).

57. *Sabicea tchapensis* K.Krause, Bot. Jahrb. Syst. 48: 408 (1912); Wernham, Monogr. *Sabicea*: 58 (1914). — Type:

Sabicea tchapensis var. *glabrescens* Wernham, Monogr. *Sabicea*: 59 (1914).

Ecology: This taxon occurs in savannahs lowland, roadside, gallery forest and it was found between 774–1200 m elevation.

Chorlogy and distribution: Lower Guinea Domains: Nigeria and Cameroon.

Note: Hallé (1966: 181) and Hepper (1958: 292) incorrectly placed *S. tchapensis* and its var. *glabrescens* under *S. efulenensis* which is in fact *S. gabonica*. *Sabicea tchapensis* can be distinguished from *S. gabonica* by its four bracts with the first order slightly fused at the base and the second opposite and decussate to the first in contrast to *S. gabonica* which possesses two wide bracts ovate to suborbicular.

Representative specimens examined: **Cameroon:** Nkolbisson, 7 km W. of Yaoundé, 3°53'N 11°27'E, 19 Jun. 1962, *F.J. Breteler 2993* (WAG); West Province, Mezam, Bali Ngemba

Forest Reserve, Forest patch near Mantum, 5º 49'20.0"N 10º4'50.0"E, 13 Apr. 2004, *M. Etuge 5421* (BR); 5 km from Foumbot, 5°33'N 10°37'E, 07 Jul. 1972, *A.J.M. Leeuwenberg 10158* (BR, WAG).

Nigeria: First hill when coming from Abakpa to the station (Bamond Province, Bamenda District), c. 7°21'N 7°51'E, 15 Feb. 1959, *B.O. Daramola 40615* (BR, WAG); Miliken Hill, road Enugu-Onitsha (Eastern State, Enugu District), c. 6°15'N 7°10'E, 29 Jun. 1972, *J.A. Emwiogbon 63173* (WAG); Mambilla plateau (N.E. State, Maisamari District), c. 6°31'N 11°22'E, 30 Mar. 1970, *Z.O. Gbile & B.O. Daramola 63242* (WAG).

58. *Sabicea uniflora* Zemagho, Sonké & O.Lachenaud **sp nov.** — Type: Gabon: Ngounié, 27 km on the road Mimongo to Koulamoutou, 4 December 2000, *Wieringa, Nzabi & Boussiengui 4567* (holo-: WAG, Figure 8).

Creeping herb up to 16 cm high, Internodes 1.2–10.2 cm long, c. 2 mm thick, glabrous. Stipules interpetiolar, persistent, erecto-patent, ovate, 4 x 2.2–4 mm, appressed trichomes on outer surface more, pilose at the base, glabrous on inner surface, more pilose at the base on both surfaces, ciliate on margin. (c. 0.5 mm long) Leaves opposite with petiole 0.6–4.6 cm with short appressed trichomes (c. 1 mm long). Leaf-blades, ± papery, oblong 1.2–7.9 x 1.2–5.1 cm, cuneate at base, rounded to sub acute at apex; green on both surfaces; upper surface, darkish green, sparsely to densely pubescent with short appressed trichomes (≤ 0.1 mm long) sometimes intermingled longer straight trichomes (c. 1 mm long) more longer on nerves (c. 2 mm long); lower surface palish green.densely puberulent with short appressed trichomes (≤0.2 mm long) more dense and longer on midrib and secondary nerves, clinate on margin (trichomes c. 1 mm long). Bracts 2 pairs not clearly form an involucre; outer pair ovate, 2–4 x 1–1.2 mm, inner pair elliptic 2–4 x 1 mm, pilose outside, glabrous inside. Inflorescence 1-flowered; c. 24 mm long, calyx pink- green outside reddish green inside, 1 x 4 mm, with appressed trichomes outside, glabrous inside; lobes elliptic, 3.5–5 x 1.2–2 mm, woolly trichomes intermingled straight trichomes (trichomes 0.5–1 mm), glabrous or ± sparsely puberulent with short appressed trichomes (c. 0.5 mm long) inside. Corolla white, tube cylindrical, 7–16 x 1–4 mm, with long trichomes on upper part (1–2 mm long) outside; lobes 2–5 x 1.2–2.5 mm, ± glabrous with short woolly trichomes inside; long appressed trichomes outside and more dense on apex, throat shortly hairy. Stamens included in the upper part of the tube, anthers sessile, c. 3 mm, narrow and shortly apiculate. Ovary with 5 locular. Disk cylindrical, 0.9 x 1.2 mm, glabrous. Style 5-lobed, in the corolla throat. Fruit unknown.

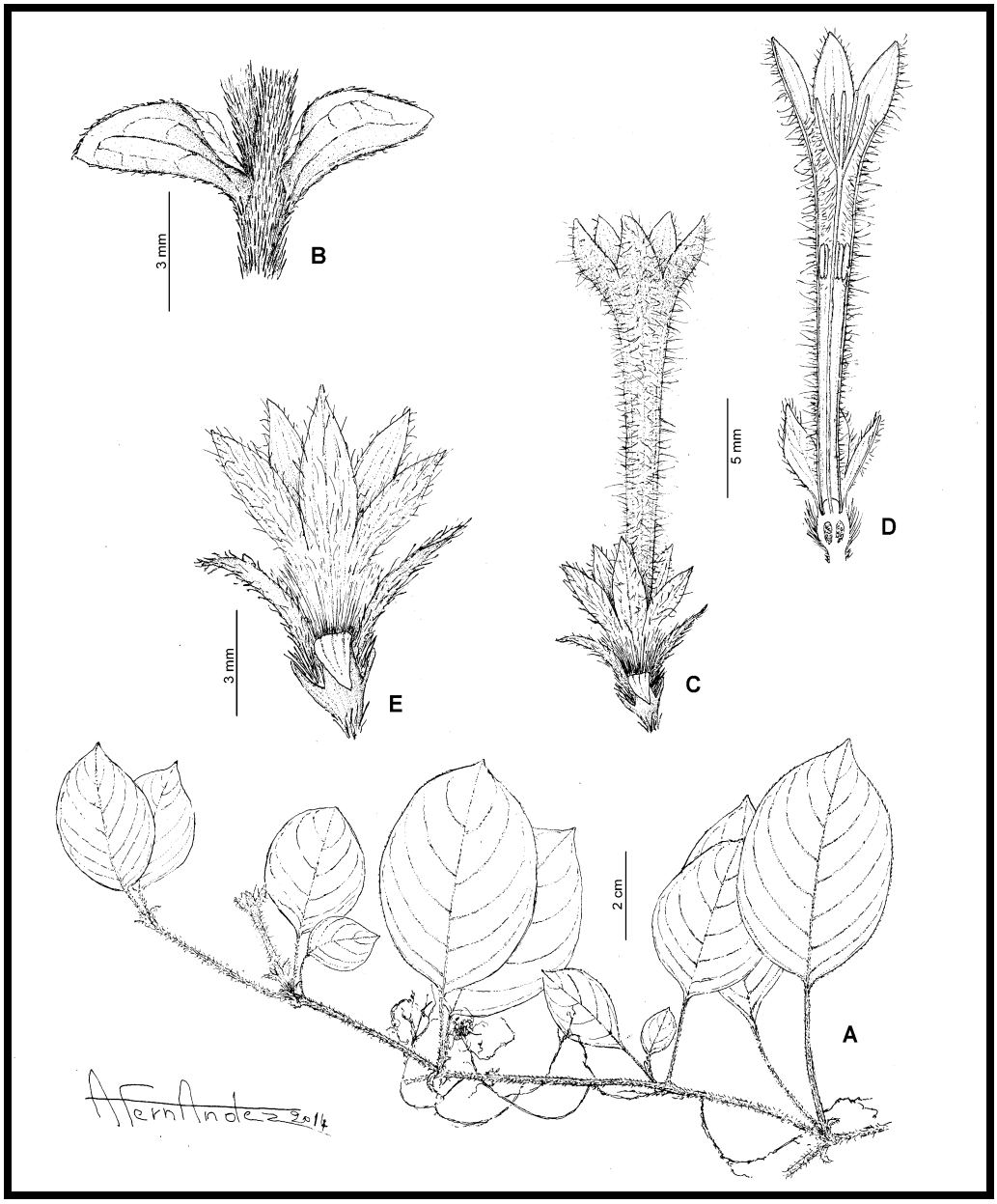

Figure 8. *Sabicea uniflora*: A, Flowering stem; B, Stipules; C, Flower; E, Calyx with bracts; E, Section of long-styled flower. From *J.J. Wieringa et al. 4567*.

Ecology: —This species was found in the primary forest.

Chorology and distribution: Lower Guinea Domain: endemic to Gabon (Fig 3).

Note: In first slight, *S. uniflora* resembles *S. geophiloides*, both species are lower slender plant. *Sabicea uniflora* has a solitary inflorescence (hence the specific name) in contrast to many-flowered in *S. geophiloides*. *S. uniflora* differs also from S. *geophiloides* with its calyx lobes elliptic, (3.5-5 x 1.2-2 mm vs narrowly ovate, 1-2 wide) in *S. geophiloides* with calyx lobes

59. *Sabicea urbaniana* Wernham in Monogr. *Sabicea*: 28 (1914). — Type: Cameroon. Fernando Po, *Mildbraed 7041* (Hb Berol).

Ecology: This taxon occurs in secondary forest, river bank and it was found between 400–500 m elevation.

Chorology and distribution: Lower Guinea Domain: S.W. Cameroon, Gabon

Representative specimens examined: **Cameroon:** South West province, near Bomana waterfalls, ca. 10. km north-east of Idenau, 4º17'N 9º7'E, 23 Feb. 2007, *L.W. Chatrou, S. Huysmans & F.T. Bakker 488* (BR); Mokoko Forest Reserve, Boa village, 4°26'N 8°55'E, 01 Jun. 1994, *N. Ekema, M. Etuge & D. Obasi 1100* (MO); Boa, 4°26'N 8°55'E, 03 Jun. 1994, *D. Pouakouyou & M. Etuge 32* (MO).

Gabon: Between Mouila and Yeno, about 40 km on the road from Mouila, 1°45'S 11°21'E, 23 Sep. 1986, *F.J. Breteler, R.H.M.J. Lemmens & T. Nzabi 8158* (BR).

60. *Sabicea urniformis* Zemagho, O.Lachenaud & Sonké, Phytotaxa 173 (4): 286 (2014). — **Type**: GABON. Ogooué – Maritime: Rabi, in rainforest, near camp, 01°55’S 09°50’E, 24 Mar. 2004, *Breteler et al. 9427* (holo-: BR; iso-: LBV, WAG).

Ecology: This taxon grows in the forest edge and in secondary forest.

Distribution: Lower Guinea Domain: Gabon, Republic of Congo.

Representative specimens examined: Congo (Brazzaville): Kouilou: Mayombe à Béna, 20 Dec. 1990, F. *Dowsett-Lemaire 1434* (BR); Béna, *F. Lisowski B-7164* (BR).
Gabon: Rabi Kounga site 2 S, 1 Jun. 2002, *H.P. Bourobou Bourobou, G. Nang-Essouma & T. Nzabi 681* (MO); Nyanga, Gamba, 12.4 km from Gamba airport in SE direction; 30 Nov. 1994, *J.J.F.E. de Wilde* & *de Wilde-Bakhuizen 11259* (WAG); concession Maurel & Prom près du Lac Ezanga, 22 Nov. 2013, O. *Lachenaud et al. 1532* (BR, BRLU, LBV, MO, P, WAG).

61. *Sabicea urceolata* Hepper in Kew Bull. 13: 293 (1958). — Type: Nigeria. East Nigeria Oban forest reserve, at about mile 66 on Calabow-Mamfe Road, 07 Feb.1957, *Onochie 36325* (holo-: K, iso-: P).

Ecology: This taxon was found in reserve forest.

Chorology and distribution: Lower Guinea Domain: E. Nigeria, Cameroon

Representative specimens examined: Cameroon. Fernando Po: Musola, 09 Jan. 1947, *Emilio Guinea 1053* (MO).

62. *Sabicea venosa* Benth., W.J. Hooker, Fl. Niger: 399 (1849); Wernham, Monogr. *Sabicea*: 32–33 (1914); Hallé, Fl. du Gabon 12: 196 (1966).

Virecta lutea G.Don, Gen. Hist. 3: 521 (1834).

Sabicea kolbeana Büttner, Verh. Bot. Vereins Prov. Brand. 31: 78 (1889).

Sabicea affinis De Wild., Ann. Mus. Congo Belge, Bot 5: 77 (1903); Wernham, Monogr. *Sabicea*: 32 (1914). —Type: DR Congo. Kisantu, 01 Jul 1899, *Gillet 159* (holo-: BR).

Sabicea venosa var. *anomala* Wernham, Monogr. *Sabicea*: 32 (1914).

Sabicea angolensis Wernham, Monogr. *Sabicea*: 42 (1914) — Type: Angola. Loanda, Cazango District, 1903, *Gossweiler 601* (holo-: P), **syn. nov.**

Sabicea amonii Wernham, J. Bot. 57: 277 (1919). — Type: Cameroon. s.l., 1919, *Bates 1411* (holo-: BM), **syn. nov**.

Sabicea entebbensis Wernham, Monogr. *Sabicea*: 33 (1914). — Type: Uganda. Entebbe. *Brown 296* (holo-: K) **syn. nov**.

Sabicea mollis K.Schum. ex Wernham, Monogr. *Sabicea* 33: 1914; Hallé, Fl. du Gabon 12, Rubiaceae 1: 194 (1966). —Type: Congo. N'jobe. *Thollon 104* (holo-: P), **syn.nov.**

Sabicea venosa var. *villosa* K.Schum., Ann. Mus. Congo Belge, Bot. II, 1 (2): 31 (1900)

Sabicea mortehanii De Wild., Pl. Bequaert. 2: 235 (1923). — Type: RD Congo: Dundusana, 15 November 1913, *Mortehan 814* (holo-: BR).

Sabicea pseudocapitellata Wernham, Monogr. *Sabicea*: 36 (1914). — Type: RD Congo. Eala, 05 October 1906, *Pynaert 515* (holo-: BR). **syn. nov.**

Ecology: This taxon occurs in different habitats such as primary and secondary forests, savannahs, open areas, along a track, sunny thicket, riverine forest, *Raphia* swamp, evergreen forest with Caesalpiniaceae and it was found 25–1500 m elevation.

Chorology and distribution: Widespread in Continental Africa: Angola, Burundi, Cameroon, Central African Republic, Republic of Congo, Equatorial Guinea, Gabon, Ghana, Guinea, Guinea Bissau, Ivory Coast, Liberia, Nigeria, DR Congo, Senegal, Sierra Leone, Uganda, Zambia.

Notes: 1. This taxon is one of the most variable in the genus and also one of the most complex taxon. Many species appear in this group as first sight distinct from others based on morphological grounds such as pubescence, venation, but many transitional features occur in this taxon after examination of many herbarium material led to regard many of previously described as a form of this taxon. Moreover, many of them have been described based on examination of a few specimens. It is important that further study be undertaken on this species complex.

2. *Sabicea pseudocapitellata* was described near *S. cameroonensis* which differs in the indumentum of the leaves and the short petioles.

3. Wernham (1914)separated *S. mollis* from *S. venosa* based on the indumentum, nervation, calyx-characters, these characters are difficult to follow when examining a considerable herbarium material.

Representative specimens examined: **Angola:** Entre a ponte do Zadi e Béu andados 10 km, Distrito Uíge, 7°10'25.22"S 15°24'24.51"E, 14 Oct. 1970, *F. Raimundo & C. Matos E Figueira 474* (BR).

Cameroon: Central Province, Mefou proposed national park, Ndanan 1, Track SE of Ndanan 1, 3º37'20.0"N 11º35'01.0"E, 19 Oct. 2002, *M. Cheek 11216* (BR); Mount Kupe, above Nyasoso, 4°49'48.0"N 9°41'26.4"E, 24 Apr. 2009, *S. Dessein, O. Lachenaud, B. Lemaire, B. Sonké & H. Taedoumg 2710* (BR); Yangba (Ngoro), 5º6'18.09"N 11º24'02.06"E, 21 Jul. 2009, *B. Sonké 5310* (BRLU).

Republic of Congo: Kouilou, Béna (Mayombe), 08 October 1990, *S. Lisowski B-7136* (BR); Bouga, Sanga, 15 Jul. 1899, *R. Schlechter 12658* (BR, BM, G, WAG); Pool, Réserve de Chasse de Léfini, banks of the Léfini river near its confluence with the Louna river, c. 20 km upstream from Mbouanbé, 3º00'S 15º28'E, 24 Oct. 1991, *D.W. Thomas, D. Harris & J.M. Moutsamboté 8730* (MO, WAG).

Equatorial Guinea: Bioco: cerca de Moca, 3°20'N 8°40'E, 06 Jul. 1986, *M.F. de Carvalho, Fernández Casas, Regueiro & Tellería 10251* (UPS, WAG); Inselberg de Bicurga, près du village de Bicurga, 1º35'N10º28'E, 20 May 2002, *I. Parmentier & P. Esono 3183* (BRLU); Centro Sur: Parque NaIvory Coastonal de Monte Alén, 1°34'51"N 10°15'15"E, 04 Jul. 1999, *M. Velayos, C. Aedo & R. Pérez-Viso 9484* (BR).

Gabon: 50 km SE of Lambaréné, c. 1º4'S 10º30'E, 01 Oct. 1968, *F.J. Breteler 5763* (WAG); M'passa, c. 0°30'N 12°45'E, 02 Jun. 1977, *J. Florence 509* (WAG); Oveng. Forest exploitation camp, 0°42'N 11°23'E, 06 Nov. 1983, *A.M. Louis, F.J. Breteler & J. de Bruijn 430* (BR, WAG).

Ghana: Elubo, (Ghana-Cote Ivoire Border) approx. 22 km ESE towards Takoradi, along Elubo-Taboradi Road, then N 8 km on road to Ankasa River Forest Reserve, N of Ankasa

River, 5°14'N 2°40'W, 14 Jul. 1995, *D.K. Harder, M.C. Merello, A. Welsing, J. Amponsah & D. Gyeke 3444* (MO).

Guinea: Monts Nimba, c.7°35'N 8°28'W, Apr. 1950, *Schnell 5136* (P).

Guinea Bissau: Fulacunda, Balanasinho; between Lacine and Buba, c. 11°46'N 15°12'W, 03 Apr. 1945, *J.V.G. do Espirito Santo 2105* (MO, NY, WAG).

Ivory Coast: 10 km W of Aboisso along road to Abidjan, c. 5°25'N 3°17'W, 20 Jun. 1975, *H.J. Beentje 475* (WAG); Abidjan. Banco Forest Reserve, Southeastern part, 5º24'N 4º03'W, 09 Jul. 1973, *J. De Koning 1941* (WAG); Near Lamé, 40 km NE of Abidjan, 28 Oct. 1958, *A.J.M. Leeuwenberg 1730* (BR, UPS, WAG).

Liberia: Webo District, Yratoke, c. 4°58'N 7°36'W, Jul. 1947, *J. J.T. Baldwin 6257* (MO, WAG).

DR Congo: Léopoldville, 4°19'S 15°19'E, 09 Apr. 1915, *Bequaert 7279* (BR); Eala, 0°3'N 18°19'E, 15 Apr. 1907, *L. Pynaert 1268* (BR); Kimayala, 5°7'S 15°11'E, 15 Apr. 1925, *P.H. Vanderyst 14669* (BR).

Senegal: Djibélor (Ziguinchor), 12°33'N-16°20'W, 30 Apr. 1963, *R.P. Berhaut 5896* (BR); Basse Casamance, Région de Bignona: forêt de Kalounayes, 12°46'N 16°06'W, 07 Mar. 1964, *R.P. Berhaut 7182* (BR).

Sierra Leone: Senehun, N Kono, 8°10'3.24''N 11°56'41.25''W, 09 Apr. 1965, *J.K. Morton SL1785* (WAG); Gbanbama, 1915, *N.W. Thomas 9366* (MO, NY).

Uganda: Near Entebbe, 0° 5'19.30''N 32°22'29.14''E, 15 Oct. 1935, *P. Chandler 1435* (BR).

Zambia: North-Western province (W province of Flora Zambesiaca), Mwinilunga district. West Lunga river at Mwinilunga, 11°44'S 24°26'E, 23 Jan. 1975, *R.K. Brummitt, S.M. Chisumpa & R.M. Polhill 14037* (BR); Luakera rapids, Mwinilunga - Ikelenge road, 11º31'38.9''S 24º24'47.5''E, 14 Apr. 2004, *S. Dessein, P. De Block, Kissling, J. Ertz & B. Luwiika 957* (BR); Ikelenge District; Zambezi Source National Heritage Site; 18.0 km S of Ikelenge then 4.8 km E on access road from Ikelenge-Mwinilunga Road, 26 Feb. 1995, *Harder, N.B. Zimba, B. Luwiika & M.M. Nawa* 2793 (MO).

63. *Sabicea vogelii* Benth., W.J. Hooker, Fl. Niger: 398 (1849); Hiern, Oliver Fl. Trop. Afr. III: 76; De Wild., Mission Laurent: 278 (1906); Wernham, Monogr. *Sabicea*: 43 (1914). — Type: Sierra Leone. *Don s.n*. (holo-: BM).

Ecology: This taxon is common on regrowth forest, in forest edge, gallery forest, hillside bush, roadside bush and it was found between 16–1600 m elevation.

Chorology and distribution: Upper Guinea Domain: Ghana, Guinea, Ivory Coast, Liberia, Sierra Leone.

Notes*:* 1. *Sabicea vogelii* is closely related to *S. harleyae* (see the differences under *S. harleyae*).

2. In Fl. Niger, the description of *S. vogelii* is correct in regards of the type species and other herbarium specimens found in the same areas but this description did not fit with the illustration. The plate used to illustrate *S. vogelii* is certainly *S. gilletii*.

3. In the same way, *S. vogelii* was cited to occur in DR Gabon. We did not found any *S. vogelii* in the Gabonese specimens and I think the signalisation of this taxon in DR Congo is probably a misidenfication as this taxon can also be confuse with *S. brevipes* and *S. gilletii*. In this fact, we restricted *S. vogelii* to occur in Upper Guinea Domain as *S. harleyae*.

Representative specimens examined: **Ghana**: Mampong, c. 7°04'N 1°24'W, 20 Mar. 1927, *F.C. Deighton 627* (WAG); 18 miles South of Tarkwa. Tarkwa, c.5°18'N 1°59'W, 15 Apr. 1952, *J.K. Morton 6538* (WAG); Simpa, c. 5°06'N 2°06'W, May 1930, *C. Vigne 1959* (WAG).

Guinea: Nzo-Mt Nimba, 7°41'N 8°19'W, 07 Jan. 1949, *J.G. Adam 3110* (MO, WAG); Mont Nimba, c.7°35'N 8°28'W, 30 Jul. 1974, *J.G. Adam 28805* (MO); Kérouane, Simandou North, mountain range, around Damaro, plot 9, 9º03.5'N 8º56.6'W, 12 Feb. 2012, *C.C.H. Jongkind 11257* (BR, WAG).

Ivory Coast: Mount Nimba, c. 7°37'N 8°25'W, 23 Jun. 1958, P. Gruys 62 (WAG); Mount Tonkouï. SW of Man, 7º27'N 7º38'W, 03 Mar. 1959, *A.J.M. Leeuwenberg 2945* (WAG); Mount Tonkouï, NW of Man, 7º27'N 7º38'W, 11 Apr. 1962, *A.J.M. Leeuwenberg 3871* (WAG).

Liberia: 1 mile of Voinjama, along the road to Laoulazu, c. 8°25'N 9°46'W, 16 Jul. 1970, *J.W.A. Jansen 2036* (WAG); Nimba, mount Gangra, 7º32.84'N 8º38.11'W, 12 Jan. 2009, *C.C.H. Jongkind 8423* (BR, WAG); Nimba, east slope of Nimba mountains, 7º31.4'N 8º30.6'W, 08 Apr. 2010, *C.C.H. Jongkind 9568* (BR, WAG).

Sierra Leone: Pic de Tibe, 1914, *J.G. Adam* 104 (MO); Mt Loma- Bintumaue, 9°13'N 11°07'W, 21 Nov. 1965, *J.G. Adam 22097* (MO); Mt Loma-Daoula, 9°09'N 11°07'W, 12 Dec. 1965, *J.G. Adam 22505* (MO).

64. *Sabicea xanthotricha* Wernham, A.B.Rendle & al., Cat. Pl. Oban: 42 (1913); Wernham, Monogr. *Sabicea*: 28 (1914). — Type: S.Nigeria. Oban, *Talbot 249* (holo-: K).

Ecology: This taxon occurs in primary forest.

Distribution: Lower Guinea Domain: Cameroon, S. Nigeria.

Representative specimens examined: **Cameroon**: Mokoko Forest Reserve, 4º27'N 8º59'E, 01 May 1994, *B. Sonké 1082* (BR); Réserve Mokoko, Mundongo, 34 km WNW Muyuka, 4º27'N 8º59'E, *J.F. Villiers 2377* (BR).

Imperfectly known species

Sabicea arachnoidea Hutch & Dalziel, Fl. W. Trop. Afr. 2: 106 (1931).

Sabicea brachiata Wernham in Monogr. *Sabicea:* 68 (1914).

Sabicea composita Wernham in Monogr. *Sabicea*: 64 (1914).

Sabicea cruciata Wernham in Monogr. *Sabicea*: 68 (1914).

Sabicea loxothyrsus K.Schum. & Dinkl. ex Stapf in H.H.Johnston, Liberia 2: 610 (1906).

Sabicea smithii Wernham in Monogr. *Sabicea*:36 (1914).

Sabicea stipularioides Wernham in Monogr. *Sabicea* 27 (1914).

Sabicea parviflora K.Schum. ex Wernham in Monogr. *Sabicea*: 57 (1914).

– *Sabicea* aff. *capitellata "a"*

Ecology: This taxon occurs along track in young secondary forest regrowth, bushes, in forest edge and it was found between 1000–1300 m elevation.

Distribution: Lower Guinea Domain: Cameroon.

Representative specimens examined: Cameroon: Rumpi hills near Dikome Balue, Province: Southwest, 4°54'28.5"N 9°14'54.2"E, 21 April 2009, *S. Dessein, O. Lachenaud, B. Lemaire, B. Sonké & H. Taedoumg 2653* (BR); Manengouba mountains, near Nkongsamba, 4°58'N 9°56'E, 06 October 1972, *A.J.M. Leeuwenberg 9566* (BR, WAG); Manengouba mountains base, 1 km S of village Manengouba, 4°57'N 9°52'E, 10 April 1972, *A.J.M. Leeuwenberg 9578* (BR, UPS, WAG).

– *Sabicea* aff. *capitellata* "c"

Ecology: This taxon occurs on bank of the river, in primary and secondary forests edge and it was found c. 1200 m elevation.

Distribution: Lower Guinea Domain : Cameroon, Equatorial Guinea.

Representative specimens examined: Cameroon: Station du Cacaoyer de N'koemvone, 14 km on the road from Ebolowa to Ambam, on bank of the Seng river, 2°49'N 11°08'E, 25 November 1974, *J.J.F.E. de Wilde 7748* (BR, P, MO, WAG). **Equatorial Guinea**: Région continentale, Parc National de Monte Alen, 5 km au NO d'Engong, 1º37'N 10º18'E, 03

January 1999, *Lejoly 99/116* (BRLU); Région continentale, Parc National de Monte Alen, 5 km au NO d'Engong, 1º37'N 10º18'E, 21 January 1999, *J. Lejoly 99/429* (BRLU).

– *Sabicea* aff. *capitellata"brunneifolia"*

Ecology: This taxon occurs in old and secondary forests, border along exploitation road, roadside and it was found between 350–630 m elevation.

Distribution: Lower Guinea Domain: Gabon.

Note: The first impression was that this taxon is distinct form *S. capitellata* according to first order bracts slightly connate at the base and not naviculate and also the lower side of the leaves brownish to slightly purplish, its short calyces (tube and lobes not exceeding 2 mm long). The pattern of the pubescence is also variable in this taxon. Some specimens are villose with straight trichomes on vegetative parts than others. We refrain however to consider it as distinct species without more investigations.

Representative specimens examined: Gabon. Km 10, Tchimbélé - Kinguele (mont Cristal), 0º38'N 10º25'E, 11 February 1986, *H. Breyne 5103* (BR); Ogooué-Lolo, Forêt des Abeilles, Makandé, 4 km E of Makandé campsite, 0º41.4'S 11º56.5'E, 12 January 2001, *J.J. Wieringa 4108* (BR, WAG); Ngounié, 25 km on the road Ikobey to Egoubi camp, 1º05.54'S 11º07.49'E, 01 April 2004, *J.J. Wieringa 5205* (WAG).

- *Sabicea* sp. aff. "*cauliflora*"

Representative specimens examined: Gabon: 18 km de Libreville, 28 Jan. 1961, *Hallé 931* (WAG).

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