

**Systematics, evolution and historical  
biogeography of the family Ochnaceae with  
emphasis on the genus *Campylopermum***

**Pulcherie Bissiengou**

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**Systematics, evolution and historical  
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**Thesis**

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# Chapter 1

## General introduction



## 1.1 Biodiversity

The evolutionary processes that have led to the astonishing high diversity of tropical rain forests have long fascinated biologists. Understanding these processes is pivotal to shed light on our knowledge of Earth's species (Mora et al. 2011), to identify biodiversity hotspot (Myers et al. 2000; Joppa et al. 2010), and for the determination of the most appropriate conservation strategy (Morley 2000; Sechrest et al. 2002). The global debate on climatic change makes such an understanding even more urgent. Indeed, human activities such as logging, mining or the conversion of forest for agriculture have led to the fragmentation and alteration of many tropical forest areas (Malhi et al. 2008; Hector et al. 2011; Brando et al. 2013; Mayaux et al. 2013; Rudel 2013). These activities contribute to huge biodiversity losses (Wilson 1992; Pimm et al. 1995) and the rise in atmospheric carbon dioxide (Brown 1993; Malhi and Grace 2000) due to the conversion of high-carbon storage of intact forest to low-carbon storage of alternative land-use (Lewis 2006), resulting in climate change (Malhi et al. 2013). Such change may in itself lead to even more severe losses of biodiversity, and hence the study of the diversity and evolution of tropical forests is at the centre of global attention.

Tropical forests cover only ca. 10% of the Earth's land surface (Lewis 2006), but house between half and two thirds of the world's species (Malhi and Grace 2000; Groombridge and Jenkins 2003), suggesting that most of them are still unknown to science (Joppa et al. 2011). Therefore, fundamental research to discover and document tropical forest diversity is still urgently needed to underpin its conservation and sustainable utilization (Mora et al. 2011; Daly et al. 2012).

In Africa, the most species-rich tropical forests are found in the Lower Guinea phytogeographical region (White 1983; Linder, Lovett, et al. 2005; Linder et al. 2012), covering south-eastern Nigeria, Cameroon, Gabon, Congo (Brazzaville) and western Democratic Republic of Congo, and show the highest concentration of endemics (Barthlott et al. 1996; Linder 1998; Cheek et al. 2001; Linder 2001; Mutke et al. 2001; La Ferla et al. 2002). The lowland rain forests of Gabon are reputedly the richest in plant species of the whole of Africa (Breteler 1990; Linder 2001; Mutke et al. 2001; Küper et al. 2004; Sosef et al. 2006; Estrella de la et al. 2012; Linder et al. 2012). From this country alone, several plant species new to science are discovered each year e.g. (Jongkind 2005; Bissiengou and Sosef 2008; Ntore et al. 2009; F. J. Breteler 2011; Lachenaud and Breteler 2011; Van der Maesen and Walters 2011; Sosef and Dauby 2012; Bissiengou et al. 2013; Breteler 2013; Sosef 2013; Van der Maesen 2013). Nonetheless, the area is still botanically under-explored (Sosef et al. 2006; Van der Maesen and Walters 2011), and many species are poorly known or remain hidden for mankind as yet.

Within the Ochnaceae family, the genus *Campylospermum* is one of these groups of plant that show their highest diversity in the Lower Guinea region, but is still in need of a thorough taxonomic revision to document the exact number of species and their individual characteristics, distribution, rarity, etc.

Although the lowland rain forests of Gabon are considered to have high plant species richness, the lack of sufficient local botanical expertise forms an urgent and serious impediment for Gabon (see National CBD Action Plan <http://www.cbd.int/countries/?country=ga>). With only two botanists trained at the PhD level, Gabon is amongst the countries with the lowest amount of local expertise in tropical Africa. This is in sharp contrast with the large need for such expertise in view of the important conservation and eco-tourism developments within the country. The current study, therefore, encompasses a broad field of systematic subdisciplines, applying state of the art techniques as well as some elements that will be important tools for the proper management of Gabon's biodiversity. The Flore du Gabon series, an indispensable tool for any study of Gabonese plants, has been revitalized (Sosef and Florence 2007) and the present project will also contribute to that series. As such, the knowledge and data provided by this project will be immediately applicable within the local setting.

## 1.2 The science of systematics

Although the term 'biodiversity' may refer to many different aspects of the diversity of life (Heywood et al. 1995; Purvis and Hector 2000) it is generally interpreted as referring to the number of species (Lanzerath and Friele 2014). Although species represent the fundamental unit of biodiversity (Claridge et al. 1997), the definition of species is not unanimously agreed upon among biologists. Depending on the nature of the scientific approach (morphological, ecological, genetic or population studies), many species concepts have been proposed and reviewed in textbooks (Cronquist 1988; Coyne and Orr 2004; Stuessy 2009). Because our taxonomic study is mainly based on a morphological study of herbarium specimens, we adhere to the morphological species concept, that is, species being defined by macro-morphological characters or, as defined by (Cronquist 1978), the smallest groups that are consistently and persistently distinct and distinguishable by ordinary means. We think that such patterns of morphological variation are caused by the fact that each species represents a group of interbreeding natural populations that are reproductively isolated from other such group, and hence the biological species concept, which defines species as such (Mayr 1995), is also applicable. However, with no investigations on the reproductive behaviour of *Campylospermum* species, their distinction cannot be tested based on this type of species hypotheses. Sometimes, a concept of discrete species can be inadequate to deal with cryptic species or the occurrence of hybrid intermediates. Population genetics can help to define such

boundaries by revealing the genetic patterns for such problematic situations (Elmer et al. 2007; Dauby et al. 2010; Duminil et al. 2010). As such, the phylogenetic species concept, in which species are the minimal elements appropriate as terminals in a phylogenetic analysis (Davis and Goldman 1993) is considered as well.

Within the field of systematics, species are being described, named and classified in a hierarchical system reflecting the evolutionary relationships. We prefer to name only monophyletic clades, that is groups of species that include all the descendants of a single most recent common ancestor (Page and Holmes 1998), although there is a fierce debate about accepting paraphyletic clades as well (Hörandl and Stuessy 2010). While some consider the terms 'taxonomy' and 'systematics' to be synonymous, others prefer to use the term 'taxonomy' to refer to the process of describing, naming and classifying, while systematics would additionally enclose the phylogenetic and historical biogeographic subdisciplines. Here, we prefer the latter view and will use the term systematics to refer to the broader discipline of classification and evolution.

Systematics is a synthetic discipline, which may draw its data from a wide variety of other fields. Data can be obtained from the organism itself (Stuessy 2009) such as its morphology (Cronquist 1988; Judd et al. 2008; Takhtajan 2009), its anatomy (Gregory 1994; Evert et al. 2006; Rudall 2007), its molecular genetics (Miyamoto and Cracraft 1991; Nei and Kumar 2000; Donoghue and Smith 2004; Felsenstein 2004; Hall 2011; Lewin et al. 2014; Watson 2014), or its phytochemistry (Smith 1976; Ferguson 1980; Gottlieb 1982; Harborne and Turner 1984). Because morphological data is sometimes not easy to interpret, there has been a strong debate amongst systematists about the adequacy of morphological data as opposed to molecular data for the reconstruction of phylogenies (Karp et al. 1998). I believe, however, that the debate of 'molecule versus morphology' is a futile one. Molecules cannot replace taxonomy or vice versa as they simply refer to a different set of characters, both equally important. Disciplines such as biodiversity, ecology, genetic, conservation, molecular systematic and many others rely on taxonomic information to conserve, manage, share knowledge on biodiversity. At any taxonomic level, molecules, on the other hand, are used to infer organismal phylogenies. But, yet a solid taxonomic at species level is still needed. That means real people need go to the field, write up taxonomic publications (revisionary work, Flora's, checklists) and establish the synonymy in order for molecular studies to continue more in-depth studies. Even the recent developments towards DNA Barcoding (CBOL Plant Working Group 2009), needs a preliminary taxonomic framework, as well as correct identification of the material used, both based on morphology, to advance. As such, both molecule and taxonomy contribution has the same value. In conclusion, molecular and morphological data should be seen as service provider to each other and complement one another, providing different types of information to arrive at a sound and stable taxonomic framework.

### 1.3 Phylogeny of Ochnaceae

The usefulness of molecular approaches in analysing phylogenetic relationships at higher rank is eminent. During the past decades, it has led to the change of existing classifications into more natural ones (APG III 2009; Chase and Reveal 2009). The large clade of the Rosids provides a nice example of such changes, demonstrated by numerous studies (Chase et al. 1993; Doyle et al. 1994; Soltis et al. 1997; Nandi et al. 1998; Qiu et al. 1999; Savolainen, Chase, et al. 2000; Savolainen, Fay, et al. 2000; APG III 2009; Chase and Reveal 2009). In Rosids, further changes are ongoing because some phylogenetic relationships are still unresolved, or the monophyly of some clades is still not well supported. Such is also the case within the Rosid order Malpighiales, one of the largest orders of the flowering plants (Wurdack and Davis 2009; Xi et al. 2012), and which includes the Ochnaceae. The order contains about 40 families and more than 16,000 species (Wurdack and Davis 2009; Endress et al. 2013). The current composition of the Malpighiales was first identified by Chase et al. (1993), based on *rbcL* gene sequence data of 499 species of seed plants. Based on the fact that no single gene sequence can provide reliable relationships, additional molecular phylogenetic studies were performed. More data (molecular as well as morphological) and taxa were added (Chase et al. 1993; Nandi et al. 1998; Qiu 1999; Savolainen, Chase, et al. 2000; Savolainen, Fay, et al. 2000; Soltis et al. 2000) to improve the resolution of poorly supported clades within Angiosperms, such as the Malpighiales. Phylogenetic studies on Malpighiales inferred from plastid, mitochondrial and nuclear markers have now provided support for the monophyly of the order and many of its component families (Davis et al. 2005; Korotkova et al. 2009; Wurdack and Davis 2009). Recent attempts using phylogenomic approaches have made significant progress (Xi et al. 2012), while comparative studies of the floral structures, pollen and tapetal evolution, provide a firm phylogenetic foundation (Matthews et al. 2012; Endress et al. 2013; Furness 2013). Nevertheless, within the Malpighiales, some relationships remain unresolved (Wurdack and Davis 2009; Xi et al. 2012), such as the phylogenetic position of the Ochnaceae.

Until about 15 years ago, not much attention had been paid to the question about the systematic position of the Ochnaceae. Apparently, taxonomists were more interested in the taxonomic division within this family. Nevertheless, based on seed and ovule characters, Van Tieghem (1902b, c) suggested two possible phylogenetic positions for the family: either within the order Oxalidales or within the Clusiales. Studies based on gene sequence data now place Ochnaceae as sister to the Medusagynaceae (a monotypic family from the Seychelles) and the Quiinaceae (from tropical America) (Fay et al. 1997; Davis et al. 2005; Schneider et al. 2006; Korotkova et al. 2009; Bell et al. 2010; Soltis et al. 2011). The APG classification (APG III 2009) unites the three families to form an expanded Ochnaceae s.l. which sits in a clade together with the

Clusiaceae, Bonnetiaceae, Hypericaceae, Calophyllaceae and, surprisingly, the weird Podostemaceae. Indeed, Podostemaceae is an aquatic herb occurring only in rapids. Its highly modified morphology is so different from any other angiosperms (Ueda et al. 1997).

Recently, the phylogeny of Ochnaceae has been analysed in more detail (Schneider et al. 2014). This is the first comprehensive molecular phylogeny of Ochnaceae inferred from combined plastid loci (*matK*, *ndhF*, *rbcL*, *trnLF*) and nuclear ribosomal DNA (ITS1, 5.8S, ITS2). The study confirmed the monophyly of the clade uniting the three families and preferred to maintain the APG classification of an expanded Ochnaceae s.l (from now on referred to as Ochnaceae), which consists of three subfamilies: Medusagynoideae Reveal, Quiinoideae Luer and Ochnoideae Burnett. This updated classification brings more stability and the three subfamilies do form distinct monophyletic clades and are morphologically well-characterized (Wurdack and Davis 2009; Matthews et al. 2012; Xi et al. 2012; Endress et al. 2013).

The phylogeny of Quiinoideae has been studied (Schneider et al. 2002; Schneider et al. 2006) and includes four genera: *Froesia* Pires, *Lacunaria* Ducke, *Quiina* Aubl. and *Touroulia* Aubl., with *Froesia* being sister to the rest of Quiinoaceae.

Ochnoideae is by far the largest subfamily of Ochnaceae and has now been subdivided into four tribes: Testuleae Schneider, Luxemburgieae Horan., Sauvagesieae Ging. ex DC. and Ochneae Bartl. The latter is, in turn, is divided into three subtribes (Elvasiinae Schneider, Lophirinae Schneider and Ochninae Kanis ex Schneider). The family has about 500 species in 27 genera (Amaral 1991; Amaral and Bittrich 2014). The Neotropical region comprises the largest number of species: some 300–350 in 15 genera. In Africa, including Madagascar, about 150 species and 9 genera occur (Perrier de la Bâthie 1951; Verdcourt, 2005 #7). The lowest diversity is observed in South-East Asia, hosting 20 species and 8 genera (Kanis 1968; Verdcourt 2005). Potential synapomorphies uniting the Ochnaceae are listed by Matthews et al. (2012) and Endress et al. (2013). The family is also distinguished by having densely spaced parallel secondary veins and the tertiary veins perpendicular to these (Amaral and Bittrich 2014). Flowers are actinomorphic or zygomorphic, basically pentamerous but the number of sepals, petals and stamens is not constant within the family (Matthews et al. 2012; Amaral and Bittrich 2014). Several genera have winged seeds, which are probably wind-dispersed (Amaral and Bittrich 2014), while fruits of others, notably those in the subtribe Ochninae, seem to be adapted to bird dispersal. In Ochnaceae, it is common to encounter adaptations for buzz-pollination (bees or bumblebees are able to grab onto the flower and move their flight muscles rapidly, causing the flower and anthers to vibrate, dislodging pollen), notably those with long, apically poricidal anthers (Kubitzki and Amaral 1991; Nadia and Machado 2005; Matthews et al. 2012).

The objective of our phylogenetic study is to:

- **reconstruct the phylogenetic history of the Ochnaceae family inferred from *matK*, *rbcl* and *trnL-F*, with special emphasis on the Old World genus *Campylopermum*;**

## 1.4 Historical biogeography of Ochnaceae

Ochnaceae is a family of trees, shrubs or rarely herbs (*Sauvagesia* L.). They are widely distributed in tropical and subtropical forests and savannas of the Old and New World.

The Neotropical Ochnaceae are distributed from Central to South America. Central America is poor in species, whereas a high level of endemic species, mainly within the genus *Ouratea*, is observed in the northern part of South America (Sastre 1987). The palaeotropical Ochnaceae are mostly found in the tropical regions of West, Central, East and South Africa (not in the southern part of South Africa where a Mediterranean climate prevails), while few species occur in Madagascar and associated islands (Seychelles and Mascarenes) as well as in the Indo-Pacific region and South-East Asia. A central question is: “How did Ochnaceae acquire their present-day disjunct distribution across all main tropical areas?”

We can distinguish two categories of relevant routes that were potentially used for the migration of plants in the past (Morley 2003). The first comprises routes related to the Gondwana break-up (late Cretaceous, early Tertiary) while the second relates to phases of plate collision (middle Eocene). Plant migration from South to North America might have been possible through different land-connections at different periods of time. Such a land-connection could have been the proto Greater Antilles (50 Ma) or Gaarlandia present during the Eocene-Oligocene (Graham 2003a; Ali 2012). In the early Tertiary, dispersal from northern America and Europe may have been possible via the North Atlantic Land Bridge (NALB). From the early Palaeogene to the late Miocene/early Pliocene, while the Bering Land Bridge (BLB) may have allowed migration from North America to Asia. These land-connections may have been available to many angiosperm plants that now show disjunct distributions between the tropics of South America, Africa and Southeast Asia, e.g. Annonaceae and Rhamnaceae (Richardson et al. 2004), Malpighiaceae (Davis et al. 2002), Lauraceae (Chanderbali et al. 2001) Campanulaceae and Rubiaceae (Antonelli et al. 2009). Here, we want to establish which path (or paths) the Ochnaceae took to move between continents.

To date, the historical biogeography of Ochnaceae has never been subject of a detailed study, mainly because a comprehensive molecular phylogenetic hypothesis was lacking. Although the Ochnaceae have originated in the late Cretaceous (Davis, et al. 2005; Xi, et al. 2012), the geographic origin of the family is still uncertain. Moreover, the position

of Ochnaceae within Malpighiales has been unclear until recently, when Xi et al. (2012) inferred that they are sister to the Clusioid clade, though with low support (Bayesian posterior probability = 0.81). Furthermore, looking at their phylogenetic tree, the branch between the stem node and crown node of the Ochnaceae reflects some 30 million years of non-traceable divergences. Because of this, it is difficult to reconstruct the biogeographic history of the family (especially the ancestral area of the crown node) with confidence. Nevertheless, the phylogeny produced within this study will be used to:

- **reconstruct the biogeographic history of the Ochnaceae family, with a special focus on the assessment of its area of origin;**
- **estimate divergence times of Ochnaceae lineages, with a special focus on the disjunctions between the Neotropical and Palaeotropical Ochnaceae lineages.**

## 1.5 Systematics of *Campylopermum*

Species of the genus *Campylopermum* Tiegh. are treelets with various architecture sensu Hallé et al. (1978) and occur in the African and Asian tropics. Within Africa, *Campylopermum* occurs from Senegal to Angola in the West and from Ethiopia to Madagascar in the East (Farron 1985). In Asia, the distribution extends into eastern China and the Malesian region (Kanis 1968). It belongs to the subfamily *Ochnoideae*, tribe *Ochneae*, subtribe *Ochninae* (Schneider et al. submitted). This subtribe contains five other genera: *Brackenridgea* A.Gray, *Idertia* Farron, *Ochna* L., *Ouratea* Aubl. and *Rhabdophyllum* Tiegh. *Brackenridgea* and *Ochna* were formerly placed into the subtribe *Ochninae* and the rest into *Ourateinae* (Farron 1963; Kanis 1968; Farron 1985; Sastre 1988; Sosef 2008, 2013). They are characterized by having a five-parted perianth, a gynobasic style, almost free carpels that are post-genitally fused, and a receptacle that becomes reddish and swollen in fruit (Schneider et al. submitted). While *Brackenridgea* and *Ochna* generally have numerous anthers, the other genera have ten.

Because flowers of *Campylopermum* are fairly uniform, characteristics of the leaf shape and venation, as well as the inflorescence structure have often been used to distinguish the species. This has led to a situation where the species are sometimes difficult to tell apart by a non-specialist. Farron (1965, 1985) worked intensively on the continental African *Campylopermum* species and subdivided the genus into six sections. His sectional subdivision was heavily based on the shape and position of the embryo and its cotyledons. Section *Bisetaria* Tiegh. included a single species, *Cercanthemum* Tiegh. three species, *Campylopermum* six species, *Diphyllopodium* Tiegh. three species, *Notocampylum* Tiegh. eight species and *Monelasmum* Tiegh. 15 species. To date, the total number of species lies close to 50 (Bissiengou et al. 2013).



The African *Campylospermum* have never been fully revised, although Farron (1963, 1965, 1968, 1985) and others (Robson 1963; Bamps and Farron 1967; Verdcourt 2005) published useful parts for such a revisionary work, at least of the continental species. Perrier de la Bâthie (1951) treated five *Campylospermum* species known from Madagascar. This number will almost certainly increase with new species that are not yet described but already stored in herbaria, which act as the major facilities for species discovery (Bebber et al. 2010). Farron (1985) established an identification key as well as the geographical distribution of each of the continental African species, but he never published full species descriptions, apart from the sixteen species treated in the *Flore d'Afrique centrale* (Bamps and Farron 1967). In his identification key, species are not keyed out according to their sectional arrangement. Furthermore, the list of accepted names and synonymy that he published in 1965 is, unfortunately, incomplete, which leaves us with several names of uncertain status. The phylogeny of the genus *Campylospermum* has never been studied, rendering the intrageneric classification proposed by Farron uncertain. Besides that, some doubts have arisen concerning the monophyly of the genus and its distinction with the genera *Idertia*, *Rhabdophyllum* and *Ouratea*. The objective of our study on the genus *Campylospermum* is to:

- **undertake a full taxonomic revision of the continental African species of *Campylospermum*, including a user-friendly identification key;**
- **assess the IUCN conservation status of each *Campylospermum* species;**
- **assess whether or not the genus comprises a monophyletic group;**
- **assess the phylogenetic relationships within the genus, and its taxonomic consequences for the sectional arrangement.**

## 1.6 Methodologies used in this study

### 1.6.1 Taxonomic part

#### *Herbarium and library*

The study starts with a thorough literature study, aiming to identify all publications that have ever been published concerning *Campylospermum*. This is done in order to identify all taxon names formerly published in the literature and to compile a definitive list of species names that need to be treated in this study. Furthermore, all data related to herbarium specimens (at least for those species occurring in continental Africa) are compiled using the BRAHMS database of the National Herbarium of the Netherlands, supplemented with electronic data obtained through the GBIF portal (<http://www.gbif.org/>) and the Aluka African Plant Initiative Database (<http://www.aluka.org/page/content/plants.jsp>). This is done in order to assess the location of all type specimens and to choose from which herbaria material should be asked on loan. Visits were realized to

herbaria such as BM, BR, K, and P that keep important collections of *Campylospermum*, in order to study their material. In all, over 4500 herbarium specimens are incorporated in this study.

### **Field work**

Field trips in Gabon and Cameroon yielded additional morphological observations not available from herbarium material of the *Campylospermum* species. Additionally, an attempt was made to make observations on pollination, phenology (flowering and fruiting periods) and seed dispersal, on which still no data existed.

During the field trips, 257 herbarium specimens were collected, representing 26 species, that is, more than 90% of the species occurring in both countries.

### **IUCN conservation status**

Despite all these efforts, our knowledge about some of the African *Campylospermum* species is still limited. Some are known from only one or two flowering collections, others seem to have a very restricted distribution area. Several species new to science have been discovered and described. In order to contribute to their conservation, a preliminary assessment for an IUCN conservation status (Red Data List) of each species was realized. Gabon has reserved more than 10% of its surface for conservation purposes, while Cameroon is close to doing the same. Such data is thus most welcome for park management and priority settings.

## **1.6.2 Phylogenetic part**

### **Taxon sampling**

Fresh DNA material was collected in the field especially from species in the genera *Campylospermum*, *Idertia*, *Lophira*, *Ochna*, *Rhabdophyllum*, *Sauvagesia* and *Testulea*. Species not encountered in the wild were sampled from herbarium material. Our final taxon sampling (Chapter 4 and 5) of Ochnaceae comprises all genera, except *Indosinia* J.E.Vidal which could not be obtained from herbarium nor from a silica sample.

### **Character sampling**

Sequence data for *matK*, *rbcL* and *trnL-trnF* (including the *trnL* intron, *trnL* 3' exon and *trnL-trnF* intergenic spacer) are produced. For many taxa only herbarium material was available, which often yielded low quality DNA. Amplification and sequencing of samples from herbarium specimens often fails due to the highly degraded nature of the DNA (Särkinen et al. 2012). Because of that, sequences of some taxa contain a high amount of missing data. However, it has been shown that the accuracy of phylogenetic analyses is robust as to the inclusion of incomplete taxa, even when the amount of missing data is substantial (Cho et al. 2011; Wiens and Morrill 2011). Therefore, taxa with incomplete

sequence data from all currently recognised subfamilies (Medusagynoideae, Quiinoideae and Ochnoideae) were included in our data set. In some cases, complete sampling of terminal taxa was obtained by sampling sequences from different individuals of the same species (Campbell and Lapointe 2009), thus creating composite terminal taxa.

### ***Phylogenetic inference***

The methods used to infer phylogenetic trees were Maximum Parsimony (MP), Maximum Likelihood (ML) and Bayesian inference. MP is a non-parametric method whereas the other two are model-based. MP searches for the tree topology which relates to the minimal amount of character state changes (in DNA sequence data these are actually nucleotide substitutions), assuming such a tree needs the lowest amount of ad-hoc hypotheses and hence is our best estimate of the actual phylogeny (Page and Holmes 1998). However, it is also possible to represent state changes via models of DNA sequence evolution. Many such model-based methods of tree inference were reviewed by Felsenstein (2004). Of these methods, ML and Bayesian phylogeny inference both use likelihood function, which provides the probability that the tree has given rise to the data observed. Bootstrap values are used to indicate supports of clades in the phylogenetic tree. To reconstruct the phylogeny of Ochnaceae, we used coding and non-coding gene regions that have different underlying evolutionary histories. To make sure that support of clade relationships depicted in the phylogenetic tree are consistent with the evolutionary histories of both types of gene regions, bayesian inferences are applied. In Bayesian inferences, parameters are allowed to vary randomly within the limits of a pre-defined parameter space, or prior distribution. This prior probability, combined with likelihood functions, provides the posterior probability distribution, which is the basis of Bayesian inference.

### **1.6.3 Molecular dating**

#### ***Divergence times***

Since any dating analysis will ultimately depend on the quality of branch length estimations, likelihood and Bayesian analyses are generally preferred over parsimony methods. Subsequently, the phylogenetic tree was tested for clock-like accumulation of the nucleotide substitutions using the software BEAST (Drummond and Rambaut 2007). BEAST is a cross-platform programme for Bayesian MCMC analysis of molecular sequences. It is entirely orientated towards rooted, time-measured phylogenies inferred using strict or relaxed molecular clock models (Drummond and Rambaut 2007). BEAST has the advantage of being flexible when defining parameters of an evolutionary model. Our dataset comprises coding and non-coding aligned DNA sequences. BEAST analyses allows us to define a different substitution rate for each partition, resulting in a different amount of rate heterogeneity among sites. In fact, any or all parameters (including

the tree itself) can be shared or independent among partitions of the sequence data (Drummond and Rambaut 2007).

Ochnaceae fossil records being unknown, secondary calibration is used under the relaxed molecular clock models.

### **Ancestral area reconstruction**

To infer biogeographic histories, model and event-based approaches are available but each of them does have their own limitations. For instance, Dispersal-Vicariance Analysis (DIVA) (Ronquist 1997; Ronquist 2001) is one of the most widely used methods for inferring biogeographic histories, but its current implementation raises two issues. First, it ignores the uncertainty in phylogenetic inference because ancestral ranges are reconstructed onto a fixed tree topology, which is assumed to be without error (J. A. A. Nylander et al. 2008). A second issue is that multiple equally optimal reconstructions often result in multiple ranges suggested at ancestral nodes (Ronquist 1997; J. A. A. Nylander et al. 2008). To deal with these uncertainties, Nylander et al. (2008) showed the utility of a non-parametric empirical Bayesian approach to DIVA. Their approach handles phylogenetic uncertainty and uncertainty in DIVA optimization. Yu et al. (2010) proposed Statistical Dispersal-Vicariance Analysis (S-DIVA), a programme which complements DIVA and determines statistical support for ancestral range reconstructions using a novel method, the S-DIVA value. The Reconstruct Ancestral State in Phylogenies (RASP) software developed by Yu et al. (2013) is another useful tool for biogeographic inference. It implements three methods, S-DIVA, Bayesian binary MCMC (BBM) and Maximum Parsimony (MP) analysis. In S-DIVA, the frequencies of an ancestral range at a node in ancestral reconstructions are averaged over all trees and each alternative ancestral range at a node is weighted by the frequency of the node occurring or by some other measure of support (posterior probabilities) for the node Yu et al. (2010). In this study, the RASP software was used to test which path (or paths) Ochnaceae took to move between continents.

## **1.7 The study outline**

The goal of this study was to investigate the evolution and historical biogeographic scenarios of the family Ochnaceae, with a special focus on the African genus *Campylospermum* for which a taxonomic revision needed to be prepared first. The current study is divided into two major parts, viz, (1) Taxonomy and (2) Phylogenetics and Biogeography. Data concerning these two parts have been gathered from the study of living (field) and conserved (herbarium specimens) material. To clarify the taxonomy of the genus *Campylospermum* more than 4500 specimens have been carefully studied. The necessary formal description of new species and new combinations are presented

in Chapter 2. In Chapter 3, we present a full taxonomic revision of the continental African species of *Campylospermum* which provides the key diagnostic characters for each of them. One of the practical applications of this chapter is the establishment of an identification key for all continental African species. A preliminary assessment of the IUCN conservation status of each species is included for park management and priority settings.

The phylogeny of the family Ochnaceae has been recently studied based on combined chloroplast and nuclear gene regions. Chapter 5 provides the results of a much more extended study, including DNA sequence data from eastern African and Malagasy species of *Campylospermum*. This phylogeny is based on a data set comprising three chloroplast markers (*matK*, *rbcL*, *trnLF*). Together with information on geography and fossils, as well as two additional markers, *ITS* and *ndhF*, chapter 5 provides a framework for hypotheses on the vicariance and dispersal events that have led to the distribution of extant Ochnaceae species.



# Chapter 2

## Taxonomic novelties in the genus *Campylospermum* (Ochnaceae)

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## Abstract

Four new species, one with two subspecies, of the genus *CampylospERMUM* are described, all endemic or sub-endemic to Gabon. These are *C. auriculatum*, *C. gabonensis*, *C. gabonensis* subsp. *australis*, *C. glaucifolium* and *C. occidentalis*. Distribution maps and scans of the holotypes are provided as well as preliminary IUCN Red List assessments. New combinations for nine species formerly assigned to the genus *Ouratea* and/or *Gomphia* are proposed: *C. andongensis*, *C. glomeratum*, *C. longestipulatum*, *C. lunzuensis*, *C. lutambensis*, *C. nutans*, *C. plicatum* and *C. warneckei*. Finally, one taxon is raised from the variety to species level, leading to the new combination *C. costatum*.

**Keywords:** Africa, *CampylospERMUM*, conservation, Gabon, *Gomphia*, IUCN Red List, *Ochnaceae*, *Ouratea*, Taxonomy



## 2.1 Introduction

The genus *CampylospERMUM* has about 50 species occurring in continental Africa, Madagascar, extending east to China and the Malesian region. It belongs to the subfamily *Ochnoideae*, tribe *Ochnaceae*, subtribe *Ouratinae* (Kanis 1968). This subtribe contains three other genera: *Rhabdophyllum* Tiegh. (Africa, 8 species), *Ouratea* Aubl. (Neotropics, c. 140 species) and *Idertia* Farron (Africa, 3 species; Farron 1985, Kanis 1968, Sastre 1988, Sosef 2008). In contrast to *Ochnaceae* specialists who recognized these genera as being distinct, generalists more often preferred a broader genus concept in which *Oura-tea* comprises the genera *CampylospERMUM* and *Idertia* (e.g. Hutchinson et al. 1954), and sometimes even *Rhabdophyllum* (e.g. Aké Assi & Gautier 2000, Verdcourt 2005).

The new species published here are part of our on-going research efforts on the systematics of *Ouratinae* in cooperation with the Senckenberg Research Institute at Frankfurt. *Rhabdophyllum* was revised recently (Sosef), but notably the taxonomy of *CampylospERMUM* is still unclear. The first author is preparing her PhD thesis on the taxonomy, phylogeny and biogeography of *Ochnaceae*, with an emphasis on *CampylospERMUM*. Most of the novelties resulting from her taxonomic work on the continental African representatives are presented here. Molecular phylogenetic work in progress (Bissiengou, unpubl. data) has not yet led to sufficient resolution in the phylogenetic tree and hence does not yet allow resolving the relationships among the four *Ouratinae* genera. Being unable to anticipate future phylogenetic results, for now we adopt a conservative approach and adhere to generic concepts based on morphology.

The generic name *Gomphia* Schreb. [1789] is to be regarded as a synonym of the older *Ouratea* Aubl. [1775], following a complex lectotypification (Kanis 1967, Bittrich & Amaral 1994). Unfortunately, the latter publication was apparently missed by Verdcourt (2005), who followed Kanis (1967) and thus erroneously re-introduced the genus name *Gomphia* in African botanical literature.

Tropical African *Ochnaceae* have been treated in various Flora's (Bamps & Farron 1967, Hutchinson et al. 1954, Robson 1963, Verdcourt 2005). However, species occurring in the Lower Guinean area (part of the Guineo-Congolian floristic region, or phytochorion; White 1979) remain without a proper taxonomic treatment to date. Although Farron (1965, 1968, 1985) published important contributions to the taxonomy of African *Ouratinae*, relevant for this area, our knowledge about this group remains highly incomplete. This information gap is seen in many other plant groups and is especially relevant in the light of the fact that the lowland rain forests of the Lower Guinean region (notably those in Cameroon and Gabon) are regarded as the most species-rich of tropical Africa (Mutke et al. 2001, Linder 2001, Küper et al. 2004, Sosef et al. 2006, Estrella de la et al. 2012, Linder et al. 2012). For this area, taxonomic revisions are indispensable, since in some cases they directly contribute to datasets that help prioritize conservation efforts (e.g. Burgess et al. 2005). The Flore du Gabon production tries to address the knowledge gap (Sosef & Florence 2007), but its existence as

well as the extraordinary species richness of Lower Guinea is further emphasized by the fact that all species in African *Oura-tinae* that have been described during the past 25 years (e.g. Sosef et al. 2007, Bissiengou & Sosef 2008, this publication) are endemic or sub-endemic to Gabon. Along with the fact that the botanical exploration of Gabon is far from complete (Sosef et al. 2006), this means that still many other novelties may be expected to emerge from Gabon's lush vegetation (see for example Walters et al. 2011).

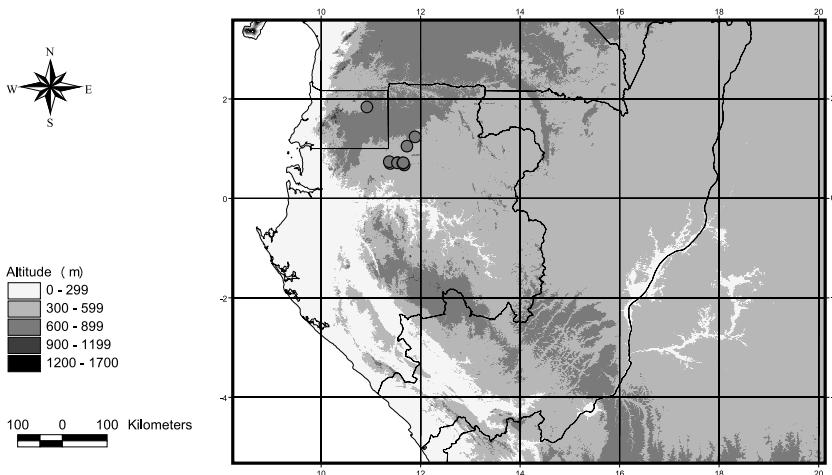
## 2.2 Materials and Methods

To perform the taxonomic revision of the genus *Campylosperrum*, herbarium material from the following herbaria has been consulted (acronyms follow Thiers 2012): A, B, BAS, BM, BR, BRLU, C, COI, E, EA, FHO, G, K, L, LBV, LISU, LY, MA, MO, NEU, P, PRE, S, SRGH, US, WAG, Z.

All specimen data have been entered into the BRAHMS (Botanical Research and Herbarium Management System) database of the National Herbarium of the Netherlands (now part of the Naturalis Biodiversity Center). To perform an assessment of the IUCN category of threat for each taxon, the BRAHMS software was used in combination with ArcView 3.3 and the IUCN Red List add-in script developed by Moat (2007). Assignments follow the IUCN guidelines (IUCN Standards and Petitions Subcommittee 2011), but not the advice to set the cell width/height to 2 km. Instead, a sliding scale grid cell width is applied, which is deemed more appropriate for herbarium record data (Moat 2007). We define a 'location' as a single grid cell. All assignments will be sent to IUCN for approval in the near future, which is why we characterize them as 'preliminary' for now.

## 2.3 New Taxa

*Campylosperrum auriculatum* Biss., *sp. nov.* — Fig. 1; Map 1



Map 1. Distribution of *C. auriculatum* Biss.

**Diagnosis:** This species resembles *C. schoenleinianum* (Klotzsch) Farron because of its auriculate to deeply cordate leaf base, but differs by the leaf blade being broader in the basal part, and by having caducous stipules, a serrate leaf margin, a flattened peduncle and shorter and more compact racemes of 3–11 cm long.

*Type:* Strijk 73 (holo WAG; iso LBV), Gabon, Woleu-Ntem, Bordamur con-cession area, some 40 km from WWF-station, N1°14', E11°53', 10 Oct. 2002.

Understorey treelet up to 6 m tall. *Stipules* caducous, 3–5 mm long. *Leaves:* petiole 0–2 mm long; leaf blade elliptic-obovate to oblanceolate, (9–)14–24(–31) by (4–)6–8(–11) cm, base auriculate to deeply cordate, often clasping the twig, apex acute, coriaceous to thick leathery, margin serrate, upper surface glossy green, lower surface dull paler green; midrib flattened above, prominent below, main lateral veins 10–20 mm apart, 16–19 on either side, curved upward to run parallel to the margin, intermediate lateral veins prominent on both sides, 0–2 in between each pair of main laterals, tertiary venation scalariform, very distinct on both sides. *Inflorescences* terminal or rarely axillary, its main axis 12–15(–18) cm long, flattened; racemes 1–6, 3–9(–11) cm long; pairwise scales absent; bracts persistent at the base of the raceme and pedicel, triangular, c. 3–5 mm long; cymules 5–9 mm apart, 2–4(–6)-flowered. *Flowers:* pedicel 5–7 mm, articulated at 2–3 mm from the base; sepals 5, ovate, in flower 7–8 by 2–3 mm, yellowish green, in fruit persistent and accrescent, 9–10 by 3–4 mm, bright red; petals 5, obovate, 7–12 by 3–4 mm, cuneate at base, rounded at apex, bright yellow; stamens 10, caducous, orange-yellow, filaments less than 1 mm long, anthers 3–4 mm long, transversely wrinkled, poricidal; ovary c. 2 mm wide; style c. 4 mm long, curved, yellow. *Fruits:* receptacle a ± flattened-globose shape, c. 5 mm wide, orange-red; drupelets 1–3 well developed per receptacle, reniform, c. 8 by 5 mm, black at maturity; cotyledons incumbent, dissimilar in size with a small outer cotyledon.

**Distribution:** Equatorial Guinea (Rio Muni) and Gabon (Woleu-Ntem province).

**Ecology:** In primary or secondary forest; on brown clay soil; at 475–600 m altitude.

**Phenology:** Flowers and mature fruits collected from October to November, flowers also observed in April, which coincides with the two rainy seasons.

**Preliminary IUCN conservation status:** VU B1/B2ab(ii, iii, iv). EOO = 6098 km<sup>2</sup>, AOO = 1653 km<sup>2</sup>, locations = 7 (cell width = 15.37 km). All collections have been made recently (the oldest one is from 1983). The only collection from Equatorial Guinea is from within a protected area (Inselberg at Akuom). The other ten collections from Gabon are from a fairly restricted area where logging companies operate which may lead to a decline in the AOO and/or extent of suitable habitat and hence we propose the 'Vulnerable' category.



**Figure 1.** Strijk 73 at WAG, holotype of *C. auriculatum* Biss. **Figure 2.** *C. auriculatum* in fruit (photo by Y. Issembé).

**Additional material:** EQUATORIAL GUINEA, Rio Muni, Wele Nzas: *Parmentier 358* (BRLU), Inselberg d'Akuom, à 1h30 de marche (6 km) du village de Nzameyong, à 25 km d'Anisoc, N1°50' E10°55', 600 m, 13 June 1999 (st).—GABON, Woleu-Ntem: *Bissiegou 667* (LBV, WAG), c. 8 km SSW of Mitzic, FOREENEX forest exploitation, N0°42.9' E11°32.0', 547 m, 6 Nov. 2009 (fr); *Bissiegou 707* (LBV, WAG), 8.5 km SSW of Mitzic, FOREENEX forest exploitation, N0°42.5' E11°31.9', 501 m, 6 Nov. 2009 (fl); *Bissiegou 714* (LBV, WAG), 13 km SE of Mitzic, FOREENEX forest exploitation, road from forestry camp to Madouaka village, N0°42.4' E11°38.2', 480 m, 7 Nov. 2009 (fl); *Bissiegou 730* (LBV, WAG), 13 km SE of Mitzic, FOREENEX forest exploitation, road from forestry camp to Madouaka village, N0°42.1' E11°38.8', 490 m, 7 Nov. 2009 (fr); *Bissiegou 769* (LBV, WAG), 35 km NNE of Mitzic, forestry road in Bordamur forest exploitation, 2 km from forestry camp, N1°02.8' E11°43.3', 545 m, 8 Nov. 2009 (st); *Breteler 8797* (LBV, WAG), 30–40 km NE of Saint Germain, E of Okano River, c. N0°40' E11°40', 475 m, 18 Apr. 1988 (fl, fr); *A.M. Louis 377* (K, LBV, WAG), Oveng, 65 km N of road Benguié-Lalara, forest exploitation camp, N0°42' E11°23', 500 m, 5 Nov. 1983 (fl, fr); *Maas 10052* (LBV, WAG), RN 2, S of Mitzic, FOREENEX-concession, N0°42.8' E11°38.9', 503 m, 30 Oct. 2011 (fl); *Reitsma 2493* (WAG), Inventory Oveng, c. 25 km WSW of Mitzic, N0°44' E11°22', 6 Nov. 1986 (fl, fr).

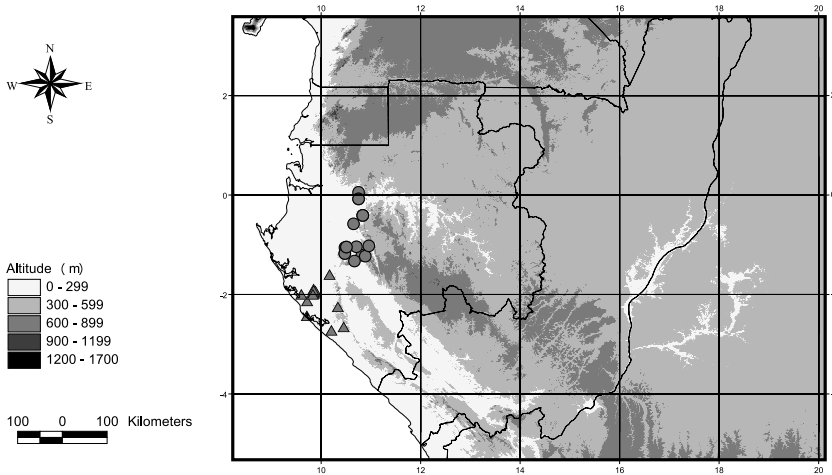
**Note:** Especially the auriculate to deeply cordate leaf base is highly reminiscent of *C. schoenleinianum*, a species confined to western tropical Africa (from Guinea to Ghana).

***Campylospermum gabonensis* Biss., sp. nov.**

**Diagnosis:** A species resembling *C. claessensii* (De Wild.) Farron, but with persistent, 7–15 mm long, stipules and an un-branched and compact inflorescence.

**Type:** *Breteler & Breteler-Klein Breteler 13124* (holo WAG; iso LBV, WAG), Gabon, Moyen-Ogooué, c. 20–30 km NNW of Ndjolé, N0°03' E10°45', 2 Oct. 1994.

⇒ subsp. *gabonensis* — Fig. 3; Map 2



**Map 2.** Distribution of *C. gabonensis* Biss. subsp. *gabonensis* (dots) and subsp. *australis* Biss. (triangles).

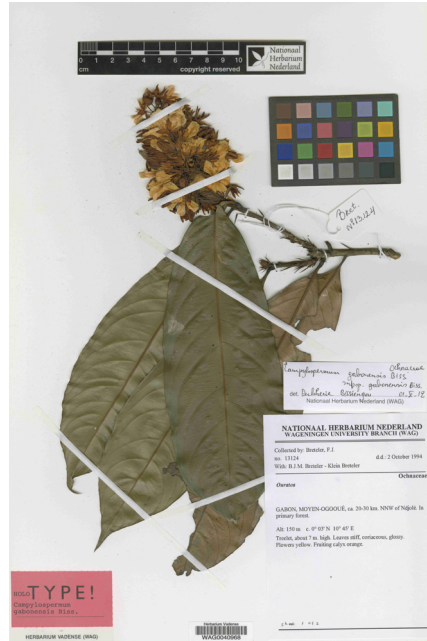
Tree or treelet, up to 7 m tall. *Stipules* persistent, narrowly triangular, 7–15 cm long. *Leaves*: petiole canaliculated above, 3–7 mm long; leaf blade narrowly elliptic to narrowly elliptic-obovate, 16–30(–35) by 6–10(–11) cm, base cuneate to tapering, apex acuminate or sometimes acute, thick leathery to coriaceous, margin serrulate or sometimes entire toward the base, rarely entire, upper surface flat or rarely bullate, dark green, lower surface paler green, both sides glossy, young leaves purple-red; midrib flattened above, prominent below, main lateral veins 6–23 mm apart, 14–27 on either side, prominent on both sides, curved upward to run parallel to the margin, intermediate lateral veins not to slightly prominent on both sides, 0–2 in between each pair of main laterals, tertiary venation scalariform, running perpendicular to the midrib, indistinct on the upper side, slightly distinct on the lower. *Inflorescences* terminal, unbranched, erect, compact, 3–13 cm long; peduncle robust; pairwise scales persistent at the base of the peduncle, narrowly triangular; bracts persistent at the base of the cymule, triangular, 2–3 mm long; cymules 3–5(–10) mm apart, 4–8-flowered. *Flowers*: pedicel 5–15 mm, articulated at 3–9 mm from the base, pale green; sepals 5, ovate, in flower 7–9 by 2–3 mm, greenish, in fruit 9–10 by 3–4 mm, persistent and accrescent, red; petals 5, obovate, yellow, 10–15 by 5–9 mm, cuneate at base, rounded at apex; stamens 10, pale yellow, filaments less than 1 mm long, anthers 5–7 mm long, transversely wrinkled, poricidal; ovary c. 2 mm wide; style 6–7 mm long, curved. *Fruits*: receptacle a ± flattened-globose shape, 3–4 mm wide, red; drupelets 1–2 well developed per receptacle, ellipsoid, c. 7 by 5 mm, black at maturity; cotyledons incumbent, dissimilar in size with a smaller outer cotyledon.

**Distribution:** Endemic to Gabon (Moyen-Ogooué and Ngounié provinces).

**Ecology:** In primary and secondary forest, sometimes along rivers or streams; at 70–400 m altitude.

**Phenology:** Flowers observed from August to November and in April; fruits collected from October to January.

**Preliminary IUCN conservation status:** VU B1ab(ii, iii, iv). EOO = 4476 km<sup>2</sup>, AOO = 2348 km<sup>2</sup>, locations = 10 (cell width = 15.32 km). All known records of this taxon are from areas exposed to mining and/or logging activities rendering a projected decline in its AOO and/or quality of the habitat most likely and hence we propose the ‘Vulnerable’ category.



**Figure 3.** *Breteler 13124* at WAG, holotype of *C. gabonensis* Biss.

**Additional material:** GABON, Moyen-Ogooué: *Azizet Issembé 176* (LBV, WAG), Camp Mboumi, Base, c. S0°25' E10°50', 16 Aug. 1999 (fl); *Breteler 10375* (LBV, WAG), Missanga, 5–15 km NNW of Ndjolé, c. E0°05' E10°45', 11 Nov. 1991 (fl); *Breteler 10983* (WAG), 5–30 km NNW of Ndjolé, c. S0°05' E10°45', 21 Apr. 1992 (fl); *Breteler 14655* (WAG), M'Boumi, chantier SHM, c. 30 km S of Ndjolé, on border of the Ogooué river near Ndjolé, S0°25' E10°50', 17 Nov. 1998 (st); *Breteler 14658* (LBV, WAG), idem; *Dibata 66* (LBV, MO, WAG), ENE de Belle Vue, Layon, S0°35' E10°39', 23 Jan. 1987 (fl). Ngounié: *Bissiengou 610* (LBV, WAG), along a forestry road of chantier EFT (Exploitation Forestière de Tsamba) starting at Ndjemba village on Fougamou-Lambaréné road, S1°03.7' E10°28.6', 129 m, 29 Oct. 2009 (fl); *Bissiengou 627* (LBV, WAG), idem, S1°10.9' E10°28.4', 165 m, 29 Oct. 2009 (fl); *Bissiengou 628* (LBV, WAG), idem; *Bissiengou 1432* (LBV, WAG), Sindara, après village Matadi 7 route exploitation forestière EGG (ancien IFL), S1°02.76' E10°42.50', 72 m, 22 June 2011 (st); *Bissiengou 1451* (LBV, WAG), Fougamou, village Nzemba route du chantier forestier EGBD, entrée école, S1°03.06' E10°30.37', 97 m, 24 June 2011 (st); *Bissiengou 1452* (LBV, WAG), idem; *Breteler 5725* (WAG), 50 km SE of Lambaréné, c. S1°04' E10°30', 28 Sept. 1968 (fl); *Breteler 14052* (WAG), between Yombi and Fougamou, E slope of Koumounabouali ridge, c. S1°20' E10°40', 22 Sept. 1997 (st); *Leeuwenberg 13617* (WAG), right bank Ngounié R., SE of Sindara, km 17 SW of Chantier Waka, S1°13' E10°49', 400 m, 22 Sept. 1985 (fl); *A.M. Louis 1324* (WAG), 2–3 km SE of Forestry Camp Waka situated ± 32 km SE of Sindara, Waka R. Basin, c. S1°14' E10°53', 350 m, 12 Dec. 1983 (fr); *Wieringa 4402* (WAG), 2 km on the road branching off near Ikobey to Magonga, S1°01.67' E10°57.46', 200 m, 25 Nov. 2001 (fr).

⇒ subsp. *australis* Biss., *subsp. nov.* — Fig. 4; Map 2

**IUCN conservation status:** VU B1/B2ab(ii, iii, iv). EOO = 6862 km<sup>2</sup>, AOO = 1545 km<sup>2</sup>, locations = 10 (cell width = 12.43 km). This taxon is known only from 15 recent collections, five of which fall within the Loango National Park and the Moukalaba-Doudou National Park. The remaining ten collections originate from logging and oil concessions while even the Loango park is under development threat from Chinese mining companies. Therefore this subspecies is best placed in the category ‘Vulnerable’.

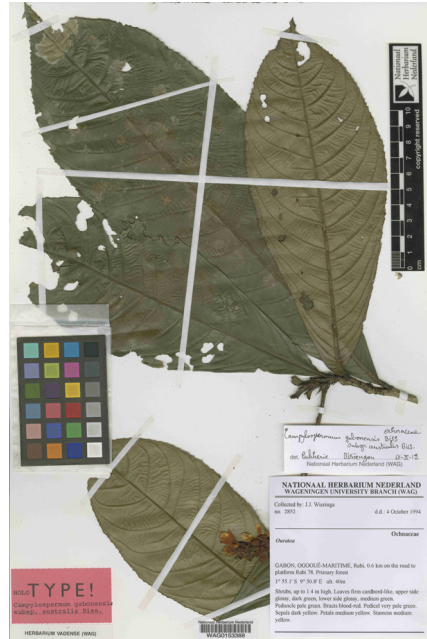
**Diagnosis:** Like the typical subspecies, but the leaf blade bullate between the lateral veins or rarely flat and the scalariform tertiary veins running perpendicular to the main lateral veins.

**Type:** *Wieringa 2852* (holo WAG; iso BR, LBV, MO), Gabon, Ogooué-Maritime, Rabi, 0.6 km on the road to platform Rabi 78, S1°55.1', E9°50.8', 4 Oct. 1994.

**Distribution:** Endemic to Gabon (Ogooué-Maritime, western Ngounié and Nyanga provinces).

**Ecology:** In primary, moist and wet forest, in valleys with small streams; on sandy soil; at 3–350 m altitude.

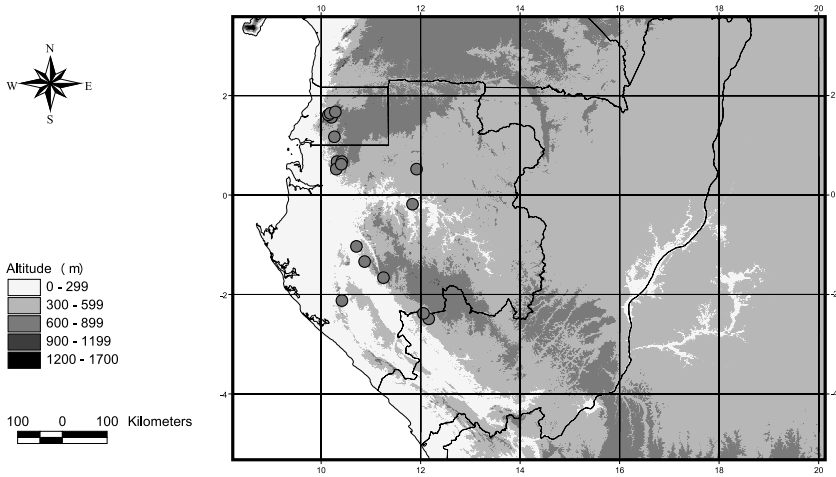
**Phenology** — Flowers observed from October to December; fruits collected from October to January.



**Figure 4.** *Wieringa 2852* at WAG, holotype of *C. gabonensis* subsp. *australis* Biss.

**Additional material:** **GABON, Ngounié:** *Le Testu 5834* (BR, P), Agouma, c. S1°36' E10°10', Dec. 1925 (st). **Nyanga:** *Jongkind 5734* (LBV, WAG), Doudou Mountains, Chantier SFN-Bakker, S2°39.2' E10°27.0', 180 m, 22 Nov. 2003 (st). **Ogooué-Maritime:** *Arends 635* (WAG), Monts Doudou, W of Doussala and Réserve de Faune de Moukalaba, c. S2°15' E10°20', 350 m, 5 Dec. 1984 (fr); *van Bergen 126* (WAG), savannah road to Vera, 32 km E from junction to Mayonami, S2°43.4' E10°12.2', 70 m, 21 Nov. 1995 (fr); *Breteler 10152* (WAG), Rabi-Kounga, Echira road, c. S2°00' E9°50', 27 Oct. 1991 (fl); *Farron 7416* (P), Koumouloundou, route d'accès au Rembo-Rabi, S2°00' E9°36', 10 June 1970 (fl); *Haegens 89* (WAG), Rabi, W of Shell platform 76, S1°57' E9°51', 30 m, 2 Dec. 1993 (fl); *van Nek 117* (WAG), Rabi-E, N of Pechoud Camp, S1°56.5' E9°52.9', 26 Oct. 1990 (st); *van Nek 289* (LBV, MO, WAG), Rabi-NW, near Rembo Rabi, NW of Rabi site, S1°53.7' E9°50.7', 13 Nov. 1990 (fl); *van Nek 560* (LBV, WAG), near Rabi, S1°57.6' E9°52.8', 11 Jan. 1991 (fr); *Schoenmaker 34* (WAG), Rabi-Kounga, opposite Buzzichelli, S1°56' E9°53', 15 Oct. 1991 (fl); *Schoenmaker 134* (WAG), Rabi-Kounga, direction Echira, c. S1°59' E9°51', 11 Nov. 1991 (fl); *J.J.F.E. de Wilde 9843* (LBV, WAG), 30 km S of Rabi, high bank of an affluent of the Echira River, S2°08' E9°43', 15 m, 28 Nov. 1989 (fr); *J.J.F.E. de Wilde 11363* (LBV, WAG), Gamba, N'Dogo Lagoon, near Sounga, S2°25.9' E9°42.7', 3 m, 10 Dec. 1994 (fl).

**Notes:** This subspecies can be added to the list of taxa endemic to the greater Loango-Rabi area (Wieringa & Mackinder 2012). It is also an addition to the recently published checklist of Loango National Park (Harris et al. 2012), and provides further evidence for the unique vegetation in this part of Gabon (Wieringa & Sosef 2011). Apart from the fact that the material shows a scalariform venation different from that of the typical subspecies, and a tendency to have more obviously bullate leaves, there seem to be no other differentiating characters. This, together with the parapatric distribution of the two entities, made us decide to distinguish the taxon at the subspecies level.

*CampylospERMUM glaucifolium* Biss., sp. nov. — Fig. 5; Map 3Map 3. Distribution of *C. glaucifolium* Biss.

**Diagnosis:** A species resembling *C. calanthum* (Gilg) Farron, but with a glaucous upper leaf surface (at least when dry), longer petiole, and a pendulous inflorescence that carries 0–2(–3) racemes.

**Type:** *J.J. de Wilde et al. 10165* (holo WAG; iso LBV), Gabon, Estuaire, 1 km W of Nkan, along the road from Assok to Méla, N0°40', E10°19', 23 Jan. 1991.

Treelet up to 2 m tall. *Stipules* caducous, 2–3 mm long. *Leaves:* petiole 7–15(–20) mm long, canaliculate above; leaf blade narrowly elliptic to narrowly elliptic-obovate, 13–25(–30) by 4–7(–8) cm, base cuneate, apex acuminate, leathery to coriaceous, margin serrulate, upper surface glossy, dark green but turning glaucous when dry, lower surface pale green, young leaves reddish; midrib generally prominent on both sides, main lateral veins 10–15 mm apart, 14–16 on either side, slightly prominent above, prominent below, curved upward to run parallel to the margin, tertiary venation scalariform, running perpendicular to the midrib thus causing the formation of a decreasing series of intermediate lateral veins, indistinct above, distinct below. *Inflorescences* terminal, pendulous, (9–)15–33 cm long; peduncle slender; racemes 0–2(–3), 3–6(–10) cm long; pairwise scales persistent at the base of peduncle; bracts caducous, triangular, c. 2–3 mm long; cymules 0.5–1(–1.5) cm apart, 1–4-flowered. *Flowers:* pedicel 3–12 mm, articulated at 1–3 mm from the base; sepals, ovate, in flower 6–7 by 2–3 mm, green-yellowish, in fruit 8–9 by 3–4 mm, persistent and accrescent, bright red; petals obovate, 7–9 by 4–5 mm, shortly clawed at base, rounded at apex, bright yellow; stamens 10, filaments less than 1 mm long, anthers 5–6 mm long, transversely wrinkled, poricidal; ovary c. 2 mm wide; style slender, 6–7 mm long. *Fruits:* receptacle a ± flattened-globose



shape, c. 3 mm wide, red; drupelets 1–4 well developed per receptacle, reniform, black at maturity; cotyledons accumbent, similar in size.

**Distribution:** Continental Equatorial Guinea (Rio Muni), Gabon and south-western Republic of the Congo (Niari).

**Ecology:** In primary and secondary forest, on creek banks and adjacent to swampy areas; at 210–1000 m altitude.

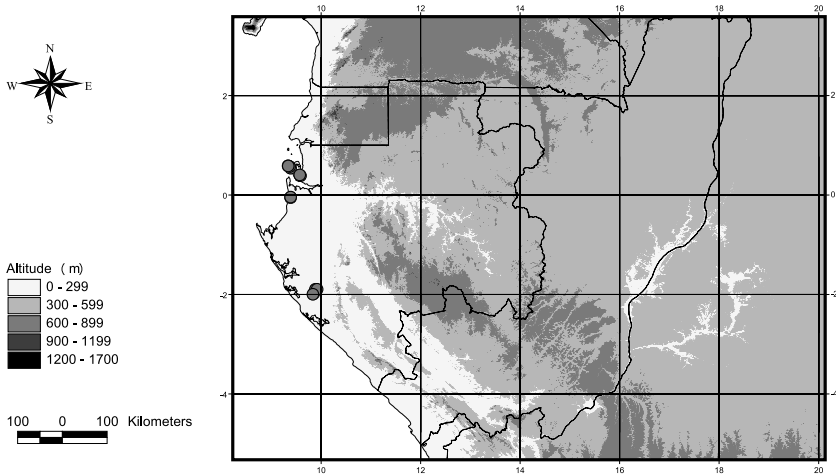
**Phenology:** Flowers collected in January, April, July and August; fruits collected from March to May and in August.

**Preliminary IUCN conservation status:** LC. EOO=72,683 km<sup>2</sup>, AOO=23,157 km<sup>2</sup>, locations = 9 (cell width = 50.79 km). This species, although being sub-endemic to Gabon, has a fairly wide distribution and hence its EOO and AOO are comparatively large, and above the IUCN thresholds. Potential future threats could come from habitat destruction (logging or land transformation) but a fair number of populations are located within protected areas (PN de Monte Alen, Monts de Cristal NP, Waka NP, Lopé Reserve). Therefore, the category of ‘Least Concern’ is here proposed.

**Additional material:** CONGO (BRAZZAVILLE), Niari: *Bissiougu* 1326 (LBV, WAG), route Malinga-Divinié, 4 km du village Mollo, S2°29.64' E12°09.61', 480 m, 13 June 2011 (st). – EQUATORIAL GUINEA, Rio Muni, Centro Sur: *Desmet, G. 242* (BRLU), Mundung ‘Les 4 montagnes’, N1°38' E10°11', 1000 m, 8 Jan. 2003 (fr); *Ngomo 418* (BRLU), Parc National de Monte Alen, c. N1°40' E10°17', 30 July 1998 (fl); *Pérez Viso 1139* (MA), Parque Nacional de Monte Alén, Esamalang, camino hacia Mondung, c. N1°33' E10°12', 13 May 1999 (fr); *Senterre 4122* (BRLU), Parc National de Monte Alen, 11 km à l’Est de la cabaña de Mosumo, N1°36.4' E10°08.5', 12 July 2003 (st); *Wilks 1796* (LBV, WAG), Monts de Cristal, 10 km ENE d’Okuamkos, N1°10' E10°16', 12 Aug. 1988 (fl). – GABON, Estuaire: *J.J.F.E. de Wilde 10257* (LBV, WAG), Crystal Mountains, 25 km on the road Tchimbélé-Kinguélé, N0°31' E10°18', 360 m, 26 Jan. 1991 (fl). Ngounié: *A.M. Louis 3058* (LBV, WAG), route chantier Leroy Massika entre Mouila et Yeno, S1°40' E11°15', 600 m, 27 Apr. 1989 (fr); *Bissiougu 1343* (LBV, WAG), route Malinga-Rebé, S2°23.07' E12°03.35', 489 m, 14 June 2011 (st); *Bissiougu 1436* (LBV, WAG), Sindara, après village Matadi 7 route exploitation forestière EGG (ancien IFL), S1°02.26' E10°42.47', 49 m, 22 June 2011 (st); *Wieringa 5192* (LBV, WAG), upper Waka area, 13 km on IFL forestry road B2, S1°20.5' E10°52.2', 180 m, 31 Mar. 2004 (fr). Ogooué-Ivindo: *Bissiougu 1056* (LBV, WAG), Nord-Est du parc de la Lopé, 25 km du carrefour qui mène à l’ancien Bououé Bac, S0°11.42' E11°50.05', 251 m, 6 Mar. 2010 (fr); *Dibata 117* (MO, WAG), Chantier Koumameyong, côté rivière-Marécage à raphia, c. N0°31' E11°55', Mar. 1987 (fr). Ogooué-Maritime: *van Valkenburg 3162* (BR, LBV, MO, WAG), old logging road leading southward from chantier CBG Peni, S2°07.76' E10°24.95', 210 m, 22 Apr. 2005 (fl). Woleu-Ntem: *Bissiougu 961* (LBV, WAG), Parc des Monts de Cristal, le long de la rivière Mbé, piste après la case picnic sur la droite, c. N0°37' E10°24', 13 Feb. 2010 (st); *Wie-ringa 500* (BR, C, LBV, MO, PRE, WAG), Crystal mountains, 5.5 km NNE of Tchimbélé, N0°40' E10°25', 31 Jan. 1990 (fl).



Figure 5. J.J. de Wilde 10165 at WAG, holotype of *C. glaucifolium* Biss.

***Campylospermum occidentale* Biss., sp. nov.** — Fig. 6; Map 4**Map 4.** Distribution of *C. occidentale* Biss.

**Diagnosis:** A species similar to *C. paucinervatum* Sosef, but leaf blade papery, with an acuminate apex, entire to serrulate margin and 7–11 main lateral veins on either side of the midrib; inflorescence lax, 4–8(–12) cm long, with 1–4(–6) racemes of 1–7(–11) cm long; pedicels 10–15 mm, articulating at 2–5 mm from the base.

**Type:** *Haegens & v.d. Burgt 106* (holo WAG; iso LBV), Gabon, Ogooué-Maritime, Rabi-Kounga, road to Divangui, S1°54', E9°55', 6 Dec. 1993.

Treelet up to 4 m tall. *Stipules* caducous, 2–3 mm long. *Leaves:* petiole 2–5 mm long; leaf blade narrowly elliptic to narrowly elliptic-obovate, 6–15 by 1.5–4.5 cm, base cuneate, apex acuminate, papery, margin entire to serrulate, glossy dark green above, paler green below; midrib slightly prominent above, prominent below, main lateral veins 9–10 mm apart, 7–11 on either side, curved upward to run parallel to the margin, tertiary venation distinct on both sides, scalariform, running perpendicular to the midrib thus causing the formation of a series of slightly prominent intermediate lateral veins. *Inflorescences* terminal, lax, 4–8(–12) cm long; peduncle slender; racemes 1–4(–6), 1–7(–11) cm long, held ± horizontally, not seldom with secondary branches; pairwise scales at the base of peduncle absent; bracts early caducous; cymules (5–)10–15 mm apart, 1–2(–3)-flowered. *Flowers:* pedicel 4–10(–15) mm, articulated at 1–6 mm from the base; sepals ovate, in flower 5–7 by 2–3 mm, greenish yellow, in fruit 6–7 by 3–3.5 mm, persistent and accrescent, red; petals obovate, 5–11 by 4–7 mm, cuneate at base, rounded to emarginate at apex; stamens 10, yellow-orange, filaments less than 1 mm long, anthers 3–4 mm long; ovary c. 2 mm wide; style slender, curved, c. 4 mm long. *Fruits:* receptacle a ± flattened-globose shape, c. 3 mm wide, red; drupelets 1–3 well developed per receptacle, ellipsoid, c. 8 by 5 mm, orange to orange-red at maturity; cotyledons incumbent, similar in size.

**Distribution:** Endemic to Gabon, only found in the coastal plain, in the Ogooué-Maritime (Rabi-Kounga) and Estuaire (Mondah forest and Bikele) provinces.

**Ecology:** Primary and secondary, moist forest, near swampy areas; on sandy soil; at 5–30 m altitude.

**Phenology:** Flowers collected from August to November, coinciding with the end of the long dry season and start of the main rainy season; mature fruits from November to December.

**IUCN conservation status:** VU. B1ab(ii, iii, iv). EOO = 5959 km<sup>2</sup>, AOO = 3388 km<sup>2</sup>, locations = 4 (cell width = 29.10 km). This species seems to have a disjunct distribution, but this is uncertain because the area between the two occupied areas is not well explored. In a situation involving a disjunct distribution the sliding scale grid size method leads to an overly large estimation of especially the AOO. Some of the occurrences in the vicinity of the capital Libreville are under threat of habitat destruction due to urbanization and overexploitation. This is likely to lead to a decline in the area of occupancy and/or number of populations or even extent of suitable habitat and hence we propose the category 'Vulnerable'.



**Figure 6.** *Haegens 106* at WAG, holotype of *C. occidentale* Biss.

**Additional material:** **GABON, Estuaire:** *A.M. Louis 1201* (WAG), secondary forest ± 17 km E of Libreville, S of Bikelé village, N0°23' E9°35', 7 Dec. 1983 (fr); *Bissengou 815* (LBV, WAG), Mondah forest, parcelle des conservateurs, N0°35' E9°20', 10 Nov. 2009 (fl); *Breteler & J.J.F.E. de Wilde 386* (BR, C, K, LBV, MO, P, PRE, SRGH, WAG), Mondah forest, 25 km along the road Libreville-Cap Esterias, N0°32' E9°23', 5 m, 2 Sept. 1978 (fl); *de Saint Aubin 2076* (P), 18 km E de Libreville, c. N0°24' E9°34', Oct. 1961 (fl); *Reitsma 1328* (MA, WAG), between Cap Santa Clara and Cap Esterias, N0°34' E9°22', 15 Aug. 1985 (fl); *Wilks 1632* (MO, WAG), Forêt de Mondah, N0°35' E9°20', 16 Sept. 1987 (fl, fr); *Wilks 2090* (LBV, MO, P, WAG), Nyonyie survey, around 1600 m on transect S, S0°02.9' E9°23.0', 3 July 1990 (fl, fr); *Wilks 2097* (MO, WAG), Nyonyie survey, 2710 m on transect S, S0°03.5' E9°23.0', 4 July 1990 (fl). **Ogooué-Maritime:** *Breteler 10161* (LBV, WAG), Rabi-Kounga, Echira road, c. S2°00' E9°50', 27 Oct. 1991 (fl); *J.J.F.E. de Wilde 9725* (WAG), 1 km on the road Rabi-Divangui, S1°54' E9°53', 25 Nov. 1989 (fr); *Schoenmaker 135* (WAG), Rabi-Kounga, direction Echira, c. S1°59' E9°51', 11 Nov. 1991 (fl).

## 2.4 New combinations

***Campylosperrum andongensis*** (Hiern) Biss., *comb. nov.*

*Ouratea reticulatum* (P.Beauv.) Engl. ex Gilg var. *andongensis* Hiern, Cat. Afr. Pl. 1 (1896) 122. — *Monelasmum andongensis* (Hiern) Tiegh. (1902) 328. — *Ouratea andongensis* (Hiern) Exell (1927) 58. — Type: *Welwitsch 4604* (holo LISU; iso BM), Angola, Pungo Andongo, 1857.

***Campylosperrum costatum*** (Tiegh.) Biss., *comb. nov.*

*Monelasmum costatum* Tiegh., Ann. Sci. Nat., Bot., ser. 8, 16 (1902) 333. — *Campylosperrum vogelii* (Hook.f.) var. *costatum* (Tiegh.) Farron (1965) 403. — Type: *Zenker 1762* (holo P; iso B, COI, G, K, L, LY, P, S, WAG), Cameroon, Bipinde, 1898.

***Campylosperrum glomeratum*** (Tiegh.) Biss., *comb. nov.*

*Monelasmum glomeratum* Tiegh., Ann. Sci. Nat., Bot., ser. 8, 16 (1902) 330. — Type: *Thollon 140* (holo P; iso A, FHO, K), Gabon, Haut Ogooué, Feb. 1895.

**Note:** The name *Ouratea dusenii* Engl. & Gilg, published in 1903, has been used most often in literature as the correct name for this species. Recently, Bissiengou & Sosef (2008) transferred that name to the genus *Campylosperrum*. However, it now turns out that the name *Monelasmum glomeratum* Tiegh. (with type specimen *Thollon 140*) refers to the same taxon and is thus also available. Since it was published in 1902, hence one year before *O. dusenii*, *Monelasmum glomeratum* Tiegh. has priority which necessitates the new combination *C. glomeratum* (Tiegh.) Biss.

***Campylosperrum longestipulatum*** (De Wild.) Biss., *comb. nov.*

*Ouratea longestipulata* De Wild., Pl. Bequaert. 4 (1929) 492. — Type: *Zenker 3577* (holo BR; iso E, G, S, US), Cameroon, Bipinde, 1908.

***Campylosperrum lunzuensis*** (N.Robson) Biss., *comb. nov.*

*Ouratea lunzuensis* N.Robson, Bol. Soc. Brot., ser. 2, 36 (1962) 38. — *Gomphia lunzuensis* (N.Robson) Verdc. (2005) 47. — Type: *Bullock 3877* (holo K; iso BR, K), Zambia, Lunzua River, 19 miles W of Abercorn, 1951.

***Campylosperrum lutambensis*** (Sleumer) Biss., *comb. nov.*

*Ouratea lutambensis* Sleumer, Repert. Spec. Nov. Regni Veg. 39 (1936) 278. — *Gomphia lutambensis* (Sleumer) Verdc. (2005) 52. — Type: *Schlieben 6110* (holo B†; iso BR, G, Z), Tanzania, 50 km W. Lindi, Lake Lutamba, Noto Plateau, 9 Mar. 1935.

***Campylosperrum nutans*** (Hiern) Biss., *comb. nov.*

*Ouratea reticulata* (P.Beauv.) Engl. ex Gilg var. *nutans* Hiern, Cat. Afr. Pl. 1 (1896) 123. — *Monelasmum nutans* (Hiern) Tiegh. (1902) 328. — *Ouratea nutans* (Hiern) Exell (1927) 59. — Type: *Welwitsch 4606* (holo BM; iso K), São Tomé and Príncipe, Pico de Papagaio, Sept. 1853.

***Campylopermum plicatum*** (Tiegh.) Biss., *comb. nov.*

*Monelasmum plicatum* Tiegh., J. Bot. (Morot) 16 (June 1902) 202.—Type: *Griffon du Bellay* 296 (holo P), Gabon, Pyrat, Oct. 1863.

***Campylopermum warneckeii*** (Gilg ex Engl.) Biss., *comb. nov.*

*Ouratea warneckeii* Gilg ex Engl., Veg. Erde 9, Die Pflanzenwelt Afrikas 3, 2 (1921) 490.—Type: *Warnecke* 468 (holo Z; iso BM, E, EA, K), Tanzania, Amani, 1907.



# Chapter 3

## Taxonomic revision of the continental African species of *Campylospermum* Tiegh. (Ochnaceae)

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### 3.1 Introduction

The genus *Campylospermum* Tiegh. comprises some 55 species occurring in the African and Asian tropics. Continental Africa harbours 48 species distributed from Senegal to Ethiopia in the North and from Angola to northern Zambia in the South. Madagascar is occupied by some five species (Perrier de la Bâthie 1941, 1951) plus some undescribed ones. Two species are found in South and South East Asia, one from India to Sri Lanka and one from Hainan and the Philippines to Indonesia. The highest species diversity is found in the Lower Guinean floristic region, Nigeria to western Democratic Republic of the Congo (White 1979, 1983) where more than half of the species occur. This situation corroborates the high botanical species-richness of that region (Linder 2001; Mutke et al. 2001; Küper et al. 2004; Sosef et al. 2006; Estrella de la et al. 2012; Linder et al. 2012) which, contrastingly, remains one of the world's most poorly studied regions (Campbell and Hammond 1989).

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p.40

### 3.2 Delimitation and position of *Campylospermum* within the family Ochnaceae

*Campylospermum* belongs to the family Ochnaceae. Many authors who treated the family recognised different subdivisions. Candolle (1811) had a narrow family concept and recognized only three genera: *Ochna* L., *Gomphia* Schreb. and *Walkera* Schreb. Candolle (1824) added the genera *Elvasia* DC. and *Castela* Turpin, previously placed with doubts in Ochnaceae and Simaroubaceae respectively (Turpin 1806; Candolle 1811). His distinction between the genera was mainly based on the characteristics of the flowers and fruits. Species that now belong to *Campylospermum* have initially been placed in *Gomphia*. That genus used to accommodate all Ochnaceae–Ourateae species with ten stamens per flower and close to *Ochna* (hence with carpels becoming free in fruit). But, Baillon (1867) found out that the older name *Ouratea* Aubl. was applicable and subsequently all species of *Gomphia* were transferred to *Ouratea* (e.g. Engler 1876). Later, some Old World genera were segregated from *Ouratea*, among which *Campylospermum* Tiegh. (Bittrich and Amaral 1994).

Planchon (1846) subdivided the family into three tribes: Gomphieae, Euthemideae and Luxemburgieae. Within the genus *Gomphia* he recognised two sections: *Eugomphia* in the New World and *Gomphiastrum* in the Old World. Those sections were based on the morphology of the stipules being either intra-axillary and fused (*Gomphiastrum*) or extra-axillary and free (*Eugomphia*).

Engler (1876) also recognised those sections and extensively studied the New World species of *Ouratea* which he, like Planchon, included in the section *Eugomphia*. Gilg (1893a) in his treatment of the family, continued using the name *Ouratea* instead of



*Gomphia* following Engler (1876). He also recognized two sections, though he called these *Neoouratea* (New World) and *Palaeoouratea* (Old World), which he later on (Gilg 1925) raised to subgeneric level.

The next milestone in the delimitation and subdivision of the Ochnaceae was the work of Van Tieghem (1902b, 1902c, 1902a, 1903). He mostly focussed on anatomical and additional morphological characters that had not been taken into consideration by previous authors. His subdivision of the family was based on leaf anatomical characters, the position and the arrangement of the floral elements, fruit characters and seed morphology (mainly shape and position of the embryo and cotyledons). He divided the Ochnaceae into two subfamilies: Ochnoideae and Elvasioideae. He then subdivided the subfamily Ochnoideae into two tribes: Ourateae and Ochneae. The tribe Ourateae was, in turn, divided into two subtribes which he called Orthosperminae (America) and Campylosperminae (Africa, Madagascar and Asia). Those subtribes are identical with Gilg's (1925) subgenera *Neoouratea* and *Palaeoouratea* within the genus *Ouratea*. Although Van Tieghem's contribution to the understanding of the family was of great value, he introduced an exceptionally narrow concept of genera and species. He recognized four genera in his first work (Van Tieghem 1902b), two months later twenty five, and finally ended up having thirty four genera in his 1907 work (Van Tieghem 1907). The present-day *Campylospermum* species were scattered across seven genera, and those of the genus *Ochna* for example across 15 (Callmander and Phillipson 2012). His views were followed by only few authors. Gilg (1925), although being critical about Van Tieghem's species and genus concept, largely agreed with the major subdivisions at higher levels.

Kanis (1968), accepted Engler's main division (1874) into Exalbuminosae and Albuminosae as two distinct subfamilies named Ochnoideae and Sauvagesioideae respectively. Within the Ochnoideae Kanis recognized the tribes Ochneae and Elvasieae and divided the tribe Ochneae into the subtribes Ochninae and Ourateinae. The latter two had previously been recognized by Van Tieghem at the level of tribes.

Finally, Amaral (1991) and Amaral and Bittrich (2014) agreed with the concept to include the family Luxemburgiaceae into the Ochnaceae and as a logical consequence distinguished three subfamilies: the Luxemburgioidae, the Sauvagesioideae and the Ochnoideae. They followed Kanis in the subdivision of the latter subfamily into two tribes, Ochneae and Elvasieae, and the recognition of the subtribes Ochninae and Ourateinae. At present, the latter subtribe comprises four genera (see below).

### 3.3 Taxonomic history of the genus *Campylospermum*

The first species of *Campylospermum* that were discovered were described as members of the genus *Gomphia* (Candolle 1811, 1824; Planchon 1846; Oliver 1868). The number of species steadily rose: Candolle (1811) mentioned three species, Planchon (1846) seven, Oliver (1868), Engler (1874) nine and Gilg (1893a) eleven. Subsequently, these were transferred to the genus *Ouratea* subgenus *Palaeouratea* section *Gomphiastrum* (Engler 1874; Gilg 1893a). It was notably Farron (1963, 1965; 1967; 1968, 1985) who, after the extensive splitting of Van Tieghem (see above), restructured the genus *Ouratea* and created the present situation with four distinct genera in the subtribe Ourateinae: *Ouratea* Aubl. ( $\pm 200$  species), *Idertia* Farron (1 species), *Rhabdophyllum* Tiegh. (8 species) and *Campylospermum* Tiegh. ( $\pm 55$  species) (Farron 1963; Kanis 1968; Farron 1985; Sastre 1988; Sastre 2003; Sosef 2008, 2013). This subtribe is characterized by having 10 stamens on very short filaments, carpels becoming free in fruit and a receptacle that becomes reddish and swollen in fruit. The genus *Ouratea* is restricted to the New World tropics, the genus *Campylospermum*, *Idertia*, and *Rhabdophyllum* are found in Old World tropics, with the latter two confined to continental Africa. *Ouratea* is distinct from the rest by having caducous sepals (not persistent and accrescent ones as in the other three genera) and free, extra-axillary stipules (fused and intra-axillary in the others). *Idertia* shares having a straight embryo and cotyledons with *Ouratea*, reason why Farron (1968) considered *Idertia* to represent the most primitive African genus of which *Rhabdophyllum* and *Campylospermum* are derived. *Rhabdophyllum* is sufficiently distinct from *Campylospermum* mostly because of its dense, straight and parallel secondary veins and the sepals which carry one or two dorsal flaps that interlock with the margin of the adjacent sepal in bud (Sosef 2008, 2013).

There has been some confusion as to the correct generic name for the African and Asian species of *Campylospermum*, when they are seen as generically distinct from their New World relatives. While some authors used the name *Ouratea* Aubl. for all Old and New World species (Gilg 1893a; De Wildeman 1920; Gilg 1925; Hutchinson et al. 1954; Robson 1963), others placed the Old World species in either a distinct genus using the name *Gomphia* Schreb. (Kanis 1967, 1968; Kanis 1972; Kanis 1973; Kanis 1987; Nicolson et al. 1988; Verdcourt 2005) or *Campylospermum* (Farron 1968, 1985; Sosef et al. 2007; Bissiengou and Sosef 2008; Bissiengou et al. 2013). These nomenclatural issues were based on an erroneous lectotypification by Kanis. The issue was solved by Bittrich & Amaral (1994) rendering the name *Gomphia* a full synonym of *Ouratea* which has its type species in the New World.

*Campylospermum* has about 55 species occurring in continental Africa, Madagascar, extending east to China and the Malesian region (Bissiengou et al. 2013). Despite of the many individual contributions, the African species of *Campylospermum* have not

been fully revised after Gilg (1925), although notably Farron (1963, 1965, 1968, 1985), Bamps & Farron (1967), Robson (1963), Verdcourt (2005) and others published useful parts for such a revisionary work of the continental species.

Farron (1968) kept some of van Tieghem's genera as sections within *Campylospermum*. He based his arrangement of six sections mainly on the shape and position of embryo and cotyledons: cotyledons being either of similar size and incumbent (section *Notocampylum*, *Diphyllopodium*) or accumbent (section *Campylospermum* and *Cercanthemum*), or being dissimilar in size and incumbent (section *Monelasmum*) or accumbent (section *Campylospermum*). The more derived species of the genus *Rhabdophyllum* tend to have heterocotyledonous embryos while the primitive ones have isocotyledonous ones (Farron 1985). Species of *Idertia* have cotyledons that are similar in size, straight and accumbent. Finally, Farron's sixth section, *Bisetaria*, is based upon the distinct close leaf venation and linear, free stipules of the species *C. lecomtei* (Tiegh.) Farron. The flowers being fairly uniform throughout the genus, species distinction is generally based on characteristics of the leaf shape and venation as well as the inflorescence structure. Because of the plasticity of these character sets, the individual species are sometimes difficult to tell apart by a non-specialist.

To evaluate Farron's sectional arrangement, the cotyledon type was studied for each species. The results proved not to be consistent with Farron's observations because different types of cotyledons were present within a section. For example, within the section *Diphyllopodium*, according to Farron characterized by accumbent cotyledons of similar size, those of *C. subcordatum* proved to be dissimilar in size with a small outer cotyledon. Furthermore, the species pairs *C. auriculatum* and *C. schoenleinianum* as well as *C. klainei* and *C. mannii* are morphologically highly similar but differ in cotyledon type, and would hence have to be grouped in different sections. Finally, the results of molecular work undertaken at the moment (Chapter 5) shows a phylogenetic tree with low resolution at species level. However, in the cases where species of *Campylospermum* are grouped, they do not follow Farron's sectional arrangement, except for the species of section *Cercanthemum*, which are grouped (0.99 posterior probabilities) along with species occurring in Madagascar. The above suggests that cotyledon type is a fairly unstable character, less suitable to be used for sectional delimitation. Because of this, we conclude that Farron's sections do not provide a natural grouping, and we decided not to retain any sectional arrangement in the current study.

### 3.4 Uses

Plants of *Campylospermum* are often very attractive in the field, especially during flowering and fruiting periods, which is why some of them are planted as ornamentals (Burkill 1997). Being shrubs or small trees, only few are useful as timber (Burkill 1997),

but a fair number have medicinal properties (Neuwinger 2000). In Liberia, the saplings of *C. squamosum* are used to bind the drum-head onto hollow log drums while the bark or pounded leaves are used in poultices to relieve body pain (Burkill 1997; Oyen 2012).

### 3.5 Seed dispersal

The mericarps are green or red when immature and red to black and shiny in mature state. The black ones are often contrasting with the red sepals and receptacle and as such represent a typical syndrome suggesting dispersal is by birds (Van der Pijl 1982), although no reports of direct observations are known to us.

### 3.6 Conservation

Our knowledge of the conservation status of many *Campylospermum* species is still limited. Some of them are known from only very few scattered collections, whereas others are known from only a very restricted area. Therefore, it was decided to add a preliminary assessment of the IUCN conservation status of each species based on the locality data of the herbarium specimens studied.

### 3.7 Materials and Methods

#### 3.7.1 Taxonomy

This revision is based on herbarium material either received on loan from or studied during visits to the following herbaria: A, AAU, B, BAS, BATA, BENIN, BR, BRLU, BM, BUC, C, CNSF, COI, CSRS, E, EA, EPU, FBC, FHO, FI, FR, G, GENT, GC, GH, HBG, IAGB, IEC, IFAN, IG, K, KIS, KRIBI, L, LAMTO, LD, LBV, LIB, LISU, LISC, LMA, LUA, LY, M, MA, MAKOK, MHU, MO, NY, NHGC, NHT, OXF, P, POZG, PR, PRE, PRF, S, SCA, SL, SEGC, SERG, SRGH, STOME, TAN, UC, UCJ, UPS, US, WAG, YA, Z. Acronyms follow Thiers (2012). In addition, field observations were made during expeditions in Gabon and Cameroon (2009–2010). In total, about 5000 herbarium specimens were studied for this revision.

Furthermore, targeted searches to locate type specimens were performed using websites such as the Aluka African Plant Initiative Database (<http://www.aluka.org/page/content/plants.jsp>), the JSTOR Plant Science (<http://plants.jstor.org/>) and the GBIF portal (<http://www.gbif.org/>).

All specimen data were entered into the BRAHMS (Botanical Research and Herbarium Management System) database of the National Herbarium of the Netherlands (now part of the Naturalis Biodiversity Center). From this database specimen citation lists were generated for each taxon.

To analyse patterns of morphological variation, standard herbarium techniques were applied (Vogel 1987). Taxa were treated as being distinct at species level when they consequently differed in two or more characters. Floral dimensions were measured either from herbarium material soaked/boiled in tap water or directly from fresh samples in the field. In the descriptions, diagnostic features are given in bold. Finally, the terminology used in the species description is based on (Stearn 1992) and (Harris and Harris 2001).

### 3.7.2 Distribution maps and IUCN conservation status

Locality data of all specimens was geo-referenced. To produce distribution maps for each species, BRAHMS was used in combination with ArcView 3.3 software (ESRI 2002). Only specimens with accuracy of 15 arcmin or less were used to produce the maps.

To perform a preliminary assessment of the IUCN category of threat for each species, the BRAHMS software in combination with ArcView 3.3 (ESRI 2002) and the IUCN Red List add-in script developed by Moat (2007) were used. The latter calculates the AOO (area of occupancy), EOO (extent of occurrence) and number of localities for each species. The threat category of each individual species was assessed by evaluating the EOO or AOO under Criterion B (IUCN 2013) and the final preliminary assessment was performed following the IUCN guidelines (Subcommittee 2013). To estimate the AOO and EOO, an appropriate cell size was generated for each individual species. The IUCN guidelines advise to have a cell width of 2 km, but this is not deemed useful when working with herbarium records (Moat 2007). Instead we applied a sliding cell size, as advised by and implemented in the add-in of Moat (2007). Furthermore, a 'location' was defined as a single grid cell. Projected continuing decline of a species either in terms of geographic range (AOO, EOO) or of subpopulation was assessed by determining the presence of that species within protected areas and/or in areas with known present-day logging activities or other relevant threats. The location of protected areas was obtained using the World Database on Protected Areas (<https://www.protectedplanet.net>).

## 3.8 Genus treatment

### *Campylospermum* Tiegh.

J. Bot. (Morot) 16: 35-40 (Febr. 1902); Bull. Mus. Hist. Nat. (Paris) 8: 215 (Apr. 1902); J. Bot. (Morot) 16: 196-197 (June 1902); Ann. Sci. Nat., sér. 8, Bot. 16: 193-296 (Dec. 1902); Farron, Bull. Soc. Bot. Suisse 73: 202 (1963); H.Perrier, Fl. Madag. 133 Ochnacees: 2-18 (1951); Farron, Bull. Jard. Bot. État Bruxelles 35: 393 (1965); Bamps & Farron, Fl. Congo Belge, Ochnaceae: 32 (1967); Farron, Candollea 23: 177-228 (1968); Farron, Bot. Helv. 95: 59-72 (1985). – Type species: *Campylospermum dybovskii* Tiegh.

*Gomphia* Schreb., Gen. Pl. ed. 8, 1: 291 (1789), pro parte (excl. the type); P.Beauv., Fl.

Oware 2(12): 22, t. 72 (1810); Candolle, Ann. Du Mus., XVII: 398 (1811); Planchon, London J. Bot. 24: 593(1846); Oliver, Fl. trop. Afr. 1: 319-322 (1868); Kanis, Taxon 16: 420 (1967); Blumea 16: 51 (1968); Rev. Fl. Ceylon 6: 251 (1988); Amaral & Bittrich, Taxon 43: 89-93 (1994); Verdc., Fl. Trop. E. Africa, Ochnac.: 43-52 (2005). – Type species: *Gomphia zeylanica* (Lamk.) DC. ≡ *Gomphia serrata* (Gaertn.) Kanis.

***Ouratea*** Aubl., Hist. Pl. Guiane: 397 (1775), nom. cons., pro parte (excl. the type); Engl. & Prantl., Nat. Pflanzenfam. ed. 1, III, 6: 79-81 (1893); Tiegh., Bull. Mus. Natl. Hist. Nat. 8: 208-218 (Jan. 1902); Gilg, Bot. Jahrb. Syst. 33: 231-275 (1904); De Wild., Rev. Zool. Afr. VII, Suppl. Bot.: B42-B71 (1920); Farron, Bull. Soc. Bot. Suisse 73: 196-217; Amaral & Bittrich, Taxon 43: 89-93 (1994). Type species: *Ouratea guianensis* Aubl.

***Bisetaria*** Tiegh., J. Bot. (Morot) 16: 44 (Feb. 1902). – Type species: *Bisetaria lecomtei* Tiegh. ≡ *Campylopermum lecomtei* (Tiegh.) Farron.

***Cercantherum*** Tiegh., J. Bot. (Morot) 16: 198 (June 1902). – Type species: *Cercantherum saclexii* Tiegh. ≡ *Campylopermum saclexii* (Tiegh.) Farron.

***Notocampylum*** Tiegh., J. Bot. (Morot) 16: 199 (June 1902). – Type species: *Notocampylum mannii* (Oliv.) Tiegh. ≡ *Campylopermum mannii* (Oliv.) Tiegh.

***Diphyllopodium*** Tiegh., J. Bot. (Morot) 16: 200 (June 1902). – Type species: *Diphyllopodium klainei* Tiegh. ≡ *Campylopermum klainei* (Tiegh.) Farron.

***Spongopyrena*** Tiegh., J. Bot. (Morot) 16: 201 (June 1902). – Type species: *Spongopyrena elongata* (Oliv.) Tiegh. ≡ *Campylopermum elongata* (Oliv.) Tiegh.

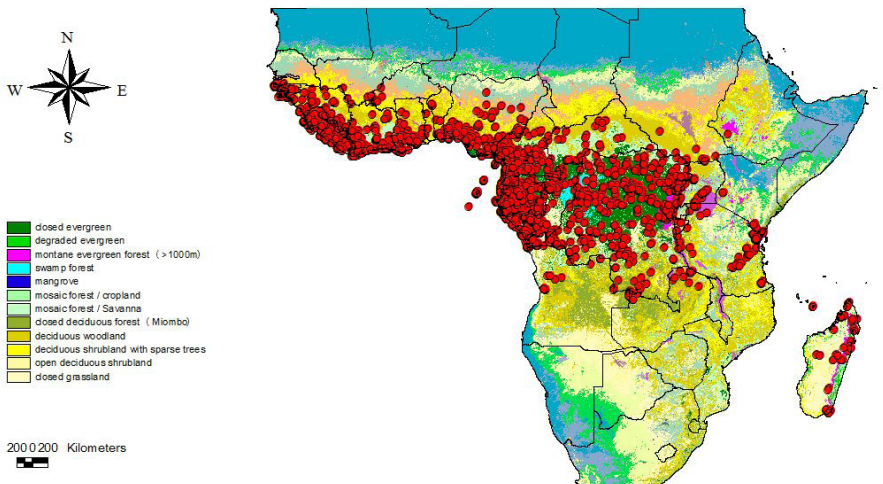
***Monelasmum*** Tiegh., J. Bot. (Morot) 16: 202 (June 1902). – Type species: *Monelasmum reticulatum* (P.Beauv.) Tiegh. ≡ *Campylopermum reticulatum* (P.Beauv.) Farron.

***Exomicrum*** Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 338 (Dec. 1902) & Bull. Mus. Nat. Hist. Nat. 8: 547 (Dec. 1902). – Type species: *Exomicrum glaberrimum* (P.Beauv.) Tiegh. ≡ *Campylopermum glaberrimum* (P.Beauv.) Farron.

Trees, treelets or shrubs, monocaulous or with branched stem, glabrous. ***Stipules intrapetiolar***, caducous or persistent, **fused** or rarely free (*C. lecomtei*), triangular to linear. *Leaves* sessile or petiolate; petiole often wrinkled; leaf blade often coriaceous, with entire to serrate margin, often decurrent onto the petiole; venation: main lateral veins well-spaced or rarely numerous and dense (*C. lecomtei*), **slightly to strongly curved up to run subparallel to the margin** or rarely straight (*C. lecomtei*), secondary lateral veins not reaching the margin, tertiary venation scalariform, sometimes reticulate towards the midrib or rarely reticulate, distinct to indistinct. *Inflorescence* **terminal** or rarely axillary, **generally composed of sessile to subsessile cymules arranged in racemes** that can be in turn solitary or branched, rarely reduced to 1–2 flowers; pairwise scales at the base of peduncle present or absent. *Flower*: bracts caducous or

persistent; pedicel articulated above the base, part below the articulation persistent; sepals 5, quincuncial in bud, green to yellowish in flower, **persistent, accrescent and turning red in fruit**; petals 5, contort, longer than the sepals, yellow or rarely whitish or orange, cuneate or rarely shortly unguiculate a base; **stamens 10**, in two whorls, free, filaments stout, **much shorter than the anthers**, generally less than 1 mm long, usually persistent, anthers yellow, narrowly to very narrowly pear-shaped, transversely wrinkled, poricidal, caducous; carpels 5, **fused below but eventually free in fruit**, 1-ovulate; style 1, slender, gynobasic, bent outward, stigma terminal, small. *Fruit: receptacle an inflated ± flattened-globose shape, red*; 1 to 5 well developed drupelets per fruit, reniform to ellipsoid or almost globose, passing through green or red to black at maturity; **cotyledons incumbent or accumbent, curved**, equal to strongly dissimilar in size.

A genus of about 55 species, 48 of which are widely distributed in tropical Africa (see **Map 1**), about five occurring in Madagascar, and 2 species in South and South-East Asia from India to Sri Lanka, Hainan, and the Philippines to Indonesia.



**Map 1.** Distribution of the African *Campylosperrum*

### 3.9 Key to the continental African species of *Campylosperrum*

1. - Monocaulous trees, hence with unbranched stem; leaves crowded at the end of the stem (collecting litter); leaf blade 17-70(-90) cm long, narrowly spatulate to narrowly elliptic-ovate or rarely narrowly elliptic; tertiary venation perpendicular to the main laterals 2
- Shrubs or trees with branched stem; leaves well-spaced along the twigs; leaf blade generally 4-95 cm long, (very) narrowly elliptic to (very) narrowly obovate

- or elliptic to obovate; tertiary venation usually perpendicular to the midrib 7
2. - Inflorescence branched, or sometimes with a bundle of 2-5 sessile racemes 3  
 - Inflorescence unbranched 5
  3. - Inflorescence axillary, very dense and corymbose, or with a bundle of 2-5 sessile racemes; leaf base broadly cuneate to cordate 4  
 - Inflorescence terminal, with 1-5 racemes on a distinct peduncle; leaf base auriculate *C. amplexans*
  4. - Inflorescence very dense, highly branched and corymbose, with many short racemes of up to 1.5 cm long *C. duparquetianum*  
 - Inflorescence with a bundle of 2-5 racemes of (3-)13-28(-35) cm long, sitting on top of a long peduncle carrying two leafy bracts at the apex *C. subcordatum*
  5. - Peduncle distinctly flattened, strap-like, 23-60(-83) cm long *C. elongatum*  
 - Peduncle angular to slightly flattened, 8-25(-32) cm long 6
  6. - Inflorescence terminal on a short lateral twig, 3-4 cm long; peduncle with 2 subopposite reduced leaves or leafy bracts at the base *C. klainei*  
 - Inflorescence axillary, without reduced leaves or leafy bracts *C. mannii*
  7. - Leaf base auriculate to cordate; leaf blade with 16-30 main lateral veins 8  
 - Leaf base attenuate to cuneate or slightly cordate, rarely cordate but then leaves with 30-50 main lateral veins 9
  8. - Leaf blade with 16-19 main lateral veins; inflorescence 12-15(-18) cm long; sepals 7-8 mm long in flower, 9-10 mm long in fruit; cotyledons dissimilar in size, with a small outer cotyledon (Equatorial Guinea and Gabon) *C. auriculatum*  
 - Leaf blade with 20-30 main lateral veins; inflorescence (10-)12-27(-39) cm long; sepals 5-7mm long in flower, 6-7 mm long in fruit; cotyledons similar in size (West Africa) *C. schoenleinianum*
  9. - Leaf margin spinose-serrate, at least in the apical half 10  
 - Leaf margin entire to serrulate or serrate 11
  10. - Leaf blade (3-)5-8(-9) cm wide, with 11-25 main lateral veins 5-25 mm apart; cotyledons dissimilar in size, with a small outer cotyledon; stipules 4-5 mm long (West and Central Africa) *C. flavum*  
 - Leaf blade (1.5-)2-3(-4.5) cm wide, with 3-12 main lateral veins 15-30(-70) mm apart; cotyledons similar in size; stipules 2-3 mm long (Tanzania, Zambia and



- south-eastern Democratic Republic of the Congo) *C. lunzuense*
11. - Inflorescence axillary, unbranched; peduncle flattened (southern Kenya and Tanzania) 12  
 - Inflorescence terminal, branched or unbranched; peduncle cylindrical or occasionally flattened but then inflorescence distinctly branched 13
  12. - Leaf blade (4-)6-10(-13) cm wide, with an acute to acuminate apex; peduncle (7-)9-28(-39) cm long; tertiary venation scalariform, perpendicular to the main lateral veins *C. sacleuxii*  
 - Leaf blade (2-)3-5(-7) cm wide, with an obtuse to rounded apex; peduncle 3-15 cm long; tertiary venation reticulate, except for a few scalariform veinlets, perpendicular to the midrib *C. scheffleri*
  13. - Leaf blade linear to very narrowly elliptic (length/width ratio > 8), rarely ratio as low as 4.5 but then midrib running through a gully 14  
 - Leaf blade narrowly elliptic or broader (length/width ratio < 7), when midrib prominent on upper side, ratio always lower than 7 15
  14. - Leaf blade with curved, well-spaced main lateral veins; stipules narrowly triangular, c. 3 mm long; inflorescence branched *C. louisii*  
 - Leaf blade with straight and closely spaced main lateral veins; stipules linear, 5-13 mm long; inflorescence unbranched *C. lecomtei*
  15. - Leaf blade with 0-7 main lateral veins, up to 10(-14) x 2(-3) cm 16  
 - Leaf blade with (7-)9-more main lateral veins, generally longer and broader 17
  16. - Leaf blade with 4-7 main lateral veins and acute apex; racemes 3-6(-9) cm long *C. glomeratum*  
 - Leaf blade with 0-2(-5) main lateral veins, the very apex apiculate; racemes 1-3 cm long *C. paucinervatum*
  17. - Leaf blade obovate, (24-)28-45(-53) x (8-)11-14(-17) cm; sepals in flower 9-10 x 6-7 mm, strongly enlarged in fruit to (20-)25-30(-35) x (10-)13-20(-25) mm (southern Cameroun and northern Gabon) *C. umbricola*  
 - Leaf blade generally smaller; sepals in flower up to 4 mm wide, in fruit up to 6 mm (tropical Africa) 18
  18. - Leaf blade distinctly bullate 19  
 - Leaf blade not or sometimes slightly bullate 25

19. - Stipules 14-17 mm long; leaf blade with tertiary venation indistinct on both sides; inflorescence unbranched, 2-4 cm long, very dense, the cymules 1-2 mm apart *C. longestipulatum*
- Stipules 2-13(-25) mm long; leaf blade with tertiary venation distinct, at least on the lower side; inflorescence branched or unbranched, (1-)3-more cm long, with cymules  $\geq 3$  mm apart 20
20. - Inflorescence unbranched, dense, cymules even at the base of the inflorescence up to 10 mm apart; sepals 7-10 x 2-4 mm in flower, 9-12 x 3-6 mm in fruit 21
- Inflorescence branched or unbranched, lax, cymules at least at the base of the inflorescence 10-20 mm apart, rarely inflorescence fairly dense and cymules closer together but then sepals 5-7 x 1.5-2 in flower and 6-8 x 2-3 mm in fruit 22
21. - Leaf blade with distinctly prominent midrib above, 10-16 main lateral veins on either side and scalariform tertiary veins running perpendicular to the midrib *C. sulcatum*
- Leaf blade with midrib flat above, 14-27 main lateral veins on either side and scalariform tertiary veins running perpendicular to the main laterals *C. gabonense* subsp. *australe*
22. - Inflorescence composed of 1-3 long racemes sitting close together terminal on the twig; flowers on a 4-5 mm long pedicel; sepals 3-4 mm long in flower, c. 5 mm long in fruit *C. descoingsii*
- Inflorescence single, branched or occasionally unbranched, but then pedicels and sepals longer 23
23. - Leaf blade with tertiary venation very distinct and prominent on both surfaces; pairwise scales at base of inflorescence absent *C. excavatum*
- Leaf blade with tertiary venation indistinct to distinct but never prominent; pairwise scales at base of inflorescence persistent 24
24. - Inflorescence with 2-7 racemes; leaf blade with tertiary venation indistinct above, fairly distinct below; pedicels articulated at 2-4 mm from the base; cotyledons accumbent, similar in size *C. calanthum*
- Inflorescence with 0-3 racemes; leaf blade with tertiary venation distinct on both surfaces; pedicels articulated at 1-2 mm from the base; cotyledons incumbent, dissimilar in size *C. claessensii*
25. - Leaf blade with rounded to cordate base; each pedicel supported by c. 3 tiny bracts *C. oliveri*
- Leaf blade with attenuate to cuneate base, rarely rounded but then each pedicel

- supported by only 1 tiny bract 26
26. - Leaf glaucous (greyish) above when dry; plants either with a pendulous inflorescence or with a combination of papyraceous leaves, a short (up to 4(-6) cm) and dense inflorescence and stipules of 3-4 mm long 27  
 - Leaf not glaucous above when dry; inflorescence erect to erecto-patent 28
27. - Inflorescence pendulous, lax, (9-)15-33 cm long *C. glaucifolium*  
 - Inflorescence erect to erecto-patent, dense, (1-)2-4(-6) cm long *C. glaucum*
28. - Inflorescence unbranched or rarely with 1-2 short, up to 4 cm long, racemes at the base, dense 29  
 - Inflorescence branched, racemes generally longer than 4 cm, lax 33
29. - Leaf blade slightly bullate (main lateral veins in a shallow depression) 30  
 - Leaf blade flat 32
30. - Leaf blade with tertiary venation consisting of closely spaced and fine parallel veinlets; pedicels articulating at the very base; cotyledons similar in size *C. congestum*  
 - Leaf blade with tertiary venation with more widely spaced parallel veinlets; pedicels generally articulated at  $\geq 2$  mm from the base; cotyledons dissimilar in size 31
31. - Leaf blade (6-)9-17(-21) x (2-)3-6(-7) cm, with tertiary scalariform veinlets running perpendicular to the midrib, 10-16 main lateral veins on either side; pedicels articulating at 2-3 mm from the base *C. sulcatum*  
 - Leaf blade 16-30(-35) x 6-10(-11) cm, with tertiary scalariform veinlets running perpendicular to the main laterals, 14-27 main lateral veins on either side; pedicels articulating at 3-9 mm from the base *C. gabonense* subsp. *australe*
32. - Leaf blade (5-)7-14 x (1.5-)2-4 cm, with 10-14 main lateral veins on either side; pedicels articulating at 1-2 mm from the base *C. cabrae*  
 - Leaf blade 16-30(-35) x 6-10(-11) cm, with 14-27 main lateral veins on either side; pedicels articulating at 3-9 mm from the base *C. gabonense* subsp. *gabonense*
33. - Leaf blade with main lateral veins indistinct to at most slightly prominent above, tertiary venation indistinct above 34  
 - Leaf blade with main lateral veins prominent above, tertiary venation distinct above 36

34. - Leaf blade (3-)5-16 x (1.5-)2-6 cm; twigs with pale brownish bark *C. glaberrimum*  
 - Leaf blade (11-)16-32(-40) x (3-)5-9(-12) cm; twigs with dark coloured bark 35
35. - Leaf blade with main lateral veins not or slightly prominent below; inflorescence with ascending racemes *C. densiflorum*  
 - Leaf blade with main lateral veins prominent below; inflorescence with horizontal racemes *C. dybowski*
36. - Petiole (5-)10-20(-25) mm long; leaf blade decurrent onto the petiole or leaf margin thickened and recurved 37  
 - Petiole (0-)2-7(-10) mm long; leaf blade not decurrent onto the petiole and leaf margin not thickened and recurved 38
37. - Leaf blade not decurrent onto the petiole, margin thickened and recurved; racemes erecto-patent to horizontal, (2-)5-9(-14) cm long *C. laeve*  
 - Leaf blade decurrent onto the petiole, margin not thickened nor recurved; racemes horizontal, (3-)8-23(-40) cm long *C. engama*
- 38 - Leaf margin sharply serrate 39  
 - Leaf margin entire to serrulate 40
39. - Leaf blade coriaceous, with 9-12 main lateral veins on either side *C. andongense*  
 - Leaf blade papyraceous, with 12-17 main lateral veins on either side *C. bukobensis*
40. - Leaf blade dark brown when dry, with blunt to rounded apex, tertiary venation distinctly reticulate throughout the leaf *C. lutambense*  
 - Leaf blade greenish to reddish brown when dry, with acute to acuminate apex, tertiary venation scalariform at least in the marginal zone 41
41. - Pedicels articulated at (4-)6-10 mm from the base; racemes slender and wiry *C. nutans*  
 - Pedicel articulated at 1-6 mm from the base; racemes fairly stout 42
42. - Racemes branched, giving the inflorescence a corymbose appearance; inflorescence 4-8(-12) cm long *C. occidentale*  
 - Racemes unbranched; inflorescence (3-)5-more cm long 43
43. - Peduncle flattened 44  
 - Peduncle cylindrical 45
44. - Inflorescence born on a very robust flattened twig; pedicels 3-7 mm long, stout, articulated at 1-2 mm from the base *C. costatum*

- Inflorescence born on a slender twig; pedicels 6-13 mm long, articulated at 3-7 mm from the base *C. vogelii*
- 45. - Upper leaf surface set with tiny bumps in between the tertiary veinlets (strong lens!), giving the surface a 'rough' appearance *C. laxiflorum*
- Upper leaf surface smooth in between the tertiary veinlets 46
- 46. - Racemes with several bracts at the top; drupelets ellipsoid-oblong, 8-14 mm long *C. plicatum*
- Racemes without apical bracts; drupelets reniform or subglobose to ellipsoid, 5-9 mm long 47
- 47. - Leaf blade tertiary venation with a pattern of very closely spaced veinlets running parallel to the scalariform veins; cotyledons similar in size *C. warneckei*
- Leaf blade tertiary venation without such veinlets; cotyledons dissimilar in size 48
- 48. - Pairwise scales at the base of the peduncle and bracts below each cymule persistent; leaf blade with tertiary venation on lower surface more or less unicolourous with the leaf mass; racemes held ± horizontally *C. squamosum*
- Pairwise scales at the base of the peduncle and bracts below each cymule caducous; leaf blade with tertiary venation on lower surface markedly darker than the leaf mass; racemes erecto-patent *C. reticulatum*

**Campylospermum amplexans** (Stapf) Farron**Fig. 1**

Bull. Jard. Bot. État Bruxelles 35: 393 (1965). – *Gomphia amplexans* Stapf, J. Linn. Soc., Bot. 37: 87 (1905). – *Ouratea amplexans* (Stapf) Engl., Pflanzenw. Afr. 3, 2: 488 (1921). – Type: *A. Whyte s.n.* (holotype: K!), Liberia, Montserrado, Kakata, within 20 miles of Kakatown, 1904.

*Tree up to 12 m tall, monocaulous*; stem with brownish coloured bark. *Stipules caducous*, triangular, 3–5 mm long. *Leaf*: petiole 0–10 mm long; leaf blade **narrowly obovate to narrowly spathulate, 17–38 × 4–9 cm, ratio 3.2–4(–4.3), base auriculate, apex acute**, coriaceous, not bullate, margin **serrulate**, upper side dull green, lower side glossy paler green; midrib slightly flattened on upper side, prominent on the lower; main lateral veins **20–30 on either side, 10–20(–30) mm apart, prominent on the upper leaf surface**, more or less at a right angle with midrib but curved upward to run parallel to the margin, intermediate lateral veins less prominent on both sides, **1 to 2** in between each pair of main laterals, tertiary venation scalariform, **perpendicular to the main lateral veins, indistinct on upper side, distinct on the lower one**. *Inflorescence*

terminal or rarely axillary, branched, dense, its main axis **3–13(–19) cm long, robust, round in cross section**; racemes **1–5, 3–6(–9) cm long**; pairwise scales **caducous**; bracts caducous, triangular, c. 2–3 mm long; cymules 5–7(–15) mm apart, **1–8(–16)-flowered**. *Flower*: pedicel 7–20 mm, articulated at 3–5 mm from the base; sepals oblong, in flower 5–6 × 3–4 mm, in fruit 10–15 × 5–6 mm and enclosing the drupelets, base truncate, apex obtuse; petals **obovate**, 9–13 × 5 mm, **shortly clawed at base, truncate and slightly emarginate at apex**; stamens: anthers 6–7 mm long; ovary c. 2 mm long; style slender, 6–8 mm long. *Fruit*: receptacle c. 3 mm thick; drupelets: 1 to 4 well developed per receptacle, **ellipsoid**, c. 7 × 5 mm; cotyledons **incumbent, similar in size**.

**Notes:** This species is closely related to *C. mannii* (Oliv.) Tiegh. and *C. klainei* (Tiegh.) Farron. It differs by having a branched inflorescence while the other two species have an unbranched one. It is also distinguished by its distinctly auriculate leaf base (resp. cordate to auriculate and cordate in *C. mannii* and *C. klainei*). Both *C. mannii* and *C. klainei* have angular to slightly flattened peduncle while *C. amplexens* has a rounded one. The tertiary venation is distinct on both sides in *C. mannii* and *C. klainei* whereas it is indistinct on the upper side in *C. amplexens*.

Still, knowing that habitat destruction in western Africa has been severe, a more detailed assessment is desirable.

**Distribution:** West Africa, from Sierra Leone to Ghana (**Map 2**).

**Ecology:** in high, closed, evergreen, primary or secondary rain forest, also in forest along streams; at 20–350 m altitude.

**Phenology:** flowers observed from September to March and mature fruits from October to March.

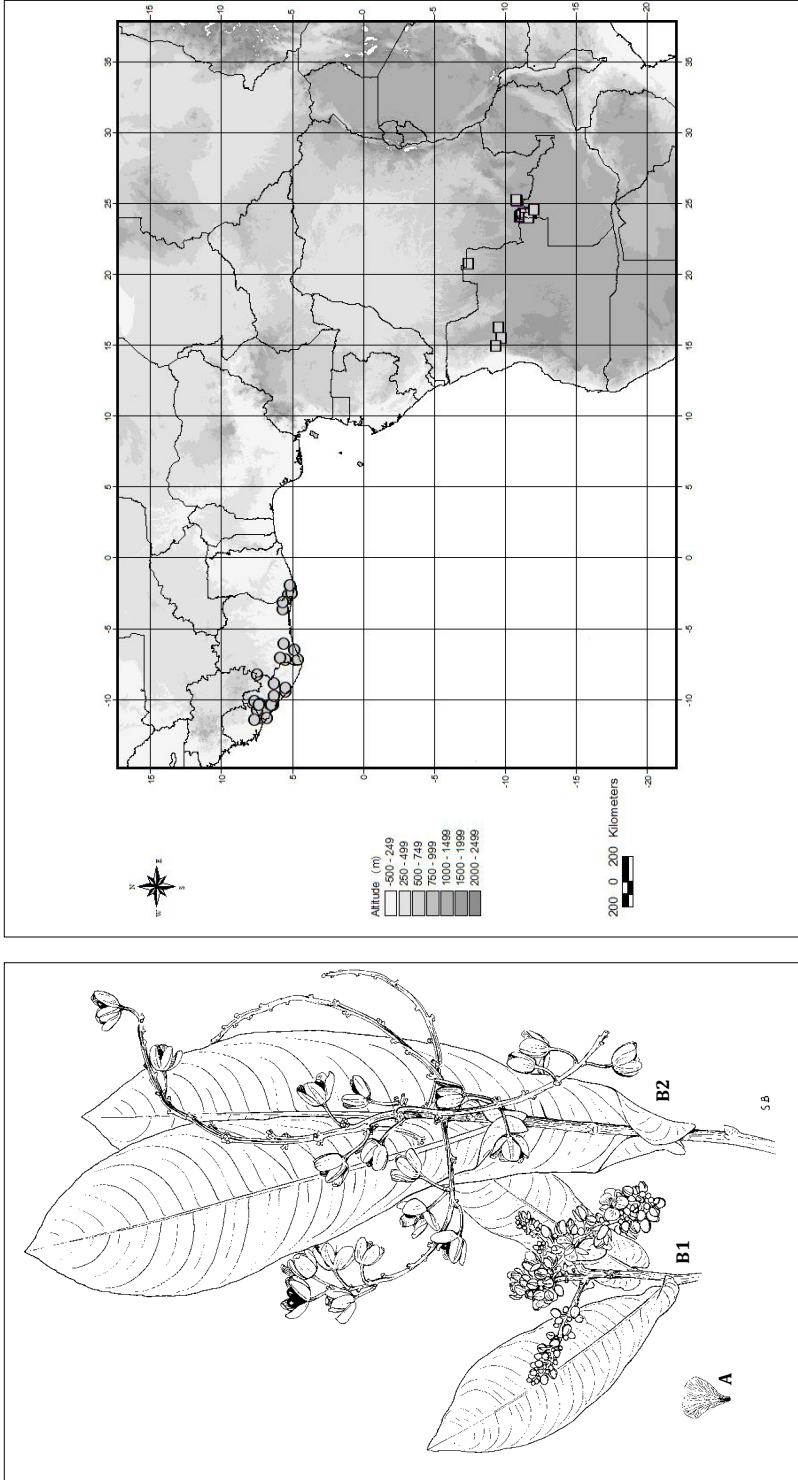
**Uses:** The wood is flexible and splinters. In Liberia, the fine wood splints are tied together to make brooms (Burkill 1997).

**IUCN conservation status:** LC B1/B2ab(iv). EOO=184,468 km<sup>2</sup>, AOO=165,172 km<sup>2</sup>, locations=29, (cell width=109 km). This species is fairly common; its most recent collection is from 2012. The number of locations is sufficient to assign this species to the category of Least Concern.

**Specimens examined:**

**GHANA, Western Region:** Abiabo, Axim distr. 5°02'N, 2°27'W. Alt: 100m, November 1928 (fl, fr), *Vigne FH 1429* (FHO); Simpa. 5°06'N, 2°06'W. Alt: 200m, February 1933 (fr), *Vigne FH 2796* (FHO); Benso. 5°09'N, 1°54'W, December 1950 (fr), *Andoh FH 5405* (K); Ankasa Forest Reserve. 5°18'N, 2°36'W, 8 January 1967 (fr), *Enti GC 36304* (K).

**IVORY COAST, Abidjan:** Forêt Classée de la Yaya., 80m, 5°40'N, 3°34'W. Alt: 80m, 27 November 1997 (fr), *Jongkind 4092* (MO,WAG); **Aboisso:** Km 5 Ayamè - Abengourou Road. 5°38'N, 3°07'W, 7 November 1968 (fl), *Breteler 5934* (WAG); **Danané:** Tiapleu. 7°27'N, 8°13'W, September 1955 (fl), *Nozeran s.n.* (P); **Guiglo:** Tai National Park; sample plots "Bono 7" between Bono River and Hana River. Past picet 184 r.Z. 5°28'N, 7°10'W, 23 January 1990 (st), *Albers, P. 40* (MO,WAG); Tai National Park; sample plots "Bono 7" between Bono River and Hana River. Picet 185 r.Z. 5°28'N, 7°10'W, 23 January 1990 (st), *Albers, P. 42* (WAG); **San-Pédro:** from Tabou 30 km to Béréby, along the road. 4°34'N, 7°10'W, 11 October 1973 (fl), *Koning, J. de 2363* (BR,E,MO,WAG); Forêt Classée Monogaga, just north of Sassandra - San Pedro road., 4°51.9'N, 6°26.8'W, 24 March 2000 (st), *Jongkind 4718* (WAG); **Sassandra:** c. 18 km S of Guéyo (between Gagnoa and Sassandra).



**Figure 1.** *Campylosperrum amplectens*. **A.** Petal. **B1.** Flowering branch. **B2.** Fruiting branch. Drawings by Sabine Bousani  
**Map 2.** Distribution of *Campylosperrum amplectens* (○) and *Campylosperrum andongensis* (□)

5°34'N, 6°01'W, 8 December 1961 (fr), *Wilde, J.J.F.E. de 3351* (B,K,WAG); **Soubré**: Soubré, Parc National de Tai. 5°50'N, 7°00'W, 24 January 1975 (fr), *Aké Assi 12651* (G).

**LIBERIA, Gbarpolu**: Kpelle Forest. North of Gaiakpa. 7°22.0'N, 10°20.8'W. Alt: 350m, 13 December 2010 (fl), *Jongkind 10119* (BR,COI,FHO,FR,HUJ,K,MA,MO,WAG); **Grand Bassa**: Cestos-Sanguin area, Logging Concession of the Cooper's, Sudan Section. 5°29.4'N, 9°23.0'W. Alt: 60m, 6 December 2002 (fr), *Jongkind 5628* (BR,WAG); **Grand Cape Mount**: north of Lake Piso. 6°48.17'N, 11°17.27'W. Alt: 20m, 21 July 2004 (st), *Jongkind 6043* (WAG); **Lofa**: Kpelle National Forest, 58 miles E of Bopolu. 7°40'N, 10°05'W, 18 January 1978 (st), *Gier, A. de 204* (MO,WAG); Gola Forest., 7°27.1'N, 10°41.5'W, 28 November 2005 (fr), *Jongkind 6939* (BR,G,WAG); Western Province, Boporo District, Tawata. 7°18'N, 10°17'W, 15 November 1947 (fl), *Baldwin jr, J.T. 10304* (K); **Montserrado**: Within 20 miles of Kakatow. 6°32'N, 10°21'W, 1904 (fl), *Whyte, A. s.n.* (K); Dukwia River, Monrovia, near Firestone Plantations. 6°23'N, 10°22'W, 26 October 1928 (fl), *Cooper, G.P. 84* (BM,K,US); Monrovia, Dukwia River. 6°23'N, 10°22'W, 7 February 1929 (fl), *Cooper, G.P. 155* (A,BM,FHO,GH,K US); Bomi Hills. Gola National Forest. 6°56'N, 10°45'W, 16 October 1965 (fl), *Meer, P.P.C. van 197* (WAG); Firestone Plantation, Division 33. 6°19'N, 10°21'W, 25 October 1970 (fl), *Stoop - v.d. Kastelee, F.S.C. 237* (LIB,MO,WAG); Firestone Plantation, Division 33. S of Kakata. 6°29'N, 10°22'W, 3 January 1971 (fr), *Stoop - v.d. Kastelee, F.S.C. 304* (MO,WAG); **Nimba**: Gbi National Forest, Southern Part. 6°18'N, 8°52'W, October 1961 (fl), *Voorhoeve 545* (WAG); Siatown. 6°18'N, 9°41'W, 10 December 1958 (fr), *Adam, J.-G. 16326* (P); **Sino**: South of Sayon Town., 70m, 5°27.1'N, 9°10.1'W. Alt: 70m, 1 December 2010 (fl), *Jongkind 9983* (WAG).

**SIERRA LEONE, Eastern Province**: Nongawa, Kambwi forest reserve. 7°38'N, 11°24'W, 31 March 1955 (fl), *Jordan, H.D. 2017* (B,K); **Southern Province**: Gola Forest Reserve, Pujehun District, makpete Chiefdom, 1 mile W of 1964 hoist site. 7°19'N, 11°18'W, 5 February 1965 (fl), *Fox, J.E.D. 20* (K); Gola Forest Reserve, BIII. 7°16'N, 11°18'W, 19 March 1952 (fl), *Small, D. 555* (K).

**Key literature**: Farron (1963, 1985), (Hawthorne and Jongkind 2006), (Hutchinson et al. 1954) and (Poorter et al. 2004).

### **CampylospERMUM andongense** (Hiern) Biss.

*CampylospERMUM andongensis* (Hiern) Biss., *Blumea* 58: 6 (2013). – *Ouratea reticulatum* (P.Beauv.) Engl. ex Gilg var. *andongensis* Hiern, *Cat. Afr. Pl. Welw.* 1: 122 (1896). – *Monelasmum andongensis* (Hiern) Tiegh., *Ann. Sci. Nat., sér. 8, Bot.* 16: 328 (1902). – *Ouratea andongensis* (Hiern) Exell, *J. Bot.* 65: 58 (1927). – Type: *Welwitsch 4604* (holotype: LISU!; isotype: BM!, C!, COI!, G!, K!) Angola, Pungo Andongo, 1857.

**Tree up to 7 m tall**, with branched trunk; twigs with dark coloured bark. *Stipules caducous*, triangular, 3–5 mm long. *Leaf*: petiole 2–5 mm long; leaf blade ovate-oblong or narrowly elliptic to narrowly elliptic-obovate, **(5–)10–21 × (1.5–)3–6 cm**, ratio **(1.8–)2.6–3.75(–4.35)**, base cuneate, apex acute to slightly acuminate, chartaceous to coriaceous, not bullate, margin **serrate, teeth with a dark tip**, upper side dark green, lower side light green; venation: midrib prominent on both sides, main lateral veins **9–12 on either side, 5–20 mm apart**, more or less at right angle with midrib but curved upward to run parallel to the margin, prominent above, not prominent but distinct below, intermediate lateral veins 0–1 in between each pair of main laterals, less prominent on both sides, tertiary venation scalariform, perpendicular to the midrib, **distinct on both sides**. *Inflorescence* terminal, branched, lax, its main axis **3–15(–20) cm long**; racemes **(0–)1–3(–5), (1–)3–10(–13) cm long**; pairwise scales **at the base of peduncle caducous**; bracts caducous; cymules 5–15 mm apart, 1–8-flowered. *Flower*: pedicel 7–15 mm, articulated at 1–4 mm from the base; sepals ovate to narrowly elliptic-ovate, in flower 7–8 × 2–3 mm, in fruit 8–9 × 2–3.5 mm, not enveloping the drupelets, base truncate, apex obtuse; petals **obovate**, 8–10 × 5–8 mm,



**cuneate at base, rounded at apex;** stamens: filaments less than 1 mm long, anthers 5–6 mm long; ovary c. 2 mm large; style slender, 5–6 mm long. *Fruit:* receptacle c. 5 mm thick; drupelets: 1 to 2 well developed per receptacle, **ellipsoid to almost globose**, (6–)8–9 × (4–)5–6 mm; cotyledons **incumbent, dissimilar in size with a small outer cotyledon.**

**Notes:** This species is similar to *C. reticulatum* (P.Beauv.) Farron. However, it has a more coarsely serrate leaf margin with teeth having a dark tip and petals rounded at the apex, whereas *C. reticulatum* has a serrulate margin with unicolourous teeth and petals with an emarginate apex.

**Distribution:** Democratic Republic of the Congo (Katanga), northern Angola, north-western Zambia (**Map 2**).

**Ecology:** in evergreen, riparian forests; at 700–1500 m altitude.

**Phenology:** flowers observed from September to January and fruits in October, December and February.

**IUCN conservation status:** LC B1/B2ab(i,ii,iii). EOO=268,354 km<sup>2</sup>, AOO=78,240 km<sup>2</sup>, locations=22, subpopulations=3, (cell width=114 km). This species is distributed across 3 subpopulations with the main one occurring in the Lavushi Manda National Park in Zambia. It is fairly well represented in herbaria, and therefore the category of Least Concern seems most appropriate.

**Specimens examined:**

**ANGOLA, Cuanza Norte:** 9°20' S, 15°00' E, (st), *Gossweiler 632* (BM,K,P); (fr), *Gossweiler 763* (K,P); **Lunda Norte:** Luachima. Sector fitocorológico das explorações da “Companhia de Diamantes de Angola”. Dundo. 7°22'S, 20°49'E. Alt: 750m, 1 September 1946 (fl), *Gossweiler 13570* (B,BM,US); Dundo, Luachimo. 7°24'S, 20°50'E. Alt: 700m, 27 October 1946 (fr), *Gossweiler 13780* (BM,K); **Malanje:** Malange: próximo da estrada Quale a 23 km de Santa Maria., 1100m, 9°32'S, 16°20'E. Alt: 1100m, 20 December 1970 (fr), *Raimundo, F. 570* (LISC, LUA); Pungo, Andongo. 9°40' S, 15°35' E, January 1857 (fl), *Welwitsch, F.M.J. 4604* (BM,C, COL, G, K, LISU).

**CONGO (KINSHASA), Katanga (Shaba):** A proximité de Kolwezi. 10°46'S, 25°19'E. Alt: 1425m, 4 September 1984 (fl), *Schajjes 2375* (BR); 30 km au SW de Kolwezi. 10°50'S, 25°14'E. Alt: 1425m, 18 January 1986 (fr), *Bamps 8141* (BR); Congo, katanga Province, 14 mls N.N.W. of Kalene Mission on border. 11°00'S, 24°08'E. Alt: 1290m, 11 November 1962 (fl), *Richards, M.A.E. 17158* (K).

**ZAMBIA, North-Western:** Nkunyi Protected Forest Area; 9.04 km from Lwawu-Mwinilunga Junction. On Kabompo-Mwinilunga Road (D286). 11°48'S, 24°21'E. Alt: 1410m, 23 February 1995 (fr), *Luwika, B. 87* (WAG); 4 mls N. of Kalene hill mission. 11°10'S, 24°12'E, 21 September 1952 (fl), *Angus 510* (FHO, K, WAG); Zambesi, c. 4 mls N. of Kalene hill-Mission., c. 11°10'S, 24°12'E, 23 September 1952 (fl), *Angus 532* (FHO); Ikelenge, Hillwood farm S. 11°14'S, 24°20'E. Alt: 1450m, 21 May 1999 (st), *Congdon, T.C.E. 559* (K); near mile post 16 on Kalene hill-Mwinilunga road., c. 11°08'S, 24°13'E, 7 November 1952 (fl), *Holmes, W.D.H. 975* (FHO, K); Matonchi Farm., 11°39'S, 24°03'E, 3 September 1930 (fl), *Milne-Redhead 1042* (K); , 12°00'S, 24°35'E, 28 October 1955 (fl), *Holmes, W.D.H. 1292* (K); Ikelenge district; Zambezi source National heritage site; 18.0 km S of Ikelenge then 4.8 km E on access road from Ikelenge-Mwinilunga Rd. 11°22.0' S, 24°18.4' E. Alt: 1500m, 26 February 1995 (fr), *Harder 2786* (BR, WAG); By R. luao between R. Matonchi and R. Kaomba., c. 11°39'S, 24°07'E, October 1937 (fl), *Milne-Redhead 3051* (BR, K); near Zambia River; 4 miles N of Kalene Hill mission., c. 11°06'S, 24°11'E, 23 September 1952 (fl), *White, F. 3339* (BM, BR, FHO, K, WAG); river, Mwinilunga. 11°44'S, 24°24'E, 19 May 1969 (fl), *Mutimushi 3371* (B); Mwinilunga. 11°06'S, 24°11'E, 27 September 1952 (fl), *White, F. 3392* (WAG); 4 miles S. of Mwinilunga., c. 11°47'S, 24°24'E, October 1937 (fl), *Milne-Redhead 3506* (BM, BR, K); 6 km N of Kalene Hill., c. 11°07'S, 24°12'E, 12 December 1963 (fr), *Robinson, E.A. 5965* (K); source of Zambezi River. 11°23'S, 24°20'E, 13 December 1963 (fl), *Robinson, E.A. 6132* (K); Lisombo R., 16 km S.W. of Klene Hill Mission. 11°18'S, 24°02'E, 11 June 1963 (fl), *Drummond, R.B. 8283* (B, BR, FHO, K); Source of the Zambesia. 11°23' S, 24°20'E. Alt: 1450m, 21 January 1975 (fr), *Brummitt 13917* (BR, K).

**Key literature:** Exell & Mendonça (1951), Farron (1965) and Robson (1963).

**Campylosperrum auriculatum** Biss.

Blumea 58: 2 (2013). – Type: *Strijk 73* (holotype: WAG!; isotype: LBV!), Gabon, Woleu-Ntem, Bordamur concession area, some 40 km from WWF-station, 1°14'N, 11°53'E, October 10<sup>th</sup>, 2002.

*Treelet* up to 6 m tall, with branched trunk; twigs with pale brown coloured bark. *Stipules* caducous, 3–5 mm long. *Leaf*: petiole 0–2 mm long; leaf blade elliptic-obovate to oblanceolate, **(9–)14–24(–31) x (4–)6–8(–11) cm, ratio 2–4(–5), base auriculate to deeply cordate, often clasping the twig**, apex acute, coriaceous to thick leathery, not bullate, margin serrate, upper surface glossy green, lower surface dull paler green; midrib flattened above, prominent below, main lateral veins 16–19 on either side, 10–20 mm apart, curved upward to run parallel to the margin, intermediate lateral veins prominent on both sides, 0 to 2 in between each pair of main laterals, tertiary venation scalariform, **very distinct on both sides**. *Inflorescence* terminal or rarely axillary, branched, fairly dense, its main axis 12–15(–18) cm long, **flattened**; racemes 1–6, 3–9(–11) cm long; pairwise scales absent; bracts persistent at the base of the raceme and pedicel, triangular, c. 3–5 mm long; cymules 5–9 mm apart, 2–4(–6)-flowered. *Flower*: pedicel 5–7 mm long, articulated at 2–3 mm from the base; sepals 5, ovate, in flower 7–8 x 2–3 mm, yellowish green, in fruit 9–10 x 3–4 mm, bright red; petals 5, obovate, 7–12 x 3–4 mm, cuneate at base, rounded at apex, bright yellow; stamens: anthers 3–4 mm long; ovary c. 2 mm wide; style c. 4 mm long. *Fruit*: receptacle c. 5 mm wide, orange-red; drupelets 1 to 3 well developed per receptacle, reniform, c. 8 x 5 mm; cotyledons incumbent, dissimilar in size with a small outer cotyledon.

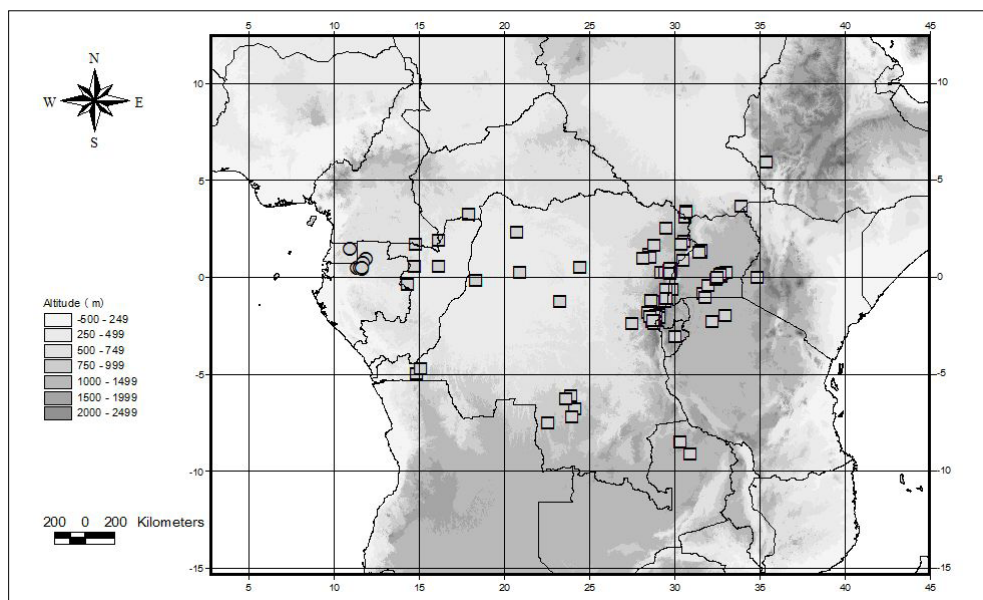
**Note:** Especially the auriculate to deeply cordate leaf base is highly reminiscent of *C. schoenleinianum* (Klotzsch) Farron, a species confined to western tropical Africa (from Guinea to Ghana).

**Distribution:** Equatorial Guinea (Rio Muni) and Gabon (Woleu-Ntem province) (**Map 3**).

**Ecology:** in primary or secondary forest; on brown clay soil; at 475–600 m altitude.

**Phenology:** flowers and mature fruits collected from October to November, flowers also observed in April, which coincides with the two rainy seasons.

**IUCN conservation status:** VU B1/B2ab(ii,iii,iv). EOO=6,098 km<sup>2</sup>, AOO=1,653 km<sup>2</sup>, locations=11 (cell width=15.36 km). All collections are of comparatively recent origin (the oldest one is from 1983). The only collection from Equatorial Guinea is from within a protected area (Inselberg at Akuom). The other ten collections from Gabon are from a fairly restricted area where logging companies operate which is supposed to lead to a decline in the AOO and/or extent of suitable habitat and hence the 'Vulnerable' category has been assigned.



**Map 3.** Distribution of *Campylosperrum auriculatum* (○) and *Campylosperrum bukobense* (□)

### **Specimens examined:**

**EQUATORIAL GUINEA, Rio Muni, Wele Nzaz:** Inselberg d'Akuom, à 1h30 demarche (6 km) du village de Nzuameyong, à 25 km d'Anisoc. 1°50'N, 10°55'E. Alt: 600m, 13 June 1999 (st), *Parmentier 358* (BRLU).

**GABON, Woleu-Ntem:** Bordamur concession area, some 40 km from WWF-station, at logging road construction site. 1°14'N, 11°53'E. Alt: 570m, 10 October 2002 (fl), *Strijk 73* (BR,K,LBV,MO,WAG); Oveng, 65 km N. of road Benguï - Lalara, forest exploitation camp., 500m, 0°42'N, 11°23'E. Alt: 500m, 5 November 1983 (fl, fr), *Louis, A.M. 377* (K,LBV,WAG); c. 8 km SSW of Mitziç, FOREENEX forest exploitation. 0°42.9'N, 11°32.0'E. Alt: 547m, 6 November 2009 (fr), *Bissiengou 667* (LBV,WAG); 8½ km SSW of Mitziç, FOREENEX forest exploitation. 0°42.5'N, 11°31.9'E. Alt: 501m, 6 November 2009 (fl), *Bissiengou 707* (LBV,WAG); 13 km SE of Mitziç, FOREENEX forest exploitation, road from FOREENEX forestry camp to Madouaka village. 0°42.4'N, 11°38.2'E. Alt: 480m, 7 November 2009 (fl), *Bissiengou 714* (LBV,WAG); 13 km SE of Mitziç, FOREENEX forest exploitation, road from FOREENEX forestry camp to Madouaka village. 0°42.1'N, 11°38.8'E. Alt: 490m, 7 November 2009 (fr), *Bissiengou 730* (LBV,WAG); 35 km NNE of Mitziç, forestry road in Bordamur forest exploitation, 2 km from Bordamur forestry camp. 1°02.8'N, 11°43.3'E. Alt: 545m, 8 November 2009 (st), *Bissiengou 769* (LBV,WAG); Inventory Oveng; primary rain forest, ca 25 km WSW of Mintsic, 0°44'N, 11°22'E, 6 November 1986 (fl, fr), *Reitsma, J.M. 2493* (WAG); About 30-40 km NE of Saint Germain, E. of Okano River. 0°40'N, 11°40'E. Alt: 475m, 18 April 1988 (fl, fr), *Breteler 8797* (LBV,WAG); RN 2, S of Mitziç, FOREEX-concession, near Parc à Bois. 0°42.8' N, 11°38.9' E. Alt: 503m, 30 October 2011 (fl), *Maas, P.J.M. 10052* (LBV,WAG).

**Key literature:** Bissiengou et al. (2013).

### **Campylosperrum bukobense** (Gilg) Farron

Bull. Jard. Bot. État 35: 393 (1965). – *Monelasmum bukobense* (Gilg) Tiegh., Ann. Sci. Nat., ser. 8, Bot. 18: 36 (June 1903). – *Ouratea bukobensis* Gilg, Bot. Jahrb. Syst. 33: 271 (1904). – Syntypes: *Stuhlmann 978, 1023, 1073, 1467, 1521, 3212, 3721, 3990, 3991, 4063* (B, none located and probably all destroyed) Tanzania, Bukoba. – Neotype (designated here): *Conrads 447* (holotype: B!; isotype: BR!, EA!, FHO!, K!) Tanzania, Marienhof Ukerewe, November 21<sup>st</sup>, 1911.

*Ouratea floribunda* De Wild., Rev. Zool. Afr. VII, Suppl. Bot.: B51 (1920). – *Gomphia floribunda* (De Wild.) Lye, Lidia 4(3): 92 (1998) (non *Gomphia floribunda* A.St.-Hil., 1825). – Type: Pynaert 522 (holotype: BR(3x)!; isotype: K!, Z!), Congo, Eala, October 5<sup>th</sup>, 1906. *Ouratea likimiensis* De Wild., Rev. Zool. Afr. VII, Suppl. Bot.: B59 (1920). – *Gomphia likimiensis* (De Wild.) Verdc., Fl. trop. E. Afr., Ochnaceae: 46 (2005). – Type: Malchair 271 (holotype: BR!; isotype: BR!), environ de Likimi, June 10<sup>th</sup>, 1910.

*Tree* up to 10 m tall, bole up to 30 cm dbh, with branched trunk; twigs with pale coloured bark. *Stipules* caducous, triangular, 1–3 mm long. *Leaf*: petiole 1–5 mm long; leaf blade narrowly elliptic to oblanceolate, **(6–)8–18(–21) x (1–)1.5–5.5 cm, ratio 3–5**, base cuneate, apex acute, **papyraceous**, not bullate, upper surface glossy, lower surface dull green, margin **regularly serrate to serrulate**, the teeth with a dark tip; midrib prominent above and below, main lateral veins **12–17** on either side, 5–15 mm apart, prominent above and below, at a ± right angle with the midrib but curved upwards to run parallel to the margin, intermediate lateral veins 1–2(–5) in between each pair of main laterals, prominent on both sides, tertiary venation **scalariform, perpendicular to the midrib, joined by cross veinlets**, very distinct on both sides. *Inflorescence* terminal, fairly lax to fairly dense, its main axis (2–)4–16(–20) cm long; racemes 2–7, (1–)3–12 cm long, ascendant, cymules 2–15 mm apart, 2–7(–11)-flowered. *Flower*: pedicel 8–17(–20) mm, articulated at 1–6 mm from the base; sepals ovate, in flower 6–7 x 2–3 mm, in fruit 8–9 x 2–3 mm, becoming coriaceous, first spreading then curved up; petals obovate, 5–9 x 4–6 mm, base cuneate, apex rounded; stamens: anthers 3–5 mm long; ovary 1 x 1 mm; style 4–6 mm long. *Fruit*: receptacle c. 1 mm long in flower, 5 x 5 mm in fruit; drupelets 2–4 well developed per receptacle, ellipsoid, 7–10 x 5–7 mm; **embryo incumbent, dissimilar in size with a small outer cotyledon.**

**Notes:** The syntype specimens of *O. bukobensis*, all Stuhlmann collections, are missing. Many requests were sent out to herbaria in order to locate duplicates of those specimens. Unfortunately these could not be traced. A Neotype, *Conrads 447*, is therefore designated here. It has been collected approximately at the same locality as the syntype specimens. The year of collection was 1911, before the Berlin herbarium, where Stuhlmann's collections were most likely kept, was largely destroyed. It has been distributed to five herbaria and two herbarium sheets are from the herbarium of Berlin (B). They carry labels with "Ouratea bukobense Gilg" in Gilg's handwriting. In addition, the serrate leaf margin and the leaf blade shape match perfectly the original description. Verdcourt (2005) recognizes *G. likimiensis* and has identified *C. bukobense* material as either *G. vogelii* or *G. likimiensis*. Actually, *G. likimiensis* is *Ouratea floribunda* De Wild but he could not use that name since *Gomphia floribunda* A.St.-Hil. exists already. He listed characters that describe both species such as the leaf texture, shape and margin. Material that has thin, narrowly elliptic-lanceolate leaves with usually spinulose teeth that are more closely spaced and more curved was identified as *O. likimiensis*. I

totally agree with him that two taxa are involved, but Verdcourt failed to see that his *C. likimiensis* also perfectly matches the description of *C. bukobense*. Verdcourt's error was maybe a logical one because he did not see any type specimens of *C. bukobense*. Now, having selected a neotype specimen and having seen many herbarium sheets identified by previous botanists as either *C. bukobense* or *O. floribunda*, to me it is obvious they belong to the same taxon, for which the correct name is *C. bukobense*.

Finally, in terms of affinity, *C. bukobense* is close to *C. andongensis*. It differs by having papyraceous leaves and more numerous lateral veins.

**Distribution:** South Central African Republic to South-East Cameroon and the North of the Republic of the Congo, extending to the Democratic Republic of the Congo, southern Ethiopia, southern Soudan, Uganda, Kenya, Tanzania and Zambia (**Map 3**).

**Ecology:** in primary, secondary and gallery forests, also in swamp forest; at 350-1650 m altitude.

**Phenology:** flowering and fruiting all year round.

**IUCN conservation status:** LC B1/B2ab(i,ii). EOO=31,36920 km<sup>2</sup>, AOO= 19,82420 km<sup>2</sup>, locations=82, subpopulations=26, (cell width=266 km). This species is scattered into many subpopulations (26) from the Republic of the Congo to eastern and north-eastern Africa. Although its most recent collection is from the nineteen eighties, it is well represented in herbaria suggesting it is not uncommon. Therefore, the category of Least Concern seems most appropriate.

#### **Specimens examined:**

**BURUNDI, Gitega:** Confluent Karuzi-Ruvuvu. 3°15'S, 30°02'E, 31 December 1958 (fr), *Ben, D. van der 2411* (EA,K).

**CAMEROON, UNKNOWN:** March 1918 (fl), *Gocker 40* (HUH); **East Province:** près Ndongo, à 40 km WNW de Moloundou (Feuille IGN 1/200.000 Souanke). 2°10'N, 14°50'E, 15 March 1973 (fl), *Letouzey 12081* (BR,K,P).

**CENTRAL AFRICAN REPUBLIC, Lobaye:** Boukoko. 3°54'N, 17°55'E, 6 February 1948 (fl), *Tisserant (Équipe), C. 674* (P); Boukoko. 3°54'N, 17°55'E, 8 April 1948 (fl), *Tisserant (Équipe), C. 839* (P); Boukoko. 3°54'N, 17°55'E, 17 May 1950 (fr), *Tisserant (Équipe), C. 1746* (P); Boukoko. 3°54'N, 17°55'E, 9 April 1948 (fl), *Tisserant (Équipe), C. 2061* (P); **Sangha-Mbaéré:** Ndakan, gorilla study area M 1500 to M 2000 to B 600. 2°21'N, 16°10'E. Alt: 350m, 27 April 1988 (fl), *Harris, D.J. 531* (E).

**CONGO (BRAZZAVILLE), Cuvette:** Alima-Likouala, région de M'Bomo, réserve de chasse d'Odzala (M'Boko). 0°13'S, 14°20'E, 15 December 1970 (fr), *Sita 2991* (WAG); Odzala National Park, saline Moba A. 0°49'N, 15°70'E, 25 January 1996 (fl), *Lejoly 96/ 295* (BRLU); Odzala National Park, Layon Tombi, partie Sud., c. 0°52'N, 14°46'E, 12 February 1994 (fl), *Lisowski, S. C 1019* (BRLU).

**CONGO (KINSHASA), Bas-Congo:** Kisantu. 5°08'S, 15°06'E, 1900 (fl, fr), *Gillet, J. s.n.* (BR); Mvuazi. 5°27'S, 14°54'E, 29 November 1947 (fl, fr), *Devred 63* (BR); Mvuazi. 5°27'S, 14°54'E, 3 June 1958 (fl), *Dubois, J. 310* (BR); Kisantu. 5°08'S, 15°06'E, 30 September 1930 (fl), *Vanderyst, H.J.R. 25776* (BR); Kisantu. 5°08'S, 15°06'E, 30 September 1930 (fl), *Vanderyst, H.J.R. 25777* (BR); **Equateur:** environ de Likimi. 2°50'N, 20°45'E, 20 April 1910 (fl), *Malchair 271* (BR); Eala. 0°03'N, 18°19'E, 5 August 1906 (fr), *Pynaert 522* (BR,K,Z); Eala., c. 0°03'N, 18°19'E, 5 October 1906 (fr), *Pynaert 523* (BR); Eala. 0°03'N, 18°19'E, October 1930 (fr), *Staner 903* (BR,EA,K,WAG); Eala. 1°11'S, 23°16'E, April 1939 (fl), *Dubois, L. 1007* (BR,EA,G,K,WAG); Eala. 0°03'N, 18°19'E, 20 March 1907 (fl), *Pynaert 1189* (BR); Eala. 0°03'N, 18°19'E, 10 May 1932 (fr), *Baland 1250* (BR); Eala., c. 0°03'N, 18°19'E, 20 June 1932 (fl), *Baland 1578* (BR); Eala. 0°03'N, 18°19'E, 1 August 1932 (fl, fr), *Baland 1670* (BR); Eala, Coquilhatville. 0°03'N, 18°19'E, 27 September 1933 (fl), *Corbisier-Baland 2052* (EA,G,US,WAG); Eala. 0°03'N, 18°19'E, 27 September 1933 (fl), *Baland 2052* (BR,US,WAG); Eala. 0°03'N, 18°19'E, 2 May 1919 (fl), *Vermoesen 2126* (BR); Befale. 0°28'N, 20°57'E, 30 June 1958 (fr), *Evrard, C.M. 4316* (BR,K,WAG); **Kasai-Oriental:** Gandajika. 6°45'S, 23°57'E, 20 June 1951 (fr), *Chalon, G. 346* (BR); Kanda-kanda. Galerie de la Mulavudi, 30 Km SE de Gandajika. 6°56'S, 23°37'E, 30 August 1945 (fl), *Luxen 563* (BR); Kanda-Kanda. 6°56'S,

23°37'E. Alt: 800m, 7 November 1957 (fl), *Risopoulos 689* (K,WAG); **Katanga (Shaba):** Mutombo-Mukulu. 7°58'S, 24°00'E, 24 August 1959 (st), *Lukuesa 695* (BR); Kapanga. 8°21'S, 22°34'E, September 1933 (fl), *Overlaet 855* (BR); Luisa Kasai., c. 8°21'S, 22°34'E, 1934 (fl), *Overlaet 859* (WAG); Kaniama - Haut Lomani. 7°31'S, 24°11'E. Alt: 860m, August 1947 (fl), *Mullenders 1273* (BR); Kaniama - Haut Lomani. 7°31'S, 24°11'E. Alt: 850m, 28 November 1947 (fr), *Mullenders 1563* (BR); Kaniama - Haut Lomani. 7°31'S, 24°11'E. Alt: 860m, 1 December 1947 (fr), *Mullenders 1630* (BR); Kaniama. 7°31'S, 24°11'E, October 1938 (fl), *Herman, E.F. 2282* (BR); Kaniama - Haut Lomani. 7°31'S, 24°11'E. Alt: 900m, 13 November 1947 (fl), *Mullenders 14800* (BR); **Nord-Kivu:** Beni, Parc National Albert, piste Mikenda Katuka. 0°33'N, 29°49'E, 26 May 1948 (fl), *Wilde, JMHJR de 20* (BR,K,WAG); Kipapashi-Madiwe. 0°28'N, 29°12'E. Alt: 1000m, October 1938 (fl), *Gille 147* (BR,K,WAG); Beni., c. 0°29' N, 29°28' E, 1938 (fl), *Gille 211* (BR,K,WAG); Rutshuru. 1°11'S, 29°27'E. Alt: 1100m, 18 August 1955 (fl), *Christiaensen 1047* (BR); Lukweti (Masisi). 1°12'S, 28°44'E. Alt: 1300m, 22 August 1957 (fl), *Gutzwiller 1584* (BR,EA,WAG); between Nezelube and Kamubene Rivers. 0°27'N, 29°46'E, 9 September 1952 (fl, fr), *Osmaston 2221* (BR); Mutongo. 1°10'S, 28°37'E. Alt: 1000m, 16 January 1959 (fl), *Léonard, A. 2581* (BR,EA,G,US,WAG); Kaseke, Mutongo., c. 1°10'S, 28°37'E. Alt: 1070m, 3 May 1958 (fl), *Gutzwiller 2717* (BR); route Rutshuru-Katwe, km32, près de la frontière Ougandaise. 1°02'S, 29°32'E. Alt: 1260m, 8 June 1959 (fl), *Pierlot 3053* (BR); Mumu, Mutongo. 1°10'S, 28°37'E. Alt: 1050m, 19 June 1958 (fl), *Gutzwiller 3177* (BR); Beni, Kibali-Ituri., 0°29'N, 29°28'E, November 1931 (fr), *Lebrun 4325* (BR,P); Beni, piste Mwenda à Katuka près du lieu dit Kalasango. 0°27'N, 29°46'E, 9 September 1952 (fl), *Witte, G.F. de 7976* (BR,K,WAG); Environs de la rivière Kamuhindi, près de la piste des Watalinga., c. 0°45'N, 29°50'E, 24 November 1952 (fl), *Witte, G.F. de 8384* (BR,UPS,WAG); Semliki, Parc national Albert. 1°13'N, 30°32'E. Alt: 660m, 21 September 1953 (fl), *Witte, G.F. de 9574* (BR,G,WAG); Kifuku na Kinawa. 0°44'N, 29°47'E. Alt: 700m, 26 September 1953 (fl), *Witte, G.F. de 9614* (BR); Byangolo. 0°26'N, 29°46'E. Alt: 1200m, 16 September 1954 (fl), *Witte, G.F. de 11058* (BR); Djelube, affluent droit Semliki. 0°36'N, 29°40'E. Alt: 1230m, 10 September 1954 (fl), *Witte, G.F. de 11184* (BR); Beniz: affluent de la Djuma; sous affluent de la semliki. 0°29'N, 29°28'E, 10 March 1955 (fl), *Witte, G.F. de 11922* (BR,K); affluent Djouma-Semliki. 0°43'N, 29°45'E, 7 March 1955 (fl), *Witte, G.F. de 12035* (BR); Djuma, affluent gauche Semliki. 0°43'N, 29°45'E. Alt: 815m, 25 October 1955 (fl), *Witte, G.F. de 12791* (BR); Beni, Musebeku, affluent gauche du Nyaleki; sous affluent de la semliki. 0°29'N, 29°28'E, 2 February 1956 (fl), *Witte, G.F. de 12872* (BR,K); Bamusingero affluent Malulu. 0°30'S, 29°31'E. Alt: 1050m, 8 February 1956 (fl), *Witte, G.F. de 12918* (BR); Byangolo-Molidi. 0°26'N, 29°46'E. Alt: 1160m, 26 March 1955 (fl), *Witte, G.F. de 13014* (BR); **Orientale:** Epulu and vicinity, c. 200 miles east of Stanleyville., c. 1°23'N, 28°36'E, 1935 (fl), *Putnam 15* (BR); Mahagi, rivière Kibali., 1380m, c. 2°09'N, 30°24'E. Alt: 1380m, 25 April 1958 (fl), *Deville, A. 149* (BR,UPS); rivière Kibali. 2°18'N, 30°34'E. Alt: 1380m, 25 April 1958 (fl), *Bamps 179* (BR); Zone de Mambasa. Ituri Forest. Afarama bord de la rivière. 1°33'N, 28°32'E. Alt: 800m, 17 November 1993 (fl), *Ewango 205* (WAG); près de la rivière Uélé (Kibali). 2°09'N, 30°24'E, 23 February 1956 (fl, fr), *Smeyers 326* (BR,K,WAG); Route Kampala (Kibali). 1350m. 2°09'N, 30°24'E. Alt: 1350m, 28 April 1959 (fl), *Froment 432* (BR,K,WAG); Penghe-Irumu. 1°20'N, 28°09'E, 28 February 1914 (fl), *Bequaert 2641* (BR); Entre gombari et Faradje. 3°04'N, 29°30'E, July 1931 (fr), *Lebrun 3344* (BR,C,WAG); Yangambi. 0°46'N, 24°27'E. Alt: 470m, 3 January 1952 (fl), *Donis 3508* (BR,C,P); Ituri, summit of Aketu Hill, c. 5 km NW of abandoned coffee plantation at Nzaro (c. 90 km N of Mambasa on road to Isiro). 2°05'N, 28°48'E. Alt: 1150m, 3 March 1994 (fl, fr), *Gereau 5418* (MO,WAG); Yangambi. 0°46'N, 24°27'E, 24 February 1938 (st), *Louis, J.L.P. 8047* (BR); Yangambi. 0°46'N, 24°27'E, 10 November 1947 (fl), *Louis, J.L.P. 16547* (BR); Yangambi. 0°46'N, 24°27'E, 20 November 1947 (fr), *Louis, J.L.P. 16837* (BR); **Sud-Kivu:** Bulira. 2°04'S, 28°55'E, 22 February 1934 (fr), *Babault 20* (P); Bulira. 2°04'S, 28°55'E, 22 September 1934 (fl), *Babault 28* (P); Bulira. 2°04'S, 28°55'E, September 1934 (fl), *Babault 36* (P); Bulira. 2°04'S, 28°55'E, February 1934 (fl), *Babault 87* (P); Inéac-Nyamunyunye. 2°20'S, 28°49'E. Alt: 1650m, 27 October 1952 (fl), *Pierlot 457* (BR); Makuta. 2°02'S, 28°39'E, 1934 (fl), *Babault 528* (P); Lac Kivu, Idjwi (Kalambo). 2°10'S, 29°05'E. Alt: 1500m, 4 September 1953 (st), *Ben, D. van der 769* (BR,K); Lac Kivu, Idjwi (Kalambo). 2°10'S, 29°05'E, 16 September 1953 (fl), *Ben, D. van der 837* (BR,K); Lac Kivu, Shuve, village du N. E. de l'île Idjwi. 1°57'S, 29°06'E, 25 September 1953 (fl, fr), *Ben, D. van der 882* (BR,K); Tshibinda. 2°19'S, 28°45'E, (fl), *Scaëtta 1061* (BR); route Kavumu-Walikale, Km 67 Buniakiri. 2°06'S, 28°34'E. Alt: 1100m, 7 November 1956 (fr), *Pierlot 1408* (BR); Mulungu-Lwamabale, Km 25 route Bukavu-Goma. 2°19'S, 28°46'E. Alt: 1600m, 18 March 1959 (fr), *Pierlot 2795* (BR); Buniakiri. 2°04'S, 28°34'E. Alt: 1000m, 4 February 1959 (fl), *Léonard, A. 2859* (BR); Route Kavumu-Walikale, vers Km 110. 1°53'S, 28°27'E. Alt: 900m, 10 April 1957 (fl), *Troupin 3171* (BR,COI,K,WAG); Route Kavumu-Walikale, vers Km 110. 1°53'S, 28°27'E. Alt: 900m, 10 April 1957 (fl), *Troupin, G.M.D.J. 3174* (BR,K,WAG); Buniakiri. 2°04'S, 28°34'E. Alt: 1400m, 2 March 1959 (fl), *Léonard, A. 3255* (BR); Route Kavumu-Walikale, vers le km 110. 1°53'S, 28°27'E. Alt: 900m, 14 May 1957 (fl), *Troupin 3419* (BR,K,WAG); Kalehe, vers Km 110 route kavum-Walikale; Irangi, réserve IRSAC. 1°53'S,

28°27'E. Alt: 900m, 14 May 1957 (fl), *Troupin 3420* (BR,K); route Kavumu-Walikale, vers km 110, Irangi. 1°53'S, 28°27'E. Alt: 900m, 6 June 1957 (fl), *Troupin 3534* (BR); Kalehe, vers Km 110 route kavum-Walikale; Irangi, réserve IRSAC. 1°53'S, 28°27'E. Alt: 900m, 7 June 1957 (fl), *Troupin 3541* (BR,K); route Kavumu-Walikale vers le Km 110. 1°53'S, 28°27'E. Alt: 900m, 7 June 1957 (fl), *Troupin 3543* (BR,EA,K); Kalehe, vers Km 110 route kavum-Walikale; Irangi, réserve IRSAC. 1°53'S, 28°27'E. Alt: 900m, 7 June 1957 (fl), *Troupin 3544* (BR,K); Bushumba., c. 2°20'S, 28°50'E, November 1945 (fl, fr), *Hendrickx 3576* (BR,EA); Route Kavumu-Walikale, vers Km 110. 1°53'S, 28°27'E. Alt: 900m, 9 July 1957 (fl), *Troupin 3785* (BR,K,WAG); Route Kavumu-Walikale, vers le km 110. 1°53'S, 28°27'E. Alt: 900m, 17 July 1957 (fl), *Troupin 3823* (BR,K,WAG); Biega. 2°23'S, 28°40'E, January 1946 (fr), *Hendrickx 3859* (BR); Ngwindja Kab., c. 2°23'S, 28°50'E, February 1946 (fr), *Hendrickx 3914* (BR,EA); Kabare. 2°29'S, 28°48'E, February 1946 (fl), *Hendrickx 3920* (BR); Route Kavumu-Walikale, vers Km 110. 1°53'S, 28°27'E. Alt: 900m, 5 August 1957 (fl), *Troupin 3957* (B,BR,K,WAG); Ile shime. 2°02'S, 28°55'E, November 1946 (fl), *Hendrickx 4267* (BR,EA); Vers Km 110 route Kavumu-Walikale; Irangi, réserve IRSAC. Catena II. 1060 m. 1°53'S, 28°27'E. Alt: 900m, 2 September 1957 (fl), *Troupin 4298* (B,BR,K); Kalehe, vers Km 110 route kavum-Walikale; Irangi, réserve IRSAC. 1°53'S, 28°27'E. Alt: 900m, 26 September 1957 (fl), *Troupin 4457* (BR,K); île Shime. 2°02'S, 28°55'E, August 1947 (fl), *Hendrickx 5023* (BR); île Abima. 2°19'S, 28°56'E, October 1948 (fl), *Hendrickx 5641* (BR,WAG); Urega. 2°30'S, 27°30'E, July 1932 (fl), *Lebrun 5757* (BR,WAG); Kalehe, route Kavumu-Walikale, vers Km 110, Irangi réserve. I.R.S.A.C. 1°53'S, 28°27'E. Alt: 900m, 30 July 1958 (fl), *Troupin 7767* (BR); Ile Idjwi, dans le Lac Kivu. 2°10'S, 29°05'E. Alt: 1600m, May 1929 (fr), *Humbert 8340* (P); Kalehe, route Kavumu-Walikale, vers Km 110, Irangi réserve. I.R.S.A.C. 1°53'S, 28°27'E. Alt: 860m, 10 February 1959 (fl), *Troupin 10013* (BR); Kalehe, route Kavumu-Walikale, vers Km 110, colline Karambi. 1°53'S, 28°27'E. Alt: 860m, 27 April 1959 (fl), *Troupin 10203* (BR); Kalehe, route Kavumu-Walikale, vers Km 110. 1°53'S, 28°27'E. Alt: 860m, 3 June 1959 (fl), *Troupin 10283* (BR); Kalehe, route Kavumu-Walikale, vers Km 110, Irangi réserve. I.R.S.A.C. 1°53'S, 28°27'E. Alt: 860m, 19 February 1959 (fl), *Troupin 11376* (BR); Km 110, route Kavumu-Walikale, Irangi, réserve IRSAC. Catena II. 1860 m. 1°53'S, 28°27'E. Alt: 860m, 2 April 1960 (fl), *Troupin 12089* (BR); Route Kavumu-Walikale, vers Km 110 Irangi, colline Bulesi. 1°53'S, 28°27'E. Alt: 860m, 27 June 1960 (fl), *Troupin 12478* (BR).

**ETHIOPIA, Kefa:** Mezan Tefari. 6°58'N, 35°25'E. Alt: 1500m, 8 August 1962 (fr), *Mooney, H.F. 9249* (K,S).

**KENYA, Nyanza:** Yala R. Kakanega. 0°12'N, 34°53'E. Alt: 1524m, April 1934 (fl), *Dale, I.R. 3244* (BR,EA,K,MA).

**SOUTH SUDAN, Central Equatoria:** Yeï dist. near Khor Abba. 4°05'N, 30°41'E, 13 May 1939 (fl, fr), *Andrews, F.W. 1211* (C,K); **Eastern Equatoria:** Lado, Yeï river: Jembi. 4°00'N, 30°40'E, 23 August 1919 (fr), *Sillitoe 290* (K); Lado, Yeï river: Jembi. 4°00'N, 30°40'E, 23 August 1919 (fl, fr), *Sillitoe 365* (K); S.W. Equatorial Province, Yeï district, Aloma Plateau, Yeï R. below Iwatoka., c. 3°45'N, 30°38'E, 22 March 1939 (fl, fr), *Hoyle 812* (FHO); Anglo-Egyptien Sudan: Khor Abba, Aloma plateau. 4°22'N, 33°57'E, 13 April 1939 (fl), *Myers 11310* (K).

**TANZANIA, Mwanza:** Marienhof, Ukerewe, Tanzania 2°03'S, 33°00'E, 21 November 1911 (fl), *Conrads 447* (B,BR,EA,FHO,K); Mdotunda (Kisukuma), Buhindi Forest Reserve. 1189m, 2°25'S, 32°15'E. Alt: 1189m, 27 August 1964 (fl), *Carmichael, W. 1080* (EA,K); Presumably on or near Ukerewe Island. 2°03'S, 33°00'E, 1929 (fl), *Conrads 6068* (EA).

**UGANDA, UNKNOWN:** November 1953 (st), *Philip, M.S. 93* (EA); **Buganda:** Minziro Forest, south Nasaka district. 1°00'S, 31°50'E. Alt: 1189m, (fl), *Brasnett 63* (EA,K); 0°44'S, 31°40'E, November 1913 (fr), *Fyffe 93* (EA,K); Buku, Entebbe, at 3800 ft. 0°04'N, 32°26'E. Alt: 1173m, February 1932 (fl, fr), *Eggeling 413* (BR,EA,FHO,K); Namauve Forest. 0°25'N, 32°50'E. Alt: 1158m, May 1932 (fl), *Eggeling 432* (LUA); Jubiya C.F.R. Bukakata. 0°15'S, 31°58'E. Alt: 1158m, May 1953 (fr), *Philip, M.S. 520* (EA); Namanve forest, Kiagwe. 0°22'N, 32°41'E. Alt: 1189m, April 1932 (fl), *Eggeling 589* (K); Namauve Forest, Kiagwe. 0°22'N, 32°41'E, May 1932 (fl), *Eggeling 707* (EA,FHO,K); Buku, Entebbe. 0°04'N, 32°26'E. Alt: 1158m, November 1932 (fl), *Eggeling 1089* (EA,FHO,K); Kasansi, near Kampala. 0°13'N, 32°32'E, February 1935 (fl), *Chandler, P. 1170* (BR); Kipayo forest. 0°15'N, 32°46'E. Alt: 1219m, 2 August 1915 (fl), *Dümmer 1395* (BM,K); Mulange. 0°31'N, 33°03'E, January (fl, fr), *Dümmer 3965* (US,Z); Kireku swamp near Bweyongerere. 0°23'N, 32°42'E. Alt: 1200m, 1 March 1997 (fl, fr), *Rwaburindore 4103* (C,MA,MO); Mulange. 0°31'N, 33°03'E. Alt: 1219m, November (fl, fr), *Dümmer 4340* (K,US,Z); Mulange, Mahia forest. 0°31'N, 33°03'E. Alt: 1219m, October 1922 (fl), *Dümmer 5597* (K); **Southern Province:** Maramagambo forest, near Bitereko. 0°32'S, 29°53'E. Alt: 1158m, 11 October 1968 (fl, fr), *Harrington 389* (EA); **Western Province:** Siba forest. 1°41'N, 31°26'E, March 1936 (fl), *Sangster, R.G. 94* (BR,K); Maramagambo. 0°32'S, 29°53'E, 8 October 1968 (fl, fr), *Synnott, T.J. 171* (EA); Budongo Forest NR. Busingiro. About 5 miles N. of Nyabyeya hill on track from new Mill site to experimental clear-felled Cynometra, ridge site. 1°47'N, 31°35'E, 5 April 1950 (fl), *Dawkins 548* (BR,EA,K); Budongo Forest, 3600ft. 1°39'N, 31°35'E. Alt: 1097m, May 1932 (fr), *Harris, C.M. 725* (EA,FHO,K); South Maramagambo CFR. c. 4miles E. of Kaizi River Bridge. 0°32'S, 29°53'E, 1 March 1969 (fl, fr), *Lock 69/43* (EA).

**ZAMBIA, Northern:** Chishimba falls. 10°08'S, 30°55'E, 10 September 1958 (fl), *Fanshawe 4787* (BR,EA,FHO,K); 21 miles from Mporokoso towards Kasama. 9°26'S, 30°22'E, 17 October 1947 (st), *Brenan 8135* (FHO,K).

**Key literature:** Bamps & Farron (1967), Farron (1963, 1985), Friis & Vollesen (1998) and Verdcourt (2005).

***Campylopermum cabrae* (Gilg) Farron**

**Fig. 2**

Bull. Jard. Bot. État Bruxelles 35: 393 (1965). – *Exomicrum cabrae* (Gilg) Tiegh., Ann. Sci. Nat., Bot. sér. 8, 18: 38 (June 1903). – *Ouratea cabrae* Gilg, Bot. Jahrb. Syst. 33: 262 (1904). – Type: *Cabra 33* (holotype: BR!) Congo.

*Treelet* up to 5 m tall, with branched stem; twigs with a pale brownish coloured bark. **Stipules persistent, very narrowly triangular, 12–15 mm long.** *Leaf:* petiole 2–6 mm long, slender; leaf blade narrowly elliptic, **(5–)7–14 x (1.5–)2–4 cm**, ratio **3–6**, base attenuate, sometimes decurrent onto the petiole, apex slightly acuminate to acute, papyraceous, not bullate, upper surface medium green, lower surface paler green, dull on both sides, margin **regularly serrulate, teeth with a dark tip**; venation: midrib **prominent above, flat to slightly canaliculate below**, main lateral veins 10–14 on either side, 5–10(–15) mm apart, slightly prominent above, flat below, more or less at a right angle with the midrib but curved upward to run parallel to the margin, intermediate lateral veins 0–1 between each pair of main laterals, distinct on both sides, tertiary venation scalariform, running perpendicular to the midrib, distinct on both sides. *Inflorescence* terminal, **unbranched** or rarely with a short sidebranch at its base, dense; pairwise scales persistent at the base of the peduncle; peduncle axis 2–5 cm long; cymules 5–7 mm apart, 1–5-flowered; bracts **persistent**, triangular-ovate to broadly ovate, 2–3 mm long, excluding the sometimes caudate apex. *Flower:* **pedicel 5–10 mm long, articulated at 1–2 mm from the base**; sepals ovate, in flower 5–6 x 2–3 mm, base truncate, apex acute, in fruit 5–8 x 3 mm and becoming coriaceous, curved up in fruit; petals **obovate to elliptic**, 6–8 x 2–3 mm, clawed at base, **rounded to slightly emarginate at apex**; stamens: anthers 5–6 mm long; ovary 1–2 mm long; style 4–5 mm long. *Fruit:* receptacle c. 1 mm thick in flower, in fruit 2–3 mm, red; drupelets 1 to 2 well developed per receptacle, **ellipsoid**, 6–7 x 4–5 mm, immature ones reddish, mature ones black; **cotyledons incumbent, dissimilar in size with a small outer cotyledon.**

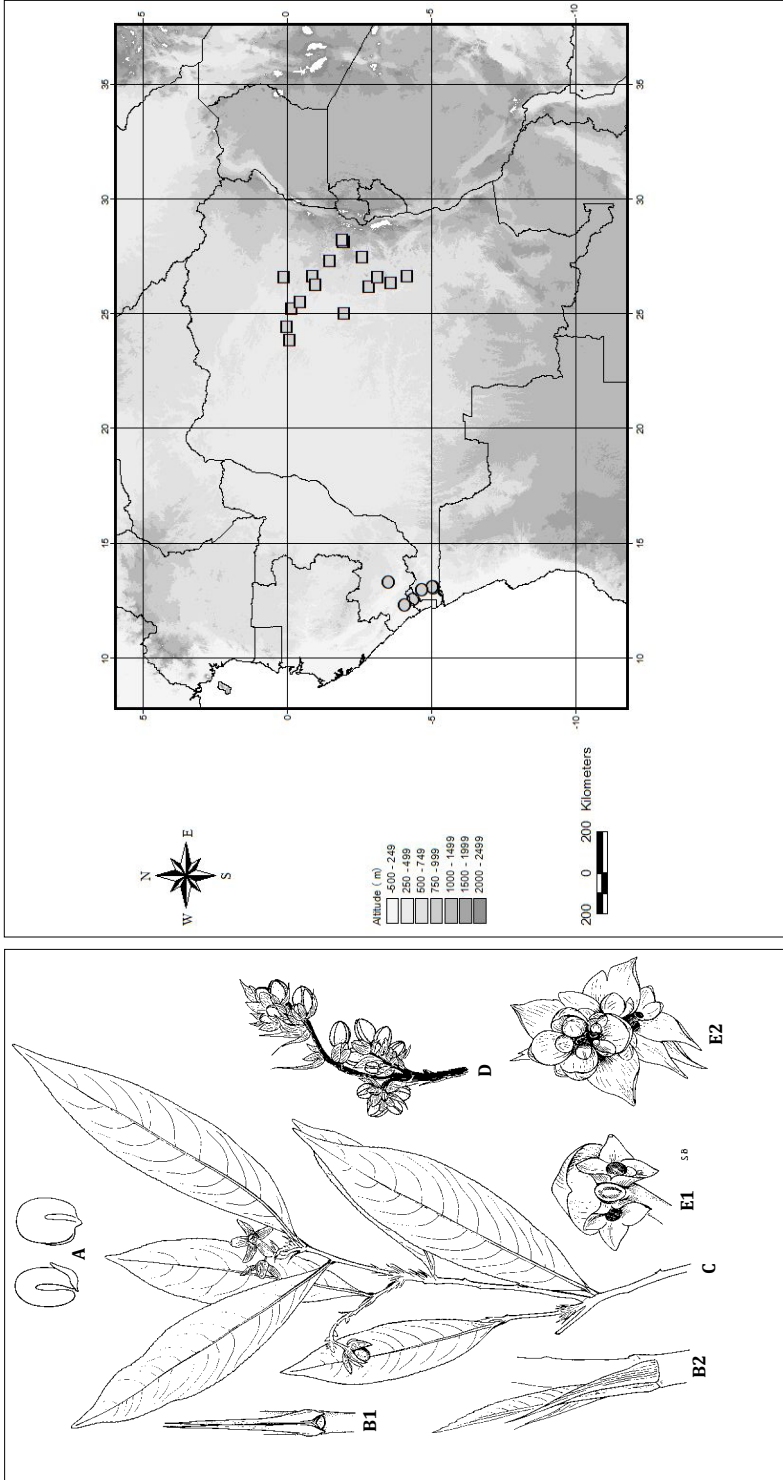
**Notes:** *C. cabrae* is a rare species. The above description is based on only 8 specimens, collected between 1897 and 1966. It is characterized by having a serrulate margin with black tipped teeth and narrowly triangular stipules. It seems close to *C. glaucum* with which it shares the same type of tertiary venation and short unbranched inflorescence, but which differs in having much shorter stipules and the cymules being 2–5 mm apart.

**Distribution:** southern Republic of the Congo, south-western Democratic Republic of the Congo (Mayombe) and Angola (Cabinda) (**Map 4**).

**Ecology:** in primary and secondary forest; at altitudes below 500 m.

**Phenology:** flowering in October, March and June; fruiting in January, March and May.





**Figure 2.** *Campylosperrum cabrae*. **A.** Incumbent cotyledons, with small outer cotyledon. **B1 & B2.** stipules. **C.** Flowering branch. **D.** Inflorescence in fruit. **E1 & E2.** Receptacle with persistent sepals. Drawings by Sabine Bousani

**Map 4.** Distribution of *Campylosperrum cabrae* (○) and *Campylosperrum claussensii* (□)

**Vernacular names: Democratic Republic of the Congo:** Luvamba (Luki).

**IUCN conservation status:** EN B1/B2ab(iv). EOO=11,573 km<sup>2</sup>, AOO=2,408 km<sup>2</sup>, locations=7, subpopulations=2 (cell width=22 km). This species is known from only 8 specimens, collected between 1897 and 1966 and hence its present-day presence needs confirmation. On top of that, none of the older records are from within presently protected areas. Thus, the category Endangered seems justified.

**Specimens examined:**

**ANGOLA, Cabinda:** Mayombe, buco Zau. 4°45'S, 12°34'E, October 1916 (fl), *Gossweiler 7193* (BM,COI,LISC).

**CONGO (BRAZZAVILLE), Kouilou:** région de les Saras à 6 et 30 km du carrefour de routes Sounda et les Saras. 4°22'S, 12°20'E, 7 June 1966 (fl), *Sita 1353* (P); **Lékoumou:** chantier forestier de la Mudongo, 24 km W Sibiti. 3°40'S, 13°20'E, 19 August 1965 (st), *Farron 4491* (P).

**CONGO (KINSHASA), Bas-Congo:** Unteres Congogebiet. 5°08'S, 12°59'E, 1897 (fr), *Cabra 33* (BR); Riobo (Mayombe). 5°34'S, 13°07'E, 19 January 1940 (fr), *Donis 80* (BM); Kiobo (Tshela) Leopoldville. 5°38'S, 13°07'E, 23 October 1945 (fl), *Donis 378* (BM,K,WAG); Luki. 5°38'S, 13°04'E, 24 March 1954 (fl, fr), *Wagemans 784* (WAG); Luki. 5°38'S, 13°04'E, 19 May 1954 (fr), *Wagemans 805* (BR,K).

**Key literature:** Bamps & Farron (1967), Farron (1963, 1985).

**Campylosperrum calanthum** (Gilg) Farron

**Fig. 3**

Bull. Jard. Bot. État Bruxelles 35: 394 (1965). – *Ouratea calantha* Gilg, Bot. Jahrb. Syst. 33: 259 (1904). – Type: *Zenker 1845* (holotype: B†; isotype: HBG!, K!, P(2x)!), Cameroon, Bipindi, 1898.

*Monelasmum zenkeri* Tiegh., J. Bot. (Morot) 16: 200 (June 1902). – Type: *Zenker 1845* (holotype: P(2x)!; isotype: HBG!, K!), Cameroon, Bipindi, 1898. (non *Campylosperrum zenkeri* (Tiegh.) Farron ≡ *C. oliveri* (Tiegh.) Farron)

*Monelasmum sibangense* (Gilg) Tiegh., Ann. Sci. Nat., sér. 8, Bot, 18: 36 (June 1903).

*Ouratea sibangensis* Gilg, Bot. Jahrb. Syst. 33: 267 (1904). – Type: *Soyaux 53* (holotype: P!; isotype: K!), Gabon, Sibange Farm, January 22<sup>th</sup>, 1880. **syn. nov.**

*Ouratea nigroviolacea* Gilg ex Bak. in Rendle *et al.*, Cat. pl. Oban: 124 (1913). – Type: *Talbot 1282* (holotype: K!), Nigeria, Oban.

*Tree* up to 10 m tall, with branched stem; twigs with dark brown coloured bark. *Stipules persistent*, narrowly to very narrowly triangular, 4–12(–25) mm long. *Leaf:* petiole **2–10 mm** long, **stout, canaliculate above**; leaf blade elliptic to elliptic-obovate or rarely obovate or narrowly elliptic-obovate, **(8–)17–20(–37.5) x (3.5–)6–10(–12.5) cm**, ratio **(2.25–)3–4**, base generally cuneate or sometimes attenuate, rarely rounded, apex acuminate or rarely acute, coriaceous, slightly to distinctly bullate, upper side green, glossy, lower side paler green, dull, margin serrulate, sometimes shallowly so, or rarely entire; venation: midrib flattened on upper side, prominent on lower side, main lateral veins **13–22** on either side, **(7–)10–20(–30) mm apart, flat to slightly prominent on both sides**, more or less at a right angle with the midrib but curved upward to run parallel to the margin, intermediate lateral veins 1–3 in between each pair of main lateral veins, **slightly sunken on upper side, prominent on lower side**, tertiary venation scalariform, perpendicular to the midrib, **indistinct on upper side**,

fairly distinct on lower. *Inflorescence* terminal, branched, lax; **pairwise scales at the base of peduncle persistent, sometimes leafy**, 15–20(–30) x 4–10 mm, its main axis (8–)15–35(–38) cm long; racemes 2–7, slender, (5–)8–19(–23) cm long, **ascendant or rarely held horizontally**; bracts **persistent**, triangular, 3–15(–30) mm long; cymules 0.5–2 cm apart, 1–6(–15)-flowered. *Flower*: pedicel 5–9 mm, articulated at 2–4 mm from the base; sepals ovate, in flower 6–8 x 3–4 mm, in fruit 7–10 x 4–6 mm, base truncate, apex acute to rounded; petals **obovate**, 3–9 x 3–6 mm, **truncate at base, rounded to slightly emarginate at apex**; stamens: anthers 5–6 mm long; ovary 1–2 mm long; style 4–5 mm long. *Fruit*: receptacle c. 1 mm thick in flower, in fruit 4–6 x 4–5 mm; drupelets 1–4 well developed per receptacle, **reniform**, slightly compressed, 8–11 x 6–8 mm; cotyledons **accumbent, ± similar in size**.

**Notes:** *C. calanthum* is sometimes difficult to tell apart from *C. dybovskii*. The former generally has much broader leaf blades with lateral veins prominent below, but some *C. calanthum* specimens may have fairly narrow leaf blades while some *C. dybovskii* specimens may have lateral veins that are slightly prominent below. In those cases, *C. calanthum* can be recognized by its persistent stipules and slightly to distinctly bullate leaves (caducous stipules and non-bullate leaves in *C. dybovskii*).

**Distribution:** south-eastern Guinea, southern Liberia, Ivory Coast to Ghana, Nigeria, Cameroon, Central African Republic, Equatorial Guinea, Gabon, Republic of the Congo, Democratic Republic of the Congo and Angola (Cabinda) (**Map 5**).

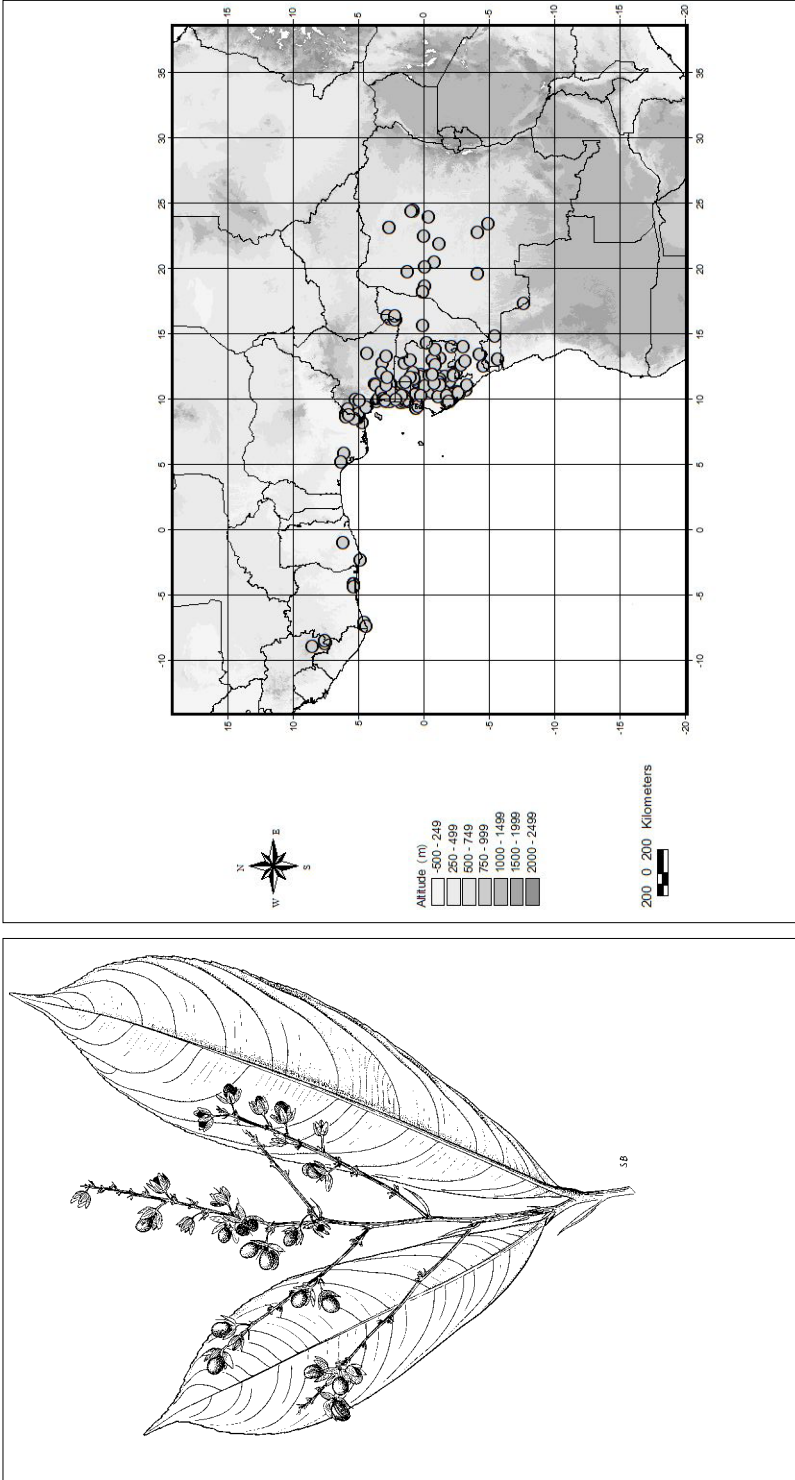
**Ecology:** in primary, secondary, high, dense gallery forest, coastal, littoral wet and swamp forest, forest edges, along rivers; on brown, sandy soil and brown reddish clay; at up to 1100 m altitude.

**Phenology:** flowering and fruiting all year round.

**IUCN conservation status:** LC B1/B2ab(i,ii,iii). EOO=3,265,430 km<sup>2</sup>, AOO=3,473,140 km<sup>2</sup>, locations=247 (cell width= 389 km). This species is quite well represented in herbaria, which seems to indicate it is not uncommon in the wild, and occurs from West Africa all the way down to Angola (Cabinda) and is found in a wide variety of habitats. Therefore, the category of Least Concern seems most appropriate.

### **Specimens examined:**

**ANGOLA, Cabinda:** Maiombe. 4°34'S, 12°37'E, 15 February 1919 (fl), *Gossweiler 7806* (BM, BR, COI, K, LISC).  
**CAMEROON, Central Province:** Nkongkengui, 12 km NNE Makak, à 50 km WSW. de Yaounde (feuille IGN 1/200000 Yaounde). 3°39'N 11°05'E, 17 July 1972 (fl), *Letouzey 11531* (K,P); **East Province:** Dja Fauna Reserve, Bali et environs. 3°09'N 12°47'E, 26 August 2003 (fl), *Nguembou Kamgang 862* (BR, YA); Réserve de la faune du Dja, Alat-Makay. 2°51.2'N 13°20.5'E, 7 July 1995 (fl), *Sonké 1596* (BR); About 10 km S. of Dimako, SW. of Bertoua. 4°19'N 13°34'E. Alt: 630m, 1 August 1961 (fr), *Breteler 1728* (BR, FI, K, LISC, M, P, WAG, YA); **Littoral:** Forstexpedition 1908. 3°44'N 11°10'E, (st), *Büsgen 404* (B); Lake Tissongo, 16 km EES of Mouanko. 3°35'N 9°52'E, 12 September 1983 (fr), *Asonganyi 651* (P); Nlonako, 5 km SSE Nkongsamba. 4°54'N 9°57'E. Alt: 1100m, 17 March 1976 (st), *Letouzey 14458* (P); **South Province:** Bipindi. 3°05'N 10°25'E, June 1899 (fr), *Zenker s.n.* (MA); Bipindi. 3°05'N 10°25'E, (fl), *Zenker s.n.* (FHO); 19 km S Lolodorf, 1 SW Ebom II, 1 km on transect 9B. Primary forest on hill top, 3°03'N 10°42'E. Alt: 370m, 29 September 1995 (fr), *Winter, A.J. de 40* (WAG); Ngongonjie hill, near Akonetey S of Ebolowa. 2°30'N 11°08'E. Alt: 630m, 16 January 1978 (fr), *Koufani 48* (P); Mvimi. 2°22'N 10°06'E, 8 January 1984 (fr), *Kaji 83* (P); Lolodorf, Ngowayang. 3°15'N 10°37'E, 14 June



**Figure 3.** *CampylospERMUM calanthum*. Fruiting branch. Drawing by Sabine Bousani  
**Map 5.** Distribution of *CampylospERMUM calanthum*

1918 (fl), *Annet 260* (P); Efulen. 2°47'N 10°32'E, 2 July 1895 (fl), *Bates, G.L. 293* (K); Mimfia, 3°04'N 10°23'E, July 1913 (fl), *Zenker 382* (B,C,G,H,UH,LD,LY,US,WAG); Block 12. 3°06'N 10°44'E. Alt: 550m, 17 November 1995 (st), *Elad 412* (KRIBI,WAG); Nkol Bidjouka, 38 km SW de Lolodorf. 3°06'N 10°25'E. Alt: 250m, 7 February 1979 (fr), *Satabié 423* (P); route Bipinde à Dihani. 3°29'N 10°05'E, 24 June 1918 (fl), *Annet 435* (P); environ d'Ebodje, 40 km S de Kribi. 2°35'N 9°54'E, 7 December 1979 (fl), *Satabié 464* (P); Kribi. 2°57'N 9°55'E, 12 November 1904 (fl), *Winkler, H.J.P. 815* (Z); near Bipaga II, km 40 Kribi-Edéa road., 30m 3°09'N 10°01'E. Alt: 30m, 28 December 1982 (fl, fr), *Kruij, A.P.M. de 975* (MO,WAG,YA); Kribi, piste menant au Mont éléphant, 7 km après village Bidou III. 2°48.23'N 10°02.04'E. Alt: 79m, 27 March 2010 (st), *Bissiengou 1206* (LBV,WAG,YA); Kribi, piste menant au Mont éléphant, 7 km après village Bidou III. 2°48.26'N 10°02.10'E. Alt: 85m, 27 March 2010 (fr), *Bisse ien*

*I hopgou 1218* (LBV,WAG,YA); route Kribi-Campo, 20 km de Kribi. 2°45.13'N 9°52.92'E. Alt: 45m, 28 March 2010 (fr), *Bissiengou 1223* (LBV,WAG,YA); route Kribi-Campo, 20 km de Kribi. 2°45.13'N 9°52.92'E. Alt: 45m, 28 March 2010 (st), *Bissiengou 1224* (LBV,WAG,YA); route Kribi-Campo, 20 km de Kribi., 39m, 2°45.17'N 9°52.85'E. Alt: 39m, 28 March 2010 (st), *Bissiengou 1225* (LBV,WAG,YA); route Kribi-Campo, 20 km de Kribi. 2°45.17'N 9°52.85'E. Alt: 39m, 28 March 2010 (st), *Bissiengou 1226* (LBV,WAG,YA); route Kribi-Bidou I, 40 km de Kribi. 3°03.55'N 10°11.52'E. Alt: 44m, 30 March 2010 (st), *Bissiengou 1236* (LBV,WAG,YA); route Kribi-Bipindi, PK7.3 avant Bipindi. 3°04.13'N 10°20.45'E. Alt: 97m, 30 March 2010 (fl, fr), *Bissiengou 1242* (LBV,WAG,YA); route Kribi-Bipindi, PK7.3 avant Bipindi. 3°04.13'N 10°20.45'E. Alt: 97m, 30 March 2010 (fr), *Bissiengou 1244* (LBV,WAG,YA); route Bipindi-Bidjouka, village Log Ndiga environ 2 km de Bipindi. 3°05.3'N 10°25.1'E. Alt: 230m, 31 March 2010 (fr), *Bissiengou 1256* (LBV,WAG,YA); route Bipindi-Bidjouka, village Log Ndiga environ 2 km de Bipindi. 3°05.3'N 10°25.1'E. Alt: 230m, 31 March 2010 (st), *Bissiengou 1257* (LBV,WAG,YA); route Bipindi-Bidjouka, village Log Ndiga environ 2 km de Bipindi. 3°05'N 10°25'E. Alt: 230m, 31 March 2010 (st), *Bissiengou 1263* (LBV,WAG,YA); Campo-Ma'an area, Bibabimvoto, along transect T4. 2°15.1'N 10°21.9'E. Alt: 40m, 1 February 2000 (fl), *Elad 1273* (KRIBI,WAG); Campo-Ma'an area, Mvini, along transect T7. 2°19.3'N 10°08.4'E. Alt: 60m, 17 February 2000 (fr), *Elad 1288* (KRIBI,WAG); colline à droite du km 28 de la route Kribi-Lolodorf. 3°03'N 10°07'E, 12 April 1949 (fr), *Letouzey 1288* (P); Campo Ma'an area, Ebianemeyong. 2°27.6'N 10°17.8'E. Alt: 460m, 24 May 2002 (fl), *Elad 1566* (KRIBI,SCA,WAG); Kribi-Ebolowa km 9. 2°53'N 9°58'E, 5 January 1968 (fr), *Bamps 1691* (BR); lolodorf. 3°14'N 10°43'E, 8 January 1968 (fl), *Bamps 1735* (BR); Urwaldgebiet. 3°05'N 10°25'E, 1898 (fl), *Zenker 1845* (BM,E,G,K,Z); Bipindi Urwaldgebiet. 3°05'N 10°25'E, 1904 (fr), *Zenker 2768* (BM,G,K,LY); Efulan, Ongongo and Nkolomekok hills in Akom II area. 2°44.9'N 10°32.5'E. Alt: 400m, 24 April 2000 (fl), *Tchouto Mbatchou 2827* (WAG); Ma'an, Nvili Ayet, Forest 1,5 hours walk North of Ma'an village, behind nvili creek. 2°22'N 10°36'E. Alt: 540m, 13 February 2001 (fr), *Andel, T.R. van 3146* (KRIBI,SCA,WAG,YA); E. of Bwambe Cath. Mission, 6 km S of Kribi, shady forest edge. 2°53'N 9°54'E, 8 November 1968 (fl), *Bos, J.J. 3238* (BR,C,K,MA,WAG); Campo Ma'an area, Ebodje, Likodo River bank., 2°34'N 9°50'E. Alt: 10m, 31 March 2001 (fr), *Andel, T.R. van 3257* (KRIBI,SCA,WAG,YA); Lobé, Pfourpfoua (Mabi), village landing. 2°51'N 9°54'E. Alt: 20m, 16 May 2001 (fl), *Andel, T.R. van 3429* (KRIBI,SCA,WAG,YA); 9 km N of Kribi. 3°00'N 9°56'E, 27 December 1968 (fl, fr), *Bos, J.J. 3508* (BR,E,K,MA,MO,P,PRE,WAG,YA); Bipindi, Bipindihof, Zenker Gardens, Nkol Mabimbi., 3°04'N 10°24'E, 8 June 2001 (fl), *Andel, T.R. van 3537* (KRIBI,WAG); Campo Ma'an area, Akom II, Nkol Dangueng. 2°48'N 10°32'E. Alt: 405m, 19 August 2001 (fr), *Andel, T.R. van 3945* (WAG); entre Fenda (60 km ESE de Kribi) et rivière Kienke. 2°49'N 10°25'E, 22 January 1962 (fr), *Letouzey 4094* (P); Nkomo près Ngoase au sud de la rivière Lobo. Feuille IGN 1/200 000 Akonolinga. 3°14'N 12°04'E, 13 February 1962 (fr), *Letouzey 4204* (P); Urwaldgebiet. 3°05'N 10°25'E, 1911 (st), *Zenker 4253* (BM,E,G,K,MA,W); Urwaldgebiet. 3°05'N 10°25'E, 1912 (fr), *Zenker 4487* (BM,E,G,K,S,W); 20 km from Kribi, 3 km N. of Lolodorf road, SFIA forest exploitation., 3°02'N 10°03'E, 18 July 1969 (st), *Bos, J.J. 5091* (BAS,BR,P,WAG,YA); 30 km N. of Kribi. 3°08'N 10°01'E, 28 November 1969 (st), *Bos, J.J. 5736* (WAG); 22 km from Kribi, 3 - 4 km S. of Lolodorf road. 2°59'N 10°04'E, 25 February 1970 (st), *Bos, J.J. 6411* (BAS,P,WAG); 28 km from Kribi, Lolodorf road, Bidou I, summit of Calvary mountain. 3°01'N 10°07'E. Alt: 300m, 17 June 1970 (st), *Bos, J.J. 6952* (BAS,BR,K,MO,P,PRE,WAG,YA); 11 km N. of Kribi, Edea road., 3°00'N 9°57'E, 24 June 1970 (st), *Bos, J.J. 6964* (BAS,WAG); 60 km N. of Kribi, 3 km E. of Edea road. 3°20'N 10°07'E, 11 July 1970 (st), *Bos, J.J. 7086* (AAU,B,BR,C,K,MA,MO,P,PRE,SRGH,WAG,YA); Kribi, Km 9 sur la route d'Edea, près du village Ebouyoie. 3°00'N 9°58'E, 25 April 1970 (st), *Farron 7131* (P); 25 km from Kribi, 2 km N. of Lolodorf road. 3°01'N 10°05'E, 28 July 1970 (st), *Bos, J.J. 7160* (AAU,B,BR,C,K,MA,MO,P,PRE,SRGH,WAG,YA); 38 km on the road from Kribi to Campo., 2°38'N 9°51'E, 3 December 1974 (st), *Wilde, J.J.F.E. de 7781* (WAG); Ongongondjé

hill, on gentle slope, 17 km NW. of Ambam, close to the village of Akonékéyé. 2°29'N 11°10'E. Alt: 730m, 27 December 1975 (st), *Wilde, J.J.F.E. de 8721* (MO,P,WAG,YA); à 20 km SSE de Zingui (soit à 50 km au SE de Kribi). 2°38'N 10°16'E, 15 March 1968 (fr), *Letouzey 9054* (P); Nkoemvone, 12 km S Ebolowa. 2°50'N 11°09'E, 26 February 1963 (fl, fr), *Raynal, J. 10038* (P); 12 km E Nyabesan vers Asseng. 2°25'N 10°32'E, 3 March 1963 (fr), *Raynal, J. 10167* (P); Ebemwok, 55 km W Ebolowa. 2°49'N 11°41'E, 13 March 1963 (fr), *Raynal, J. 10436* (P); 30 km SE of Bipindi. 2°55'N 10°35'E, 26 February 1993 (fr), *Breteler 12018* (WAG); 40-50 km E. of Campo. 2°30'N 10°15'E, 1 March 1993 (fr), *Breteler 12036* (WAG); Campo Ma'an area, Eboundja, in the Campo area between Lobe and Campo. 2°45.2'N 9°54.8'E. Alt: 40m, 13 February 2002 (fl, fr), *Tchouto Mbatchou EBOUX 39* (WAG); Akom II, Efulan hills between plots EFOU1 and 4. 2°44.9'N 10°32.5'E. Alt: 480m, 26 April 2000 (fr), *Tchouto Mbatchou EFOUX 8* (WAG); Ma'an, forest between Meyos Ntem and Nsengou. 2°10.9'N 10°34.8'E. Alt: 440m, 5 February 2001 (fr), *Tchouto Mbatchou NSEX 235* (WAG); Onoyong, forest between plots ONO1 en 10. 2°31.7'N 10°41.8'E. Alt: 360m, 18 March 2001 (fr), *Tchouto Mbatchou ONOX 104* (WAG); Campo Ma'an area, Bibabimvoto, in the National Park along transect T3. 2°13.5'N 10°01.0'E. Alt: 40m, 15 May 2000 (fl), *Tchouto Mbatchou T3X 49* (WAG); **South-West Province**: Réserve forestière d'Eymojoek env. 50 km E Manfe. 5°42'N 8°51'E, 14 February 1985 (fr), *Onana 178* (P); Nndian-Dibonda- Ekumbako road. 4°55'N 8°52'E. Alt: 100m, 24 November 1986 (fl, fr), *Nemba, J. 358* (MO,P,WAG); Korup National Park, P transect, plot 23T. 5°00'N 8°48'E. Alt: 100m, 23 January 2000 (fl, fr), *Burgt, X.M. van der 583* (G,G,SCA,WAG); Korup Reserve, Transect R. 4°59'N 8°51'E, March 1979 (fl), *Thomas, D.W. 708* (K,WAG); Korup National Park. Mature rain forest on sandy soil. 5°01'N 8°50'E. Alt: 50m, 5 December 1984 (fl, fr), *Thomas, D.W. 4152* (BR,K,MO); Mundemba town. 5°58'N 8°55'E. Alt: 100m, 20 June 1984 (fl), *Thomas, D.W. 4236* (K,MO,WAG); Mundemba town. 4°58'N 8°55'E. Alt: 100m, 1 September 1984 (st), *Thomas, D.W. 4260* (BR,MO); 2 km S of Ikassa last Bush-Mosongisele trail on right of way being cleared for new military road to Bakassi. 4°56'N 8°46'E. Alt: 60m, 18 November 1994 (fl, fr), *Gereau 5544* (BR,WAG); Lake Ejaghan forest reserve. 5°46'N 9°17'E, 6 March 1963 (fr), *White, F. 8624* (FHO); Kumba div. S. Bakundu F. R. About 1 miles W. of Banga Village. 4°24'N 9°27'E, 11 March 1948 (fl), *Brenan FHI 9303* (K); along the line in compartment 1 in Banga N.A.F.R. S. Bakundu. 4°24'N 9°27'E, 9 January 1956 (fr), *Binuyo FHI 35165* (FHI,FHO,K,P); **West Province**: Mts. Bamboutos, route des Mbos. 5°15'N 10°00'E. Alt: 1100m, 10 March 1967 (fl, fr), *Meurillon, A. CNAD 653* (BR,K).

**CENTRAL AFRICAN REPUBLIC, Sangha-Mbaéré**: Bayanga. 2°32'N 16°10'E. Alt: 350m, July 1987 (fl, fr), *Harris, D.J. s.n.* (E,WAG); Sangha Economique. Dzanga-Sangha Reserve, 45 km S of Lidjombo. Ndakan gorilla study area on trail from Keni, to Njeke stream E from K 3000. 2°22'N 16°10'E. Alt: 350m, 16 November 1988 (fr), *Harris, D.J. 1600* (K,MO,UPS,WAG); Kongana research camp, 25 km SE of Bayanga, 2°47'N 16°25'E, 20 May 1994 (fl), *Harris, D.J. 4901* (E).

**CONGO (BRAZZAVILLE), UNKNOWN**: 28 September 1965 (fr), *Farron 4631* (P); **Cuvette**: Alima-Likouala, région de M'Bomo, réserve de chasse d'Odzala (M'Boko). 0°13'S 14°20'E, 15 December 1970 (fr), *Sita 2993* (P,WAG); Alima-Likouala Bassin, Lekoli affluent, M'Boko Reserve. 0°03'N 15°42'E, 10 August 1961 (fl, fr), *Descoings 9164* (BR,P,WAG); **Kouilou**: Kissanou. 4°15'S 13°30'E, 26 June 1984 (st), *Zinga 106* (P); **Lékoumou**: Kindamba district, environs de Massina et Mingali. 3°03'S 14°04'E, 10 December 1971 (fl), *Sita 3230* (BR,P); **Niari**: route Mossendjo, Mayoko Km 10. 2°53'S 12°40'E, 16 May 1965 (fr), *Bouquet, A. 1312* (P); route Malinga-Divénié, 4 km du village Mollo. 2°29.64'S 12°09.61'E. Alt: 480m, 13 June 2011 (st), *Bissengou 1325* (LBV,WAG); à 45 km environ de Komonom, Chantier SIDETRA route de Mossendjo près du village Nyanga. 3°08'S 12°56'E, 19 January 1968 (st), *Bouquet, A. 2377* (P); **Sangha**: 15 km E of Kabo. 2°10.27'N 16°08.42'E, 19 August 2006 (st), *Mbani, O.A. 6* (E,IEC). 2°12.86'N 16°23.76'E. Alt: 322m, 16 April 2011 (fl), *Ndolo Ebika 585* (E,IEC,WAG); Makamba Bai. 2°09.61'N 16°09.18'E, 27 June 2007 (fr), *Harris, D.J. 9462* (E,IEC,WAG).

**CONGO (KINSHASA), Bandundu**: chute de Bata (Kwango). 7°40'S 17°20'E, July 1975 (fl), *Dujardin 418* (BR); Ipamu. 4°07'S 19°37'E, May 1921 (fr), *Vanderyst, H.J.R. 9437* (BR); Ipamu. 4°07'S 19°37'E, June 1921 (fl), *Vanderyst, H.J.R. 9681* (BR); Ipamu. 4°07'S 19°37'E, September 1921 (fr), *Vanderyst, H.J.R. 10683* (BR); **Bas-Congo**: Réserve de la Luki. 5°38'S 13°04'E, 26 August 1959 (fl), *Compère 173* (BR); Luki, pont de la Nkakala, Luvamba. 5°38'S 13°04'E, 15 May 1954 (fl), *Wagemans 806* (BR); **Equateur**: environ de Coquilhatville. 0°03'N 18°15'E, 1913 (fr), *Broun s.n.* (BR); Bokuma. 0°06'S 18°41'E, 7 March 1941 (fl, fr), *Hulstaert 164* (BR); Eala. 0°03'N 18°19'E, 1936 (fl), *Leemans, J. 371* (K,WAG); Botsima, station de recherche. 1°09'S 21°57'E, 4 March 1991 (fr), *Dhetchuvi Matchu-Mandje 854* (BR); Bokote. 0°06'S 20°08'E, 1943 (fl), *Hulstaert 908* (BR); Wamba, zone de Djolu. 0°01'N 22°33'E, 3 December 1988 (fr), *Nsola 1216* (BR); Bolili. 0°23'S 23°57'E, January 1939 (fl), *Gilbert, G.C.C. 2040* (BR); Watsi-Kengo, bac de la Solonga. 0°48'S 20°33'E, 1 February 1957 (fl, fr), *Evrard,*

*C.M. 2192* (K,WAG); Basankusu. 1°13'N 19°49'E, 19 September 1958 (fr), *Evrard, C.M. 4823* (WAG); **Kasai-Oriental**: Dibebe. 4°07'S 22°50'E, 1 December 1903 (fl), *Laurent, É. s.n.* (BR); Lusambo. 4°58'S 23°26'E, 1 December 1903 (fl), *Laurent, É. s.n.* (BR); **Kinshasa**: M'Vuasi (Thysville). 5°27'S 14°54'E, 30 January 1956 (fr), *Dubois, J. 95* (WAG); **Oriental**: Mobwasa. 2°40'N 23°11'E, April 1913 (fl), *Giorgi 677* (BR); Mobwasa. 2°40'N 23°11'E, May 1913 (fl), *Giorgi 852* (BR); Yangambi, le long de la rivière Isalowe. 0°46'N 24°30'E. Alt: 470m, 16 June 1938 (fl), *Louis, J.L.P. 9802* (BR); 15 km au Nord-Est de Yambao. 0°59'N 24°27'E. Alt: 470m, 3 July 1939 (fl), *Louis, J.L.P. 15456* (BR); 22 km à l'Est de Yangambi., 0°46'N 24°27'E, 23 September 1939 (fr), *Louis, J.L.P. 16107* (BM,BR,K,P).

**EQUATORIAL GUINEA, Rio Muni**: West-Afrika: spanisch-Guinea. (fl), *Tessmann 104* (K); West-Afrika: spanisch-Guinea. (fl), *Tessmann 120* (K); 9 July 1999 (st), *Eneme Efua 415* (BATA,BRLU,WAG); West-Afrika: spanisch-Guinea. (fl), *Tessmann 807* (K); **Rio Muni, Centro Sur**: Monte Alen. 1°40'N 10°17'E, 13 March 1997 (fr), *Ngomo 2* (BRLU); Parc National de Monte Alen, transect de Monte Chocolate. 1°46'N 10°16'E, 8 January 1998 (fl), *Reeth 146* (BRLU); Monte Alen. 1°40'N 10°17'E, 28 May 1997 (fr), *Ngomo 177* (BRLU); subida al Monte Chocolate, transecto que está entre Monduá y el transecto de Aconanguí. 1°45'N 10°16'E, 14 August 2001 (fr), *Cabezas 205* (MA); Parc National de Monte Alen, transect de Mosumo., 1°37'N 10°02'E, 18 January 1998 (fl, fr), *Reeth 277* (BRLU); Parc National de Monte Alen, transect de Mosumo. 1°37'N 10°02'E, 19 January 1998 (fl), *Reeth 288* (BRLU); Parc National de Monte Alen. 1°37'N 10°16'E, 10 August 1998 (fl), *Ngomo 438* (BRLU); S.O. du parc National de Monte Alen, sur le transect ECOFAC de Mosumo à 500 m du début du layon. 1°35.89'N 10°02.21'E. Alt: 195m, 15 February 2001 (fr), *Senterre 452* (BRLU); S.O. du parc National de Monte Alen, 200 m au Sud du transect ECOFAC de Mosumo à 1620 m du début du layon. 1°35.62'N 10°03.30'E. Alt: 410m, 4 March 2001 (fr), *Senterre 631* (BRLU); région continentale. Parc Nat. Monte Alen, Mosumo, confluence Rio Lana avec Rio Mbini [=Benito]. 1°36'N 10°02'E, 25 January 1998 (fr), *Obama 680* (BRLU); Parque Nacional de Monte Alén: senda que va desde el lago Atok hasta Mako. 1°35'N 10°15'E, 6 July 1999 (fr), *Pérez Viso 1342* (MA); S.O. du parc National de Monte Alen, 2 km au NE du site de traversée du Rio Uolo pour aller aux cataractas. 1°37.13'N 10°04.69'E. Alt: 440m, 11 January 2002 (fr), *Senterre 1769* (BRLU); S.O. du parc National de Monte Alen, 2 km au NE du site de traversée du Rio Uolo pour aller aux cataractas. 1°37.49'N 10°04.53'E. Alt: 270m, 15 January 2002 (fr), *Senterre 1880* (BRLU); S. du parc National de Monte Alen, au Nord du Rio Lana, près de la Cabana ECOFAC de Misergue. 1°26.18'N 10°13.16'E. Alt: 530m, 29 January 2002 (fr), *Senterre 2098* (BRLU); S. du parc National de Monte Alen, près de la Cabana ECOFAC de Esamalanas. 1°31.26'N 10°12.37'E. Alt: 640m, 30 January 2002 (fl), *Senterre 2124* (BRLU); Parc National de Monte Alen, 5 km à l'Ouest du village d'Engong. 1°37'N 10°18'E. Alt: 1100m, 11 May 2002 (fr), *Parmentier 2880* (BRLU); Parc National de Monte Alen, transect de Mosumo. 1°37'N 10°18'E. Alt: 1107m, 11 May 2002 (fl, fr), *Parmentier 2930* (BRLU); Evinayong-Niefang, km 32-33. 1°35'N 10°27'E, 8 December 1990 (fl), *Carvalho, M.F. de 4598* (B,G,K,WAG); Parque Nacional de Monte Alén, Subida al mirador. 1°40'N 10°18'E, 16 December 2001 (fr), *Velayos 10024* (MA); Parc National de Monte Alen, transect de monte Alen, km 0 à 1. 1°39'N 10°18'E, 11 July 1995 (fr), *Lejoly 95/135* (BRLU); Monte Alen. 1°40'N 10°18'E, 22 September 1997 (fr), *Lisowski 1559* (BRLU); **Rio Muni, Litoral**: Rio Mbambala, campement Shimmer km 16 (entre Rio Muni et Monte Mitra)., 1°16'N 9°54'E, 22 August 1997 (fl), *Nguema Miyono 26* (BRLU); Ayamiken ( Reserva de Rio Campo). 2°07'N 10°01'E, 1 February 1997 (fr), *Obama 33* (BRLU); Estuaire du Rio Muni, Ncoho., 1°14'N 9°54'E, 7 December 1997 (fl), *Nguema Miyono 131* (BRLU); Monte Mitra. 1°23'N 9°57'E, 28 November 1997 (fl), *Obama 313* (BRLU); Alen (15 miles from mouth of River Benito), near village. 1°35'N 9°46'E, 4 December 1897 (fl), *Bates, G.L. 588* (G,Z); Litoral: Sendje. 1°34'N 9°50'E, 22 February 2000 (fl, fr), *Pérez Viso 1630* (MA); Eyan Bot, Km 12 de la carreta del puerto a Kogo. 1°47'N 9°47'E, 26 July 2000 (fr), *Pérez Viso 3564* (MA); Sendje à Ongamnsok. 1°22'N 9°58'E, 19 February 2001 (st), *Lejoly 01/24* (BRLU); Sendje à Ongamnsok. 1°22'N 9°58'E, 19 February 2001 (st), *Lejoly 01/52* (BRLU); **Rio Muni, Wele Nzás**: Eviam, Aconibe-Acurenam. 1°11'N 10°47'E, 7 March 2000 (fr), *Pérez Viso 1773* (MA); Inselberg Dumu. Région continentale. 1°22'N 11°19'E. Alt: 750m, 15 January 1999 (st), *Lejoly 99/346* (BRLU).

**GABON, Estuaire**: 0°25'N 9°30'E, 22 January 1880 (fl), *Soyaux 53* (K,P); Forest exploitation Leroy, 20 km N.W. of Asok. 0°53'N 10°12'E. Alt: 550m, 26 January 1983 (fl), *Wilde (WALK-B), J.J.F.E. de 237* (BR,LBV,MO,WAG); Crystal Mountains, 41350m on transect F. 0°57'N 10°10'E, 28 February 2001 (fl), *Mayombo-Nzengue 505* (LBV); Crystal Mountains, 5200m on transect D., 0°35'N 10°26'E, 23 November 2000 (fl), *Nguema Miyono 1435* (LBV,WAG); Secondary forest (Forêt de la Mondah), ca 10 km NNW of Libreville. 0°35'N 9°23'E, 22 April 1986 (fr), *Reitsma, J.M. 2136* (WAG); route Libreville-Cap Estérias, savane entourée de la forêt, 0°41'N 9°40'E,

19 February 1988 (fl), *Louis, A.M. 2828* (LBV,MO,WAG); Monts de Cristal, 14 km de Kingué. 0°20'N 10°10'E, 20 January 1968 (st), *Hallé, N. 4596* (P); Crystal Mountains, 5 km on road Kingué to Libreville. 0°24.7'N 10°15.6'E. Alt: 70m, 13 December 2001 (fl), *Wieringa, J.J. 4728* (WAG); Mondah forest, military area S of Cap Estérias, along the road to Cap Militaire. 0°34.89'N 9°19.16'E. Alt: 30m, 20 November 2004 (fl), *Wieringa, J.J. 5455* (BR,LBV,MO,WAG); Crystal Mountains N.P., left bank of Mbei River opposite Kingué, in permanent Ha-plot 5 of Smithsonian. 0°27.35'N 10°16.84'E. Alt: 180m, 25 March 2013 (fr), *Wieringa, J.J. 7708* (WAG); Waterfalls above the hydroelectric power station at Kingué. 0°28'N 10°17'E. Alt: 200m, 21 November 1986 (fl), *Wilde, J.J.F.E. de 8920* (BR,LBV,M,P,PRE,WAG); Crystal Mountains, 25 km on the road Kingué-Tchimbélé. 0°32'N 10°17'E. Alt: 340m, 20 January 1991 (fr), *Wilde, J.J.F.E. de 10096* (LBV,MO,WAG); NW of Libreville, near road to Cap Esterias. 0°35'N 9°20'E. Alt: 1m, 29 October 1977 (fl), *Leeuwenberg 11385* (WAG); Agonenzorck, sur le Haut-Komo. 0°13'N 10°19'E, 7 October 1912 (fl), *Chevalier, A.J.B. 26930* (P); Agonenzorck, sur le Haut-Komo. 0°13'N 10°19'E, 7 October 1912 (fl), *Chevalier, A.J.B. 26980* (P); **Haut-Ogooué**: Mpassa River's edge. Collected by boat. 2°07.56'S 14°04.08'E. Alt: 420m, 26 November 2001 (fl), *Bradley, A.F. 1100* (MO,WAG); 37 km road Okondja to Akiéni. 0°52.27'S 13°50.32'E. Alt: 440m, 3 February 2008 (fl, fr), *Wieringa, J.J. 6403* (LBV,WAG); 40 km on road Okondja to Akiéni, then 2 km on a new CEB forestry road heading East. 0°53.8'S 13°50.8'E. Alt: 420m, 6 February 2008 (fr), *Wieringa, J.J. 6503* (LBV,WAG); 5-10km W of Boungou-Madouma Railway Station. 1°15'S 13°12'E, 3 December 1993 (fl), *Breteler 12508* (HBG,LBV,MO,WAG); **Moyen-Ogooué**: 13 km E de Belle Vue. 0°35'S 10°37'E, 13 January 1987 (fl), *Dibata 39* (LBV,MO,WAG); zone de Mabounié, à 45 km au sud-ouest de Lambaréné, rive nord de la rivière Ngounié. 0°49.12'S 10°31.33'E. Alt: 18m, 5 February 2013 (fl, fr), *Bidault 1056* (BRLU,LBV,MO,P,WAG); zone de Mabounié, à 45 km au sud-ouest de Lambaréné, rive sud de la rivière Ngounié. 0°48.85'S 10°29.88'E. Alt: 52m, 7 February 2013 (fr), *Bidault 1080* (BRLU,LBV,MO,P,WAG); Ezanga. Layon A nord. 1°07'S 10°14'E, 1991 (fr), *Wilks 2447* (LBV,WAG); Missanga, 5-15 km NNW of Ndjolé. 0°05'S 10°45'E, 11 November 1991 (fl), *Breteler 10384* (BR,LBV,MO,WAG); 5-15 km NNW of Ndjolé. 0°05'S 10°45'E, 15 November 1991 (fl), *Breteler 10507* (BR,LBV,MO,WAG); c. 5-30 km NNW of Ndjolé. 0°05'S 10°45'E, 19 April 1992 (fl, fr), *Breteler 10900* (LBV,WAG); c. 20-30 km NNW of Ndjolé. 0°03'N 10°45'E. Alt: 150m, 1 October 1994 (fl, fr), *Breteler 13114* (BR,E,HUJ,IEC,K,MA,MEL,MO,NY,PE,WAG,YA); **Ngounié**: Missionary station at Mouyanama 15 km on the road Mimongo - Mbigou (60 km along the road from Mbigou). 1°39'S 11°46'E. Alt: 690m, 6 February 1983 (fl), *Wilde (WALK-B), J.J.F.E. de 418* (BR,C,LBV,MO,P,WAG); Waka National Park, Mt. Boutoumbe, lower slope. 1°14.8'S 11°08.7'E. Alt: 600m, 6 June 2006 (fr), *Nguema Ekomo 635* (LBV); après village Mavova, route du chantier forestier EGG. 2°19.04'S 11°56.47'E. Alt: 290m, 18 June 2011 (st), *Bissiengou 1384* (LBV,WAG); vieux chantier forestier. 2°18.08'S 11°53.10'E. Alt: 411m, 19 June 2011 (st), *Bissiengou 1399* (LBV,WAG); vieux chantier forestier. 2°16.78'S 11°52.65'E. Alt: 471m, 19 June 2011 (st), *Bissiengou 1400* (LBV,WAG); vieux chantier forestier. 2°16.78'S 11°52.65'E. Alt: 471m, 19 June 2011 (st), *Bissiengou 1401* (LBV,WAG); CFAD de Rimbunan Hijau, au Sud-Ouest du Parc National de la Lopé. 0°51.0'S 11°15.9'E. Alt: 375m, 28 January 2009 (fr), *Dauby 1432* (BRLU,LBV,MO); E of Waka National Park, 29 km along the road from Mimongo village heading in SE direction. 1°10.58'S 11°19.82'E. Alt: 660m, 25 March 2007 (fr), *Sosef 2548* (BR,K,LBV,MO,WAG); E of Waka National Park, along the road from Mimongo village heading in SE direction. 1°09.83'S 11°19.67'E. Alt: 725m, 25 March 2007 (fr), *Sosef 2552* (BR,LBV,MO,WAG); 10 km on the road Ikobey to Bakongue, Eghaba Mountain. 1°02.0'S 11°02.6'E. Alt: 650m, 28 November 2001 (fl), *Wieringa, J.J. 4471* (WAG); c. 5 km NE of Ikobey. 1°01.9'S 11°01.3'E. Alt: 400m, 30 November 2001 (fl, fr), *Wieringa, J.J. 4511* (BR,LBV,MO,WAG); Guidouma. 1°35'S 10°40'E, November 1924 (st), *Le Testu 5132* (BM,BR,P); Echiras. 1°40'S 10°20'E, December 1925 (st), *Le Testu 5840* (BM,BR,P); Moumba Côte Ouest. 1°15'S 11°35'E. Alt: 800m, 19 May 1963 (st), *Hallé, N. 6061* (P); road from Mandji into CBG concession, 18 km W of Mandji, Sentier Botanique. 1°45.0'S 10°16.9'E. Alt: 108m, 11 November 2011 (fl), *Maas, P.J.M. 10234* (LBV,WAG); 35 km on the road Lebamba - Yéno., 300m, 1°58'S 11°25'E. Alt: 300m, 9 February 1991 (fr), *Wilde, J.J.F.E. de 10473* (BR,E,K,LBV,MO,WAG); **Nyanga**: Mayombe forest, summit, highest point in Mont Pelé mountain range 50 km south of Tchibanga. 3°19'S 11°09'E. Alt: 860m, 9 April 2009 (fr), *Koenen, E.J.M. 118* (LBV,WAG); chantier CEB 65 km SSW of Doussala. 2°36'S 10°35'E. Alt: 480m, 17 May 1985 (fl), *Reitsma, J.M. 1008* (LBV,MO,NY,WAG); Moukalaba Doudou national park, chantier SFN. 2°38.08'S 10°32.66'E. Alt: 350m, 16 February 2004 (fl, fr), *Valkenburg 2757* (BR,LBV,MO,WAG); Inventory, ca 50 km SSW of Doussala. 2°36'S 10°35'E. Alt: 480m, 14 April 1987 (fr), *Reitsma, J.M. 3237* (WAG); eastern slopes of Doudou-mountains. 2°30'S 10°37'E, 20 April 1987 (fl, fr), *Reitsma, J.M. 3370* (MA,WAG); Doudou Mountains, Chantier



SNF-Bakker. 2°42.7'S 10°25.3'E. Alt: 130m, 29 November 2003 (fl), *Jongkind 5827* (BR,E,K,LBV,MO,WAG); 22 km along the road mayumba - Tchibanga, and then 12 km along a forest exploitation track leading in an eastern direction. Near the River Doussa. 3°16'S 10°46'E. Alt: 100m, 10 December 1986 (fr), *Wilde, J.J.F.E. de 9268* (MO,WAG); 48 km S.S.W. of Doussala. Culmination point of the road Doussala - Igotshi. 2°35'S 10°32'E. Alt: 420m, 19 March 1988 (fr), *Wilde, J.J.F.E. de 9489* (WAG); **Ogooué-Ivindo**: 6 km du pont Offoué direction Lastoursville. 0°20'S 11°48'E, 3 November 1982 (st), *Louis, A.M. 38* (MO,WAG); réserve de la faune de la Lopé. 3 km sur la route vers Lopé. 0°20'S 11°30'E, 4 November 1982 (st), *Louis, A.M. 60* (LBV,MO,WAG); chantier S.H.M. en layon Z. 0°50'N 12°05'E, 13 February 1988 (fl), *Dibata 400* (LBV); route Lopé-Mikongo, après carrefour vers Gongué (village PK0). 0°26.2'S 11°52.3'E. Alt: 282m, 5 March 2010 (fr), *Bissiengou 1023* (LBV,WAG); route Lopé-Mikongo, après carrefour vers Gongué (village PK0). 0°26.2'S 11°52.3'E. Alt: 282m, 5 March 2010 (fr), *Bissiengou 1025* (LBV,WAG); route Lopé-Mikongo, après carrefour vers Gongué (village PK0). 0°26.2'S 11°52.3'E. Alt: 282m, 5 March 2010 (fl), *Bissiengou 1026* (LBV,WAG); Lopé-route Nationale, 18 km de la sorite principale de la Lopé. 0°04.07'S 11°03.47'E. Alt: 240m, 9 March 2010 (fr), *Bissiengou 1091* (LBV,WAG); Inventory in chantier SOFORGA, Lopé-reserve. 0°30'S 11°33'E, 27 November 1986 (fl), *Reitsma, J.M. 2609* (MA,WAG); 10 km N. of Djidji. 0°18'N 11°47'E, 17 May 1987 (fl), *Reitsma, J.M. 3432* (LBV,WAG); About 20-40 km NNE of Koumémayoung. 0°15'N 11°55'E, 12 April 1988 (fr), *Breteler 8620* (LBV,WAG); Lopé Reserve, 29 km in Southern direction from Old Ayem Station. 0°17.1'S 11°27.1'E. Alt: 170m, 21 December 1996 (fl), *Wilde, J.J.F.E. de 11788* (BR,LBV,MO,SEGC,WAG); Réserve de Lopé-Okanda, 1 km S. of Campement (= 26 km E. of Ayem). 0°06'S 11°30'E. Alt: 200m, 1 November 1982 (fl, fr), *Leeuwenberg 12423* (WAG); Ivindo, between river Sing and river Oua. 1°00'N 13°00'E, 14 September 1990 (fr), *Minkébé Series W 596* (WAG); **Ogooué-Lolo**: Station de la Makandé. 0°40.7'S 11°54.6'E. Alt: 250 - 420m, 29 October 1996 (fl), *Doucet, J.-L. 442* (BR); Mont Iboundji. 1°09'S 11°47'E. Alt: 800 - 900m, 9 February 2000 (fr), *Sosef 694* (LBV,WAG); camp Makandé, layon Heron 350. 0°41'S 11°55'E, 9 January 1994 (fr), *Moungazi 1002* (LBV); 10 km S of confluence Gongue-Offoue., 0°49'S 11°54'E, 11 August 1993 (fl), *Dibata 1186* (MO,WAG); Makandé, just NE of campsite. 0°40.8'S 11°54.8'E. Alt: 250m, 12 January 2001 (fr), *Wieringa, J.J. 4077* (LBV,MO,WAG); 11 km W from Lastoursville. Chantier SBL, near headquarters. 0°52'S 12°40'E. Alt: 290m, 16 November 1988 (fr), *Maesen, L.J.G. van der 5486* (BR,G,LBV,MA,MO,WAG); c. 30 km ENE of Lastoursville, east of Bambidie, 7.5 km on CEB exploration road NZ P/2. 0°43.0'S 13°03.8'E. Alt: 290m, 22 March 2013 (fr), *Wieringa, J.J. 7657* (WAG); Bambidie 30 km E of Lastoursville. 0°40'S 13°00'E, 29 April 1992 (fr), *Breteler 11184* (WAG); Bambidie 30 km E of Lastoursville. 0°40'S 13°00'E, 1 May 1992 (fl), *Breteler 11214* (LBV,WAG); c. 40km E of Lastoursville. 0°50'S 13°05'E, 13 December 1993 (fl), *Breteler 12606* (HBG,LBV,MO,WAG); Makande surroundings 65 km SSW of Booué. 0°41'S 11°55'E, 22 January 1999 (st), *Breteler 14739* (LBV,WAG); Makande surroundings 65 km SSW of Booué. 0°41'S 11°55'E, 1 February 1999 (st), *Breteler 14879* (LBV,WAG); Makande surroundings 65 km SSW of Booué. Makande. 0°41'S 11°55'E, 13 February 1999 (st), *Breteler 15049* (LBV,WAG); **Ogooué-Maritime**: Rabi-Kounga, near Rabi 55. 1°56'S 9°52'E. Alt: 30m, 29 December 1993 (fr), *Haegens 212* (LBV,MO,WAG); Rabi-Kounga, near Rabi 55. 1°56'S 9°52'E. Alt: 30m, 29 December 1993 (fl), *Haegens 214* (E,LBV,MO,WAG); Rabi-Kounga, near Rabi 9. 1°55'S 9°52'E. Alt: 40m, 28 January 1994 (fl, fr), *Haegens 264* (LBV,MO,WAG); Rabi-NW, near Rambo Rabi, NW of Rabi site. 1°53.8'S 9°50.5'E, 13 November 1990 (st), *Nek 297* (BR,E,MO,WAG); Rabi-NW, near Rambo Rabi, NW of Rabi site., 1°53.8'S 9°50.5'E, 13 November 1990 (fr), *Nek 298* (WAG); Rabi Kunga. 1°55'S 9°52'E, 27 February 2002 (fl), *Bourobou 546* (LBV,WAG); near Rabi-Hill. 1°59.5'S 9°51.0'E, 12 January 1991 (fl), *Nek 563* (BR,LBV,MO,WAG); Monts Doudou, W. of Doussala and Rés. de Faune de Moukalaba. 2°15'S 10°20'E. Alt: 360m, 4 December 1984 (fl), *Arends 602* (WAG); Toucan. 1°47'S 9°53'E, 29 May 2002 (fl), *Bourobou 631* (K,LBV,P,WAG); Réserve des Monts Doudou, à ± 40 km sur la route à partir de Doussala, direction Nord-Ouest. 2°13'S 10°24'E. Alt: 300m, 17 March 2000 (fr), *Sosef 796* (LBV); Monts Doudou, à ± 40km au Nord-Ouest de Doussala, autour du campement II. 2°13'S 10°24'E. Alt: 425m, 8 April 2000 (fl, fr), *Sosef 1162* (LBV); Monts Doudou, à ± 40km au Nord-Ouest de Doussala, autour du campement II. 2°13'S 10°24'E. Alt: 375m, 10 April 2000 (fl), *Sosef 1198* (LBV); Rabi-Shell concession, Rabi, N of airport. 1°55.7'S 9°52.4'E. Alt: 56m, 24 January 2010 (fr), *Dauby 2136* (BRLU,LBV,MO); Rabi-Shell concession, just SW of Rabi oil field. 1°58.9'S 9°51.1'E. Alt: 106m, 26 January 2010 (fl), *Dauby 2198* (BRLU,LBV,MO); Rabi, Divangui savannah. 1°57.3'S 10°00.0'E. Alt: 20m, 23 March 1994 (fr), *Wieringa, J.J. 2566* (BR,LBV,MO,WAG); Rabi oil field, hectare plot, position in plot: 83E 34S. 1°55.65'S 9°52.42'E. Alt: 45m, 23 January 2005 (fr), *Wieringa, J.J. 5610* (BR,E,K,LBV,MA,MO,WAG); 30 km N.W. of Doussala, in the direction of Bongo. 2°12'S 10°24'E. Alt:

400m, 16 March 1988 (fr), *Wilde, J.J.F.E. de 9389* (LBV,WAG); Rabi, near Camp. 1°55'S 9°50'E, 24 March 1990 (fr), *Breteler 9422* (WAG); Rabi, near Shell camp. 1°57'S 9°53'E, 24 March 1990 (fr), *Breteler 9473* (WAG); Ca 40 km N.N.W. of Doussala. 2°02'S 10°25'E. Alt: 380m, 24 March 1988 (fr), *Wilde, J.J.F.E. de 9547* (BR,LBV,MO,P,WAG); Ca 40 km N.N.W. of Doussala. 2°02'S 10°25'E. Alt: 380m, 24 March 1988 (fr), *Wilde, J.J.F.E. de 9558* (LBV,MO,WAG); 3 km NE of Rabi Camp., 40m 1°56'S 9°53'E. Alt: 40m, 1 December 1989 (fl), *Wilde, J.J.F.E. de 9914* (BR,LBV,MO,WAG); Rabi, Shell/Gabon, oilfield, well no 7., 90m, 1°56'S 9°52'E. Alt: 90m, 23 January 1993 (fr), *Wilde, J.J.F.E. de 10915* (LBV,WAG); Rabi, Shell/Gabon, near well no 78, platform M. 1°55'S 9°50'E. Alt: 50m, 25 January 1993 (fl, fr), *Wilde, J.J.F.E. de 10955* (B,BR,K,LBV,MA,MO,WAG); Rabi - Kounga. 1°55'S 9°55'E, 14 May 1992 (fl, fr), *Breteler 11443* (BR,K,LBV,MO,WAG); **Woleu-Ntem**: Crystal Mountains, Tchimbélé, sur sentier botanique entre transect D et (croisement transect.), 0°37'N 10°25'E, 21 January 2001 (fl), *Mayombo-Nzengue 241* (LBV); Crystal mountains, 3 km E of Tchimbélé. 0°38'N 10°26'E. Alt: 530m, 27 December 1989 (fl), *Wieringa, J.J. 297* (BR,C,LBV,MO,WAG); Ngwein / Mbei-Akelayong entre camp Y 3550 et Pont Mveng sur R.N., 0°52'N 10°32'E, 31 January 2001 (fl), *Mayombo-Nzengue 303* (LBV); 10 km Lalara - Makokou, than exploitation road along Okano River, upstream for c. 42 km. 0°33'N 11°42'E. Alt: 380m, 6 September 1978 (fl, fr), *Breteler; Wilde 459* (LBV,WAG); 6 km SSW of Mitzic, FOREENEX forest exploitation. 0°43.8'N 11°32.1'E. Alt: 508m, 6 November 2009 (fl), *Bissiegou 702* (LBV,WAG); 13 km SE of Mitzic, FOREENEX forest exploitation, road from FOREENEX forestry camp to Madouaka village. 0°42.1'N 11°38.8'E. Alt: 490m, 7 November 2009 (fl), *Bissiegou 733* (LBV,WAG); 14 km SE of Mitzic, road from FOREENEX forestry camp to Madouaka village. 0°41.9'N 11°38.5'E. Alt: 481m, 7 November 2009 (fl), *Bissiegou 739* (LBV,WAG); 35 km NNE of Mitzic, 2 km from Bordamur forestry camp. 1°02.8'N 11°43.3'E. Alt: 545m, 8 November 2009 (st), *Bissiegou 770* (LBV,WAG); Parc des Monts de cristal, environ du Plot II, Smithsonian. 0°37.1'N 10°24.6'E, 11 February 2010 (st), *Bissiegou 933* (LBV,WAG); Parc des Monts de cristal, environ du Plot I, Smithsonian. 0°37.0'N 10°24.8'E, 11 February 2010 (st), *Bissiegou 934* (LBV,WAG); Parc des Monts de cristal, environ du Plot I, Smithsonian. 0°37.0'N 10°24.8'E, 11 February 2010 (st), *Bissiegou 935* (LBV,WAG); Parc des Monts de cristal, environ du Plot II, Smithsonian. 0°37.1'N 10°24.6'E, 12 February 2010 (fr), *Bissiegou 947* (LBV,WAG); Crystal Mountains, 300m on transect C1., 0°36'N 10°25'E, 17 November 2000 (st), *Nguema Miyono 1373* (LBV,WAG); ca 15 km NE of Oveng; Inventory. 0°44'N 11°22'E, 11 May 1986 (fl), *Reitsma, J.M. 2255* (WAG); Inventory Oveng; 25 km WSW of Mintsic. 0°44'N 11°22'E, 7 February 1987 (fl), *Reitsma, J.M. 2893* (MA,WAG); Minkébé area, near plot R. 1°30'N 12°48'E, 6 April 1990 (fl), *Minkébé Series W 95* (WAG).

**GHANA, Eastern Region**: Kade ARS 6°08'N 0°55' W, 30 May 1970 (fl), *Enti GC 40265* (FHO,K,WAG); **Western Region**: 4°52'N 2°14' W, June 1882 (fr), *Burton s.n.* (K).

**GUINEA, Nzérékoré**: NW of Pic de Foko. 8°29.98'N 8°54.03' W. Alt: 1015m, 24 January 2010 (fl, fr), *Haba, P.K. 646* (K,NHGC,WAG); Nimba Mountains, plot JRFL13, near Yah River. 7°35.33'N 8°27.75' W. Alt: 649m, 11 December 2007 (st), *Nimba Botanic Team JR 2003* (WAG).

**IVORY COAST, Abidjan**: Adiopodoumé. 5°21'N 4°08' W, 12 February 1972 (fl, fr), *Doorn 32* (WAG); 17 km of Abidjan., 5°21'N 4°08'W, 16 May 1969 (fl), *Versteegh 64* (WAG); Jardin botanique d'Adiopodoumé. 5°20'N 4°08'W, 21 September 1964 (fl), *Cremers 286* (BR); Jardin botanique d'Adiopodoumé. 5°20'N 4°08'W, 16 December 1965 (fl), *Cremers 360* (BR); Jardin Botanique d'Adiopodoumé. 5°20'N 4°06'W, 6 August 1962 (fr), *Aké Assi 6234* (G); Jardin Botanique d'Adiopodoumé. 5°20'N 4°06'W, 11 October 1960 (fl), *Aké Assi 6991* (G); Adiopodoumé, 17 km W Abidjan. Vers le petit sentier menant à l'hôtel de l'IDERT. 5°20'N 4°20'W, 14 April 1970 (fl), *Farron 7071* (P); **San-Pédro**: route de Béréby, forêt à 3km de l'embranchement de la route Béréby-Grabo. 4°33'N 7°01'W, 5 June 1973 (fr), *Aké Assi 12101* (G); **Tabou**: c. 15 km E of Tabou along road to San Pedro. 4°31'N 7°15' W, 11 July 1978 (fl, fr), *Dekker, A.J.F.M. 91* (WAG); route de Tabou, forêt près de Djiroutou. 4°25'N 7°22'W, 28 December 1985 (fr), *Aké Assi 17202* (G).

**LIBERIA, Nimba**: Valley between Mt Gangra and Mt Yuelliton. 7°33.92'N 8°38.22'W. Alt: 720m, 16 January 2009 (st), *Jongkind 8516* (K,WAG); Nimba. 7°32'N 8°32'W. Alt: 600m, 4 March 1965 (st), *Adam, J.-G. 21092* (K,P); Jekepa. Village Mimba-franfa. 7°29'N 8°34' W, 14 May 1973 (st), *Adam, J.-G. 27556* (B,BR,WAG); between Mt Gangra and Mt Yuelliton, plot SNLF01. 7°33.36'N 8°38.02' W. Alt: 715m, 13 January 2009 (st), *Nimba Botanic Team NS 51* (WAG).

**NIGERIA, Akwa-Ibom State**: along the road from Orukun to James town. 4°42'N 8°16'E, 4 October 1964 (fr), *Daramola FHI 55281* (WAG); **Cross River State**: Oban. 5°17'N 8°33'E, (fl), *Talbot, P.A. 1282* (BM,K); South Eastern State. Ekinta River Forest Reserve. Northern part, between pillars 18 and 19., 4°58'N 8°35'E,

26 April 1971 (fl), *Meer, P.P.C. van 1467* (WAG); Ikom, Afi River forest Reserve, near aboama. 5°58'N 8°42'E, 9 December 1950 (fr), *Keay FHI 28181* (K,P); **Edo State**: Jamieson River. 6°06'N 5°53'E, (fr), *Kennedy, J.D. 1577* (A,FHO); Okomu forest reserve. Compartement No. 6°20'N 5°15'E, 14 February 1948 (fr), *Brenan 9025* (BM,FHO,K).

**Key literature:** Bamps & Farron (1967), Cheek (2004), Exell & Mendonça (1951), Farron (1963, 1985), Friis & Vollesen (1998), Hawthorne & Jongkind (2006).

**Campylospermum claessensii** (De Wild.) Farron

**Fig. 4**

Bull. Jard. Bot. État Bruxelles 35: 394 (1965). – *Ouratea claessensii* De Wild., Pl. Bequaert. 4: 450 (1928). – Lectotype (designated here): *Claessens 338* (BR!; isotype: BR!), Democratic Republic of the Congo, Batama, March 1921.

*Treelet* up to 4 m tall, with branched stem; twigs with pale coloured bark. *Stipules* caducous, narrowly triangular, 3–7 mm long. *Leaf*: petiole 3–10 mm long; leaf blade **narrowly elliptic-obovate** to elliptic-obovate, **11–25 x 3.5–9** cm, ratio **2–3**, base cuneate, apex acuminate, coriaceous, bullate, upper side medium green, lower side paler green, ± glossy on both sides, margin serrulate; venation: midrib prominent on upper side, strongly prominent on lower side, main lateral veins 12–17 on either side, 8–22 mm apart, **shallowly sunken on upper side, prominent on lower side**, at a **right to oblique angle with the midrib** but curved upward to run parallel to the margin, intermediate lateral veins **0–3 in between each pair of main lateral veins**, sunken on upper side and prominent on lower sides, tertiary venation scalariform, perpendicular to the midrib, **fairly distinct on upper side, distinct on lower**. *Inflorescence* terminal, branched or sometimes unbranched, **robust, lax**, its main axis 21–26(–31) cm long; pairwise scales at the base of peduncle **persistent**; racemes, 0–3, 10–17(–29) cm long, **ascendant; bracts persistent, triangular, 2–4 mm long**; cymules **0.5–2 cm apart, 1–20-flowered**. *Flower*: pedicel 8–12 mm long, articulated at 1–2 mm from the base; sepals ovate, in flower 4–6 x 2–3 mm, in fruit 5–10 x 3–4 mm, first patent then erecto-patent; petals **obovate**, 9–10 x 5–7 mm, **clawed at base**, rounded at apex; stamens: anthers 4–5 mm long; ovary 1–2 mm long; style 4–5 cm long. *Fruit*: receptacle enlarged to 3–5 mm wide; drupelets **broadly ellipsoid**, 7–8 x 5–6 mm; cotyledons **incumbent, dissimilar in size, with a small outer cotyledon**.

**Notes:** The protologue cites two syntypes, one collected by Claessens and one by Bequaert. It seems logic, in line with the etymology, to choose the first one as the lectotype. *C. claessensii* is close to *C. gabonense* by having obovate leaves with shallowly sunken main lateral veins, persistent pairwise scales at the base of the peduncle and persistent bracts. However, *C. claessensii* differs from *C. gabonense* by having a much longer and more lax inflorescence, pedicels articulating at only 1–2 mm from the base as well as caducous and smaller stipules.

**Distribution:** endemic to the eastern half of the Democratic Republic of the Congo (Maniema, North Kivu, South Kivu and Orientale provinces) (**Map 4**).

**Ecology:** in high primary and secondary forest, swamp forest; at 470–800 m altitude.

**Phenology:** flowers observed in all months except for February and May; fruits observed in March, June, October and December.

**Vernacular names: Democratic Republic of the Congo:** Kashindabakoi (lega).

**IUCN conservation status:** LC B1/B2ab(i,ii,iv). EOO=148,609 km<sup>2</sup>, AOO=65,699 km<sup>2</sup>, locations=17, subpopulations=2 (cell width= 64 km). This species is only known from 18 collections, the most recent one is from 1989, and some collections fall into two protected areas (Maiko NP and collaborative Fishery Management Area). Thus, although endemic to the eastern Democratic Republic of the Congo, it does not seem to be under severe threat and the category of Least Concern seems most appropriate.



**Figure 4.** *Campylosperrum claessensii*. A. Flower buds. B. Flowering branch.

**Specimens examined:**

**CONGO (KINSHASA), Equateur:** Beondo (Lomani). 1°42'S 25°03'E, 20 April 1959 (fl), *Bamps 577* (BR); **Maniema:** Pangi (Maniema). 3°11'S 26°38'E, 24 June 1942 (fr), *Michelson, A. 35* (BR); Parc National de la Maïko, 45 km au Nord de Lubutu, Péné Aluta, rive droite de la Maïko, entre les affluents Ukungu et Utambe. 0°20'S 26°40'E, 2 June 1977 (st), *Lejoly 1792* (BR); Lumuna. 3°46'S 26°24'E, August 1932 (fl), *Lebrun 5887* (BR); Moyengo territoire Kindu. 2°48'S 26°12'E, 18 August 1959 (fl), *Léonard, A. 5917* (K,US,WAG); route de Mobanga-Karomo, village Saboni. 4°27'S 26°40'E, June 1952 (fl, fr), *Germain, R.G.A. 7897* (BM,BR); Maniéma, près de Mengwé (à 53 km au N.W. de Lubutu), 0°29'S 26°18'E, 6 December 1981 (st), *Lejoly 81/ 534* (BR); Maniéma, près de Mengwé (à 53 km au N.W. de Lubutu), 0°29'S 26°18'E, 6 December 1981 (fr), *Lejoly 81/ 541* (BR); **Nord-Kivu:** Nyamakombola. 1°41'S 28°09'E, 23 October 1989 (fr), *Terashima 152* (BR); Kabunga. 1°42'S 28°09'E, 17 November 1958 (fl), *Léonard, A. 1726* (K,WAG); Musenge, territoire Walikale. 1°38'S 28°16'E. Alt: 800m, 10 December 1958 (fl, fr), *Léonard, A. 2148* (BR,P); entre Walikale et Lubutu. 1°05'S 27°20'E, 3 January 1915 (fl), *Bequaert 6604* (BR); **Orientale:** Batama. 0°53'N 26°38'E, March 1921 (fl), *Claessens 338* (BR,WAG); Wanierukula, km 60 rivière Maïko. 0°11'N 25°32'E, 20 March 1981 (fr), *Mosango 495* (BR); North-East of Kisangani (Stanleyville). 0°35'N 25°15'E, 29 September 1957 (fl), *Croockewit 709* (WAG); village Yabwesu-Ogeto (Bas-Lomami). 0°38'N 23°54'E, 13 April 1956 (fl), *Germain, R.G.A. 8747* (BR); Yangambi, sources de la Bohonde. 0°46'N 24°27'E. Alt: 470m, October 1938 (fl), *Louis, J.L.P. 13258* (BR); **Sud-Kivu:** Urega. 2°30'S 27°30'E, July 1932 (fl), *Lebrun 5730* (BR,P).

**Key literature:** Bamps & Farron (1967), Farron (1963, 1985).

***Campylospermum congestum* (Oliv.) Farron**

Bull. Jard. Bot. État Bruxelles 35: 394 (1965). – *Gomphia congesta* Oliv., Fl. trop. Afr. 1: 322 (1868). – *Ouratea congesta* (Oliv.) Engl. ex Gilg in Engl. & Prantl., Nat. Pflanzenfam. ed. 1, III, 6: 142 (1893). – *Exomicrum congestum* (Oliv.) Tiegh., Ann. Sci. Nat., Bot. 16: 338 (1902). – Type: *Mann s.n* (holotype: K!), Sierra Leone.

*Treelet up to 2 m tall*, with branched trunk, twigs with brown coloured bark. *Stipules persistent*, triangular to narrowly triangular, 2–6 mm long. *Leaf*: petiole 3–8 mm long; leaf blade **elliptic or elliptic-obovate to narrowly elliptic**, 6–20(–25) x (2–)3–6(–8) cm, ratio **(2–)3–4**, **base cuneate, apex acute to acuminate**, coriaceous, slightly bullate, margin **serrulate** but entire towards the base, upper side medium green, lower side paler green; midrib **prominent on upper side, flattened beneath**, main lateral veins **12–20** on either side, **5–20 mm apart**, prominent on upper side, **flat to shallowly impressed beneath, at a slightly acute to right angle with the midrib** but curved upward to the margin, intermediate lateral veins 1–3 in between each pair of main lateral veins, less prominent, tertiary venation **scalariform, consisting of very fine and parallel veins**, distinct to slightly so above, slightly distinct below. *Inflorescence* terminal, **compact, unbranched or occasionally with a few short racemes at the base**, its main axis 3–12(–15) cm long; **racemes 0(–2), 1–2 cm long**; pairwise scales at the base of the peduncle persistent, triangular, 3–5 mm long; bracts caducous; cymules **0.5–1 cm apart, 2–6-flowered**. *Flower*: pedicel **4–11 mm, articulated at the very base**; sepals ovate, in flower 4–6 x 2–3 mm, in fruit 5–7 x 3 mm and patent to erecto-patent, base rounded, apex obtuse; petals obovate to broadly spatulate, **5–10 x 4–8 mm, rounded at apex**; stamens: anthers 3–5 mm long; ovary c. 1 x 1 mm; style 5–6 mm long. *Fruit*: receptacle c. 2 x 1 mm in flower, c. 3 x 2 mm in fruit; drupelets 1–3 well developed per receptacle, **globose, 5–6 x 5–6 mm; cotyledons incumbent, ± similar in size**.

**Notes:** The leaves of this species are quite reminiscent of those of *C. squamosum* by looking at the serrulate margin and prominent main laterals on the upper side. However, its compact, short and often simple inflorescence readily distinguishes it from the latter which has lax, long and a much-branched inflorescence. Moreover, in *C. squamosum* the tertiary venation is more distinct and even prominent on the lower surface, while the pedicel is articulated well above the base. See also the note under *C. squamosum*.

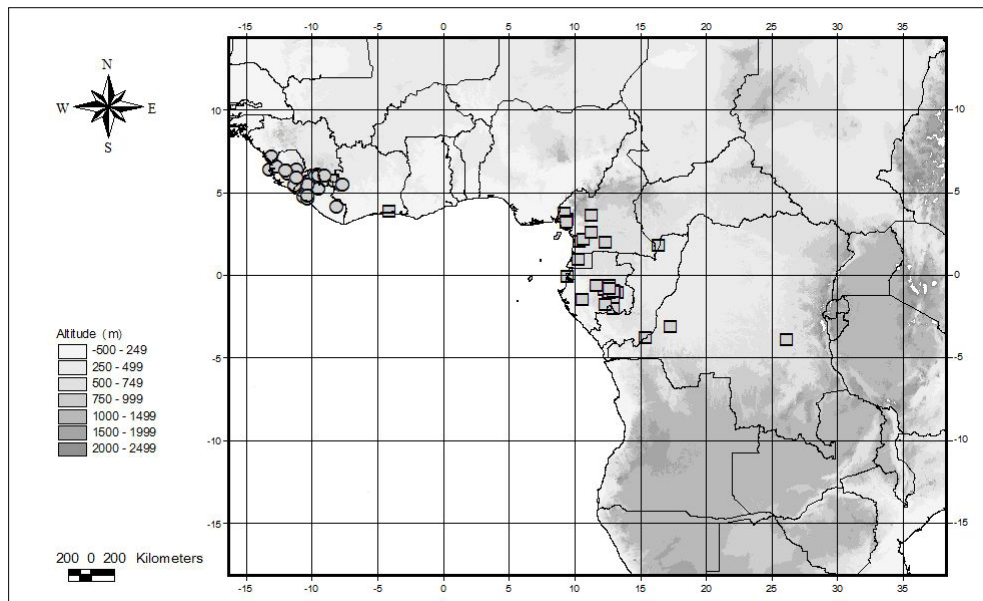
**Distribution:** West Africa, from Guinea to western Ivory Coast (**Map 6**).

**Ecology:** in primary and secondary, high, disturbed forest, along streams; at 15–1248 m altitude.

**Phenology:** flowering all year except for June and July; fruits collected from January to May and in September.

**Uses:** The Mende people of Sierra Leone crush the leaves and then put it on the cut of a palm that has just been tapped to keep off bees who would otherwise drink the palm-sap (Burkill, 1997).

**IUCN conservation status:** LC B1/B2(iii,iv). EOO=118,981 km<sup>2</sup>, AOO=89,629 km<sup>2</sup>, locations=33, subpopulations=9 (cell width=69 km). This species seems to have a scattered occurrence while some subpopulations occur in Forest Reserves such as Sangouine (Ivory Coast), Kpelle (Liberia), Lorma (Liberia) and Mont Tonkouli (Guinea). Therefore, the category of Least Concern has been assigned.



Map 6. Distribution of *Campylosperrum congestum* (○) and *Campylosperrum costatum* (□)

### Specimens examined:

**GUINEA, Kindia:** Basse-Guinée, région de Forécariah. 9°26'N 13°06'W, May 1950 (st), *Schnell 5513* (P); **Nzérékoré:** Mt. Yonon, Plot GF1. 8°01.0'N 9°03.3'W. Alt: 512m, 5 February 2012 (fl), *Simons, E.L.A.N. 814* (WAG); Nimba Mountains, plot JRFG04. 7°39.17'N 8°22.30'W. Alt: 1248m, 1 December 2007 (fl), *Nimba Botanic Team JR 1058* (WAG).

**IVORY COAST, Man:** forêt de Sangouine. 7°18'N 7°48'W, 25 January 1969 (fl), *Bamps 1933* (BR); forêt classée Sangouine. 7°18'N 7°48'W, 4 March 1969 (fl, fr), *Bamps 2189* (BR); Mont Tonkouli. 7°22'N 7°42'W, January 1950 (fl), *Schnell 4049* (P); Mont Tonkouli. 7°22'N 7°42'W, January 1950 (fl), *Schnell 4090* (P).

**LIBERIA, UNKNOWN:** 1895 (fl), *Cook, O.F. 129* (US); **Bong:** 7°00'N 9°29'W, 19 September 1926 (fl, fr), *Linder, D.H. 624* (A,K); Gbanga. 7°00'N 9°29'W, 19 September 1926 (st), *Linder, D.H. 625* (K); **Gbarpolu:** Kpelle Forest. East of Gainkpa. 7°20.2'N 10°20.2'W. Alt: 350m, 14 December 2010 (fl), *Jongkind 10140* (BR,MO,WAG); Kpelle Forest. South of Gainkpa. 7°18.2'N 10°20.1'W. Alt: 340m, 16 December 2010 (fl), *Jongkind 10206* (BR,WAG); **Grand Cape Mount:** 4 miles N of Settlement of MMAL mine company. 7°22'N 11°06'W, 12 February 1970 (fl, fr), *Jansen, J.W.A. 1779* (BR,MO,WAG); Genna Tanyehun 7°15'N 10°44'W, 21 December 1947 (st), *Baldwin jr, J.T. 10757* (K); **Grand Gedeh:** Putu Hills, East Range. 5°41.1'N 8°08.2'W. Alt: 275m, 20 January 2010 (fl), *Jongkind 9158* (MO,WAG); **Lofa:** between Nikabuzu and Zigida. 8°05'N 9°32'W, 7 March 1944 (fl), *Bequaert (Liberia series) 122* (A,K); Kpelle National Forest 58 miles E of Bopolu. 7°40'N 10°05'W, 18 January 1978 (st), *Gier 189* (MO,WAG); North Loma National Forest. 8°02'N 9°44'W, 21 November 2005 (fl), *Jongkind 6782* (WAG); between Ziggida and Mt Wonegisi. 8°02.0'N 9°29.6' W. Alt: 530m, 9 February 2010 (fl, fr), *Jongkind 9391* (FHO,WAG); South-west of Ziggida. 8°01.3'N 9°30.1'W. Alt: 490m, 15 February 2010 (fr), *Jongkind 9523* (WAG); **Montserratado:** Kakatow. 6°32'N 10°21'W, 1904 (fl), *Whyte, A. s.n.* (K); (fl), *Straub, F.C. 52* (US); near Firestone plantation. 6°16'N 10°20'W, (fl), *Warner, R.M. 94* (K); Firestone Plantation, division 33. 6°19'N 10°21'W, 3 January 1970 (fl, fr), *Stoop - v.d. 131* (MO,WAG); Dukwia River, 6°23'N 10°22'W, 7 February 1929 (fl), *Cooper, G.P. 162* (A,BM,FHO,K,US); Du River. Firestone Plantation No. 3. 6°20'N 10°20'W, 2 August 1926 (fl), *Linder, D.H. 217* (A); New University Arboretum

Site 30 km from Monrovia. 6°24'N 10°39'W, 2 January 1964 (fl), *Harten 223* (WAG).

**SIERRA LEONE, UNKNOWN:** 27 March 1956 (fl), *Marmo 218* (K); **UNKNOWN:** 16 December 1955 (fl), *Marmo 221* (K);

**UNKNOWN:** 1915 (fl, fr), *Thomas, N.W. 8666* (K); **Eastern Province:** Gola North FR (Garua). 7°16'N 11°18'W, 24 February 1960 (fl), *Bakshi 39* (K); Nimini Forest Reserve. 8°30'N 11°08'W, 12 January 1965 (fl), *Fox, J.E.D. 44* (K); Lower Neaboi, Kambui Hills F.R. 7°50'N 11°15'W, 15 February 1966 (fl), *Samai, S.K. 286* (K); Bobobu near Giewahun (Tunkia). 7°35'N 11°10'W, 13 December 1939 (fl), *Deighton 3812* (K); Kenema., 7°52'N 11°12'W, 20 January 1914 (fl), *Thomas, N.W. 7557* (K); Kenema., 7°52'N 11°12'W, 20 January 1914 (fl), *Thomas, N.W. 7730* (K); **Northern Province:** Roniester., 76m 8°23'N 11°54'W. Alt: 76m, 17 November 1914 (fl), *Thomas, N.W. 5287* (FHO); Ronietta., 76m 8°22'N 12°00'W. Alt: 76m, 17 November 1914 (fl), *Thomas, N.W. 5364* (K); Ronietta., 76m 8°22'N 12°00'W. Alt: 76m, 17 November 1914 (fl), *Thomas, N.W. 5656* (K); Magbile., 15m 8°44'N 12°42'W. Alt: 15m, December (fl), *Thomas, N.W. 5984* (K); **Southern Province:** Gola forest. 7°16'N 11°18'W, 30 December 1950 (fl), *King, E.L. 113* (K); Zimi, Bahama road. 7°19'N 11°18'W, 1 December 1933 (fl), *Thomas, D.G. 128* (FHO); Gorahun. 8°10'N 11°53'W, 22 November 1926 (fl), *Deighton 453* (K); **Western Area:** Heddles Farm (Colomguli). 8°30'N 13°15'W, May 1912 (fl), *Lane-Poole 117* (K).

**Key literature:** Farron (1963, 1985), Hawthorne & Jongkind (2006), Hutchinson, Dalziel & Keay (1954), Johnston & Stapf (1906).

### *Campylosperrum costatum* (Tiegh.) Biss.

**Fig. 5**

Blumea 58: 6 (2013). – *Monelasmum costatum* Tiegh., Ann. Sci. Nat., ser. 8, Bot., 16: 333 (1902). – *Campylosperrum vogelii* (Hook.f.) var. *costatum* (Tiegh.) Farron, Bull. Jard. Bot. État Bruxelles 35: 403 (1965). – Type: *Zenker 1762* (holotype: P(2x)!; isotype: B!, COI!, G!, K!, L!, LY!, S!, WAG(2x)!), Cameroon, Bipinde, 1898.

*Ouratea bracteata* Gilg, Bot. Jahrb. Syst. 33: 264 (1904). – Type: *Staudt 161* (holotype: B†; isotype: BR(x2)!, E!, P!), Cameroon, Lolodorf.

*Tree* up to 6 m tall, with branched trunk; twigs with pale coloured bark. *Stipules persistent to caducous*, triangular to narrowly so, 4–10 mm long. *Leaf:* petiole 3–7 mm long, **stout**; leaf blade **narrowly elliptic to narrowly obovate, (11–)14–35(–46) x (4–)6–12(–15) cm**, ratio **3–3.5**, base **cuneate to rounded**, apex acute to acuminate, **coriaceous**, not bullate, margin **regularly serrate, teeth with a dark tip**, upper side glossy, dark green, lower side glossy, medium green; midrib prominent on both sides, main lateral veins 10–25 on either side, 10–20(–40) mm apart, more or less at a right angle with the midrib but curved upward, prominent on both sides, intermediate lateral veins 1 to 2 in between each pair of main laterals, prominent on both sides, tertiary venation **scalariform to reticulate, distinct on both sides**. *Inflorescence* terminal, **on top of a very robust flattened twig, branched, lax to fairly dense**, its main axis **(4–)5–18 cm long; racemes 3–6, (2–)6–7(–13) cm long, the axes flattened**; pairwise scales present at the base of the peduncle, triangular; bracts caducous, ovate, 1.5–4 mm long; cymules **0.5–2 cm apart**, 3–7-flowered. *Flower:* **pedicel 3–7 mm long, stout**, articulated at **1–2 mm from the base**; sepals narrowly ovate, in flower 7–8 x 2–4 mm, in fruit up to 10 x 5 mm and erecto-patent, base **rounded**, apex **acute**; petals **obovate, 7–9 x 4–5 mm, cuneate** at base, **rounded** at apex; stamens: anthers 4–6 mm long; ovary c. 1 mm long; style 4–6 mm long, *Fruit:* receptacle 4–6 mm wide; drupelets 3–5 well developed per receptacle, globose to broadly ellipsoid, c. 6–8 x 5–7 mm; **cotyledons**

**incumbent, dissimilar in size, with a small outer cotyledon.**

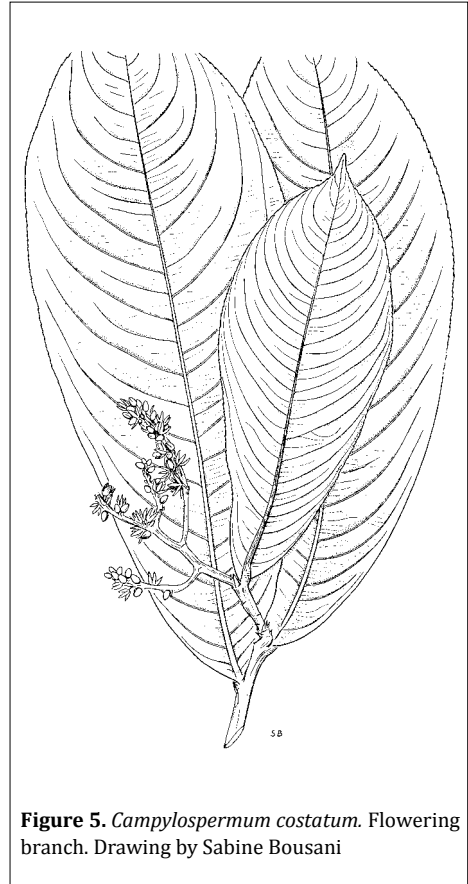
**Notes:** *C. costatum* was judged to be a mere variety of *C. vogelii* by Farron (1965, 1985), but we found sufficient characters to raise it to species level. It mainly differs from *C. vogelii* by often having longer and broader leaves, a stout petiole, an inflorescence sitting on top of a robust and flattened twig and often shorter and stout pedicels.

**Distribution:** Ivory Coast? (only one doubtful collection), Central African Republic (Sangha-Mbaéré), Cameroon, Equatorial Guinea, Gabon, Republic of the Congo and Democratic Republic of the Congo (**Map 6**).

**Ecology:** secondary forest, degraded and exploited forest; at 100–700 m altitude.

**Phenology:** flowering in March, April, and from September to November; fruiting from March to May, and in October and November.

**IUCN conservation status:** LC. EOO=1,584,220 km<sup>2</sup>, AOO=1,366,610 km<sup>2</sup>, locations=34 (cell width=352 km). With the doubtful outlier specimen from Ivory Coast excluded, these figures are EOO=553,852, AOO=203,063, locations=29 (cell width=124.981). Although some populations might well be under threat (notably the large one around Lastoursville (Gabon), where logging companies operate), its preference for secondary habitats probably renders it less susceptible to logging. Even around Lastoursville, it was still present in 2009 and, moreover, it has a large distribution area. Thus, the category of Least Concern seems most appropriate here.



**Figure 5.** *Campylosperrum costatum*. Flowering branch. Drawing by Sabine Bousani

**Specimens examined:**

**CAMEROON, Central Province:** 40 km au SW sur la route de Makak. Réserve forestière d'Ototomo. 3°44'N 11°20'E, 26 May 1970 (st), *Farron 7348* (P); 6 km NW de Banda. 5°05'N 11°20'E, 2 April 1963 (fl), *Raynal 10685* (P); **South Province:** Johann-Albrechtshöhe, Urwaldgebiet. 3°14'N 10°43'E, 23 March 1895 (fl), *Staudt 161* (E); Yaoude. 3°01'N 12°22'E, 1919 (fl), *Bates, G.L. 1388* (BM); Bipindi, bei Copenjang. 3°05'N 10°25'E. Alt: 400m, May 1898 (fr), *Zenker 1762* (B,BM,COI,G,K,L,LY,S,WAG); **South-West Province:** Ikiliwindi, mile 14, north of Kumba on Mamfe road. 4°45.0'N 9°29.0'E. Alt: 250m, 4 March 1987 (fr), *Etuge 501* (MO,US,WAG); ancienne réserve du South Bakundu, 15 km Ouest du village Small Ekomba. 4°30.6'N 9°22.8'E. Alt: 131m, 2 April 2010 (fr), *Bissengou 1270* (LBV,WAG,YA); near Kumba. 4°36'N 9°26'E. Alt: 150m, 12 April 1985 (fl), *Thomas, D.W. 4687* (BR,K,MO,P); south of Baro Village. 5°14'N 9°15'E. Alt: 250m, 31 March 1988 (fl), *Thomas, D.W. 7487* (BR,MO,WAG).

**CENTRAL AFRICAN REPUBLIC, Sangha-Mbaéré:** 25 km SE of Bayanga, Kongana research camp., 2°47'N 16°25'E, 9 February 1994 (st), *Harris, D.J. 4546* (E); 25 km SE of Bayanga, Kongana research camp., 2°47'N 16°25'E, 16 February 1994 (st), *Harris, D.J. 4644* (E); Kongana research camp, 25 km SE of Bayanga., 2°47'N



16°25'E, 19 May 1994 (fr), *Harris, D.J. 4886* (E,WAG).

**CONGO (BRAZZAVILLE), Pool:** île M'Bamou, près de Moutou ya N'Gombé. 4°13'S 15°25'E, November 1967 (fl), *Sita 1920* (P).

**CONGO (KINSHASA), Bandundu:** Djuma. 3°23'S 17°21'E, 1902 (fl), *Gillet, J. 2722* (BR); **Maniema:** Malela. 4°22'S 26°08'E, 4 January 1919 (fl), *Vermoesen 1302* (BR).

**EQUATORIAL GUINEA, Rio Muni, Centro Sur:** Monte Alen. 1°40'N 10°17'E, 12 March 1997 (fl), *Ngomo 90* (BRLU).

**GABON, Estuaire:** Environs de Libreville, 0°25'N 9°27'E, 24 September 1896 (fl), *Klaine 141* (P); Environs de Libreville 0°25'N 9°27'E, 19 September 1898 (fl), *Klaine 195* (P); Environs de Libreville 0°25'N 9°27'E, 12 September 1898 (fr), *Klaine 1318* (P); **Haut-Ogooué:** Lekoko forest exploitation, 60 km SSW of Moanda. 2°03'S 13°00'E. Alt: 700m, 12 October 1970 (fl, fr), *Breteler 6852* (WAG); **Ngounié:** W of road Fougamou to Yombi. 1°21.8'S 10°37.1'E. Alt: 100m, 31 October 1994 (fr), *Wieringa, J.J. 3004* (LBV,MO,WAG); **Ogooué-Ivindo:** Lope Reserve. Plot 4. 0°15'S 11°40'E. Alt: 200m, 24 September 1993 (fl), *White, L.J.T. 1075* (MO,SEGC,WAG); **Ogooué-Lolo:** ± 70 km N.W. of Lastoursville, along rd. to Achouka, old forest along Lolo R. near Wagny settlement., 250m, 0°36'S 12°19'E. Alt: 250m, 13 November 1983 (fr), *Louis, A.M. 653* (WAG); 36 km along the road Lastoursville - Mouanda., 475m, 1°04'S 12°55'E. Alt: 475m, 24 September 1978 (fl), *Breteler; Wilde 781* (WAG); Bambié, circuit 1 du sentier Botanique, base CEB., 275m, 0°44'S 12°58'E. Alt: 275m, 13 November 2009 (st), *Bissiangou 831* (LBV,WAG); Milolé, route première zone d'exploitation de CEB. 0°16'S 12°42'E, 14 November 2009 (fr), *Bissiangou 853* (LBV,WAG); route vers Milolé. 0°30'S 12°42'E. Alt: 413m, 16 November 2009 (fl), *Bissiangou 872* (LBV,WAG); 22 km on road Lastoursville to Koulamoutou. 0°56.6'S 12°37.4'E. Alt: 280m, 15 November 1994 (fr), *Wieringa, J.J. 3186* (WAG); 10.5 km from Lastoursville Railway Bridge, E - W road, Chantier SBL. 0°47'S 12°45'E. Alt: 300m, 18 November 1988 (fr), *Maesen L.J.G. van der 5599* (BR,G,LBV,MA,MO,WAG); N of main road Lastoursville-Moanda, chantiers EGG, 31 km SE of Lastoursville, 12 km off main road. 0°58'S 12°55'E. Alt: 390m, 21 November 1988 (fl, fr), *Maesen, L.J.G. van der 5701* (LBV,WAG); Chantier SFM. 10 km E off main road, 51 km Lastoursville to Moanda. 1°10'S 13°00'E, 28 November 1988 (fr), *Maesen, L.J.G. van der 5904* (WAG); region de Lastoursville. 0°50'S 12°42'E, October 1929 (st), *Le Testu 7535* (P); region de Lastoursville, Bidyabiki. 1°43'S 12°20'E, September 1930 (st), *Le Testu 8400* (BM,P); 30 km E of Lastoursville. 0°40'S 13°00'E, 21 November 1991 (fr), *Breteler 10638* (WAG); 30 km E of Lastoursville. 0°40'S 13°00'E, 30 November 1991 (fr), *Breteler 10835* (LBV,WAG); road from Lastoursville to Okoundja, 9 km E of Ndambi. 0°47'S 13°17'E, 11 October 1994 (fl), *Breteler 13224* (BR,E,K,MO,WAG); east of Lastoursville, near Bambié, C.E.B. chantier. 0°46'S 13°03'E. Alt: 250m, 18 September 1996 (fl), *McPherson, G.D. 16632* (MO,WAG); east of Lastoursville, near Bambié, C.E.B. chantier. 0°45'S 13°03'E. Alt: 250m, 25 September 1996 (fl), *McPherson, G.D. 16695* (MO,WAG).

**IVORY COAST, Abidjan:** Banco Forest Reserve. 5°23'N 4°03' W, 19 November 1973 (fl), *Koning, J. de 2754* (MO,WAG).

**Key literature:** Bamps & Farron (1967), Farron (1963, 1985), Hawthorne & Jongkind (2006), Johnston & Stapf (1906).

### **Campylospermum densiflorum** (De Wild. & T.Durand) Farron

Bull. Jard. Bot. État Bruxelles 35: 394 (1965). – *Ouratea densiflora* De Wild. & T.Durand, Ann. Mus. Congo, Bot., sér. 3, 1: 37 (1901). – *Exomicrum densiflorum* (De Wild. & T.Durand) Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 339 (1902). – *Monelasmum densiflorum* (De Wild. & T.Durand) Tiegh., Ann. Sci. Nat., sér. 8, Bot. 18: 35 (1903). – *Gomphia densiflora* (De Wild. & T.Durand) Verdc., Ochnaceae, Fl. trop. E. Africa: 50 (2005). – Type: *Dewèvre s.n.* (holotype: BR!), Democratic Republic of the Congo.

*Ouratea reticulata* (P.Beauv.) Engl. ex Gilg var. *schweinfurthii* Engl., Bot. Jahrb. Syst. 17: 81 (1893). – *Monelasmum schweinfurthii* (Engl.) Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 328 (1902). – Type: *Schweinfurth 3169* (holotype: K!), Democratic Republic of the Congo, Kusumbo im Lande der Monbuttu, March 16<sup>th</sup>, 1870.

*Ouratea coriacea* De Wild. & T.Durand, Ann. Mus. Congo, Bot., ser. 3, 1: 36 (1901). –

*Exomicrum coriaceum* (De Wild. & T.Durand) Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 338 (1902). – Type: *Dewèvre 795* (holotype: BR!; isotype: BR!), Democratic Republic of the Congo, entre Lukolela et Gombe, February 17<sup>th</sup>, 1896.

*Exomicrum grandifolium* Tiegh., Ann. Sci. Nat., sér. 9, Bot. 5: 172 (June 1907). – Type: *Chevalier 6922* (holotype: P!), Tchad, Ndellé, territoire du Chari, December 25<sup>th</sup>, 1902.

*Monelasmum coriaceum* Tiegh., Ann. Sci. Nat., sér. 9, Bot. 5: 171 (June 1907). – *Gomphia coriacea* (Tiegh.) Lye, Lidia 4(3): 91(1998). – Type: *Chevalier 7318* (holotype: P!), Tchad, Mbélé, territoire du Chari, January 20<sup>th</sup>, 1903.

*Ouratea laevis* De Wild. & T.Durand var. *ipamuensis* De Wild., Pl. Bequaert. 4: 482 (1929). – Lectotype (designated here): *Vanderyst 10997* (BR!), Democratic Republic of the Congo, Ipamu, August 1921.

*Campylopermum katangense* Farron, Bull. Jard. Bot. État Bruxelles 35: 397 (1965). – Type: *Young 127a* (holotype: BM!; isotype: BR!), Democratic Republic of the Congo, Katanga (Shaba), Dilolo, July 20<sup>th</sup>, 1932. **syn. nov.**

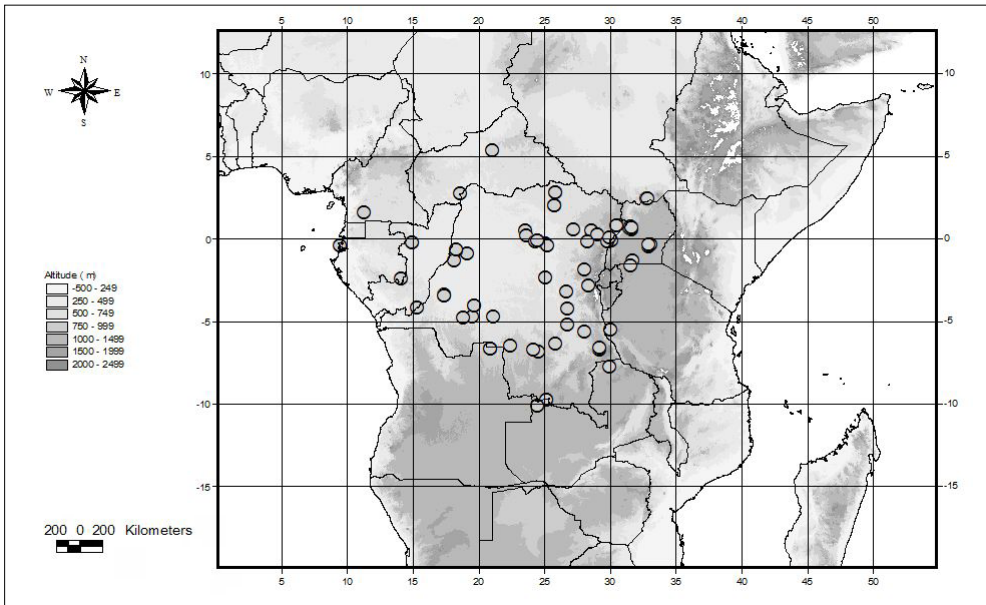
*Tree*, erect or rarely scandent, **up to 20 m tall; bole up to 8 cm in diameter**, with branched trunk; twigs with dark coloured bark. *Stipules* caducous, triangular, **(2–)4–9 mm long**. *Leaf*: **petiole 5–12 mm long, stout**; leaf blade **narrowly elliptic to narrowly elliptic-obovate or sometimes elliptic-obovate**, (10–)19–32(–36) × (2.5–)7–9(–12) cm, ratio **2–3(–4)**, base rounded to cuneate, apex blunt to acuminate, coriaceous, not bullate, glossy above, slightly glossy below, margin regularly serrulate; venation: midrib flat to ± **canaliculate towards the base above**, prominent beneath, main lateral veins **10–15** on either side, **10–40 mm apart, mostly indistinct above, distinct on the lower side**, at a ± right angle with the midrib, curved upwards to run parallel to the margin, intermediate lateral veins 1–5, distinct on the lower side, tertiary venation **scalariform, indistinct above, slightly distinct to distinct below**. *Inflorescence* terminal or sometimes axillary, branched, fairly lax its main axis (5–)10–26(–32) cm long, **more or less angular, robust; racemes 2–7, (3–)6–23(–30) cm long, ascendant**; pairwise scales **caducous**; bracts caducous, sometimes leafy, elliptic, 5–8 × 2–3 cm; cymules **0.5–1 cm apart**, 1–9(–16)-flowered. *Flower*: pedicel **7–15 mm, articulated at (2–)4–5(–7) mm from the base**; sepals ovate to elliptic, 6–7 × 3–4 mm in flower, 8–11 × 4–5 mm in fruit, erecto-patent; petals obovate, 6–11 × 4–8 mm, **base without or with a broad claw, apex rounded**; stamens: anthers 4–6 mm long; ovary c. 1 × 1 mm; style 5–7 mm long. *Fruit*: receptacle c. 1 mm thick in flower, 6 × 5 mm in fruit; drupelets 3 to 4 well developed per receptacle, **ellipsoid, 7–10 × 4–6 mm**; cotyledons **incumbent, dissimilar in size with a small outer cotyledon**.

**Notes:** *C. densiflorum* is similar to *C. dybovskii*, but differs by having a distinct though not or slightly prominent main lateral veins on the lower leaf surface. It also differs from *C. dybovskii* by its highly branched inflorescence having an angular peduncle.

The material described as *C. katangense* only differs from *C. densiflorum* by its smaller

leaves and reduced inflorescence. It is here regarded as a depauperate form of the latter. The material cited by De Wildeman (1929) under his new variety *ipamuensis* (within *Ouratea laevis*) belongs to three different species (*C. densiflorum*, *C. dybovskii* and *C. plicatum*, see also Farron, 1967). By choosing a lectotype here, we solved this situation, and sink the name into the synonymy of the first.

**Distribution:** Cameroon, Central African Republic, Equatorial Guinea, Gabon, Democratic Republic of the Congo, north-eastern Angola, southern Sudan, Uganda, Kenya, Burundi, Tanzania and northern Zambia (**Map 7**).



**Map 7.** Distribution of *Campylosperrum densiflorum*

**Ecology:** in primary and secondary rain forest, dry and gallery forest, savannah and montane forest, seasonal swamp forest, along rivers and streams, near waterfalls; on yellow-brown or grey clay soil; at 300-2000 m altitude.

**Phenology:** flowering and fruiting all year round.

**IUCN conservation status:** LC B1/B2(i,ii). EOO=4,031,040 km<sup>2</sup>, AOO=3,965,950 km<sup>2</sup>, locations=184 (cell width=282 km). The species is well represented in herbaria (we studied 253 collections) suggesting it is fairly common. It has been collected in various protected areas such as Odzala National Park (Republic of the Congo), Loango National Park and Plateaux Batéké (Gabon), Dzanga-Sangha National Park (Central African Republic), Virunga National Park (Democratic Republic of the Congo), Budongo Forest Reserve (Uganda), etc. Therefore, the category of Least Concern seems most appropriate.

**Specimens examined:**

**ANGOLA, Lunda Norte:** Lunda: Dunda, R. Dundundo. 7°24'S 20°50'E, 12 August 1932 (fl), Young, R.G.N.

456 (BM,COI); Lunda: Dunda, R. Camaquenso. 7°24'S 20°50'E, 13 August 1932 (fl), *Young, R.G.N. 503* (BM,COI); Murhura. 7°24'S 20°50'E, 17 June 1948 (fl), *Gossweiler 14107* (B,K,US).

**BURUNDI, Bururi:** Kigwena Kitamba. 4°10'S 29°32'E. Alt: 820m, 9 November 1969 (fl), *Lewalle 4017* (BM); 4°10'S 29°31'E. Alt: 800m, 20 April 1980 (st), *Reekmans 8939* (EA).

**CAMEROON, East Province:** Ngoko. 1°56'N 15°39'E, September 1899 (fr), *Schlechter 12754* (BR); **North Province:** riv. Amiya, 28 km Nord de Bessou. 6°43'N 14°51'E, February 1916 (fl, fr), *Tisserant 221* (P); **South Province:** 17 km on the road from Ebolowa to Minkok. 2°58'N 11°17'E. Alt: 500m, 29 July 1975 (fr), *Wilde, J.J.F.E. de 8394* (B,BR,EA,K,LG,MA,MO,P,PRE,SRGH,WAG,YA); près de Nloubessa Boulou, 60 km ESE d'Ebolowa (feuille IGN 1/200000 Ebolowa). 2°47'N 11°40'E, 23 January 1970 (fl, fr), *Letouzey 9909* (K).

**CENTRAL AFRICAN REPUBLIC, Bamingui-Bangoran:** Sangba. 7°40'N 21°00'E. Alt: 500m, 18 April 1992 (fr), *Peeters, J. 239* (BR); 3.5 km S. of Camp Koumbala on Koumbala river. 8°29'N 21°23'E. Alt: 580m, 3 February 1983 (fl), *Fay, J.M. 4190* (K); Territoire du Haut Oubangui, Dar Banda Kaga, Baidjia. 7°51'N 20°14'E, 8 December 1902 (fl), *Chevalier, A.J.B. 6707* (K,P); Ndelle. 8°25'N 20°38'E, 19 December 1902 (fl), *Chevalier, A.J.B. 6890* (P); Ndelle. 8°25'N 20°38'E, 20 December 1902 (fl), *Chevalier, A.J.B. 6922* (P); Pays de Senoussi, Haute Chari Oriental, galerie de la Gounda. 8°14'N 21°02'E, 20 January 1903 (fr), *Chevalier, A.J.B. 7318* (P); Parc Manovo-Gounda-St. Floris, vicinity of Camp Koumbala. 8°29'N 21°12'E, (fr), *Fay, J.M. 8371* (US); **Haut-Mbomou:** environs d'Obo, entre le Bac de la Ouarra et PK 36 sur la route de Djemah. 5°20'N 26°27'E, 28 December 1963 (fl, fr), *Descoings 12046* (P); **Haute-Kotto:** route Briayalinga. 6°29'N 22°41'E, 25 January 1951 (fl), *Sillans 396* (P,WAG); Yalinga. 6°31'N 23°15'E, 3 May 1921 (fl), *Le Testu 2535* (BM,P); **Kémo:** Krébedjé, moyenne Comi, forêt Sibut. 5°44'N 19°05'E, 4 October 1902 (st), *Chevalier, A.J.B. 5628* (P); **Ombella M'poko:** Bangui. 4°22'N 18°35'E, 13 September 1968 (fr), *Breyne, H. 1431* (BR); Bangui. 4°22'N 18°33'E, 18 December 1903 (fr), *Chevalier, A.J.B. 10859* (P); **Ouaka:** galerie Bambari. 5°46'N 20°41'E, December 1928 (fl), *Tisserant 2792* (P); **Sangha-Mbaéré:** Dzanga - Sangha Reserve, 40 km South of Lidjombo on tributary of kenié. 2°24'N 16°09'E. Alt: 350m, 26 October 1988 (fl), *Harris, D.J. 1489* (K).

**CONGO (BRAZZAVILLE), Cuvette:** Osika. 1°34'S 14°35'E, 1884 (fl), *Brazza 6* (P); Odzala National Park, 150 m du site du camp Ikouele. 0°22'N 15°47'E, 15 April 1995 (fl), *Kouka, L.A. 239* (BRLU); district Mbomo, salines de Mbouébé, au N. de la Lékoli, en amont du confluent avec la Pandaka. 0°38'N 14°54'E. Alt: 350m, 13 January 1995 (fl, fr), *Champluvier. 5246* (BR); Parc National d'Odzala, au N. du camp Mboko (=camp caravati). 0°38'N 14°54'E, 8 December 1993 (fl, fr), *Lejoly 93/483* (BR,BRLU); Odzala National Park, Moba sur la berge de la rivière Mambili. 0°48'N 15°50'E, 21 January 1996 (fr), *Lejoly 96/134* (BRLU); Odzala National Park, grand escarpement d'Odzala, bai de l'ombrette. 1°04'N 14°28'E, 28 November 1996 (fl), *Lejoly 96/976* (BRLU); Odzala National Park, piste entre la rivière Lekoli et la saline Mbouebe. 0°38'N 14°54'E, 5 February 1994 (fl), *Lisowski C 355* (BRLU); Odzala National Park, grande saline de Lango. 0°37'N 14°56'E, 9 February 1994 (fl), *Lisowski C 494* (BRLU); **Niari:** frontière Congo-Gabon, à 500 m de la Loambitsi. 2°38'S 12°18'E, 4 February 1975 (fl), *Sita 3883* (P); chantier forestier de la Lebolou, à 56 km au Sud-Ouest de la Gare Thomas. 2°21'S 12°31'E, 9 February 1975 (fl), *Sita 3887* (P); **Pool:** 25 km W of Brazzaville, Djoumouna. 4°23'S 15°10'E, 12 July 1985 (fl), *Cusset 1350* (P).

**CONGO (KINSHASA), UNKNOWN:** (fr), *Dewèvre s.n.* (BR); **Bandundu:** entre Lubue et Bena-Makima. 4°58'S 21°06'E, May 1910 (fl), *Sapin s.n.* (BR); Bienge. 5°37'S 19°46'E, (fl), *Sapin s.n.* (BR); Patambalu. 2°15'S 18°19'E, 23 February 1958 (fl), *Tailfer 4* (K); bord du Kwilu (Kikwit). 5°02'S 18°48'E, 4 May 1946 (fl), *Renier, M. 88* (BR); Kikwit. 5°02'S 18°48'E, 30 October 1991 (fl), *Masens, B. 1184* (BR,BRLU); Kwango, Kiyaka. 5°19'S 18°56'E, 13 July 1955 (fl), *Devred 2165* (BR); Vallée de la Djuma. 3°23'S 17°21'E, July 1902 (fl, fr), *Gillet, J. 2837* (BR); Vallée de la Djuma. 3°23'S 17°21'E, July 1902 (fr), *Gillet, J. 2921* (BR); Région Babunda. 5°00'S 19°30'E, March 1921 (fr), *Vanderyst 8966* (BR); Banlundu. 3°18'S 17°21'E, March 1921 (fl), *Vanderyst 8991* (BR); entre Ipamou et Panga. 4°07'S 19°49'E, June 1921 (fl), *Vanderyst 9561* (BR); Ipamu. 4°07'S 19°37'E, July 1921 (fl), *Vanderyst 9877* (BR); Ipamu. 4°07'S 19°37'E, August 1921 (fl), *Vanderyst 10997* (BR); **Equateur:** Bwado. 3°18'N 19°27'E, 1912 (fr), *Sapin s.n.* (BR); Riv. Ikelemba. 0°07'N 18°16'E, May 1913 (fl, fr), *Bonnivair 45* (BR); Dua-Ebola. 3°20'N 20°55'E, 30 October 1938 (st), *Leontovitch 118* (BR); Bala-Lundji. 0°24'S 19°23'E, 1904 (fl), *Pynaert 236* (BR); environ de Likimi. 2°50'N 20°45'E, 20 April 1910 (fr), *Malchair 261* (BR); Bangu. 0°04'N 19°12'E, December 1933 (fl, fr), *Dubois, L. 296* (BR); Bala-Lundji. 0°24'S 19°23'E, 20 August 1904 (fl), *Pynaert 382* (BR); Yakussu, Pays des Bangalas.

1°36'N 19°09'E, (st), *Demeuse 389* (BR); Boyasegeze. 3°38'N 20°34'E, 5 March 1955 (fl), *Evrard, C.M. 402* (BR); Itimbiri River. 2°02.85'N 22°49.42'E. Alt: 350m, 13 May 2010 (fl), *Boyekoli Ebale Congo 2010 Expedition 430* (BR); Bena Longa (Lomani). 2°03'S 25°04'E, 15 April 1959 (fr), *Bamps 483* (BR); Eala. 0°03'N 18°19'E, 9 October 1938 (fl, fr), *Coûteaux, G. 493* (K,WAG); Eala. 0°03'N 18°19'E, 1925 (fl, fr), *Robyns, FHEAW 513* (B); rive droite du Ruki. 0°05'N 18°16'E, 10 September 1946 (fr), *Léonard, J.J.G. 559* (BR); Coquilhatville. 0°03'N 18°15'E, 28 September 1925 (fl), *Robyns, FHEAW 741* (BR,WAG); Bobele (Zone Bikoro). 0°45'S 18°07'E, 4 August 1984 (fl), *Nsola 771* (BR); île située à mi-chemin entre Loukolela et N'Gombi. 0°45'S 18°07'E, 17 February 1896 (fl), *Dewèvre 795* (BR,P); entre Ruki et Khalemba. 0°11'S 18°14'E, July 1930 (fl), *Lebrun 806* (BR); Bala-Lundji. 0°24'S 19°23'E, 17 December 1906 (fr), *Pynaert 809* (BR); Yambata. 2°26'N 22°02'E, (fr), *Giorgi 1762* (BR); près de Eala. 0°03'N 18°19'E. Alt: 470m, 2 June 1936 (fl), *Louis, J.L.P. 2156* (K,P); Bolombo. 0°28'N 19°11'E, 7 November 1957 (fl, fr), *Evrard, C.M. 2748* (BR,K); Rivière Busira, en amont de Ioola. 0°10'S 19°08'E, 2 March 1958 (fl), *Evrard, C.M. 3597* (WAG); **Kasai-Occidental**: Mwembe, zone d'Ilelo. 4°25'S 20°20'E, 26 May 1978 (fl), *Dumont, A. 256* (BR); Sengi. 3°06'S 26°40'E, 1921 (fl, fr), *Claessens 456* (BR); 29 km S.E. Luluabourg. 6°00'S 22°33'E, 30 June 1948 (st), *Duvigneaud P.A. 1091* (BRLU); Rivière Kataba (terr. Luisa). 7°12'S 22°24'E, 16 May 1957 (fl, fr), *Liben 3317* (BM,BR); **Kasai-Oriental**: 20 KM Ouest de Gandajika. 6°45'S 23°47'E, 23 August 1945 (fl), *Luxen 553* (BR); **Katanga (Shaba)**: Plateau de Munila (Kansimba). 7°20'S 29°09'E, 29 October 1986 (fl), *Kisimba 4* (WAG); Kalambula (Muhuya). 6°06'S 28°04'E, 28 June 1934 (fl), *Saeger 24* (BR); Dilolo, R. Luau. 10°42'S 22°21'E, 20 July 1932 (fl), *Young, R.G.N. 127* (BM,BR); Katundu, vallée riv. Kina. 5°34'S 26°42'E, 4 August 1952 (fl), *Delvaux 443* (BR); Kaniama-haut Lomami. 7°31'S 24°11'E, August 1947 (fl), *Mullenders 2269* (BR); Mutalala en Kibemba (Grelco-section I). 7°40'S 24°30'E, July 1931 (fl, fr), *Quarré 2640* (BR,K); Kamunza. 7°02'S 25°50'E, 24 September 1957 (fl, fr), *Schmitz, A. 5913* (BR,K); Dans le ravin Laula. 7°28'S 29°12'E, 3 October 1981 (st), *Malaisse 11957* (C,UPS,WAG); **Kinshasa**: environ de Leopoldville. 4°19'S 15°19'E, July 1902 (fr), *Gillet, J. 2683* (BR); Maluku, rivière Bombo. 4°03'S 15°33'E, 27 May 1976 (fl), *Breyne, H. 3002* (BR); **Kivu**: Mutanbo (Kasongo). 4°24'S 26°43'E. Alt: 600m, 8 August 1959 (fl, fr), *Léonard, A. 5680* (BR,WAG); **Maniema**: chantier forestier de Elundu (Kibombo). 3°12'S 25°51'E, 29 July 1959 (fl), *Gaillez, L. 301* (BR); **Nord-Kivu**: Beni, Parc National Albert, section Watalinga. 0°45'N 29°50'E, 22 November 1948 (fl), *Wilde, JMHR de 196* (WAG); Watalinga. 0°40'N 29°40'E, 22 November 1948 (fr), *Wilde, JMHR de 197* (BR); chefferie Wanande. 0°50'N 29°45'E. Alt: 1250m, 13 February 1949 (fl), *Wilde, JMHR de 222* (BR); Watalinga. 0°40'N 29°40'E. Alt: 800m, 11 March 1954 (fl, fr), *Wilde, JMHR de 576* (BR); route Kavumu-Walikale, Km 79. 1°48'S 28°19'E. Alt: 1000m, 19 September 1955 (fl), *Pierlot 879* (BR); Ironga, Mutongo. 1°10'S 28°37'E, 8 May 1958 (fl), *Gutzwiller 2844* (BR); Lesse. 0°45'N 29°46'E, 23 March 1914 (fl, fr), *Bequaert 3165* (BR); Lesse. 0°45'N 29°46'E, 29 March 1914 (fr), *Bequaert 3269* (BR); entre Masisi-Walikale. 1°25'S 28°29'E, March 1932 (fl), *Lebrun 5116* (BR,P); Masisi-Walikale. 1°25'S 28°03'E, 2 January 1915 (fl), *Bequaert 6459* (BR); Albert National Park, rivière Homola, affluent Issehe. 1°18'N 29°48'E. Alt: 1150m, 19 July 1955 (fl), *Witte, G.F. de 12619* (BR); Albert National Park, affluent gauche Semleki. 0°43'N 29°45'E. Alt: 800m, 31 October 1955 (fl), *Witte, G.F. de 12825* (BR); **Oriental**: Yakussu. 0°34'N 25°01'E, 15 January 1904 (fl), *Laurent, É. s.n.* (BR); Doruma. 4°43'N 27°41'E, 5 May 1932 (fl), *Graer 3* (BR); Borumba. 1°34'N 23°31'E, 6 December 1920 (fl), *Claessens, J. 5* (BR,S); Niangara, Mayombo. 3°41'N 27°52'E, September 1947 (st), *Dewez 25* (BR); Doruma. 4°43'N 27°41'E, 19 April 1930 (fr), *Graer 30* (BR); Epulu. 1°25'N 28°35'E. Alt: 750m, 29 January 1998 (fr), *Ntumba 37* (BR); Bosodula. 4°29'N 20°18'E, (fr), *Bilderling 55* (BR); Zone de Mambasa (Ituri Forest). 1°33'N 28°32'E, 16 February 1996 (fl), *Liengola 131* (WAG); Kuleponge. 3°19'N 25°42'E, 5 February 1952 (fl), *Gérard, P. 135* (BM,BR,K); Bambesa. 3°28'N 25°43'E, (fl), *Vrydagh 144* (BR); Epulu (Ituri). 1°25'N 28°35'E. Alt: 750m, 11 November 1981 (fl), *Hart, T.B. 148* (BR); Bambesa. 3°28'N 25°43'E, 16 February 1940 (st), *Vrydagh 151* (BR); Galerie de la rivière Kibali. 2°09'N 30°24'E, 25 April 1958 (fl), *Devillé, A. 156* (K); Lula., 0°27.0'N 25°12.0'E, 16 February 1920 (fl), *Claessens 173* (BR); Mogbogoma, à 500 m. 3°29'N 22°35'E, 17 February 1909 (fl, fr), *Thonner 187* (K); RésERVE de Djugu. 1°56'N 30°30'E, 21 March 1952 (fl), *Smeyers 203* (EA,G,US,WAG); Bas Uele. 4°06'N 22°23'E, 16 October 1934 (fl, fr), *Dewulf, A. 221* (BR); Bambesa. 3°28'N 25°43'E, 22 March 1940 (fr), *Vrydagh 249* (BR); Yangambi. 0°46'N 24°27'E, 18 April 1958 (fl), *Léonard, A. 300* (BR); Kulu. 3°28'N 23°46'E, 1930 (fl), *Brande 308* (BR); Djugu, rivière Uélé (source Kibali). 1°56'N 30°30'E, 1952 (fl), *Smeyers 330* (EA); Bambesa. 3°28'N 25°43'E, 4 March 1940 (fr), *Vrydagh 351* (BR); Bambesa. 3°28'N 25°43'E, 10 April 1940 (st), *Vrydagh 377* (BR); Kulu. 3°28'N 23°46'E, 4 February 1931 (fl), *Brande 403*

(BR,WAG); environ de Mobwasa. 2°40'N 23°11'E, 1913 (fr), *Reygaert 436* (BR); Kulu. 3°28'N 23°46'E, 18 March 1931 (fl), *Brande 495* (BR); environ de Mobwasa. 2°40'N 23°11'E, (fl), *Reygaert. 531* (BR); Yangambi, km 6 route de Ngazi. 1°00'N 24°31'E. Alt: 470m, 1 November 1935 (fl, fr), *Louis, J.L.P. 544* (BR); Bomane, Aruwini River. 1°16.34'N 23°44.13'E. Alt: 365m, 20 May 2012 (fl, fr), *Boyekoli Ebale Congo 2010 Expedition 555* (BR); Bambesa. 3°28'N 25°43'E, 1934 (fl), *Brédo 668* (BR,K); Basoko. 1°13'N 23°36'E, July 1910 (fl, fr), *Claessens 682* (BR); Village Mutoni (Butu). 1°40'N 27°10'E, June 1921 (fr), *Claessens 693* (BR); Bambesa. 3°28'N 25°43'E, (fl, fr), *Bois, H. du 742* (BR); Bambesa. 3°28'N 25°43'E, (fl, fr), *Hendrickx 743* (BR); Ituri. 1°25'N 28°35'E. Alt: 750m, February (fl), *Hart, T.B. 885* (BR); Région de Bambesa. 3°28'N 25°43'E, April 1934 (fl, fr), *Brédo 1001* (BR); Buta, environ du poste. 2°48'N 24°47'E, 22 December 1925 (fl), *Robyns, FHEAW 1217* (BR,WAG); région Bas-Uele, zone Bambesa, village Dingila. Rive gauche de l'Uele, 1 km en aval de la centrale hydroélectrique. 3°28'N 25°43'E, 31 January 1988 (fl), *Szafrański, F. 1301* (BR,C); Ango., 4°02'N 25°52'E, 29 April 1955 (fr), *Gérard, P. 1656* (BR,K); Ibele. 3°28'N 25°43'E, 17 April 1936 (fl), *Louis, J.L.P. 1699* (BR,C); Kivu, terr. Mambasa, rivière Ngawe. 0°45'N 28°15'E. Alt: 700m, 2 June 1956 (fl), *Christiaensen 1779* (K,WAG); Tukpwo (Ango). 4°26'N 25°51'E, 27 February 1956 (fl), *Gérard, P. 2063* (WAG); Yambuya-Ngasi. 1°16'N 24°33'E, February 1939 (fl, fr), *Gilbert, G.C.C. 2112* (BR); entre Yambuya et Mongandjo. 1°21'N 24°20'E, 21 January 1957 (fl, fr), *Evrard, C.M. 2128* (BR); Penghe. 1°20'N 28°09'E, 2 February 1914 (fl), *Bequaert 2242* (BR); Likati. 3°20'N 23°57'E, March 1931 (st), *Lebrun 2455* (BR,P); Barumbu. 1°14'N 23°31'E, May 1921 (fl, fr), *Goossens, V.G. 2557* (BR); Bambesa. 3°28'N 25°43'E, 3 January 1957 (fl), *Gérard, P. 2628* (BR); Madabu. 2°42'N 25°43'E, 25 February 1957 (fl), *Gérard, P. 2714* (BR); Ubundu, rives du fleuve Zaïre et îles en amont d'Ubundu. 0°26'S 25°28'E, 12 March 1978 (fr), *Lejoly 2906* (BR); Lula. 0°27'N 25°12'E, May 1921 (fl), *Goossens, V.G. 2963* (BR); Lula. 0°27'N 25°12'E, May 1921 (fr), *Goossens, V.G. 2987* (BR); Kurukwata. 3°51'N 30°08'E, 25 February 1957 (fl, fr), *Gérard, P. 3108* (BR,K); Kurukwata. 3°51'N 30°08'E, 5 April 1957 (fr), *Gérard, P. 3146* (BR,K); Kussumbo, in Lande der Monbuttu. 4°00'N 28°00'E, 16 March 1870 (fl), *Schweinfurth 3169* (K); Madabu (Zobia). 2°42'N 25°43'E, 9 December 1957 (fl, fr), *Gérard, P. 3501* (BR,K); Ango. 4°02'N 25°52'E, 23 March 1958 (fl), *Gérard, P. 3768* (BR,K); Djugu-Kibali-Ituri. 1°56'N 30°30'E, October 1931 (fl), *Lebrun 3991* (C); île Kongolo à la confluence de la Lindi avec le fleuve Zaïre. 0°34'N 25°05'E, 25 October 1978 (fr), *Lejoly 4204* (BR); bank of Lindi River. 0°33'N 25°05'E, 10 September 1973 (fl, fr), *Bokdam, J. 4234* (MO,WAG); Ango (Tukpwo). 4°26'N 25°51'E, 12 March 1960 (fl, fr), *Gérard, P. 4439* (BR,WAG); Mboga. 1°02'N 29°57'E, 19 June 1914 (fl), *Bequaert 4816* (BR); route de Ngazi, à km 12. 0°46'N 24°27'E, 13 July 1937 (fl, fr), *Louis, J.L.P. 5557* (B,BR); Ngene-Ngene, à 17 km au NE du centre de Kisangani. 0°36'N 25°18'E, 4 February 1984 (fl, fr), *Pauwels 6784* (BR,WAG); plateau de l'Itasukulu. 0°50'N 24°27'E, 21 December 1937 (st), *Louis, J.L.P. 7158* (BM,BR,FHO); Yangambi. 0°46'N 24°27'E, 1937 (st), *Louis, J.L.P. 8059* (K); île Boosa, en face d'Isangi. 0°45'N 24°19'E. Alt: 470m, 17 May 1938 (st), *Louis, J.L.P. 9370* (BR,C); south Bank of Congo River. 1°10'N 23°37'E. Alt: 300m, 8 November 2004 (fl), *Luke 10687* (BR); Mongwalu Mine Site, village pt 077 to pt 076. 1°56.31'N 29°59.71'E. Alt: 1300m, 23 October 2010 (st), *Luke 14539* (BR); rive gauche de Yangambi. 0°46'N 24°27'E, 16 May 1939 (st), *Louis, J.L.P. 14839* (C); **Sud-Kivu**: near Lushasha. 2°12'S 28°47'E, August 1934 (fl), *Babault 669* (P); Kashewe. 1°58'S 28°30'E, January 1935 (fr), *Babault 772* (P); Kalimbi. 2°12'S 28°44'E, 23 March 1959 (fl), *Léonard, A. 3561* (K); Maziba (Kabare). 2°39'S 28°22'E, 22 July 1959 (st), *Léonard, A. 5049* (K,WAG).

**EQUATORIAL GUINEA, Rio Muni, Centro Sur**: West-Afrika: spanisch-Guinea (Mabungo). 1°44'N 10°39'E, (fl), *Tessmann 147* (K).

**GABON, Estuaire**: Libreville. 0°25'N 9°27'E, (fl, fr), *Baudon 111* (BR); **Haut-Ogooué**: Parc National des Plateaux Batéké. Forêt de bord de la rivière Mpassa. 1°59.60'S 14°02.18'E, 2 June 2005 (st), *Niangadouma 467* (MO,WAG); Batéké Plateau, Mpassa River drainage. 81 km from Projet de Protection des Gorilles. 2°07'S 14°03'E, 2 December 2001 (fl), *Walters, G.M. 1037* (MO,WAG).

**KENYA, Nyanza**: Kakamega. 0°17'N 34°45'E, July 1944 (fl), *Carroll, R.W. H44/ 62* (EA,K).

**SOUTH SUDAN, Central Equatoria**: Azza forest, Mongalla. 5°11'N 31°47'E, 21 February 1936 (fr), *Turner, L. 136* (K); **Eastern Equatoria**: Laboni, border Sudan-Uganda. 3°49'N 32°46'E. Alt: 1219m, 8 February 1929 (fl), *Chipp, T.F. 39* (K); Gilo, near the bridge across Ngairigi River. 4°02'N 32°51'E. Alt: 1750m, 9 November 1980 (st), *Friis 78* (C,K); Palotaka. 4°03'N 32°26'E. Alt: 1200m, January 1979 (fl, fr), *Shigeta 156* (EA); Acholi Hills, River Iyedo. 4°04'N 32°34'E. Alt: 1450m, 12 February 1948 (fl, fr), *Jackson, J.K. 262* (FHO); Equatoria, Letti forest. 4°02'N 32°32'E. Alt: 1000m, (fl), *Jackson, J.K. 590* (FHO); Talanga.

4°01'N 32°45'E. Alt: 1100m, 7 December 1980 (fl), *Friis 752* (C,K); Opari Tcholi Hills near Issore. 3°54'N 32°48'E, 20 April 1930 (fl), *Snowden, J.D. 1693* (BM,K); Opari Tcholi Hills near Issore. 3°54'N 32°48'E, 20 April 1930 (fl), *Snowden, J.D. 1694* (BM,K); Imatong Mts. 4°00'N 32°50'E, 31 January 1976 (fl), *Howard, W.J. IM 24* (K); Imatong Mts., 1981m 4°00'N 32°50'E. Alt: 1981m, (fl), *Howard, W.J. IM 30* (EA,K); **Western Bahr el Ghazal:** Numatinna River Distr. 7°14'N 27°37'E, (fl), *Turner, L. 270* (K); **Western Equatoria:** S.W. Equatorial province, Azza forest, S. of Meridi. 4°50'N 29°28'E, 16 March 1939 (fr), *Hoyle 762* (BM,FHO); Linduku, Land der Niarniam. 4°40'N 28°00'E, 28 February 1870 (fr), *Schweinfurth 3069* (BR,P).

**TANZANIA, Kagera:** Murere F.R. Bukoba. 1°00'S 31°50'E. Alt: 1371m, April 1950 (fl), *Watkins 400* (EA); Munene Forest., 1°16'S 31°34'E, 13 February 1995 (fl), *Congdon 409* (K); Kihuru forest, bukoba dist. 1°05'S 31°48'E, 17 February 1936 (fr), *Gillman 446* (EA,FHO,K); Minziro Forest. 1°00'S 31°50'E, August 1957 (fl, fr), *Procter 650* (EA,K); Minziro forest reserve. 1°05'S 31°30'E. Alt: 1225m, 4 July 2000 (fl, fr), *Bidgood 4841* (C,K); **Kigoma:** Kasakati Basi Area. 5°25'S 29°55'E, 1966 (fr), *Itani 14* (EA); Kasakati. 5°25'S 29°55'E. Alt: 1219m, July 1965 (fl), *Suzuki, A. 289* (EA); Mkuti River. 5°25'S 29°55'E, June 1955 (fl), *Procter 409* (EA,K); 30 miles south of Kibondo. 3°51'S 30°45'E. Alt: 1219m, July 1951 (fl), *Eggeling 6215* (EA,K); **Rukwa:** Mahale Mountains, Kasoje. 6°09'S 29°44'E. Alt: 800m, 8 December 1983 (fl), *Takasaki 104* (K); between Pasagulu and Musenabantu. 6°00'S 30°00'E. Alt: 1524m, 9 August 1959 (fl), *Harley, R.M. 9246* (B,BR,K,S); Mahale Mountains, N.P.T4. 6°12'S 29°50'E, 5 September 1991 (fl), *Hamai 91004* (K). **UGANDA, UNKNOWN:** (fl), *Eggeling 1179* (A,FHO); **Buganda:** Mabira Forest. 0°30'N 32°57'E, 4 September 1908 (fl, fr), *Brown, E. s.n.* (BM); Mabira forest, chagwe. 0°23'N 33°00'E, March 1908 (fl), *Ussher 20* (K); Mabira forest, chagwe. 0°23'N 33°00'E, March 1908 (fl, fr), *Ussher 21* (K); Namalala, Mozinda. 0°53'S 31°40'E, November 1913 (fr), *Fyffe 59* (K); 0°44'S 31°40'E, November 1913 (fr), *Fyffe 92* (K,Z); near Mabira forest. 0°30'N 32°57'E. Alt: 1219m, 1904 (fl), *Dawe 162* (K); Mabira C.F.R. Coupe 69. 0°30'N 32°57'E, 21 November 1962 (fr), *Styles 229* (FHO); Mabira C.F.R. on access path to R.P. 532. 0°30'N 32°57'E. Alt: 1219m, 22 September 1964 (fl), *Smith, A.M.S. 250* (EA); Kayanja. 0°22'N 32°53'E. Alt: 1219m, 1913 (fl), *Dümmer 294* (BM,US,Z); Mukono, Kasara river. 4 miles east of Mukono beside and north of the new Kampala-Jinja road. 0°22'N 32°45'E. Alt: 1219m, 20 December 1950 (fl, fr), *Dawkins 684* (EA,FHO,K); Kyagwe Co. East Mengo distr. 2-3 km S of Wantuluntu church. 0°31'N 32°55'E, 13 April 1969 (fr), *Lye 2501* (EA,UPS); Mulange. 0°31'N 33°03'E. Alt: 1219m, October (fl), *Dümmer 3048* (BM,US); Minzero Forest, S. Buddu. 1°00'S 31°50'E, July 1938 (fl), *Eggeling 3742* (FHO,LUA); 4 miles SSW. of Katera. 0°55'S 31°39'E. Alt: 1150m, 2 October 1953 (fl, fr), *Drummond, R.B. 4568* (EA,K); 4 km west of Katera. 0°55'S 31°36'E. Alt: 1160m, 3 May 1972 (fr), *Lye 6798* (EA); 0°08'N 32°24'E, (fr), *Maitland, T.D. Uganda 1144* (K); 0°08'N 32°24'E, (fl), *Maitland, T.D. Uganda 1150* (K); **Western Province:** Budongo forest. 1°39'N 31°35'E. Alt: 1067m, January 1932 (fl, fr), *Harris, C.M. 41* (BR,EA,K); U2. Masindi distr. Budongo forest, Kaniyo. 1°50'N 31°34'E. Alt: 1010m, February 1996 (fl), *Hafashimana 67* (C,K); Siba forest. 1°41'N 31°26'E, March 1936 (fl), *Sangster, R.G. 112* (BR,K); Semliki valley, Bwamba forest. 0°50'N 30°05'E, 14 January 1938 (fl, fr), *Longfield 116* (BM,BR,UPS); Budongo forest reserve. 1°43'N 31°31'E. Alt: 1100m, September 1995 (st), *Nkuutu 201* (C); Buyoro distr., Budongo forest along elephant control road Cpt W26. 1°47'N 31°35'E. Alt: 1150m, 12 December 1970 (fl), *Synnott, T.J. 490* (C,EA,K,UPS); Budongo forest. 1°44'N 31°28'E. Alt: 1050m, 6 March 1971 (fl, fr), *Synnott, T.J. 528* (EA); Budongo forest. 1°44'N 31°33'E. Alt: 914m, 23 February 1906 (fl), *Bagshawe 929* (BM); Budongo forest. 1°44'N 31°28'E. Alt: 1050m, 22 December 1972 (fl), *Synnott, T.J. 1343* (EA); Budongo forest. 1°44'N 31°33'E. Alt: 1067m, 16 February 1907 (fl, fr), *Bagshawe 1498* (BM); Budongo. 1°39'N 31°35'E, 8 February 1935 (fl), *Taylor-de C, G. 3333* (BM,G); Budongo Forest, near Sonso River about 100 m West of bridge. 1°43'N 31°32'E. Alt: 1050m, 15 February 1999 (fl), *Lye 23478* (K); Budongo Forest, near Sonso River about 100 m West of bridge. 1°43'N 31°32'E. Alt: 1050m, 15 February 1999 (fl), *Lye 23479* (K).

**ZAMBIA, North-Western:** Mwinilunga 10 mls. W of Kakomo. 11°17'S 25°06'E, 28 September 1952 (fl, fr), *Angus 561* (FHO,K,WAG); Mwinilunga 10 mls. W of Kakomo. 11°17'S 25°06'E, 28 September 1952 (fl), *Angus 562* (FHO,K,WAG); Musera river, 10 mls W. of Kakoma. 11°18'S 25°06'E, 28 September 1952 (fl, fr), *Angus 564* (FHO,K); Mwinilunga. 11°45'S 24°26'E, 27 August 1930 (fl), *Milne-Redhead 973* (BR,K); River Lunga. 11°45'S 24°26'E, 5 October 1937 (fl, fr), *Milne-Redhead 2537* (BR,K); Kalene Hill. 11°06'S 24°07'E, 12 December 1963 (fl), *Robinson, E.A. 5962* (K); 12°00'S 24°35'E, 25 August 1955 (fl), *Holmes, W.D.H. H 1199* (K); **Northern:** Lumangwe Falls on Kalunguishi R., 9°33'S 29°22'E, 19 October 1967 (fl), *Simon, B.K. 1131* (K); Lumangwe. 8°50'S 29°56'E, 14 November 1957 (fr), *Fanshawe 4004* (BR,FHO,K).

**Key literature:** Farron (1963, 1967, 1985), Friis & Vollesen (1998), Robson (1963), Verdcourt (2005).

**Campylopermum descoingsii** Farron

**Fig. 6**

Bull. Jard. Bot. État Bruxelles 35: 395 (1965). – Type: *Farron 4021* (holotype: P!, isotype: P(2x)!, IEC), Republic of the Congo, îlot forestier sur le Congo, à hauteur de Moutampa, March 1965.

*Treelet* up to 4 m tall, with branched trunk, twigs with pale brown coloured bark. *Stipules* **persistent**, triangular, 2–7 mm long. *Leaf:* petiole 2–5 mm long; **leaf blade narrowly elliptic to narrowly elliptic-obovate, (9–)12–25(–27) × (3–)4–5(–7) cm**, ratio 3–4, base cuneate to rounded, apex acuminate, **papyraceous, bullate between the lateral veins, margin serrulate to entire**, upper side slightly dull dark green, lower side dull medium green; venation: midrib ± flattened on the upper side, prominent on the lower, **main lateral veins 10–19 on either side, 5–15 mm apart, prominent but sunken in the bullae above, prominent below**, at a more or less right angle with the midrib but curved upwards toward the margin, intermediate lateral veins prominent on both sides, tertiary venation **scalariform, perpendicular to the midrib**, distinct on both sides. *Inflorescence* terminal, composed of **1–3 long racemes sitting close together on the twig, pendulous**; their main axis 11–19 cm long; **pairwise scales at the base of peduncle persistent; bracts persistent, triangular, 1–2 mm long**; cymules 0.3–1 cm apart, 1–5-flowered. *Flower:* pedicel 4–5 mm long, articulated at c. 1 mm from the base; sepals ovate to elliptic, in flower c. 3–4 × 2 mm, in fruit 5 × 3 mm; petals obovate, 5–7 × 2–5 mm, base rounded, apex slightly emarginate; stamens: anthers slender, 3–4 mm long; style 3–4 mm. *Fruit:* receptacle c. 1 mm thick in flower, in fruit 3–4 mm; drupelets **1–2 well developed per receptacle, ellipsoid**, more or less compressed; **cotyledons accumbent, similar in size.**

**Notes:** This species is mainly characterized by its bullate upper leaf surface. It is close to *C. excavatum* by having a distinct tertiary venation. However, it differs by having an unbranched inflorescence composed of 1–3 racemes sitting close together terminal on the twig, whereas *C. excavatum* has a branched inflorescence.

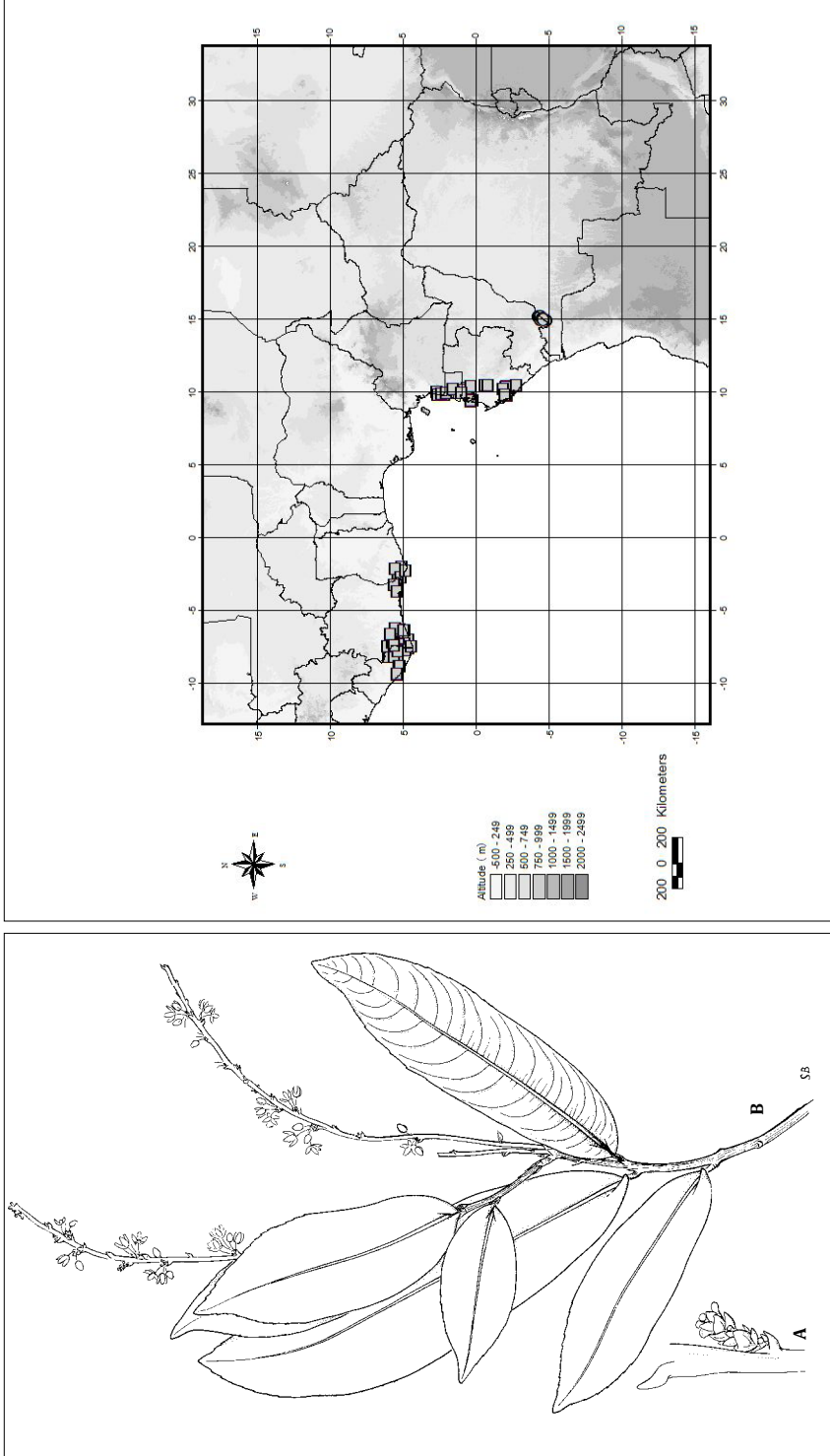
**Distribution:** Republic of the Congo (province of Pool) and Democratic Republic of Congo (province of Bas-Congo) (**Map 8**).

**Ecology:** in high and secondary forest.

**Phenology:** flowering from November to December and in January and March; fruits observed in January, March and May.

**IUCN conservation status:** CE B1/B2 (i,ii). EOO=712 km<sup>2</sup>, AOO=305 km<sup>2</sup>, locations=8, subpopulations=4 (cell width= 7 km). This species is only known from 11 collections, all outside of protected areas. Its last collection dates back to 1968, thus its present occurrence needs to be confirmed. Therefore, the category of Critically Endangered has been assigned.





**Specimens examined:**

**CONGO (BRAZZAVILLE), Pool:** village de Moutampa. 4°31'S 15°02'E, 15 December 1964 (fl), *Bouquet, A. 877* (P); Chutes de Foulakari., 4°35'S 14°58'E, 24 October 1967 (fl), *Sita 1844* (P); Plateau des cataractes, piste Taba-Mandzakala, région de Kinkala, entre Mandzakala et le pont Voula. 4°22'S 14°58'E, 11 October 1968 (fl), *Sita 2661* (BR,P); Plateau des cataractes, piste Taba-Mandzakala, région de Kinkala. 4°22'S 14°58'E, 11 October 1968 (fl), *Sita 2667* (WAG); Moutampa. 4°31'S 15°02'E, 2 March 1965 (fl, fr), *Farron 4021* (BR,P); Station de Pisciculture de Djoumouna, 15 km S.W. Brazzaville. 4°15'S 15°10'E, 15 October 1965 (fl), *Farron 4664* (P); Chutes de Foulakari. 4°35'S 14°58'E, 15 October 1965 (fl), *Farron 4709* (P); Djoumouna. 4°23'S 15°10'E, 5 January 1967 (fl, fr), *Farron 5278* (P); Kimpanzou, près de chutes de la Foulakari., 4°36'S 14°59'E, 15 November 1986 (fl), *Lejoly 86/133* (BRLU).

**CONGO (KINSHASA), Bas-Congo:** Zongo. 4°47'S 14°54'E, February 1954 (fl), *Callens 4520* (BR); **Kinshasa:** Gombe. 4°24'S 15°10'E, 4 October 1946 (fl), *Jans, E. 299* (BR).

**Key literature:** Bamps & Farron (1967), Farron (1963, 1985).

***Campylosperrum duparquetianum* (Baill.) Tiegh.****Fig. 7**

*J. Bot.* (Morot) 16: 43 (1902). – *Gomphia duparquetiana* Baill., *Adansonia* 9: 77 (1868). – *Ouratea duparquetiana* (Baill.) Gilg, *Bot. Jahrb. Syst.* 33: 258 (1904). – Type: *Duparquet 60* (holotype: P!), Gabon, December 1862.

*Ouratea corymbosa* Engl., *Bot. Jahrb. Syst.* 17: 80 (1893). – Type: *Soyaux 40* (holotype: B†; isotypes: K!, P!, Z!), Gabon, Munda, Sibang Farm, 1879.

*Ouratea cameronii* Hutch. & Dalziel, *Fl. W. trop. Afr.*, ed. 1, 1: 193 (1927). – Type: *Burton & Cameron* s.n. (holotype: K!), Ghana, Axim.

*Treelet* up to 8 m tall, **monocaulous** bark dark brown. *Stipules* caducous, triangular, 3–5 mm long. *Leaves* all grouped at the top of the stem; petiole 0–10 mm long; leaf blade **narrowly spatulate to narrowly elliptic-spatulate, 26–49(–58) x 5–12(–17) cm**, ratio **3–5(–6.23)** base broadly cuneate to rounded or slightly cordate, apex acute to slightly acuminate, coriaceous to papery, not to slightly bullate, margin regularly serrate, upper side dark green, glossy, lower side light green, dull; venation: midrib prominent on both sides, main lateral veins 20–30 on either side, 7–35 mm apart, making a slight angle with the midrib and slightly curved upward, prominent but running often through a gully above, prominent below, with 0–2 intermediate lateral veins in between subsequent main ones, tertiary venation **scalariform, running perpendicular to the main lateral veins**, indistinct to slightly distinct above, distinct below. *Inflorescence* **axillary, corymbose**; peduncle cylindrical, **woody**, 2–5(–6) cm long, with many short racemes of up to 1.5 cm long and (4–)20–35 **solitary** flowers, with **2 to 4 leafy bracts in its apical part; pairwise scales 4–8 mm long, persistent** at the base of peduncle; bracts triangular, 1–2 mm long. *Flower*: pedicel **10–50 mm long**, articulated at **4–8 mm** from its base; sepals narrowly ovate, in flower 7–11 x 3 mm, orange green, in fruit 15–20 x 6–8 mm, red; petals obovate, 16–18 x 4–8 mm, **shortly clawed at base, slightly emarginate at apex**; stamens: **anthers 6–7 mm long**; ovary more or less flattened, 2–3 mm long; style c. 7 mm long. *Fruit*: receptacle globose, 5 x 6 mm; drupelets 2–4 well developed per receptacle, **obovoid**, 9–10 x 5–7 mm; cotyledons **incumbent**, more or less **similar in size**.

**Notes:** A very distinct species belonging to a small group of monocaulous species with similarly large and narrowly spatulate to narrowly elliptic-spatulate leaves. However, its short and corymbose inflorescence renders this species very different from the others.

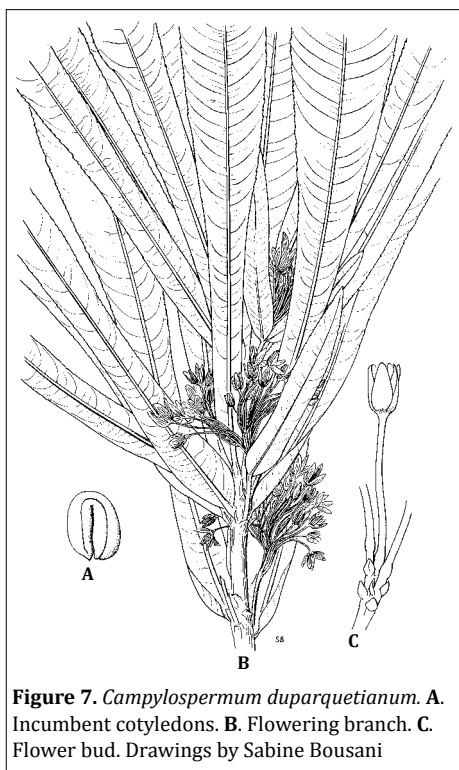
**Distribution:** from Liberia to Ghana and in Cameroon, Equatorial Guinea and Gabon (**Map 8**).

**Ecology:** in primary and secondary rain forest, sometimes in disturbed forest along forestry roads, in dried swamps, and riverine forest; on sandy clay soil; at 10–410 m altitude.

**Phenology:** flowers observed in all months except for August; fruits observed in all months except for the period July to October.

**Uses:** The plant is occasionally planted as an ornamental.

**IUCN conservation status:** LC B1/B2(i,ii). EOO=841,579 km<sup>2</sup>, AOO=512,109 km<sup>2</sup>, locations=75 (cell width= 238 km). A species with a disjunct but fairly wide distribution occurring in National Parks such as Moukalaba-Doudou and Pongara in Gabon, Monte Alen in Equatorial Guinea, Sapo in Liberia, and Taï in Ivory Coast. Therefore, the category of Least Concerned has been designated.



**Figure 7.** *Campylospermum duparquetianum*. A. Incumbent cotyledons. B. Flowering branch. C. Flower bud. Drawings by Sabine Bousani

### **Specimens examined:**

**BURKINA FASO, Houet:** 1963 (fl), *Jaeger, P. 6695* (P).

**CAMEROON, South Province:** Campo-Ma'an area, Bibabimvoto, around the Bongola river. 2°15.5'N 9°52.7'E. Alt: 20m, 29 January 2000 (fr), *Tchouto Mbatchou 2457* (KRIBI,WAG); Campo Ma'an area, Boussebeliga. near Pygmeé doctor's house. 2°43'N 9°52'E. Alt: 40m, 26 October 2001 (fl), *Andel, T.R. van 4230* (WAG); 20 km SE. of Kribi, SE. of Mt. Elephant, W. of route Minière., 2°45'N 10°02'E, 23 July 1970 (st), *Bos, J.J. 7129* (WAG); 45 km S. of Kribi, Campo road., 2°38'N 9°51'E, 26 August 1970 (st), *Bos, J.J. 7297* (BAS,K,P,WAG,YA); Massif des Mamelles. 2°26.7'N 9°54.9'E. Alt: 260m, 19 April 2001 (fl, fr), *Tchouto Mbatchou MMX 47* (WAG).

**EQUATORIAL GUINEA, Rio Muni:** près de la frontière gabonaise, chantier forestier à l'Est de Congo. 1°05'N 10°00'E. Alt: 10m, 2 May 1989 (st), *McPherson, G.D. 13994* (LBV); **Rio Muni, Centro Sur:** région continentale, Monte Alen. 1°40'N 10°17'E, 12 March 1997 (fr), *Ngomo 4* (BRLU); Parc National de Monte Alen, sur la piste du Rio Uolo au transect Ecofac de Mosumo. 1°36.9'N 10°03.4'E. Alt: 200m, 6 February 2001 (fr), *Senterre 53* (BRLU); Parc National de Monte Alen, 200 m du transect Ecofac de Mosumo. 1°35.6'N 10°03.3'E. Alt: 410m, 11 March 2001 (st), *Senterre 827* (BRLU); SO du Parc National de Monte Alen, 2 km au NE du site de traversée du Rio Uolo., 1°37.4'N 10°04.6'E, 17 January 2002 (fr), *Senterre 1936* (BRLU); **Rio Muni, Litoral:** région continentale, Sud ouest de Ayamiken. 2°07'N 10°01'E, 30 April 1997 (fr), *Obama 186* (BRLU); 7 km ENE de Okuankos., 1°06'N 10°11'E, 8 July 1988 (fl), *Wilks 1741* (LBV,WAG); Sendje à Ongamnsok., 1°22'N 9°58'E, 19 February 2001 (fr), *Lejoly 01/5* (BRLU).

**GABON, UNKNOWN:** December 1862 (fl), *Duparquet 60* (P); **Estuaire:** Pointe Owendo. 0°18'N 9°30'E, 6 February 1912 (fl), *Péripet 28* (P); Sibange Farm. 0°25'N 9°30'E, 6 December 1879 (fl, fr), *Soyaux 40* (K);

Mont Bouet. 0°26'N 9°28'E, (fl), *Jolly 115* (P); Libreville. 0°25'N 9°26'E, March 1891 (fr), *Jolly 118* (P,WAG); route Akok-brigade de reboisement de la Mvoum, 9 km. 0°39'N 10°18'E, 19 November 1982 (st), *Louis, A.M. 132* (BR,MO,WAG); c. 7 km E. of M'voun, 24 km NE of Ntoun. 0°33'N 9°52'E. Alt: 60m, 31 October 1983 (fl), *Louis, A.M. 209* (LBV,WAG); Imkoy Bandja, 50 m. 0°24'N 9°34'E, 27 October 1973 (fl), *Bogner 644* (K); 65 km de Libreville, sur la route de Lamboréné, embranchement de route au Nord. 0°25'N 10°25'E, 23 June 1970 (st), *Farron 7488* (P); **Moyen-Ogooué**: 13 km ENE de Belle Vue. 0°35'S 10°30'E, 5 January 1987 (fl, fr), *Dibata 7* (LBV,MO,WAG); Mabounié, forest west of camp. 0°45.07'S 10°31.27'E. Alt: 109m, 13 May 2012 (fr), *Bidault 552* (BRLU,LBV,MO); **Ngounié**: road from Mandji into CBG concession, 20-25 km W of Mandji, Sentier Botanique. 1°46.1'S 10°14.0'E. Alt: 73m, 11 November 2011 (fl, fr), *Maas, P.J.M. 10233* (LBV,WAG); **Nyanga**: concession SFN. 2°40.4'S 10°29.1'E. Alt: 200m, 30 October 2003 (fl), *Valkenburg 2533* (LBV,MO,P,WAG); **Ogooué-Maritime**: Rabi-Kounga, near Rabi 25, behind hectare plot of Jan Wieringa. 1°55.7'S 9°52.5'E. Alt: 30m, 3 December 1993 (fl), *Haegens 91* (WAG); Rabi-Kounga. 1°55'S 9°52'E, 23 November 1991 (fr), *Schoenmaker, J. 194* (WAG); Rabi-E, E of S entrance of Camp Pechaud. 1°56.6'S 9°53.8'E, 7 November 1990 (st), *Nek 233* (BR,MO,WAG); Rabi-Kounga, site 2. 1°55'S 9°52'E, 3 June 2002 (fl), *Bouroubou 688* (LBV); Rabi-Kounga, N of landing strip, in ha-plot. 1°55.7'S 9°52.5'E. Alt: 45m, 1 June 1992 (fr), *Wieringa, J.J. 1085* (LBV,WAG); Rabi-Shell concession, Rabi, N of airport. 1°55.7'S 9°52.4'E. Alt: 56m, 24 January 2010 (fl), *Dauby 2135* (BRLU,LBV,MO); Doudou Mountains National Parc 40 km S of Mandji. 2°00.6'S 10°24.0'E. Alt: 200m, 16 November 2005 (fl, fr), *Josef 2321* (BR,E,HU),K,LBV,MO,WAG); Rabi, N of airstrip, in 1-ha plot. 1°55.7'S 9°52.5'E. Alt: 45m, 12 March 1994 (fr), *Wieringa, J.J. 2452* (LBV,WAG); Ca. 60 km along an exploitation track in a W.N.W. direction from Doussala. 2°12'S 10°11'E. Alt: 200m, 27 November 1986 (fl), *Wilde, J.J.F.E. de 8987* (MO,WAG); 40 km N.N.W. of Doussala. 2°02'S 10°25'E. Alt: 380m, 24 March 1988 (fr), *Wilde, J.J.F.E. de 9549* (MO,WAG); 30 km S of Rabi, along the road to Echira, platform called 'Echira Horizontal'. 2°03'S 9°49'E. Alt: 40m, 26 November 1989 (fl, fr), *Wilde, J.J.F.E. de 9770* (WAG); Rabi-Kounga, Echira road. 2°00'S 9°50'E, 27 October 1991 (fl), *Breteler 10170* (BR,K,LBV,MO,WAG).

**GHANA, Western Region**: 4°52'N 2°14'W, June 1882 (fl), *Burton s.n.* (K); Western. Ankasa, along Ankasa river. 5°13'N 2°39'W. Alt: 50m, 14 March 1996 (fl, fr), *Merello 1430* (MO,UPS); Bawdia, W prov. 5°38'N 2°06'W, December 1933 (fl), *Vigne FH 3154* (FHO); 10 mls S. of Tarkwa 5°10'N 1°59'W, 10 March 1952 (st), *Morton, J.K. GC 6554* (K); Bronikrom, 30 km SSE Samreboi. 5°25'N 2°25' W, 25 May 1977 (fr), *Hall, J.B. GC 46607* (WAG). **IVORY COAST, Abidjan**: Alépé. 5°30'N 3°39'W, 1907 (st), *Chevalier, A.J.B. 17411* (P); **Aboisso**: Ayamé. 5°40'N 3°10'W, 12 May 1965 (fl), *Aké Assi s.n.* (G); **Guiglo**: N'guisankro (Baoulé camp) 8 km S of Zagné, then 11 km on track in direction east to forest. Just S. of border between Forêt classé and Parc National Tai, along LS3-plot between 0 and 1. 6°07'N 7°24'W. Alt: 200m, 3 May 1990 (st), *Albers, P. 74* (WAG); Tai Forest, 20 km SE of Tai, right side of the Audrenisrou. 5°44'N 7°25'W, 21 November 1981 (fl), *Barink 76* (WAG); Relevé 78; Zaipobly, 5°57'N 7°28'W, 6 December 1985 (fl), *Rouw, A. de 122* (WAG); réserve de Tai. 5°50'N 7°10' W. Alt: 150m, 21 September 1986 (fl), *Gautier, L. 387* (G); Tai. 5°52'N 7°27'W, December 1981 (fr), *Stäuble 446* (G); 140 km N of Tabou 25 km S of Tai. 5°42'N 7°20'W, 13 October 1963 (fl), *Wilde, W.J.J.O. de 1070* (WAG); 14 km S of Tai., 5°45'N 7°20'W, 9 March 1962 (fl), *Wilde, J.J.F.E. de 3571* (WAG); de oppido Tienkula; ad orientem per 5-9 km. 6°07'N 7°26'W, 2 March 1962 (st), *Bernardi, L. 8383* (G,K); entre Sakré et Nigré. 5°40'N 7°22'W, 28 December 1987 (fl), *Aké Assi 17851* (G); entre le moyen Sassandra le moyen Cavally. 5°50'N 7°05'W, 1 June 1907 (fl), *Chevalier, A.J.B. 19229* (P); Tai. 5°52'N 7°27'W, 21 November 1981 (fl, fr), *Stäuble 47/ 412* (G); **San-Pédro**: along the road starting 40 km from San Pedro to Grand Béréby. 4°41'N 6°57' W. Alt: 40m, 23 March 1970 (fl), *Koning, J. de 272* (WAG); **Sassandra**: San Pedro, nouvelle piste vers le Nord. 4°56'N 6°17'W, March 1970 (fl), *Bamps 2561* (K,P); 30 km SW of Guéyo. 5°37'N 6°10' W. Alt: 100m, 31 March 1962 (fl), *Leeuwenberg 3797* (B,L,WAG); entre Sassandra et San Pedro. Le long de la route de Soubré, 5 km au N. du carrefour. 5°00'N 6°20'W, 10 April 1970 (fl), *Farron 7028* (P); 48 Km Grabo-Tai road. 5°18'N 6°16'W, 15 April 1974 (fl), *Breteler 7429* (WAG); **Soubré**: near Guiglo rapids in the Sassandra River. 8 km S.S.E. of Subré, west of the Sassandra. 5°39'N 6°40' W, 22 November 1961 (fl), *Wilde, J.J.F.E. de 3287* (WAG); Guideko. 5°57'N 6°35'W, May 1907 (fl), *Chevalier, A.J.B. 16364* (P); **Tabou**: Djiroutou. 5°22'N 7°17'W, 8 April 1986 (fl), *Poilecot 1120* (G); close to Kouadjokro. 4°59.8'N 7°17.9'W. Alt: 150m, 2 May 1999 (fr), *Jongkind 4432* (WAG); FC de la Ht Dodo. 4°58.3'N 7°15.0'W. Alt: 150m, 5 May 1999 (fl), *Jongkind 4523* (MO,WAG); along road via Irputou to Cavally River, 4°41.0'N 7°31.4'W, 8 April 2000 (st), *Jongkind 4981* (WAG); 13 km NW of Tabou. 4°30'N 7°24'W, 12 April 1974 (fl), *Breteler 7384* (WAG).

**LIBERIA, Grand Bassa**: Cestos-Sanguin area, Logging Concession of the Cooper's, Sudan Section. 5°29.9'N 9°22.2'W. Alt: 80m, 6 December 2002 (fl), *Jongkind 5664* (WAG); **Grand Gedeh**: Eastern Province, Putu District. New road from Chiehn (Zwedru Village) to Cape Palmas. About 10 km S. of Kanweake, a small village

c. 70 km S. of Chiehn. 5°25'N 8°04'W, 28 March 1962 (fl), *Wilde, J.J.F.E. de 3681* (WAG); along Zwedru-Harper road, north of Tiama Town. 5°42'N 8°06'W. Alt: 300m, 6 June 2005 (fr), *Jongkind 6648* (WAG); Zwedru. 6°04'N 8°08'W, 3 August 1947 (st), *Baldwin jr 7008* (K); Grebo Forest. 5°24'N 7°44'W. Alt: 200m, 10 December 2005 (fl), *Jongkind 7269* (BR,G,WAG); **Sino**: Sapu NP, buffer zone, near Sinoe River. 5°21'N 8°48' W. Alt: 115m, 23 November 2002 (fl), *Jongkind 5386* (BR,G,WAG); Diebla 4°55'N 7°40'W, 3 July 1947 (st), *Baldwin jr 6292* (K); Jabroke 4°58'N 7°36'W, 12 July 1947 (st), *Baldwin jr 6493* (K); Inside Sapu NP close to cano crossing of Sinoe River. 5°20'N 8°47'W. Alt: 110m, 7 March 2009 (fr), *Jongkind 8853* (WAG); Sapu National Park. 5°20.2'N 8°47.9'W. Alt: 100m, 30 January 2010 (st), *Jongkind 9321* (WAG); Sapu National Park not far from Camp 6. 5°18.3'N 8°44.7'W. Alt: 165m, 22 November 2010 (fl), *Jongkind 9824* (WAG); South-west of Togba Ville. 5°28.4'N 9°15.9'W. Alt: 80m, 29 November 2010 (fl), *Jongkind 9899* (WAG).

**UNKNOWN**: (st), *Chase, M.W. 704* (K).

**Key literature**: Farron (1963, 1985), Hawthorn & Jongkind (2006), Hutchinson, Dalziel & Keay (1954).

### ***Campylospermum dybovskii* Tiegh.**

**Fig. 8**

Ann. Sci. Nat., sér. 8, Bot. 16: 298 (Dec. 1902). – *Ouratea dybovskii* (Tiegh.) Aké Assi, Candollea 55(2): 281 (2000). – Type: *Dybovski 139* (holotype: P!), Gabon, Cap Lopez, February 17<sup>th</sup>, 1894.

*Ouratea gentilii* De Wild., Rev. Zool. Afr., Bot. 7: B53 (1920). – Type: *Gentil 33* (holotype: BR!; isotype: BR(x4)!), Democratic Republic of the Congo, bord des eaux, vallée de la Loange (Lualaba-Kasai), January 5<sup>th</sup>, 1902.

*Ouratea latepaniculata* De Wild., Rev. Zool. Afr., Bot. 7: B56 (1920). – Type: *Laurent 1153* (holotype: BR!), Democratic Republic of the Congo, Eala, July 1<sup>st</sup>, 1905.

*Ouratea malelaensis* De Wild., Pl. Bequaert. 4: 497 (1929). – Lectotype (designated here): *Vermoesen 1312* (holotype: BR!; isotype: K!, S!), Democratic Republic of the Congo, environs de Malela, 1909.

**Tree up to 25 m tall; bole up to 13 cm in diameter, with multiple branches**; twigs with dark coloured bark. **Stipules** caducous, **leaving a conspicuous scar at the base of the petiole**, triangular, c. 7 mm long. **Leaf**: petiole 2–10 mm long, **stout, canaliculate above**; leaf blade **narrowly elliptic to narrowly elliptic-obovate, (11–)16–32(–40) x (3–)5–8(–11) cm, ratio 3–5**, base cuneate to rounded, apex acute to acuminate, coriaceous, not bullate, upper surface green, glossy, lower surface paler green, margin **entire** or shallowly serrulate towards the apex; venation: midrib flattened to slightly prominent above, prominent beneath, **main lateral veins 9–19(–26) on either side, 7–17 mm apart**, not to slightly prominent above, prominent below, more or less at a right angle with the midrib but curved upward to run parallel to the margin, intermediate lateral veins **1 to 2** in between each pair of main laterals, **tertiary venation scalariform**, perpendicular to the main laterals or to the midrib, **indistinct above, distinct below**. **Inflorescence** terminal, **lax**, its main axis 12–30(–40) cm long, **generally in a zig-zag shape; pairwise scales at the base of the peduncle absent**; racemes **2-7, generally held horizontal, 11–19(–27) cm long**, occasionally these branched again; bracts **caducous**, sometimes a reduced leaf present at the base of peduncle, elliptic, 3–6 x

0.5–2 cm; cymules **0.5–3 cm apart, 1–4(–7)-flowered**. *Flower*: pedicel **5–12 mm long**, articulated at 1–4 mm from the base; sepals narrowly ovate to narrowly elliptic, in flower (6–)7–8 x 2–4 mm, in fruit 12–13 x 5–8 mm, base **cuneate**, apex **rounded**, enclosing the drupelets, coriaceous; petals obovate, (8–)12–19 x (5–)6–8 mm, **truncate at base, rounded at apex**; stamens: anthers 5–6 mm long; ovary c. 1–2 mm long; style 4–5 mm long, curved. *Fruit*: receptacle c. 1 mm long in flower, in fruit 4 x 5 mm; drupelets 1–5 well developed per receptacle, broadly reniform, 7–8 x 6–7 mm; cotyledons **accumbent, similar in size**.

**Notes:** This species is very close to *C. calanthum* and *C. densiflorum* (see the note under *C. densiflorum*). Its leaves differ by having a cuneate to rounded base and being narrowly elliptic to narrowly elliptic-obovate. Its main lateral veins are prominent while those of *C. calanthum* are sunken. The racemes are held horizontally whereas in *C. calanthum* they are ascending. However, exceptionally specimens of *C. dybovskii* may be encountered specimens that have a distinctly acuminate apex and marked secondary nerves that are not prominent on the upper side. Furthermore, some show a lax inflorescence with ascending racemes as in *C. calanthum*. Those specimens were formerly assigned to *O. malelaensis* and *O. latepaniculata*, but we follow Farron (1963) in regarding these as being conspecific with *C. dybovskii*.

*Ouratea malelaensis* was originally published with the citation of two syntypes: *Vermoesen 1312* and *1222*. *Vermoesen 1312* has been designated as lectotype of *O. malelaensis* because this specimen is distributed in three herbaria and consists of fruiting material. Both sides of the leaf blade show the venation pattern character that is deemed important for the distinction with related species.

*Campylospermum dybovskii* Tiegh. was originally published as *C. dybowskii* by the French author Van Tieghem who named the plant after the plant collector M. Dybovski but he accidentally misspelled his family name. To be in accordance with the Code of Nomenclature, we regarded *C. dybowskiii* as being an orthographic error and *C. dybovskii* is to be retained (ICBN Melbourne, Art. 60.1).

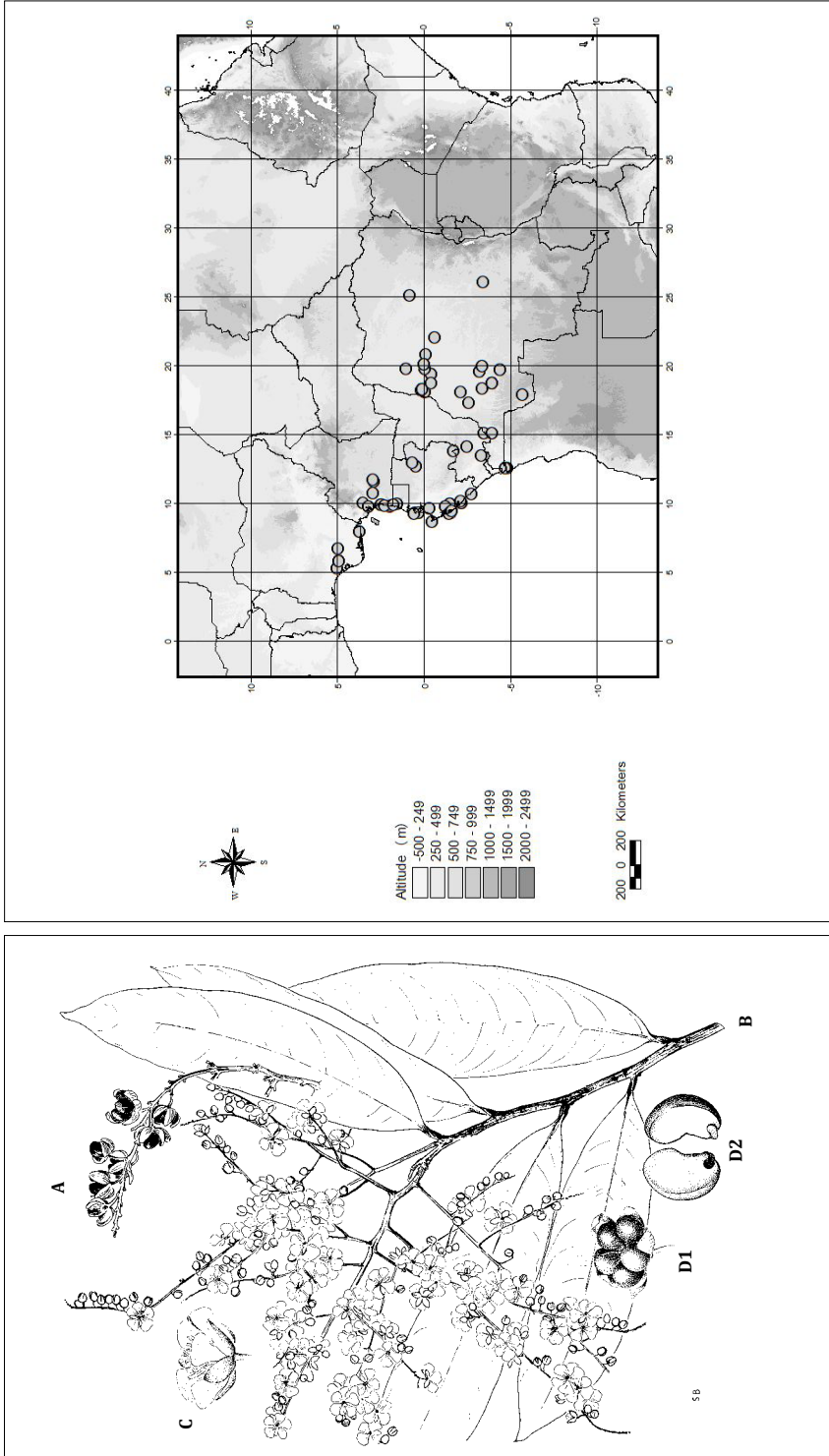
**Distribution:** Nigeria, Cameroon, Equatorial Guinea, Gabon, Republic of the Congo, Democratic Republic of the Congo and Angola (Zaire prov.) (**Map 9**).

**Ecology:** in primary or secondary forest, riverine forest, swampy and flooded forest; on laterite quarry, white and sandy soil; at 5–630 m altitude.

**Phenology:** flowering and fruiting all year round.

**Uses:** Roots are ground with seeds of *Aframomum melegueta* and eaten to remedy impotence (Neuwinger, 2000).

**IUCN conservation status:** LC B1/B2(i,ii,iv). EOO=2,112,090 km<sup>2</sup>, AOO=1,811,660 km<sup>2</sup>, locations=80 (cell width=259 km). This species has a wide distribution and is well represented in herbaria indicating it is not uncommon. Moreover, many of the collecting localities, at least in Gabon, are located inside National Parks (Moukalaba-Doudou,



**Figure 8. *Campylospermum dybovskii*. A. Fruiting branch. B. Flowering branch. C. Flower. Drawings by Sabine Bousani**  
**Map 9. Distribution of *Campylospermum dybovskii***

Loango, Lopé, Pongara, Ivindo, Plateaux Batéké). Thus, the category of Least Concern seems most appropriate.

### **Specimens examined:**

**ANGOLA, Zaire:** Peco, Rivulet, proximum flumen Congo. 6°08'S 12°37'E, 14 December 1921 (fl), *Gossweiler 8647* (K).

**CAMEROON, Central Province:** Subdivision Eseka, dans les chantiers des bois du Cameroun. 3°39'N 10°46'E, 8 June 1955 (fl, fr), *Mbarga 22* (P,WAG,YA); 15-20 km E. of Mbalmayo. 3°33'N 11°37'E. Alt: 630m, 21 July 1961 (st), *Breteler 1629* (BR,K,LISC,M,P,WAG,YA); **Littoral:** à 12 km E de Bonepoupa, près Dibamba. 3°57'N 9°40'E, 31 July 1949 (fr), *Letouzey 1345* (P); 3 km E. of km 21 of road Yabassi-Douala. 4°20'N 10°05'E. Alt: 100m, 17 August 1965 (st), *Leeuwenberg 6410* (BAS,BR,K,MO,P,WAG,YA); 20 km SE of Douala, 2 km NW of ferry on Dibamba R. in road to Ndonga (= old road to Edéa). 3°58'N 9°48'E, 20 August 1965 (st), *Leeuwenberg 6475* (BAS,BR,K,MO,P,PRE,WAG,YA); route de Douala à Yabassi, 30 km N. de la bifurcation pour Edéa. 4°24'N 10°00'E, 12 May 1970 (fl), *Farron 7290* (P); **South Province:** Lolodorf. 3°14'N 10°44'E, 16 June 1918 (fl), *Annet 360* (P); 3km S. of Boussibelika., 2°45'N 9°52'E, 22 December 1980 (fl), *Beentje 1535* (MO,WAG); 10 km N. of Kribi. 3°02'N 9°57'E. Alt: 5m, 10 August 1964 (st), *Wilde, W.J.J.O. de 2915* (BR,P,WAG); 9 km N of Kribi, just inside littoral forest. 3°00'N 9°56'E, 27 December 1968 (fl, fr), *Bos, J.J. 3506* (C,UPS,WAG); Kribi, 9 km sur la route d'Edéa. 3°00'N 9°57'E, 24 April 1970 (st), *Farron 7126* (P); between Campo I and Campo II. 2°23'N 9°50'E, 5 December 1974 (fl), *Wilde, J.J.F.E. de 7804* (BR,EA,K,MA,MO,P,PRE,SRGH,WAG,YA); 15 km along forest exploitation track leading from Ipono to bridge crossing the Bongola River to Dipikar Island. 2°19'N 9°54'E. Alt: 80m, 2 December 1975 (fl), *Wilde, J.J.F.E. de 8694* (BR,EA,K,LG,MA,MO,P,PRE,SRGH,WAG,YA); Vallée de la TOFINI, pres Ubanga 25 km SE de Yaoundé. 3°37'N 11°45'E, 19 June 1972 (fl, fr), *Letouzey 11313* (K,WAG).

**CONGO (BRAZZAVILLE), Bouenza:** Région de Mayoko, chantier Aubeville. 4°16'S 13°33'E, 11 March 1973 (fl), *Sita 3514* (WAG); **Kouilou:** Dimonika derrière la case de l'ORSTOM. 4°14'S 12°26'E, 30 April 1983 (fr), *Moutsamboté 1797* (P); environ N'Tiétié, à 13 km du village vers N'Gongo. 3°55'S 11°30'E, 9 December 1974 (fl), *Sita 3815* (P); **Lékoumou:** piste de Brazzaville, village d'Oboté, near Zanaga. 2°54'S 13°52'E, 16 October 1965 (fl), *Bouquet, A. 1821* (P); **Pool:** Région de Kindamba, environs de Kikouimba sur piste de Mâ- Kinzona à 1 km de Mâ. 3°14'S 14°10'E, 4 December 1971 (fl), *Sita 3168* (WAG); Plateau Batéké, à 3 km du camp du Km 45. 4°04'S 15°29'E, 21 September 1963 (st), *Trochain 12266* (P).

**CONGO (KINSHASA), Bandundu:** Bienge. 5°37'S 19°46'E, October 1907 (fr), *Sapin s.n.* (BM,S); Kutu. 2°44'S 18°08'E, 31 October 1903 (fl), *Laurent, É. s.n.* (BR); Bienge. 5°37'S 19°46'E, October 1907 (fl), *Sapin s.n.* (BR); environ de Madibi. 4°18'S 18°24'E, 1907 (fl), *Sapin s.n.* (BR); Kikwit. 5°02'S 18°49'E, January 1914 (fl), *Vanderyst 3056* (BR); Kikwit. 5°02'S 18°49'E, January 1914 (fl, fr), *Vanderyst 3104* (BR); Bandundu. 3°18'S 17°21'E, December 1914 (fl), *Vanderyst 5136* (BR); Kikwit. 5°02'S 18°49'E, March 1921 (fl), *Vanderyst 9127* (BR); Kikwit. 5°02'S 18°49'E, March 1921 (fl), *Vanderyst 9131* (BR); Ipamou. 4°07'S 19°37'E, April 1921 (fl, fr), *Vanderyst 9232* (BR); entre Eala et Kikwit. 5°02'S 18°49'E, July 1921 (fl), *Vanderyst 9728* (BR); Ipamou. 4°07'S 19°37'E, (fl), *Vanderyst 12792* (BR); Panzi-Manzengale. 7°13'S 17°58'E, 1925 (fl), *Vanderyst 17322* (BR); **Bas-Congo:** Malela, Biluku. 5°59'S 12°37'E, February 1913 (fr), *Verschueren, R.C.M. 351* (BR); 5°59'S 12°37'E, 5 January 1919 (fr), *Verwoesen 1312* (K,S); Kisantu, Boko Ngufu. 5°02'S 15°10'E, December 1949 (fl), *Callens 2137* (BR); **Equateur:** Eala. 0°03'N 18°19'E, 1 July 1905 (fl), *Laurent, M.D.J. s.n.* (BR,K); 0°03'N 18°19'E, 1 July 1905 (fl), *Laurent, M.D.J. 2* (Z); Lifumba (Basankusu). 0°04'S 19°12'E, 12 September 1912 (fl, fr), *Mengé 12* (BR); Eala. 0°03'N 18°19'E, 25 September 1935 (st), *Louis, J.L.P. 161* (BR,K); Boyera (Ingende). 0°38'S 19°25'E, November 1933 (fl), *Dubois, L. 189* (EA,WAG); Boyera. 0°38'S 19°25'E, November 1933 (fl), *Dubois, J. 189* (BR,K); Busanga. 0°51'S 22°04'E, March 1953 (fl), *Gorbatoff 193* (BR); Eala, sur la rive droit du Ruki. 0°03'N 18°19'E, 23 July 1946 (fl), *Léonard, J.J.G. 215* (BR,EA,FHO,G,K,UPS,US,WAG); Boende. 0°13'S 20°52'E, December 1933 (fl), *Dubois, L. 342* (K,WAG); Eala. 0°03'N 18°19'E, 4 October 1937 (fl, fr), *Coûteaux, G. 354* (K,WAG); Eale, rive droite de la Ruki. 0°03'N 18°19'E, 10 September 1946 (fr), *Léonard, J.J.G. 559* (K,WAG); Eala. 0°03'N 18°19'E, July 1930 (fl, fr), *Lebrun 674* (BR,P); Rive Lua-Lusangania. 0°04'N 19°21'E, September 1937 (fr), *Dubois, L. 806* (BR); Bokote. 0°06'S 20°08'E, (fl), *Hulstaert 830* (BR); Maringa (Basankusu). 1°13'N 19°49'E, August 1938 (fr), *Dubois, L. 949* (BR,K,WAG); Eala. 0°03'N 18°19'E, 1 July 1905 (fl), *Laurent, M.D.J. 1153* (BR); Bokote. 0°06'S 20°08'E, 1943 (fr), *Hulstaert 1211* (BR,K); Eala, Coquilhatville. 0°03'N 18°19'E, 24 June 1933 (fl), *Corbisier-Baland 1731* (WAG); Eala. 0°03'N 18°19'E, 24 June 1933 (fl), *Baland 1731* (BR,K); En face d'Eale, rive du Ruki. 0°03'N 18°19'E. Alt: 300m, 12 January 1944 (fr), *Germain, R.G.A. 1879* (K,WAG); en face d'Eala, rive droite du Ruki. 0°03'N 18°19'E. Alt: 330m, 12 January 1944 (fr), *Evrard, C.M. 1879* (BR); en face d'Eala, rive droite de la Ruki. 0°05'N 18°16'E. Alt: 410m, 17 May 1936 (fl), *Louis, J.L.P. 1928* (BM,C,EA);



Eala, rive droit du Ruki. 0°03'N 18°19'E. Alt: 470m, 21 May 1936 (fl), *Louis, J.L.P. 1981* (BM, BR, K, P); Ikengo. 0°08'S 18°08'E, 18 March 1958 (fr), *Evrard, C.M. 3687* (BR, K); Rivière Salonga, rive gauche. 3 km en amont de la Yenge. 0°10'S 19°50'E, 4 August 1958 (fr), *Evrard, C.M. 4480* (BR, K); Bakatola. 0°38'S 18°46'E, June 1925 (fl), *Goossens, V.G. 6177* (BR); **Kasai-Occidental**: Loange. 4°18'S 20°02'E, 5 January 1902 (fl), *Gentil 33* (BR); **Kinshasa**: Ngombe-plage. 4°24'S 15°11'E, 29 March 1967 (fl, fr), *Breyne, H. 360* (WAG); Maluku, route Bita-Kingankati Km 5. 4°03'S 15°33'E, 10 November 1970 (fl), *Breyne, H. 962* (BR); Maluku, mare Funu (Pt Bateke). 4°03'S 15°33'E, 16 September 1976 (fl), *Breyne, H. 3064* (BR); **Maniema**: environ Malela. 4°22'S 26°08'E, 26 December 1918 (fr), *Vermoesen 1222* (BR); **Orientale**: Bengamisa Km 22. 0°56'N 25°09'E, June 1937 (fr), *Gilbert, G.C.C. 70* (C, K); Yangambi, près de la rivière Lusambila. 0°46'N 24°28'E, 20 February 1961 (fl, fr), *Yafunga 100* (BR); Mobwasa. 2°40'N 23°11'E, 15 May 1913 (fl), *Lemaire, H. 191* (BR); Yambuya. 1°16'N 24°33'E, 2 March 1906 (fr), *Laurent, M.D.J. 1468* (BR).

**EQUATORIAL GUINEA, Rio Muni, Litoral**: región Continental. Conisio. Distrito de Kogo. 0°55'N 9°19'E, 1999 (fl), *Obama 741* (BRLU); Bata-Pembe: Eyang Mbaha. Estrada kms 33-34. 1°53'N 10°01'E, 28 February 1992 (fr), *Carvalho, M.F. de 5031* (MA, WAG); Bata-Pembe: Pradera de Pembe. 2°06'N 9°57'E, 8 July 1994 (fl), *Carvalho, M.F. de 5587* (MA, WAG).

**GABON, Estuaire**: 0°37'N 9°20'E, 27 April 1935 (fr), *Klein, H. 41* (B, K, P); Parc National de la Pongara. Pointe Ouingombé, près du camp de Gabon Environnement. 0°19.8'N 9°19.3'E. Alt: 10m, 23 December 2006 (fl), *Dauby 73* (BRLU, LBV); Pointe Denis/Pongara/Ovingombé, 5m, 0°20'N 9°21'E. Alt: 5m, 18 December 1999 (fl), *Simons, E.L.A.N. 410* (LBV, WAG); Pointe Denis/Pongara/Ovingombé, 5m, 0°20'N 9°21'E. Alt: 5m, 20 December 1999 (fl, fr), *Simons, E.L.A.N. 482* (LBV, WAG); Parc National Pongara, Pointe Pongara. 0°20.8'N 9°21.2'E, 17 December 2012 (fl, fr), *Simons, E.L.A.N. 1062* (BR, K, LBV, MO, WAG); Forêt Classée de la Mondah, à l'est de la route Libreville-Cap Estérias (piste entre la savane incluse et le marécage à *Stipularia*). 0°34.65'N 9°20.97'E, 5 March 2011 (fl), *Lachenaud 1182* (LBV, MO); Mbangtang, rive droite de l'Igombin, Parc National de la Pongara. 0°03.13'N 9°36.63'E, 8 March 2011 (st), *Lachenaud 1227* (LBV, MO); About 20 km N of Libreville. 0°35'N 9°22'E, 29 January 1987 (fl), *Reitsma, J.M. 2886* (WAG); **Haut-Ogooué**: Parc National des Plateaux Batéké. Ouest du Bai Jobo sur une piste de chasseur. 2°13.77'S 13°50.63'E, 8 June 2005 (st), *Niangadouma 584* (MO); **Moyen-Ogooué**: Eastern part of the Presidential Reserve Wonga-Wongué 100 km S of Libreville. 0°30'S 9°40'E. Alt: 130m, 28 February 1983 (fr), *Wilde (WALK-B) 810* (BR, LBV, MO, WAG); Département Ogooué-et-des-Lacs, Lake Oguemoué. 1°03.92'S 10°02.92'E, 16 November 2012 (fr), *Quiroz-Villarreal 1923* (WAG); **Nyanga**: mayumba peninsular 15 km S of Maynumba town, the surf of the ocean within hearing distance. 3°30'S 10°44'E. Alt: 5m, 18 February 1983 (fr), *Wilde (WALK-B) 649* (BR, C, LBV, MO, P, WAG); **Ogooué-Ivindo**: M'passa. 0°30'N 12°45'E, 23 March 1977 (st), *Florence 80* (P); M'passa. 0°30'N 12°45'E, 19 May 1977 (st), *Florence 294* (P); lower Zadié river. 0°46'N 13°00'E, 8 September 1990 (fl, fr), *Minkébé Series W 523* (WAG); **Ogooué-Maritime**: Cap Lopez. 0°46'S 8°47'E, July 1902 (fr), *Chevalier, A.J.B. s.n.* (P); Parc National Loango. 1°57.40'S 9°20.50'E, 11 March 2004 (fl), *Mouandza Mbembo 16* (BR, K, LBV, MO, P, WAG); Cap Lopez. 0°41'S 8°44'E, 21 February 1894 (st), *Dybowski 139* (P); Gamba, 3 km W of Vembo. 2°43.4'S 10°12.2'E. Alt: 5m, 21 December 1995 (fl), *Bergens 185* (LBV, MO, PRE, WAG); Gamba-E, road from Gamba airport to the north, new laterite road direction 'plaines'. 2°47.5'S 10°03.7'E, 11 November 1990 (st), *Nek 261* (BR, LBV, MO, WAG); Rabi-Kounga. East of Divangui. 1°57'S 10°00'E, 30 January 1992 (fl), *Schoenmaker, J. 375* (BR, E, K, LBV, MO, WAG); Rabi-Kounga, N of Checkpoint EST. 1°57'S 10°00'E, 19 February 1992 (fr), *Schoenmaker, J. 396* (BR, K, LBV, MO, WAG); Near Lac Bavinga. 1°39'S 9°51'E, 1 July 1992 (st), *Wilks 2592* (MO, WAG); Loango National Park, Nick's camp, by Louri lagoon 12 km south of Iguela. 2°00.6'S 9°23.2'E. Alt: 10m, 30 April 2005 (st), *Harris, D.J. 8250* (E, IG, LBV, WAG); Loango National Park, Nick's camp, by Louri lagoon 12 km south of Iguela. 2°00.6'S 9°23.2'E. Alt: 10m, 1 May 2005 (st), *Harris, D.J. 8281* (E, LBV); Loango National Park, Nick's camp, by Louri lagoon 12 km south of Iguela. 2°00'S 9°23'E. Alt: 10m, 3 May 2005 (st), *Harris, D.J. 8350* (E, LBV); Loango National Park 1 km west of Iguela Lodge. 1°55'S 9°18'E. Alt: 15m, 4 May 2005 (st), *Harris, D.J. 8361* (E, LBV, WAG); Loango National Park, Tassisud. 2°07.0'S 9°28.8'E. Alt: 10m, 20 May 2005 (fr), *Harris, D.J. 8743* (E, LBV, WAG); 3.6 km SE of Gamba airport, along road to Vera. 2°48.0'S 10°04.4'E, 2 December 1994 (fl), *Wilde, J.J.F.E. de 11278* (BRLU, LBV, MO, WAG).

**IVORY COAST, UNKNOWN**: not mentioned but probably Ivory Coast. 12 February 1957 (fr), *Aubréville, A. 1957/106* (P).

**NIGERIA, Akwa-Ibom State**: Ibeno, on the path from Ibeno to the Western Boundary of Stubbs Creek F.R. 4°34'N 7°59'E, 12 May 1953 (fl), *Onochie FHI 32094* (K); **Edo State**: Asaba, central division, South province. 6°11'N 6°45'E, 6 August 1906 (fl), *Leslie, J.C. 31* (K); Sapoba, 6°06'N 5°53'E, (fr), *Kennedy, J.D. 213* (FHO); side of Jamieson River, near Sapoba. 6°06'N 5°53'E, 13 November 1949 (fr), *Meikle 550* (K, P); Sapado, Jamieson River. 6°06'N 5°53'E, (fl), *Kennedy, J.D. 1687* (FHO); Sapoba, SE of Benin, by R. jamieson. 6°06'N 5°53'E, 13 July

1971 (fr), Lowe, J. 2269 (K); Sapado, Jamieson River. 6°06'N 5°53'E, (fl), Kennedy, J.D. 2789 (FHO); Sapado, Jamieson River. 6°06'N 5°53'E, (fl), Kennedy, J.D. 2823 (FHO); Okomu forest reserve. Nikrowa creek, O.F.R. 6°14'N 5°21'E, 28 February 1948 (fl, fr), Brenan 9187 (FHO,K); Sapoba, Jameson River between the forestry station and the UAC. Timber beach. 6°06'N 5°53'E, 8 June 1947 (fl, fr), Onochie FHI 23314 (K).

**Key literature:** Bamps & Farron (1967), Farron (1963, 1985).

**Campylosperrum elongatum** (Oliv.) Tiegh.

**Fig. 9**

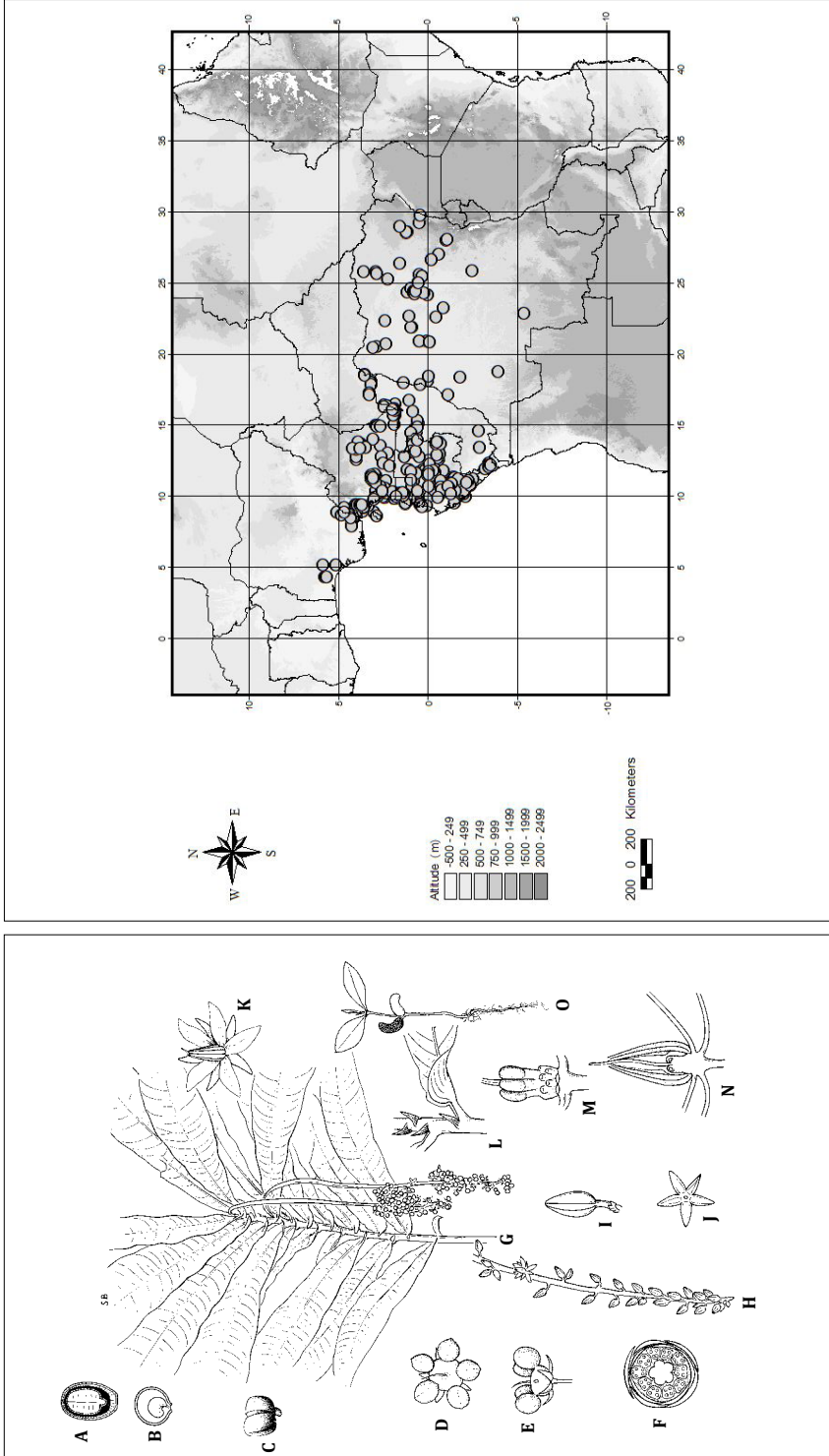
J. Bot. (Morot) 16: 43 (Febr. 1902). – *Gomphia elongata* Oliv., Fl. trop. Afr. 1: 321 (1868). – *Ouratea elongata* (Oliv.) Engl. ex Gilg in Engl. & Prantl, Nat. Pflanzenfam., ed. 1, III, 6: 142 (Febr. 1893). – *Spongopyrena elongata* (Oliv.) Tiegh., Bull. Mus. Hist. Nat. (Paris) 8: 216 (Apr. 1902). – Type: Mann 77 (holotype: K!; isotype: E!), Equatorial Guinea, Ile Fernando-Po, 1859.

*Spongopyrena cyanescens* Tiegh., J. Bot. (Morot) 16: 201 (June 1902). – Type: *Soyaux 179* (holotype: P!; isotype: K!, Z!), Gabon, Sibange-Farm, territoire de Munda, January 1881.

*Spongopyrena reniformis* Tiegh., Ann. Sci. Nat. sér. 8, Bot. 16: 319 (1902). – Type: Zenker 975 (holotype: P!; isotype: BM!, G!, K!, S!, WAG!), Cameroon, Bipindi, 1896.

*Treelet*, up to 7 m tall, **monocaulous or rarely sparingly branched at the top**; bark brown. *Stipules* persistent, triangular, 8–10 mm long. *Leaves* clustered at the apex of the stem; petiole 5–8 mm long, **stout**; leaf blade **narrowly elliptic to narrowly obovate**, 18–61 x 4–15 cm, ratio **4–5(–7)**, base slightly cordate or sometimes rounded, apex acute to acuminate, papery to coriaceous, not bullate, margin **distantly serrulate, teeth with a dark tip**, upper side glossy dark green, lower side paler, fairly dull; venation: midrib flat and sunken on upper surface, **angular on the lower**, main lateral veins **20–35** on either side, **7–20(–30) mm apart**, slightly sunken on upper side, prominent on lower side, more or less at a right angle to the midrib but curved up towards the margin, intermediate lateral veins 1–3 in between each pair of main lateral, tertiary venation **scalariform, running more or less perpendicular to the main lateral veins**, distinct on both sides. *Inflorescence* **axillary, unbranched, fairly lax, pendant**, its main axis **distinctly flattened, 23–60(–83) cm long, 4–5 mm wide, without leafy bracts**, the part bearing flowers (5–)8–25 cm long; pairwise scales at the base of the peduncle persistent, **triangular, 6–11 mm long**; cymules 0.3–2.2 cm apart, 1–3(–6)-flowered; bracts tiny. *Flower*: pedicel 5–10 mm long, articulated at c. 1 mm from its base; sepals ovate to triangular, in flower 7–9 x 2–4 mm and green, in fruit up to 8–10 x 3–5 mm and red; petals elliptic, 7–9 x 3 mm, base cuneate, **apex acute**; stamens: anthers 5–7 mm long; ovary 2 mm high; style c. 6 mm long. *Fruit*: receptacle **up to 10(–12) mm wide**; drupelets 3–5 well developed per receptacle, **broadly reniform to almost globose**, 8–10 x 6–10 mm; **cotyledons accumbent, similar in size**.

**Notes:** A species easily recognized by its remarkably long and flattened peduncle. One specimen shows cymules elongated into short racemes, which is regarded as a rare mutation.



**Figure 9.** *Campylosperrum elongatum*. A. Seed, longitudinal section. B. Seed, cross section. C. Accumbent cotyledons. D. Receptacle in fruit, top view. E. Receptacle in fruit, side view. F. Receptacle diagram. G. Flowering branch. H. Inflorescence. I. Flower bud. J. Sepals top view. K. Flower. L. Stipules. M. Stamens. N. Ovary and style. O. Young plant. Drawings by Sabine Bousani

**Map 10.** Distribution of *Campylosperrum elongatum*

**Distribution:** from Nigeria to Cameroon, southern Central African Republic, Equatorial Guinea, Gabon, Republic of the Congo, Angola (Cabinda) and the Democratic Republic of the Congo (**Map 10**).

**Ecology:** in primary and secondary forest, also in riverine or seasonally flooded rain forest; on sandy soil with humus; at 5–1150 m altitude.

**Phenology:** flowering and fruiting all year round.

**Vernacular names: Democratic Republic of the Congo:** Abé moro (Fang), Bololondgi (Lomongo), Edaka masese (Bila), Egbwapu/Bengia (Babua/Azandé), I Mbasa (Bakota), Kabesebese (Kinande), Kikusu (Dondolondo), Lengbalangwe Penza (Babua), Lifofa (Turumbu), Ndakamasese (Bila d'Epulu), Ngabi (Mitsogho), Ilili Bo Kikereke, Gole, Gwanga, Mondondolindo.

**IUCN conservation status:** LC. EOO=2,654,780 km<sup>2</sup>, AOO=2,803,160 km<sup>2</sup>, locations=289 (cell width=291 km). A species widespread and fairly common in Central Africa. Therefore, the status of Least Concern seems most appropriate.

**Specimens examined:**

**CAMEROON, Central Province:** Yaounde station. 3°52'N 11°31'E, 1894 (fl), *Zenker; Staudt 134* (K); near Ndanan 2. 3°37'N 11°34'E. Alt: 700m, 22 March 2004 (fr), *Darbyshire, I.A. 200* (K,SCA,WAG,YA); près de la mission de Ouassa. 4°54'N 12°36'E, 16 February 1959 (fr), *Letouzey 1415* (P); 9 km SW. of Yaoundé, N. of road to Makak, Etoug Ebé, path to Eloumden. 3°50'N 11°28'E. Alt: 750m, 18 July 1961 (st), *Breteler 1598* (WAG); Essong. 4°53'N 12°49'E, 6 May 1952 (fr), *Letouzey 1852* (P); Makak. 3°33'N 11°02'E, October 1938 (st), *Jacques-Félix 2258* (P); Near the village of Lobo 50 km NW of Yaoundé. 3°54'N 11°14'E. Alt: 500m, 30 March 1964 (st), *Wilde, W.J.J.O. de 2264* (P,WAG); 70 km SW. of Eseka. Along the Njong river 15 km SW. of the new bridge. 3°32'N 10°25'E. Alt: 200m, 15 July 1964 (st), *Wilde, W.J.J.O. de 2821* (WAG); Mbalmayo, N of Yaoundé. 3°31'N 11°30'E, 13 December 1957 (fr), *Wit, H.C.D. de 7186* (WAG); 25 km S. of Yaoundé. 3°40'N 11°31'E, 12 December 1957 (fr), *Wit, H.C.D. de 7187* (WAG); Yaounde, colline du Mont Kala. 3°51'N 11°22'E. Alt: 900-1150m, 4 April 1970 (fr), *Farron 7223* (P); Ototomo Reserve, à 40 km de Yaoundé sur la route de Kribi. 3°40'N 11°20'E, 5 May 1970 (fr), *Farron 7254* (P); Yaounde, à environ 40 km au SW sur la route de Makak. 3°44'N 11°20'E, 26 May 1970 (fr), *Farron 7349* (P); Vicinity of Ndanan I, Forest path immediately NE. 3°37.55'N 11°34.82'E. Alt: 700m, 12 October 2002 (fr), *Cheek 11014* (K,WAG); **East Province:** Bouamir et environs. 3°11'N 12°48'E, 3 September 2001 (fr), *Nguembou Kamgang 88* (P,YA); Precp. 1400mm. 2°20'N 16°09'E. Alt: 350m, 17 January 1988 (fl, fr), *Harris, D.J. 143* (K,MO,P); environs de Bertoua près de Deng Deng. 4°39'N 13°25'E, 19 December 1955 (fr), *Nana, P. 389* (P); Bertoua, 6 km along road to Batouri, junction of road to Bétaré Oya. 4°35'N 13°44'E. Alt: 670m, 17 December 1960 (st), *Breteler 854* (P,WAG,YA); 30km NW of Moloundou. 2°15'N 15°05'E. Alt: 440m, 8 December 1982 (fr), *Kruif, A.P.M. de 889* (WAG,YA); Along Sanaga river S. of Goyoum, 20 km W. of Deng-Deng. 5°12'N 13°23'E. Alt: 635m, 27 January 1961 (st), *Breteler 936* (P,WAG); Doumé. 4°14'N 13°28'E, 1 May 1907 (fr), *Hédin, L. 1019* (P); 14 km S. of Yokadouma, road to Moloundou. 3°25'N 15°00'E. Alt: 540m, 22 June 1961 (st), *Breteler 1545* (WAG); Dzanga-Sangha Reserve. 45 km South of Lidjombo, NDAKAN gorilla study area. Precp. 1400 m. 2°21'N 16°10'E. Alt: 350m, 6 November 1988 (fl, fr), *Harris, D.J. 1556* (K,MO); Sud Dimako, rive droite de la rivière Mbonda. (Bertoua). 4°14'N 13°27'E, 18 January 1960 (fr), *Letouzey 2673* (P); Poute, Bertoua. 4°56'N 13°19'E, 1 February 1960 (fl), *Letouzey 2891* (P); près de Goyoum. 5°12'N 13°23'E, 31 January 1961 (fl), *Letouzey 3338* (P); 15 km au SSW de Koso, village situé à 60 km au SSW de Batouri. 3°46'N 14°05'E, 26 July 1963 (fr), *Letouzey 5499* (P); Km. 29 of road Bertoua-Bétaré Oya. Near Gounté. 4°45'N 13°50'E. Alt: 750m, 9 June 1965 (st), *Leeuwenberg 5809* (WAG); Djembe road head, 300 m south of camp, edge of Sangha. 2°12'N 16°05'E, 17 October 1998 (st), *Harris, D.J. 5935* (E); Lac Lobeke Reserve 40 km west of Djembe. 2°09'N 15°44'E, 18 October 1998 (fr), *Harris, D.J. 5973* (E,MO,WAG); 7 km W. of Yokadouma, along path to Lomié. 3°31'N 15°00'E. Alt: 550m, 13 July 1965 (st), *Leeuwenberg 6071* (WAG); Lobeke Reserve. Small Bai. 2°17'N 15°43'E, 1 November 1998 (st), *Harris, D.J. 6113* (E); 18 km W. of Yokadouma, 6 km W. of Mbol. 3°30'N 14°57'E. Alt: 550m, 17 July 1965 (st), *Leeuwenberg 6175* (BAS,P,WAG); Lobeke Reserve. Surroundings of Djangi Bai. 2°19'N 15°46'E, 5 November 1998 (fl), *Harris, D.J. 6233*

(E,MO,WAG); 5 km N. of Lomié, near Bingongol. 3°12'N 13°38'E. Alt: 650m, 11 September 1965 (st), *Leeuwenberg 6634* (WAG); Rive de la Boumba à 40 km SSW Yokadouma, près Nouveau Ngato-Madjwé. 3°15'N 14°58'E, 18 March 1981 (fl), *Meijer, W. 15177* (WAG); **Littoral**: Forstexpedition. 3°44'N 11°10'E, 1908 (fr), *Büsgen 135* (B); Pongo-Sonho (Mouanko). 3°37'N 9°56'E, 8 January 1974 (fl, fr), *Mezili 240* (K); Pongo-Songo (Mouanko) Edea. 3°39'N 9°49'E, 8 January 1974 (fl), *Letouzey 240* (P); **North Province**: Relict forest near Kumba. 4°36'N 9°26'E. Alt: 150m, 17 February 1985 (fr), *Thomas, D.W. 4392* (MO); **South Province**: Bipindi. 3°05'N 10°25'E, 1902 (fl), *Zenker s.n.* (MA); Bipindi Urwaldgebiet. 3°05'N 10°25'E, (fl), *Zenker s.n.* (FHO,G); 15 km S Lolodorf, 6 km NE Ebom (plot I2-azobé 48). 3°06.2'N 10°43.7'E. Alt: 400m, 19 September 1995 (fr), *Winter, A.J. de 29* (WAG); Mbouma et environs. 2°44'N 13°04'E, 31 July 2001 (fr), *Nguembou Kamgang 73* (YA); environs d'Oveng, 8 km W. de Nyabessan. 2°24'N 10°21'E, 27 November 1982 (fr), *Nkongmeneck 368* (P); Lolodorf. 3°14'N 10°43'E, (fr), *Staudt 730* (BM,COI,COI,K,S,Z); 3°05'N 10°25'E, 1896 (fl), *Zenker 975* (BM,G,K,S,W,WAG,Z); c. 50km E of Campo, in Reserve de Faune de Campo. 2°22'N 10°09'E. Alt: 500m, 12 January 1983 (fl), *Kruif, A.P.M. de 1086* (WAG,YA); route Kribi-Bipindi, PK7.3 avant Bipindi. 3°04.13'N 10°20.45'E. Alt: 97m, 30 March 2010 (fr), *Bissiengou 1243* (LBV,WAG,YA); Campo Ma'an area, Melen. 2°19.4'N 10°20.5'E. Alt: 320m, 24 June 2002 (fl), *Elad 1594* (KRIBI,SCA,WAG); Bitye, near the River Ja. 3°01'N 12°22'E, 4 April 1921 (st), *Bates, G.L. 1830* (K); C. 15 km South of Ebolowa. 2°50'N 11°10'E, 28 February 1964 (st), *Wilde, W.J.J.O. de 1978* (WAG); Urwaldgebiet. 3°05'N 10°25'E, 1899 (fr), *Zenker 1979* (BM,E,G,K); Campo-Ma'an area, Mabiogo, Dipikar Island. 2°15.7'N 9°52.6'E. Alt: 20m, 28 January 2000 (fl, fr), *Tchouto Mbatchou 2390* (KRIBI,WAG); Urwaldgebiet. 3°05'N 10°25'E, 1904 (fl), *Zenker 3168* (BM,COI,E,G,K,LY,MA,S,W,Z); 7.5 km from Kribi, 2 km N of Ebolowa road 2°54'N 9°57'E, 26 November 1968 (fl, fr), *Bos, J.J. 3389* (WAG); Bipindi, Bipindihof, Zenker Gardens. Pipeline route, across road to Ebom and Akom II. 3°04'N 10°24'E. Alt: 35m, 7 June 2001 (fl), *Andel, T.R. van 3513* (KRIBI,SCA,WAG,YA); Bipindi, Bipindihof, Zenker Gardens, Nkol Mabimbi, 3°04'N 10°24'E, 8 June 2001 (fr), *Andel, T.R. van 3532* (KRIBI,SCA,WAG,YA); Campo Ma'an area, road Nko Elon-Mvini. Akok-Beryat Rock. 2°23.9'N 10°04.3'E. Alt: 135m, 12 June 2001 (fl), *Andel, T.R. van 3615* (KRIBI,WAG,YA); Bipindi, Urwaldgebiet. 3°05'N 10°25'E, 1908 (st), *Zenker 3672* (BM,G,K,US,Z); Bipindi, Urwaldgebiet. 3°05'N 10°25'E, 1909 (fr), *Zenker 3864* (BM,K,US); 28 km from Kribi, Lolodorf road. 3°02'N 10°07'E, 8 April 1969 (st), *Bos, J.J. 4297* (BAS,P,WAG,YA); Ngusi, rive mungo. 3°00'N 10°00'E, 26 January 1986 (fr), *Breyne, H. 5056* (BR); 36 km N. of Kribi, Edea road, Lokoundjé river at Ebéa falls. 3°11'N 10°02'E, 30 December 1969 (st), *Bos, J.J. 6020* (BAS,WAG); 7 km from Kribi, Ebolowa road, few km N. of road. 2°55'N 9°58'E, 17 March 1970 (st), *Bos, J.J. 6576* (WAG); 65 km au NE de Kribi. 3°04'N 10°24'E, 27 April 1970 (fr), *Farron 7172* (P); 7.5 km from Kribi, few km N. of Ebolowa road. 2°56'N 9°57'E, 24 August 1970 (st), *Bos, J.J. 7262* (WAG); Station du Cacaoyer de N'koemvone, S. of Ebolowa, 14 km on the road to Ambam. Along the Seng river. 2°49'N 11°08'E. Alt: 470m, 8 April 1975 (st), *Wilde, J.J.F.E. de 8151* (WAG); Mebemonko (20 km NO d'Oveng). 2°33'N 12°10'E, 24 October 1966 (fr), *Letouzey 8172* (P); 30 km SE of Bipindi. 2°55'N 10°35'E, 26 February 1993 (fr), *Breteler 12019* (WAG); Campo Region. Dipikar island. 2°14.0'N 9°53.0'E. Alt: 5m, 10 December 1998 (st), *Wilde, J.J.F.E. de 12126* (WAG); Campo Reserve. Near the village Ebianemeyong, not very far from the Ntem River. 2°24.3'N 10°21.4'E. Alt: 400m, 11 December 1998 (st), *Wilde, J.J.F.E. de 12143* (WAG); près Ndogtina Nyong, 15 km NE de l'embouchure Nyong. 3°23'N 10°00'E, 3 February 1974 (fr), *Letouzey 12870* (P); **South-West Province**: R.F. d'Ejagham, environ 42 km W. Manfé. 5°45'N 8°54'E, 22 September 1984 (fr), *Onana 20* (P); Tiko. 4°05'N 9°22'E, 9 January 1926 (fl), *Dunlap 92* (K); Johann-Albrechtshöhe, Urwaldgebiet. 4°38'N 9°25'E, 1896 (fl), *Staudt 555* (COI,S); Mokoko forest reserve. 4°27'N 8°59'E, 1 May 1994 (fr), *Sonké 1099* (BR); route Kumba-Mamfe, 14 km après village Baduma. 4°51.5'N 9°27.6'E. Alt: 251m, 2 April 2010 (fr), *Bissiengou 1265* (LBV,WAG,YA); village Mafoko-Kindongi, 8 km Ouest du village Small Ekomba. 4°33.23'N 9°23.00'E. Alt: 170m, 4 April 2010 (fr), *Bissiengou 1297* (LBV,WAG,YA); Near Ekoumbé village, S. of Mbonge, Kumba area, W. Cameroon. 4°29'N 9°09'E, 23 July 1969 (st), *Bos, J.J. 5104* (BAS,WAG); 40 km north of Kumba on Mmfe road, along Mungo River by Kurume Hammock bridge. 4°57'N 9°28'E, January 1986 (fr), *Thomas, D.W. 5412* (B,WAG); South Bakundu forest Reserve, Kendongi. 4°32'N 9°25'E, 14 May 1970 (fr), *Farron 7298* (P); along the footpath from Esukutang to Ekogate. Starting 5 Km west of Esukutang. 5°25'N 9°04'E. Alt: 250m, 30 May 1988 (fl), *Thomas, D.W. 8044* (WAG); Lake Ejagham forest reserve. 5°46'N 9°17'E, 6 March 1963 (fr), *White, F. 8607* (FHO); Bopo, S. Bakundu Forest Reserve, Banga. 4°38'N 9°25'E, 11 March 1948 (fr), *Brenan 9271* (FHO,K); between 60 and 80 chs. on line 3 west. 4°38'N 9°25'E, 20 May 1946 (fl), *Ejiofor FHI 14022* (FHO); Kumba district, Mombo-Southern Bakosi in S.A. 4°38'N 9°25'E, 14 May 1951 (fl, fr), *Olorunfemi FHI 30577* (K); Bambuko F.R., near Kuke Bova. 4°25'N 9°14'E, 30 January 1958 (fl), *Keay FHI 37464* (FHI,K).

**CENTRAL AFRICAN REPUBLIC, Lobaye**: Ngotto, zone conservation LC1. 3°59'N 17°09'E, 6 May 1996 (st), *Zawa s.n.* (BRLU); La Maboke. 3°54'N 17°53'E, 29 August 1968 (fr), *Badré 167* (P); Boukoko. 3°54'N 17°56'E, 10

September 1947 (fl, fr), *Tisserant (Équipe) 238* (BM,P); site ECOFAC. 4°01'N 17°19'E, 22 April 2000 (st), *Yongo 418* (BRLU); Mbaiki. 3°53'N 18°00'E, January 1945 (st), *Tisserant (Équipe) 3738* (P); Lole forest, 70 km S.W. of Bangui. 3°53'N 18°06'E, 10 December 1969 (st), *Hepper 4158* (K); **Ombella M'poko**: Bangui. 4°20'N 18°33'E, 18 December 1904 (fr), *Chevalier, A.J.B. 11025* (P); **Sangha-Mbaéré**: Bai Hoku, 25 km E of Bayanga. 2°57'N 16°28'E. Alt: 400m, 15 April 1987 (st), *Harris, D.J. s.n.* (E); Ndakan., 2°21'N 16°09'E, April 1994 (st), *Kuroda 55* (E); 45 km S of Lidjombo; Ndakan gorilla study area. 2°21'N 16°09'E. Alt: 350m, 30 November 1989 (fr), *Harris, D.J. 2236* (MO,WAG); Dzangha from camp to saline, 11 km NE of Bayanga. 2°57'N 16°21'E, 19 October 1993 (fr), *Harris, D.J. 3533* (E,WAG); Dzangha camp, 11 km NE of Bayanga. 2°57'N 16°21'E, 5 December 1993 (fl), *Harris, D.J. 3906* (E); 25 km SE of Bayanga Kongana research camp. From camp to southern trail, west of Kongana stream. 2°47'N 16°25'E, 3 February 1994 (fr), *Harris, D.J. 4449* (E,WAG); 25 km SE of Bayanga, Kongana research camp. 2°47'N 16°25'E, 15 February 1994 (fr), *Harris, D.J. 4616* (E); Kongana research camp, 25 km SE of Bayanga. 2°47'N 16°25'E, 5 June 1994 (st), *Harris, D.J. 5087* (E,WAG).

**CONGO (BRAZZAVILLE), Cuvette**: Layon Mbandza (Km IX). 0°36'N 15°23'E, 21 August 1995 (fr), *Kouka 340* (BR,BRLU); Odzala National Park, piste Mbandza, camp Caravat. 0°42'N 14°36'E, 13 February 1993 (fl), *Bitsindou, M. 462* (BRLU); Odzala National Park, entre le Camp Mboko et l'embarcadère. 0°38'N 14°54'E, 9 December 1993 (fl), *Diafouka 561* (BRLU); Odzala National Park, entre le Camp Mboko et l'embarcadère. 0°38'N 14°54'E, 9 December 1993 (fr), *Diafouka 569* (BRLU); Odzala National Park, Olouma, poste de garde à la limite Est du Parc, sur la Mambili. 0°33'N 15°08'E, 2 February 1995 (fr), *Champluvier 5362* (BR); Odzala National Park, environ 35 km NE de Mbomo, domaine de chasse de Mboko. Lékénié, près du camp Mboko. 0°36'N 14°54'E, 9 February 1995 (fr), *Champluvier 5382* (BR); Odzala National Park, rivière Mambili, de Moba vers Ekagna, à 4 h de pirogue de Moba. 0°58'N 16°01'E, 22 November 1996 (fr), *Lejoly 96/ 151* (BRLU); Odzala National Park, entre village Mbanza et le layon de Mbanza (à 10 km au nord du village). 0°37'N 14°00'E, 30 January 1996 (fr), *Lejoly 96/ 409* (BRLU); Odzala National Park, grand escarpement d'Odzala, le Belvedere. 1°04'N 14°29'E, 23 November 1996 (fr), *Lejoly 96/ 821* (BRLU); Odzala N.P. Saline Mbouébé. 0°50'N 14°47'E, 10 February 1994 (fr), *Lisowski C 106* (BRLU,K); **Kouilou**: Route de Kakamoeka à la Loundji, Mayombe. 4°10'S 12°00'E, 21 March 1969 (fr), *Attims 87* (WAG); Les Saras, piste Cofibois env. 8 km avant le village. 4°22'S 12°21'E, 16 September 1987 (fl, fr), *Foresta 1476* (P); bord de route Dumanga, (M'Bokan). 4°23'S 12°15'E, September 1950 (fr), *Koechlin 1523* (P); route du chantier de Boungolo, Pointe Noire. 4°07'S 11°57'E, 31 January 1966 (fl), *Farron 4875* (P); Louvoulou, chantier forestier (Mayombe) Pointe Noire. 4°21'S 12°08'E, 4 February 1966 (fr), *Farron 4962* (P); chantier forestier de Noyettes, Fourastié (Pointe Noire). 4°29'S 12°15'E, 8 February 1966 (st), *Farron 5057* (P); **Lékoumou**: chantier forestier de Manderi, 20 km S.E de Sibiti. 3°45'S 13°30'E, 20 August 1965 (fr), *Farron 4526* (P); chantier forestier de Manderi, 20 km S.E de Sibiti. 3°45'S 13°30'E, 20 August 1965 (fr), *Farron 4534* (P); **Likouala**: sous-préfecture d'Impfondo, village de Mohitou. 1°37'N 18°00'E, 21 January 1966 (st), *Bouquet, A. 2015* (P); Bangui. Poste de Ballois. 0°24'N 17°53'E, 20 December 1903 (st), *Chevalier, A.J.B. 10982* (P); **Pool**: Bangou, 1 km E. campement Meya (Kindamba). 3°40'S 14°40'E, 27 April 1965 (fr), *Farron 4080* (P); **Sangha**: secteur forestier nord, UFA Pokola. 1°11'N 16°46'E, 14 November 2003 (fl, fr), *Gillet, J.-F. 77* (BR); Nouablé-Ndoki National Park, Goulougo Study Site, 37.84 km E de Bomassa. 2°11.8'N 16°31.7'E. Alt: 373m, 2 December 2007 (fl, fr), *Ndolo Ebika 268* (E,WAG); 2.5 km NNE of Bomassa village. 2°13.51'N 16°11.72'E. Alt: 350m, 22 March 2010 (fl), *Harris, D.J. 9682* (E,IEC).

**CONGO (KINSHASA), Bandundu**: Kikwit. 5°02'S 18°48'E, 21 November 1990 (fr), *Masens, B. 625* (BR,WAG); Bankaie. 2°22'S 18°25'E, 21 September 1953 (fr), *Gilbert, G.C.C. 14858* (BR); **Equateur**: Ingolo. 0°11'S 18°28'E, (fl, fr), *Ledoux 18* (BR); Bofonge de Likote. 1°02'N 21°56'E, 15 May 1935 (fl), *Collart 23* (BR); environ de Likimi. 2°50'N 20°45'E, 30 April 1910 (fr), *Malchair 42* (BR); Yumoandja de Likote. 1°03'N 21°56'E, 21 May 1937 (fl, fr), *Collart 70* (BR); Boyasegese. 3°29'N 20°32'E, 18 October 1954 (fr), *Evrard, C.M. 84* (BR); Lukolela. 1°30'S 17°12'E, 6 July 1906 (fr), *Pynaert 230* (BR); Bodangabo. 3°45'N 20°29'E, 23 February 1955 (fl, fr), *Evrard, C.M. 333* (BR); Wendji, environ de Coquilhatville. 0°04'S 18°10'E, May 1930 (fl, fr), *Lebrun 368* (BR); Boende. 0°13'S 20°52'E, 28 May 1941 (fl), *Hulstaert 373* (BR); Lokolenge. 1°11'N 22°40'E, 21 May 1927 (st), *Ghesquière 703* (BR); Ikela. 1°11'S 23°16'E, April 1939 (fr), *Dubois, L. 1022* (BR); Dundusana. 2°53'N 22°23'E, January 1914 (fl), *Mortehan 1067* (BR); Boende. 0°13'S 20°52'E, 24 July 1944 (fl), *Hulstaert 1339* (BR); Boende. 0°03'S 20°58'E, 24 July 1944 (fr), *Hulstaert 1389* (WAG); Zongo. 4°21'N 18°36'E, 13 July 1957 (fr), *Evrard, C.M. 2556* (BR); Solengi (Befale). 0°28'N 20°57'E, 19 February 1958 (fr), *Evrard, C.M. 3499* (WAG); Befale. 0°28'N 20°57'E, 18 June 1958 (fr), *Evrard, C.M. 4261* (K,WAG); Yalikungu (Mondombe). 0°42'S 22°36'E, 10 January 1959 (fr), *Evrard, C.M. 5518* (BR); **Kasai-Occidental**: route Bena Kabangala-Lubi. 6°49'S 22°54'E, 7 February 1957 (st), *Liben 2426* (BM,BR); **Maniema**: bloc Sanga-Elundu (Kibombo). 3°12'S 25°51'E, 9 April 1959 (fr), *Gaillez 219* (BR); route Lubutu Km 44. 0°18'N 25°28'E, 15 June 1981 (fl), *Ndjele 269* (BR); route Lubutu

Km 44. 0°18'N 25°28'E, 15 June 1981 (fl), *Ndjele 305* (BR); **Nord-Kivu:** Irango (Madiwe). 0°30'N 29°17'E, October 1938 (fr), *Gille 38* (BR); Kampala. 1°27'S 28°04'E, 14 November 1958 (fl), *Léonard, A. 1666* (BR); route Nezelube, North of Mwenda. 0°25'N 29°46'E, 17 September 1952 (fl), *Osmaston 2630* (BR); Nyaferege; Walikale. 1°25'S 28°03'E. Alt: 790m, 19 June 1959 (fr), *Léonard, A. 4673* (WAG); **Orientale:** Lenda. 1°19'N 28°38'E. Alt: 750m, 16 November 1997 (fr), *Amsini 47* (BR); Ituri Forest, Nduye. 1°50'N 28°59'E, 31 October 1989 (fr), *Ichikawa, M. 89* (BR); Bambesa, Uélé. 3°28'N 25°43'E, 24 June 1942 (fr), *Dubois, H. 248* (BM, BR); Lenda. 1°24'N 28°34'E. Alt: 750m, 26 January 2001 (fl, fr), *Mokbondo 382* (K, MO, WAG); Bambesa. 3°28'N 25°43'E, 23 October 1952 (st), *Gérard, P. 448* (BR, K); Yangambi. 0°46'N 24°27'E, 15 June 1953 (fr), *Maudoux 606* (BR); environ de Bambesa, Uele. 3°28'N 25°43'E, 1936 (fr), *Pittery, R. 624* (BR); environ de Bambesa, Uele. 3°28'N 25°43'E, 1936 (fr), *Pittery 628* (BR); Bambesa. 3°28'N 25°43'E, March 1944 (fr), *Dubois, H. 749* (BR); île Kongolo à Kisangani. 0°34'N 25°04'E. Alt: 420m, 14 June 1978 (fl), *Mandango 772* (BR); Yalibutu. 1°04'N 24°40'E, 4 October 1961 (fr), *Bolema 793* (BR); Parc National de Maïko, au Nord du village Ubukala, 0°54'S 27°03'E, 7 January 1977 (fr), *Lejoly 853* (BR); Ituri Forest. 1°25'N 28°35'E. Alt: 750m, 28 July 1990 (fl), *Hart, T.B. 1072* (BR); Yangambi. 0°46'N 24°27'E, 9 September 1958 (fr), *Léonard, A. 1171* (BR, K); Kalagwa (Panga). 1°51'N 26°25'E, 23 December 1913 (fl, fr), *Bequaert 1602* (BR); Parc National de la Maïko, 45 km au Nord de Lubutu, Péné Aluta, rive droite de la Maïko, entre les affluents Ukungu et Utambe. 0°20'S 26°40'E, 2 June 1977 (st), *Lejoly 1721* (BR); Parc National de la Maïko, 45 km au Nord de Lubutu, Péné Aluta, rive droite de la Maïko, entre les affluents Ukungu et Utambe. 0°20'S 26°40'E, 2 June 1977 (fr), *Lejoly 1808* (BR); Banalia, Rivière Aruwimi, entre Yambuya et Mongandjo. 1°19'N 24°25'E, 21 January 1957 (fr), *Evrard, C.M. 2148* (K, WAG); Yangambi, route Bengamisa Km 20. 0°46'N 24°27'E, March 1936 (fr), *Gilbert, G.C.C. 2184* (BR); Yangambi, Réserve botanique de l'Issaloe. 0°46'N 24°27'E. Alt: 470m, 12 June 1936 (fr), *Louis, J.L.P. 2240* (BR); Yangambi, Km 8,4 de la route de Ngazi. 0°53'N 24°27'E. Alt: 470m, 25 August 1936 (fr), *Louis, J.L.P. 2506* (BR); Yangambi, Km 8 au nord-ouest. 0°52'N 24°24'E. Alt: 470m, 8 November 1936 (fr), *Louis, J.L.P. 2814* (BR); Angodia. 3°32'N 25°47'E, May 1931 (fl), *Lebrun 2989* (BR, P); Yangambi. 0°46'N 24°27'E. Alt: 470m, 5 October 1951 (st), *Donis 3120* (BR, K); Km 52, route de Kisangani vers Bafwasende (route de l'Ituri), réserve forestière. 0°29'N 25°39'E, 24 June 1978 (fl), *Lejoly 3778* (BR); Rubi (Buta). 2°43'N 25°16'E, 26 June 1958 (fr), *Gérard, P. 3924* (BR); Yangambi, à 6 Km au nord-ouest du poste, plateau de la Mbutu. 0°51'N 24°20'E. Alt: 470m, 30 May 1937 (st), *Louis, J.L.P. 4001* (BR); Yangambi à 6 km au N.W. du poste plateau de la Mbutu. 0°46'N 24°27'E, 30 May 1937 (fr), *Louis, J.L.P. 4005* (C, K); Yangambi, village Yayoli. 0°46'N 24°27'E, 4 March 1960 (fr), *Devred 4199* (BR); île Kongolo à la confluence de la Lindi et du fleuve Zaïre. 0°34'N 25°05'E, 14 December 1978 (fl), *Lejoly 4417* (BR); Km 30, route de Kisangani à Wanie-Rukula, 5km à l'Est de la route (exploitation forestière). 0°25'N 25°27'E, 29 June 1979 (fl), *Lejoly 5223* (BR); Digba-Ango. Akare entre rivière Bili et Asa. 4°23'N 25°48'E, 7 December 1963 (st), *Gérard, P. 5647* (BR); Yangambi. 0°46'N 24°27'E, 1937 (st), *Louis, J.L.P. 5907* (BR, K, P); à l'Ouest de la Lindi, au N de Yakusu, à 7km de la road pour Yangambi. 0°35'N 25°01'E, 17 November 1982 (fr), *Pauwels 6580* (BR); peu en aval de Yakusu. 0°46'N 24°27'E, 21 March 1938 (st), *Louis, J.L.P. 8526* (B, FHO); Yangambi, tête de source de Isolowe. 0°46'N 24°30'E, 18 May 1938 (fr), *Louis, J.L.P. 9421* (BR, K); Yangolo, à 20 km, à l'ouest de Yangambi. 0°50'N 24°16'E. Alt: 470m, 27 October 1938 (fl), *Louis, J.L.P. 12103* (BR); Yangambi, vallée de la Bonyi. 0°46'N 24°27'E. Alt: 470m, 10 November 1938 (fr), *Louis, J.L.P. 12519* (BR); Yaluwe sur le Lomami. 0°07'S 24°12'E, 18 January 1939 (fr), *Louis, J.L.P. 13349* (C); Yatolema-Bambole. 0°09'N 24°20'E. Alt: 470m, February 1939 (fr), *Louis, J.L.P. 14092* (BR).

**EQUATORIAL GUINEA, Bioco (Fernando Poo):** Fernando Poo. 3°30'N 8°42'E, 1859 (fl), *Mann, G. 77* (K, P); Malabo-Cupapa, km 22-23, camino de la fuente de agua mineral, 32NMK9005, 200 m. 3°40'N 8°55'E, 31 May 1988 (fl, fr), *Carvalho, M.F. de 3464* (K, MA); Cerca de Cupapa, camino de la fuente de aguas sulfurosas, 32NMK9005, 200 m, bosque bastante denso. 3°40'N 8°55'E, 9 February 1989 (fl), *Fernández Casas 11399* (K, MA); **Rio Muni:** 27 May 1999 (st), *Eneme Efua 197* (BATA, BRLU, WAG); 28 July 1999 (st), *Eneme Efua 469* (BATA, BRLU, WAG); **Rio Muni, Centro Sur:** Monte Alen. 1°40'N 10°17'E, 12 March 1997 (fr), *Ngomo 56* (BRLU); Monte Alen. 1°40'N 10°17'E, 28 May 1997 (fr), *Ngomo 178* (BRLU); SO du parc National de Monte Alen, sur le transect ECOFAC de Mosumo à 500 m du début du layon. 1°35.89'N 10°02.21'E. Alt: 185m, 10 February 2001 (st), *Senterre 179* (BRLU); Monte Alen. 1°40'N 10°17'E, 25 June 1998 (fr), *Ngomo 376* (BRLU); Monte Alen. 1°40'N 10°17'E, 31 October 1998 (fr), *Ngomo 533* (BRLU); SO du parc National de Monte Alen, sur le transect ECOFAC de Mosumo à 500 m du début du layon. 1°35.89'N 10°02.21'E. Alt: 200m, 3 March 2001 (st), *Senterre 584* (BRLU); SO du parc National de Monte Alen, 2 km au NE du site de traversée du Rio Uolo pour aller aux cataractas. 1°37.49'N 10°04.53'E, 11 January 2002 (fl), *Senterre 1787* (BRLU); S. du parc National de Monte Alen, près de la Cabana ECOFAC de Esamalana. 1°31.29'N 10°12.20'E. Alt: 540m, 3 January 2002 (fl, fr), *Senterre 2120* (BRLU); N. du parc National de Monte Alen, à proximité du transect ECOFAC de

Monte Chocolate, à 160 m de l'origine. 1°46.12'N 10°16.80'E. Alt: 500m, 14 November 2002 (st), *Senterre 3417* (BRLU); Centro Sur. Parque Nacional de Monte Alén, cabaña del lago. 1°34'N 10°15'E, 5 July 1999 (fr), *Velayos 9518* (MA); Parc National de Monte Alén. 1°39'N 10°18'E, 4 October 94 (fr), *Lejoly 94/ 131* (BRLU); **Rio Muni, Litoral:** Apiladero de Jandje (4 km à l'Est du village), réserve de Ndote. 1°29'N 9°34'E, 20 August 1997 (fr), *Eneme Efuá 115* (BRLU); Ayamiken, réserve de Rio Campo. 2°07'N 10°01'E, 1 February 1997 (fr), *Obama 143* (BRLU); région continentale, Sud ouest de Ayamiken. 2°06'N 10°01'E, 30 April 1997 (fr), *Obama 199* (BRLU); Litoral: Sendje1, km 47 de la carretera de Kogo. 1°34'N 9°50'E, 1 June 2000 (fl, fr), *Pérez Viso 2914* (MA); Litoral: Mokomo, Km 19 de la carretera de Kogo. 1°09'N 9°49'E, 4 September 2000 (fr), *Pérez Viso 3898* (MA); Bata-Río Campo. Estrada km 48-49. 2°06'N 9°53'E, 16 May 1991 (fr), *Carvalho, M.F. de 4676* (MA,WAG); Bata-Niefang: Estrada Km 35. En dirección de Adjape a la zona de Comayá. Entre Sama y Comayá. 1°51'N 10°03'E, 10 January 1995 (fl), *Carvalho, M.F. de 5777* (BRLU,MA); Ndote Nord, près du village Jandyé. 1°27'N 9°32'E, 28 August 1997 (fr), *Lisowski 149* (BRLU); **Rio Muni, Wele Nzaz:** inselberg de Akoak Ebanga, à 1h de marche du village de Ngong Mocomo, à 10 km de Nsork. 1°04'N 11°12'E. Alt: 580m, 31 May 2002 (st), *Parmentier 3558* (BRLU).

**GABON, Estuaire:** environ de Libreville. 0°25'N 9°26'E, May 1917 (fr), *Chevalier, A.J.B. s.n.* (P); La Nkoulounga. 0°36'N 9°46'E, 19 June 1958 (st), *Touzet 23* (P); Libreville. Parcelle 1: Arboretum de Sibang. 0°25'N 9°29'E. Alt: 50m, 17 November 1999 (fl), *Simons, E.L.A.N. 56* (LBV,WAG); Libreville. 0°25'N 9°26'E, 1891 (fr), *Jolly 62* (P); Parc National de la Pongara. Sur la route entre la pointe Ouingombé et le camp de Kenguéré de Gabon Environnement. Dans l'ancienne plantation de manguier et des bambous de Chine. 0°18.5'N 9°19.8'E. Alt: 20m, 15 December 2006 (fl, fr), *Dauby 63* (BRLU,LBV); La Nkoulounga. 0°36'N 9°46'E, 26 January 1959 (st), *Touzet 124* (P); in ditone Munda. 0°25'N 9°29'E, 16 January 1881 (fr), *Soyaux 179* (K,P,Z); Libreville, arboretum de Sibang. 0°25'N 9°29'E. 7 October 2009 (fr), *Bissiengou 268* (LBV,WAG); Libreville. Parcelle 1: Arboretum de Sibang. 0°25'N 9°29'E. Alt: 50m, 5 December 1999 (fl), *Simons, E.L.A.N. 283* (LBV,WAG); surroundings of Libreville. 0°24'N 9°28'E, 15 September 1899 (fr), *Klaine 398* (FHO,K,P); Libreville. Arboretum de Sibang, Parcelle I. 0°25'N 9°29'E. Alt: 50m, 11 January 2000 (st), *Simons, E.L.A.N. 619* (LBV,WAG); Département de Noya, Parc National d'Akanda, Path from débarcader to NO Ayong. 0°54.69'N 9°40.32'E. Alt: 44m, 13 September 2012 (st), *Quiroz-Villarreal 1642* (WAG); Nyonyie survey, Plaine des Images, c.3250 m on transect N. 0°00.2'S 9°23.0'E, 10 July 1990 (fr), *Wilks 2148* (MO,WAG); au débarcadère Remboué I. 0°12'S 10°01'E, 28 June 1990 (fl, fr), *Louis, A.M. 3258* (LBV,WAG); environs de Libreville. 0°25'N 9°26'E, 26 April 1917 (st), *Chevalier, A.J.B. 33662* (P); **Haut-Ogooué:** 20 km E de Lelama. 1°00'S 13°43'E. Alt: 441m, 17 November 2009 (fr), *Bissiengou 897* (LBV,WAG); nouvelle exploitation CEB, vers Okondja. 0°45.4'S 13°50.8'E. Alt: 457m, 18 November 2009 (fl, fr), *Bissiengou 924* (LBV,WAG); 4 km road Okondja to Akiéni. 0°39.8'S 13°42.6'E. Alt: 480m, 31 January 2008 (fl, fr), *Wieringa, J.J. 6292* (LBV,MO,WAG); 40 km on road Okondja to Akiéni, then 2 km on a new CEB forestry road heading East. 0°53.8'S 13°50.8'E. Alt: 420m, 6 February 2008 (fr), *Wieringa, J.J. 6502* (LBV,MO,WAG); **Moyen-Ogooué:** Ndjolé. 0°11'S 10°45'E, December 1897 (fl), *Thollon 65* (P); N'Djolé, région de l'Ogooué. 0°11'S 10°45'E, 22 July 1896 (fr), *Klaine 66* (P); 20 km S of Ezanga Lake near Lambaréné. 1°05'S 10°16'E, 30 January 1991 (st), *Nek 586* (WAG); 30 km ENE of Lambaréné, 10 km ENE of Bellevue. 0°34.9'S 10°28.4'E. Alt: 30m, 6 April 1994 (fl, fr), *Wieringa, J.J. 2660* (WAG); 31 km ENE of Lambaréné, 11 km E of Bellevue. 0°36'S 10°29'E. Alt: 40m, 7 April 1994 (fr), *Wieringa, J.J. 2675* (LBV,MO,WAG); forest near Bellevue. Previously logged forest and tracks. 0°34'S 10°28'E. Alt: 50m, 9 June 1987 (fl), *Thomas, D.W. 6676* (LBV,MO,WAG); environs du village N'Gomo sur l'Ogooué. 0°50'S 9°59'E, 4 September 1912 (fr), *Chevalier, A.J.B. 26442* (P); **Ngounié:** Waka forest exploitation road. 1°18'S 10°57'E. Alt: 370m, 19 November 1984 (fr), *Arends 316* (WAG); après le pont du village Doudou, piste tout au long de la rivière Doudo (route Mouila-Fougamou). 1°46'S 10°55'E. Alt: 89m, 27 October 2009 (st), *Bissiengou 595* (LBV,WAG); along a forestry road of chantier EFT (Exploitation Forestière de Tsanba) starting at Ndjemba village on Fougamou-Lambaréné road. 1°11.1'S 10°28.2'E. Alt: 179m, 29 October 2009 (fr), *Bissiengou 642* (LBV,WAG); along a forestry road of chantier EFT (Exploitation Forestière de Tsanba) starting at Ndjemba village on Fougamou-Lambaréné road. 1°09.7'S 10°25.6'E. Alt: 204m, 29 October 2009 (fr), *Bissiengou 646* (LBV,WAG); Massif du Chaillu, near Guévedé village, ± 40 km N. of Lébamba. 1°55'S 11°25'E. Alt: 500m, 30 November 1983 (st), *Louis, A.M. 1057* (LBV,WAG); concession CBG, ± 20 km à l'ouest de Mandji. 1°44.0'S 10°12.5'E. Alt: 67m, 30 July 2008 (fr), *Dauby 1089* (BRLU,LBV,MO); vallée de la Waka, 27km ENE du confluent Ngounié-Waka. 1°16'S 10°59'E, 24 January 1986 (fl, fr), *Wilks 1187* (BRLU,C,E,G,K,LBV,MA,MO,P,WAG); Sindara, après village Matadi 7 route exploitation forestière EGG (ancien IFL). 1°02.26'S 10°42.47'E. Alt: 49m, 22 June 2011 (st), *Bissiengou 1437* (LBV,WAG); Sindara, après village Matadi 7 route Nimbié-Ikobé. 0°58.98'S 10°41.64'E. Alt: 114m, 22 June 2011 (fr), *Bissiengou 1441* (LBV,WAG); Fougamou, village Nzemba route du chantier forestier EGBD, entrée



école. 1°03.06'S 10°30.37'E. Alt: 97m, 24 June 2011 (fr), *Bissiangou 1450* (LBV,WAG); 45 km de Fougamou. 1°33.80'S 10°42.33'E. Alt: 83m, 25 June 2011 (fr), *Bissiangou 1465* (LBV,WAG); 45 km de Fougamou. 1°33.07'S 10°44.33'E. Alt: 115m, 25 June 2011 (fl), *Bissiangou 1475* (LBV,WAG); forestry road km 10 leading in N direction from road Evouta-Oghoubi camp. 0°58.38'S 11°08.78'E. Alt: 390m, 23 March 2007 (fl, fr), *Sosef 2523* (LBV,WAG); Chantier Leroy, route Mouila-Yeno. 1°59'S 11°19'E, 11 February 1988 (fl, fr), *Louis, A.M. 2711* (BR,MO,WAG); upper Waka area, 13 km on IFL forestry road B2. 1°20.7'S 10°52.1'E. Alt: 200m, 28 March 2004 (fr), *Wieringa, J.J. 5114* (LBV,MO,WAG); Mouila. 1°50'S 11°00'E, January 1925 (st), *Le Testu 5194* (BM,P); 50 km SE of Lambaréné. 1°04'S 10°30'E, 30 September 1968 (fl), *Breteler 5754* (WAG); 0°48.98'S 10°30.40'E. Alt: 49m, 18 October 2012 (fr), *Sonké 6090* (MO); 22 km along a track in a northern direction from Doussala. 2°12'S 10°36'E. Alt: 100m, 4 December 1986 (fr), *Wilde, J.J.F.E. de 9153* (WAG); 15 km N. of Doussala. 2°11'S 10°39'E. Alt: 160m, 19 March 1988 (fr), *Wilde, J.J.F.E. de 9460* (BR,LBV,MO,WAG); 18 km on forest exploitation track from Bilengui to Mouila, Ogoulou River bridge. 1°55'S 11°20'E. Alt: 150m, 10 February 1991 (fl), *Wilde, J.J.F.E. de 10480* (BR,LBV,MO,WAG); Dikaki Chantier. Bindolo R. basin, NW of Fougamou. 1°15'S 10°29'E. Alt: 300m, 20 September 1997 (st), *Breteler 14003* (LBV,WAG); between Yombi and Fougamou, E slope of Koumounabouali ridge. 1°20'S 10°40'E, 22 September 1997 (st), *Breteler 14064* (LBV,WAG); **Nyanga**: route Tchibanga-Mayumba. 3°05.7'S 10°48.9'E, 19 October 2009 (st), *Bissiangou 325* (LBV,WAG); route Tchibanga-Mayumba. 3°05.7'S 10°48.9'E, 19 October 2009 (fr), *Bissiangou 329* (LBV,WAG); route Tchibanga-Ndende. 2°58.3'S 11°06.4'E. Alt: 252m, 25 October 2009 (st), *Bissiangou 514* (LBV,WAG); route Tchibanga-Ndende. 2°58.3'S 11°06.4'E. Alt: 252m, 25 October 2009 (fr), *Bissiangou 517* (LBV,WAG); route Tchibanga-Ndende. 2°58.3'S 11°06.4'E. Alt: 252m, 25 October 2009 (st), *Bissiangou 518* (LBV,WAG); 14 km de Ndendé (route Ndende-Mouila). 2°16.0'S 11°16.1'E. Alt: 116m, 27 October 2009 (st), *Bissiangou 582* (LBV,WAG); Monts Dou dou, brigade de la Moukalaba à Morindi. 2°34'S 10°44'E. Alt: 100m, 19 March 2000 (fl, fr), *Sosef 840* (LBV); Tchibanga. 2°50'S 11°00'E, 4 August 1907 (fl), *Le Testu 1080* (BM); Inventory; chantier CEB, ca 50 km SW of Doussala; 2°36'S 10°35'E. Alt: 480m, 21 August 1985 (fr), *Reitsma, J.M. 1344* (WAG); Pélé Mountains 27 km on the road Tchibanga-Moulengui Binza (counted from the bifurcation with road to Mayumba), village Birougou, and then 12 km on a track in SW direction to village Bikamba, from there following track in direction of the hills. 3°16'S 11°17'E. Alt: 350m, 5 April 2009 (fr), *Sosef 2628* (LBV,WAG); Dou dou Mountains, Chantier SNF-Bakker. 2°42.7'S 10°25.3'E. Alt: 130m, 29 November 2003 (fr), *Jongkind 5831* (LBV,WAG); **Ogoué-Ivindo**: Lopé Reserve rue de la cascade near broken bridge. 0°11'S 11°34'E, 13 February 1998 (fr), *Leal, M.E. 41* (BR,K,MO,WAG); Station d'études des Gorilles et Chimpanzés, Lopé. 0°10'S 11°35'E, 2 August 1993 (fl), *McDonald, K.E. 43* (E); Bélinga, mines de fer. 1°06'N 13°12'E. Alt: 900m, 13 August 1966 (st), *Hallé & Le Thomas 456* (P); à l'ouest du Chantier Mitendi. 0°36'S 11°42'E. Alt: 350m, 21 October 1999 (fr), *Sosef 586* (LBV,WAG); Lopé-Okanda Game Reserve, between Achouka and Kongo-Boumba, ± 1 km S. of camp. 0°06'S 11°30'E. Alt: 200m, 10 November 1983 (fr), *Louis, A.M. 597* (WAG); route Lopé-Mikongo, après carrefour vers Gougué (village PK0). 0°27'S 11°52'E. Alt: 280m, 5 March 2010 (fl), *Bissiangou 1031* (LBV,WAG); Nord-Est du parc de la Lopé, 42 km sur la route Lopé-Kassamabika. 0°08.28'S 11°42.87'E. Alt: 250m, 5 March 2010 (fr), *Bissiangou 1037* (LBV,WAG); Nord-Est du Parc de la Lopé, ancienne route Lopé qui mène à Booué. 0°07.56'S 11°46.63'E. Alt: 211m, 6 March 2010 (fr), *Bissiangou 1044* (LBV,WAG); Parc d'Ipassa makokou, après château d'eau. 0°31'N 12°48'E. Alt: 350m, 10 March 2010 (fr), *Bissiangou 1092* (LBV,WAG); Lope, Point de Vue. 0°10.0'S 11°34.7'E. Alt: 600m, 19 August 2012 (fr), *Towns 1127* (LBV,WAG); Lope. 0°11.50'S 11°36.30'E. Alt: 302m, 6 September 2012 (fl), *Towns 1136* (LBV,WAG); route Makokou-Mekambo. 0°45'N 13°14'E. Alt: 619m, 13 March 2010 (fr), *Bissiangou 1179* (LBV,WAG); Masaha, NE de Makokou. 0°44'N 13°11'E, 25 February 1961 (st), *Hallé, N. 1309* (P); Ivindo National Park, camp éléphant. 0°15'S 12°20'E, 8 April 2004 (fl, fr), *Moungazi 1532* (LBV,WAG); 18 km SSW de Koumameyong. 0°04'N 11°48'E, 20 August 1987 (fl, fr), *Wilks 1626* (MO,WAG); La Nké, piste du chantier. 0°05'N 11°51'E, 9 October 1983 (fr), *Floret 1778* (LBV,P); Bélinga. 1°05'N 13°08'E, 12 November 1964 (st), *Hallé, N. 3157* (P); Ivindo National Park. Langoué Bai. At north end of bai near NGS platform. 0°11.16'S 12°33.42'E, 27 November 2002 (fr), *Stone, J.R. 3504* (LBV,MO,WAG); road Mékambo to Makokou, 4 km W of Mbela-Baya. 0°58.5'N 13°52.7'E. Alt: 500m, 31 December 2000 (fr), *Wieringa, J.J. 3751* (WAG); Bengoué Mountain, just N of Ikei-Bokaboka. 0°55.2'N 13°41.8'E. Alt: 600m, 7 January 2001 (fr), *Wieringa, J.J. 4007* (WAG); About 20-40 km NNE of Koumémayoung. 0°15'N 11°55'E, 12 April 1988 (fr), *Breteler 8617* (LBV,WAG); Lopé Reserve. 29 km in Southern direction from Old Ayem Station. 0°17.1'S 11°27.1'E. Alt: 170m, 21 December 1996 (fl), *Wilde, J.J.F.E. de 11791* (WAG); Eastern border of Lopé-Okanda Reserve, along roads S of SEG lumber camp, W of Offoué River. 0°27'S 11°45'E. Alt: 200m, 15 May 1992 (fr), *McPherson, G.D. 15763* (LBV,MO); eastern border of Lopé-Okanda Reserve, along roads S of SEG lumber camp, W of Offoué River. 0°27'S 11°45'E. Alt: 200m, 15 May 1992 (fl), *McPherson, G.D. 15764* (LBV,MO,WAG);

**Ogooué-Lolo:** Bambidi, axe Lastoursville-Ndangui. 0°45.71'S 12°58.99'E, 21 May 2003 (fr), *Nziengui 523* (LBV,WAG); concession de CEB, Nord de la zone de Milolé, Sud du Parc National de l'Ivindo. 0°14.7'S 12°44.6'E. Alt: 433m, 14 February 2010 (fr), *Dauby 2394* (BRLU,LBV,MO); Montagne Iboundji, piste vers chute Moughoungoulou à ± 2km. 1°10'S 11°49'E, 16 February 1988 (fr), *Louis, A.M. 2778* (LBV,MO,WAG); 10.5 km from Lastoursville Railway Bridge, E-W road, Chantier SBL. 0°47'S 12°45'E. Alt: 300m, 18 November 1988 (fr), *Maesen, L.J.G. van der 5616* (LBV,WAG); 21 km SE of Lastoursville, then 20 km E of CGG headquarters. 0°58'S 13°00'E. Alt: 450m, 26 November 1988 (fr), *Maesen, L.J.G. van der 5862* (LBV,WAG); 4 km Catholic Mission Lastoursville to Koulamoutou. 0°51'S 12°39'E, 28 September 1970 (fr), *Breteler 6678* (WAG); 40-50 km ESE of Lastoursville. 0°53'S 13°18'E, 4 May 1992 (fl, fr), *Breteler 11286* (BR,LBV,MO,WAG); Makande surroundings 65 km SSW of Booué. 0°41'S 11°55'E, 1 February 1999 (st), *Breteler 14881* (LBV,WAG); **Ogooué-Maritime:** 25 km E Gamba, à 100m de la parcelle N°2, Gamba, Monts Doudou-Projet Smithsonian. 2°39'S 10°14'E. Alt: 30m, 27 March 2003 (fl), *Niangadouma 223* (BR,LBV,MO,WAG); Monts Doudou, campagne. 2°31.3'S 10°33.5'E. Alt: 240m, 18 September 2000 (fr), *Bourobou 311* (LBV,WAG); Monts Doudou, à ± 15 km à O-SO de Doussala, autour du campement 5. 2°22.50'S 10°29.80'E. Alt: 225m, 1 June 2000 (fr), *Azizet Issembé 404* (LBV,WAG); Doudou Mountains National Parc 40 km S of Mandji. 2°00.6'S 10°24.0'E. Alt: 200m, 16 November 2005 (fr), *Sosef 2323* (LBV,MO,WAG); Gamba. 2°46'S 10°02'E, 21 September 1968 (fl), *Breteler 5601* (WAG); région Omboué-Sette Cama, Koumouloundou. 2°00'S 9°35'E, 6 June 1970 (st), *Farron 7374* (P); **Woleu-Ntem:** Inselberg Milobo. 0°55'N 10°31'E. Alt: 500m, 7 July 2001 (fr), *Ngok Banak 15* (BRLU,LBV); Inselberg Milobo. 0°56.3'N 10°30.9'E. Alt: 750m, 8 July 2001 (fr), *Ngok Banak 44* (BRLU,LBV,WAG); Inselberg Milobo. 0°56.9'N 10°30.1'E. Alt: 630m, 16 August 2001 (fr), *Ngok Banak 131* (BRLU,LBV,WAG); Bordamur concession area some 40 km from WWF-station and 1.5 km from logging road. 1°14'N 11°53'E. Alt: 570m, 19 October 2002 (fr), *Strijk 237* (WAG); 10 km Lalara-Makokou, than exploitation road along Okano River, upstream for 42 km. 0°33'N 11°42'E. Alt: 380m, 6 September 1978 (fr), *Breteler; Wilde, J.J.F.E. de 464* (WAG); Minkébé district, Nsyé valley. 1°30'N 12°48'E, 19 February 1990 (fr), *Wieringa, J.J. 587* (BR,C,LBV,MO,WAG); 13 km SE of Mitzic, road from FOREENEX forestry camp to Madouaka village. 0°42.1'N 11°38.8'E. Alt: 490m, 7 November 2009 (fr), *Bissingou 729* (LBV,WAG); 14 km SE of Mitzic, road from FOREENEX forestry camp to Madouaka village. 0°41.9'N 11°38.5'E. Alt: 481m, 7 November 2009 (fl, fr), *Bissingou 741* (LBV,WAG); 40 km NE of Mitzic, forestry road in Bordamur forest exploitation. 1°03.4'N 11°47.4'E. Alt: 550m, 8 November 2009 (st), *Bissingou 791* (LBV); chantier Rougier-Océan, Oveng. 0°52'N 11°10'E, 7 May 1985 (fl, fr), *Reitsma, J.M. 876* (WAG); Parc des Monts de cristal, à 10 m du camping l'Esplanade en direction de la rivière. 0°36.82'N 10°24.03'E. Alt: 460m, 13 February 2010 (fr), *Bissingou 972* (LBV,WAG); forestry concession Bordamur 70 km NE of Mitzic, slopes of Mount Minko. 1°19'N 11°54'E. Alt: 600 - 800m, 8 February 2003 (fr), *Sosef 1930* (LBV,WAG); Rocher Mbou, Est de Médouneu. 1°00'N 10°45'E, 7 February 1968 (st), *Hallé, N. 5023* (P); Minkébé area, 2190 m on transect B. 1°30'N 12°49'E, 4 May 1990 (fr), *Minkébé Series W 204* (WAG).

**NIGERIA, Cross River State:** Oban. 5°19'N 8°34'E, 1911 (fr), *Talbot, P.A. 423* (K,WAG,Z); Oban. 5°19'N 8°34'E, 1911 (fl), *Talbot, P.A. 424* (BM); Oban. 5°19'N 8°34'E, 1911 (fl), *Talbot, P.A. 425* (BM); Oban district. 5°17'N 8°33'E, (fl), *Talbot, P.A. 1371* (K); 15 km SE of Ikom. 5°52'N 8°46'E, 18 May 1971 (fl), *Meer, P.P.C. van 1680* (WAG); East boundary of Boje enclave pillar 26. 6°17'N 8°55'E, 14 May 1946 (fl), *Jones, A.P.D. FHI 18603* (FHO,K); Okarara. 5°22'N 8°42'E, 14 May 1952 (fr), *Ujor FHI 30838* (K); Ikom. 5°58'N 8°42'E, 18 July 1952 (fr), *Latilo FHI 31862* (K); Itu, lower Enyong F.R. 5°16'N 7°57'E, 19 May 1953 (fl), *Onochie FHI 33207* (K); Buden Dunlop Estate. 5°16'N 8°13'E, 24 July 1959 (fr), *Binuyo FHI 41404* (FHO,K); Calabar (Ikpai). Between miles 69 & 70 on Calabar- Mamfe road. 5°32'N 8°46'E, 24 February 1964 (fl, fr), *Latilo FHI 53990* (K,WAG); Cross North Forest Reserve, Ikom. South-East State, Ikom District. 5°58'N 8°42'E, 8 June 1972 (fl), *Emwiogbon FHI 65832* (K,WAG); Cross North Forest Reserve, Ikom. South-East State. 5°58'N 8°42'E, 8 June 1972 (fr), *Emwiogbon FHI 65837* (WAG); **Edo State:** Okomu forest reserve, Compartiment No. 6°20'N 5°15'E, 8 December 1947 (fl, fr), *Brenan 8425* (FHO,K); Okomu Forest Reserve, compartment 58. 6°20'N 5°15'E, 27 February 1948 (fr), *Onochie FHI 9177* (K); **Ondo State:** Akure F.R. (Owenna district). 7°15'N 5°12'E, 25 October 1948 (fr), *Adekunle FHI 24225* (K); **Osun State:** Banks of the Oni river, 9 miles south west of Okeigbo and several miles north of the Shasha reserve boundary. 7°00'N 4°22'E, 10 February 1946 (st), *Jones, A.P.D. FHI 14735* (FHO,K); **Oyo State:** On profile II 2 miles south of Gbegbe's Camp on the Awe-Oni R. U.A.C. Road. 7°09'N 4°23'E, 12 February 1946 (fl, fr), *Jones, A.P.D. FHI 17556* (FHO).

**Key literature:** Bamps & Farron (1967), Cheek et al. (2004), Exell & Mendonça (1951), Farron (1965, 1968, 1985), Hutchinson, Dalziel & Keay (1954).

**Campylospermum engama** (De Wild.) Farron**Fig. 10**

Bull. Jard. Bot. État Bruxelles 35: 396 (1965). – *Ouratea engama* De Wild., Rev. Zool. Afr., Bot. 7: B48 (1920). – Lectotype (designated here): *Lemaire 337* (holotype: BR!; isotype: BR!), Democratic Republic of the Congo, Mobwasa, June 1913.

*Tree* up to 11 m tall, with branched stem; twigs greenish. *Stipules* caducous, triangular, c. 2 mm long. *Leaf*: petiole **(5-)10-18(-25) mm long**; leaf blade narrowly elliptic to narrowly elliptic-oblong or ovate to obovate, (9-)16-25(-39) x (2.5-)4-7(-9) cm, ratio **3-4(-5.5)**, base **typically attenuate, decurrent onto the petiole**, apex acute to obtuse, sometimes mucronate, papyraceous, not bullate, upper side glossy, dark green, lower side dull, paler green, margin serrate all along, the teeth with a black tip; venation: midrib flattened above, prominent beneath, main lateral veins generally **12-19 on either side, 10-25(-35) mm apart**, prominent on both sides, at a right angle with the midrib but curved upwards to run parallel to the margin, intermediate lateral veins 1-5 in between each pair of main laterals, distinct on both sides, tertiary venation **scalariform**, more or less perpendicular to the midrib, **joined by cross veinlet, distinct on both sides**. *Inflorescence* terminal or sometimes axillary, branched, **lax**, its main axis (20-)25-33(-35) cm long, **more or less angular to flattened**; pairwise scales absent; bracts caducous; **racemes (3-)4-8, (3-)8-23(-40) cm long**, perpendicular to the main axis, **occasionally with secondary racemes**; cymules 1-2(-3) cm apart, 1-8(-11)-flowered. *Flower*: pedicel 5-10(-15) mm long, articulated at 1-5(-8) mm from the base; sepals ovate, 5-7 x 2-3 mm in flower, 8-10 x 3-5 mm in fruit; petals obovate, 7-10 x 3-6 mm, **base clawed, apex rounded**; stamens: anthers 4-7 mm long; ovary 1 mm high; style 5-7 mm long. *Fruit*: receptacle enlarged up to 6 x 5 mm; drupelets 3 to 4 well developed per receptacle, broadly **ellipsoid to globose**, 6-9 x 5-7 mm; cotyledons **incumbent, dissimilar in size with a small outer cotyledon**.

**Notes:** A lectotype has been designated from amongst the two syntypes available: *Lemaire 337* and *De Giorgi 737*. Because the latter material could not be traced, we have chosen for *Lemaire 337*.

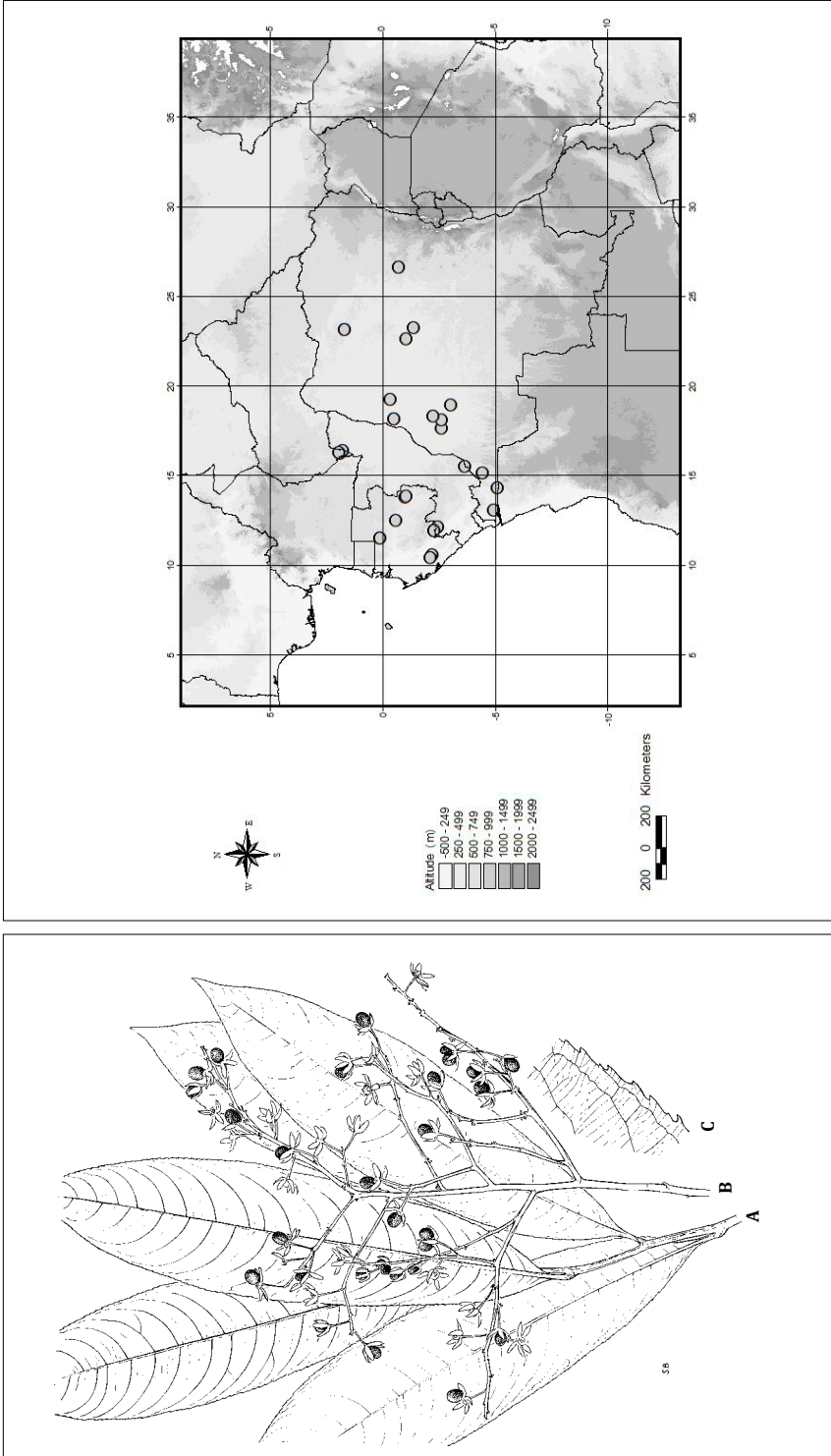
*C. engama* is sometimes closely resembling *C. laeve*, especially when the latter have inflorescences with long racemes, because both share a very long petiole. However, *C. laeve* can generally easily be distinguished by its thickened and often revolute leaf margin and markedly longer sepals (see also the note under *C. laeve*).

**Distribution:** Cameroon, southern Central African Republic (Sangha-Mbaéré province), Gabon, Republic of the Congo and Democratic Republic of the Congo (**Map 11**).

**Ecology:** in primary, secondary and understory forest, in dry and gallery forest; on sandy soil; at 100-620 m altitude.

**Phenology:** flowering from October to March, also in May and June; fruits observed in February, May, June, August and December.

**Uses:** The wood is used as timber (Farron 1967).



**Figure 10.** *Campylospermum engama*. A. Sterile branch. B. Fruiting branch. C. Leaf margin. Drawings by Sabine Bousani  
**Map 11.** Distribution of *Campylospermum engama*

**Vernacular names:** Democratic Republic of Congo: Engama, Lengama (Mobwasa).

**IUCN conservation status:** LC. EOO=1,075,501 km<sup>2</sup>, AOO=627,110 km<sup>2</sup>, locations=27 (cell width=182 km). Although from the amount of herbarium collections this species appears to be fairly rare and to have a scattered occurrence, its area of occupancy is very large. Moreover, it is found inside National Parks such as the Lopé Reserve and Loango NP, both in Gabon, and the Dzanga-Sangha NP in the Central African Republic. Therefore, the category of Least Concern seems most appropriate.

### **Specimens examined:**

**CENTRAL AFRICAN REPUBLIC, Sangha-Mbaéré:** Kongana research camp, 25 km SE of Bayanga, 2°55'N 16°16'E, 2 June 1994 (fl, fr), *Harris, D.J. 5037* (E,WAG); Kongana research camp, 25 km SE of Bayanga, 2°47'N 16°25'E, 9 June 1994 (fl, fr), *Harris, D.J. 5117* (E,WAG); Madibwé, close to St. Francois road 12 km NE of Bayanga, 2°58'N 16°18'E, 28 May 2001 (fl, fr), *Harris, D.J. 7878* (E,WAG).

**CONGO (BRAZZAVILLE), Niari:** route Malinga-Divénié, 4 km du village Mollo. 2°31.21'S 12°09.44'E. Alt: 492m, 13 June 2011 (st), *Bissiegou 1320* (LBV,WAG).

**CONGO (KINSHASA), Bandundu:** Patambalu. 2°15'S 18°19'E, 10 March 1953 (fl), *Tailfer 108* (BR); Lukenie. 2°44'S 18°08'E, 31 October 1948 (fl), *Jans, E. 811* (BR); Nioki. 2°43'S 17°40'E, 1940 (fl), *Flamigni 6034* (BR); Buna. 3°14'S 18°59'E, December 1942 (fl), *Flamigni 6265* (BR); **Bas-Congo:** Banza. 5°51'S 14°20'E, 18 December 1959 (fl), *Compère 1086* (BR,K); Kisantu. 5°02'S 15°10'E, December 1948 (fl), *Callens 1954* (BR); Luki. 5°38'S 13°04'E, 27 November 1948 (fl), *Donis 2136* (BR,K); **Equateur:** Wendje (Coquilhatville). 0°04'S 18°10'E, May 1930 (fl, fr), *Lebrun 365* (K,WAG); Wendji. 0°04'S 18°10'E, August 1930 (fr), *Lebrun 1153* (BR,K); Djoa. 0°08'N 19°16'E, 28 February 1958 (fr), *Evrard, C.M. 3576* (BR,K); Ikela. 1°11'S 23°16'E, 17 December 1958 (fr), *Evrard, C.M. 5299* (BR); Yongo, (Ikela). 0°46'S 22°40'E, 6 May 1959 (fl, fr), *Evrard, C.M. 6278* (WAG);

**Kinshasa:** Inkiene, Kin. Maluku. 4°03'S 15°33'E, 6 March 1970 (fl), *Breyne, H. 802* (BR); **Orientale:** Mobwasa. 2°40'N 23°11'E, June 1913 (fl), *Lemaire, H. 337* (BR); Mobwasa. 2°40'N 23°11'E, May 1913 (fl), *Giorgi 737* (BR); Parc National de la Maïko, 45 km au N. de Lubutu, Pene Aluta, rive droite de la Maïko, entre affluents Ukungu et Utambe. 0°20'S 26°40'E, 1 June 1977 (fr), *Lejoly 1607* (BR,BRLU); Parc National de la Maïko, 45 km au Nord de Lubutu, Péné Aluta, rive droite de la Maïko, entre les affluents Ukungu et Utambe. 0°20'S 26°40'E, 2 June 1977 (fr), *Lejoly 1904* (BRLU).

**GABON, Haut-Ogooué:** après pont de la rivière Sebe. 0°43'S 13°49'E. Alt: 453m, 18 November 2009 (fl), *Bissiegou 912* (LBV,WAG); nouvelle exploitation CEB, vers Okondja. 0°45.4'S 13°50.8'E. Alt: 457m, 18 November 2009 (fl), *Bissiegou 925* (LBV,WAG); **Ngounié:** vieux chantier forestier. 2°18.85'S 11°55.70'E. Alt: 356m, 19 June 2011 (st), *Bissiegou 1390* (LBV,WAG); vieux chantier forestier. 2°18.98'S 11°55.58'E. Alt: 404m, 19 June 2011 (st), *Bissiegou 1392* (LBV,WAG); 22 km along a track in a northern direction from Doussala. 2°12'S 10°36'E. Alt: 100m, 4 December 1986 (fl), *Wilde, J.J.F.E. de 9154* (E,LBV,MO,P,WAG); **Ogooué-Ivindo:** Ivindo National Park 3 km W of Langoué Bai at WCS camp. 0°10.92'S 12°32.70'E, 26 November 2002 (fl), *Stone, J.R. 3491* (LBV,MO,WAG); **Ogooué-Maritime:** Doudou Mountains National Parc 50 km S of Mandji. 2°07.8'S 10°26.4'E. Alt: 230m, 15 November 2005 (fl), *Sosef 2316* (LBV,WAG); **Woleu-Ntem:** 8 km SSW of Mitzic, FOREENEX forest exploitation. 0°42.9'N 11°32.0'E. Alt: 547m, 6 November 2009 (fl), *Bissiegou 676* (LBV,WAG); 8½ km SSW of Mitzic, FOREENEX forest exploitation. 0°42.5'N 11°31.9'E. Alt: 501m, 6 November 2009 (fl), *Bissiegou 706* (LBV,WAG).

**Key literature:** Bamps & Farron (1967), Farron (1963, 1985).

### **Campylospermum excavatum** (Tiegh.) Farron

**Fig. 11**

Bull. Jard. Bot. État Bruxelles 35: 396 (1965). – *Exomicrum excavatum* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 340 (Dec. 1902). – Type: *Zenker 1077a* (holotype: P!; isotype: E(2x)!, G(2x)!, K!), Cameroon, Bipinde, 1896.

*Ouratea mimfiensis* Gilg., nom. nud.

*Shrub* or *treelet* up to 6 m tall, with branched stem; twigs with a whitish green coloured bark. *Stipules* persistent, triangular, **2–6(–10) mm long**. *Leaf:* petiole 3–5(–7) mm long;

leaf blade narrowly elliptic to narrowly elliptic-obovate, 9–17(–19) x 2–4(–5) cm, ratio **3–4(–6)**, base cuneate to narrowly cuneate, apex acute to acuminate, parchmentaceous, **distinctly bullate between the lateral veins**, upper side green, glossy, lower side paler green, margin **serrulate**, generally more distinctly so **in the upper half, rarely almost entire**; venation: midrib prominent above and below, main lateral veins **8–15(–19)** on either side, **7–15 mm apart, prominent but sitting in a furrow above**, prominent beneath, **making a slight angle with the midrib** and curved upward to run parallel to the margin, intermediate lateral veins **1 or 2** in between each pair of main laterals, prominent on both sides, tertiary venation scalariform, perpendicular to the midrib, **very distinct on both sides** or sometimes slightly distinct below. *Inflorescence* terminal, unbranched or sometimes branched, lax, its main axis (2–)4–10(–14) cm long, flattened to cylindrical; **pairwise scales at the base of peduncle absent**; bracts caducous, triangular, 1–3 mm long; racemes **0–2(–4), 2–4(–8) cm long**; cymules 0.5–1.5 cm apart, 1–4(–6)-flowered. *Flower*: pedicel **(4–)7–10 mm long**, articulated at 1–3 mm from the base; sepals narrowly ovate, in flower 5–7 x 1.5–2 mm, in fruit 6–8 x 2–3 mm, base truncate, apex rounded; petals obovate, 6–7 x 3–4 mm, **cuneate at base, rounded at apex**; stamens: anthers 4–6 mm long; ovary c. 1–2 mm high; style 4–5 mm long, persistent in fruit. *Fruit*: receptacle c. 1 mm thick in flower, in fruit 4–6 thick and 5–6 mm in diameter; drupelets 1 to 2 well developed per receptacle, **broadly ellipsoid to broadly reniform**, 6–12 x 5–10 mm, immature ones reddish, mature ones black; cotyledons incumbent, dissimilar in size with a small outer cotyledon.

**Notes:** *C. excavatum* resembles *C. sulcatum* and *C. descoingsii*. For the distinction with the former, see Notes below that species. The latter has a longer main inflorescence axis, broader leaves and flowers sitting on shorter pedicels (see also the note under *C. vogelii*).

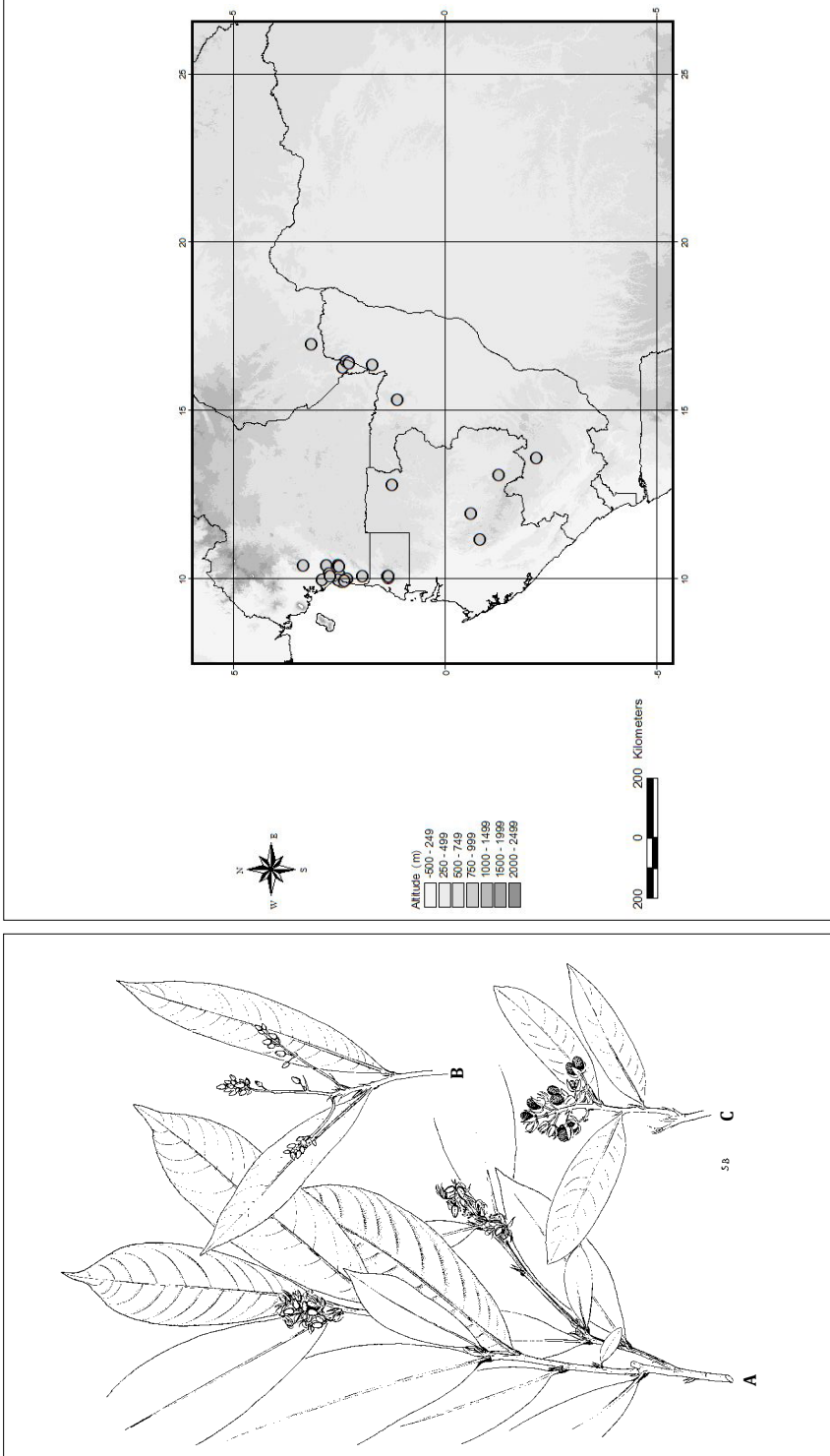
**Distribution:** Cameroon, southern Central African Republic, Equatorial Guinea, Gabon, and the Republic of the Congo (**Map 12**).

**Ecology:** in primary and secondary forest, high forest on mountain slope; at 20–440 m altitude.

**Phenology:** flowering from January to April and July, fruiting from February to May, also in September and November.

**Uses:** In case of chest problems, leaves are ground with seeds of *Afromomum melegueta*, pulverized and rubbed into scarifications (Neuwinger 2000).

**IUCN conservation status:** LC. EOO=389,139 km<sup>2</sup>, AOO=101,075 km<sup>2</sup>, locations=34, subpopulations=8 (cell width=28 km). This species has a considerable number of locations. Its recent collection is from 2011 and it occurs in protected areas such as the Dzanga-Sangha National Park (Central African Republic), the Monte Alen National Park (Equatorial Guinea) and the Minkébé National Park (Gabon). Therefore, the category of Least Concern seems most appropriate.



**Figure 11.** *Campylosperrum excavatum*. **A.** Flowering branch. **B.** Flowering branch with flower bud. **C.** Fruiting branch with flower bud. Drawings by Sabine Bousani  
**Map 12.** Distribution of *Campylosperrum excavatum*

**Specimens examined:**

**CAMEROON, Central Province:** 60 km SW of Eséka, S. of Nyong R. 12 km W. of Songbong. 3°26'N 10°24'E. Alt: 200m, 9 March 1965 (st), *Leeuwenberg 5025* (P,WAG); 60 km SW of Eséka, S. of Nyong R. 12 km W. of Songbong. 3°26'N 10°24'E. Alt: 200m, 11 March 1965 (st), *Leeuwenberg 5102* (BAS,P,WAG,YA); **Littoral:** 8 km W. of Masok. 4°08'N 10°24'E. Alt: 400m, 27 March 1965 (st), *Leeuwenberg 5215* (BAS,BR,K,LISC,MO,P,PRE,WAG,YA); **South Province:** Bipinde, Mimfia., 3°04'N 10°23'E, (fl), *Zenker s.n.* (G); réserve de la Faune de Campo. 2°23'N 10°06'E, 28 March 1983 (fr), *Nkongmeneck 487* (P); Urwaldgebiet. 3°05'N 10°25'E, 1896 (fl), *Zenker 1077* (E,G); Bipindi. 3°05'N 10°25'E, 1896 (st), *Zenker 1077* (BM,E); route Kribi-Londji, 30 km de Kribi, après village pygmée. 3°05.48'N 9°59.26'E. Alt: 29m, 29 March 2010 (fr), *Bissiengou 1230* (LBV,WAG,YA); route Kribi-Londji, 30 km de Kribi, après village pygmée. 3°35.3'N 9°59.3'E. Alt: 79m, 29 March 2010 (st), *Bissiengou 1232* (LBV,WAG,YA); Kribi, Mahale, Forest patch behind Hotel La Belle Hollandaise. 2°59'N 9°56'E. Alt: 40m, 18 March 2001 (fl, fr), *Andel, T.R. van 3245* (KRIBI,SCA,WAG,YA); Urwaldgebiet. 3°05'N 10°25'E, 1907 (fl), *Zenker 3345* (BM,COI,E,G,K,LY,MA,S,US,W,Z); 7.5 km from Kribi, 2 km N of Ebolowa road. 2°54'N 9°57'E, 26 November 1968 (fr), *Bos, J.J. 3388* (BR,C,E,K,LMA,MO,P,PRE,WAG,YA); 18 km from Kribi, Lolodorf road. 3°00'N 10°02'E, 5 March 1969 (st), *Bos, J.J. 4071* (BAS,BR,K,LMA,M,MO,P,WAG,YA); Urwaldgebiet. 3°05'N 10°25'E, 1911 (fr), *Zenker 4268* (BM,E,G,K,LY,S,W); 28 km from Kribi, Lolodorf road., 3°02'N 10°07'E, 8 April 1969 (st), *Bos, J.J. 4296* (WAG,YA); Urwaldgebiet. 3°05'N 10°25'E, 1912 (fl), *Zenker 4535* (E); Bipindi Urwaldgebiet. 3°05'N 10°25'E, 1912 (fl), *Zenker 4555* (BM,BR,G,K,S); 60 km S. of Edéa, S. of Mboké, 11 km E. of km 58 of road Edéa-Kribi. 3°21'N 10°10'E. Alt: 100m, 22 April 1965 (st), *Leeuwenberg 5496* (BAS,BR,P,WAG,YA); 15 km from Kribi, 1 km S. of Ebolowa road. 2°51'N 10°01'E, 20 February 1970 (fr), *Bos, J.J. 6386* (BAS,BR,MO,P,WAG,YA); 15 km SE. of Kribi, between airstrip and Mt. Elephant. 2°50'N 10°00'E, 26 March 1970 (st), *Bos, J.J. 6642* (WAG); Kribi, just E. of town, S. bank of Kienke river. 2°56'N 9°55'E, 16 April 1970 (st), *Bos, J.J. 6818* (BAS,BR,P,WAG); route d'Edea-Kribi, Km 70 à partir d'Edea. 3°20'N 10°05'E, 23 April 1970 (st), *Farron 7093* (P); Kribi, km 5 sur la route d'Ebolowa. 2°55'N 9°57'E, 25 April 1970 (st), *Farron 7147* (P).

**CENTRAL AFRICAN REPUBLIC, Sangha-Mbaéré:** Forêt de Ngotto, Bambioi. 3°54'N 16°59'E, 10 May 1999 (fr), *Zawa 467* (BRLU); Kongana Camp, 22 km SE of Bayanga. 2°47'N 16°26'E, 13 April 1996 (fl), *Fangounda 526* (E,WAG); Bai Hoku Gorilla study area, 25 km E of Bayanga. 2°52'N 16°29'E. Alt: 435m, 22 February 1988 (fl), *Carroll, R.W. 1032* (E,MO); 25 km SE of Bayanga, Kongana research camp. 2°47'N 16°25'E, 28 January 1994 (fl), *Harris, D.J. 4317* (E,MO,WAG); 25 km SE of Bayanga, Kongana research camp. 2°47'N 16°25'E, 4 February 1994 (fl), *Harris, D.J. 4462* (E,WAG); 25 km SE of Bayanga, Kongana research camp., 2°47'N 16°25'E, 6 February 1994 (fl), *Harris, D.J. 4487* (E,WAG); 25 km SE of Bayanga, Kongana research camp. 2°47'N 16°25'E, 15 February 1994 (fl), *Harris, D.J. 4627* (E); Kongana research camp, 25 km SE of Bayanga. 2°47'N 16°25'E, 31 May 1994 (fr), *Harris, D.J. 5005* (E); around Kongana camp, 25 km SE of Bayanga. 2°47'N 16°26'E, 11 November 2000 (st), *Harris, D.J. 7161* (E); Madibwé, close to St. Francois road 12 km NE of Bayanga. 2°58'N 16°18'E, 6 May 2001 (fr), *Harris, D.J. 7575* (E,WAG); Kongana camp. 25 km SE of Bayanga. 2°48'N 16°25'E, 23 May 2001 (fr), *Harris, D.J. 7811* (E,WAG).

**CONGO (BRAZZAVILLE), Cuvette:** Odzala National Park, Ekagna. 1°20'E, 15°20'E, 22 January 1996 (fl), *Lejoly 96/169* (BRLU); **Lékoumou:** Komono, Zanaga Project, just South of MPD Congo S.A. camp. Plot 8. 2°46.73'S 13°35.97'E. Alt: 638m, 31 March 2009 (fr), *Cheek 14650* (IEC,K,MO,P,WAG); **Sangha:** Plot 15, 31 km E of Kabo. 2°05.45'N 16°21.97'E, 19 February 2007 (fl), *Harris, D.J. 8894* (E,IEC).

**EQUATORIAL GUINEA, Rio Muni, Centro Sur:** SO du parc National de Monte Alen, sur le transect ECOFAC de Mosumo à 500 m du début du layon. 1°35.89'N 10°02.21'E. Alt: 185m, 14 February 2001 (st), *Senterre 341* (BRLU); SO du parc National de Monte Alen, 200 m du transect ECOFAC de Mosumo à 1620 m du début du layon. 1°35.62'N 10°03.30'E. Alt: 410m, 12 March 2001 (st), *Senterre 853* (BRLU); SO du parc National de Monte Alen, 2 km au NE du site de traversée du rio Uolo pour aller aux cataractas. 1°37.44'N 10°04.57'E. Alt: 250m, 20 January 2002 (st), *Senterre 1999* (BRLU); SO du parc National de Monte Alen, 2 km au NE du site de traversée du rio Uolo pour aller aux cataractas. 1°37.13'N 10°04.69'E. Alt: 440m, 13 February 2002 (st), *Senterre 2312* (BRLU).

**GABON, Haut-Ogooué:** 23 km route Moanda-Bakoumba. 1°40'S 13°06'E, 18 September 1970 (fr), *Breteler 6516* (WAG); **Ngounié:** just west of bridge crossing the Oumba River, in the northern part of Waka National Park. 1°06.09'S 11°11.10'E. Alt: 400m, 18 March 2007 (fr), *Sosef 2408* (LBV,WAG); **Ogooué-Lolo:** 0°50'S 11°57'E, 29 July 1993 (fl), *Dibata 1136* (MO,WAG); **Woleu-Ntem:** Minkébé area, base camp. 1°30'N 12°48'E, 6 April 1990 (fl), *Minkébé Series W 94* (WAG).

**Key literature:** Farron (1963, 1965, 1985).



**Campylospermum flavum** (Schumach. & Thonn.) Farron**Fig. 12**

Bull. Jard. Bot. État Bruxelles 35: 397 (1965). – *Gomphia flava* Schumach. & Thonn., Beskr. Guin. pl.: 236 (1827). – *Monelasmum flavum* (Schumach. & Thonn.) Tiegh., J. Bot. (Morot) 16: 202 (June 1902). – *Ouratea flava* (Schumach. & Thonn.) Hutch. & Dalziel ex Stapf, Bot. Mag. 149: t. 9023 (1924). – Type: *Thonning s.n.* (holotype: C!; isotype: C!), Guinea.

*Monelasmum acutum* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 331 (Dec. 1902). – Type: *Pobéguin 36* (holotype: P!), Ivory Coast, Zegbé village, 1895.

*Monelasmum bolamense* Tiegh. Ann. Sci. Nat., sér. 8, Bot. 16: 335 (Dec. 1902). – Type: *Souza s.n.* (holotype: COI!), Guinea-Bissau, Bolama, 1883.

*Monelasmum chevalieri* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 333 (Dec. 1902). – Type: *Chevalier 471* (holotype: P!; isotype: P(7x)!), French Soudan, Diaragouéla, February 1899.

*Monelasmum fuscum* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 330 (Dec. 1902). – Type: *Thollon 517* (holotype: P!; isotype: P(2x)!), Gabon, 1885.

*Monelasmum pungens* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 333 (1902). – Type: *Le Testu 253* (holotype: P!; isotype: P(4x)!), Dahomey, Adja Ouéré, December 1901.

*Monelasmum souzae* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 335 (Dec. 1902). – Type: *Souza s.n.* (holotype: COI!, isotype: COI!), Guinea-Bissau, Bolama, 1883.

*Monelasmum thoiréi* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 332 (Dec. 1902). – Type: *Thoiré 204* (holotype: P!), Ivory Coast, San-Pedro, March 1901.

*Monelasmum viride* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 332 (1902). – Type: *Paroisse 79* (holotype: P!), French Guinea, Labaya Kouinsi-bêla, 1893.

*Monelasmum schlechteri* (Gilg) Tiegh., Ann. Sci. Nat., sér. 8, Bot. 18: 36 (June 1903). *Ouratea schlechteri* Gilg, Bot. Jahrb. Syst. 33: 269 (1904). – Type: *Schlechter 12719* (holotype: BR!; isotype: K!, LY(2x)!), Cameroon, Sanga, August 1899.

*Monelasmum krebedjense* Tiegh., Ann. Sci. Nat., sér. 9, Bot. 5: 171 (1907). – Type: *Chevalier 10667* (holotype: P!; isotype: P(2x)!, K!), territoire Chari, Krébedjé, Fort Sibut, 1903.

*Monelasmum nanense* Tiegh., Ann. Sci. Nat., sér. 9, Bot. 5: 171 (1907). – Type: *Chevalier 6261* (holotype: P!; isotype: K!, P(2x)!), territoire Chari, entre le poste de Nana et celui des trois marigots, November 1902.

*Ouratea monticola* Gilg, Bot. Jahrb. Syst. 33: 272 (1904). – *Campylospermum monticulum* (Gilg) Cable, Pl. Mount Cameroon: Conserv. Checklist: 92 (1998) (as "*C. monticola*"); Cheek, Pl. of Kupe, Mwanenguba and the Bakossi Mountains, Cameroon: Conserv. Checklist: 353 (2004). – Lectotype (designated here): *Deistel 283* (holotype: K!; isotype: A!, BM!), Cameroon, Buea, 1904.

*Ouratea spinuloso-serrata* Gilg, Bot. Jahrb. Syst. 33: 265 (1904). – Lectotype (designated here): *Schlechter 13022* (holotype: G!; isotype: G!), Nigeria, Ibadan and Abeokuta.

*Ouratea laurentii* De Wild., Rev. Zool. Afr. 7, Suppl. Bot.: B57 (1920). – Lectotype

(designated here): *E. & M. Laurent s.n.* (holotype: BR!; isotype: BR!), Congo, Ukatoraka, January, 5<sup>th</sup> 1904.

*Ouratea pynaertii* De Wild., Rev. Zool. Afr. 7, Suppl. Bot.: B62 (1920). – Type: *Pynaert 184* (holotype: BR!; isotype: BR(2x)!, Z!), Congo, forêt de Lukolela, July 6<sup>th</sup>, 1906.

*Ouratea ashantiensis* De Wild., Pl. Bequaert. 4: 441 (1928). – Type: *Kitson s.n.* (holotype: BR!; isotype: BM!), Gold Coast, Akumadai district, Ashanti, April 1916.

*Ouratea newiensis* De Wild., Pl. Bequaert. 4: 501 (1929). – Type: *Kitson s.n.* (holotype: BR!; isotype: BM!), South Nigeria, January 6<sup>th</sup>, 1909.

*Ouratea talbotii* De Wild., Pl. Bequaert. 4: 514 (1929). – Type: *Talbot s.n.* (holotype: BR!; isotype: BM!), southern Nigeria, Oban, 1911.

*Tree* up to 15 m tall, with branched trunk; twigs with brownish coloured bark. *Stipules* caducous, triangular, 4–5 mm long. *Leaf*: petiole 3–8 mm long; leaf blade **elliptic to narrowly elliptic or narrowly elliptic-obovate, (7–)13–26(–45) x (3–)5–8(–9) cm** ratio **2–4**, base cuneate, apex from slightly acuminate to blunt, **coriaceous**, not bullate, upper side slightly glossy dark green, lower glossy medium green, **margin closely to distantly spinose-serrate**; venation: midrib flat to slightly prominent on the upper side, prominent on the lower side, main lateral veins generally 11–25 on either side, 5–25 mm apart, at a ± right angle with the midrib but curved upwards to run parallel to the margin, prominent on both sides, intermediate lateral veins 1–5 in between the main ones, prominent, **tertiary venation scalariform, sometimes joined by cross veinlets, perpendicular to the midrib, distinct on the upper side, very distinct on the lower side**. *Inflorescence* terminal, branched or occasionally unbranched, fairly dense, its main axis (7–)10–20(–31) cm long; **pairwise scales at the base of the peduncle absent**; racemes 0–5, (3–)6–18(–21) cm long, spread out ± horizontally, occasionally the lowest ones branched; **cymules 0.5–1 cm apart, (1–)3–10-flowered**. *Flower*: pedicel (5–)7–15(–17) mm, articulated at 1–4(–5) mm from the base; sepals narrowly ovate, **6–7 x 2–3 mm in flower, 6–7 x 3–5 mm in fruit**, apex acute, greenish-yellow in flower, red and patent in fruit; petals obovate, 5–10 x 4–8 mm, base cuneate, **apex rounded to slightly emarginate**; stamens: anthers 5–6 mm long; ovary c. 2 mm long; style c. 5 mm long. *Fruit*: receptacle c. 1 mm long in flower, 5 x 5 mm in fruit; drupelets 3 to 4 well developed per receptacle, ellipsoid to broadly ellipsoid, 6–10 x 4–6 mm; **cotyledons incumbent, dissimilar in size with a small outer cotyledon**.

**Notes:** This species is generally easily recognized by the leaves with spinulose-serrate margin, a branched inflorescence with comparatively small flowers in rather closely set cymules. Some forms are close to *C. bukobense*, but that species has papyraceous and more elongated leaves, and a less pronounced serrate leaf margin.

Specimens previously identified as *Ouratea laurentii* show some dissimilarities with typical *C. flavum*. Their inflorescence is either branched or not. When not branched, those specimens are close to *C. glaucum*, but differ by having a strongly dentate margin

and longer leaves.

The following specimens: *Preuss 760*, *Preuss 829*, *Lehmbach 111* and *Deistel 283* were cited as types of *C. monticola* in the protologue. The latter has been designated as lectotype of *C. monticola* since the other two specimens have not been traced. Lectotypes for *Ouratea laurentii* and *Ouratea spinuloso-serrata* were also designated. Both specimens have two duplicates present in BR and G respectively and the material has both flowers and fruits.

**Distribution:** from Guinea Bissau to Cameroon, the Central African Republic, Gabon, northern Republic of the Congo and the Democratic Republic of the Congo (**Map 13**).

**Ecology:** in primary and secondary forests, swampy, dry and riverine or gallery forest, and in coastal savannah; on sandy, laterite and clayish soil; at 15–2200 m altitude.

**Phenology:** flowering and fruiting observed all year round.

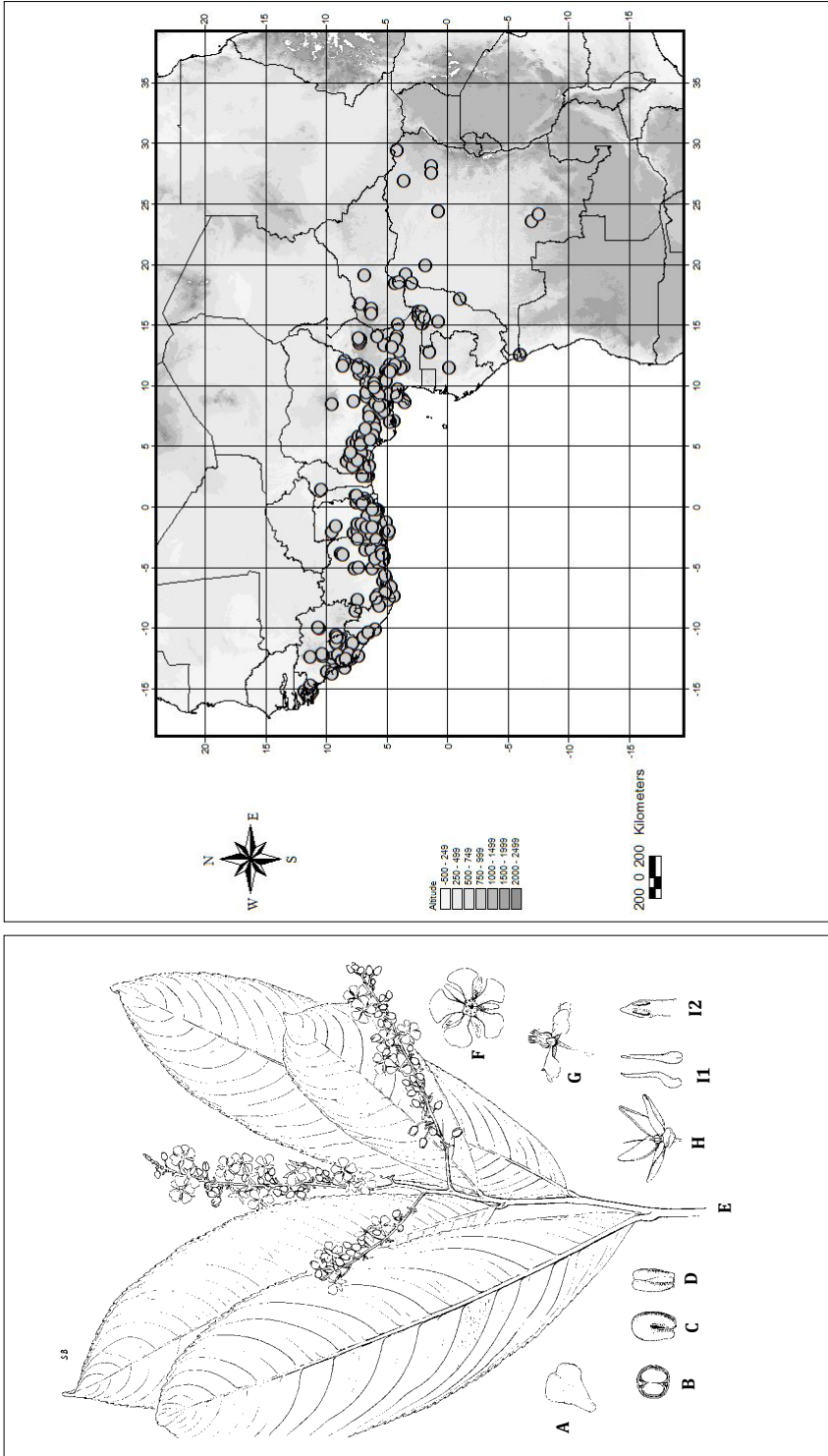
**Vernacular names:** **Cameroon:** Kpemtele (Bobili). **Democratic Republic of the Congo:** Bolili bo kikereke (turumbu). **Ghana:** Epebégai, Hiatsò (Ta), Laba (Ewe). **Guinea Bissau:** N'Saunte (Nalu). **Nigeria:** Fulami (Yakaro), Yakaro/Nyambu (Fulfude).

**IUCN conservation status:** LC. EOO=5,492,550 km<sup>2</sup>, AOO=6,062,220 km<sup>2</sup>, locations=275 (cell width=502 km). This species is widely distributed from West to Central Africa. It is well represented in herbaria, with numerous recent collections, and so seems to be fairly common. Thus, the category of Least Concerned has been assigned.

#### **Specimens examined:**

**BENIN, Atakora:** Tétanté. 10°25'N 1°27'E. Alt: 521m, 15 August 2000 (fl, fr), *Essou 2317* (BENIN,WAG); **Ouémé:** Ita Djébou, 12 km N de Sakété. 6°48'N 2°37'E, 29 October 1970 (st), *Zon, A.P.M. van der 138* (BR,HUJ,IFAN,K,MO,WAG); Adja Ouéré. 7°00'N 2°37'E, 20 December 1901 (fl), *Le Testu 253* (P); Ouando. 6°30'N 2°36'E, 22 November 1967 (fl, fr), *Eijnatten 2228* (BR,HUJ,IFAN,K,MO,WAG); Pobè. 6°57.38'N 2°40.11'E. Alt: 125m, 14 March 2001 (st), *Akoègninou 4370* (BENIN,WAG); Forêt de Toffo, 4-5 km W of Pobè, road to Adja-Ouère. 6°59.7'N 2°37.7'E, 24 November 1998 (st), *Maesen, L.J.G. van der 6623* (BENIN,WAG); entre Sakété et Pedjilé. 6°43'N 2°40'E, 1 February 1910 (fl), *Chevalier, A.J.B. 22912* (P).

**CAMEROON, UNKNOWN:** P.T.Rd. Mt. S. 24 March 1961 (fl, fr), *Swarbrick 2322* (E); **Adamawa Region:** 45 km E Ngaoundere. 7°22'N 13°59'E. Alt: 1700m, 20 January 1982 (fl), *Satabié 621* (P); **Central Province:** Yaoundé station. 3°52'N 11°31'E, (fl), *Zenker; Staudt 14* (E); environs du bureau SRCam (sur rayon 800 m environ) Eaux et Forêts. 3°52'N 11°31'E, 26 November 1958 (st), *Endengle 79* (P); Yaoude station. 3°52'N 11°31'E, (fl, fr), *Zenker; Staudt 102* (BM,G,S); Mont Ngoro à 58 km SW de Linte. 5°05'N 11°18'E, 17 April 1982 (fr), *Nkongmeneck 271* (P); piste directe Kom-Confluent Noun-Mbam, 23 km NW Bafia. 4°54'N 11°06'E, 23 January 1981 (fl), *Satabié 577* (P); près chefferie Bazou de Bangangzé. 5°04'N 10°28'E, January 1947 (fl), *Letouzey 1104* (P); Centre agronomique N'Kolbisson, 8 km W. of Yaoundé. 3°53'N 11°27'E. Alt: 750m, 6 December 1963 (fl, fr), *Wilde, W.J.J.O. de 1395* (B,BR,EA,FHI,GENT,K,MHU,P,PRE,WAG,YA,Z); entre Zogela et Mbomba. 4°02'N 12°53'E, 25 April 1959 (fl, fr), *Letouzey 1803* (P); Goura. 4°33'N 11°24'E, December 1938 (fl), *Jacques-Félix 2375* (P); Bafia. 4°45'N 11°14'E, December 1938 (fl), *Jacques-Félix 2418* (P); Nkolbisson, 7 km W. of Yaoundé. 3°53'N 11°27'E. Alt: 800m, 3 March 1965 (st), *Leeuwenberg 5015* (BAS,BR,P,WAG,YA); 50 km Ayos West. 3°54'N 12°05'E, 16 December 1957 (fl), *Wit, H.C.D. de 7188* (B,K,WAG,Z); Bafia region. 4°45'N 11°14'E, 18 December 1957 (fl), *Wit, H.C.D. de 7189* (K,WAG); Obala, à 45 km au NE, bords de la Sanaga, confluent de l'Assamba, près de la gare de Njoré. 4°20'N 11°45'E, 21 May 1970 (fr), *Farron 7317* (P); Issandja, 40 km NWE de NTUI. Feuille IGN 1/200000 Bafia. 4°46'N 11°46'E, 18 December 1969 (fl), *Letouzey 9712* (K); Route Ndanan I-Ndangan I Left path left into forest after bridge, parallel to water course. 3°37.2'N 11°35.1'E. Alt: 710m, 10 March 2004 (fl), *Cheek 11636* (K MO,SCA,WAG,YA); **East Province:** Moyen Congo, rive de la Ngoko. 1°56'N 15°39'E, March 1920 (fl), *Pobéguin (central Africa series) 61* (P); Ndjassi. 4°16'N 13°51'E, 19 March 1927 (fl), *Hédin, L. 344* (P); 50 km de Bertoua, vers Aboumadjali. 4°34'N 13°16'E, 11 February 1956 (fr),



**Figure 12.** *Campylospermum flavum*. **A.** Petal. **B.** Seed, cross section. **C.** Seed, side view. **D.** Seed, bottom view. **E.** Flowering branch. **F.** Flower, top view. **G.** Flower, side view. **H.** Persistent sepals. **I1 & I2.** Anthers. Drawings by Sabine Bousani

**Map 13.** Distribution of *Campylospermum flavum*

*Nana*, P. 465 (P,WAG); 6 km NW du confluent Boumba-Dja-Ngoko (Feuille IGN Moloundou 1/200000). 2°06'N 15°11'E, 17 April 1971 (fl, fr), *Villiers, J.F. 664* (P); near Moloundou, along Boumba River. 2°02'N 15°10'E. Alt: 340m, 9 December 1982 (fl), *Kruif, A.P.M. de 891* (MO,WAG,YA); Dzanga-Sangha Reserve, 45 km South of Lidjombo, East bank of Sangha River from NDAKAN. 2°21'N 16°09'E. Alt: 350m, 4 November 1988 (fl), *Harris, D.J. 1542* (E); Near Yoko-Betugu, road to Ndemba II, along river Do 30 km NW. of Bertoua. 4°45'N 13°33'E. Alt: 670m, 12 December 1961 (st), *Breteler 2208* (BR,K,P,WAG,YA); Near Bimba, bank of Doumé river, 40 km SW. of Batouri. 4°10'N 14°07'E. Alt: 580m, 15 April 1962 (st), *Breteler 2798* (WAG); près Goyoum. 5°12'N 13°23'E, 31 January 1961 (fl), *Letouzey 3339* (P); au N. du Monay. 5°48'N 14°05'E, 28 February 1971 (fr), *Letouzey 3570* (P); Lobeke Reserve. Djangi Bai and surroundings. 2°19'N 15°46'E, 2 November 1998 (fl), *Harris, D.J. 6137* (E,MO,WAG); Lobeke Reserve. Djaloumbe bai., 2°23'N 15°45'E, 26 November 1998 (fr), *Harris, D.J. 6573* (E,MO,WAG); **Littoral**: Km 14 Melong-Dschang road. 5.17 N 9.59 E, 5°17'N 9°59'E. Alt: 700m, 19 January 1972 (st), *Leeuwenberg 9219* (BR,K,MO,P,PRE,WAG,YA); Km 14 Melong-Dschang road. 5.17 N 9.59 E, 5°17'N 9°59'E. Alt: 700m, 13 March 1972 (fl), *Leeuwenberg 9470* (B,BR,C,EA,FHI,GC,H,HBG,K,LD,LISC,M,MO,P,PRE,UP,S,US,WAG,YA); Douala. 4°03'N 9°42'E, 31 December 1949 (fl), *Baldwin jr 13992* (K); **North Province**: Plateau of the Adamaoua, grounds of the cattle breeding centre at Wakwa, between 8 and 11 km S. of Ngaoundéré. 7°14'N 13°35'E. Alt: 1200m, 8 October 1960 (st), *Breteler 435* (U,WAG); Falls in the Vina river 15 km SE. of Ngaoundéré. 7°12'N 13°43'E. Alt: 1200m, 1 December 1964 (st), *Wilde, W.J.J.O. de 4456* (K,P,WAG); near falls in the Tello river 47 km E. of Ngaoundéré. 7°10'N 13°55'E. Alt: 1200m, 9 December 1964 (st), *Wilde, W.J.J.O. de 4702* (K,P,WAG); **North-West Province**: British Cameroons. Mashi, Kentu. 6°37'N 10°16'E. Alt: 610m, March 1932 (fl, fr), *Johnstone, A.T. 296* (FHO); Bali to Bamoa. 5°53'N 10°01'E. Alt: 1300m, 12 February 1928 (fl), *Migeod 501* (BM,K); River Kimbi, Bridge, Bendel. 6°39'N 10°20'E. Alt: 1070m, 11 February 1958 (fl, fr), *Hepper 1925* (K,S); Tinachong, 30km WNW. Bamenda et 20km NNE. Batibo (feuille IGN 1/200.000 Akwaya). 6°02'N 9°52'E. Alt: 1800m, 10 August 1975 (st), *Letouzey 14232* (K,P,YA); British Cameroons. Bamenda Div. Mufung. 5°56'N 10°10'E, February 1931 (fl, fr), *Johnstone, A.T. 31/41* (FHO); **South-West Province**: Victoria. 4°01'N 9°10'E, (fl, fr), *Unknown s.n.* (B); Buea. 4°09'N 9°14'E. Alt: 975m, 1930 (fr), *Maitland, T.D. s.n.* (K); Mamfe. 5°50'N 9°30'E. Alt: 305m, 1930 (fr), *Maitland, T.D. s.n.* (K); Gorge at Kumba. 4°50'N 9°20'E. Alt: 274m, 15 April 1937 (fr), *Hutchinson, J. 151* (K); Urwaldgebiet. 4°11'N 9°11'E, 1904 (st), *Deistel 283* (A,B,M,K); Oban-Mamfe road in Kembong F.R. 5°39'N 9°14'E, 16 March 1955 (fl, fr), *Richards, P.W. 5207* (K); Kumba, Banga, S. Bakoundi Forest Reserve. 4°24'N 9°27'E, 14 March 1948 (fl), *Brenan 9440* (BM,FHO,K); près Bonékanda I, 7 km NE Duéa. 4°11'N 9°11'E. Alt: 2200m, 6 August 1972 (fr), *Letouzey 11590* (P); Kumba Distr., along the pine line which comes from the lake down to the town. 4°50'N 9°20'E, 8 April 1959 (fl), *Daramola, B.O. FHI 41019* (FHI,K); Buea Mountain 4.500 ft. 4°10'N 9°12'E, 26 April 1960 (fl, fr), *Adebusuyi FHI 44021* (FHO,K); **West Province**: Ndop plain. lava piton below Ndop rest house. 6°00'N 10°15'E, 1 March 1962 (fl), *Brunt, M. 40* (K); Bangwa 16 km NW of Bangangté. 5°12'N 10°29'E. Alt: 1300m, 7 May 1964 (st), *Wilde, W.J.J.O. de 2497* (BAS,BR,K,P,WAG,YA); Mbo, 7 km E. of Melong-Dschang road. 5.19 N 10.02 E. Alt: 700m, 14 April 1972 (fl), *Leeuwenberg 9594* (B,BR,FHI,HBG,K,LISC,MO,P,PRE,UPS,US,WAG,YA); Western Cameroon , (fl, fr), *Mildbraed 10235* (K).

**CENTRAL AFRICAN REPUBLIC, Mambéré-Kadéï**: 4 km from Gamboula, village near the boundary along road Berberati-Batouri, on left bank Kadéï R. 4°05'N 15°08'E, 9 December 1965 (fl, fr), *Leeuwenberg 7293* (BAS,BR,K,P,WAG); **Nana-Grébizi econ. pref.**: Haut Chari, pays des Mandjos, poste des trois Marigots. 6°50'N 19°10'E, 20 November 1902 (fl), *Chevalier, A.J.B. 6261* (K,P); **Ombella M'poko**: Haut Oubangui, Krebedje. 4°22'N 18°32'E, (fl), *Chevalier, A.J.B. 10667* (K,P); **Ouham**: Boguilla region. 7°12'N 16°48'E. Alt: 600m, (fr), *Fay, J.M. 5350* (K); Boguilla region. 7°12'N 16°48'E. Alt: 600m, (fl, fr), *Fay, J.M. 5351* (K); **Ouham-Pendé**: Haut Logone, route de Bouala au Mont Kari. 6°17'N 15°57'E, 13 January 1907 (fl), *Lenfant 1131* (P); Neu Cameroon, Bozoum. 6°20'N 16°21'E, 14 March 1914 (fl), *Tessmann 2261* (K); Bozoum (Oubangui). 6°19'N 16°23'E, 7 January 1933 (fl, fr), *Tisserant 2342* (P); **Sangha-Mbaéré**: Ndakan, gorilla study area. 2°21'N 16°09'E. Alt: 350m, 2 March 1988 (fl), *Harris, D.J. 274* (E).

**CONGO (BRAZZAVILLE), Cuvette**: Odzala National Park, 2 km à l'Ouest d'Ekagna, saline Ossassanga. 0°44'N 15°20'E, 23 January 1996 (fl), *Lejoly 96/182* (BRLU); **Likouala**: île du L'Oubangui. 2°55'N 18°28'E, 13 July 1900 (fl), *Foureau 3116* (P); **Sangha**: 14 km E of Kabo., 2°10.27'N 16°08.43'E, 19 August 2006 (fl), *Iyenguet 4* (E,IEC).

**CONGO (KINSHASA), Bas-Congo**: Malela. 5°59'S 12°37'E, 19 December 1918 (fr), *Vermoesen 1167* (BR); Malela. 5°59'S 12°37'E, 1 January 1919 (fl), *Vermoesen 1294* (BR); Malela. 5°59'S 12°37'E, 3 July 1915 (fl), *Bequaert 7923* (BR); **Equateur**: Ukatoraka. 1°50'N 20°00'E, 5 January 1904 (fl, fr), *Laurent, É. s.n.* (BR); Lukolela. 1°03'S 17°12'E, 6 July 1906 (fl), *Pynaert 184* (BR,PZ); entre Libenge et Zongo. 4°00'N 18°37'E,

November 1930 (fl), *Lebrun 1664* (BR,K); Entre Libenge et Gemena. 3°27'N 19°12'E, December 1930 (fl), *Lebrun 1860* (K,WAG); **Kasai-Oriental**: Kanda-Kanda. 6°56'S 23°37'E, 3 September 1957 (fl), *Liben 3739* (BM,G,K,WAG); **Katanga (Shaba)**: Kaniama. 7°31'S 24°11'E. Alt: 830m, 26 August 1958 (fl), *Gathy 1834* (BR); **Oriental**: Parc National de la Garamba (Dungu). 4°10'N 29°30'E, 10 February 1950 (fl), *Saeger 95* (K,WAG); village Gongo. 3°38'N 26°56'E, 8 November 1905 (fl, fr), *Seret 310* (BR); Avakubi. 1°20'N 27°35'E, 5 January 1914 (fl, fr), *Bequaert 1773* (BR); Penghe. 1°20'N 28°09'E, 27 January 1914 (fl), *Bequaert 2144* (S); Yangambi, île Booke wa Mbole. 0°44'N 24°28'E, 1 September 1938 (fl), *Louis, J.L.P. 11096* (BR); Yangambi, île Esali. 0°46'N 24°27'E, 27 March 1931 (fl), *Louis, J.L.P. 14406* (BR,BRLU,K).

**EQUATORIAL GUINEA, Bioco (Fernando Poo)**: Fernando Poo. 3°32'N 8°42'E, (fl), *Mann, G. 271* (HUH,K); Malabo-Cupapa, km 20-21. 3°41'N 8°54'E. Alt: 350m, 26 March 1989 (fl, fr), *Carvalho, M.F. de 3851* (K,MA,WAG). **GABON, UNKNOWN**: Bonni. November 1886 (fl), *Thollon 680* (P); **Ogooué-Ivindo**: Ogooué. 0°07'S 11°31'E, August 1885 (fl), *Thollon 517* (P); **Woleu-Ntem**: Minkébé district, Nsyé valley. 1°30'N 12°48'E, 19 February 1990 (fl, fr), *Wieringa, J.J. 582* (BR,C,LBV,MO,PRE,WAG); Minkébé area, 1010 m on transect B. 1°30'N 12°49'E, 22 February 1990 (st), *Minkébé Series AM 17* (WAG).

**GHANA, UNKNOWN**: (fl), *Thonning s.n.* (C); (fr), *Thonning s.n.* (C,W,WAG); (fl, fr), *Farmar 388* (K); 13 March 1902 (fl, fr), *Johnson, W.H. 901* (K); **Ashanti Region**: Ashanti, Akumadai district. 7°24'N 1°57'W, April 1916 (fl, fr), *Kitson s.n.* (BM); Manpong Scarp, main road, Akwapin. 7°04'N 1°24'W, 14 June 1953 (fl, fr), *Morton, J.K. s.n.* (K); Obuasi. 6°12'N 1°40'W, 1 April 1923 (fl), *King-Church 870* (K,P); Huhunya. 6°10'N 0°11'W, May 1925 (fr), *Howes, F.N. 1009* (P); Abenengi. 1928 (fl), *Moor (Mrs) 1023* (FHO); Aburi hill. 5°51'N 0°11'W, November 1925 (fl, fr), *Howes, F.N. 1025* (FHO); Kumasi., 274m 6°51'N 1°70'W. Alt: 274m, February 1929 (fl), *Akwa 1624* (BM,FHO,K); Ajura Scarp. 7°23'N 1°22'W, 31 March 1957 (fr), *Adams, C.D. 2447* (K); Obuasi. 6°12'N 1°40'W, June 1936 (fl), *Andoh 4211* (K,P); Kwadaso agricultural station. 6°42'N 1°39'W, 27 August 1963 (fl), *Obeng-Darko 5137* (K); Ajura scarp. 7°23'N 1°22'W, 9 December 1953 (fl, fr), *Morton, J.K. 9775* (K); Kumasi. 6°41'N 1°37'W. Alt: 274m, March 1930 (fl, fr), *Andoh FH 1878* (EA,FHO); Berman, Mont Kumasi. 6°44'N 1°38'W. Alt: 274m, February 1931 (fl, fr), *Andoh FH 2148* (A,FHO,K); near Kumasi, Amenhyasu. 6°41'N 1°37'W. Alt: 274m, March 1931 (fl), *Andoh FH 2211* (A,BM,FHO,K); Kumasi. 6°41'N 1°37'W, 11 January 1933 (fl), *Lyon, F.J. FH 2875* (FHO); **Brong-Ahaho Region**: near Kwapon 100 km WSW of Kumasi. 6°37'N 2°29'W, 21 December 1963 (fl), *Oldeman, R.A.A. 784* (BR,K,P,WAG); just N of Wenchi Farm Institute. 7°46'N 2°05'W. Alt: 200m, 19 March 1996 (fr), *Jongkind 2634* (WAG); On Berekum Road from Techiman. 7°27'N 2°35'W, 21 March 1953 (fr), *Morton, J.K. 8570* (K); **Central Region**: Cape Coast. 5°06'N 1°15'W, (fl), *Brass, W. s.n.* (BM); **Eastern Region**: road from Medea to Kotoku Railway station. 5°59'N 0°43'W, 8 November 1953 (fl), *Morton, J.K. s.n.* (K); Aburi. 5°51'N 0°11'W, 15 March 1924 (fr), *Obeng-Darko s.n.* (K); Tinkang. 5°59'N 0°14'W. Alt: 183m, July 1927 (fl), *Moor (Mrs) 76* (FHO,K); Bunso, Akim. 6°17'N 0°28'W. Alt: 229m, 21 December 1941 (fl), *Scholes 342* (K); Aburi Hill. 5°51'N 0°11'W, 18 November 1899 (fr), *Johnson, W.H. 450* (K); Aburi. 5°51'N 0°11'W. Alt: 457m, 24 March 1901 (fl), *Brown, T.W. 681* (K); Pokoase EP. 5°41'N 0°17'W, 12 November 1955 (fl), *Obeng-Darko 1055* (K,P); Nswam. 5°48'N 0°21'W, January 1933 (fr), *Irvine, F.R. 1934* (K); Ayirebi (Oda). 6°05'N 1°08'W, 4 December 1970 (fl), *Obeng-Darko 5696* (WAG); Nswam-Aburi Road. 5°48'N 0°21'W, 10 January 1954 (fl), *Morton, J.K. 25319* (K); Nswam., 5°48'N 0°21'W, 13 March 1930 (fr), *Thomas, A.S. D 143* (K); Mt Edjuanima. 6°35'N 0°44'W, 28 May 1948 (fl, fr), *Robertson, N.F. K 10* (K); **Greater Accra Region**: Mole National Park. 9°12'N 1°33'W, 5 April 1976 (fr), *Lieberman GC46342* (US, WAG); **Volta Region**: by the road of Biakpa, Togo. 6°50'N 0°25'E, 14 November 1953 (fl), *Morton, J.K. s.n.* (K); Worawora. 7°31'N 0°22'E, 22 February 1935 (fl, fr), *Unknown 19* (FHO); Danyigba, Anfoega District. 6°56'N 0°16'E, 3 April 1960 (fl), *Maessen, T. 25* (WAG); Nr Bishop Herman College, Kpandu, V.R. 7°00'N 0°18'E, 26 April 1974 (fl, fr), *Rodenburg 26* (WAG); kpando. 7°00'N 0°18'E, 9 April 1934 (fl), *Asamany 113* (K); 6°51'N 0°26'E, February 1926 (fl, fr), *Irvine, F.R. 166* (FHO,K); Ho, Klefe village. 6°37.1'N 0°26.5'E. Alt: 163m, 25 August 2010 (fl, fr), *Andel, T.R. van 6034* (GC,WAG); 1 km W of Tsurkpe, village 5 km W of Vakpo. 6°47'N 0°17'E. Alt: 200m, 10 March 1977 (fl), *Leeuwenberg 11193* (BR,FHO,GC,K,MO,WAG); 2 mls below Amedzofe. 6°49'N 0°26'E, 25 March 1952 (fl), *Morton, J.K. GC 6500* (K,WAG); **Western Region**: near Oponu, W.P. 5°54'N 2°39'W, 14 March 1939 (fl), *Foggie 187* (FHO); 5 mls inland from Dixcove. 4°48'N 1°57'W, 31 March 1954 (fr), *Morton, J.K. A 466* (K); 5 mls inland from Dixcove W.P. 4°50'N 1°57'W, 31 March 1954 (fr), *Morton, J.K. A 482* (K); road from Axim to Ancobra River, about 4 miles from river. 4°52'N 2°14'W, 1 June 1956 (fr), *Morton, J.K. A 2227* (K); March 1927 (fr), *Vigne FH 229* (BM,K); Awasu, Anwhiaso Forest Reserve. 6°17'N 2°11'W, 20 February 1927 (fl), *Vigne FH 277* (FHO); Anwhiaso Forest Reserve. 6°17'N 2°11'W. Alt: 121m, March 1927 (fl, fr), *Vigne FH 278* (A,FHO,K); Simpa W.P. 5°06'N 2°06'W, February 1933 (fl), *Vigne FH 2770* (FHO); Simpa (near Takura). 5°06'N 2°06'W, 16 February 1934 (fl), *Andoh FH 3244* (FHO); Anibil, W.P. colony. 4°59'N 2°10'W, March 1934 (fl, fr), *Andoh FH 3254* (FHO,K).

**GUINEA, Boké:** Bindélya. 2 km de Kandiafara. 11°18'N 14°42'W, (fl), *Paroisse 10* (P); **Conakry:** Ile de Kouaky. 9°31'N 13°43'W, (fl), *Maclaud 63* (P); Kouinsi-bêla. 9°55'N 13°35'W, 1893 (fl), *Paroisse 79* (P); **Faranah:** cercle de Faranah, Koubikoro. 9°13'N 10°32'W, 2 February 1909 (fl), *Chevalier, A.J.B. 20650* (P); cercle de Faranah, Timbikounda. 9°05'N 10°41'W, 30 January 1909 (fl), *Chevalier, A.J.B. 20996* (P); **Kankan:** Diaragouéla. 10°36'N 9°58'W, 27 February 1899 (fl), *Chevalier, A.J.B. 471* (P); Kouroussa. 10°39'N 9°53'W, (fl, fr), *Pobéguin (Guinea series) 827* (P); **Labé:** Mamadou-Guimi, Fouta Djallon. 11°20'N 12°20'W, 1889 (fl), *Noury s.n.* (P); **Mamou:** Konkoure. 10°17'N 12°14'W, 1907 (fl), *Pobéguin (Guinea series) s.n.* (P); Mamou. 10°22'N 12°04'W, April 1907 (fl), *Pobéguin (Guinea series) 1558* (P); Kouria. 10°19'N 12°15'W, 2 February 1906 (fl), *Chevalier, A.J.B. 18217* (P).

**GUINEA-BISSAU, Bijagós:** Bolama. 11°34'N 15°31'W, 1883 (fl), *Souza (Guinea-Bissau 1883), J.A. de s.n.* (COI); Bolama. 11°34'N 15°31'W, (fl), *Souza (Guinea-Bissau 1883), J.A. de s.n.* (COI); Bolama. 11°34'N 15°31'W, 1884 (fl), *Carvalho, M.R. de 108* (COI); Bolama. 11°35'N 15°29'W, March 1934 (fl), *Espirito Santo 605* (COI); Bolama, Nova Sintra. 11°35'N 15°30'W, 8 April 1945 (fl, fr), *Espirito Santo 1921* (COI,LISC,WAG); **Quínara:** Fulacunda. 11°46'N 15°10'W, 13 May 1945 (fr), *Espirito Santo 2031* (COI,K,WAG); **Tombali:** Cantanhez-Caontchinque. 11°18'N 15°25'W, 21 March 1994 (fl), *Moreira, A. 186* (LISC); Crossing of road Cantanhez-Quiledje. 11°13'N 15°03'W, 3 April 1954 (fl, fr), *Albuquerque D'Orey, J.D.S. de 372* (COI); Cacine. 11°08'N 15°10'W, August 1933 (fr), *Espirito Santo 605* (COI); Bedanda-Jambarem. 11°18'N 15°05'W, 9 May 1961 (fr), *Alves Pereira 1913* (MA).

**IVORY COAST, UNKNOWN:** 1955 (fr), *Wit, H.C.D. de 8242* (WAG); **Abengourou:** near Ghana. 6°44'N 3°29'W, 31 July 1969 (fl, fr), *Thijssen, M.T. 154* (BR,MO,WAG); **Abidjan:** Boubo. 5°18'N 4°23'W, March 1896 (fl, fr), *Jolly 13* (P); Campus, université d'Abidjan. 5°21'N 4°00'W, December 1972 (fr), *Frédoux 161* (G); km 60 new road Abidjan-Ndouci 10 km NE of Sikensi. 5°42'N 4°32'W, 19 July 1979 (fl), *Kruif, A.P.M. de 218* (BR,K,MO,UCJ,WAG); N. of I.R.F.A.C. About 10 km NW. of O.R.S.T.O.M. 17 Km W of Abidjan. 5°20'N 4°08'W, 28 June 1963 (fl, fr), *Wilde, W.J.J.O. de 319* (K,WAG); Garden of Centre Neerlandais, ORSTOM, 17 km west of Abidjan. 0°00'N 0°00'W, 27 June 1969 (fl, fr), *Versteegh 388* (WAG); près d'Abidjan. 5°20'N 4°02'W, May 1975 (fr), *Frédoux 508* (G); Anguedédou, 20 Km à l'Ouest d'Abidjan. 5°24'N 4°09'W, 14 January 1969 (fl, fr), *Bamps 1843* (BR); seed source Banco Forest. 5°23'N 4°03'W, 18 July 1973 (st), *Koning, J. de 1932* (WAG); Banco Forest Reserve. Between the Apollo Plantation and Anguededou. 5°24'N 4°04'W, 20 August 1973 (fl), *Koning, J. de 2070* (BR,MO,WAG); near Adiopodoumé, 17 km W. of Abidjan. 5°20'N 4°07'W. Alt: 40m, 29 November 1958 (fl, fr), *Leeuwenberg 2103* (K,WAG,Z); Banco Forest Reserve, between Apollo Plantation and Anguededou. 5°24'N 4°04'W, 28 February 1974 (fr), *Koning, J. de 3380* (BR,MO,WAG); Jardin botanique de Bingerville. 5°21'N 3°54'W, 26 August 1955 (fl), *Wit, H.C.D. de 7465* (WAG); Adiopodoumé. 5°20'N 4°09'W, 2 December 1954 (fl), *Roberty 15745* (G); Bingerville B.30.09Da. 5°21'N 3°53'W, 7 December 1954 (fr), *Roberty 15776* (G); entre la lagune Potou et Alépé. 5°25'N 3°35'W, 24 February 1907 (fl), *Chevalier, A.J.B. 17438* (P); Attié, Alépé. 5°30'N 3°39'W, 3 March 1907 (fl, fr), *Chevalier, A.J.B. 17455* (P); Bingerville, jardin d'essai. 5°21'N 3°54'W, September 1930 (fl), *Chevalier, A.J.B. 34238* (P); 18 February 1930 (fl), *Aubrèville SF 201* (A,K); **Adzopé:** Mbasso. 6°17'N 3°29'W, 15 March 1907 (fr), *Chevalier, A.J.B. 17596* (P); **Agboville:** Pont de l'Agbo, chemin de fer km 82. 5°56'N 4°13'W, 3 January 1907 (fl), *Chevalier, A.J.B. 16764* (P); Agboville. 5°56'N 4°13'W, 12 April 1931 (fl), *Aubrèville SF 420* (P); **Bouaké:** Kokondekro. 7°38'N 5°02'W, 23 June 1984 (st), *Poilecot 243* (G); **Bouna:** Toupé (Parc Komoé). 8°37'N 3°56'W, 11 June 1977 (fr), *César 583* (P); 30 km N. of Kakpin, along Iringou river. 8°50'N 3°47'W, 13 February 1968 (fl, fr), *Geerling 2034* (K,WAG); **Grand-Lahou:** village Zegbé. 5°10'N 5°35'W, 1895 (fl), *Pobéguin (Ivory Coast series) 36* (P); **Guiglo:** Tai. 5°52'N 7°27'W, 26 March 1961 (fr), *Aké Assi s.n.* (G); Tai, au bord du Cavally. 5°52'N 7°27'W, 11 April 1970 (fr), *Farron 7058* (P); ad occidentem miserimi oppidi Tai nuncupati, ultra flumem Cavali. 5°51'N 7°27'W, 3 March 1962 (fl, fr), *Bernardi, L. 8424* (G,K,US,WAG); 13 km Est de Sakré. 5°41'N 7°16'W, 23 February 1973 (fl), *Aké Assi 11941* (G); 10 km Est de Sakré. 5°41'N 7°16'W, 2 June 1973 (fl), *Aké Assi 12040* (G); **Man:** Mont Tonkoui. 7°27'N 7°39'W. Alt: 950m, 4 March 1969 (fl), *Bamps 2198* (BR,WAG); **Oumé:** Lamto. 6°13.50'N 5°01.00'W, 9 July 1986 (fl), *Gautier; Béguin 165* (CSRS,G,LAMTO); Lamto. 6°13.50'N 5°01.00'W, 11 July 1968 (fl, fr), *Dugerdil 395* (G,LAMTO); **San-Pédro:** San Pedro. 4°40'N 6°37'W, 18 March 1901 (fr), *Thoiré 204* (P); between San Pedro to Grand Béréby. 4°42'N 6°47'W. Alt: 40m, 24 March 1970 (fl, fr), *Koning, J. de 286* (BR,E,MA,MO,WAG); between San Pedro to Grand Béréby. 4°42'N 6°47'W. Alt: 40m, 25 March 1970 (fl, fr), *Koning, J. de 304* (BR,E,MA,MO,WAG); 7 km N of Béréby. 4°42'N 6°58'W, 14 November 1963 (fl), *Oldeman, R.A.A. 664* (WAG); near Monogaga, in roadside. 4°48'N 6°27'W, 1 April 1968 (fl, fr), *Geerling 2421* (WAG); **Sassandra:** 14 km WSW of Kpata-Aidou. 5°03'N 5°52'W. Alt: 15m, 9 May 1975 (fr), *Burg, W.J. van der 245* (MO,WAG); 10 km N of Sassandra. Near left border of Sassandra river. 5°02'N 6°08'W, 10 May 1975 (fl), *Burg, W.J. van der 270* (MO,WAG); Island in the Sassandra river, near Louga. 5°03'N 6°11'W, 8 April 1973 (fl), *Koning, J. de 1274* (BR,MO,WAG); On bank of Sassandra river, near Louga. 5°03'N 6°13'W, 9

April 1973 (fr), *Koning, J. de 1343* (MO,WAG); behind Fuyt plantation. 5°03'N 6°14'W, 12 November 1973 (fl), *Koning, J. de 2683* (BR,E,MA,MO,WAG); W of Beyó, 56 km N of Sassandra. 5°18'N 6°05'W. Alt: 90m, 18 February 1959 (fl, fr), *Leeuwenberg 2737* (K,WAG,Z); 18 km NW of Sassandra. 5°00'N 6°15'W, 27 February 1959 (fl, fr), *Leeuwenberg 2905* (COI,FHO,K,WAG); **Tabou**: Mont Niénokoué. 5°23'N 7°10'W, February 1982 (fl, fr), *Stäuble 559* (G); FC de la Ht Dodo, close to Kouadjokro. 5°00'N 7°18'W. Alt: 150m, 4 May 1999 (st), *Jongkind 4485* (BP,IAGB,MO,WAG); route Tabou-Tai 50 km au S. de Tai., 5°10'N 7°04'W, 12 April 1970 (fr), *Farron 7055* (P); Tabou. 4°25'N 7°21'W, 8 April 1971 (fr), *Aké Assi 11521* (G); **Yamoussoukro**: région du Nzi, Sénécro. 7°19'N 4°59'W, 12 March 1907 (fl, fr), *Chevalier, A.J.B. 20147* (P).

**LIBERIA, UNKNOWN**: June 1877 (fr), *Carder s.n.* (K); **Grand Bassa**: Edina. 5°55'N 10°05'W, January 1907 (fl), *Reilingh, W. 1140* (WAG); **Grand Gedeh**: along recently finished OTC road. The road going east-west and passing along Jaudee. 5°35.5'N 8°09.4'W. Alt: 300m, 23 May 2005 (fl, fr), *Jongkind 6322* (BR,WAG); **Montserrado**: Gola Forest. 6°56'N 10°45'W, 2 April 1910 (fl, fr), *Bunting, R.H. s.n.* (BM); within 20 miles of Kukatown. 6°32'N 10°21'W, 1904 (fr), *Whyte, A. s.n.* (K); Firestone Plantation, Division 18 6°24'N 10°19'W, 11 February 1970 (fr), *Stoop - v.d. Kastele 142* (MO,WAG); **Nimba**: Mont nimba. 7°35'N 8°32'W, 25 July 1974 (fr), *Adam, J.-G. 28767* (WAG); **Sino**: Diebla 4°55'N 7°40'W, 4 July 1947 (st), *Baldwin jr 6335* (K,US).

**NIGERIA, UNKNOWN**: 1908 (fr), *Kitson s.n.* (BM); (fr), *Unknown 172* (FHO); 14 November 1968 (fr), *Meer, P.P.C. van 1029* (BR,BUC,K,MO,POZG,WAG); March 1948 (fr), *Irvine, F.R. 3602* (K); **Abeokuta**: Ilaro F.R. south of Igbogun road on the 1945 enumeration base line. 6°47'N 3°04'E, 16 December 1952 (fl), *Onochie FHI 32447* (K,P); **Adamawa State**: Sardauna Province Mambilla Plateau. 7°16'N 11°02'E. Alt: 1676m, 24 April 1973 (fl, fr), *Chapman, J.D. 3087* (FHO); Sardauna Province, Mambilla Plateau. 7°16'N 11°02'E. Alt: 1524m, 24 May 1973 (fl, fr), *Chapman, J.D. 3150* (FHO); Sardauna Prov. Kurmin Dodo. 7°02'N 11°30'E, 4 February 1975 (fl, fr), *Chapman, J.D. 3672* (FHO,K); Gongola state, ganye local, Govt area. 8°26'N 12°04'E. Alt: 46m, 21 February 1977 (fl), *Chapman, J.D. 4726* (FHO,K); **Benue State**: Abinsi and Vicinity. 7°45'N 8°45'E, 3 April 1912 (fl, fr), *Dalziel 781* (K); **Cross River State**: Oban, S. 5°20'N 9°00'E, 1912 (fl), *Talbot, P.A. s.n.* (BM); Newi district wet Zone. 6°01'N 6°55'E, 1909 (fr), *Kitson s.n.* (BM); Old Calabar. 4°57'N 8°19'E, (fr), *Robb s.n.* (BM); Newi. Ipurundza, Magami. 6°01'N 6°55'E, 6 January 1909 (fl), *Kitson s.n.* (BM); Oban. 5°19'N 8°34'E, 1909 (fl), *Talbot, P.A. s.n.* (BM); Itu., 5°12'N 7°59'E, 30 August 1891 (fr), *Holland, J.H. 39* (K); Old Calabar. 4°57'N 8°19'E, 1862 (fl, fr), *Thomson, W.C. 50* (E); Calabar. 4°57'N 8°19'E, June 1882 (fr), *Burton 50* (K); Calabar. 4°57'N 8°19'E, January 1931 (fr), *Smith, J. 62* (FHO); Itu. 5°12'N 7°59'E, February 1932 (fl, fr), *Smith, J. 73* (FHO); Adiabo. 5°40'N 8°15'E, 23 March 1898 (fl), *Holland, J.H. 91* (K); Ikrom and Okuni. 5°57'N 8°38'E, 16 January 1900 (fl), *Holland, J.H. 241* (K); Obudu plateau. 6°40'N 9°10'E. Alt: 1524m, 11 February 1964 (fl, fr), *Tuley 554* (K); Newland Unundike. 5°55'N 6°28'E. Alt: 27m, 12 March 1964 (fl), *Tuley 584* (K); Hansa, Ikom road. 5°58'N 8°42'E, 18 January 1931 (fl, fr), *Rosevear 31/ 21* (FHO); Ukwop-Eyere-Ugbem. 5°35'N 8°10'E, 18 February 1931 (fl), *Rosevear 31/ 35* (FHO); Ogoja Province Reserve, Ayi Forest Reserve. 6°18'N 8°59'E, 1933 (st), *Smith, J. FHI 1969* (FHO); Oban. 5°19'N 8°34'E, 12 February 1946 (fr), *Aninze FHI 15410* (K); R. ata, below Koloishe. 5°37'N 7°80'E. Alt: 1219m, 22 December 1948 (fl), *Savory FHI 25058* (K); Abakaliki Prov, Obubara dist. Inv. 288 Agoi F.R. Block B2. 6°20'N 9°01'E, 20 January 1961 (fl), *Adebusuyi FHI 44119* (FHO,K); **Edo State**: Sapoba, Oshun Reserve. 6°06'N 5°53'E, 12 January 1928 (fr), *Kennedy, J.D. 95* (FHO); Sapoba, Oshun Reserve. 6°06'N 5°53'E, 12 January 1928 (fr), *Kennedy, J.D. 95* (FHO); Sapoba, foret Unugu. 6°13'N 7°14'E. Alt: 150m, 14 January 1928 (fl, fr), *Cons. of Forests 204* (FHO); Sapoba Forest Experimental Station near Sapele. 6°07'N 5°47'E, 16 January 1928 (fl), *Cons. of Forests 224* (FHO); Sapoba Forest Experimental Station near Sapele. 6°07'N 5°47'E, 14 January 1928 (fr), *Cons. of Forests 225* (FHO); Sapoba. 6°06'N 5°53'E, (fl, fr), *Kennedy, J.D. 760* (BM,FHO,K); Ona Taungya farm near Sapoba (SE of Benin). 6°06'N 5°53'E, 13 February 1966 (fl, fr), *Lowe, J. 895* (WAG); (st), *Kennedy, J.D. 2034* (A,BM,FHO,K,US); Sapoba. 6°06'N 5°53'E, 1931 (fl), *Kennedy, J.D. 2066* (K,P); (fl, fr), *Kennedy, J.D. 2248* (BM,FHO,K,US); Ezi. 6°25'N 6°34'E. Alt: 152m, 10 February 1913 (fl), *Thomas, N.W. 2350* (K); Benin Prov. Benin div., Sapoba, near Forest House. 6°06'N 5°53'E, 30 January 1948 (fl, fr), *Brenan 8938* (FHO,K); Onitsha Province. 4 mls from Mniatia. 6°10'N 6°47'E, 3 February 1943 (fl, fr), *Jones, A.P.D. FHI 522* (FHO); Sapoba, in experimental area. 6°06'N 5°53'E, 7 April 1944 (fr), *Onyeagocha FHI 7120* (K); arboretum bordering Jameson R. 7°01'N 5°53'E, 28 January 1944 (fl, fr), *Onyeagocha FHI 7616* (FHO); Owerri Province, Taylor No.1. 5°35'N 7°45'E, 9 March 1946 (fl), *Akpata FHI 16512* (FHO); along Isioriri farm path, 1/2 miles from Isioriri in Warruke (Kukuruku district). 19 March 1948 (fr), *Okon FHI 22753* (K); 1949 Abedi Taungya in Sapoba F.R. 6°20'N 5°38'E, 27 November 1950 (fl, fr), *Dundas FHI 27241* (K); Ishan, Ugboha N.A. reserve. 6°45'N 6°28'E, 13 March 1952 (fl), *Henry, R.W.T. FHI 29129* (K); Abe. 6°43'N 9°32'E, 25 June 1952 (fl), *Ejiofor FHI 32005* (K); Sapoba (Benin). by the path between forest labour camp and the rest house. 6°06'N 5°53'E, 21 March 1962 (fl, fr), *Eimwiogbon FHI 45329* (WAG); Sapoba F.R. 6°06'N 5°53'E, 22 May 1974 (fl, fr), *Eimunjeze FHI 72556* (K,P);



East of Sapoba 40 Km SE of Benin. 6°05'N 5°52'E, 3 April 1988 (fl, fr), *Lowe, J. UIH 21317* (K); **Enugu State:** Enugu. 6°26'N 7°29'E, 28 April 1963 (fr), *Schwabe, W. 25* (B); near Amechi village on Enugu Abakaliki road. 6°25'N 7°59'E, 21 February 1973 (fr), *Latilo FHI 67621* (K,WAG); **Kaduna State:** Nimbira F.R., 9°30'N 8°32'E, 3 April 1963 (fr), *Latilo FHI 17141* (K); **Lagos State:** 6°27'N 3°23'E, April 1883 (fl, fr), *Moloney s.n.* (K); Lagos. 6°27'N 3°24'E, 1890 (fl, fr), *Rowlan s.n.* (P); 6°27'N 3°23'E, 1946 (fl), *Batten-Poole 7* (K); 6°27'N 3°23'E, 1946 (fl), *Batten-Poole 85* (K,P); Egbado district, Igbogila. 6°36'N 3°16'E, 15 November 1973 (fl), *Eimunjjeze FHI 68013* (K,WAG); **Ogun State:** road from Ijebu Igbo to Araromi 10 km N. of Ijebu Igbo, near Lagada village. 7°02'N 4°01'E, 24 January 1968 (fl, fr), *Meer, P.P.C. van 561* (WAG); Shasha Forest Reserve, Ijebu Province. 7°05'N 4°30'E, 30 January 1935 (fl, fr), *Richards, P.W. 3026* (BM,S); between Olokemeji and Ado-awaye. 7°50'N 3°26'E, 5 February 1955 (fl), *Richards, P.W. 5014* (K); entre Ibadan et Abokokuta. 7°16'N 3°37'E, March 1899 (fl), *Schlechter, F.R.R. 13022* (G); 6°36'N 4°15'E, 7 April 1946 (fl), *Jones, A.P.D. FHI 16837* (FHO); Abakurudu. 22 March 1946 (fl, fr), *Jones, A.P.D. FHI 17024* (FHO,K); **Ondo State:** (fl), *Kennedy, J.D. 2584* (FHO); Owo forest Reserve. 7°05'N 5°22'E, 7 February 1963 (fl), *White, F. 8198* (FHO); In Carter's peak, Idanre. 7°03'N 5°06'E. Alt: 500m, 1 January 1948 (fl), *Brenan 8656* (FHO,K); motor road, 17 February 1946 (fl), *Tamajong 14693* (FHO); between Idoani & Ikun. 7°20'N 5°50'E, 9 April 1979 (fr), *Daramola; Osanyinlusi 79/5* (FHI,K,WAG); 12 miles, Owena-Akure Road. 7°12'N 5°10'E, 5 February 1969 (fr), *Gbile, Z.O. FHI 20561* (K); Ifaki-Ikole road. About 1 ml. from Ilupeju. 7°48'N 5°22'E, 28 February 1973 (fl, fr), *Olorunfemi FHI 70668* (K,WAG); Ago (Owo) panu Ewure-Ikere rd. 7°28'N 5°21'E, 8 March 1973 (fl), *Olorunfemi FHI 70732* (WAG); **Osun State:** 90 km from Ore on benin Ore road. 7°58'N 4°34'E, 10 January 1994 (fl), *Daramola, B.O. 94/353* (K); **Oyo State:** near Owi river about miles of Ibadan. 7°23'N 3°54'E, 7 January 1945 (fl, fr), *Burt, B.L. 17* (K); road to Ibanda. 7°23.27'N 3°53.78'E, 11 February 1962 (fl, fr), *Head, D. 68* (K); Ijaiye forest reserve 10 miles W. of Ijaiye, 21 miles NW of Ibadan. 7°40'N 4°10'E, 5 March 1968 (fl), *Meer, P.P.C. van 649* (WAG); near Ibadan. 7°23'N 3°54'E, 29 December 1949 (fl, fr), *Meikle 907* (K,P); near Ibadan. 7°23'N 3°54'E, 6 January 1950 (fl, fr), *Meikle 978* (B,EA,K,MA,S); Ijaiye Forest Reserve (Western State, Ibadan District). 7°40'N 3°30'E, 21 December 1971 (st), *Wit, P. 1057* (FHI,K,WAG); Gambari, 20 miles S.E. of Ibadan. 7°08'N 3°50'E, 22 May 1966 (fl), *Eijnatten 1545* (WAG); Ibadan. 7°23'N 3°54'E, 18 May 1936 (fr), *Roberty 1714* (G); Gambari forest Reserve. 7°80'N 3°50'E, 23 March 1962 (fl, fr), *Bernardi, L. 8720* (G,K,UPS); Lademo. 7°23'N 3°54'E, 29 March 1950 (fl), *Hall, T.H.R. FHI 27456* (WAG); Gamberi group forest reserve, enumeration Block. 7°08'N 3°50'E, March 1956 (fl, fr), *Latilo FHI 34984* (K); Olla hills F.R. in the west east slope. 8°02'N 4°15'E, 27 March 1958 (fr), *Binuyo FHI 36912* (K); University College Botanical Gardens, Ibadan. 7°23.27'N 3°53.78'E, 23 October 1959 (fl), *Latilo FHI 37956* (K); Oba F.R. along the Omi stream. 7°45'N 4°07'E, 11 April 1959 (fl, fr), *Adebusuyi FHI 40946* (K,P); **Plateau State:** Ngel Nyaki, northern Mambilla. 7°27'N 11°30'E. Alt: 1676m, February 1959 (fl), *Wimbush FHI 48394* (K); **Rivers State:** Port Harcourt, 4°46'N 7°02'E, (fl), *Stubbings C. 134* (K); **Taraba State:** Adamawa Division, mambilla District. Mambilla Plateau. 7°00'N 11°10'E. Alt: 1650m, 20 January 1958 (fl), *Hepper 1725* (K,S); NE state, Muri div. Mumuye distr. Gangoro Forest reserve. 8°40'N 11°41'E. Alt: 1372 - 1524m, 1 December 1975 (fl), *Chapman, J.D. 4023* (FHO,K); NE state, Muri div. Mumuye distr. Gangoro Forest reserve. 8°40'N 11°41'E. Alt: 1524m, 11 February 1976 (fl), *Chapman, J.D. 4156* (FHO,K); NE state, Muri div. Mumuye distr. Gangoro Forest reserve. 8°40'N 11°41'E. Alt: 1524m, 1 March 1976 (fl, fr), *Chapman, J.D. 4234* (FHO,K); Gongola state, Mambilla div. Gashaka, chappal Hendu c. 5500 ft. 7°22'N 11°44'E, 22 April 1976 (fr), *Chapman, J.D. 4370* (FHO,K); Gongola State: Sardauna, Linedi (Faadahsee). Mambilla Plateau at the N.E. corner overlooking Mayo Sabese. 7°04'N 11°04'E. Alt: 1524m, 10 February 1977 (fl), *Chapman, J.D. 4647* (FHO,K); Gongola State, Sadauna Local govt Area, Mambilla Plateau Gono (Mayo Ndaga). 6°55'N 11°30'E. Alt: 1524m, 15 November 1977 (fl), *Chapman, J.D. 5060* (FHO,K); Gongola State, Sardauna. Akwaijantar Forest, W. foothills of Mambilla Plateau. 6°31'N 11°18'E. Alt: 1067m, 1 February 1978 (fl), *Chapman, J.D. 5180* (FHO,K); Gongola State, Sadauna Local govt Area, River Amboi Forest Reserve Baissa, close to Gidan Giwa. 6°55'N 11°30'E, 8 April 1978 (fl), *Chapman, J.D. 5305* (FHO,K); Mayo-Wombo-Mai-Idoanu. 7°05'N 11°22'E, 31 December 1954 (fl, fr), *Latilo FHI 28975* (FHO,K).

**SIERRA LEONE, UNKNOWN:** (fl), *Afzelius, A. s.n.* (UPS); (fl), *Don Jr, G. s.n.* (BM); 1844 (fl), *Whitfield, T. s.n.* (BM); (fl, fr), *Afzelius, A. s.n.* (UPS); (fl, fr), *Afzelius, A. s.n.* (UPS); (fl, fr), *Afzelius, A. s.n.* (UPS); (fl), *Afzelius, A. s.n.* (S); (fl, fr), *Afzelius, A. s.n.* (UPS); (fr), *Afzelius, A. s.n.* (UPS); (fl), *Thomas, N.W. 8046* (K); 1915 (fl, fr), *Thomas, N.W. 8894* (K); 1915 (fr), *Thomas, N.W. 8974* (K); 1915 (st), *Thomas, N.W. 8999* (K); 1915 (fr), *Thomas, N.W. 9114* (K); **Eastern Province:** Mattru. 7°52'N 11°22'W, 1 April 1956 (fr), *Pyne 118* (B,K); Gbenderu. 7°50'N 11°11'W. Alt: 15m, 5 January 1915 (st), *Thomas, N.W. 7134* (K); Gbenderu. 7°50'N 11°11'W. Alt: 15m, 3 January 1915 (fl), *Thomas, N.W. 7353* (K); Tingi Mountains. 8°55'N 10°47'W, 10 April 1965 (fl, fr), *Morton, J.K. SL 1808* (K); **Northern Province:** Batkanu. 9°05'N 12°25'W. Alt: 701m, 20 April 1914 (fl), *Thomas, N.W. 59* (K); Samaia.

9°32'N 12°26'W. Alt: 137m, 5 May 1914 (fr), *Thomas, N.W. 195* (K); Makeni. 8°25'N 12°32'W, 23 March 1966 (fr), *Samai, S.K. 305* (K); Bumbau. 9°03'N 12°09'W. Alt: 198m, 4 September 1914 (fl), *Thomas, N.W. 1974* (K); near Mofari, Scarcies. 9°12'N 12°55'W, 11 January 1892 (fl), *Scott Elliot 4437* (BM); Magbile. 8°44'N 12°42'W. Alt: 15m, 3 December 1918 (fl), *Thomas, N.W. 5977* (K); Magbile. 8°44'N 12°42'W. Alt: 15m, 3 December 1918 (st), *Thomas, N.W. 6001* (K); Magbile. 8°44'N 12°42'W. Alt: 15m, 3 December 1918 (fl), *Thomas, N.W. 6066* (K); Magbile. 8°44'N 12°42'W. Alt: 15m, 3 December 1918 (fl), *Thomas, N.W. 6085* (K); Magbile. 8°44'N 12°42'W. Alt: 15m, 3 December 1918 (fl), *Thomas, N.W. 6490* (K); Loma. 9°10'N 11°07'W, 22 May 1966 (st), *Jaeger, P. 9006* (P); Loma. 9°10'N 11°07'W, 27 May 1966 (fl), *Jaeger, P. 9106* (G); Kabala (Mt Loma). 9°10'N 11°07'W, 14 February 1966 (fl), *Adam, J.-G. 23709* (C); between Kondembaia and foot of Loma mountains. 9°07'N 11°16'W, 24 March 1964 (fl), *Morton, J.K. SL 1011* (K,WAG); **Southern Province**: Njala. 8°07'N 12°05'W, 10 May 1951 (fr), *Small, D. 24* (K); Torma (Bum). 7°19.85'N 12°14.60'W, 9 March 1960 (fl), *Bakshi 85* (K); 1960 (fr), *Bakshi 85* (K); Njala. 8°07'N 12°05'W, 19 January 1927 (fl), *Deighton 494* (K); Moyamba. 8°10'N 12°25'W, 31 March 1931 (fl), *Deighton 1916* (K); Kanya. 7°50'N 12°09'W. Alt: 457m, 8 October 1914 (fl, fr), *Thomas, N.W. 3001* (FHO); (st), *Thomas, N.W. 8092* (K); (fl), *Thomas, N.W. 8153* (K); (fl), *Thomas, N.W. 8188* (K); (fl), *Thomas, N.W. 8280* (K); 1915 (fl), *Thomas, N.W. 8297* (K); (fl), *Thomas, N.W. 8340* (K); (fl), *Thomas, N.W. 8366* (K); (fl), *Thomas, N.W. 8426* (K); (fl), *Thomas, N.W. 8481* (K); (fl), *Thomas, N.W. 8557* (K); 1915 (fr), *Thomas, N.W. 9371* (K); 1915 (fl), *Thomas, N.W. 9746* (K); Moyamba S.P. 7°57'N 12°31'W, 13 March 1967 (fl), *Morton, J.K. SL 3991* (K); **Western Area**: Kissy on hill above the town, Freetown. 8°28'N 13°12'W, 28 January 1964 (st), *Morton, J.K. SL 690* (K,WAG).

**TOGO, Plateaux**: 5 km E. of Badou on the road to Atakpamé. 7°35'N 0°39'E, 30 April 1978 (fr), *Hakki 610* (B,K); Kloto. 6°80'N 0°45'E, 1974 (fl), *Brunel 1219* (B); Ayomé (West 1. Atakpamé). 7°30'N 0°57'E, 4 March 1978 (fl), *Ern 3271* (B,K); mont Agou, bord de conte. 6°51'N 0°44'E. Alt: 800m, 4 May 1983 (fl), *Schäfer, P.A. 7707* (B,WAG); (fl, fr), *Unknown s.n.* (BM).

**Key literature**: Akoègninou et al. (2006), Bamps & Farron (1967), Farron (1963, 1985), Hawthorne & Jongkind (2006), Hutchinson, Dalziel & Keay (1954).

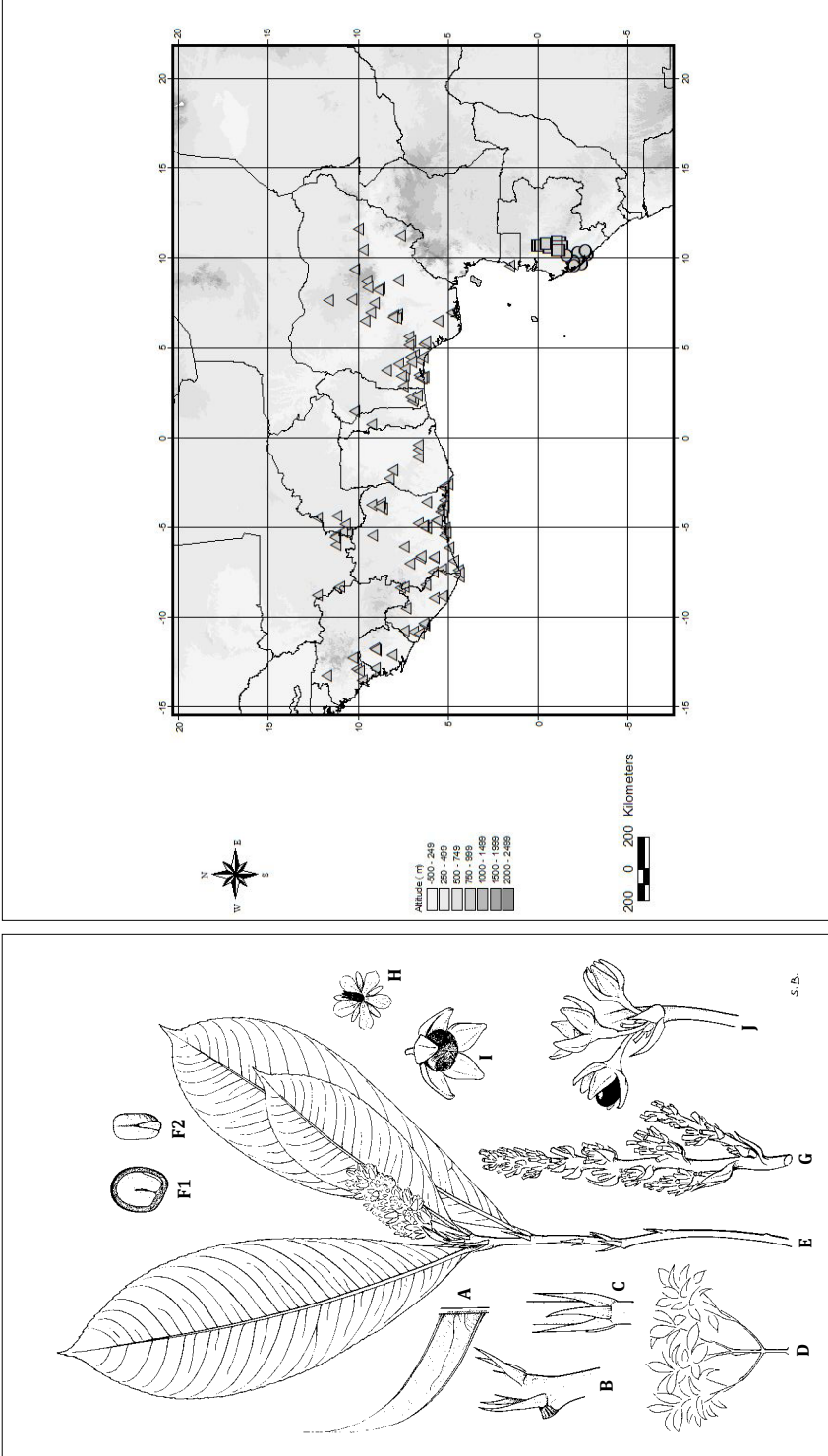
### **Campylospermum gabonense** Biss.

*Blumea* 58: 4 (2013; as '*C. gabonensis*'). – Type: *Breteler & Breteler-Klein Breteler 13124* (holotype: WAG; isotype: LBV, WAG), Gabon, Moyen-Ogooué, ca. 20–30 km NNW of Ndjolé, 0°03'N, 10°45'E, October 2<sup>nd</sup>, 1994.

⇒ subsp. **gabonense**

**Fig. 13**

*Tree or treelet*, up to 7 m tall, with branched trunk; twigs with brownish bark. *Stipules* persistent, narrowly triangular, **7–15 mm long**. *Leaf*: petiole canaliculate above, 3–7 mm long; leaf blade narrowly elliptic to narrowly elliptic-obovate, **16–30(–35) x 6–10(–11) cm**, ratio **2–4.5**, base cuneate to tapering, apex acuminate or sometimes acute, thick leathery to coriaceous, upper surface flat or rarely bullate, margin serrulate or sometimes entire toward the base, rarely entire, upper surface dark green, lower surface paler green, both sides glossy, young leaves purple-red; venation: midrib flattened above, prominent below, main lateral veins **14–27 on either side**, 6–23 mm apart, prominent on both sides, curved upward to run parallel to the margin, intermediate lateral veins 0 to 2 in between each pair of main laterals, not to slightly prominent on both sides, tertiary venation scalariform, **running perpendicular to the midrib**, indistinct on the upper side, slightly distinct on the lower. *Inflorescence* terminal, **unbranched**, erect, **compact**, its main axis 3–13 cm long; peduncle robust; pairwise scales persistent at the base of the peduncle, narrowly triangular; bracts persistent at the base of the cymules, triangular, 2–3 mm long; cymules 3–5(–10) mm apart, 4–8-flowered. *Flower*: pedicel



**Figure 13.** *Campylospermum gabonense*. **A.** Tertiary venation at the midrib. **B.** Stipule. **C.** Pairwise scales. **D.** Leaf branch. **E.** Flowering branch. **F1 & F2.** Seeds and cotyledons. **G.** Inflorescence. **H.** Flower. **I.** Sepals in fruit. **J.** flowered cymule. Drawings by Sabine Bousant

**Map 14.** Distribution of *Campylospermum gabonense* ssp. *australe* (○), *Campylospermum gabonense* ssp. *gabonense* (□) and *Campylospermum glaberrimum* (Δ)

5–15 mm, articulated at 3–9 mm from the base; sepals ovate, in flower 7–9 x 2–3 mm, greenish, in fruit 9–10 by 3–4 mm, red; petals obovate, 10–15 x 5–9 mm, cuneate at base, rounded at apex, yellow; stamens: anthers 5–7 mm long; ovary c. 2 mm wide; style 6–7 mm long. *Fruit*: receptacle 3–4 mm wide; drupelets 1 to 2 well developed per receptacle, ellipsoid, c. 7 x 5 mm, black at maturity; cotyledons incumbent, dissimilar in size with a smaller outer cotyledon.

**Notes:** The species epithet was originally published as “gabonensis”, but the correct spelling is “gabonense”, an error here corrected.

**Distribution:** endemic to Gabon (Moyen-Ogooué and Ngounié provinces; **Map 14**).

**Ecology:** in primary and secondary forest, sometimes along rivers or streams; at 70–400 m altitude.

**Phenology:** flowers observed from August to November and in April; fruits collected from October to January.

**IUCN conservation status:** VU B2ab(ii,iii,iv). EOO=4,477 km<sup>2</sup>, AOO=2,348 km<sup>2</sup>, locations=13 (cell width=15.32 km). All known records of this taxon are from areas exposed to mining and/or logging activities rendering a decline in its AOO and/or quality of the habitat most likely and hence the ‘Vulnerable’ category has been assigned.

#### **Specimens examined:**

**GABON, Moyen-Ogooué:** ENE de Belle Vue. Layon X. 0°35'S 10°39'E, 23 January 1987 (fl), *Dibata* 66 (LBV,MO,WAG); Camp Mboumi, Base. 0°25'S 10°50'E, 16 August 1999 (fl), *Azizet Issembé* 176 (LBV,WAG); Missanga, 5-15 km NNW of Ndjolé. 0°05'S 10°45'E, 11 November 1991 (fl), *Breteler 10375* (BR,E,K,LBV,MO,WAG); 5-30 km NNW of Ndjolé. 0°05'S 10°45'E, 21 April 1992 (fl), *Breteler 10983* (WAG); 20-30 km NNW of Ndjolé. 0°03'N 10°45'E. Alt: 150m, 2 October 1994 (fl, fr), *Breteler 13124* (LBV,WAG); M'Boumi, chantier SHM 30km S of Ndjolé, on border of the Ogooué river near Ndjolé. 0°25'S 10°50'E, 17 November 1998 (st), *Breteler 14655* (WAG); M'Boumi, chantier SHM 30km S of Ndjolé, on border of the Ogooué river near Ndjolé. 0°25'S 10°50'E, 17 November 1998 (st), *Breteler 14658* (LBV,WAG); **Ngounié:** along a forestry road of chantier EFT (Exploitaion Forestière de Tsanba) starting at Ndjemba village on Fougamou-Lambaréné road. 1°03.7'S 10°28.6'E. Alt: 129m, 29 October 2009 (fl), *Bissiengou 610* (LBV,WAG); along a forestry road of chantier EFT (Exploitaion Forestière de Tsanba) starting at Ndjemba village on Fougamou-Lambaréné road. 1°10.9'S 10°28.4'E. Alt: 165m, 29 October 2009 (fl), *Bissiengou 627* (LBV,WAG); along a forestry road of chantier EFT (Exploitaion Forestière de Tsanba) starting at Ndjemba village on Fougamou-Lambaréné road. 1°10.9'S 10°28.4'E. Alt: 165m, 29 October 2009 (fl), *Bissiengou 628* (LBV,WAG); Old forest 2-3 km SE of Forestry Camp Waka situated ± 32 km S.E. of Sindara, Waka R. Basin. 1°14'S 10°53'E. Alt: 350m, 12 December 1983 (fr), *Louis, A.M. 1324* (WAG); Sindara, après village Matadi 7 route exploitation forestière EGG (ancien IFL). 1°02.76'S 10°42.50'E. Alt: 72m, 22 June 2011 (st), *Bissiengou 1432* (LBV,WAG); Fougamou, village Nzemba route du chantier forestier EGBD, entrée école. 1°03.06'S 10°30.37'E. Alt: 97m, 24 June 2011 (st), *Bissiengou 1451* (LBV,WAG); Fougamou, village Nzemba route du chantier forestier EGBD, entrée école. 1°03.06'S 10°30.37'E. Alt: 97m, 24 June 2011 (st), *Bissiengou 1452* (LBV,WAG); 2 km on the road branching off near Ikobey to Magonga. 1°01.67'S 10°57.46'E. Alt: 200m, 25 November 2001 (fr), *Wieringa, J.J. 4402* (WAG); 50 km SE of Lambaréné. 1°04'S 10°30'E, 28 September 1968 (fl), *Breteler 5725* (WAG); Right bank Ngounié R., SE of Sindara, km 17 SW of Chantier Waka. 1°13'S 10°49'E. Alt: 400m, 22 September 1985 (fl), *Leeuwenberg 13617* (WAG); between Yombi and Fougamou, E slope of Koumounabouali ridge. 1°20'S 10°40'E, 22 September 1997 (st), *Breteler 14052* (BR,BRLU,MO,WAG).

**Key literature:** Bissiengou et al. (2013).

⇒ subsp. **australe** Biss.

*Blumea* 58: 5 (2013; as 'subsp. *australis*'). – Type: *Wieringa 2852* (holotype: WAG!; isotype: BR!, LBV!, MO!), Gabon, Ogooué-Maritime, Rabi, 0.6 km on the road to platform Rabi 78, 1°55.1'S, 9°50.8'E, October 4<sup>th</sup>, 1994.

Like the typical subspecies, but the leaf blade bullate between the lateral veins or rarely flat and the scalariform tertiary veins running perpendicular to the main lateral veins.

**Notes:** The subspecies name was originally published as “*australis*”, but the correct spelling is “*australe*”, an error here corrected.

**Distribution:** endemic to Gabon (Ogooué-Maritime, western Ngounié and Nyanga provinces; **Map 14**).

**Ecology:** in primary, moist and wet forest, in valleys with small streams; on sandy soil; at 3–350 m altitude.

**Phenology:** flowers observed from October to December; fruits collected from October to January.

**IUCN conservation status:** VU B1/B2ab(ii,iii,iv). EOO=6,862 km<sup>2</sup>, AOO=1,544 km<sup>2</sup>, locations=15 (cell width=12.43 km). This taxon is known from only 15 recent collections, five of which fall within the Loango National Park and the Moukalaba-Doudou National Park. The remaining ten collections originate from logging and oil concessions while even the Loango park is under development threat from Chinese mining companies. Therefore, this subspecies is best placed in the Vulnerable category.

**Specimens examined:**

**GABON, Ngounié:** Agouma. 1°36'S 10°10'E, December 1925 (st), *Le Testu 5834* (BR,P); **Nyanga:** Doudou Mountains, Chantier SFN-Bakker. 2°39.3'S 10°27.0'E. Alt: 180m, 22 November 2003 (st), *Jongkind 5734* (LBV,WAG); **Ogooué-Maritime:** Rabi-Kounga, opposite Buzzichelli. 1°56'S 9°53'E, 15 October 1991 (fl), *Schoenmaker, J. 34* (WAG); Rabi, W of Shell platform 76, 100m in the forest. 1°57'S 9°51'E. Alt: 30m, 2 December 1993 (fl), *Haegens 89* (WAG); Rabi-E, N of Pechoud Camp. 1°56.5'S 9°52.9'E, 26 October 1990 (st), *Nek 117* (WAG); savannah road to Vera, 32 km E from junction to Mayonami. 2°43.4'S 10°12.2'E. Alt: 70m, 21 November 1995 (fr), *Bergen 126* (WAG); Rabi-Kounga. Direction Echira. 1°59'S 9°51'E, 11 November 1991 (fl), *Schoenmaker, J. 134* (WAG); Rabi-NW, near Rembo Rabi, NW of Rabi site. 1°53.7'S 9°50.7'E, 13 November 1990 (fl), *Nek 289* (LBV,MO,WAG); near Rabi, S of old Rubbish-heap. 1°57.6'S 9°52.8'E, 11 January 1991 (fr), *Nek 560* (LBV,WAG); Monts Doudou, W. of Doussala and Rés. de Faune de Moukalaba. 2°15'S 10°20'E. Alt: 350m, 5 December 1984 (fr), *Arends 635* (WAG); Rabi, 0.6 km on the road to platform Rabi 78. 1°55.1'S 9°50.8'E. Alt: 40m, 4 October 1994 (fl), *Wieringa, J.J. 2852* (BR,LBV,MO,WAG); Koumouloundou, route d'accès au Rembo-Rabi. 2°00'S 9°36'E, 10 June 1970 (fl), *Farron 7413* (P); 30 km S of Rabi, high bank of an affluent of the Echira River. 2°08'S 9°43'E. Alt: 15m, 28 November 1989 (fr), *Wilde, J.J.F.E. de 9843* (LBV,MO,WAG); Rabi-Kounga, Echira road. 2°00'S 9°50'E, 27 October 1991 (fl), *Breteler 10152* (WAG); Gamba. N'Dogo Lagoon, near Sounga. 2°25.9'S 9°42.7'E. Alt: 3m, 10 December 1994 (fl), *Wilde, J.J.F.E. de 11363* (BRLU,LBV,MO,WAG).

**Key literature:** Bissiengou et al. (2013).

**Campylospermum glaberrimum** (P.Beauv.) Farron

**Fig. 14**

Bull. Jard. Bot. État Bruxelles 35: 397 (1965). – *Gomphia glaberrima* P.Beauv., Fl. Oware: 22 (1807). – *Ouratea glaberrima* (P.Beauv.) Engl. ex Gilg in Engl. & Prantl., Nat. Pflanzenfam. ed. 1, III, 6: 142 (1893). – *Monelasmum glaberrimum* (P.Beauv.) Tiegh., J.

Bot. (Morot) 16: 202 (June 1902). – *Exomicrum glaberrimum* (P.Beauv.) Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 338 (Dec. 1902). – Type: *Palisot de Beauvois s.n.* (holotype: G!), Nigeria, Oware, 1805.

*Notocampylum decrescens* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 312 (Dec. 1902). – *Ouratea decrescens* (Tiegh.) A.Chev., Expl. Bot. Afr. Occ. 1: 107 (1920). – Type: *Chevalier 881* (holotype: P (2x)!), French Sudan, Soukouraba, 1899.

*Notocampylum chevalieri* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 312 (Dec. 1902). – Type: *Chevalier 880* (holotype: P (2x)!), French Sudan, Soukouraba, 1899.

*Notocampylum nigricans* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 312 (Dec. 1902). – Type: *Chevalier 770* (holotype: P!), French Sudan, Fincolo, 1899.

*Monelasmum glaucum* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 332 (Dec. 1902). – Type: *Pobeguain 227* (holotype: P (2x)!), Ivory Coast, Grand-Lahon, December 1896.

*Ouratea insculpta* Gilg, Bot. Jahrb. Syst. 33(2): 263 (1904). – Type: *Rowland s.n.* (holotype: B†; isotype: K!, P (2x)!), Upper Guinea: West of Lagos.

*Tree* up to 5 m tall, rarely lianescent, **with multiple stems; twigs with pale or whitish bark. Stipules persistent**, triangular, 2–4 mm long. *Leaf*: petiole 3–6 mm long, **stout**; leaf blade **narrowly elliptic to elliptic or sometimes elliptic-obovate, (3–)5–16 x (1.5–)2–6 cm**, ratio **2–3(–6.4)**, base cuneate to rounded, apex blunt to acute or occasionally acuminate but very apex always blunt to acute, **coriaceous, margin almost entire to serrulate**, upper side glossy, dark green, paler green beneath; venation: midrib flat to slightly prominent above, prominent below, **main lateral veins 5–15 on either side, 5–15 mm apart, at a more or less right to slight angle with the midrib** and curved upward to run parallel to the margin, **not prominent on both sides**, intermediate lateral veins 1–2 in between each pairs of main laterals, **tertiary venation scalariform to the midrib, indistinct to slightly distinct on the upper side, indistinct to distinct on the lower**. *Inflorescence* terminal or rarely axillary, **unbrached or rarely with up to 4 racemes, lax, its main axis (1–)6–20(–31) cm long**; peduncle **woody at base, slender upward**; racemes **0–2(–5), 3–5(–15) cm long**; pairwise scales 1–2 mm long, **persistent** at the base of the peduncle; cymules **0.5–2 cm apart, 1–4-flowered, rarely 14-flowered**. *Flower*: **pedicel 7–18 mm long**, articulated at c. 2–5 mm from the base; sepals elliptic, in flower 7–8 x 3 mm, pale green, in fruit 7–10 x 3–4 mm, erecto-patent and red, base rounded, apex obtuse; petals obovate, 8–14 x 7–9 mm, cuneate at base, rounded to slightly emarginate at apex; stamens: anthers 5–7 mm long; ovary c. 1 x 1 mm; style 6–7 cm long. *Fruit*: receptacle c. 1 x 1 mm in flower, c. 4 x 2 mm in fruit, red; drupelets 1 to 2 well developed per receptacle, **ellipsoid to obovoid**, c. 8 x 4 mm; cotyledons **incumbent, dissimilar in size** with a small outer cotyledon.

**Notes:** This species is morphologically similar to *C. congestum* but differs by its main lateral veins being not prominent on both sides and often longer pedicels (7–18 mm in *C. glaberrimum*, 4–11 mm in *C. congestum*).

**Distribution:** Guinea, Sierra Leone, Liberia, southern Mali, Burkina Faso, Ivory Coast, Ghana, Togo, Benin and Nigeria, with a single collection from Equatorial Guinea (**Map 14**).

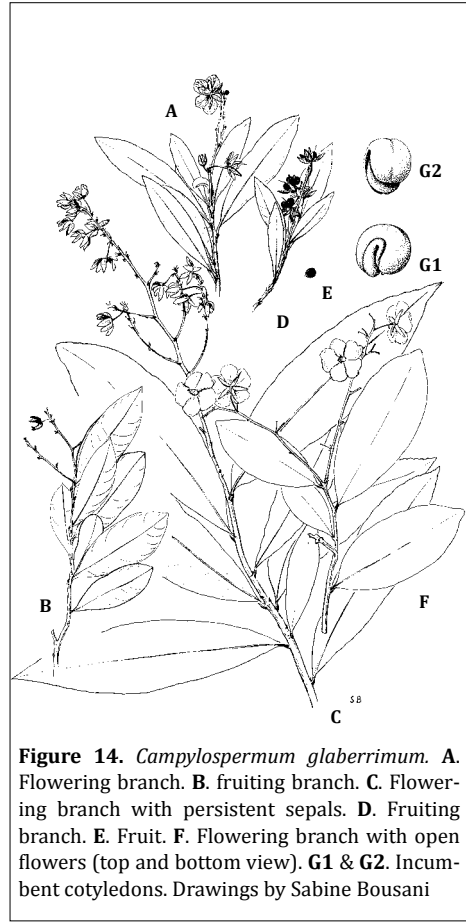
**Ecology:** in secondary forest, along forest edges, in swampy, mangrove and riverine forest; on sandy, loamy, granitic and clayish soil; at 0–760 m altitude.

**Phenology:** flowers and fruits collected all year round.

**Uses:** The wood is reported to be usable, without indication of a purpose, and the plant (no specific part mentioned) to yield a dyestuff (Burkill, 1997).

**Vernacular name:** **Benin:** Alové; **Nigeria:** Otchireda (Igbuira).

**IUCN conservation status:** LC. EOO=2,397,370 km<sup>2</sup>, AOO=2,359,270 km<sup>2</sup>, locations=147 (cell width=276 km). This species is widely distributed in West Africa inside as well as outside National Parks, from the tropical to the dryer Sudanian savannah zone. It is frequently collected and well represented in herbaria, reasons why the category of Least Concern has been assigned.



**Figure 14.** *Campylospermum glaberrimum*. **A.** Flowering branch. **B.** fruiting branch. **C.** Flowering branch with persistent sepals. **D.** Fruiting branch. **E.** Fruit. **F.** Flowering branch with open flowers (top and bottom view). **G1 & G2.** Incumbent cotyledons. Drawings by Sabine Bousani

**Specimens examined:**

**BENIN, UNKNOWN:** (fr), *Poisson s.n.* (P); **Atakora:** Perma, Kouatena. 10°12.08'N 1°30.10'E. Alt: 454m, 21 February 2001 (st), *Akoègninou 4258* (BENIN,WAG); Perma, 10°12.1'N 1°30.1'E. Alt: 454m, 21 October 2001 (fl, fr), *Akoègninou 5575* (BENIN,WAG); Kouatena, 10 km NE of Perma, RNIE 6. Goldmine area. 10°11.78'N 1°30.01'E, 13 April 2001 (st), *Maesen, L.J.G. van der 7563* (BENIN,WAG); **Atlantique:** Togbota, Agué, Issawémè. 6°43'N 2°24'E, 7 February 2001 (fl), *Hanon, L. 9* (BRLU); Togbota, Agué, Issawémè. 6°43'N 2°24'E, 20 November 2000 (st), *Dan 157* (BR,BRLU); Togbota, Issawémè. 6°43'N 2°24'E, 29 August 2001 (st), *Dan 532* (BRLU); **Zou:** Lama. 6°56.46'N 2°10.25'E, June 2001 (fl), *Adomou 26* (BENIN,WAG); Bénin-Lokoli, Dohokpa. 7°02.89'N 2°16.58'E, 22 April 2004 (fl, fr), *Dan 899* (BR); Lama. 6°59'N 2°12'E, 21 June 1998 (st), *Akoègninou 1458* (BENIN,BR,IFAN,K,MO,WAG); Lama. 6°58'N 2°04'E, 30 July 1998 (st), *Akoègninou 1798* (BENIN,BR,MO,WAG); Lama. 6°57'N 2°05'E. Alt: 79m, 13 August 2001 (fl), *Adjakidjè 4814* (BENIN,WAG); Lama 6°58'N 2°05'E, 14 August 2001 (fl), *Adjakidjè 4844* (BENIN,WAG).

**BURKINA FASO, Comoé:** Banfora, cascade. 10°43'N 4°49'W, 22 September 1958 (fl), *Jaeger, P. 5260* (P); chutes Conoé (Banfora). 10°43'N 4°49'W, 22 September 1958 (fl), *Adam, J.-G. 15290* (P); Leraba, Lera. 10°35.77'N 5°18.78'W. Alt: 332m, 15 July 2009 (fl, fr), *Sanou BUR 728* (CNSE,K); **Houet:** Bobo-Dioulasso. 11°11'N 4°18'W, 9 October 1967 (fl, fr), *Geerling 1230* (WAG); Haute Volta. Bobo. Orodara. Koumi. 12°15.33'N 4°25.63'W, 14 August 2008 (fl, fr), *Sanou BUR 659* (CNSE,K); **KénéDougou:** Soukouraba. 10°51'N 5°11'W, 13 May 1899 (fr), *Chevalier, A.J.B. 880* (P); Soukouraba. 10°51'N 5°11'W, 13 May 1899 (fr), *Chevalier, A.J.B. 881* (P).

**EQUATORIAL GUINEA, Rio Muni, Litoral:** Benito. 1°35'N 9°37'E, 1927 (fl), *Bates, G.L. 812* (BM).

**GHANA, UNKNOWN:** 15 September 1906 (fl), *Farmar 368* (BM,K); **Ashanti Region:** N. Ashanti. 6°38'N

1°04'W, (fl), *Dalziel 43* (E,K); **Brong-Ahafo Region:** Fuller Waterfall, 300m, 8°05.0'N 1°47.7'W. Alt: 300m, 9 March 1995 (fl, fr), *Jongkind 2114* (MA,MO,WAG); Fuller Falls, Kintampo. 8°05'N 1°47'W, October 1932 (fl), *Vigne FH 2537* (FHO); **Eastern Region:** by Afram at Mankrong. 6°40'N 0°23'W, 14 May 1961 (fl), *Morton, J.K. A 4198* (K); Kwahu Nteso to Ankoma., 6°38'N 0°39'W, 17 January 1968 (fr), *Hall, J.B. GC 37503* (FHO,K); **Western Region:** Tano Rapids. 5°13'N 2°45'W, 4 December 1911 (fl), *Brent 36* (K); Ankasa Game Reserve following footpath right just after entrance going parallel to Ankasa R. 5°13'N 2°39'W. Alt: 100m, 19 March 1995 (fl), *Jongkind 2150* (MO,WAG); Atuabo-Beyin road. 4°59'N 2°33'W, 2 July 1966 (fl, fr), *Hall, J.B. GC 35683* (FHO); Bui. 8°16'N 2°16'W, 24 July 1976 (fr), *Hall, J.B. GC 46229* (WAG).

**GUINEA, Boké:** Kamba. 11°45'N 13°12'W. Alt: 300m, 1990 (fl, fr), *Cordonnier 222* (BR); **Kindia:** French guinea: Friguiagbe. 9°57'N 12°56'W, 8 May 1937 (fl), *Chillou 407* (BR,P); Monts Kakoulima. 9°46'N 13°27'W, February 1945 (fl), *Schnell 2485* (P); Friguiagbe. 9°57'N 12°56'W, 10 October 1942 (fl), *Chillou 3490* (BR,P); Le gangan C.28.18.Fa. 10°04'N 12°51'W, 3 May 1955 (fl), *Roberty 17784* (G); **Mamou:** Fouta-Djallon, bord du Konkouré. 10°17'N 12°14'W, 1893 (fl), *Paroisse 211* (P); **Nzérékoré:** Mt Nimba, Nzo. 7°40'N 8°19'W, 20 April 1945 (fl, fr), *Adam, J.-G. 146* (C,K,P,SE,RG,WAG).

**IVORY COAST, Abidjan:** Lac Bakré. 5°15'N 4°05'W, 20 May 1965 (fl, fr), *Miège s.n.* (G); Petit Lahon. 5°07'N 5°17'W, January 1895 (fl), *Pobéguin (Ivory Coast series) 28* (P); Rocher de Brafovédi, near Bécédi, on the road to Sikensi. 5°39'N 4°34'W. Alt: 100m, 23 January 1970 (fl, fr), *Koning, J. de 66* (BR,E,MA,MO,WAG); 8 km west of Grand Bassam, north of the main road to Abidjan. 5°13'N 3°48'W, 28 May 1969 (fl), *Versteegh 146* (WAG); between Port Bouet and Grand Bassam. 5°14'N 3°51'W. Alt: 10m, 7 February 1970 (fl, fr), *Koning, J. de 219* (BR,MO,WAG); Abou-abou, between Abidjan and Grand Bassam. 5°16'N 3°52'W, 31 July 1963 (fl), *Oldeman, R.A.A. 239* (WAG); I.R.H.O. (cocos cultivation) 20 km W of Grand Bassam; near the beach, between Port Bouet and Grand Bassam. 5°16'N 3°50'W, 1 July 1963 (fl, fr), *Wilde, W.J.J.O. de 350* (K,WAG,Z); Forêt du Banco. 5°24.50'N 4°04.00'W, 25 November 1978 (fl), *Knecht 445* (G); Banco. 5°24'N 4°05'W, 18 November 1975 (fl), *Frédoux 536* (G); Adiopodoumé, près du Laboratoire Botanique ORSTOM. 5°19'N 4°08'W, 26 March 1979 (fr), *Knecht 686* (G); Abouabou. 5°17'N 3°52'W, 2 March 1954 (fl), *Aké Assi 2257* (P); Abouabou, between Abidjan and Grand Bassam. 5°17'N 3°54'W. Alt: 2m, 6 January 1959 (fl, fr), *Leeuwenberg 2344* (B,C,COI,FHO,K,UPS,WAG); Port Bouet à 150 m de la plage. 5°15'N 3°55'W, 5 October 1930 (fl), *Hédin, L. 2552* (P); near Brafovédi, 75 km NW of Abidjan. 5°37'N 4°35'W. Alt: 100m, 24 April 1959 (fr), *Leeuwenberg 3336* (BR,FHO,K,WAG); Abouabou. 5°17'N 3°52'W, January 1956 (fl), *Aké Assi 3424* (P); Banco Forest Reserve. 5°23'N 4°03'W, 22 March 1974 (fl), *Koning, J. de 3465* (BR,C,E,G,MA,MO,P,PRE,WAG); Abouabou. 5°17'N 3°52'W, 22 November 1955 (fr), *Aké Assi 3808* (P); Grand Bassam. 5°14'N 3°45'W, December 1949 (fl), *Schnell 3953* (P); Aubouin (Lagune d'Abidjan). 5°15'N 4°11'W, 24 August 1955 (fr), *Wit, H.C.D. de 5601* (WAG); near Grand Bassam, NW along road to Aboisso. 5°13'N 3°43'W, 12 November 1968 (fl), *Breteler 5966* (B,C,K,S,US,WAG); Adiopodoumé. 5°20'N 4°07'W, 14 April 1970 (fl, fr), *Farron 7025* (P); In nemore banco tuto, Abidjanii vicinioribus. 5°23'N 4°03'W, 21 February 1962 (fl), *Bernardi, L. 8079* (G,US); Lagune Abidjan, forêt d'Agbas. 5°19'N 4°01'W, 12 January 1961 (fl), *Wit, H.C.D. de 9014* (WAG); Mouson, 5 km NW Grand Bassam. 5°13'N 3°44'W, 3 March 1965 (fl, fr), *Raynal, J. 13569* (BR,COI,K); Audouin, 14 km W Abidjan., 5°18'N 4°09'W, 6 March 1965 (fl), *Raynal, J. 13631* (BR,P,WAG); Banco. 5°24'N 4°05'W, 19 October 1977 (fl), *Aké Assi 13778* (G); Grand Bassam. 5°12'N 3°44'W, February 1917 (fl), *Chevalier, A.J.B. 33077* (P); entre Grand Bassam et Petit Bassam. 5°14'N 3°52'W, August 1930 (fl), *Chevalier, A.J.B. 34249* (P); **Aboisso:** Botanical Reserve Nganda Nganda, 5 km south of Adiaké. 5°12'N 3°26'W. Alt: 30m, 22 April 1970 (fl), *Koning, J. de 354* (MO,WAG); **Adzopé:** Bas Comoé. 6°12'N 3°32'W, March 1907 (fl), *Chevalier, A.J.B. 17570* (LY); **Bouna:** along road from Gawi to Seye. 9°14'N 3°41'W, 12 July 1967 (fl, fr), *Geerling 201* (B,WAG); Comoé, Gansé, à proximité du lac sur la rive gauche. 8°37'N 3°56'W, 4 February 1988 (fl), *Gautier, L. 781* (CSRS,G); near the confluence of the Comoé and Iringo river. 8°49'N 3°48'W, 7 February 1968 (fl, fr), *Geerling 1966* (C,K,WAG); near the confluence of the Congo River and Comoé River. 8°48'N 3°47'W, 22 April 1968 (fl), *Geerling 2632* (WAG); P.N. Comoé, Gansé. Ravin de Gansé, 8°40'N 3°54'W, 28 June 1990 (fr), *Poilecot 3114* (G); P.N. Comoé Sud. 8°45'N 3°35'W, 5 July 1990 (fl, fr), *Poilecot 3142* (G); **Danané:** Tiapleu. 7°25'N 8°15'W, 7 March 1968 (st), *Aké Assi 10000* (K); **Dimbokro:** rivière Kan. 6°38'N 4°46'W, 3 May 1971 (fr), *Audru 3951* (P); **Grand-Lahou:** Grand Lahon. 5°08'N 5°01'W, December 1895 (fl), *Pobéguin (Ivory Coast series) 227* (P); Kokroum. 5°13'N 5°24'W, April 1949 (fl), *Bégué SF 3153* (P); **Issia:** Rock d'Issia. 6°32'N 6°40'W, 24 August 1956 (fr), *Wilde, J.J.FE. de 431* (WAG); Issia. 6°29'N 6°35'W, 14 February 1951 (fl), *Roberty 13828* (G); Issia. 6°29'N 6°35'W, 11 December 1954 (fr), *Roberty 15957* (G); Boka d'Issia. 6°29'N 6°35'W, 14 February 1951 (fl), *Roberty 19847* (G); **Korhogo:** 50 km south east of Korhogo. 9°13'N 5°25'W, 17 July 1969 (fl, fr), *Versteegh 537* (WAG); **Oumé:** Réserve de Lamto. à l'E. du marigot salé. 6°13.00'N 5°01.33'W, 22 October 1992 (fl, fr), *Bänninger 61* (G,WAG); Lamto. 6°13.50'N 5°01.00'W, 10 February 1990 (fl), *Chatelain 85* (G,LAMTO); Réserve



de Lamto, à l'E. du marigot salé. 6°13'N 5°01'W, 22 May 1992 (fl, fr), *Bänninger 29651* (G); Réserve de Lamto. 6°13.00'N 5°01.33'W, January 1972 (st), *Spichiger 72/ 271* (CSRS,G,LAMTO); **San-Pédro**: near Sékré 15 km E of Béréby. 4°40'N 6°48'W, 7 November 1963 (fl, fr), *Oldeman, R.A.A. 541* (K,MO,WAG); **Sassandra**: Nahoua sacred waterfalls and rapids in the Sassandra River 2 km W.N.W. of Soubré. 5°47'N 6°39'W, 27 November 1961 (fl, fr), *Wilde, J.J.F.E. de 3321* (K,WAG); Port de Sassandra. 4°58'N 6°05'W, May 1907 (fl), *Chevalier, A.J.B. 16336* (P); **Soubré**: Sassandra, Soubré. 5°47'N 6°36'W, 18 June 1907 (fl), *Chevalier, A.J.B. 19105* (P); Soubré. 5°47'N 6°36'W, 7 February 1951 (fl), *Roberty 19769* (G); **Tabou**: E of Tabou. 4°25'N 7°20'W. Alt: 10m, 3 September 1975 (fl, fr), *Beentje 849* (MO,UCJ,WAG); Right bank of the Hana River, near the crossing of this river with the road Tai-Tabou. 5°22'N 7°18'W, 12 March 1962 (fl, fr), *Wilde, J.J.F.E. de 3612* (B,K,WAG); embouchure du Cavally à Bliéron. 4°22'N 7°31'W, 11 August 1907 (fl), *Chevalier, A.J.B. 19917* (P); **Toumodi**: Oroumba Boka. 6°22'N 4°54'W, 3 October 1956 (fl), *Wilde, J.J.F.E. de 619* (WAG); Orumbo-Boka. 6°23'N 4°53'W, 15 February 1963 (fr), *Portères 743* (P); Boka. 6°23'N 4°53'W, 20 August 1954 (fl), *Jaeger, P. 4812* (P); Assakra. 6°22'N 4°53'W, 30 August 1955 (fl), *Wit, H.C.D. de 5777* (WAG); Mont Orumbo-Boka. 6°22'N 4°53'W, August 1954 (fl), *Schnell 6479* (K,P); **Vavoua**: F.C. du Haut-Sassandra, Centre, relevé FNK28. 7°07'N 7°00'W, 31 March 1995 (fl), *Kouamé 1482* (CSRS,G); **Zuénoula**: 15 km S. de Zuénoula. 7°25'N 6°02'W, 8 January 1947 (fl), *Roberty 6834* (G).

**LIBERIA, Bomi Hills**: Jenne, bank of Loffa River, 6°36'N 10°53'W, January 1921 (fr), *Bequaert 30* (K); **Bong**: 12 May 1946 (fr), *Harley, W.J. 1409* (WAG); **Grand Gedeh**: Tchien, Mim Timber Co (Fijnhout), along Cavally river: 6°16'N 8°11'W. Alt: 250m, 14 May 1970 (fl, fr), *Koning, J. de 477* (BR,MO,WAG); Right bank Cavally River, 7 km S of Taï. 5°50'N 7°26'W. Alt: 120m, 8 March 1959 (fl), *Leeuwenberg 3002* (FHO,K,WAG); **Lofa**: Loffa county, Gbarnga-Zorzor road, W bank of St. Paul river. 7°20'N 9°28'W, 20 December 1966 (fl), *Bos, J.J. 2485* (LIB,WAG); Gola. 7°27.1'N 10°41.5'W, 29 November 2005 (fl), *Jongkind 6993* (WAG); **Maryland**: Cape Palmas. 4°22'N 7°43'W, 6 December 1908 (fl), *Dinklage 2372* (B); Maryland Co. 4°22'N 7°43'W, 14 June 1947 (fl), *Baldwin jr 5979* (K); **Montserrado**: Banks of farmington River. 6°20'N 10°18'W, 23 December 1943 (fr), *Bequaert 6* (K); 6 miles N of Bomi Hills, along Maher river, near Bomi Hills Summer Camp. 6°56'N 10°45'W, 30 January 1971 (st), *Goll 94* (MO,SL,WAG); Boporo district. 6°18'N 10°23'W, 18 December 1947 (fr), *Baldwin jr 10695* (K,US); **Sino**: Krahn Bassa Forest. 5°45'N 8°55'W, 30 January 1964 (st), *Harten 285* (WAG); Sapo National Park. 5°19.2'N 8°49.1'W. Alt: 105m, 1 February 2010 (fl), *Jongkind 9348* (MO,WAG).

**MALI, Koulikoro**: Faille Dibley Ko. 12°16'N 8°44'W. Alt: 631m, 20 June 2008 (fl), *Birnbaum 1343* (BRLU,IFAN,P); **Sikasso**: 11°13'N 5°55'W. Alt: 400m, 15 February 1968 (fl), *Laferrère 33* (K); Sirakoro. 11°13'N 5°55'W, 17 July 1968 (fl, fr), *Laferrère 158* (K); Fincolo. 11°16'N 5°31'W, 22 April 1899 (fl), *Chevalier, A.J.B. 770* (P); Sikasso, galerie du Farako, confluent en aval du pont métallique. 11°15'N 5°26'W, 20 May 1964 (fl), *Demange, R. 2229* (P); entre Bougouni et Kankan. 11°00'N 8°15'W, 12 February 1947 (fl), *Roberty 7115* (G,Z).

**NIGERIA, UNKNOWN**: Northern Nigeria. June 1911 (fl), *Yates, C.C. s.n.* (K); 26 February 1961 (fl), *Head, D. 30* (K); S. Nigeria. (fl), *Rosevear 30/ 97* (FHO); **Abeokuta**: Eggua Forest Reserve. 7°30'N 2°54'E, April 1946 (fr), *Taiwo FHI 15018* (K,P); **Bauchi State**: near the bridge 3 miles east of Jemaa. Sanga River Forest Reserve. 10°01'N 11°37'E, 31 March 1958 (fl, fr), *Jones, E.W. s.n.* (FHO); Yankari Game Reserve, Barkono Pass. 9°45'N 10°30'E, 12 April 1971 (fl), *Geerling 3537* (WAG); **Benue State**: N. Nigeria, Abinsi. 7°45'N 8°45'E, 1912 (fr), *Dalziel s.n.* (COL,S); Kabba, Koton Karifi Swamp Forest Reserve. 7°50'N 6°40'E, (st), *Johnstone, A.T. K 12* (FHO); **Delta State**: Jelba, 5°33'N 6°33'E, 1857 (fl, fr), *Barter 1642* (K); **Edo State**: Nikrowa. 6°16'N 5°20'E, 21 March 1935 (fl, fr), *Ross, R. 122* (BM); Okomu Forest Reserve, Compartiment No. 6°20'N 5°15'E, 28 February 1948 (fl), *Brenan 9186* (BM,FHO,K); **Kaduna State**: Northern Nigeria, Allowa Zaria Prov. 11°40'N 7°42'E, February 1908 (fl), *Dalziel 428* (K); Gurara falls, near Abudja. 10°10'N 9°25'E, March 1962 (fl), *Vaillant, A. 2790* (K); 3 miles E. of Old Jema'a (Zaria prov.). 9°28'N 8°23'E, 17 January 1968 (fl), *Jackson, J.A.D. FHI 18103* (K); 12 miles, Kaduna-Kaciya. (Zaria province). 10°20'N 7°45'E, 19 January 1969 (fl, fr), *Jackson, J.A.D. FHI 20523* (K); **Kogi State**: Northern Nigeria, Niger River, Jemata. 8°04'N 6°46'E, 29 December 1905 (fl, fr), *Elliott, W.R. 221* (K); Koton Karifi. 7°50'N 6°40'E, (fl), *Johnstone, A.T. FHI 3272* (K,P); Kabba Province, along the motor road from Mozum to Odugbo. 7°48'N 6°55'E, 12 June 1958 (fl), *Daramola, B.O. FHI 36946* (FHO,K); Kabba Province, Kotokerifi distr. Along the river Oyinmi on the way to Adanjere by the edge of the river. 8°00'N 6°50'E, 24 October 1956 (fl, fr), *Daramola, B.O. FHI 38407* (FHO,K); **Lagos State**: Lagos. 6°27'N 3°23'E, April 1883 (fl), *Moloney s.n.* (K); Lagos. 6°27'N 3°23'E, 1867 (fr), *Bates, G.L. s.n.* (K); W. Lagos. 6°27'N 3°24'E, August 1890 (fl), *Rowland s.n.* (K,P); Lagos. 6°27'N 3°23'E, October 1905 (fl), *Foster, E.W. 22* (K,P); Lagos. 6°27'N 3°23'E, 15 March 1906 (fl), *Foster, E.W. 50* (K); Ido Island, Lagos. 6°27'N 3°23'E, December 1892 (fl), *Millen 53* (K); Lagos. 6°27'N 3°23'E, May 1906 (fl), *Foster, E.W. 87* (K,P); Federal, left of the road from College of Technology to Lagos University. 6°33'N 3°22'E, 25 July 1965 (fl, fr), *Killick, H.J. 260* (K); Nigeria anglais: Lagos. 6°27'N 3°23'E,

December (fl), *Hagerup 778* (C); Lagos on the Island. 6°20'N 3°25'E, 18 October 1916 (fl, fr), *Dalziel 1035* (K); **Nassarawa**: Gudi, 60 miles south of Kafanchon. 8°53'N 8°16'E. Alt: 366m, March 1928 (fl, fr), *Thornewill 45* (K); Wana, Mada Hill. 8°46'N 8°20'E. Alt: 610m, May 1930 (fl, fr), *Hepburn, I.D. 94* (K); **Niger State**: Niger Province, Gwari distr. Bonu, by Gurara falls. 9°19'N 7°01'E. Alt: 320m, 15 June 1958 (fl, fr), *Onochie FHI 40154* (FHO,K); North-West state, Minna district, Gurara Falls. 9°37'N 6°33'E, 17 May 1973 (fl), *Eimunjeze FHI 66386* (K); **Ogun State**: Akilla. 6°37'N 4°20'E, (fl), *Kennedy, J.D. 2010* (FHO); Shasha Forest Reserve, Akilla. 7°05'N 4°30'E, 27 January 1935 (fl, fr), *Richards, P.W. 3020* (BM); Shasha Forest Reserve. 7°05'N 4°30'E, 3 May 1935 (fl, fr), *Richards, P.W. 3420* (BM); Egba 1/2 miles S.W. of olokemeji Railway station. 7°25'N 3°32'E, 29 November 1945 (fl), *Tamajong FHI 14340* (K); On line 4, near Etemi enclave village. 6°53'N 4°38'E, 3 April 1946 (fl), *Jones, A.P.D. FHI 16834* (FHO,K); Ogun River F.R. (Ikorodu). 6°37'N 3°31'E, 29 December 1952 (fl), *Ejiofor FHI 32025* (K); Omo Forest Reserve. 7°00'N 4°15'E, 14 May 1974 (fr), *Adebusuyi FHI 67020* (P); **Ondo State**: Eba Island. 6°24'N 4°30'E, 16 March 1935 (fl, fr), *Ross, R. 101* (BM); Owo Forest Reserve 2 miles N of Igbatoro. 7°05'N 5°22'E, 18 April 1943 (fl), *Jones, A.P.D. FHI 3475* (FHO); Owo Forest Reserve. 7°10'N 5°39'E, 5 May 1943 (fl), *Jones, A.P.D. FHI 3570* (FHO); Owena. 7°12'N 5°10'E, 6 February 1969 (fl), *Gbile FHI 20578* (K); Ikalé-Aye district, Agbaje. 7°05'N 4°30'E, 8 November 1961 (fl), *Emwiogbon FHI 43950* (FHO,K,WAG); **Oyo State**: Ibadan. 7°23'N 3°54'E, 3 February 1963 (fr), *Head, D. 118* (K); Oba Hills near the Reserve (West State, Oyo District). 7°45'N 4°10'E, 23 December 1971 (st), *Wit, P. 1071* (FHI,K,WAG); Ibuya, Upper Ogun Game Reserve. 8°24'N 3°47'E, 27 July 1971 (fl, fr), *Geerling 3717* (MO,WAG); Ijaiye-Lanlate F.R. boundary where River Ogun is joined by the Odogun. 7°36'N 3°27'E, 1 March 1947 (fl, fr), *Keay FHI 21167* (K); Gurara falls (Minna). 9°05'N 7°32'E, 17 May 1973 (fr), *Adebusuyi FHI 66386* (WAG); **Plateau State**: Jemaa, 50 miles South of Vom. 10°10'N 9°25'E. Alt: 762m, 6 February 1955 (fl, fr), *McClintock, A.A. 189* (K); Kwarra, Plateau Province 1700 feet. 9°30'N 8°42'E, January 1958 (fl), *Wimbush FHI 41821* (FHO); **Rivers State**: Nkpokum, Port Harcourt. 4°46'N 7°01'E, 23 January 1958 (fl), *Stubbings 134* (K); Port Harcourt (Nkpoku). 4°46'N 7°01'E, December 1957 (fr), *Stubbings 167* (K); **Taraba State**: Gangumi. 7°40'N 11°15'E, 4 December 1954 (fl, fr), *Latilo FHI 28819* (FHO,K).

**SIERRA LEONE**: (fl), *Afzelius, A. s.n.* (UPS); (fl), *Warner 11* (K); **Northern Province**: Makumri. 9°02'N 12°49'W. Alt: 107m, 15 June 1918 (fl, fr), *Thomas, N.W. 509* (K); Southern Sula Mountains, south of Bumbuna, Rokel river near village Kabumba. 9°01.16'N 11°49.08'W. Alt: 115m, 9 March 2010 (st), *Burgt, X.M. van der 1454* (FBC,K,SL,WAG); Bunduna. 9°03'N 11°44'W, 26 January 1939 (fr), *Deighton 3600* (K,P); c. 2 km north of Bumbuna. 9°06'N 11°43'W. Alt: 164m, 27 March 2006 (fl), *Hawthorne 206a 796* (FHO); **Southern Province**: Njala. 8°06'N 12°05'W, 12 July 1951 (fr), *Deighton 5557* (K); Njala. 8°06'N 12°05'W, 23 July 1951 (st), *Deighton 5567* (K).

**TOGO, Centre**: River Mo at new bridge on Bassar to Boulo road. 9°15'N 0°47'E, 4 April 1984 (fl), *Lock, J.M. 84/68* (K).

**Key literature**: Akoègninou et al. (2006), Farron (1963, 1985), Hawthorne & Jongkind (2006), Hutchinson, Dalziel & Keay (1954).

### **Campylospermum glaucifolium** Biss.

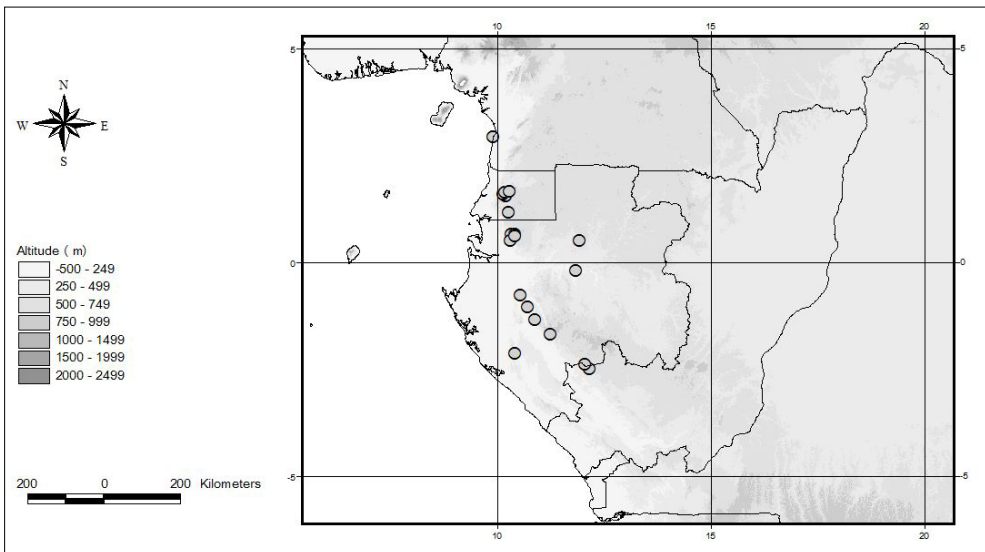
Blumea 58: 5 (2013). – Type: *J.J. de Wilde* et al. 10165 (holotype: WAG!; isotype: LBV!), Gabon, Estuaire, 1 km W of Nkan, along the road from Assok to Méla, 0°40'N, 10°19'E, January 23<sup>rd</sup>, 1991.

*Treelet* up to 2 m tall, with branched trunk; twigs with whitish bark. *Stipules* caducous, 2–3 mm long. *Leaf*: **petiole 7–15(–20) mm long**, canaliculate above; leaf blade narrowly elliptic to narrowly elliptic-obovate, **13–25(–30) x 4–7(–8) cm**, ratio **3.8–4.6**, base cuneate, apex acuminate, leathery to coriaceous, not bullate, margin serrulate, upper surface glossy, dark green but **turning glaucous when dry**, lower surface pale green, young leaves reddish; venation: midrib generally prominent on both sides, main lateral veins 14–16 on either side, 10–15 mm apart, slightly prominent above, prominent below, curved upward to run parallel to the margin, tertiary venation scalariform,

running perpendicular to the midrib thus causing the formation of a decreasing series of intermediate lateral veins, indistinct above, distinct below. *Inflorescence* terminal, **pendulous**, branched or unbranched, lax, its main axis (9-)15-33 cm long; peduncle slender; racemes 0-2(-3), 3-6(-10) cm long; pairwise scales persistent at the base of peduncle; bracts caducous, triangular, c. 2-3 mm long; cymules 0.5-1(-1.5) cm apart, 1-4-flowered. *Flower*: pedicel 3-12 mm, articulated at 1-3 mm from the base; sepals ovate, in flower 6-7 x 2-3 mm, green-yellowish, in fruit 8-9 x 3-4 mm, bright red; petals obovate, 7-9 x 4-5 mm, shortly clawed at base, rounded at apex; stamens: anthers 5-6 mm long; ovary c. 2 mm wide; style 6-7 mm long. *Fruit*: receptacle c. 3 mm wide, red; drupelets 1-4 well developed per receptacle, reniform 7-10 x 6-8 mm, black at maturity; cotyledons accumbent, similar in size.

**Notes:** This species resembles *C. calanthum* (Gilg) Farron, but differs by its glaucous upper leaf surface (at least when dry), longer petiole, and pendulous inflorescence that carries 0-2(-3) racemes.

**Distribution:** continental Equatorial Guinea (Rio Muni), Gabon and southwestern Republic of the Congo (Niari; see **Map 15**).



**Map 15:** Distribution of *Campylosperrum glaucifolium*

**Ecology:** in primary and secondary forest, on creek banks and along swampy areas; at 50-1000 m altitude.

**Phenology:** flowers collected in January, April, July and August; fruits collected from March to May and in August.

**IUCN conservation status:** LC. EOO=72,683 km<sup>2</sup>, AOO=23,157 km<sup>2</sup>, locations=19 (cell width=65 km). This species, although being sub-endemic to Gabon, has a fairly wide

distribution and hence its EOO and AOO are comparatively large, and above the IUCN thresholds. Therefore, the category of 'Least Concern' seems most appropriate here.

**Specimens examined:**

**CAMEROON, South Province:** Kribi, bords du Kienké, derrière la mission catholique. 2°56'N 9°54'E, 26 April 1970 (st), *Farron 7156* (P).

**CONGO (BRAZZAVILLE), Niari:** route Malinga-Divinié, 4 km du village Mollo. 2°29.64'S 12°09.61'E. Alt: 480m, 13 June 2011 (st), *Bissengou 1326* (LBV,WAG).

**EQUATORIAL GUINEA, Rio Muni, Centro Sur:** Mundung 'Les 4 montagnes'. 1°38'N 10°11'E. Alt: 1000m, 8 January 2003 (fr), *Desmet, G. 242* (BRLU); Parc national de Monte Alén. 1°40'N 10°17'E, 30 July 1998 (fl), *Ngomo 418* (BRLU); Centro Sur: Parque Nacional de Monte Alén: Esamalang, camino hacia Mondung. 1°33'N 10°12'E, 13 May 1999 (fr), *Pérez Viso 1139* (MA); Monts de Cristal. 10 km ENE d'Okuamkos. 1°10'N 10°16'E, 12 August 1988 (fl), *Wilks 1796* (LBV,WAG); Parc National de Monte Alén, 11 km à l'Est de la cabaña de Mosumo., 1°36.4'N 10°08.5'E, 12 July 2003 (st), *Senterre 4122* (BRLU).

**GABON, Estuaire:** Crystal Mountains, 1 km W of Nkan, along the road Assok-Méla. 0°40'N 10°19'E. Alt: 750m, 23 January 1991 (fl), *Wilde, J.J.F.E. de 10165* (WAG); Crystal Mountains, 25 km on the road Tchimbélé-Kinguélé. 0°31'N 10°18'E. Alt: 360m, 26 January 1991 (fl), *Wilde, J.J.F.E. de 10257* (LBV,WAG); **Moyen-Ogooué:** Mabounié, forest area south of camp. 0°45.98'S 10°32.62'E. Alt: 62m, 7 May 2012 (fr), *Bidault 489* (BRLU, LBV, MO, WAG); zone de Mabounié, à 45 km au sud-ouest de Lambaréné, rive nord de la rivière Ngounié. 0°45.95'S 10°32.55'E. Alt: 49m, 3 February 2013 (fl), *Bidault 1047* (BRLU, LBV, MO, P, WAG); **Ngounié:** route Malinga-Rebé. 2°23.07'S 12°03.35'E. Alt: 489m, 14 June 2011 (st), *Bissengou 1343* (LBV,WAG); Sindara, après village Matadi 7 route exploitation forestière EGG (ancien IFL). 1°02.26'S 10°42.47'E. Alt: 49m, 22 June 2011 (st), *Bissengou 1436* (LBV,WAG); route chantier Leroy Massika entre Mouila et Yeno. 1°40'S 11°15'E. Alt: 600m, 27 April 1989 (fr), *Louis, A.M. 3058* (LBV,WAG); upper Waka area, 13 km on IFL forestry road B2. 1°20.5'S 10°52.2'E. Alt: 180m, 31 March 2004 (fr), *Wieringa, J.J. 5192* (BR, LBV, MO, WAG); 51 km on the road Mouila to Yeno. 1°43.16'S 11°20.40'E. Alt: 595m, 6 March 2013 (fr), *Wieringa, J.J. 7103* (WAG); **Ogooué-Ivindo:** Chantier Koumameyong. Côté rivière-Marécage à raphia. 0°31'N 11°55'E, March 1987 (fr), *Dibata 117* (MO, WAG); Nord-Est du parc de la Lopé, 25 km du carrefour qui mène à l'ancien Booué Bac. 0°11.42'S 11°50.05'E. Alt: 251m, 6 March 2010 (fr), *Bissengou 1056* (LBV,WAG); **Ogooué-Maritime:** old logging road leading southward from chantier CBG Peni. 2°07.76'S 10°24.95'E. Alt: 210m, 22 April 2005 (fl), *Valkenburg 3162* (BR, LBV, MO, WAG); **Woleu-Ntem:** Crystal mountains, 5½ km NNE of Tchimbélé. 0°40'N 10°25'E. Alt: 540m, 31 January 1990 (fl), *Wieringa, J.J. 500* (BR, C, LBV, MO, PRE, WAG); Parc des Monts de cristal, piste après la case picnic sur la droite. 0°37'N 10°24'E, 13 February 2010 (st), *Bissengou 961* (LBV,WAG).

**Key literature:** Bissengou et al. (2013).

**CampylospERMUM glaucum** (Tiegh.) Farron

**Fig. 15**

Bull. Jard. Bot. État Bruxelles 35: 397 (1965). – *Exomicrum glaucum* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 340 (Dec. 1902). – Type: *Zenker 1647* (holotype: P!; isotype: E!, G!, K(2x)!, P!, S!, WAG!, Z!), Cameroon, Bipinde, 1898.

*Exomicrum membranaceum* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 340 (Dec. 1902). – Type: *Zenker 1030* (holotype: P!; isotype: E!, G!), Cameroon, Bipinde, 1898.

*Monelasmum brachybotrys* (Gilg) Tiegh., Ann. Sci. Nat., sér. 8, Bot. 18: 36 (June 1903). – *Ouratea brachybotrys* Gilg, Bot. Jahrb. Syst. 33: 270 (1904). – Lectotype (designated here): *Zenker 2180a* (holotype: K!; isotype: E!, G!, LY!), Cameroon, Bipinde.

*Ouratea bella* Gilg in Engl. & Prantl, Nat. Pflanzenfam. ed. 21: 73 (1925), nom. nud.

*Treelet* up to 8 m tall, with branched trunk; twigs with whitish bark. *Stipules* persistent, triangular, 3–4 mm long. *Leaf:* petiole 5–7(–10) mm long; leaf blade narrowly elliptic-obovate to narrowly elliptic, (7–)11–20(–23) x (2.5–)4–5(–7) cm, ratio

**2-3.8**, base cuneate or sometimes rounded, apex acute to acuminate or sometimes tapering, papyraceous, not bullate, margin **serrulate to subentire**, **glaucous on the upper surface**; venation: midrib almost flat to prominent above, prominent beneath, main lateral veins (7-)10-18 on either side, **7-20(-25) mm apart, flat to slightly prominent on both sides**, at a  $\pm$  right angle with the midrib but curved upwards to run parallel to the margin, intermediate lateral veins 2-3 in between each pair of main laterals, tertiary venation **scalariform, perpendicular to the midrib, distinct on both sides**. *Inflorescence* terminal, erect to erecto-patent, branched, dense, its main axis **(1-)2-4(-6) cm** long; pairwise scales few, persistent at the base of the peduncle; bracts persistent, **sometimes leaving a conspicuous scar**, triangular, 1-2 mm long; **racemes 1-3**, (1-)2-3 cm long; cymules **2-5 mm apart**, 1-6(-8)-flowered. *Flower*: pedicel **6-10(-12) mm long**, articulated at 2-4 mm from the base; sepals ovate, 5-7 x 1.5-3 mm in flower, 9-10 x 3-5 mm in fruit, greenish-yellow in flower, red in fruit; petals **obovate, 6-7 x 3-4 mm**, base cuneate to truncate, apex **emarginate**; stamens: anthers 3.5-6 mm long; ovary 1-2 mm long; style **persistent in fruit**, 4-5 mm long. *Fruit*: receptacle c. 1 mm thick in flower, 3 x 5 mm in fruit, red; drupelets 1 to 2 well developed per receptacle, **ellipsoid to slightly reniform**, 7-10 x 4-5 mm; cotyledons **incumbent, dissimilar in size with a small outer cotyledon**.

**Notes:** *C. glaucum* is characterized by its glaucous upper leaf surface. This is reminiscent of those sometimes encountered in *C. glaucifolium* which is, however, easily distinguished by its long, lax and pendant inflorescence.

The name *Ouratea brachybotrys* was published with several syntypes. *Zenker 2180a* has been designated as lectotype because it represents fruiting material and duplicates are distributed in 4 herbaria.

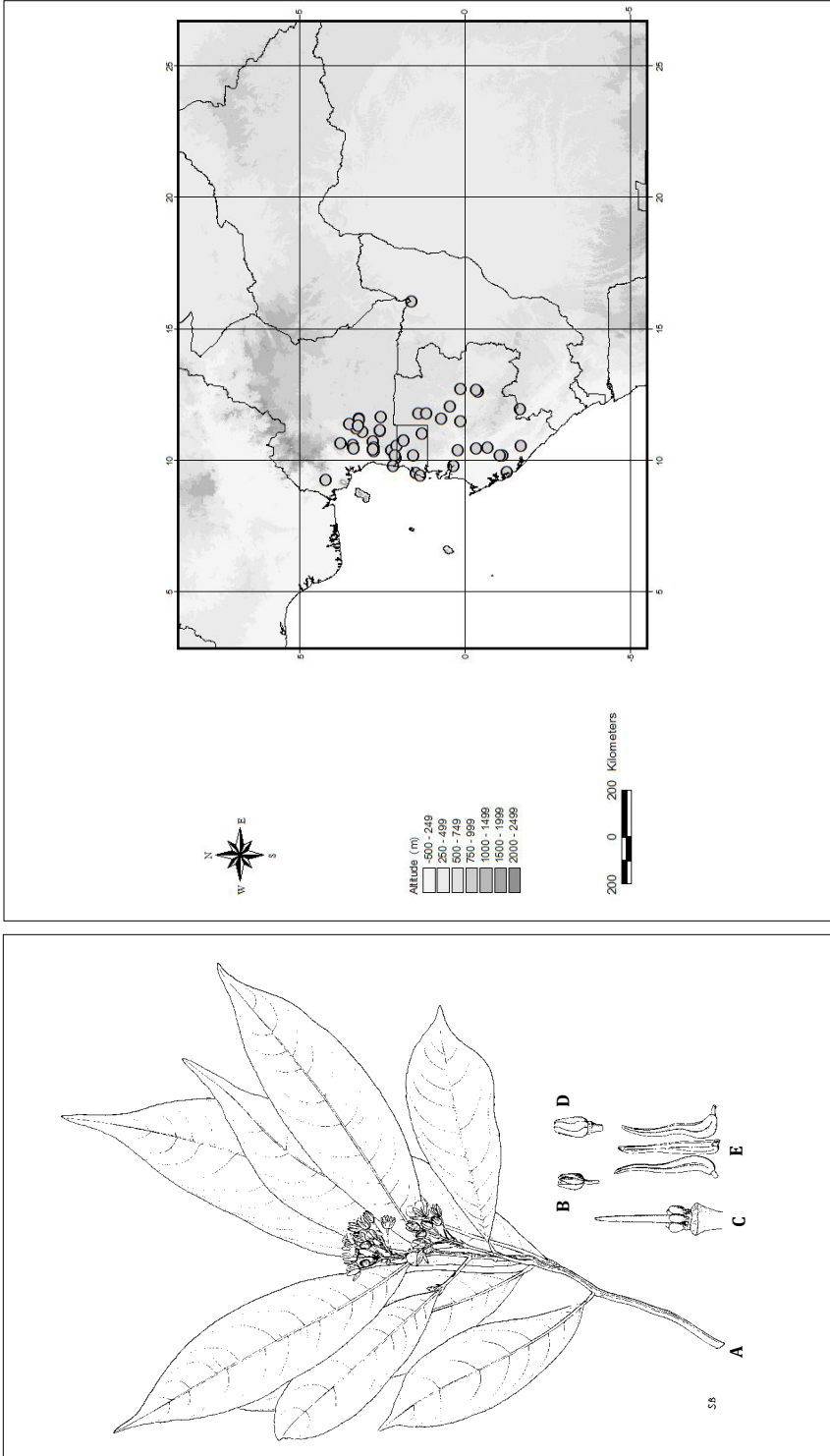
**Distribution:** Nigeria, Cameroon, southern Central African Republic, Equatorial Guinea, Gabon and Republic of the Congo (**Map 16**).

**Ecology:** in primary, secondary forest, understory of open forest, swampy and periodically inundated forest, riparian forest and forest edges near rivers; at 40-1100 m altitude.

**Phenology:** flowering all year round; fruits observed in August, September, November and from January to May.

**Vernacular name: Gabon:** Avom.

**IUCN conservation status:** LC. EOO=364,900 km<sup>2</sup>, AOO=188,880 km<sup>2</sup>, locations=54 (cell width=87 km). This species is not under threat because most of its locations are found inside National Parks such as Moukalaba-Doudou, Loango, Lope, Ivindo and Minkebe, all in Gabon, Monte Alen in Equatorial Guinea, and Dzanga-Sangha in the Central African Republic. It is fairly frequently collected suggesting it is not rare. Therefore, the category of Least Concern has been assigned.



**Figure 15.** *CampylospERMUM glaucum*. **A.** Flowering branch. **B.** Flower bud. **C.** Style. **D.** Receptacle with stamens. **E.** Stamens. Drawings by Sabine Bousani  
**Map 16.** Distribution of *CampylospERMUM glaucum*

**Specimens examined:**

**CAMEROON, Central Province:** Mefou Proposed National Park. 3°37.7'N 11°34.6'E, 10 March 2004 (fl, fr), *Nana, F. 62* (K,WAG); Ndanan 1 to Ndanan 2. 3°37'N 11°34'E. Alt: 700m, 22 March 2004 (fl, fr), *Darbyshire, I.A. 183* (K,SCA,WAG,YA); near Ndanan 2. 3°37'N 11°34'E. Alt: 700m, 22 March 2004 (fl), *Darbyshire, I.A. 198* (K,MO,SCA,WAG,YA); near Ndanan 2. 3°37'N 11°34'E. Alt: 700m, 22 March 2004 (fl, fr), *Darbyshire, I.A. 199* (K,WAG,YA); Ndanan 1 to Ndanan 2. 3°37'N 11°33'E. Alt: 680m, 25 March 2004 (fl, fr), *Darbyshire, I.A. 255* (K,WAG,YA); Ndahgan 1, Mefou National park, West of big chimpanzee enclosure. 3°37'N 11°35'E. Alt: 700m, 29 March 2004 (fl), *Tadjouteu 612* (K,SCA,WAG,YA); colline Nkolfee dans le massif Mbaminkom. 3°59'N 11°24'E. Alt: 1070m, 14 March 1978 (fl), *Dang 664* (P); 33 km N. of Eséka, near the road Yaoundé-Douala. 3°51'N 10°35'E, 22 December 1963 (st), *Wilde, W.J.J.O. de 1616* (WAG); 8 km SW of Makak. Reserve forestière des Eaux et Forêts. 3°30'N 11°05'E. Alt: 650m, 27 March 1964 (st), *Wilde, W.J.J.O. de 2233* (BAS,BR,P,WAG,YA); Trail into Mefon NP. 3°37'N 11°34'E, 24 March 2004 (fl), *Onana 2821* (K,WAG); along a footpath heading west from Nkoabock II. 3°42.72'N 11°14.80'E. Alt: 685m, 25 February 2007 (fl), *Wieringa, J.J. 5800* (WAG,YA); Ototomo Reserve 40 km de Yaoundé sur la route de Kribi. 3°40'N 11°20'E, 5 May 1970 (fr), *Farron 7267* (P); Ototomo Reserve 40 km de Yaoundé sur la route de Kribi. 3°40'N 11°20'E, 26 May 1970 (fr), *Farron 7345* (P); road to Ndangan 1. 3°37.5'N 11°34.9'E. Alt: 710m, 9 March 2004 (fl), *Cheek 11551* (K WAG, YA); Ndangan 1 to Ndangan II. 3°37.2'N 11°35.1'E. Alt: 710m, 10 March 2004 (fr), *Cheek 11652* (K,MO,SCA,WAG,YA); Eastern part of park, West of Ndangan I. 3°38'N 11°35'E. Alt: 710m, 18 March 2004 (fr), *Cheek 11829* (K,WAG,YA); **Littoral:** 50 km NW. of Eséka, W. of Yaoundé. On opposite of the Kelè river. 3°50'N 10°27'E. Alt: 100m, 21 November 1963 (st), *Wilde, W.J.J.O. de 1261* (MO,WAG); 50 km NW. of Eséka, W. of Yaoundé. On opposite of the Kelè river. 3°50'N 10°27'E. Alt: 100m, 22 November 1963 (st), *Wilde, W.J.J.O. de 1284* (MO,WAG); 40 km NW. of Eséka, W. of Yaoundé. 3°51'N 10°32'E, 12 December 1963 (st), *Wilde, W.J.J.O. de 1421* (MO,WAG,YA); Massanqui près de Botbea, 20 km NE de Ngambe (feuille IGN 1/200000. Ndninimeki). 4°20'N 10°40'E, 22 January 1972 (fl), *Letouzey 11056* (K,P); **South Province:** Bipindi. 3°05'N 10°25'E, (fr), *Zenker s.n.* (FHO); Bipindi. 3°05'N 10°25'E, February 1906 (fl), *Zenker s.n.* (FHO); Bipindi. 3°05'N 10°25'E, (fr), *Zenker s.n.* (FHO); Bipindi, Mimfia., 3°04'N 10°23'E, (fl), *Zenker 4* (B,C,HUH,WAG); 10km south of Mekalat. Between Mekalat and Lolodorf. Wijma concession: Chantier 1222, Block I2. 3°06'N 10°44'E. Alt: 400m, 20 March 1996 (fr), *Mutsaers 7* (WAG); 5 km NE of Cohoundje; Ebimimbang. 3°03'N 10°29'E. Alt: 100m, 27 February 1997 (fl, fr), *Gemerden 18* (WAG); Mimfia. 3°04'N 10°23'E, March 1913 (st), *Zenker 263* (C,LD); Mimfia. 3°04'N 10°23'E, March 1913 (fl), *Zenker 263* (C,G); Mimfia., 3°04'N 10°23'E, March 1913 (fl), *Zenker 264* (B,HUH,WAG); Urwaldgebiet. 3°05'N 10°25'E, 1896 (fr), *Zenker 1030* (BM,E,G); route Kribi-Bipindi, environ 2 km avant Bipindi. 3°04.38'N 10°22.94'E. Alt: 79m, 30 March 2010 (fr), *Bissengou 1248* (LBV,WAG,YA); route Bipindi-Bidjouka, village Log Ndiga environ 2 km de Bipindi. 3°05.3'N 10°25.1'E. Alt: 230m, 31 March 2010 (fr), *Bissengou 1255* (LBV,WAG,YA); Approximately 3 km WNW of Bipindi. 3°05'N 10°23'E. Alt: 120m, 16 January 1987 (fl), *Manning, S.D. 1396* (MO,WAG); Urwaldgebiet. 3°05'N 10°25'E, 1898 (fr), *Zenker 1647* (BM,E,G,K,S,W,Z); 15 km South of Ebolowa. 2°50'N 11°10'E, 29 February 1964 (st), *Wilde, W.J.J.O. de 2008* (BR,P,WAG); Urwaldgebiet. 3°05'N 10°25'E, (fr), *Zenker 2180* (E,G,K,L,Y); Campo-Ma'an area, Nyabizian, Forest around the Bongola river. 2°24.4'N 10°23.5'E. Alt: 400m, 30 March 2000 (fl, fr), *Tchouto Mbatchou 2677* (KRIBI,WAG,YA); 3°05'N 10°25'E, 1904 (fl), *Zenker 2830* (BM,G,K,S,W,WAG,Z); Campo-Ma'an area, Bibambivoto, 500m along transect T4 in the Campo area. 2°14.4'N 10°05.8'E. Alt: 40m, 21 August 2000 (fl), *Tchouto Mbatchou 2965* (KRIBI,WAG,YA); Urwaldgebiet. 3°05'N 10°25'E, 1908 (fl), *Zenker 3733* (BM,BR,E,G,K,W); Urwaldgebiet. 3°05'N 10°25'E, 1912 (fl), *Zenker 4349* (BM,COI,E,K,L,Y,S,W,Z); Station du Cacaoyer de N'koemvone, S. of Ebolowa, 14 km on the road to Ambam. Along the Seng river. 2°49'N 11°08'E, 28 August 1974 (st), *Wilde, J.J.F.E. de 7437* (BR,MA,MO,P,PRE,WAG,YA); Station du Cacaoyer de N'koemvone, S. of Ebolowa, 14 km on the road to Ambam. 2°49'N 11°08'E, 16 October 1974 (st), *Wilde, J.J.F.E. de 7648* (MO,WAG,YA); Nloubessa Boulou, 60 km ESE d'Ebolowa sur route de Mvangan. feuille IGN 1/200 000. 2°47'N 11°40'E, 22 January 1970 (fl), *Letouzey 9892* (BR,K); Ma'an forest between Meyos Ntem and Nsengou. 2°10.9'N 10°34.8'E. Alt: 440m, 5 February 2001 (fl, fr), *Tchouto Mbatchou NSEX 270* (WAG); Mvini, forest in the Campo area along transect T6. 2°16.2'N 10°11.0'E. Alt: 200m, 14 September 2000 (fl), *Tchouto Mbatchou T6X31* (WAG); **South-West Province:** Rumpi Hills near Dikome Balue. 4°54.05'N 9°16.20'E. Alt: 1101m, 21 April 2009 (fl, fr), *Dessein 2683* (BR,WAG,YA).

**CONGO (BRAZZAVILLE), Niari:** Massif du Chaillu, Nord E. de Divenié, 4 km de Moukoudi sur la route de Moukala. 2°29'S 11°57'E, 1975 (fl), *Sita 3936* (P); **Sangha:** prope Wesso juxta flumen Sanga. 1°37'N 16°03'E, August 1899 (fl), *Schlechter, F.R.R. 12719* (BM,K,L,Y).

**EQUATORIAL GUINEA, Rio Muni:** West-Afrika: Spanisch-Guinea. 22 March 1910 (fl), *Tessmann 804* (K); West-Afrika: Spanisch-Guinea. 22 March 1910 (fl), *Tessmann 828* (K); **Rio Muni, Centro Sur:** Centro

Sur. Parque Nacional de Monte Alén: Esamalang. 1°34'N 10°12'E, 3 November 1998 (fl, fr), *Pérez Viso 526* (MA); **Rio Muni, Litoral**: région continentale, réserve de Ndote. 1°17'N 9°26'E, September 1997 (fl), *Eneme Efua 155* (BRLU); Region Continental, marécage Jaudjè. 1°27'N 9°32'E, 29 July 1999 (fl), *Eneme Efua 460* (BATA,WAG); West-Afrika: Spanisch-Guinea: Bebai Camp. 2°19'N 9°48'E, 5 September 1908 (fl), *Tessmann 529* (K); **Rio Muni, Wele Nzas**: West-Afrika: Spanisch-Guinea:Nkolentangan. 1°55'N 10°45'E, 15 February 1908 (fl), *Tessmann 201* (K); région continentale, Obamico (Parque N. de Nsork). 1°13'N 11°01'E, 22 August 1998 (fl, fr), *Nguema Miyono 282* (BRLU); West-Afrika: Spanisch-Guinea: Nkolentangan. 1°55'N 10°45'E, 25 March 1908 (fl), *Tessmann 302* (K); West-Afrika: Spanisch-Guinea:Nkolentangan. 1°55'N 10°45'E, 29 March 1908 (fl), *Tessmann 319* (K).

**GABON, Estuaire**: Billagone. 0°01'N 9°48'E. Alt: 46m, 21 August 1938 (fl), *Thomson, A.P. 7* (K); Ekouk, piste du Lac de Nguen. 0°08'S 10°23'E, 29 September 1983 (fr), *Floret 1556* (LBV,MA,WAG); **Moyen-Ogooué**: Mabounié. 0°47.47'S 10°29.88'E, 5 November 2012 (fr), *Boupaya-Mapikou 839* (BRLU,LBV,MO,WAG); Mabounié, between the entry of mine concession and the Ngounié. 0°50.05'S 10°27.78'E. Alt: 63m, 10 May 2012 (fl, fr), *Stévert, TOBEB 4498* (LBV,MO); **Ngounié**: concession CBG, ± 20 km à l'ouest de Mandji. 1°43.8'S 10°11.9'E. Alt: 79m, 31 July 2008 (fl), *Dauby 1128* (BRLU,LBV,MO); concession CBG, ± 20 km à l'Ouest de Mandji. 1°48.9'S 10°11.0'E. Alt: 60m, 3 August 2008 (fl), *Dauby 1213* (BRLU,LBV,MO); along stream Ngounie. 0°39.37'S 10°22.93'E. Alt: 22m, 17 October 2012 (fl), *Sonké 6076* (MO); Dikaki Chantier. Bindolo R. basin, NW of Fougamou. 1°15'S 10°29'E. Alt: 300m, 20 September 1997 (st), *Breteler 14007* (BR,BRLU,E,G,HUJ,K,M,MA,MO,NY,P,TI,US,WAG); **Ogooué-Ivindo**: Lopé Reserve. 0°15'S 11°30'E, 1985 (fl), *Williamson, E.A. 201* (K); 17 km SE de Sogalem. 0°10'N 12°03'E, 11 August 1985 (fl), *Wilks 1121* (K,LBV,WAG); **Ogooué-Lolo**: 6 km along the road Mekouyi (12 km S.W. of Lastoursville) towards Koulamoutou. 0°55'S 12°38'E. Alt: 300m, 25 September 1978 (fr), *Breteler; Wilde, J.J.F.E. de 806* (WAG); concession de CEB, Nord de la zone de Milolé, Sud du Parc National de l'Ivindo. 0°14.0'S 12°43.6'E. Alt: 378m, 15 February 2010 (fl), *Dauby 2414* (BRLU,LBV,MO); 4 km SW of Lastoursville, right side Ogooué R., 0°50'S 12°41'E, 24 September 1970 (fr), *Breteler 6615* (PWAG); **Ogooué-Maritime**: Monts Doudou. 2°31.3'S 10°33.5'E. Alt: 200m, 18 September 2000 (fl, fr), *Bouroubou 293* (K,LBV,WAG); Koumouloundou, chantier forestier Mittner. 2°00'S 9°35'E, 6 June 1970 (st), *Farron 7375* (P); **Woleu-Ntem**: 10 km Lalara-Makokou, than 31 km along an exploitation road following the Okano River upstream. 0°30'N 11°36'E. Alt: 320m, 8 September 1978 (fl), *Breteler; Wilde 498* (C,MA,WAG); 40 km NE of Mitziç, forestry road in Bordamur forest exploitation. 1°03.4'N 11°47.4'E. Alt: 550m, 8 November 2009 (fr), *Bissiengou 794* (LBV,WAG); forestry concession Bordamur 60 km NE of Mitziç. 1°22.1'N 11°47.1'E. Alt: 650m, 10 February 2003 (fl), *Sosef 1977* (BR,LBV,MO,WAG); **UNKNOWN**: March 1920 (fl), *Allouette s.n.* (L).

**Key literature**: Bamps & Farron (1967), Farron (1963, 1985).

### **CampylospERMUM glomeratum** (Tiegh.) Biss.

Blumea 58: 6 (2013). – *Monelasmum glomeratum* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 330 (Dec. 1902). – Type: *Thollon 140* (holotype: P!; isotype: A!, FHO! K!), Gabon, Haut Ogooué, février 1895.

*Ouratea reticulata* (P.Beauv.) Engl. ex Gilg var. *angustifolia* Engl., Bot. Jahrb. Syst. 17: 81 (1893). – *Monelasmum angustifolium* (Engl.) Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 328 (Dec. 1902). – *Ouratea angustifolia* (Engl.) Gilg, Bot. Jahrb. Syst. 33: 269 (1904). – Type: *Soyaux 159* (holotype: B†; isotype: K!), Gabon, Munda, Sibange Farm, September 19<sup>th</sup>, 1880.

*Ouratea dusenii* Engl. & Gilg, Bot. Jahrb. Syst. 33: 260 (1904). – *CampylospERMUM dusenii* (Engl. & Gilg.) Biss. & Sosef, Blumea 53(3): 631 (2008). – Type: *Dusén 289* (B†), Cameroon.

*Exomicrum conrauanum* (Engl. & Gilg) Tiegh., Ann. Sci. Nat., sér. 8, Bot. 18: 38 (June 1903). – *Ouratea conrauana* Engl. & Gilg, Bot. Jahrb. Syst. 33: 260 (1904). – Type: *Conrau 37* (holotype: P!; isotype: E!), bei Tinto, Nördliches Cameroon, 1898.

*Ouratea gilgiana* H.Winkl., Bot. Jahrb. Syst. 41: 282 (1908). – Type: *Winkler 890* not



located. Neotype (designated here): *Versuchsanstalt Kamerun 493* (holotype: B! isotype: FHO!), Cameroon, Botanischen Garten Victoria.

*Treelet* 6 m tall, with branched trunk; **branches upright**; twigs with pale brown-whitish bark. *Stipules persistent*, triangular, 1–2 mm long. *Leaf*: petiole 4–6 mm long; leaf blade **narrowly to very narrowly elliptic, (4–)6–10(–14) x (0.8–)1–2(–3) cm**, ratio 4–6, base cuneate, apex acute, **papyraceous to subcoriaceous**, not bullate, glossy on both sides, dark green above, paler green beneath, margin distantly and shallowly serrulate; venation: midrib strongly prominent on upper side, prominent on the lower; main lateral veins **4–7 on either side, 5–13 mm apart**, more prominent below than above, at a  $\pm$  right angle with the midrib but curved upwards to run parallel to the margin, intermediate lateral veins **1–2** between each pair of main lateral ones, distinct on both sides, tertiary venation **scalariform**, indistinct on the upper side, distinct on lower side. *Inflorescence* terminal, **erect, branched, fairly dense**; its main axis (2–)4–9(–13) cm long; pairwise scales **persistent at the base of the peduncle, triangular**, small; racemes 2–3, ascendant, 3–6(–9) cm long; cymules 2–13 mm apart, **with 2–3 persistent, narrowly triangular bracts at their base**, 1–4-flowered. *Flower*: pedicel (8–)10–11(–13) mm long, articulated at 2–3(–4) mm from the base; sepals ovate, 8–9 x 3–4 mm in flower, 8–10 x 3–4 mm in fruit, greenish-yellow in flower, red in fruit; petals obovate, 11–13(–15) x 7–11 mm, base narrowly cuneate, apex **slightly emarginate**; stamens: anthers 4–8 mm long; ovary 1–2 mm long; style 5–6 mm long. *Fruit*: receptacle 1–2 mm thick in flower, in fruit 4–6 mm, reddish; drupelets 1 to 2 well developed per receptacle, **ellipsoid**, 6–4 x 3–4 mm; cotyledons incumbent, dissimilar in size with a small outer cotyledon.

**Notes:** The name *Ouratea dusenii* Engl. & Gilg, published in 1903, has been used most often in literature as the correct name for this species. Its type specimen *Dusen 289* is probably lost in Berlin. However, the name *Monelasmum glomeratum* Tiegh (with type specimen *Thollon 140*) is also available for this species. It perfectly fits the description of the former, as well as its ecological environment. After studying the type, *Thollon 140*, it is clear the name refers to the same taxon. Since it was published in 1902, one year before *Ouratea dusenii*, *Monelasmum glomeratum* Tiegh. is the legitimate name to be used which necessitated the new combination *C. glomeratum* (Tiegh.) Biss.

The name *Ouratea gilgiana* was published with *Winkler 890* as the type specimen. It could not be located and was probably destroyed during the World War II in Berlin. Therefore, a cultivated plant from the Victoria Botanical Garden (Cameroon) numbered 493 is designate here as neotype. The duplicates are in B and FHO and the material carries fruits.

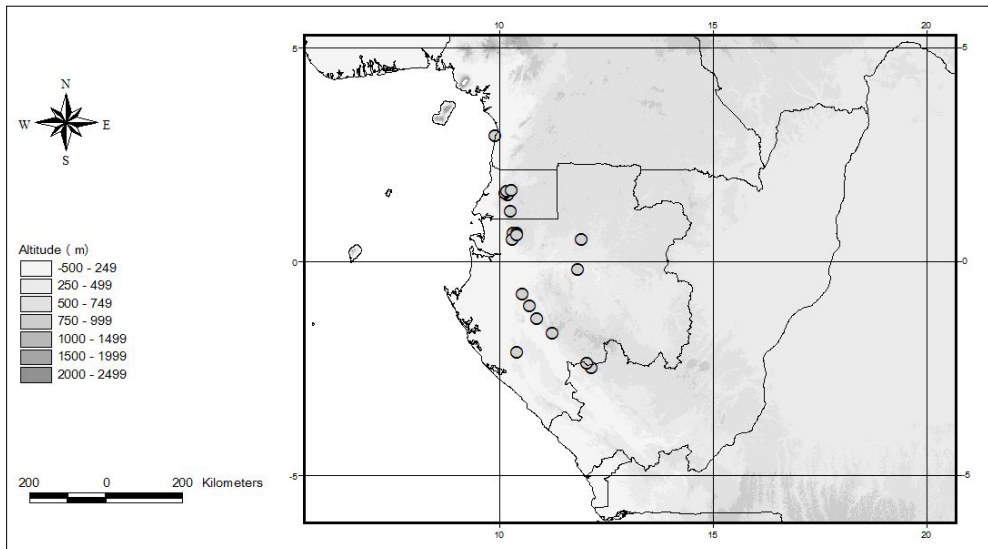
This species is close to *C. paucinervatum* by having relatively small, narrowly elliptic leaves. It differs, however, by having more bracts at the base of the cymules, its long and ascendant racemes and of course by having more lateral veins.

**Distribution:** Cameroon, Equatorial Guinea and Gabon (**Map 17**).

**Ecology:** in seasonally inundated gallery forest along rivers, on rocky river banks, in river beds; on rock white sandy soil; at 10-600 m altitude.

**Phenology:** flowering all year round; fruiting all year, except in September and November.

**IUCN conservation status:** LC. EOO=116,412 km<sup>2</sup>, AOO=50,789 km<sup>2</sup>, locations=27 (cell width=68 km). This species occurs mainly along rivers and in rocky river banks, habitats which are generally not suitable for human activities. Moreover, it is collected within National Parks such as Lopé in Gabon and Campo-Ma'an and Korup in Cameroon. It is fairly well represented in herbaria, suggesting it is not rare. Thus, the category of Least Concern seems most appropriate despite its rather limited area of distribution.



**Map 17:** Distribution of *Campylosperrum glomeratum*

### **Specimens examined:**

**CAMEROON, UNKNOWN:** (fl), *Versuchsanstalt Kamerun 493* (B,FHO); **Littoral:** bordure de la Sanaga en amont (rive gauche) du pont dit de Kikot (route Douala-Bafia), 70 km de Bafia. 4°11'N 11°02'E, 3 January 1970 (fl, fr), *Letouzey 9794* (BR,K); près de Toumbassala, Nkam sur route Bafang. Yabassi à 18 km au SSW de Nkondjok (feuille 1/200 000. Ndikiniméki). 4°28'N 9°58'E, 5 February 1972 (fl), *Letouzey 11127* (K,P); **South Province:** Campo-Ma'an area, Bibabimvoto. 2°17.2'N 9°57.1'E. Alt: 10m, 10 March 2000 (fl), *Tchouto Mbatchou 2647* (KRIBI,SCA,WAG,YA); Campo-Ma'an area, Bibabimvoto. 2°15.6'N 10°06.0'E. Alt: 10m, 23 August 2000 (fl), *Tchouto Mbatchou 3006* (KRIBI,WAG,YA); Campo-Ma'an area, Memve'ele water falls. 2°24.0'N 10°21.8'E. Alt: 360m, 16 January 2002 (fl), *Tchouto Mbatchou 3360* (KRIBI,SCA,WAG,YA); 26 km along a track from Ipono to Dipikar island, bank of Northern Ntem affluent (= Bougola river). 2°17'N 9°57'E, 26 June 1975 (st), *Wilde, J.J.F.E. de 8326* (BR,MO,P,WAG); Canon du Ntem a Oveng, pres Nyabessan (60 km Est de Campo). feuille IGN 1/200.000 kribi. 2°24'N 10°24'E, 9 April 1970 (fl, fr), *Letouzey 10318* (BR,K); Campo Ma'an area, Bibabimvoto. 2°17.0'N 9°57.0'E. Alt: 40m, 16 August 2002 (fl), *Tchouto Mbatchou BONGOX 7* (WAG); **South-West Province:** bei der Caulwellstation bei Tinto am Fiffusse. 5°32'N 9°36'E. Alt: 150m, 1898 (st), *Conrau 37* (E,P); Korup Reserve. 4°45'N 8°44'E, 12 February 1978 (fl), *Thomas, D.W. 333* (K); Buea-Douala. Bank of Mana (Ndian) River. 4°55'N 8°50'E. Alt: 50m, 8 June 1983 (fl, fr), *Thomas, D.W. 2157* (K,MO,WAG); Ndian river, Komp National

park. 4°55'N 8°55'E, 1 December 1988 (fl), *Lawton, R.M. 2631* (FHO); by Ndian waterfall, Bulu docks. 4°56'N 8°51'E, 17 January 1985 (fl), *Thomas, D.W. 4266* (K,MO); Ndian. 4°45'N 8°44'E, 28 January 1988 (fl, fr), *Tuley 5005* (K); Br. Cameroons: Ndian, Kumba. 4°45'N 8°44'E. Alt: 30m, 3 March 1936 (fl, fr), *Smith, J. cam79/36* (FHO,K).

**EQUATORIAL GUINEA, Rio Muni, Centro Sur:** Monte Alen, région continental. 1°40'N 10°17'E, 26 June 1997 (fl), *Ngomo 208* (BRLU); région continentale. Parc Nat. Monte Alen, Mosumo, confluence Rio Lana avec Rio Mbini. 1°36'N 10°02'E, 25 January 1998 (fl), *Obama 698* (BRLU); **Rio Muni, Litoral:** Bata-Senye: Estrada kms 40. Chegada a Senye sobre el Rio Benito. 1°37'N 9°49'E, 28 October 1991 (fl), *Carvalho, M.F. de 4913* (MA,WAG); près du village Sendje, Rio Uele. 1°34'N 9°50'E, 1 September 1997 (st), *Lisowski 590* (BRLU); près du village Sendje, Rio Uele. 1°34'N 9°50'E, 1 September 1997 (fl), *Lisowski 1254* (BRLU).

**GABON, Moyen-Ogooué:** Ogooué fleuve. Congo français. 0°11'S 10°45'E, January 1895 (fl, fr), *Thollon 140* (A,FHO,K,P); Rocky riverbank and seasonally flooded bed of the Okano river near its confluence with the Ogooué at Alembé. 0°06'S 10°47'E. Alt: 80m, 22 July 1986 (fl), *Thomas, D.W. 6597* (MO,WAG); Banks of Ogooué river at Junkville between Alembe and Ayem (1/2 way). 0°05'S 11°13'E. Alt: 100m, 23 July 1986 (fl, fr), *Thomas, D.W. 6624* (B,K,MO,S,WAG); **Ogooué-Ivindo:** Ogooué River, Booué. 0°06'S 11°56'E, 30 July 1966 (st), *Hallé; Le Thomas 247* (P); Lopé hotel. 0°06.10'S 11°35.54'E. Alt: 109m, 4 March 2010 (fl), *Bissiangou 1008* (LBV,WAG); Lopé hotel. 0°05.9'S 11°35.5'E. Alt: 100m, 4 March 2010 (fl), *Bissiangou 1012* (LBV,WAG); Lopé, en dessous du pont sur l'Ogooué. 0°06.29'S 11°24.93'E. Alt: 106m, 9 March 2010 (fl), *Bissiangou 1087* (LBV,WAG); Lopé, en dessous du pont sur l'Ogooué. 0°06.29'S 11°24.93'E. Alt: 106m, 9 March 2010 (fl), *Bissiangou 1090* (LBV,WAG); Lope Reserve. Ogooué Hotel. 0°15'S 11°40'E. Alt: 200m, 16 October 1993 (fl), *White, L.J.T. 1093* (LBV,MO,SEGC,WAG); Boué, départ de la piste de Petit Okano. 0°06'S 11°56'E, 7 October 1983 (fl), *Floret 1716* (MA,P,WAG); La Lope, Portes d'Okanda; rocky island in the Ogooué River. 0°07'S 11°39'E, 14 August 1993 (fl, fr), *Wilks 2744* (MO,WAG); near Lopé Hotel. Bank of Ogooué River. 0°05.3'S 11°36.1'E. Alt: 120m, 17 February 1998 (fl), *Wilde, J.J.F.E. de 11965* (LBV,WAG).

**Key literature:** Bissiangou & Sosef (2008), Hutchinson, Dalziel & Keay (1954), White & Abernethy (1997).

### **Campylospermum klainei** (Tiegh.) Farron

Bull. Jard. Bot. État Bruxelles 35: 398 (1965). – *Diphyllopodium klainei* Tiegh., Bull. Mus. Hist. Nat. (Paris) 8: 376 (June 1902). – Type: *Klaine 157* (holotype: P!), Gabon, environs de Libreville, 1896.

*Treelet* up to 6 m tall, **monocaulous** bark whitish. *Stipules* caducous, triangular, up to 15 mm long. *Leaf:* petiole 0–5 mm long, **stout**; leaf blade **narrowly spatulate, (30–)44–70(–90) x 10–20 cm**, ratio **3.4–4.7**, **base cordate, apex acuminate, papery**, not bullate, margin serrulate in the distal half, indistinctly so in the basal half, upper side dull dark green, lower side glossy bright green; venation: midrib slightly prominent on the upper side, strongly prominent on the lower, **main lateral veins (22–)26–34 on either side, 7–30 mm apart**, prominent on the upper side, prominent to slightly prominent below, **making a slight angle with the midrib**, straight and only towards the margin slightly curved up, intermediate lateral veins 0–2 in between each pair of main laterals, tertiary venation scalariform, **running perpendicular to the main lateral veins**, joined by cross veinlet, **distinct on both sides**. *Inflorescence* **terminal on a 3–4 cm long lateral twig (and thus appearing to be axillary), unbranched, dense**, its main axis 15–20 cm long; peduncle angular to slightly flattened, **bearing two subopposite, slightly reduced leaves or small leafy bracts at its base**, leafy bracts ovate and 3–4 x 1–1.5 cm; pairwise scales absent; cymules **2–5 mm apart, 4–10-flowered**. *Flower:* pedicel 10–15 mm long, articulated at 2–3 mm from the base; sepals ovate, in flower

7–9 x 4–5 mm, apex obtuse, green, in fruit 16–18 x 5–6 mm, red, coriaceous, curved over the drupelets; petals **obovate**, 13–15 x 4–5 mm, **base shortly clawed, apex rounded**; stamens: anthers 5–6 mm long; ovary 1–2 mm high; style 5–6 mm long. *Fruit*: receptacle flat, enlarged to 4–5 mm wide; drupelets 1 to 2 well developed per receptacle, **ellipsoid, 10–11 x 5–7 mm; cotyledons incumbent, similar in size**.

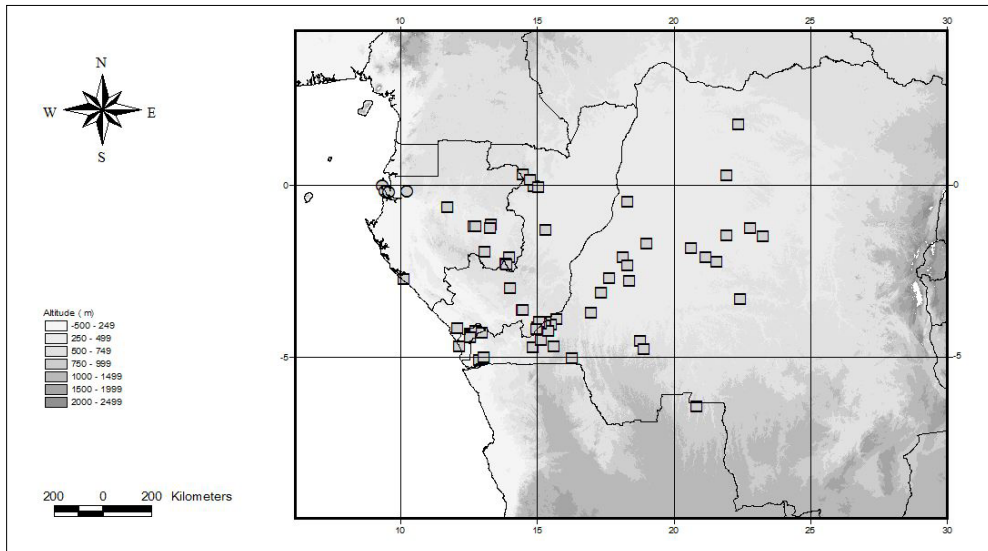
**Notes:** This species resembles *C. mannii* (Oliv.) Tiegh. morphologically. It differs by having papery leaves and inflorescences that are born on a short lateral twig. Furthermore, their distributions do not overlap; while *C. mannii* occurs in Cameroon and south-eastern Nigeria, *C. klainei* is a narrow endemic from north-western Gabon.

**Distribution:** only known from north-western Gabon, from the Crystal Mountains (Kinguélé) to the Mondah area (**Map 18**).

**Ecology:** in primary forest on hill slopes, on rocky or iron-rich soil; at up to 80 m altitude.

**Phenology:** flowering in August and September.

**IUCN conservation status:** CE B1/B2(ii,iv). EOO=1,072 km<sup>2</sup>, AOO=436 km<sup>2</sup>, locations=4 (cell width=10 km). This species occurs within the Mondah Forest Reserve in Gabon, but being close to the capital, this reserve and the zone around it is becoming very fragmented by human activities leading to a decline of suitable habitat for this species. Therefore, the category of Critically Endangered has been assigned.



**Map 18.** Distribution of *Campylosperrum klainei* (○) and *Campylosperrum laeve* (□)

**Specimens examined:**

**GABON, Estuaire:** Environs de Libreville 0°25'N 9°27'E, 1896 (fr), *Klaine 157* (P); Cap Estérias. 0°37'N 9°20'E, 4 August 1959 (st), *Hallé, N. 810* (P); Environs de Libreville 0°25'N 9°27'E, 1898 (st), *Klaine 1328* (P); S of Kinguélé. 0°25'N 10°15'E. Alt: 80m, 13 September 1994 (fl), *Breteler 12847* (BR,MO,WAG); Ikoy. 0°24'N 9°34'E, November 1957 (st), *Gauchotte SRFG 1906* (P).

**Key literature:** Farron (1965, 1968, 1985), Sosef et al. (2006), Tieghem (1902).

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p.140

**Campylospermum laeve** (De Wild. & T.Durand) Farron**Fig. 16**

Bull. Jard. Bot. État Bruxelles 35: 399 (1965). – *Ouratea laevis* De Wild. & T.Durand, Bull. Soc. Roy. Bot. Belgique 38(2): 34 (1899). – *Monelasmum laeve* (De Wild. & T.Durand) Tiegh., Ann. Sc. Nat., sér. 8, Bot. 16: 327 (1902). – Type: *Cabra 58* (holotype: BR!; isotype: BR!), Democratic Republic of the Congo, Tshela, 1897.

*Monelasmum lecomtei* Tiegh., Ann. Sc. Nat., sér. 8, Bot. 16: 331 (Dec. 1902). – Type: *Lecomte s.n.* (holotype: P!; isotype: P!), Congo, forêt de Moabi, sur le sentier de Brazzaville, January 1894.

*Ouratea buchneri* Gilg, Bot. Jahrb. Syst. 33: 270 (1904). – *Monelasmum buchneri* (Gilg) Tiegh., Ann. Sc. Nat. sér. 8, Bot. 18: 36 (1903). – Type: *Buchner 541* (B, probably destroyed). Neotype (designate here). *Missão de Estudos Florestais a Angola 684* (holotype: LISC!), Angola, Cabinda, Maiombe, Buco Zau, June 14<sup>th</sup>, 1960.

*Ouratea lundensis* Cavaco, Bull. Mus. Natl. Hist. Nat. sér. 2, 26: 641 (1954). – *Ouratea* sp., Consp. Fl. Angolensis: 297 (1951). – Type: *Gossweiler 13570* (holotype: COI!; isotype: B!, BM!, K! US!), Angola, Nordeste da Lunda, Dundo, 10<sup>th</sup>, September 1946. **syn. nov.**

*Tree* up to 15 m tall, with brached stem; bole up to 16 cm in diameter; twigs with whitish-brownish bark. *Stipules* caducous, triangular to narrowly triangular, 6–9 mm long. *Leaf*: petiole **(6–)10–20(–25) mm long, stout**; *leaf blade* elliptic to narrowly elliptic or narrowly elliptic-oblong (6–)14–29(–36) x (2.5–)4–8(–10) cm, ratio (2.0–)2.5–6.0(–8.5), base attenuate to narrowly cuneate or occasionally broadly cuneate, apex acuminate, often abruptly so, or rarely blunt, coriaceous, slightly glossy above, **margin distinctly thickened and often revolute**, finely and regularly serrulate; venation: midrib flattened to slightly prominent on the upper side, prominent beneath, main lateral veins **9–12(–15) on either side, 10–30(–42) mm apart**, mostly prominent above, prominent to slightly so beneath, at a ± right angle with the midrib but curved upwards to run parallel to the margin, intermediate lateral veins 1–7 in between each pair of main laterals, less distinct above, prominent below, tertiary venation **scalariform, joined by cross veinlets**, perpendicular to the midrib, less distinct above, distinct beneath. *Inflorescence* terminal, branched, lax, its main axis (5–)15–30(–35) cm long, **more or less angular**; pairwise scales absent; racemes 1–5(–7), (2–)5–9(–14) cm long, **erecto-patent to horizontal**, sometimes branched again; cymules 0.5–1.5 cm apart, 1–7-flowered; bracts caducous, 1–2 mm long. *Flower*: pedicel **10–12 mm long**, articulated at 1–2 mm from the base; sepals ovate, (6–)9–11 x 3–5 mm in flower, 8–12 x 4–6 mm in fruit, apex rounded or sometimes acute, greenish-yellow in flower, red in fruit; petals obovate, 6–12 x 3–5 mm, base cuneate, **apex rounded**; stamens: anthers 4–6 mm long; ovary 1–2 mm long; style 5–6 mm long. *Fruit*: receptacle enlarged to c. 5 x 5 mm in fruit; drupelets 3 to 4 well developed per receptacle, **ellipsoid**, 9 x 5–6 mm; cotyledons incumbent dissimilar in size with a small outer cotyledon.

**Notes:** The type specimen of the name *Ouratea buchneri* was *Buchner 541*. It could not

be located, and was probably destroyed at B. Therefore, a neotype is designated here. It originates from the same area (Angola). Unfortunately, collections of *Ouratea buchneri* from Angola do not have duplicates. We selected *Missão de Estudos Florestais a Angola 684* because it carries both flowers and fruits.

This species is easily distinguished by its revolute, finely and regularly serrulate margin. The range in leaf ratio is remarkable: from 2.0 to 8.5. It resembles *C. engama* with which it shares the long petiole, but differs by having a leaf blade that is not decurrent onto the petiole, and by its shorter racemes. It is pictured on a 1986 postal stamp from Gabon.

**Distribution:** Gabon, Republic of the Congo, Democratic Republic of the Congo and Angola (Cabinda, Lunda Norte province) (**Map 18**).

**Ecology:** in high and gallery forest; at 30–750 m altitude.

**Phenology:** flowering and fruiting all year round.

**Use:** The wood is used as timber whereas the leaves could be used against headache or toothache. Dried leaves are smoked like tobacco (Bamps and Farron 1967).

**Vernacular names:** **Angola:** Libambo, Limbembe (Kikongo). **Democratic Republic of the Congo:** Elonaanai, Itelisho, Lyonga (Mongo); Ifanjanjoku (Bokuma); Ntambo (Bokoro); Mumpele, Mumpeve (Luki), Lulaki lu mbwa.



**Figure 16.** *Campylospermum laeve*. A. Fruiting branch with persistent sepals. B. Flowering branch. C. Fruiting branch. Drawings by Sabine Bousani

**IUCN conservation status:** LC. EOO=1,114,450 km<sup>2</sup>, AOO=650,281 km<sup>2</sup>, locations=62 (cell width=150 km). This species is widely distributed in both the Democratic Republic of the Congo and the Republic of the Congo, where it does not appear to be rare. Recent collections are from Gabon and collected in Lopé National Park. Thus, the category of Least Concern seems most appropriate.

**Specimens examined:**

**ANGOLA, Cabinda:** Cabinda-Buco Zau, talhão permanente da Chiaca. 4°49'S 12°33'E, 9 March 1959 (fr), *Murta 1* (COI); Chiaco, Maiombe. 4°53'S 12°34'E. Alt: 70m, 20 October 1951 (st), *Câmeira 127* (LUA); Reserva Indígena do Chiaco, Maiombe. 4°53'S 12°34'E. Alt: 70m, 24 October 1951 (st), *Câmeira 291* (LUA); Maiombe, reserva do Cacongo. 5°14'S 12°10'E, 3 July 1959 (fr), *Missão de Estudos Florestais a Angola 549* (LISC); Maiombe, buco Zau. 4°45'S 12°34'E, 14 June 1960 (fl, fr), *Missão de Estudos Florestais a Angola 684* (LISC); Rio Luali, Maiombe. 4°39'S 12°46'E, 1924 (fl, fr), *Gossweiler 6042* (COI); Chiaca. 4°53'S 12°34'E. Alt: 100m, 20 April 1964 (fr), *Teixeira, J.M.L.B. 7655* (LUA); **Lunda Norte:** Luachima. 7°24'S 20°50'E. Alt: 750m, 15 September 1946 (fl), *Gossweiler 13570* (B,COI,K,US).

**CONGO (BRAZZAVILLE), Cuvette:** Odzala National Park, layon Tombi. 0°52'N 14°46'E, 23 January 1995 (fr), *Kouka 54* (BRLU); village de Mbéré, terre Ongondza, sous préfecture de Boundji. 0°58'S 15°19'E, 23 June 1965 (fl), *Bouquet, A. 1463* (P); Parc National d'Odzala. 0°38'N 14°54'E, 10 April 1994 (fl), *Dowsett-Lemaire 1706* (BR); Parc National d'Odzala, district de Mbomo. 0°38'N 14°54'E. Alt: 400m, 23 December 1994 (fr), *Champluvier 5169* (BR); district de Mbomo, P.N Odzala. «salines» de Mbouébé, au N de la Lékoli, en amont du confluent avec la Pandaka. 0°38'N 14°54'E. Alt: 400m, 13 January 1995 (fl), *Champluvier 5255* (BR,WAG); Odzala National Park, au Nord du Camp Mboko, Camp Caravati, Mbouebe. 0°38'N 14°54'E, 8 December 1993 (fr), *Lejoly 93/472* (BRLU); le Belvedere. 1°04'N 14°29'E, 23 November 1996 (fl), *Lejoly 96/805* (BR,BRLU); Odzala National Park, grand escarpement d'Odzala, entre Belvedre et le Camp du Daman. 1°04'N 14°29'E, 24 November 1996 (fl), *Lejoly 96/874* (BR,BRLU); Odzala National Park, rivière Lékoli, en amont de l'embarcadère. 0°36'N 15°03'E, 6 February 1994 (fl), *Lisowski C 538* (BRLU); Odzala National Park, layon Tombi, partie sud. 0°52'N 14°46'E, 13 February 1994 (fr), *Lisowski C 797* (BRLU); **Kouilou:** Moabi sur le sentier de Brazzaville. 4°33'S 12°05'E, January 1894 (fl), *Lecomte, P.H. s.n.* (P); **Lékoumou:** District de Zanaga, région de Makélé. 3°05'S 14°01'E, 6 December 1971 (fl), *Sita 3185* (BR,P); **Pool:** route Brazzaville-Linzolo à 22 km de Brazzaville (Alata), Réserve de la Djoumouna. 4°23'S 15°10'E, 27 February 1962 (st), *Charvet 58* (P); Bangou, M'Passa Ecole. 3°54'S 14°27'E, 19 September 1964 (fr), *Bouquet, A. 536* (P); village de Moutampa. 4°31'S 15°02'E, 15 December 1964 (fl), *Bouquet, A. 856* (P); Forêt de la Djoumouna. 4°23'S 15°10'E, 11 December 1969 (fl), *Hallé, F. 1698* (WAG); Plateau des cataractes, région de Moutampa. 4°31'S 15°02'E, 30 October 1967 (st), *Sita 1882* (P,WAG); entre le village Moutampa et le Congo. 4°31'S 15°02'E, 2 March 1965 (fr), *Farron 4010* (P); piste Mpassa-Bangou (Kindamba). 3°53'S 14°30'E, 28 April 1965 (fr), *Farron 4124* (P); Djoumouna. 4°23'S 15°10'E, 14 April 1966 (st), *Farron 5111* (P); Kimpanzou, près de chutes de la Foulakari. 4°36'S 14°59'E, 15 November 1986 (fl), *Lejoly 86/127* (BRLU); Loukanga II, à 25 km de Brazzaville. 4°20'S 15°05'E, 16 November 1986 (fl, fr), *Lejoly 86/188* (BRLU).

**CONGO (KINSHASA), Bandundu:** Patambalu. 2°15'S 18°19'E, 23 February 1958 (fr), *Tailfer 1* (BR); Bokoro. 2°50'S 18°23'E, 1 December 1948 (fr), *Jans, E. 820* (BR); Kikwit. 5°02'S 18°48'E, 18 July 1993 (fr), *Masens, B. 1256* (BRLU,K,WAG); Kwango. 4°00'S 17°00'E, July 1913 (fr), *Vanderyst 1435* (BR); Wombali. 3°16'S 17°22'E, August 1913 (fl), *Vanderyst 2008* (BR); Wombali. 3°16'S 17°22'E, October 1913 (fl), *Vanderyst 2303* (BR); Wombali. 3°16'S 17°22'E, October 1913 (fl), *Vanderyst 2390* (BR); Wombali. 3°16'S 17°22'E, October 1913 (fl), *Vanderyst 2401* (BR); Kwango. 5°19'S 18°56'E, 20 October 1955 (fr), *Devred 2721* (BR,K); Kabama. 5°40'S 16°18'E, 25 June 1959 (st), *Pauwels 3563* (BR); Kabama. 5°40'S 16°18'E, 25 August 1959 (st), *Pauwels 4213* (BR); Nioki. 2°43'S 17°40'E, 1940 (fr), *Flamigni 6009* (BR); Selenge. 1°58'S 18°10'E, (fr), *Flamigni 6024* (BR); Kiri. 1°27'S 19°00'E, July 1925 (fr), *Goossens 6230* (BR); **Bas-Congo:** 4°44'S 12°59'E, 1897 (fr), *Cabra 58* (BR); Luki (Mayumbe). 5°44'S 12°53'E, (fr), *Wagemans 367* (BR); Luki. 5°38'S 13°04'E, 8 February 1955 (fr), *Wagemans 945* (BR,K); Kimbuanga. 5°13'S 15°38'E, 25 January 1960 (fr), *Compère 1315* (BR); Luki, ligne de crête N'kula N'kakala. 5°38'S 13°04'E, 11 December 1947 (fl), *Donis 1623* (BR,FHO); Mbimbi. 5°15'S 14°52'E, 11 March 1960 (fr), *Compère 1643* (BR,K,P); Luki. 5°38'S 13°04'E, 18 March 1958 (fr), *Wagemans 1897* (BR,K); Luki, ligne de crête N'kula N'kakala. 5°38'S 13°04'E, 28 April 1946 (fr), *Toussaint, L. 2006* (BR); Upese. 4°59'S 15°09'E, 8 April 1959 (fr), *Pauwels 2217* (BR); Sanda. 4°40'S 15°26'E, May 1903 (fr), *Gillet, J. 3024* (BR); Luki, Parc National de la Nkula. 5°38'S 13°04'E, 21 June 1978 (fr), *Breyne, H. 3339* (BR); Sanda. 4°40'S 15°26'E, November 1903 (fl), *Gillet, J. 3554* (BR); Sanda. 4°40'S 15°26'E, June 1915 (fl), *Vanderyst 5523* (BR); Leopoldville. 4°19'S 15°19'E, 9 May 1915 (fl), *Bequaert 7561* (BR); Sanda. 4°40'S 15°26'E, April 1925 (fr), *Vanderyst 14550* (BR); Sanda. 4°40'S 15°26'E, April 1925 (fr), *Vanderyst 14635* (BR); **Equateur:** Yaliemba de Likote. 1°02'N 21°57'E, 17 May 1937 (fr), *Collart 45* (BR); Mondombe. 0°54'S 22°49'E, (fr), *Jespersen, K. 187* (BR); Botsima, parc. 1°09'S 21°57'E, 20 February 1991 (fl), *Dhetchuvi Matchu-Mandje 590* (BR); Dundusana. 2°53'N 22°23'E, January 1914 (fl), *Mortehan 1101* (BR); environ d'Eala. 0°03'N 18°19'E, 15 July 1905 (fr), *Laurent, É. 1472* (BR); Iwama. 2°08'S 21°34'E, 10 October 1957 (fl), *Evrard, C.M. 2803* (BR);

Isandja. 1°57'S 21°11'E, 19 October 1957 (fr), *Evrard, C.M. 2861* (BR); Parc National Monkoto. 1°38'S 20°39'E, 5 August 1958 (fr), *Evrard, C.M. 4483* (BR); Yalikingu, Mondombe. 1°11'S 23°16'E, 5 January 1959 (fl), *Evrard, C.M. 5442* (BR); **Kasai-Oriental**: Kole. 3°29'S 22°27'E, (fr), *Claessens 310* (BR); **Kinshasa**: Village Mofinu, sur route Menkae-King. 4°14'S 15°43'E, 18 December 1968 (fl), *Breyne, H. 702* (WAG); Kimuenza. 4°28'S 15°17'E, (fr), *Gillet, J. 1917* (BR,P); Pic Mense, Masina. 4°26'S 15°31'E, 22 December 1970 (fl), *Breyne, H. 2038* (BR); Kimuenza. 4°28'S 15°17'E, May 1901 (fr), *Gillet, J. 2205* (BR).

**GABON, Haut-Ogooué**: Parc National de Plateaux Batéké à 17 km de la station PPG en aval vers le débarcadère. 1°58.63'S 14°00.18'E. Alt: 385m, 29 January 2004 (fl), *Niangadouma 400* (LBV,WAG); Parc National des Plateaux Batéké. Bai Jobo. 2°12.53'S 13°52.45'E, 4 June 2005 (st), *Niangadouma 503* (MO); Batéké Plateau National Park, Bai Djobo. 2°13.4'S 13°54.0'E. Alt: 400m, 11 September 2006 (st), *Nguema Ekomo 802* (LBV); 30 km route Moanda to Bakoumba. 1°45'S 13°05'E, 2 October 1970 (fl, fr), *Breteler 6725* (C,K,WAG); **Ogooué-Ivindo**: Nord-Est du parc de la Lopé, route Lopé-Kassamabika, 5 km après village Kassamabika. 0°07.22'S 11°44.15'E. Alt: 265m, 6 March 2010 (fl), *Bissiengou 1062* (LBV,WAG); Nord-Est du parc de la Lopé, route Lopé-Kassamabika, 3 km après village Kassamabika. 0°07.36'S 11°44.08'E. Alt: 306m, 8 March 2010 (fr), *Bissiengou 1066* (LBV,WAG); Nord-Est du parc de la Lopé, route Lopé-Kassamabika, 3 km après village Kassamabika. 0°07.36'S 11°44.08'E. Alt: 306m, 8 March 2010 (fr), *Bissiengou 1067* (LBV,WAG); Nord-Est du parc de la Lopé, route Lopé-Kassamabika, 3 km après village Kassamabika. 0°07.36'S 11°44.08'E. Alt: 306m, 8 March 2010 (fr), *Bissiengou 1068* (LBV,WAG); Nord-Est du parc de la Lopé, route Lopé-Kassamabika, 3 km après village Kassamabika. 0°07.4'S 11°44.1'E. Alt: 306m, 8 March 2010 (fl, fr), *Bissiengou 1072* (LBV,WAG); Nord-Est du parc de la Lopé, route Lopé-Kassamabika, 3 km après village Kassamabika. 0°07.26'S 11°44.05'E. Alt: 290m, 8 March 2010 (fl, fr), *Bissiengou 1076* (LBV,WAG); Nord-Est du parc de la Lopé, route Lopé-Kassamabika, 3 km après village Kassamabika. 0°07.26'S 11°44.05'E. Alt: 290m, 8 March 2010 (fl), *Bissiengou 1077* (LBV,WAG); **Ogooué-Lolo**: region de Lastoursville. 0°50'S 12°42'E, 6 May 1929 (fl), *Le Testu 7335* (BM,BR,P); region de Lastoursville, Moudoungou. 0°50'S 12°45'E, 20 November 1929 (fl), *Le Testu 7662* (BM,BR,P); 50 km ESE of Lastoursville. 0°53'S 13°18'E, 4 May 1992 (fr), *Breteler 11290* (LBV,MO,WAG); 19 km E of Ndambi, road from Lastoursville to Okondja. 0°46'S 13°19'E, 15 October 1994 (fl), *Breteler 13307* (WAG); **Ogooué-Maritime**: Gamba. 15,2 km along the road from Gamba airport to Vera. Tondou forest. 2°44.7'S 10°08.6'E. Alt: 40m, 13 December 1994 (fl), *Wilde, J.J.F.E. de 11398* (BRLU,LBV,MO,WAG).

**Key literature**: Bamps & Farron (1967), Farron (1963, 1985).

**Campylospermum laxiflorum** (De Wild. & T.Durand) Tiegh.

**Fig. 17**

J. Bot. (Morot) 16: 197 (June 1902). – *Ouratea laxiflora* De Wild. & T.Durand, Bull. Soc. Roy. Bot. Belgique 38(2): 33 (1899). – *Monelasmum laxiflorum* (De Wild. & T.Durand) Tiegh., Ann. Sc. Nat., sér. 8, Bot. 16: 327 (Dec. 1902). – Type: *Thonner 20* (holotype: BR!; isotype: BR!), Congo, Ngali, August 28<sup>th</sup>, 1896.

*Monelasmum sulcatum* Tiegh., Ann. Sc. Nat., sér. 8, Bot. 16: 334 (Dec. 1902). – Lectotype (designated here): *Zenker & Staudt 768* (holotype: P!; isotype: BM!, COI!, GOET, K!, LE, Z), Cameroon, Yaunde, 1894-95.

*Monelasmum marquesii* Tiegh., Ann. Sc. Nat., sér. 8, Bot. 16: 334 (Dec. 1902). – Type: *Marques 201* (holotype: COI!), Angola, rio Guillo, June 1885. **syn. nov.**

*Monelasmum leroyanum* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 330 (Dec. 1902). – *Ouratea leroyana* (Tiegh.) Keay, Kew Bull. 1953: 81 (1953). – Type: *Leroy s.n.* (holotype: P!; isotype: P(2x)!), Gabon, forêt environs de Libreville (Mt Bouet), October 1895.

*Monelasmum setigerum* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 334 (Dec. 1902). – Type: *Zenker s.n.* (holotype: P!; isotype: COI!), Cameroon, Yaoundé, 1896.

*Ouratea macrobotrys* Gilg, Bot. Jahrb. Syst. 33: 268 (1904). – Lectotype (designated here): *Zenker & Staudt 768* (holotype: B†; isotype: BM!, COI!, GOET, K!, LE, P, Z), Cameroon, Yaunde, 1894-95.



*Ouratea ituriensis* Gilg & Mildbr., Wiss. Erg. deut. Zentr.-Afr. Exped., Bot. 2: 558 (1913). – Type: *Mildbraed 2984* specimen not located. Neotype (designated here): *Lebrun 2752* (holotype: BR!; isotype: K!, WAG!), Democratic Republic of the Congo, Buta, Titule, May 1931.

*Ouratea flamignii* De Wild., Rev. Zool. Afr. 7, Suppl. Bot.: B50 (1920). – Type: *Flamigni 116* (holotype: BR!; isotype: BR!), Democratic Republic of the Congo, Bena-Dibele, June 19<sup>th</sup>, 1905.

*Ouratea bracteato-pedunculata* De Wild., Ann. Soc. Sci. Bruxelles, sér. B 48, compt. rend.: 26 (1928). – Type: *Claessens 268* (holotype: BR!; isotype: BR!), Democratic Republic of the Congo, Bena-Dibele, June 12<sup>th</sup>, 1909.

*Ouratea dubiosa* De Wild., Ann. Soc. Sci. Bruxelles, sér. B 48, compt. rend.: 28 (1928). – Type: *Claessens 396* (holotype: BR!; isotype: BR!), Democratic Republic of the Congo, Katako Kombe, January 1910.

*Tree or treelet* up to 10 m tall, with branched stem; **bole up to 10 cm in diameter**; twigs with whitish-brownish bark. *Stipules persistent*, narrowly triangular, (3-)4–10 mm long. *Leaf*: petiole 2–7 mm long; leaf blade narrowly elliptic-obovate to narrowly elliptic or rarely elliptic-obovate or elliptic, **(5-)13–23(-32) x (1.5-)6–9(-11) cm**, ratio **2–4.5**, base narrowly cuneate to rounded, apex gradually acuminate, papyraceous to subcoriaceous, slightly bullate or sometimes smooth, in dry condition **set with tiny bumps in between the tertiary veins on the upper surface giving it a ‘rough’ appearance**, glossy above, margin serrulate; venation: midrib prominent above and below, main lateral veins 7–18 on either side, **10–15(-20) mm apart**, prominent but often running in a slight depression above, prominent below, at a ± right angle with the midrib but curved upwards to run parallel to the margin, intermediate lateral veins **1–2 in between each pair of main laterals**, distinct, tertiary venation **scalariform**, perpendicular to the midrib, with numerous cross-veins giving it a reticulate appearance, **distinct on both sides**. *Inflorescence* terminal, branched, lax, its main axis (5-)11–35(-50) cm long; pairwise scales **persistent at the base of the peduncle**, triangular, 5–10 mm; racemes (1-)2–8, (4-)7–21(-23) cm long; cymules 1–2 cm apart, 1–12-flowered. *Flower*: pedicel (7-)10–18(-20) mm long, articulated at 1–5(-7) mm from the base; sepals ovate, 5–7 x 2–3 mm in flower, 5–8 x 2.5–4 mm in fruit; petals **obovate**, 7–12 x 5–10 mm, base attenuate, **apex emarginate**; stamens: anthers 4–6 mm long; ovary c. 1 x 1 mm; style 3–5 mm long. *Fruit*: receptacle enlarged up to c. 6 x 5 mm in fruit; drupelets 1 to 3 well developed per receptacle, **ellipsoid**, 4–10 x 4–6 mm; cotyledons incumbent, dissimilar in size with a small outer cotyledon.

**Notes:** *Monelasmum sulcatum* and *Ouratea macrobotrys* were simultaneously described based on duplicates of the same collections. A lectotype *Zenker & Staudt 768* is designated for both species. It has several duplicates located in seven herbaria and the fruits are present in all herbarium sheets.

The type specimen (*Mildbraed 2984*) of the name *Ouratea ituriensis* could not be located. Therefore, another specimen *Lebrun 2752* has been appointed as neotype. It has fruits and the duplicates are kept in 4 different herbaria. It was collected more or less in the same area.

This species shares some features with *C. reticulatum*, especially the tertiary venation with many cross veinlets is reminiscent of that species. However, the tiny bumps on the often slightly bullate upper leaf surface generally makes *C. laxiflorum* stand out (see also the note under *C. reticulatum*). In addition it has persistent stipules, whereas *C. reticulatum* has caducous ones.

**Distribution:** from south-western Senegal to Ghana and from southern Nigeria to the Democratic Republic of the Congo and northern Angola (Malanje) (**Map 19**).

**Ecology:** primary and secondary forest, high forest on slopes, in swampy, inundated forest, in forest along rivers or streams and gallery forest; on sandy soil; at 0–1500 m altitude.

**Phenology:** flowering and fruiting all year round.

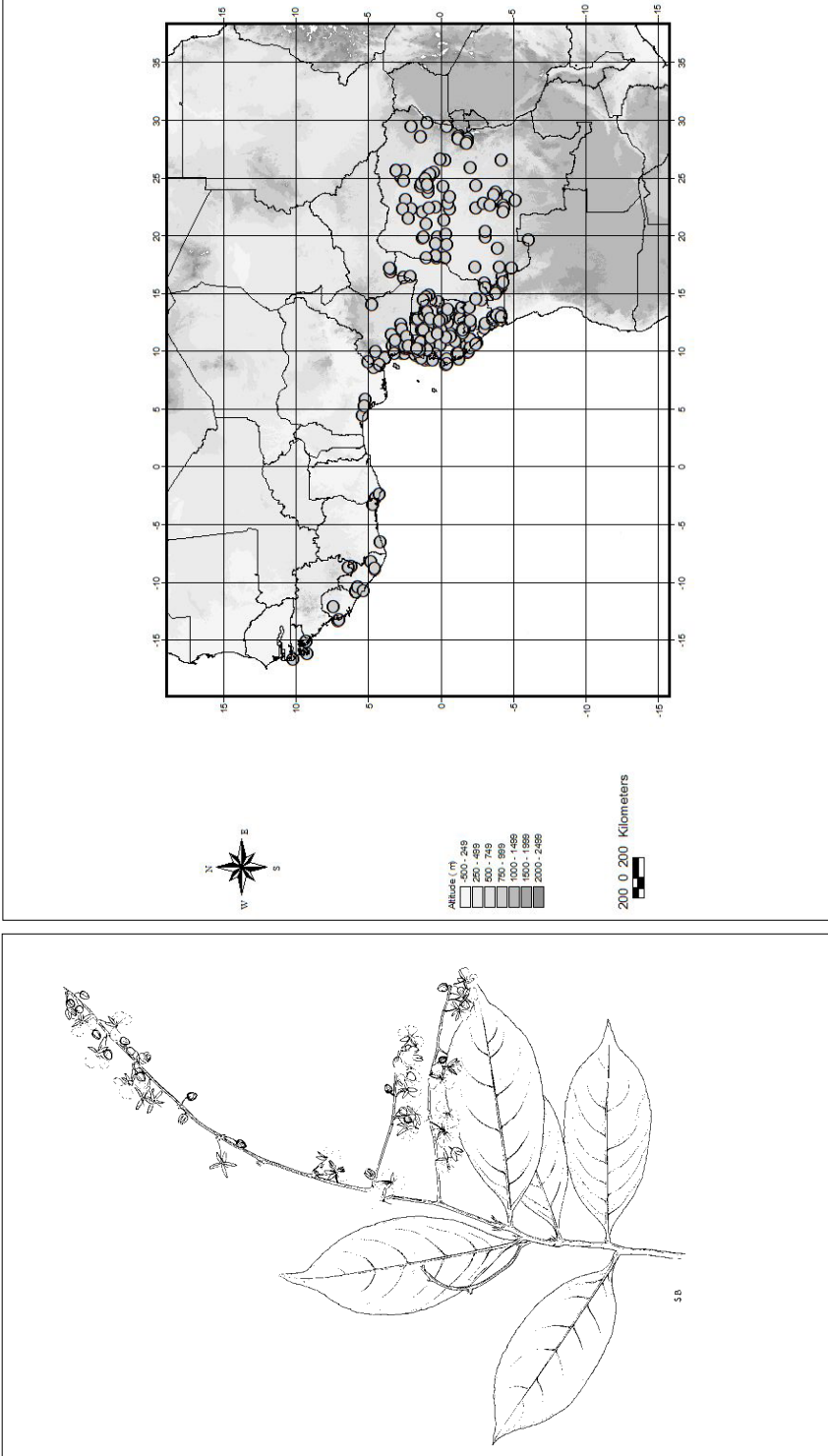
**Vernacular names:** **Democratic Republic of the Congo:** Engbongbo (Babua), Bolilibo Kikereke, Yeka Olili Ikekeleke (Turumbu), Lofandjandjoku (Lokundu), Luhaha (Kitembo).

**IUCN conservation status:** LC. EOO=4,784,680 km<sup>2</sup>, AOO=6,481,380 km<sup>2</sup>, locations=322 (cell width=531 km). This species is common and widely distributed in Central Africa, less so in West Africa. It has numerous recent collections and thus the category of Least Concern has been assessed.

#### **Specimens examined:**

**ANGOLA, Cabinda:** Reserva Indígena do Chiaco, Maiombe. 4°53'S 12°34'E. Alt: 25m, 1 November 1951 (fl), *Câmeira 151* (LUA); **Lunda Norte:** Cassádil, nos valles de rio Cuillo. 8°00'S 19°40'E, (fl), *Marques, S.A. 201* (COI).

**CAMEROON, Central Province:** Yaoundé Urwaldgebiet. 3°52'N 11°31'E, 1896 (fl), *Zenker s.n.* (COI,P); Yaoundé station. 3°52'N 11°31'E, (fl), *Zenker 207* (COI,S); Yaunde. 3°52'N 11°31'E, (fl), *Zenker; Staudt 760* (S,US); Yaoundé. 3°52'N 11°31'E, (fr), *Zenker 768* (BM,COI,K,P); 45 km S. of Badjob, 50 km SW. of Eséka, 5 km S. of the Nyong river. 3°26'N 10°30'E, 28 January 1964 (st), *Wilde, W.J.J.O. de 1716* (BR,MO,WAG); 50 km South of Badjob 60 km Southwest of Eseka, South bank of the Njong river. 3°28'N 10°30'E, 19 March 1964 (st), *Wilde, W.J.J.O. de 2138* (WAG); Makak. 3°33'N 11°02'E, October 1938 (fl), *Jacques-Félix 2262* (P); **East Province:** Bétaré Oya, 5 km from Mission along road to Bertoua. 5°33'N 14°06'E. Alt: 900m, 17 February 1961 (fl, fr), *Breteler 1066* (A,BR,FI,K,LISC,M,P,WAG,YA); **Littoral:** Edea, Forstexpedition. 3°44'N 11°10'E, September 1908 (fl), *Büsgen s.n.* (B); west of lake Tissongo, 16 km EES of Mouanko. 3°35'N 9°51'E, 19 September 1983 (fr), *Asonganyi 689* (P); 40 km NW. of Eséka, along the Kelé river. 3°47'N 10°31'E, 31 January 1964 (st), *Wilde, W.J.J.O. de 1751* (WAG); **South Province:** Bipindi, Urwaldgebiet. 3°05'N 10°25'E, February 1907 (fr), *Zenker s.n.* (US); Mboro near Ngom, 16 km from Ambam on road Ebolowa-Ambam. 2°36'N 11°18'E, 1 September 1978 (fl), *Koufani 174* (P); Mvila, Nyangong, Nyangongakwe 2°58'N 10°44'E, 28 July 1999 (fl), *Smits, A.P. 277* (WAG); Yaoundé station 800 m. 3°05'N 10°25'E, 1911 (st), *Zenker 423* (L,US); Bitey S. 3°01'N 12°22'E, 1917 (fl), *Bates, G.L. 969* (BM,Z); Ma'an, Nvili Ayet, Forest 1,5 hours walk North of Ma'an village, behind nvili creek. 2°22'N 10°36'E. Alt: 540m, 13 February 2001 (fl, fr), *Andel, T.R. van 3149* (KRIBI,SCA,WAG,YA); 7.5 km S of Kribi, Grand Batanga road. 2°53'N 9°54'E, 4 November 1968 (st), *Bos, J.J. 3194* (MO,WAG); 5 km from Kribi, Ebolowa road. 2°55'N 9°56'E, 21 November 1968 (fl), *Bos, J.J. 3355* (MO,WAG,YA); 17 km N. of Kribi. 3°02'N 9°58'E, 4 March 1969 (fl), *Bos, J.J. 4055* (BAS,P,WAG,YA); Elephant Mont, near stonecutter's camp. 2°47'N 10°01'E. Alt: 195m, 22 October 2001 (fl), *Andel, T.R. van 4175* (KRIBI,WAG); Campo Ma'an area, Boussebeliga



**Figure 17.** *Campylosperrum laxiflorum*. Flowering branch. Drawing by Sabine Bousani  
**Map 19.** Distribution of *Campylosperrum laxiflorum*

creek, forest behind Pygme doctor's house. 2°43'N 9°52'E. Alt: 40m, 29 October 2001 (fr), *Andel, T.R. van 4204* (WAG); 2 km S. of Kribi. 2°55'N 9°54'E, 16 September 1969 (st), *Bos, J.J. 5341* (BAS,WAG); Just E. of Kribi, Kienke river, 2°56'N 9°55'E, 6 September 1970 (st), *Bos, J.J. 7342* (WAG); Ongongondjé hill, 17 km NW. of Ambam, close to the village of Akonékéyé. 2°29'N 11°10'E. Alt: 850m, 27 December 1975 (fl), *Wilde, J.J.F.E. de 8719* (BR,K,MA,MO,P,PRE,WAG,YA); près Enelessi, 30 km W. de Sangnelima, Ebolona. 2°56'N 11°59'E, 10 March 1970 (fl, fr), *Letouzey 10141* (COI,K); 12 km E Nyabesan. 2°25'N 10°32'E, 4 March 1963 (fl), *Raynal, J. 10202* (P); Nkolemenlong (Nkolebenga), à l'Ouest d'Ebianemeyong, près Nyabessan (60 km Est de Campo). 2°25'N 10°20'E, 10 April 1970 (fl), *Letouzey 10328* (COI,K); Campo Ma'an area, Bifa, in the National Park. 2°39.5'N 10°17.0'E. Alt: 120m, 12 October 2001 (fl), *Tchouto Mbatchou BIFAX 143* (WAG); Akom II, Efoulan and Egongo hills. 2°44.8'N 10°32.9'E. Alt: 840m, 6 December 2000 (fl), *Tchouto Mbatchou EGONX 313* (WAG); Campo Ma'an area, Ebianemeyong, toward Nyabissan in the Ma'an area. 2°27.6'N 10°17.8'E. Alt: 480m, 24 May 2002 (fr), *Tchouto Mbatchou NGOMAX 37* (WAG); **South-West Province**: Abonando. 5°54'N 9°07'E, 2 March 1902 (fl), *Rudatis 8* (G,K,W); at Mbu Bolomi. 4°59'N 9°20'E. Alt: 900m, 20 November 1986 (fl), *Mambo 268* (EA,G,MA,MO,UPS,US,WAG); forest between Bulu and Dibunda. 4°55'N 8°52'E. Alt: 50m, March 1984 (fl, fr), *Thomas, D.W. 3264* (K,MO,WAG); between Baro and Ikenge villages, along foot path, in the Korup National Park. 5°15'N 9°09'E. Alt: 250m, 1 April 1988 (fl), *Thomas, D.W. 7504* (MO,WAG); S. Bakundu Reserve, Banga. 4°24'N 9°27'E, 11 March 1948 (fl), *Brenan 9282* (FHO,K); Kumba. S. Bakundu 1 mile W. of Banga village. 4°24'N 9°27'E, 11 March 1948 (fl), *Onochie 9303* (FHO); **West Province**: route de Mbos, Mt. Bamboutos. 5°15'N 10°00'E. Alt: 1100m, 10 March 1967 (fr), *Meurillon CNAD 651* (BR,K,P).

**CENTRAL AFRICAN REPUBLIC, Lobaye**: Ngotto, Layon L6 (4.5 km). 3°59'N 17°09'E, 8 April 2000 (fl), *Yongo 367* (BRLU); Ngotto, Badoundji. 4°00'N 17°15'E, 30 March 1999 (fl), *Zawa 404* (BRLU); **Sangha-Mbaéré**: Dadia. 22 November 1999 (fl, fr), *Yangakola 347* (BRLU); Mangoro, commune de Bamdio. 3°57'N 16°57'E, 22 November 1999 (fl), *Yangakola 639* (BRLU); 25 km SE of Bayanga, Kongana research camp. 2°47'N 16°25'E, 15 February 1994 (fl), *Harris, D.J. 4627* (E,WAG); Kongana camp. 25 km SE of Bayanga. 2°48'N 16°25'E, 20 May 2001 (st), *Harris, D.J. 7770* (E,WAG).

**CONGO (BRAZZAVILLE), Cuvette**: Odzala National Park, layon Tombi, 15 km. 0°52'N 14°46'E, 15 June 1995 (fr), *Kouka 116* (BRLU); Odzala National Park, Lengi-Lengi. 0°28'N 14°30'E, 2 October 1993 (fl), *Diafouka 232* (BRLU); Odzala National Park, autour de la saline Mbouebe. 0°38'N 14°54'E, 18 April 1995 (fl), *Kouka 281* (BRLU); Odzala National Park, layon Tombi, 9 km. 0°52'N 14°46'E, 15 March 1996 (fl), *Kouka 510* (BRLU); Odzala National Park, entre le Camp Mboko et l'embarcadère. 0°38'N 14°54'E, 9 December 1993 (fl), *Diafouka 585* (BRLU); Alima-Likouala, région de M'Bomo, réserve de chasse d'Odzala (M'Boko). 0°13'S 14°20'E, 15 December 1970 (fl), *Sita 2997* (BR,P); Odzala National Park, grand escarpement d'Odzala, entre Belvedere et le camp du daman. 1°04'N 14°29'E, 24 November 1996 (fr), *Lejoly 96/ 880* (BRLU); Odzala National Park, grand escarpement d'Odzala, bai de l'ombrette. 1°04'N 14°28'E, 27 November 1996 (fl, fr), *Lejoly 96/ 955* (BRLU); **Kouilou**: Congo, environs de Dimonika. 4°14'S 12°26'E, 16 December 1982 (fl), *Cusset 1234* (P); région de Kakamoeka, embranchement Missafou, nouveau chantier forestier S.F.N. sur piste Bumico. 4°09'S 12°05'E, 6 June 1966 (fr), *Sita 1343* (P); **Lékoumou**: Région de Kindamba, environs des grottes de Meya au dessous du Campement O.R.S.T.O.M. 3°54'S 14°27'E, 26 September 1968 (fl), *Sita 2568* (BR); District de Zanaga, Mouoni. 2°51'S 13°50'E, 8 December 1971 (fl), *Sita 3203* (P); **Niari**: c. 45km W of Mossendjo 150km N of Dolisie. 2°57'S 12°20'E. Alt: 600m, 15 September 1964 (fl), *Braakenburg van Backum 51* (MO,WAG); village de Mouteké, route de Mossendjo. 2°57'S 12°44'E, 16 January 1965 (fr), *Bouquet, A. 930* (P); route Malinga-Rebé. 2°25.80'S 12°06.55'E. Alt: 485m, 14 June 2011 (st), *Bissiengou 1337* (LBV,WAG); Environs de M'Binda, vers la frontière Congo-Gabonaise. 2°06'S 12°52'E, 17 March 1973 (fl), *Sita 3545* (WAG); **Pool**: village Mountota. 3°26'S 14°36'E, 21 December 1992 (st), *Bitsindou, M. 284* (BRLU); **Sangha**: Nouablé-Ndoki National Park, Goulougo Study Site, 37 km E de Bomassa. 2°12.7'N 16°31.1'E. Alt: 389m, 12 April 2007 (fl, fr), *Ndolo Ebika 36* (E,WAG).

**CONGO (KINSHASA), Bandundu**: Kiyaka. 5°19'S 18°56'E, 12 October 1955 (fl), *Devred 2706* (BR); entre Kisantu et Kwango. 3°23'S 17°21'E, (fl), *Gillet, J. 3349* (BR); Kintutila. 5°19'S 15°21'E, 18 August 1959 (st), *Pauwels 4067* (BR); Pelende. 6°31'S 17°15'E, January 1955 (fl), *Callens 4765* (BR); entre la Lubue et la Loange. 4°13'S 19°57'E, 1922 (st), *Vanderyst 12498* (BR); Mbau. 5°29'S 17°19'E, (fr), *Vanderyst 16415* (BR); **Bas-Congo**: Luki. 5°38'S 13°04'E, 27 September 1947 (fl), *Donis s.n.* (BR); Kisafu (Maduda). 4°54'S 13°02'E, October 1951 (fl), *Hauzer 24* (BR); Chimbanze. 4°54'S 12°45'E, 1897 (fl), *Cabra 62* (BR); Luki. 5°38'S 13°04'E, 15 October 1948 (fl), *Maudoux 79* (BM,BR); Luki, plateau du poste. 5°38'S 13°04'E, 20 December 1948 (fr), *Maudoux 125* (BR,K); Luki réserve. 5°38'S 13°04'E, 6 January 1967 (st), *Nsimundele 139* (BR); route Kinzaou Vuete. 5°45'S 16°30'E, 8 September 1959 (fl), *Compère 261* (BR,K); Luki. 5°38'S 13°04'E, 1951 (fl), *Wagemans*

262 (BR); Mbwela. 5°08'S 15°04'E, 1910 (fl), *Allard, J. 286* (BR); Ngilumbonda. 5°08'S 15°04'E, 1910 (fl), *Allard, J. 297* (BR); Luki. 5°38'S 13°04'E, 1959 (st), *Dubois, J. 423* (BR); Vaku. 5°16'S 13°10'E, November 1923 (fl), *Wellens 444* (BR); Kibambi. 5°18'S 15°20'E, 17 August 1979 (fl), *Nsimundele 511* (BR); Réserve Luki, Parc de la Nkila. 5°38'S 13°04'E, 26 September 1979 (fl), *Nsimundele 544* (BR); Gimbi. 5°31'S 13°22'E, 11 December 1953 (fl), *Wagemans 722* (WAG); Kinkosi-Lidi. 5°38'S 15°40'E, 20 August 1981 (fl), *Nsimundele 842* (BR); Luki. 5°38'S 13°04'E, 1 October 1957 (fl), *Wagemans 1793* (BR,K); Luki. 5°38'S 13°04'E, 27 August 1946 (fl), *Toussaint, L. 2020* (BR); A l'Ouest de la route Luki. 5°38'S 13°04'E, 4 September 1946 (fl), *Toussaint, L. 2031* (BR); Luki. 5°38'S 13°04'E, 6 June 1947 (fl), *Toussaint, L. 2374* (BR); Kimbula. 5°43'S 15°58'E, 13 May 1959 (fl), *Pauwels 3007* (BR); Kisantu. 5°08'S 15°06'E, 16 February 1975 (fl), *Pauwels 5250* (BR); Benga. 5°50'S 16°00'E, (fr), *Vanderyst 15754* (BR); Benga. 5°50'S 16°00'E, (fr), *Vanderyst 15764* (BR); Luki (Léopoldville). 5°38'S 13°07'E, 2 January 1947 (fr), *Toussaint Luki 2065* (BM,BR,K,WAG); Boma, Luki, vallée de la N'Kula. 5°38'S 13°07'E, 21 August 1947 (fl), *Toussaint Luki 2442* (BR,EA,WAG); ligne de crête N'kula-Ntosi. 5°38'S 13°07'E, 13 September 1947 (fl), *Toussaint Luki 2459* (BR,FHO); **Equateur**: Bikoro. 0°45'S 18°07'E, 1 October 1957 (fl), *Moureau-Chevard 4* (BR); Yokungwaenge. 1°00'S 22°49'E, 8 August 1929 (fl), *Theuwissen 5* (BR); Ngali. 2°26'N 21°34'E, 28 August 1896 (fl, fr), *Thonner, F. 20* (BR); Djombo. 1°10'N 22°05'E, 21 November 1912 (fr), *Mengé 36* (BR); entre village Bofungi et Nkoie. 1°08'N 19°56'E, 24 October 1913 (fl, fr), *Nannan 53* (BR); Djolu. 0°35'N 22°27'E, 2 March 1912 (fl), *Mengé 84* (BR); Mabali. 0°53'N 18°07'E. Alt: 350m, 8 November 1957 (fl, fr), *Thonet 133* (BR); Busira. 0°06'S 19°55'E, December 1933 (fl), *Dubois, L. 295* (BR,K); Aela. 0°03'N 18°19'E, 1936 (fl), *Leemans 327* (G,K,WAG); Wendji. 0°04'S 18°10'E, May 1930 (fl, fr), *Lebrun 334* (BR); Zone Bikoro. 0°45'S 18°07'E. Alt: 350m, 21 February 1984 (fl, fr), *Nsola 501* (BR); Bantoi. 0°04'N 18°20'E, June 1930 (fl), *Lebrun 534* (BR); Eala. 0°03'N 18°19'E, June 1930 (fl), *Lebrun 583* (BR); Eala, sentier Esobe. 0°04'N 18°20'E, 25 September 1946 (fr), *Léonard, J.J.G. 742* (BR,WAG); Bumba. 2°11'N 22°23'E, 25 October 1913 (fl), *Bequaert 937* (BR); Dundusana. 2°53'N 22°23'E, June 1913 (fl), *Giorgi 1007* (BR); Ikela. 1°11'S 23°26'E, April 1939 (fl, fr), *Dubois, L. 1020* (BR); 0°03'N 18°19'E, 1 February 1907 (fl), *Pynaert 1073* (S); Wendji-environ. 0°04'S 18°10'E, August 1930 (st), *Lebrun 1074* (BR,C); Eala. 0°03'N 18°19'E, 12 December 1905 (fl), *Laurent, M.D.J. 1077* (BR); Bolima. 0°03'N 19°23'E, 14 September 1943 (fr), *Hulstaert 1087* (BR); Wamba, zone de Djolu. 0°01'N 22°33'E, 2 December 1988 (fl), *Nsola 1203* (BR); Eala. 0°03'N 18°19'E, 1 August 1905 (fl), *Laurent, M.D.J. 1465* (BR); environ d'Eala. 0°03'N 18°19'E, 19 July 1909 (fr), *Laurent, M.D.J. 1466* (BR); 0°03'N 18°19'E, 10 August 1905 (fl), *Laurent, M.D.J. 1470* (BR,S); environ de Bamania. 0°01'N 18°19'E, 1 August 1909 (fl), *Laurent, M.D.J. 1471* (BR); environ Bikoro. 0°45'S 18°07'E, December 1920 (fr), *Goossens 2356* (BR); Likete. 0°43'S 21°24'E, 16 June 1887 (fl), *Louis, J.L.P. 2728* (BR); Yenge-Loile, limite Parc National. 0°52'S 20°12'E, 3 August 1958 (fl), *Evrard, C.M. 4454* (BR); Route Basankusu-Bokakata. 1°13'N 19°49'E, 18 September 1958 (fl), *Evrard, C.M. 4798* (BR,WAG); route Bokota-Yalifafu. 1°09'S 22°24'E, 13 February 1959 (fl), *Evrard, C.M. 5704* (BR); Bolengambi, piste vers Kiri. 0°56'S 19°18'E, 12 April 1959 (fl), *Evrard, C.M. 6103* (BR); Befale, env. 20 km de Bokoli. 0°51'N 21°05'E, November 1980 (fl), *Dechamps 8081* (BR); **Kasai**: Miabi (Bakwanga). 6°12'S 23°23'E, 21 November 1956 (fr), *Liben 1975* (US,WAG); **Kasai-Occidental**: Sankuru. 4°17'S 20°25'E, August 1903 (fl), *Sapin s.n.* (BR); Kapulumba. 5°50'S 22°05'E, 5 January 1907 (fr), *Sapin s.n.* (BR); Muetshi. 4°42'S 22°39'E, 25 April 1983 (fl), *Casier 447* (BR,WAG); Lusambo, route Luluabourg, rivière Mwanzangoma. 5°49'S 22°41'E, 22 February 1957 (fl), *Liben 2359* (BR); Lubi. 6°51'S 23°04'E, 28 August 1957 (fl), *Liben 3588* (BR); Luluabourg. 5°54'S 22°25'E, 21 July 1930 (fr), *Vanderyst 24078* (BR); Luluabourg. 5°54'S 22°25'E, 21 July 1930 (fl), *Vanderyst 24080* (BR); Luluabourg. 5°54'S 22°25'E, 4 July 1930 (fl), *Vanderyst 24171* (BR); **Kasai-Oriental**: Kole. 3°29'S 22°27'E, December 1909 (fl), *Claessens s.n.* (BR); Bena-Dibele. 4°07'S 22°50'E, 19 June 1905 (fr), *Flamigni 116* (BR); Katako-Kombe. 3°25'S 24°25'E, 20 March 1937 (fl), *Gillardin 234* (BR); Kole. 3°29'S 22°27'E, 4 December 1904 (fl), *Claessens 298* (BR); Pania Mutombo. 5°11'S 23°51'E, 16 May 1905 (fl), *Lesrauwaert 387* (BR); Sagaie. 4°57'S 23°33'E. Alt: 500m, March 1939 (fl), *Gillardin 528* (BR,K); Sangaie. 4°57'S 23°33'E, March 1939 (fl), *Gillardin 536* (BR); Bena-Dibele. 4°07'S 22°50'E, October 1904 (fl), *Claessens 934* (BR); **Katanga (Shaba)**: Kombe. 5°36'S 26°36'E, 25 July 1958 (fl), *Delvaux 864* (BR,K); Kombe. 5°36'S 26°36'E, 12 October 1958 (fr), *Delvaux 871* (BR,K); **Kinshasa**: Bassin de la Nsele. 4°14'S 15°33'E, 1900 (fl), *Butaye 1451* (BR); Plateau des Batéké, Dumé. 4°10'S 15°55'E, 2 February 1982 (fl), *Robbrecht 1725* (BR); Monenga, rive gauche de la Ndjélé (Ngafulo). 4°31'S 15°22'E, 14 April 1977 (fl), *Pauwels 5852* (BR); Haut Nsele. 4°14'S 15°33'E, January 1925 (fl), *Vanderyst 14262* (BR); **Maniema**: Kindu. 2°57'S 25°55'E, (fr), *Rossignol 28* (BR); route Lubutu Km 45. 0°44'S 26°35'E, 3 March 1981 (fl), *Ndjele 237* (BR); Parc National de la Maïko, 45 km au nord de Lubutu, Péné Aluta, rive droite de la Maïko, entre les affluents Ukungu et Utambe. 0°20'S 26°40'E, 1 June 1977 (fr), *Lejoly 1603* (BR); Parc National de la Maïko, 45 km au nord de Lubutu, Péné Aluta, rive droite de la Maïko, entre les affluents Ukungu et Utambe. 0°20'S 26°40'E, 1 June 1977 (st), *Lejoly*

1605 (BR); Lubutu-Kirungu. 0°44'S 26°35'E, 9 February 1915 (fl), *Bequaert 6878* (BR); **Nord-Kivu:** Kisaro. 0°58'S 29°33'E. Alt: 1500m, 27 August 1954 (fl), *Christiaensen 614* (BR); Maboli, affluent Mamutum; nouvelle route Watalinga. 0°45'N 29°50'E. Alt: 1000m, 1 February 1954 (fr), *Witte, G.F. de 9729* (BR,K); route Watalinga. 0°45'N 29°50'E. Alt: 1000m, 4 February 1954 (fl, fr), *Witte, G.F. de 9748* (BR); **Orientale:** Epulu and vicinity 200 miles east of Stanleyville. 1°23'N 28°36'E, 1935 (fr), *Putman 14*; Yangambi. 0°46'N 24°27'E, 29 September 1960 (fl, fr), *Bolema 32* (BR); Yambuya. 1°16'N 24°33'E, 1906 (fr), *Solheid 39* (BR); Lenda. 1°19'N 28°38'E, 30 November 1997 (st), *Amsini 56* (BR); Yangambi. 0°46'N 24°27'E, 11 October 1060 (fr), *Menavanza 65* (BR); Yangambi. 0°46'N 24°27'E, 7 November 1960 (fl), *Bolema 199* (BR); Yangambi. 0°46'N 24°27'E, 2 July 1962 (fl, fr), *Yafunga 214* (BR); Yangambi. km 8. 0°46'N 24°27'E, 15 October 1935 (fr), *Louis, J.L.P. 260* (B,FHO); 60 km de Kissangani près de la rivière Maiko, près de Wanie-Rukula. 0°11'N 25°32'E, 20 March 1981 (fl), *Mosango 494* (BR); piste Ngazi-Bengamisa, Km 76. 0°58'N 25°00'E. Alt: 550m, 12 November 1935 (fl), *Louis, J.L.P. 611* (BR); Bambesa. 3°28'N 25°43'E, 13 April 1953 (fl), *Gérard, P. 612* (WAG); Bambesa. 3°28'N 25°43'E, 13 April 1953 (fl, fr), *Gérard, P. 672* (BR,K); Yangambi, Km 7 route de Ngazi. 0°48'N 24°28'E. Alt: 470m, 25 November 1935 (fl), *Louis, J.L.P. 701* (BR); Stanley pool. 0°30'N 25°12'E, 13 February 1896 (fl), *Dewèvre 720* (BR); Yangambi, 7 km route Ngazi. 0°46'N 24°27'E, 30 November 1935 (fl), *Louis, J.L.P. 745* (BM,BR,C); Yangambi, Km 8 route de Ngazi. 0°48'N 24°28'E. Alt: 470m, 9 December 1935 (fr), *Louis, J.L.P. 788* (BR,P); environ Mobwasa. 2°40'N 23°11'E, July 1913 (fl), *Reygaert 800* (BR); Yalibutu. 1°04'N 24°40'E, 8 November 1961 (fr), *Bolema 819* (BR); just downstream from Yamfira, Lomani River. 0°41.86'N 24°12.72'E. Alt: 368m, 27 May 2010 (fl, fr), *Boyekoli Ebale Congo 2010 Expedition 853* (BR,WAG); Yangambi. 0°46'N 24°27'E, 11 July 1958 (fl), *Léonard, A. 905* (BR); Mogandjo. 1°21'N 24°20'E, 10 March 1906 (fr), *Laurent, M.D.J. 946* (BR); Yangambi. 0°46'N 24°27'E, 18 July 1958 (fl), *Léonard, A. 960* (BR); Bambesa. 3°28'N 25°43'E, April 1934 (fl), *Brédo, HJAER 1026* (BR); Bambesa. 3°28'N 25°43'E, April 1934 (fl), *Brédo, HJAER 1036* (BR); plateau de Yaselia, en amont de Yangambi, 6 km au N. du fleuve. 0°48'N 24°27'E. Alt: 470m, 24 January 1936 (fl), *Louis, J.L.P. 1103* (BR); Yangambi. 0°46'N 24°27'E, 20 June 1963 (fl), *Bolema 1114* (BR); Bambesa. 3°28'N 25°43'E, April 1934 (fr), *Brédo, HJAER 1186* (BR); rivière Lubilaya, N.E. de Yangambi. 0°46'N 24°36'E. Alt: 470m, 16 February 1936 (fl), *Louis, J.L.P. 1277* (BR); Isalowe. 0°46'N 24°30'E, August 1938 (fl), *Gilbert, G.C.C. 1361* (BR); Yangambi, plateau de la Lusambila, 8 km au N.E. 0°49'N 24°36'E. Alt: 470m, 13 March 1936 (fl, fr), *Louis, J.L.P. 1468* (BR); Parc National de la Maiko, 45 km au N. de Lubutu, Pene Aluta, rive droite de la Maiko, entre affluents Ukungu et Utambe. 0°20'S 26°40'E, 2 June 1977 (fr), *Lejoly 1862* (BR); Entre Yamboa et Mongandjo, rivière Limbete. 0°46'N 24°27'E, 15 January 1957 (fl), *Evrard, C.M. 2101* (K,WAG); Yangambi. 0°46'N 24°27'E, 1936 (fl), *Louis, J.L.P. 2238* (BR,K); Bangamissa. 0°46'N 24°27'E, 25 May 1936 (fl, fr), *Gilbert, G.C.C. 2332* (BR); Bangamissa. 0°46'N 24°27'E, 28 May 1936 (fr), *Gilbert, G.C.C. 2345* (BR); Yangambi. 0°46'N 24°27'E, 1936 (fl), *Louis, J.L.P. 2488* (BR,K); Buta. 2°48'N 24°47'E, March 1931 (fl), *Lebrun 2491* (BR,P); Mandefu. 2°08'N 29°30'E, 27 February 1914 (fr), *Bequaert 2583* (BR); Titule. 3°02'N 25°10'E, April 1931 (fl, fr), *Lebrun 2752* (BR,K,WAG); Mudabu. 2°42'N 25°43'E, 28 March 1957 (fl), *Gérard, P. 2769* (BR,K); Bambesa. 3°28'N 25°43'E, 2 April 1962 (fl), *Gérard, P. 5152* (BR); 0°46'N 24°27'E, 13 September 1937 (st), *Louis, J.L.P. 6023* (BR,EA); ancienne route pour Butu. 0°46'N 25°14'E, 20 January 1984 (fl, fr), *Pauwels 6745* (BR); Stanleyville. 0°31'N 25°11'E, 9 March 1915 (fl), *Bequaert 7062* (BR); Ligasa, rive Lokombe. 0°42'N 23°50'E, 3 March 1955 (fl), *Germain, R.G.A. 8510* (BR,K); Vallée de l'Isalowe. 0°46'N 24°27'E, 9 May 1938 (st), *Louis, J.L.P. 8805* (BR,C); Yamboa, 25 km au N.W. de Yangambi. 0°59'N 24°27'E. Alt: 470m, 21 April 1938 (fl), *Louis, J.L.P. 8973* (BR); Yangambi. 0°46'N 24°27'E. Alt: 470m, 26 April 1938 (fl), *Louis, J.L.P. 9086* (BR); Yalibwa, 22 km au N.W. de Yangambi. 0°56'N 24°30'E. Alt: 470m, 25 June 1938 (fl), *Louis, J.L.P. 9962* (BR); Yangambi, plateau de l'Isolowe. 0°46'N 24°27'E, 17 August 1938 (st), *Louis, J.L.P. 10868* (BR,K); Yangambi, réserve flore Isalowe. 0°46'N 24°27'E. Alt: 470m, 9 September 1938 (fl), *Louis, J.L.P. 11188* (BR); Yangambi, plateau de la Luweo. 0°46'N 24°27'E, 28 September 1938 (fl), *Louis, J.L.P. 11365* (BR); plateau de l'Isalowe, route Yakusu. 0°46'N 24°27'E. Alt: 470m, 11 November 1938 (fl, fr), *Louis, J.L.P. 12536* (BR); vallée de la rivière Lomoma, Nord de Ngazi. 1°03'N 24°31'E. Alt: 470m, 5 February 1939 (fl), *Louis, J.L.P. 13548* (BR,P); Opala, vallée du Lomami. 0°37'S 24°21'E. Alt: 470m, February 1939 (fl), *Louis, J.L.P. 14136* (BR); 5 km au Sud de Yambuya. 1°16'N 24°33'E, 15 May 1939 (fl), *Louis, J.L.P. 14819* (BR,S); Yangambi. 0°46'N 24°27'E. Alt: 470m, 18 May 1939 (fl, fr), *Louis, J.L.P. 14884* (BR); Malélé, 15 km à l'Est de Kisangani. 0°32'N 25°21'E, 29 November 1981 (fl), *Lejoly 81/ 458* (BR,BRLU); **Sud-Kivu:** Kimbili. 2°41'S 28°12'E. Alt: 1500m, 7 October 1937 (fr), *Paquay 11* (BR); Irangi, Km 110 route Kavumu-Walikale. 1°53'S 28°27'E. Alt: 850m, 26 February 1954 (fl), *Christiaensen 373* (BR); Kabishula. 1°55'S 28°35'E. Alt: 1000m, 13 March 1954 (fl), *Christiaensen 393* (BR); abords de Kigulube, à l'Ouest de Bukavu sur la route vers Shanbunda par Kimbili. 2°39'S 28°01'E, July 1949 (fr), *Michelson, A. 925* (BR); abords de Kigulube, à l'Ouest de Bukavu sur la route vers Shanbunda par Kimbili. 2°39'S 28°01'E, April 1960 (fl), *Michelson, A. 1095* (BR); route Bukavu-Shabunda. 2°41'S 28°28'E, 20 August 1958 (fr), *Pierlot 2417* (BR,K); Km 110, route Kavumu-Walikale, Irangi,

réserve IRSAC. 1°53'S 28°27'E. Alt: 900m, 7 September 1956 (fl), *Troupin 2480* (BR,COI); Kalehe.vers Km 110 route kavumu-Walikale; Irangi, réserve IRSAC. 1°53'S 28°27'E, 21 March 1957 (fl, fr), *Troupin 3153* (BR,K); Km 110, route Kavumu-Walikale, Irangi, réserve IRSAC. Catena II. 1°53'S 28°27'E. Alt: 900m, 9 May 1957 (fl), *Troupin 3387* (BR,K); Kalehe, Tubalaka, Bunyakiri. 2°04'S 28°34'E, 17 March 1958 (fl), *Gutzwiller 3659* (BR,K); Nzowo. 2°35'S 28°05'E, 13 April 1956 (fl), *Léonard, A. 3856* (BR,K); vers Km 108 route Kavumu-Walikale. 1°53'S 28°27'E, 24 July 1957 (fl), *Troupin 3878* (BR); Km 110, route Kavumu-Walikale, Irangi, réserve IRSAC. Catena II. 1°53'S 28°27'E. Alt: 900m, 19 August 1957 (fl), *Troupin 4043* (BR,G,K,US); Kalehe, vers km 110 route Kavumu-Walikale; Irangi, Réserve IRSAC. Catena II. 1°53'S 28°27'E. Alt: 900m, 20 August 1957 (fl), *Troupin 4049* (K,UPS,WAG); Kalehe, vers km 110 route Kavumu-Walikale. 1°53'S 28°27'E. Alt: 900m, 30 August 1957 (fl), *Troupin 4283* (K,WAG); Km 110, route Kavumu-Walikale, Irangi, réserve IRSAC. Catena II. 1°53'S 28°27'E. Alt: 900m, 2 September 1957 (fl), *Troupin 4293* (B,BR,K); Kalehe, vers km 110 route Kavumu-Walikale. 1°53'S 28°27'E. Alt: 900m, 3 September 1957 (fl), *Troupin 4305* (K,WAG); Km 110, route Kavumu-Walikale, Irangi, réserve IRSAC. Catena II. 1°53'S 28°27'E. Alt: 900m, 7 September 1957 (fl), *Troupin 4338* (BR,K); Kalehe, vers km 110 route Kavumu-Walikale; Irangi, Réserve IRSAC. Catena II. 1°53'S 28°27'E. Alt: 900m, 9 September 1957 (fl), *Troupin 4347* (B,K,WAG); Kalehe, vers km 110 route Kavumu-Walikale. Catena II. 1°53'S 28°27'E. Alt: 900m, 10 September 1957 (fl), *Troupin 4358* (K,WAG); Km 110, route Kavumu-Walikale, Irangi, réserve IRSAC. Catena I. 1°53'S 28°27'E. Alt: 900m, 12 September 1957 (fl), *Troupin 4364* (BR,K); Km 110, route Kavumu-Walikale, Irangi, réserve IRSAC. Catena I. 1°53'S 28°27'E. Alt: 900m, 12 September 1957 (fl), *Troupin 4368* (BR,EA,K); Kalehe, vers km 110 route Kavumu-Walikale; Irangi, Réserve IRSAC. 1°53'S 28°27'E. Alt: 900m, 13 September 1957 (fl), *Troupin 4372* (K,WAG); vers km 110 route kavumu-Walikale; Irangi réserve IRSAC. 1°53'S 28°27'E, 17 September 1957 (fl), *Troupin 4394* (BR,K); Kalehe, vers km 110 route Kavumu-Walikale; Irangi, Réserve IRSAC. Catena I. 1°53'S 28°27'E. Alt: 900m, 18 September 1957 (fl), *Troupin 4397* (BR,K,WAG); Km 110, route Kavumu-Walikale, Irangi, réserve IRSAC. Catena III. 1°53'S 28°27'E. Alt: 900m, 19 September 1957 (fl), *Troupin 4409* (BR,K); Km 110, route Kavumu-Walikale, Irangi, réserve IRSAC. Catena II. 1°53'S 28°27'E. Alt: 900m, 20 September 1957 (fl), *Troupin 4421* (BR,K); Km 110, route Kavumu-Walikale, Irangi, réserve IRSAC. Catena II. 1°53'S 28°27'E. Alt: 900m, 21 September 1957 (fl), *Troupin 4428* (BR,K); Km 110, route Kavumu-Walikale, Irangi, réserve IRSAC. Catena III. 1°53'S 28°27'E. Alt: 900m, 23 September 1957 (fl), *Troupin 4438* (BR,K); Kalehe, vers km 110 route Kavumu-Walikale; Irangi, Réserve IRSAC. Catena II. 1°53'S 28°27'E. Alt: 900m, 26 September 1957 (fl), *Troupin 4460* (K,WAG); Km 110, route Kavumu-Walikale, Irangi, réserve IRSAC. Catena I. 1°53'S 28°27'E. Alt: 900m, 2 October 1957 (fl), *Troupin 4475* (BR,K); Kalehe, vers km 110 route Kavumu-Walikale. Irangi réserve IRSAC. Catena II. 1°53'S 28°27'E. Alt: 900m, 9 October 1957 (fl), *Troupin 4499* (BR,K,WAG); Km 110, route Kavumu-Walikale, Irangi, réserve IRSAC. Catena I. 1°53'S 28°27'E. Alt: 900m, 22 October 1957 (fl, fr), *Troupin 4557* (BR,K); Km 110, route Kavumu-Walikale, Irangi, réserve IRSAC. Catena II. 1°53'S 28°27'E. Alt: 900m, 25 October 1957 (fr), *Troupin 4584* (BR,EA,K); Kalehe, vers km 110 route Kavumu-Walikale. 1°53'S 28°27'E. Alt: 900m, 7 February 1957 (fl), *Troupin 4657* (BR,K,WAG); Km 110, route Kavumu-Walikale, Irangi, réserve IRSAC. Catena I. 1°53'S 28°27'E. Alt: 900m, 12 November 1957 (fl, fr), *Troupin 4685* (BR,K); Km 110, route Kavumu-Walikale, Irangi, réserve IRSAC. Catena II. 1°53'S 28°27'E. Alt: 900m, 13 November 1957 (fl, fr), *Troupin 4692* (BR,K); Km 110, route Kavumu-Walikale, Irangi, réserve IRSAC. Catena II. 1°53'S 28°27'E. Alt: 900m, 16 November 1957 (fl, fr), *Troupin 4707* (BR,K); Km 110, route Kavumu-Walikale, Irangi, réserve IRSAC. Catena II. 1°53'S 28°27'E. Alt: 900m, 21 November 1957 (fl), *Troupin 4720* (BR,K); Km 110, route Kavumu-Walikale, Irangi, réserve IRSAC. Catena II. 1°53'S 28°27'E. Alt: 900m, 3 December 1957 (fl), *Troupin 5339* (BR); Km 110, route Kavumu-Walikale, Irangi, réserve IRSAC. Catena II. 1°53'S 28°27'E. Alt: 900m, 6 December 1957 (fl), *Troupin 5360* (BR); Km 110, route Kavumu-Walikale, Irangi, réserve IRSAC. Catena III. 1°53'S 28°27'E. Alt: 900m, 7 December 1957 (fl), *Troupin 5373* (BR,UPS); Km 110, route Kavumu-Walikale, Irangi, réserve IRSAC. Catena II. 1°53'S 28°27'E. Alt: 900m, 20 December 1957 (fl), *Troupin 5462* (BR); Km 110, route Kavumu-Walikale, Irangi, réserve IRSAC. Catena II. 1°53'S 28°27'E. Alt: 900m, 28 May 1958 (fl), *Troupin 7685* (BR); Km 110, route Kavumu-Walikale, camp Irangi. 8 1°53'S 28°27'E. Alt: 860m, 6 May 1959 (fl), *Troupin 10214* (BR); Km 110, route Kavumu-Walikale, Irangi, réserve IRSAC. Catena II. 1°53'S 28°27'E. Alt: 900m, 24 August 1959 (fl), *Troupin 10683* (BR); Km 110, route Kavumu-Walikale, Irangi, réserve IRSAC. Catena III. 1°53'S 28°27'E. Alt: 860m, 29 September 1959 (fl), *Troupin 10831* (BR).

**EQUATORIAL GUINEA, Rio Muni, Centro Sur:** Centro Sur. Parque Nacional de Monte Alé, alrededores del lago Atok. 1°35'N 10°15'E, 2 July 1998 (fl, fr), *Pérez Viso 38* (MA); SE du Parc National de Monte Alen, sur le transect ECOFAC de Nkumekie. 1°28.8'N 10°17.9'E, 3 February 2001 (fr), *Senterre 40* (BRLU); Parc National de Monte Alen, de Nkumekie de Mosumo. 1°37'N 10°02'E, 27 January 1998 (fl), *Reeth 302* (BRLU); Parc National de Monte Alen, entre la station ECOFAC de Mosumo et Monte Boracho. 1°36.1'N 10°02.7'E, 14 February 2001

(fl), *Senterre 392* (BRLU); Parc National de Monte Alen. 1°40'N 10°17'E, 30 June 1999 (fr), *Nguema Miyono 426* (BRLU); Parc National de Monte Alen. 1°37'N 10°16'E, 29 August 1998 (fl), *Ngomo 475* (BRLU); Monte Alén. 1°37'N 10°16'E, 31 October 1998 (fl), *Ngomo 516* (BRLU); région continentale. Etembue, Espigon (réserve de Ndote). 1°17'N 9°26'E, 22 January 1998 (fl), *Obama 605* (BRLU); Parc National de Monte Alen, 2 km au NE du site de traversée du Rio Uolo pour aller aux cataractes. 1°37.4'N 10°04.6'E, 19 January 2002 (st), *Senterre 1972* (BRLU); Centro Sur: Parque Nacional de Monte Alén: esamalang. 1°33'N 10°12'E, 28 June 2000 (fl), *Pérez Viso 3303* (MA); SE du parc National de Monte Alen, au Sud du Rio Lana, près de la Cabana ECOFAC de Misergue. 1°26.30'N 10°12.38'E. Alt: 850m, 13 July 2002 (fl), *Senterre 3315* (BRLU); Parc National de Monte Alen, à 1h30 de marche du site ECOFAC. 1°40'N 10°17'E. Alt: 1110m, 27 May 2002 (fl), *Parmentier 3414* (BRLU); Parc National de Monte Alen, à 1h30 de marche du site ECOFAC. 1°40'N 10°17'E. Alt: 1110m, 27 May 2002 (fl), *Parmentier 3425* (BRLU); Parc national de Monte Alen, transect de Monte Alen. 1°39'N 10°18'E, 7 October 1994 (fl), *Lejoly 94/166* (BRLU); Parc National de Monte Alen, 5 km au NO de Engong. 1°37'N 10°18'E. Alt: 1120m, 3 January 1999 (fl), *Lejoly 99/130* (BRLU); Parc National de Monte Alen, 5 km NO du village Engong. 1°37'N 10°18'E. Alt: 1120m, 21 January 1999 (fr), *Lejoly 99/445* (BRLU); montagne près de Bikurga. 1°35'N 10°28'E, 23 September 1997 (fl), *Lisowski 1368* (BRLU); **Rio Muni, Litoral:** région continentale, Etembue (réserve de Ndote). 1°17'N 9°26'E, 17 August 1997 (fl), *Eneme Efua 2* (BRLU); région continentale, Espigon/Pradera de Baga (réserve de Ndote). 1°20'N 9°28'E, 19 August 1997 (fl, fr), *Eneme Efua 101* (BRLU); Región Continental. 1°26'N 9°58'E. Alt: 940m, 30 November 1997 (fl), *Obama 335* (BRLU,WAG); Litoral: Corisco: playa al S.O. de la isla. 0°55'N 9°18'E, 15 March 2000 (fl), *Pérez Viso 1987* (MA); Bata-Bome. 1°49.9'N 9°45.0'E, 12 August 1991 (fl), *Carvalho, M.F de 4764* (MA,WAG); 11 km S of Bata, along coastal road and then 2 km along track in Southern direction. 1°45.7'N 9°44.2'E. Alt: 5m, 25 February 1998 (st), *Wilde, J.J.F.E. de 11988* (WAG); Ndote Sud, près du village Etembue. 1°17'N 9°26'E, 6 September 1997 (fl), *Lisowski 520* (BRLU); Ndote Sud, près d'Etembue. 1°17'N 9°26'E, 7 September 1997 (fl), *Lisowski 1111* (BRLU); **Rio Muni, Wele Nzase:** inselberg de Mungum, à 45 minutes de marche du village de Kukumancoc. 1°19'N 10°49'E. Alt: 750m, 22 May 2002 (fr), *Parmentier 3348* (BRLU); inselberg de Mungum, à 45 mn de marche du village Kukumancoc. 1°19'N 10°49'E. Alt: 750m, 22 May 2002 (fr), *Parmentier 3389* (BRLU).

**GABON, Estuaire:** Parc National de la Pongara. Pointe Ouingombé à 6 Km de la Pointe Denis. 0°19.2'N 9°19.1'E. Alt: 10m, 5 December 2006 (fl), *Dauby 9* (BRLU,LBV,MO); Billagone. 0°01'N 9°48'E, 16 September 1938 (fl), *Thomson, A.P. 37* (K,P); Parc National de la Pongara. Entre la pointe Ouingombé et la pointe Denis. A ± 1km de la pointe Ouingombé. 0°19.6'N 9°19.5'E. Alt: 10m, 22 December 2006 (fl), *Dauby 69* (BRLU,LBV,MO,WAG); Sibange Farm. 0°25'N 9°30'E, 22 September 1880 (fl), *Soyaux 133* (BM,K,P); Forest exploitation Leroy, 20 km N.W. of Asok. 0°53'N 10°12'E. Alt: 610m, 27 January 1983 (fl), *Wilde (WALK-B)289* (BR,LBV,MO,P,WAG); 1864 (fl), *Griffon du Bellay 325* (P); Nkoulounga. 0°42'N 9°50'E, 11 July 1959 (st), *Hallé, N. 751* (P); c. 17 km along the road Libreville-Cap Esterias. 0°34'N 9°20'E. Alt: 30m, 25 February 1983 (fl), *Wilde (WALK-B) 762* (BR,C,LBV,MO,PSRGH,WAG); Mondah forest, parcelle des conservateurs. 0°35'N 9°20'E, 10 November 2009 (fr), *Bissengou 820* (LBV,WAG); Mondah forest, parcelle des conservateurs. 0°35'N 9°20'E, 10 November 2009 (fl), *Bissengou 822* (LBV,WAG); Crystal Mountains, 6225m on transect D. 0°35'N 10°26'E, 24 November 2000 (fl), *Nguema Miyono 1444* (LBV,WAG); Monts de Cristal. 0°47'N 10°12'E, December 1959 (fr), *Aubrèville 1959/123* (P); **Haut-Ogooué:** Batéké Plateau National Park, Bai Djobo. 2°13.2'S 13°50.8'E. Alt: 450m, 7 September 2006 (fl, fr), *Nguema Ekomo 738* (LBV,WAG); 20 km E de Lelama. 1°00'S 13°43'E. Alt: 441m, 17 November 2009 (fl, fr), *Bissengou 901* (LBV,WAG); 70km S of Okondja on road to Franceville. 1°07.5'S 13°33.3'E. Alt: 300m, 2 November 2005 (fl, fr), *Sosef 2191* (LBV,MO,WAG); 6 km route Moanda-Franceville. 1°33'S 13°15'E. Alt: 450m, 3 September 1970 (fl), *Breteler 6283* (WAG); Lekoko forest exploitation, 60 km SSW of Moanda. 2°03'S 13°00'E. Alt: 700m, 14 October 1970 (fl), *Breteler 6912* (P,WAG); near Okondja. 0°37'S 13°31'E, 29 September 1997 (st), *Breteler 14115* (WAG); near Okondja, 'Route de Falaises', 0°37'S 13°31'E. Alt: 700m, 6 October 1997 (st), *Breteler 14231* (WAG); 9 km S of Bambidie (± 30 km E of Lastoursville). 0°42'S 13°00'E, 7 October 1997 (st), *Breteler 14247* (BR,BRLU,MO,WAG); **Moyen-Ogooué:** Camp Mboumi, Base. 0°25'S 10°50'E, 2 September 1999 (fl), *Azizet Issembé 249* (LBV,WAG); Mabounié, à 45 km au sud-ouest de Lambaréné. 0°46.08'S 10°32.70'E. Alt: 55m, 26 October 2012 (fl), *Bidault 1015* (LBV,MO); Ayem, SW de Ndjolé. 0°22'S 10°35'E, 24 April 1963 (st), *Hallé, N. 1829* (P); Mabounié. 0°47.00'S 10°32.63'E. Alt: 73m, 13 October 2012 (fl), *Sonké 6009* (MO); Mabounie. 0°48.23'S 10°30.10'E. Alt: 98m, 25 October 2012 (fr), *Sonké 6162* (MO); 30 km NNW of Ndjolé. 0°03'N 10°45'E. Alt: 150m, 29 September 1994 (fl), *Breteler 13077* (WAG); 30 km NNW of Ndjolé. 0°03'N 10°45'E. Alt: 150m, 30 September 1994 (fl), *Breteler 13094* (WAG); **Ngounié:** mission de St. Martin. 1°41'S 10°56'E, (fl), *Walker, A.A. s.n.* (P); Est du Parc National de Waka, à ± 5 km au Sud de la rivière Mayi. 1°13.6'S 11°17.3'E. Alt: 613m, 17 February 2008 (fl), *Dauby 560* (BRLU,LBV,MO,WAG); entre village Mbinambi et Nzenzelé. 2°20.30'S 11°40.28'E. Alt: 266m, 16 June 2011 (st), *Bissengou 1363* (LBV,WAG);



entre village Mbinambi et Nzenzelé. 2°20.30'S 11°40.28'E. Alt: 266m, 16 June 2011 (fr), *Bissiangou 1365* (LBV,WAG); vieux chantier forestier. 2°19.34'S 11°56.34'E. Alt: 311m, 19 June 2011 (st), *Bissiangou 1388* (LBV,WAG); vieux chantier forestier. 2°18.98'S 11°55.58'E. Alt: 404m, 19 June 2011 (st), *Bissiangou 1391* (LBV,WAG); vieux chantier forestier. 2°18.98'S 11°55.58'E. Alt: 404m, 19 June 2011 (st), *Bissiangou 1393* (LBV,WAG); vieux chantier forestier. 2°18.08'S 11°53.10'E. Alt: 411m, 19 June 2011 (st), *Bissiangou 1398* (LBV,WAG); CFAD de Rimbunan Hijau, au Sud-Ouest du Parc National de la Lopé. 0°51.1'S 11°15.9'E. Alt: 375m, 29 January 2009 (fl), *Dauby 1466* (BRLU,LBV,MO); E of Waka National Park, along the road from Mimongo village heading in SE direction. 1°09.5'S 11°19.9'E. Alt: 830m, 26 March 2007 (fl, fr), *Sosef 2571* (BR,LBV,MO,WAG); 10 km on the road Ikobey to Bakongue, Eghaba Mountain. 1°02.0'S 11°02.6'E. Alt: 650m, 28 November 2001 (fl), *Wieringa, J.J. 4465* (WAG); Modoumou. 1°38'S 11°25'E, October 1925 (st), *Le Testu 5598* (BM,P); Moumba Côte Ouest. 1°15'S 11°35'E. Alt: 800m, 19 May 1963 (st), *Hallé, N. 6051* (P); 53 km road Mouila to Yeno. 1°42.69'S 11°21.25'E. Alt: 605m, 9 March 2013 (fl), *Wieringa, J.J. 7225* (WAG); 22 km along a track in a northern direction from Doussala. 2°12'S 10°36'E. Alt: 100m, 4 December 1986 (fl, fr), *Wilde, J.J.F.E. de 9152* (BR,LBV,MA,MO,P,PRE,WAG); Massif de Chaillu, au nord-est de Mouila; chantier Leroy; à l'est de Belingué, 1°57'S 11°28'E. Alt: 400m, 26 April 1989 (fl), *McPherson, G.D. 13959* (MO,WAG); **Nyanga**: Côte du Loango. 3°25'S 10°40'E, 1922 (fl), *Piveteau s.n.* (P); Nyanga. 2°57'S 10°20'E, 20 January 1894 (st), *Dybowski, J. 20* (P); Mourindi. 2°33.6'S 10°44.6'E. Alt: 93m, 15 September 2000 (fl), *Bouroubou 243* (LBV,WAG); route Tchibanga-Ndende. 2°58.3'S 11°06.4'E. Alt: 252m, 25 October 2009 (fl), *Bissiangou 515* (LBV,WAG); route Tchibanga-Ndende. 2°58.3'S 11°06.4'E. Alt: 252m, 25 October 2009 (fl), *Bissiangou 516* (LBV,WAG); route Tchibanga-Ndende. 2°58.3'S 11°06.4'E. Alt: 252m, 25 October 2009 (fl), *Bissiangou 519* (LBV,WAG); route Tchibanga-Ndende. 2°58.3'S 11°06.4'E. Alt: 252m, 25 October 2009 (fl), *Bissiangou 520* (LBV,WAG); route Tchibanga-Ndende. 2°58.3'S 11°06.4'E. Alt: 252m, 25 October 2009 (fl), *Bissiangou 521* (LBV,WAG); route Tchibanga-Ndende. 2°58.3'S 11°06.4'E. Alt: 252m, 25 October 2009 (fl, fr), *Bissiangou 522* (LBV,WAG); mayumba peninsular 15 km S of Mayumba town, the surf of the ocean within hearing distance. 3°30'S 10°44'E. Alt: 5m, 18 February 1983 (fl), *Wilde (WALK-B) 658* (LBV,WAG); chantier CEB, Monts Doudou 20 km WSW of Doussala. 2°25'S 10°30'E. Alt: 675m, 20 May 1985 (fl), *Reitsma, J.M. 1095* (LBV,MO,NY,WAG); Mayumba. 3°25'S 10°40'E, 22 October 1986 (fl), *Louis, A.M. 2229* (LBV,MO,WAG); chantier SFN. 2°37.42'S 10°32.36'E. Alt: 350m, 28 November 2003 (fl), *Valkenburg 2662* (LBV,MO,WAG); **Ogoué-Ivindo**: Bjaddié Liboumba-Bafoala Mékambo. Zadinoué, km 68 de Mékambo. 0°50'N 13°29'E, 14 August 1966 (fl), *Hallé, Le Thomas 299* (P); Réserve de la Lopé, pente du Chameau. 0°13'S 11°34'E. Alt: 500m, 19 October 1999 (fl), *Sosef 510* (LBV,P,WAG); Bélinga, Iron mine exploration, summit called "The Belvédère". 1°04'N 13°11'E. Alt: 1000m, 12 September 1978 (fl, fr), *Breteler; Wilde 544* (WAG); 24 km along the SOMIFER-road towards Makokou. 0°54'N 13°12'E. Alt: 975m, 18 September 1978 (fl), *Breteler; Wilde (C,K,WAG)*; 15km SSE du confluent Ogoué-Ivindo. 0°17'S 12°13'E, 13 December 1983 (fl), *Wilks 769* (LBV,WAG); Lope. 0°05.03'S 11°36.45'E. Alt: 123m, 5 September 2012 (fl), *Towns 969* (LBV,WAG); route Lopé-Mikongo, après carrefour vers Gongué (village PK0). 0°25.8'S 11°52.2'E. Alt: 236m, 5 March 2010 (fr), *Bissiangou 1018* (LBV,WAG); route Lopé-Mikongo, après carrefour vers Gongué (village PK0). 0°25.8'S 11°52.2'E. Alt: 236m, 5 March 2010 (fr), *Bissiangou 1021* (LBV,WAG); route Lopé-Mikongo, après carrefour vers Gongué (village PK0). 0°26.2'S 11°52.3'E. Alt: 282m, 5 March 2010 (fr), *Bissiangou 1027* (LBV,WAG); route Bélinga, 21 km après village Zadié. 0°53.07'N 13°10.23'E. Alt: 535m, 11 March 2010 (fr), *Bissiangou 1124* (LBV,WAG); Lope, Point de Vue. 0°10.0'S 11°34.7'E. Alt: 600m, 19 August 2012 (fl), *Towns 1124* (LBV,WAG); route Bélinga, 22 km après village Zadié. 0°53.43'N 13°10.25'E. Alt: 669m, 11 March 2010 (fl, fr), *Bissiangou 1129* (LBV,WAG); route Bélinga, 23 km après village Zadié. 0°53.5'N 13°10.3'E. Alt: 697m, 11 March 2010 (fl, fr), *Bissiangou 1135* (LBV,WAG); route Bélinga, 23½ km après village Zadié. 0°53.26'N 13°10.30'E. Alt: 718m, 11 March 2010 (fl), *Bissiangou 1137* (LBV,WAG); route Bélinga, 27 km après village Zadié. 0°55.41'N 13°10.95'E. Alt: 888m, 11 March 2010 (st), *Bissiangou 1140* (LBV,WAG); route Bélinga, 34 km après village Zadié. 4 km du carrefour qui mène au chantier Sunli. 0°57.99'N 13°12.50'E. Alt: 851m, 11 March 2010 (fl, fr), *Bissiangou 1141* (LBV,WAG); route Bélinga, 34 km après village Zadié. 4 km du carrefour qui mène au chantier Sunli. 0°58.0'N 13°12.5'E. Alt: 851m, 11 March 2010 (fl, fr), *Bissiangou 1142* (LBV,WAG); route Bélinga, 34 km après village Zadié. 4 km du carrefour qui mène au chantier Sunli. 0°58'N 13°13'E. Alt: 851m, 11 March 2010 (fl), *Bissiangou 1147* (LBV,WAG); route Bélinga, 5 km après village Mbondo. 0°53'N 13°10'E. Alt: 586m, 12 March 2010 (st), *Bissiangou 1155* (LBV,WAG); route Bélinga, 5 km après village Mbondo. 0°53'N 13°10'E. Alt: 586m, 12 March 2010 (fl), *Bissiangou 1156* (LBV,WAG); route Belinga, 9 km après entrée Belinga-Mayibout. 1°02.15'N 13°11.74'E. Alt: 870m, 12 March 2010 (fl), *Bissiangou 1160* (LBV,WAG); route Belinga, 14 km après entrée Belinga-Mayibout. 1°02.91'N 13°12.10'E. Alt: 894m, 12 March 2010 (fl), *Bissiangou 1165* (LBV,WAG); route Belinga, 14 km après entrée Belinga-Mayibout. 1°03'N 13°12'E. Alt: 894m, 12 March 2010 (fl), *Bissiangou 1167* (LBV,WAG); route Belinga, 14 km après entrée Belinga-

Mayibout. 1°03'N 13°12'E. Alt: 894m, 12 March 2010 (fl, fr), *Bissiegou 1170* (LBV,WAG); route Makokou-Mekambo, 1 km de l'antenne Celtel. 0°49.02'N 13°28.16'E. Alt: 738m, 13 March 2010 (st), *Bissiegou 1186* (LBV,WAG); Lope. 0°05.03'S 11°36.57'E. Alt: 130m, 8 October 2012 (fr), *Towns 1382* (LBV,WAG); Lope. 0°11.28'S 11°36.63'E. Alt: 213m, 9 October 2012 (fl), *Towns 1392* (LBV,WAG); Département de Booué, Parc National de la Lopé. 0°05.36'S 11°35.68'E, 1 September 2012 (fl, fr), *Quiroz-Villarreal 1542* (WAG); 74 km ENE of Makokou 2 km W of Zadundoué. 0°50'N 13°29'E, 2 September 1992 (fl, fr), *Wieringa, J.J. 1557* (C,LBV,MO,WAG); Mt. Sassamongo, rocky plateau W of Sassamongo village. 0°49.70'N 13°27.52'E. Alt: 486m, 16 May 2003 (fl), *Ngok Banak 1776* (LBV,WAG); 4km NNW of Ikei-Bokaboka, Bengoué Mountain. 0°57.13'N 13°41.47'E. Alt: 685m, 18 May 2003 (fl), *Ngok Banak 1843* (LBV,P,WAG); Bélinga. 1°05'N 13°08'E, 24 October 1964 (st), *Hallé, N. 2763* (P); Mont de Casque 20 km NW of Booué. 0°02'S 11°48'E, 16 May 1987 (fr), *Reitsma, J.M. 3403* (WAG); 25 km NE of Koumameyong. 0°20'N 11°56'E, 20 May 1987 (fl), *Reitsma, J.M. 3502* (MA,WAG); Ivindo National Park. Langoué Bai. 0°11.22'S 12°33.36'E, 27 November 2002 (fr), *Stone, J.R. 3528* (LBV,MO); Mt. Sassamongo, rocky plateau W of Sassamongo village. 0°49.65'N 13°27.55'E. Alt: 540m, 9 January 2001 (fl), *Wieringa, J.J. 4032* (WAG); Makokou, plateau d'ipassa. 0°34'N 12°52'E, 27 June 1970 (fl), *Farron 7539* (P); 1 km WSW of Biological Station SECG Lopé. 0°10'S 11°35'E. Alt: 400m, 24 November 1995 (fl), *Wilde, J.J.F.E. de 11416* (BR,LBV,MO,SEGC,WAG); Camp de la Makande, 0°41'S 11°54'E, 21 July 1993 (st), *Lejoly 93/254* (BRLU); **Ogooué-Lolo**: 10 km along the road Lastoursville-Mékouyi. 0°53'S 12°39'E. Alt: 250m, 25 September 1978 (fl), *Breteler; Wilde 795* (WAG); route vers Milolé. 0°18'S 12°40'E. Alt: 457m, 16 November 2009 (fl), *Bissiegou 888* (LBV,WAG); route de Gambidie vers Milolé. 0°33'S 12°48'E, 19 November 2009 (st), *Bissiegou 929* (LBV,WAG); 10 km S of confluence Gongue-Offoue. 0°49'S 11°54'E, 11 August 1993 (fl), *Dibata 1190* (MO,WAG); 25 km on the road Lastoursville-Koulamoutou. 0°58.3'S 12°34.6'E. Alt: 250m, 29 October 2005 (fl), *Sosef 2095* (LBV,MO,WAG); concession de CEB, Nord de la zone de Milolé, Sud du Parc National de l'Ivindo. 0°15.2'S 12°44.3'E. Alt: 393m, 12 February 2010 (fl), *Dauby 2291* (BRLU,LBV,MO); Makande study zone. 0°42'S 11°54'E, 26 July 1993 (fl), *Wilks 2690* (MO,WAG); 16 km E of Lastoursville Road bridge. Chantier SBL. 0°48'S 12°48'E, 17 November 1988 (fr), *Maesen, L.J.G. van der 5530* (WAG); 40 km ENE of Lastoursville, 20 km on road from Gambidie heading N. 0°36.68'S 13°00.90'E. Alt: 360m, 25 January 2008 (fl, fr), *Wieringa, J.J. 6156* (LBV,WAG); 30 km E of Lastoursville, 5 km on road heading S from Gambidie. 0°47.5'S 12°57.4'E. Alt: 315m, 26 January 2008 (fl), *Wieringa, J.J. 6186* (LBV,WAG); 30 km ENE of Lastoursville, east of Gambidie, 4.8 km on CEB exploration road NZ P/2. 0°43.00'S 13°02.56'E. Alt: 315m, 18 March 2013 (fl), *Wieringa, J.J. 7521* (WAG); 30 km ENE of Lastoursville, east of Gambidie, start of CEB exploration road NZ P/2. 0°44.30'S 13°01.10'E. Alt: 315m, 21 March 2013 (fr), *Wieringa, J.J. 7609* (WAG); 30 km ENE of Lastoursville, east of Gambidie, just S of 2.7 km on CEB exploration road NZ P/2. 0°43.7'S 13°02.1'E. Alt: 320m, 21 March 2013 (fl), *Wieringa, J.J. 7616* (WAG); 30 km E of Lastoursville. 0°40'S 13°00'E, 6 May 1992 (fr), *Breteler 11324* (LBV,WAG); c. 60km E of Lastoursville. 0°50'S 13°20'E, 12 December 1993 (fr), *Breteler 12592* (WAG); East of Lastoursville, near Gambidie, C.E.B. chantier. Tall forest. 0°46'S 13°00'E. Alt: 250m, 30 September 1996 (fl), *McPherson, G.D. 16751* (MO,WAG); **Ogooué-Maritime**: Gamba, west bank of Vevy lagoon. 2°46.9'S 10°00.8'E, 22 December 1995 (fr), *Houten, M.H. van den 16* (MO,WAG); Monvorobe. 0°54'S 8°57'E, June 1921 (fl), *Pobéguin (central Africa series) 58* (P); Gamba, «site F». 2°47.52'S 10°03.68'E, 20 November 2001 (fl), *Raymakers 71* (LBV,WAG); Parc National Loango, 5m de l'hotel a gauche, apres l'île des chauves-sourris. 1°55.18'S 9°22.53'E. Alt: 27m, 21 April 2004 (fl), *Mouandza Mbembo 89* (BR,K,LBV,MO,P,WAG); Gamba, laterite road to Pont Dick, turnoff. 2°48.1'S 10°02.5'E. Alt: 5m, 12 November 1995 (fl), *Bergen 94* (FHO,IAGB,MO,PRE,WAG); Rabi-Kounga. Direction Echira. 1°59'S 9°51'E, 11 November 1991 (fr), *Schoenmaker, J. 133* (WAG); Eastern foothills of the Doudou Mountains. 2°15'S 10°20'E. Alt: 580m, 7 December 1984 (fl), *Arends 684* (WAG); Toucan. 1°47'S 9°53'E, 18 June 2002 (fl), *Bourobou 763* (LBV); Monts Doudou, à ± 40km au Nord-Ouest de Doussala, autour du campement II. 2°13'S 10°24'E. Alt: 375m, 7 April 2000 (fr), *Sosef 1146* (LBV,WAG); Gamba, near N'Dogo. 2°44'S 10°00'E, 29 July 1992 (fl, fr), *Wieringa, J.J. 1323* (C,LBV,MO,WAG); Rabi-Shell concession, Rabi, N of airport. 1°55.7'S 9°52.4'E. Alt: 56m, 24 January 2010 (fl), *Dauby 2133* (BRLU,LBV,MO); 15 km SE of Port Gentil. 0°50'S 8°52'E. Alt: 1m, 13 September 1968 (fl), *Breteler 5532* (B,C,WAG); Gamba. 2°46'S 10°02'E, 23 September 1968 (fl), *Breteler 5646* (B,WAG); Loango National Park, Nick's camp, by Louri lagoon 12 km south of Iguela., 10m, 2°00.6'S 9°23.2'E. Alt: 10m, 1 May 2005 (st), *Harris, D.J. 8277* (E,E,LBV,WAG); Loango National Park, Nick's camp, by Louri lagoon 12 km south of Iguela. 2°00'S 9°23'E. Alt: 10m, 3 May 2005 (st), *Harris, D.J. 8354* (E,IG,LBV,WAG); 60 km along an exploitation track in a W.N.W. direction from Doussala. 2°12'S 10°11'E. Alt: 200m, 27 November 1986 (fl), *Wilde, J.J.F.E. de 8976* (BR,C,K,LBV,MA,MO,P,PRE,WAG); 30 km N.W. of Doussala, in the direction of Bongo. 2°12'S 10°24'E. Alt: 400m, 16 March 1988 (fr), *Wilde, J.J.F.E. de 9396* (WAG); Rabi-Kounga. 1°55'S 9°55'E, 26 October 1991 (fl), *Breteler 10131* (LBV,WAG); Parc National de Loango, near Tassi. 2°01.1'S 9°23.5'E. Alt: 10m, 8 November 2011 (fl), *Maas, P.J.M. 10169* (LBV,UC,WAG); Gamba, just S of Shell jetty (oil terminal) 200 m from ocean shore. 2°47.3'S 10°01.1'E. Alt: 5m, 21 November 1994 (fl), *Wilde, J.J.F.E. de 11131* (BRLU,E,K,LBV,MO,WAG); Gamba, along the

airport. 2°48'S 10°03'E, 23 July 1998 (st), *Breteler 14453* (BR,C,E,LBV,MA,MO,PRE,WAG); Gamba, near the office of Shell, 2°42'S 9°56'E, 4 November 1998 (st), *Breteler 14543* (BR,K,LBV,MO,PRS,WAG); Gamba, near airport. 2°42'S 9°56'E, 5 November 1998 (st), *Breteler 14570* (LBV,WAG); village Yombé, aux environs de Cap-Lopez. 0°55'S 9°23'E, 18 September 1912 (fl), *Chevalier, A.J.B. 26718* (P); **Woleu-Ntem**: along logging road in Bordamur concession area, some 19 km from the WWF-station. 1°08'N 11°47'E. Alt: 560m, 7 October 2002 (fr), *Strijk 25* (LBV,WAG); Bordamur concession area, some 40 km from WWF-station, at logging road construction site. 1°14'N 11°53'E. Alt: 570m, 10 October 2002 (fr), *Strijk 88* (LBV,MO,WAG); Assok, on transect F. 0°43'N 10°23'E, 17 January 2001 (fr), *Mayombo-Nzengue 214* (LBV); 11 km SE of Mitzi, FOREENEX forest exploitation, bridge over Okano river at FOREENEX forestry camp. 0°42.9'N 11°37.8'E. Alt: 488m, 7 November 2009 (st), *Bissengou 764* (LBV,WAG); 48 km NE of Mitzi, forestry road in Bordamur forest exploitation. 1°04.8'N 11°52.2'E. Alt: 560m, 8 November 2009 (fl, fr), *Bissengou 810* (LBV); chantier Rougier-Océan, Oveng. 0°40'N 11°22'E. Alt: 760m, 8 May 1985 (fl, fr), *Reitsma, J.M. 911* (LBV,NY,WAG); Parc des Monts de cristal, environ du Plot I, Smithsonian. 0°37.0'N 10°24.8'E, 12 February 2010 (st), *Bissengou 953* (LBV,WAG); concession Rougier du Haut-Abanga, Sud-Est de Mikongo, partie Nord des montagnes Mekié. 0°25.3'N 11°13.5'E. Alt: 737m, 17 July 2008 (fl), *Dauby 1012* (BRLU,LBV,MO); Crystal Mountains, 1050m on transect B. 0°37'N 10°24'E, 15 November 2000 (fl), *Nguema Miyono 1320* (LBV,WAG); Chantier Rougier Ocean, Oveng; ca 25 km SW of Mintsic. 0°44'N 11°22'E, 23 September 1985 (fl), *Reitsma, J.M. 1548* (BR,WAG); Chantier Rougier-Océan, 25 km NNW of Oveng. 0°44'N 11°22'E, 25 September 1985 (fr), *Reitsma, J.M. 1591* (WAG); Minkébé National Park, southern inselberg area. 1°22.48'N 12°32.39'E. Alt: 515m, 4 May 2003 (fl), *Ngok Banak 1619* (LBV,WAG); forestry concession Bordamur 40 km NE of Mitzi. 1°04.8'N 11°52.4'E. Alt: 500m, 6 February 2003 (fl), *Sosef 1879* (BR,LBV,MO,WAG); Inventory Oveng; 25 km WSW of Mintsic. 0°44'N 11°22'E, 6 November 1986 (fr), *Reitsma, J.M. 2494* (WAG); Crystal Mountains, 5 km on old road Tchimbélé to Asok. 0°38.51'N 10°24.77'E. Alt: 700m, 12 December 2001 (fl), *Wieringa, J.J. 4699* (WAG); 40 km on the road E. of SEF Camp. 0°48'N 10°50'E. Alt: 500m, 13 September 1985 (fl), *Leeuwenberg 13515* (WAG); Minkébé area, river Nouna. 1°43'N 12°51'E, 18 December 1990 (fl), *Minkébé Series D 52* (K,LBV,MAKOK,MO,P,WAG); Minkébé area, near plot R. 1°30'N 12°48'E, 6 April 1990 (fl), *Minkébé Series W 95* (WAG); Minkébé area, summit Mt. Minkébé. 1°37'N 12°50'E, 9 May 1990 (fr), *Minkébé Series W 260* (WAG); crest to the south of Mount Minkébé. 1°35'N 12°52'E, 10 May 1990 (fl, fr), *Minkébé Series W 290* (WAG); Minkébé area, 1600 m on transect A. 1°30'N 12°48'E, 24 May 1990 (fr), *Minkébé Series W 469* (WAG); Minkébé area, on site of old village. 1°44'N 12°52'E, 25 December 1990 (fl), *Minkébé Series W 668* (K,LBV,MAKOK,MO,P,WAG); Minkébé area, 10 x 10 m inventory plot X, placed 2-12 m north at 815-825 m on transect B. 1°30'N 12°48'E, February 1990 (st), *Minkébé Series X 146* (WAG).

**GHANA, Western Region**: Ankasa Game Reserve following footpath right just after entrance going parallel with Ankasa R. 5°13'N 2°39'W. Alt: 100m, 20 March 1995 (fl), *Jongkind 2156* (MO,WAG); 4°56'N 2°21'W. Alt: 15m, November 1928 (st), *Vigne FH 1456* (BM,FHO,K); Ankasa FR 5°15'N 2°37'W, 30 December 1966 (st), *Enti GC 36217* (K).

**GUINEA-BISSAU, Bijagós**: Bolama, sector de Uno. Ilha de Orange, Rio Amebaca de Ambuduco. 11°10'N 16°06'W, 2 May 2000 (fl, fr), *Catarino 858* (LISC,WAG); **Tombali**: Camocote environ Jemberem (Guinée Bissau). 11°13'N 15°02'W. Alt: 20m, 20 January 1995 (fl), *Malaisse 14521* (BR); Camocome. 11°14'N 15°02'W, 5 November 1995 (fl), *Malaisse 14794* (BR).

**IVORY COAST, Aboisso**: De Alunta à Aboisso. 5°28'N 3°12'W, 30 March 1907 (fl), *Chevalier, A.J.B. 17763* (LY); **San-Pédro**: Forêt Classée Monogaga, just south of Sassandra-San Pedro road. 4°51.8'N 6°26.5'W, 25 March 2000 (fl), *Jongkind 4745* (FHO,OXF,WAG).

**LIBERIA, Bong**: Bong Range. 6°49'N 10°20'W. Alt: 100m, 9 July 1960 (st), *Voorhoeve 12* (WAG); Western part of Bong-Range between Waimu and Bagoleta 32 km N. of Kakata. 6°49'N 10°20'W, 21 April 1962 (fl, fr), *Wilde, J.J.FE. de 3884* (A,EA,K,MA,WAG); **Grand Gedeh**: Putu Hills, East Range, East slope. 5°39.3'N 8°10.5'W. Alt: 490m, 17 January 2010 (fl), *Jongkind 9097* (WAG); **Montserrado**: Gola National Forest, Bomi Hills. 6°56'N 10°45'W, 22 July 1965 (st), *Meer, P.P.C. van 22* (WAG); "Small Bopolu", near Maher River. 6°55'N 10°39'W, 24 July 1965 (st), *Meer, P.P.C. van 58* (WAG); Gola National Forest, NE of Bomi Hills, high forest on banks of Mahe river. 6°55'N 10°45'W, 27 April 1966 (fl), *Bos, J.J. 1910* (LIB,WAG); Feuchte Urwaldränder, Oldfield. Oldfield near Duport. 6°16'N 10°40'W, 1 December 1926 (fl, fr), *Dinklage 3016* (Z); Gola National Forest, 12 km NE of Bomi Hills. 6°56'N 10°45'W, 15 April 1962 (fl), *Wilde, J.J.FE. de 3805* (A,K,WAG); **Nimba**: Mt Yuelliton, 7°33.92'N 8°37.97'W. Alt: 740m, 11 January 2009 (fl), *Jongkind 8419* (WAG); Bobei Mt 7°22'N 8°36'W, 29 September 1947 (st), *Baldwin jr 9584* (K); **Sino**: southwest corner of Sapo National Park. 5°18.2'N 8°44.8'W. Alt: 190m, 31 January 2010 (fl, fr), *Daniels, A.K. 50* (MO,SL,WAG); Close after Sinoe River crossing from Jalay's Town into Sapo NP. 5°20.2'N 8°48.0'W. Alt: 100m, 4 March 2009 (fl), *Jongkind 8783* (WAG); inside Sapo NP close to cano crossing of the Sinoe River. 5°20'N 8°48'W. Alt: 100m, 11 March 2009 (fl), *Jongkind 8935* (WAG).

**NIGERIA, Cross River State:** Oban forest reserve. About 1.5 miles west of mile 66, along Calabar-Mamfe motor road. 5°25'N 8°39'E, 26 January 1957 (fl), *Okafor FHI 36169* (FHO); **Edo State:** Sapoba. 6°06'N 5°53'E, (fl, fr), *Kennedy, J.D. 886* (E,FHO); Okumo forest reserve, Nikrowa. 6°14'N 5°21'E, 19 March 1935 (fl, fr), *Richards, P.W. 3263* (BM); **Ondo State:** Eba Island. 6°24'N 4°30'E, (fl), *Kennedy, J.D. 1723* (FHO).

**SENEGAL, Casamance:** Park National de Basse Casamance. 12°24'N 16°36'W, 11 August 1982 (st), *Champluvier S/122* (BR).

**SIERRA LEONE, UNKNOWN:** (fl), *Afzelius, A. s.n.* (LD,UPS); **Northern Province:** Makéni WSW. 8°52'N 12°05'W, 1 April 1955 (fl), *Roberty 17271* (G); **Western Area:** F.B.C. Botanic Garden, Freetown. 8°30'N 13°15'W, 3 July 1964 (fl), *Morton, J.K. SL 1372* (K,WAG); Regent Road. 8°27'N 13°14'W. Alt: 274m, August 1937 (fl), *Pelly SLFD 155* (FHO); Regent Road. 8°27'N 13°14'W, August 1937 (fl), *Pelly SLFD 157* (FHO).

**Key literature:** Bamps & Farron (1967), Farron (1963, 1985), Hutchinson, Dalziel & Keay (1954).

### ***Campylospermum lecomtei*** (Tiegh.) Farron

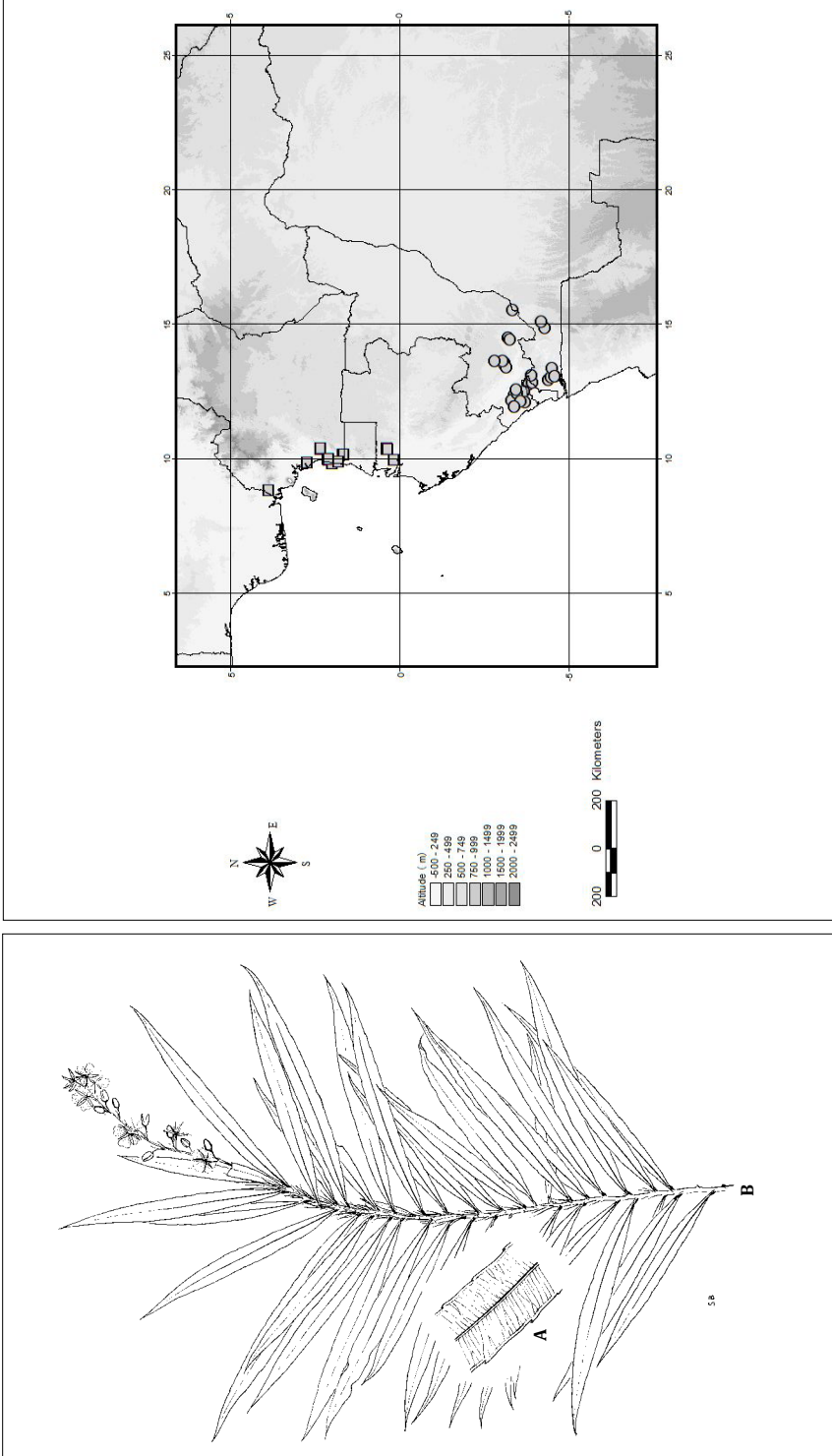
**Fig. 18**

Bull. Jard. Bot. État Bruxelles 35: 399 (1965). – *Ouratea lecomtei* Tiegh., Bull. Mus. Natl. Hist. Nat. 8: 51 (Jan. 1902). – *Bisetaria lecomtei* (Tiegh.) Tiegh., J. Bot. (Morot): 45 (Febr. 1902). – Type: *Lecomte s.n.* (holotype: P!; isotype: P(2x!)), Congo, bords du Kouilou entre Kitabi et Kakamoeka, 1893.

*Bisetaria febrifuga* (Engl & Gilg) Tiegh., Ann. Sc. Nat., sér. 8, Bot. 18: 14 (June 1903). – *Ouratea febrifuga* Engl & Gilg, Bot. Jahrb. Syst. 33: 257 (1904). Type: *Laurent s.n.* (holotype: BR!), Bas Congo, August 1893.

*Shrub* or *treelet* up to 2 m tall, with branched stem; **twigs upright, often grouped at the end of the branches or stem, with whitish bark**. *Stipules* persistent, **linear, 5–13 x 1 mm**. *Leaf:* petiole 1–2 mm long, **swollen**; leaf blade **very narrowly elliptic to linear, (5–)7–11(–13) x (0.5–)1–1.5 cm**, ratio **(3–)7–13**, base narrowly cuneate, **apex tapering into a bristle-like acumen**, coriaceous, not bullate, upper side green, slightly glossy, lower side paler green, dull, margin **thickened, distantly serrulate**; venation: midrib prominent above and below, **main lateral veins numerous, c. 1 mm apart, straight**, more prominent above than below, more or less at a right angle with the midrib, **intermediate lateral veins absent, tertiary venation indistinct on both sides**. *Inflorescence* terminal, **pendulous, usually unbranched**, lax, its main axis (5–)9–20 cm long; pairwise scales at the base of peduncle persistent; bracts persistent, linear, 3–6 mm long; cymules 5–20 mm apart, 1–5-flowered. *Flower:* pedicel (5–)7–10(–13) mm long, articulated at 1–4 mm from the base; sepals oblong to narrowly elliptic, in flower 6–9 x (1–)2–3 mm, in fruit 6–12 x 3–4 mm, base rounded, **apex obtuse**; petals obovate, 6–10 x 3–6 mm, cuneate at base, **rounded to slightly emarginate** at apex; stamens: anthers 4–6(–8) mm long; ovary 1–2 mm long; style 4–5 cm long. *Fruit:* receptacle c. 1 mm thick in flower, in fruit 2–3 mm; drupelets 1–3 well developed per receptacle, **ovoid, 7–9 x 4–5 mm**; cotyledons accumbent, similar in size.

**Notes:** This species is easily recognized by its very narrow leaves. In that sense it resembles *C. glomeratum* and *C. louisii*, but can be easily distinguished by its numerous parallel main lateral veins and long and linear stipules.



**Figure 18.** *Campylosperrum lecontei*. **A.** Main lateral veins. **B.** Flowering branch. Drawings by Sabine Bousani  
**Map 20.** Distribution of *Campylosperrum lecontei* (○) and *Campylosperrum longestipulatum* (□)

**Distribution:** southern Republic of the Congo, south-western Democratic Republic of the Congo (Bas-Congo) and Angola (Cabinda) (**Map 20**).

**Ecology:** understory of primary and secondary forest; on granitic or dry soil; no exact altitudinal data known, but probably at 100–600 m.

**Phenology:** flowering and fruiting observed in January to April, June, August, November and December.

**Vernacular names: Democratic Republic of the Congo:** Ditsasa ya gumba (Mayumbe).

**IUCN conservation status:** NT B1/B2(ii,iii). EOO=64,085 km<sup>2</sup>, AOO=25,575 km<sup>2</sup>, locations=27 (cell width=40 km). Although *C. lecomtei* has a fairly small distribution range, it does not appear to be rare, since a fair amount of specimens (42) have been collected. Still, the most recent collection dates from 1992. Moreover, the species occurs mainly outside protected areas in regions where logging activities are common, which is why the category of Near Threatened has been assigned.

### **Specimens examined:**

**ANGOLA, Cabinda:** Mayombe. 4°48'S 12°50'E, November 1921 (fl), *Dawe 223* (K); Belise-Maiombe. 4°39'S 12°46'E, 14 February 1914 (fr), *Gossweiler 6959* (COI); Belize. 4°39'S 12°46'E, December 1918 (fl), *Gossweiler 8180* (K,LISC).

**CONGO (BRAZZAVILLE), Kouilou:** Congo, Mayumbe. 4°30'S 12°30'E, 7 January 1977 (st), *Bitsindou, I. s.n.* (P); Dimonika. 4°14'S 12°26'E, 3 December 1978 (fl), *Cusset 763* (P); après le carrefour de Makaba ancienne route de Voula. 4°08'S 12°22'E, 4 December 1978 (fl), *Cusset 784* (K,P); environ de Dimonika. 4°14'S 12°26'E, 6 March 1980 (fr), *Cusset 920* (P); environ de Dimonika. 4°14'S 12°26'E, 25 April 1986 (st), *Foresta 939* (P); environs de Dimonika avant Kuilila. 4°14'S 12°26'E, 10 March 1980 (fl), *Cusset 1026* (P); Mayombe. 4°32'S 12°06'E, 1 May 1951 (st), *Koechlin 1885* (P); village de Boungonlo, Mayombe Kakamoeka, route SFN. 4°07'S 11°57'E, 6 November 1965 (fl), *Bouquet, A. 1930* (P); Mayombe. 4°12'S 12°34'E, 5 December 1972 (fl), *Makany 2069* (P); route du chantier de Boungolo (Kakamoeka), pointe Noire. 4°07'S 11°57'E, 31 January 1966 (fl), *Farron 4906* (P); Louvoulou, chantier forestier (Mayombe), Pointe noire. 4°21'S 12°08'E, 4 February 1966 (fl), *Farron 4970* (P); Les Sara. 4°22'S 12°22'E, 30 June 1989 (st), *Dechamps 13205* (WAG); Les Sara. 4°22'S 12°22'E, 30 June 1989 (fl, fr), *Dechamps 13221* (BR); Kitabi. 4°01'S 12°11'E, 1893 (fl), *Lecomte, P.H. A 46* (P); **Lékoumou:** village de Mayéyé, route de Doudou. 3°41'S 13°38'E, 12 February 1965 (st), *Bouquet, A. 1240* (P); Monts Ndomou, après le village d'Isiéélé. 3°23'S 13°38'E, 10 October 1965 (st), *Bouquet, A. 1768* (P); chantier de Manderi, 20 km S.E. de Sibiti. 3°45'S 13°30'E, 20 August 1965 (fr), *Farron 4535* (P); Moussoumo à 35 km ESE Sibiti, non loin de la Bouenza. 3°45'S 13°35'E, 28 August 1965 (fr), *Farron 4542* (P); 4 km W, grand-bois route forestière. 3°50'S 13°25'E, 24 August 1965 (fr), *Farron 4609* (P); **Pool:** Bangou. 3°58'S 14°26'E, 16 December 1992 (fl), *Bitsindou, M. 73* (BRLU); piste Meyá-Mpassa. 3°53'S 14°30'E, 28 April 1965 (fr), *Farron 4089* (P).

**CONGO (KINSHASA), Bas-Congo:** Luki. 5°38'S 13°04'E, 27 February 1951 (fl), *Hombert 5* (BR); Luki. 5°38'S 13°04'E, 20 December 1951 (fl, fr), *Hombert 10* (BR,K); Luki. 5°38'S 13°04'E, 27 February 1951 (fr), *Hombert 11* (BR); Réserve de la Luki. 5°38'S 13°04'E, 6 August 1959 (fr), *Compère 34* (BR,K); Sandanda. 5°34'S 13°07'E, 19 January 1940 (fl, fr), *Donis 73* (BR); Luki (Lukula). 5°38'S 13°04'E, 23 June 1955 (fl), *Hombert 142* (WAG); M'Vuazi (Thysville). 5°15'S 14°52'E, 9 April 1958 (st), *Dubois, J. 261* (EA,WAG); Luki. 5°38'S 13°04'E, 14 April 1953 (fl, fr), *Wagemans 491* (BR,K); Gimbi plateau. 5°31'S 13°22'E, 18 November 1948 (fl), *Toussaint, L. 649* (BR); Monzi. 5°38'S 13°04'E, 8 January 1955 (st), *Wagemans 929* (BR,K); Zema:Mayombe. 5°29'S 13°03'E, 4 April 1919 (st), *Vermoesen 1943* (BR,K); Luki. 5°38'S 13°04'E, 27 November 1948 (fl), *Donis 2128* (BR); Luki. 5°38'S 13°04'E, 27 February 1952 (st), *Hombert 2211* (P); Nkai-Mbaku. 4°46'S 13°07'E, 4 August 1975 (fl), *Breyne, H. 2684* (BR); Lusanga-Sundi. 5°23'S 12°57'E, 22 June 1978 (fl), *Breyne, H. 3374* (BR); Kisantu. 5°08'S 15°06'E, January 1955 (fl), *Callens 4679* (BR); **Kinshasa:** Maluku, Balumu, rivière Bombo. 4°03'S 15°33'E, 8 January 1967 (fr), *Breyne, H. 335* (BR).

**Key literature:** Bamps & Farron (1967), De Wildeman (1929), Exell & Mendonça (1951), Farron (1963, 1985).

***Campylospermum longestipulatum* (De Wild.) Biss.**

Blumea 58: 7 (2013). – *Ouratea longestipulata* De Wild., Pl. Bequaert. 4: 492 (1929).–

Type: *Zenker 3577* (holotype: BR!; isotype: E!, G!, S!, US!), Cameroon, Bipinde, 1908.

*Ouratea cella* Gilg ex De Wild., Pl. Bequaert. 4: 492 (1929), nom. nud.

*Treelet* up to 3 m tall, with branched stem; twigs with whitish bark. *Stipules* persistent, **narrowly triangular, 14–17 mm long**. *Leaf*: petiole 3–10 mm long, fairly slender to stout, generally canaliculate above; leaf blade narrowly **elliptic or narrowly elliptic-obovate oblong-elliptic, (10–)12–22(–30) x (3.5–)4–6(–9) cm**, ratio 2–3.5, base cuneate, decurrent onto the petiole, apex acute to acuminate, **parchmentaceous, bullate**, margin serrulate in the distal half, generally entire in the basal, upper side glossy, dark green, glossy, paler green beneath; venation: midrib strongly prominent on both sides, **main lateral veins (10–)15–20(–23) on either side, 7–20 mm apart**, ± at a right angle with midrib but curved upward to run parallel to the margin, **sunken on upper side, prominent on lower side**, intermediate lateral veins 0–1 in between each pair of main laterals, **flattened beneath, shallowly impressed above**, tertiary venation scalariform, perpendicular to the midrib, **indistinct on both sides**. *Inflorescence* terminal, **unbranched, dense, its main axis 2–4 cm long**; peduncle robust; pairwise scales triangular, persistent at the base of the peduncle; cymules only **1–2 mm apart**, with 1 or 2 broadly triangular bracts at their base. *Flower*: pedicel 11–13(–20) mm long, articulated at 3–5 mm from the base; sepals ovate, in flower 6–8 x 3–4 mm, in fruit 12–13 x 3–5 mm, base rounded, apex obtuse; petals obovate, 9–12 x 7–9 mm, cuneate at base, rounded at apex; stamens: anthers 4–5 mm long; ovary c. 1 x 1 mm, style 5–6 mm long. *Fruit*: receptacle c. 1 x 1 mm in flower, c. 4 x 2 mm in fruit; drupelets 1 to 2 well developed per receptacle, **reniform**, c. 8 x 4–6 mm; cotyledons **incumbent, dissimilar in size with a small outer cotyledon**.

**Notes:** This species is morphologically similar to *C. sulcatum*, because of its bullate leaves and unbranched, compact inflorescence. It can be distinguished from the latter by its long and persistent stipules, its generally more numerous main lateral veins and its indistinct tertiary venation. De Wildeman (1929) highlights the fact that some specimens of *C. longestipulatum* were first distributed from the herbarium of Berlin under the name *Ouratea cella* Gilg, a manuscript name present only on herbarium labels and never formally published. He did not use that name because some specimens of *O. cella* were confused with those of *C. oliverianum* (see note under *C. sulcatum*). Quit some material placed here under *C. longestipulatum* was previously identified as *C. oliverianum* by Farron. However, the type specimen of that name clearly belongs to *C. sulcatum*.

**Distribution:** coastal regions of Cameroon and northern Gabon (**Map 20**).

**Ecology:** in primary and secondary forest, high forest, littoral forest, forest along streams; at 50–530 m altitude.

**Phenology:** flowers collected in January, March, June and August; fruits collected from February to April and in October and December.

**IUCN conservation status:** NT B1/B2(iii,iv). EOO=38,627 km<sup>2</sup>, AOO=22,448 km<sup>2</sup>, locations=17 (cell width=53 km). Although its recent collection is from 2010 and some of its locations occur in protected areas such as the Crystal Mountains National Park in Gabon and the Mount Elephant and Edea Reserves in Cameroon, it has a fairly small distribution area and is only known from 21 collections from 17 localities. Therefore, the category of Near Threatened seems most appropriate.

### **Specimens examined:**

**CAMEROON, Littoral:** Edea Reserve, near Lake Tissongo. 3°35'N 9°54'E, January 1978 (fl), *Thomas, D.W. 298* (C,K,WAG); **South Province:** Kribi, piste menant au Mont éléphant, 7 km après village Bidou III. 2°48.23'N 10°02.04'E. Alt: 79m, 27 March 2010 (st), *Bissiengou 1207* (LBV,WAG,YA); Kribi, piste menant au Mont éléphant, 7 km après village Bidou III. 2°48.23'N 10°02.04'E. Alt: 79m, 27 March 2010 (st), *Bissiengou 1208* (LBV,WAG,YA); Kribi, piste menant au Mont éléphant, 7 km après village Bidou III. 2°48.08'N 10°01.40'E. Alt: 73m, 27 March 2010 (fr), *Bissiengou 1215* (LBV,WAG,YA); Campo-Ma'an area, Mvini. 2°14.4'N 10°10.7'E. Alt: 220m, 19 February 2000 (fr), *Tchouto Mbatchou 2609* (KRIBI,WAG); Campo-Ma'an area, Mvini, Forest along Transect T5. 2°15.2'N 10°11.2'E. Alt: 200m, 13 June 2000 (fl), *Tchouto Mbatchou 2945* (KRIBI,WAG,YA); Elephant Mont, near stone cutters cliff at summit. 2°47'N 10°01'E. Alt: 200m, 17 April 2001 (fl), *Andel, T.R. van 3354* (WAG); Urwaldgebiet. 3°05'N 10°25'E, 1908 (fr), *Zenker 3577* (BM,BR,E,G,S,US,W); SE slopes of Mt. Elephant, SE of Kribi. 2°47'N 10°01'E. Alt: 200m, 26 February 1970 (st), *Bos, J.J. 6414* (MO,WAG); Summit of Mt. Elephant, SE of Kribi. 2°48'N 10°00'E. Alt: 300m, 13 March 1970 (st), *Bos, J.J. 6543* (BAS,MO,P,WAG,YA); Bipindi 4 km N of town, E of Memel road, on low mountain. 3°06'N 10°24'E, 9 April 1970 (st), *Bos, J.J. 6768* (BAS,MO,WAG); 20 km SE. of Kribi, E. slopes of Mt. Elephant. 2°47'N 10°01'E, 22 August 1970 (st), *Bos, J.J. 7249* (BAS,BR,K,MO,P,WAG); 40 km S. of Kribi, Campo road. 2°40'N 9°52'E, 25 August 1970 (st), *Bos, J.J. 7273* (WAG); 40 km S of Kribi, Campo road. 2°40'N 9°52'E, 25 August 1970 (st), *Bos, J.J. 7275* (BAS,K,MO,P,WAG,YA); 20 km E. of Kribi, along road to Ebolowa. 2°50'N 10°01'E, 19 March 1975 (st), *Wilde, J.J.F.E. de 8094* (MO,WAG); Massif des Mamelles. 2°26.7'N 9°54.9'E. Alt: 260m, 19 April 2001 (fr), *Tchouto Mbatchou MMX 126* (WAG); **South-West Province:** Mature rain forest at southern end of Korup National Park, along transect "P" and in 25 HA study plot. 5°01'N 8°51'E. Alt: 50m, 10 March 1986 (fl), *Thomas, D.W. 5853* (MA,MO,P,WAG). **GABON, Estuaire:** Waterfalls in the Tchimbélé River. 0°37'N 10°24'E. Alt: 500m, 15 August 1978 (fl), *Breteler; Wilde 52* (BR,MO,P,WAG); c. 40 km east of Ntoun. 2 km north of Grand Route off logging road. 0°21.66'N 9°58.38'E. Alt: 200m, 22 October 2000 (fr), *Stone, J.R. 3115* (MO,WAG); **Woleu-Ntem:** Crystal mountains, 3 km E of Tchimbélé. 0°38'N 10°26'E. Alt: 530m, 27 December 1989 (fr), *Wieringa, J.J. 301* (WAG); Parc des Monts de cristal, le long de la rivière Mbé, piste après la case picnic sur la droite. 0°37'N 10°24'E, 13 February 2010 (fr), *Bissiengou 971* (LBV,WAG).

**Key literature:** Bissiengou et al. (2013).

### **CampylospERMUM louisii** Bissiengou & Sosef

*Blumea* 53: 627 (2008). – Type: *A.M. Louis 2849* (holotype: WAG!; isotype: LBV!, MO!), Gabon, Estuaire Province, route Tchimbélé vers Kinguélé à 19.6 Km, February 23<sup>rd</sup>, 1988.

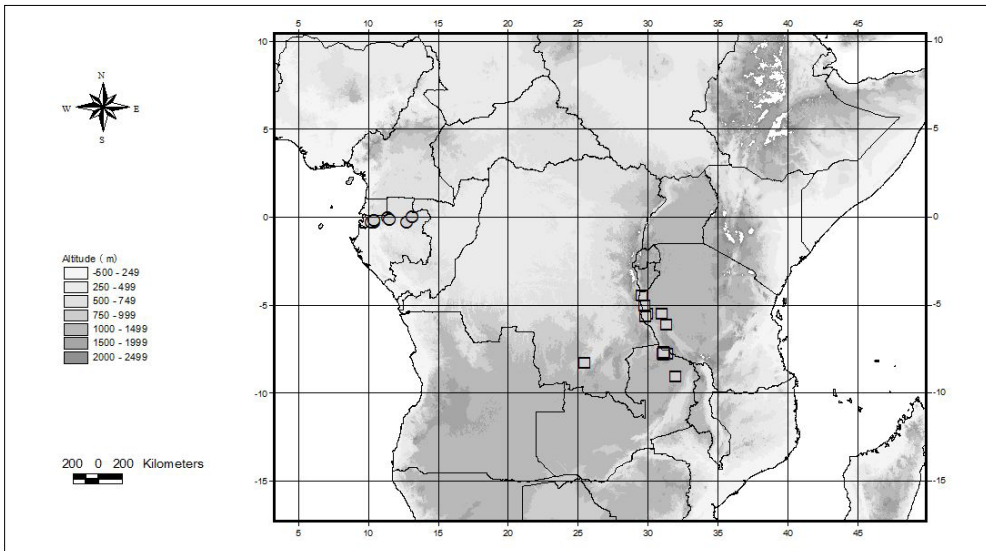
*Treelet* up to 1.5 m high, with branched stem; twigs with whitish bark. *Stipules:* persistent, narrowly triangular, c. 3 mm long. *Leaf:* petiole 1.5–5 mm long; leaf blade **narrowly to very narrowly elliptic, 9.5–28 x 1.3–2.4 cm**, ratio **4.5–15**, base cuneate to attenuate, apex long tapering and sometimes mucronulate at the very tip, papyraceous, not or slightly bullate, margin entire to serrulate with distant, reduced teeth, upper surface glossy dark green, lower surface greenish; venation: midrib **prominent but running**



**through a gully** on the upper surface, prominent on the lower, main lateral veins (**12–15–20 on either side, 5–12 mm apart**, more or less at right angles with midrib but strongly curved up toward the margin, prominent on both surfaces, intermediate lateral veins absent, tertiary venation scalariform towards the margin but reticulate towards the midrib, scalariform venation perpendicular to the midrib, distinct on both sides. *Inflorescence* terminal, branched, slender, lax, its main axis (4–)7–18 cm long; racemes 1–4, 2–6 cm long; pairwise scales **persistent at the base of the peduncle**, minute; cymules 1–2.5 cm apart, 1–3(–4)-flowered; bracts caducous, narrowly triangular, 1–2 mm long. *Flower*: pedicel 3–10 mm long, articulating at 1–5 mm from the base; sepals narrowly ovate, 5–6 x 2–3 in flower, 3–8 x 1–3 mm in fruit, apex rounded; petals not observed; stamens not observed; ovary c. 0.5 mm high; style 3 mm long. *Fruit*: receptacle accrescent to a ± globose shape; drupelets only 2 to 3 well developed per receptacle, ellipsoid, 5–9 x 4–7 mm, green turning pink (presumably immature) and finally black; cotyledons incumbent, more or less equal.

**Notes:** The similarity to and distinction from *C. laeve* was already discussed in Bissiengou & Sosef (2008).

**Distribution:** endemic to Gabon (**Map 21**).



**Map 21.** Distribution of *Campylospermum louisii* (○) and *Campylospermum lunzuense* (□)

**Ecology:** in primary and secondary forest; at 500–650m altitude.

**Phenology:** flowering in February; fruiting in March, May and November.

**Vernacular name:** Gabon: Alen-opwbon (Fang).

**IUCN conservation status:** VU. EOO=9,912 km<sup>2</sup>, AOO=7,509 km<sup>2</sup>, locations=10 (cell width=33 km). This species occurs at higher altitudes in the Crystal Mountains and the

Bélinga Mountains in Gabon where logging activities are rare, although there is some threat for habitat destruction by mining activities. The Vulnerable category is assigned based on the fact that it has a limited distribution and is only known from 10 localities.

**Specimens examined:**

**GABON, Estuaire:** Monts de Cristal, Mbe National Park, on slope (steep) of Mt. Mbilan-ridge. 0°28.2'N 10°15.4'E. Alt: 650m, 5 April 2005 (fr), *Leal, M.E. 499* (MO,WAG); route Kingélé vers Tchimbélé à 19,6 km. 0°34'N 10°19'E, 23 February 1988 (fl), *Louis, A.M. 2849* (LBV,MO,WAG); Crystal Mountains, 49030m on transect G. 0°31'N 10°25'E, 3 May 2001 (fr), *Wilks AP 3445* (LBV,MO,WAG); **Ogooué-Ivindo:** route Bélinga, 21 km après village Zadié. 0°53.1'N 13°10.2'E. Alt: 535m, 11 March 2010 (fr), *Bissiengou 1128* (LBV,WAG); route Bélinga, 5 km après village Mbondo. 0°53'N 13°10'E. Alt: 586m, 12 March 2010 (fr), *Bissiengou 1154* (LBV,WAG); Station I.R.E.T. (M'Passa Field Station), 10 km S de Makokou sur la riviere Ivindo. 0°30'N 12°45'E. Alt: 500m, 12 May 1985 (fr), *Dorr, L.J. 4230* (BAS,MO,WAG); **Woleu-Ntem:** Near Lara River, close to Otouk village on rd. Mitzi-Médouneu. 0°49'N 11°25'E, 7 November 1983 (fr), *Louis, A.M. 463* (WAG); Crystal mountains, ½ km SW of Tchimbélé. 0°37'N 10°24'E. Alt: 520m, 27 January 1990 (fr), *Wieringa, J.J. 472* (LBV,WAG); c. 8 km SSW of Mitzi, FOREENEX forest exploitation. 0°42.9'N 11°32.0'E. Alt: 547m, 6 November 2009 (fr), *Bissiengou 668* (LBV,WAG); Parc des Monts de cristal, environ du Plot I, Smithsonian. 0°37.0'N 10°24.8'E, 12 February 2010 (fl), *Bissiengou 952* (LBV,WAG).

**Key literature:** Bissiengou & Sosef (2008).

**Campylospermum lunzuense** (N.Robson) Biss.

**Fig. 19**

*Campylospermum lunzuensis* (N.Robson) Biss., *Blumea* 58: 7 (2013). – *Ouratea lunzuense* N.Robson, *Bol. Soc. Brot.*, ser. 2, 36: 38 (1962). – *Gomphia lunzuense* (N.Robson) Verdc., *Fl. trop. E. Africa, Ochnac.*: 47 (2005). – Type: *Bullock 3877* (holotype: K!), Zambia, Lunzua River, 19 miles west of Abercorn, 1951.

*Treelet* up to 6 m tall, with branched stem; twigs spreading, wiry, with whitish bark. *Stipules* caducous, triangular, 2–3 mm long. *Leaf:* petiole 2–5 mm long; leaf blade elliptic to narrowly elliptic, **(4–)7–13(–19) x (1.5–)2–3.5(–4.5) cm**, ratio **3.5–6.5**, base attenuate, apex **slightly acuminate or sometimes acute**, mucronate, coriaceous to parchmentaceous, not bullate, upper side slightly glossy, dark green, lower side medium green, **margin spinose-serrate, entire towards the base**; venation: midrib prominent on both sides, main lateral veins 3–12 on either side, 15–30(–70) mm apart, at a ± right angle with the midrib but strongly curved upwards to run parallel to the margin, intermediate lateral veins 0–1 in between each pair of main laterals, distinct on both sides, **tertiary venation scalariform along the margin and perpendicular to the midrib but reticulate towards the midrib**, very distinct on both sides. *Inflorescence* terminal, unbranched or branched, dense to lax, its main axis 1–8 cm long, **slender**; pairwise scales caducous; racemes 0–3, 1–6 cm long; cymules 1–5 mm apart, 2–6-flowered; bracts persistent, triangular, 1–1.5 mm long. *Flower:* pedicel **9–22(–30) mm long, articulated at (2–)3–7(–12) mm from the base**; sepals narrowly ovate, 6–7 x 2–3 mm in flower, 7–8 x 2–4 mm in fruit, apex obtuse to rounded; petals obovate, 6–9 x 3–4 mm, base cuneate, apex rounded; stamens: anthers 4–6 mm long; ovary c. 1 mm high; style 4–5 mm long. *Fruit:* receptacle c. 1 mm long in flower, 4 x 4 mm in fruit; drupelets 2 to 3 well developed per receptacle, **cylindric-ellipsoid**, 7–8 x 5–5.5 mm; cotyledons incumbent, ± similar in size.

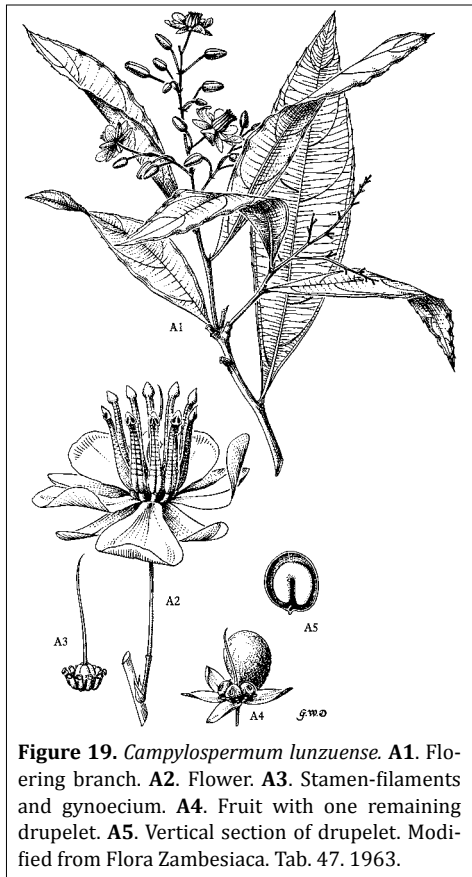
**Notes:** *C. lunzuense* was synonymized with *C. reticulatum* by Farron (1965) without justification. However, it differs from *C. reticulatum* by having a spinulose-serrate leaf margin, pedicels that articulate generally much higher up, often a denser inflorescence and its cotyledons being similar in size. Therefore, we agree with Verdcourt (2005) in recognizing *C. lunzuense* as a distinct species. *C. lunzuense* is also similar to *C. warneckeii* from which it differs by having a spinulose-serrate leaf margin and pedicels articulated well above the base.

**Distribution:** western Tanzania, northern Zambia, with one collection in south-eastern Democratic Republic of the Congo (**Map 21**).

**Ecology:** in riverine forest, sometimes on steep river banks, in dry gallery forest and evergreen rain forest; at 900–1524 m altitude.

**Phenology:** flowers observed in May, June and from August to October; fruits observed in May, June and from August to November.

**IUCN conservation status:** LC. EOO=252,064 km<sup>2</sup>, AOO=52,312 km<sup>2</sup>, locations=15 (cell width=72 km). This species is not frequently collected (only 21 specimens known) and hence seems to be fairly rare. It has not been collected since 1993. However, the area of occupancy is fairly large as is the number of locations. Some specimens come from National Parks such as the Gombe National Park in Tanzania, Lunzua in Zambia and some from a Forest Reserve near the Mbala Hills. Therefore, the category Least Concern seems most suitable.



**Figure 19.** *Campylospermum lunzuense*. **A1.** Flowering branch. **A2.** Flower. **A3.** Stamen-filaments and gynoecium. **A4.** Fruit with one remaining drupelet. **A5.** Vertical section of drupelet. Modified from Flora Zambesiaca. Tab. 47. 1963.

**Specimens examined:**

**CONGO (KINSHASA), Katanga (Shaba):** pont de la Kalule Nord, route Kolwezi à Luéna. 9°29'S 25°30'E, 22 October 1959 (fl, fr), *Schmitz, A. 6689* (BR).

**TANZANIA, Kigoma:** Gombe stream Nat. Park Mkenke Valley. 4°42'S 29°36'E. Alt: 914m, 31 October 1969 (fl, fr), *Clutton-Brock 174* (EA); Gombe stream Nat. Park Mkenke Valley. 4°42'S 29°36'E. Alt: 914m, 20 August 1969 (fr), *Clutton-Brock 253* (BR,EA); Gombe stream Nat. Park Mkenke Valley. 4°42'S 29°36'E, 26 September 1969 (fr), *Clutton-Brock 285* (EA); kabogo Mts. 5°27'S 29°48'E. Alt: 1150m, 21 June 1963 (st), *Toyoshima 578* (EA); **Rukwa:** Mahali Mts, Kasogo. 6°09'S 29°45'E, 21 November 1953 (fr), *Uehara 183* (EA); Nyamansi River 25 mls North of Mpanda. 6°00'S 31°01'E, November 1954 (fr), *Procter 301* (EA,FHO); Nyamansi River 25 mls North of Mpanda. 6°00'S 31°01'E, September 1961 (fr), *Procter 1947* (EA); Kungwe-Mahali, Peninsula. Highland between Pasagulu and Musenabantu. 6°00'S 30°00'E. Alt: 1524m, 8 August 1959 (fl), *Harley, R.M. 9221* (B,BR,S); Mbala Hills, Kapapa. 6°48'S 31°22'E. Alt: 1200m, 27 October 1959 (fr), *Richards, M.A.E. 11555* (K).

**ZAMBIA, Northern:** Abercorn distrin Lunzua Falls. 8°57'S 31°09'E, 26 October 1952 (fr), *Robertson, R.G. 173*

(K); Abercorn. 8°50'S 31°23'E, 14 September 1962 (fl, fr), *Lawton 982* (FHO,K); Abercorn. 8°50'S 31°23'E, 11 September 1966 (fl, fr), *Lawton 1429* (FHO); Mpulungu-Abercorn, near Lunzua Falls. 8°56'S 31°09'E, 17 September 1950 (fl), *Bullock, A.A. 3336* (K); Lunzua River, 19 miles west of Abercorn. 8°50'S 31°03'E. Alt: 1219m, 14 May 1951 (fl), *Bullock, A.A. 3877* (BR,K); Ulungu, village Uechinda. 8°46'S 31°07'E, 11 November 1948 (st), *Brédo, HJAER 6236* (BR); Ulungu, village Uechinda. 8°46'S 31°07'E, 11 November 1948 (st), *Brédo, HJAER 6266* (BR); Chinsali, from anthill thickets on the river flats. 10°30'S 32°01'E, 27 September 1967 (fr), *Fanshawe 10184* (LISC); Abercorn district above Lunzua Falls. 8°57'S 31°09'E, 24 June 1957 (fl, fr), *Richards, M.A.E. 10200* (BR,EA,K); Abercorn District, Isoko valley, Mwanbeshi River. 8°48'S 31°11'E. Alt: 900m, 5 September 1960 (fl, fr), *Richards, M.A.E. 13193* (BR); Rhodesia bor. orien.:ad fluvium Lunzua. 8°45'S 31°10'E, 8 November 1911 (st), *Fries, R.E. Centr.Afr. 1226* (UPS).

**Key literature:** Exell et al. (1963), Robson (1963), Verdcourt (2005).

### **Campylosperrum lutambense** (Sleumer) Biss.

*Campylosperrum lutambensis* (Sleumer) Biss., *Blumea* 58: 7 (2013). – *Ouratea lutambense* Sleumer, *Repert. Spec. Nov. Regni Veg.* 39: 278 (1936). – *Gomphia lutambense* (Sleumer) Verdc. *Fl. trop. E. Africa, Ochnac.*: 52 (2005). – Type: *Schlieben 6110*. (holotype: B†; isotype: BR!, G!, Z!), Tanzania, 50 km W. Lindi, Lake Lutamba, Noto Plateau, March 9<sup>th</sup>, 1935.

*Tree* up to 4 m tall, rarely scandent, with branched stem; twigs with brownish bark. *Stipules persistent*, triangular, 3–5 mm long. *Leaf*: petiole 0–5 mm long, stout; leaf blade elliptic to narrowly elliptic or elliptic-obovate, **10–22(–30) x 3–6(–8.5) cm**, ratio **2.25–3.2**, **base rounded, apex blunt to rounded**, coriaceous, not bullate, margin entire to distantly serrulate, upper side very glossy, dark green, lower side glossy bright green; venation: midrib flattened above, prominent below, main lateral veins **14–30(–35)** on either side, **4–9 mm apart**, making a slight angle with the midrib and curved upwards, **prominent on both sides**, intermediate lateral veins 0–2 in between each pair of main laterals, prominent on both sides, **tertiary venation reticulate, very distinct on both sides**. *Inflorescence* terminal, unbranched or sometimes with 1 or 2 short racemes, **robust**, its main axis (4–)6–9(–13) cm long; racemes **0–2**, c. **1–1.5 cm long**; pairwise scales caducous; cymules **1–5 mm apart, 1–6-flowered**; bracts persistent, triangular, 1–1.5 mm long. *Flower*: pedicel 5–10 mm long, articulated at 1 mm from the base; sepals **ovate**, in flower 6 x 3–4 mm, in fruit 7 x 3–4; petals oblong-spathulate, **9–10 x 5 mm**, truncate at base, **rounded** at apex; stamens: anthers 5–6 mm long; ovary c. 1 mm long; style c. 5 mm long. *Fruit*: receptacle 6 mm thick; drupelets 1 to 2 well developed per receptacle, **reniform, 7 x 5 mm**; cotyledons **accumbent, similar in size**.

**Notes:** This species was previously only known from south-eastern Tanzania, but recently a single specimen from south-eastern Democratic Republic of the Congo (Katanga prov.) was discovered. It is similar to *C. densiflorum* by having thick and coriaceous, blunt leaves, but the prominent main lateral veins and especially the striking reticulate tertiary venation readily sets it apart.

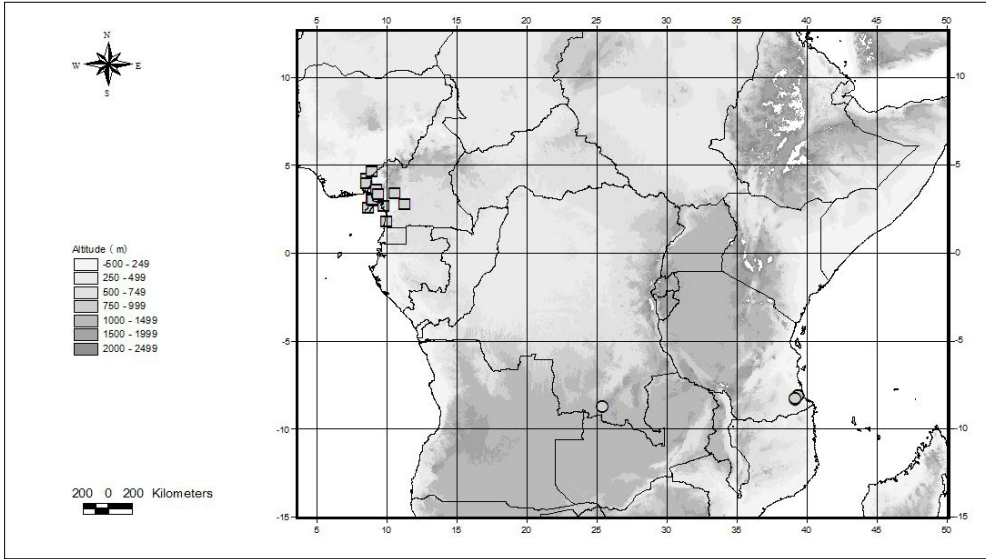
**Distribution:** Democratic Republic of the Congo (Katanga prov.) and Tanzania (Lindi prov.) (**Map 22**).

**Ecology:** in semi-evergreen forest; on grey sandy soil; at 700–1430 m altitude.

**Phenology:** flowers observed in March and December; fruits in February and March.

**IUCN conservation status:** CE B1/B2(i,ii), EOO=18,870 km<sup>2</sup>, AOO=46,972 km<sup>2</sup>,

locations=4, subpopulations=2 (cell width=153 km). This species is only known from four collections, and thus seems to be very rare. Its most recent collection is from 2004. Three collections are found in the Rondo Forest Reserve (Tanzania). Although the AOO suggests a category of Least Concern, this species could be in threat since one of its only two subpopulations is found outside a protected area. Furthermore, collections found in Rondo were last collected in 1991 and its presence needs confirmation. Therefore, for now, the category of Vulnerable seems most appropriate.



Map 22. Distribution of *Campylosperrum lutambense* (○) and *Campylosperrum mannii* (□)

**Specimens examined:**

**CONGO (KINSHASA), Katanga (Shaba):** 2.2 km au N. de Tshala (environs de Kolwezi). 10°38.86'S 25°25.77'E. Alt: 1430m, 17 August 2004 (st), *Malaise*; *Kisimba 15* (BR).

**TANZANIA, Lindi:** Rondo plateau. 10°07'S 39°13'E. Alt: 700m, 15 February 1991 (fr), *Bidgood 1581* (K,NHT); 50 Km W. Lindi; Lutambasee, Notoplateau. 9°54'S 39°24'E, 9 March 1935 (fl, fr), *Schlieben 6110* (BR,G,Z); S face of Rondo escarpment, Mchinjiri. 10°08'S 39°11'E. Alt: 762m, December 1951 (fl), *Eggeling 6416* (EA,FHO,K).

**Key literature:** Verdcourt (2005).

***Campylosperrum mannii* (Oliv.) Tiegh.**

**Fig. 20**

J. Bot. (Morot) 16: 43 (Febr. 1902). – *Gomphia mannii* Oliv, Fl. trop. Afr: 1: 321 (1868).  
– *Notocampylum mannii* (Oliv.) Tiegh., Ann. Sci. Nat., sér. 2, Bot. 16: 311 (Dec. 1902).  
– Type: *Mann 24* (holotype: K!; isotype: HUH!, P(2x)!), Equatorial Guinea, Île Fernando-Po, 1860.

*Treelet* up to 5 m tall, **monocaulous**; stem with whitish bark. *Stipules* caducous, triangular, 3–4 mm long. *Leaf*: petiole 0–5 mm long, stout; leaf blade **narrowly elliptic-obovate to narrowly spatulate**, 31–55 x 7–15 cm, ratio 3–4.4, gradually narrowing into the cordate to auriculate base, apex rounded to acuminate, coriaceous, slightly bullate, margin serrate in the apical half, subentire further down, upper side dull dark

green, lower side glossy bright green; midrib prominent above and below, **main lateral veins 20–26 on either side**, 12–30 mm apart, prominent but running through a gully above, slightly prominent below, **making a slight angle with the midrib** and slightly curved up towards the margin, intermediate lateral veins 0–1(–2) in between each pair of main laterals, tertiary venation scalariform, running perpendicular to the main lateral veins, joined by cross veinlet, distinct on both sides. **Inflorescence axillary, unbranched, dense**; its main axis 8–25(–32) cm long, angular to slightly flattened; pairwise scales at the base of the peduncle absent; cymules **0.3–1.5(–2.5) cm apart, 9–28-flowered**. **Flower**: pedicel 8–15 mm long, articulated at 2–4 mm from the base; sepals elliptic to elliptic-ovate, in flower 8–9 x 4–5 mm, green, in fruit 12–15 x 7–10 mm, red, coriaceous, apex obtuse, incurved over the drupelets; petals obovate, 11–15 x 6 mm, base truncate, apex rounded; stamens: anthers 6–7 mm long; ovary 2 mm high; style c. 6 mm long. **Fruit**: receptacle flat, enlarged in fruit to 8–9 mm in diameter; drupelets 1 to 3 well developed per receptacle, **ovoid to ellipsoid, 8–12 x 6–7 mm; cotyledons incumbent, of similar size**.

**Notes**: This species is morphologically similar to *C. klainei* (Tiegh.) Farron from Gabon. It can be distinguished by its axillary inflorescence whereas it is terminal in *C. klainei*. Moreover, *C. klainei* has reduced leaves or leafy bracts at the base of its inflorescence whereas, *C. mannii* does not. The distribution of the two species does not overlap.

**Distribution**: south-eastern Nigeria (Calabar), Cameroon (West and Southwest province), and Equatorial Guinea (Bioco) (**Map 22**).

**Ecology**: in primary or secondary high forest, on hill slopes; on iron-rich soil, young volcanic soil or sometimes rocky places; at 100–200 m altitude.

**Phenology**: flowering in February, March and December; fruits observed in February, March, August and December.

**IUCN conservation status**: NT B1/B2(iii, iv). EOO=66,854 km<sup>2</sup>, AOO=18,717 km<sup>2</sup>, locations=14 (cell width=41 km). This species has not been collected in the past 10 years and is known from only 15 specimens suggesting it is rare. It occurs in highly disturbed forest and some of its specimens were collected in what today are protected areas, like Pico de Basilé on the island of Bioco, South Bakundu in Cameroon and Oban in Nigeria. Thus, the category of Near Threatened seems most appropriate.



**Figure 20.** *Campylosperrum mannii*. **A.** Persistent sepals. **B.** Flowering branch. **C.** Fruiting branch. Drawings by Sabine Bousani

**Specimens examined:**

**CAMEROON, Central Province:** NW de Ndoknabao, à 30 km au SW de Ndiikinimeki. 4°34'N 10°38'E, 18 December 1971 (fr), *Letouzey 10877* (P); **Littoral:** Pongo-Songo (Mouanko) Edea. 3°39'N 9°49'E, 8 January 1974 (fr), *Mezili 238* (P); Edea. 3°48'N 11°20'E, (fr), *Annet 493* (BR); **South Province:** Nko'Elon, 25 km E. campo. 2°33'N 10°02'E, 6 December 1979 (fl), *Letouzey 15310* (P); **South-West Province:** Njonji. 4°08'N 9°01'E, 14 February 1992 (fl, fr), *Mbani, J.M. 26* (K); Idenau. 4°17'N 8°59'E. Alt: 100m, 6 March 1992 (fr), *Mbani, J.M. 31* (K,SCA,YA); Njonji. 4°08'N 9°00'E. Alt: 100m, 17 August 1992 (fr), *Tekwe 125* (K,SCA,YA); near village of Njonji. 4°06'N 9°08'E, 5 February 1992 (fl, fr), *Sunderland 1077* (K); south Bakundu F.R. Kendongi. 4°32'N 9°25'E, 14 May 1970 (st), *Farron 7292* (P); Kumba Distr. 22 chains on Line 3 east. 4°50'N 9°20'E, 1946 (fl), *Ejiofor FHI 14077* (FHI,K).

**EQUATORIAL GUINEA, Bioco (Fernando Poo):** Fernandoo-Poo. 3°32'N 8°42'E, December 1859 (fl, fr), *Mann, G. 24* (HUH,K).

**NIGERIA, UNKNOWN:** 2 February 1937 (fr), *Rosevear 30/78* (FHO); **Cross River State:** oban district. 5°19'N 8°34'E, 4 March 1912 (st), *Talbot, P.A. s.n.* (K); Miles from Akoum to Aboutong. 5°19'N 8°34'E, 12 March 1945 (fl, fr), *Onyeagocha FHI 7720* (FHO); Ogoja Prov. Aboabam. 6°08'N 9°00'E, 12 December 1950 (fl), *Keay FHI 28229* (K); Calabar. Oban Forest Reserve. Orem. 5°36'N 8°35'E, 28 January 1957 (fr), *Onochie FHI 36176* (FHO,K); Oban Group Forest Reserve, near Orem village (South East State, Ikpai District). 5°36'N 8°35'E, 8 March 1973 (fr), *Latilo FHI 70536* (FHI,WAG).

**Key literature:** Farron (1965, 1968, 1985), Hutchinson, Dalziel & Keay (1954), Tieghem (1902b), Oliver (1868).

***Campylospermum nutans* (Hiern) Biss.**

Blumea 58: 7 (2013). – *Ouratea reticulata* (P.Beauv.) Engl. ex Gilg var. *nutans* Hiern, Cat. afr. pl. 1: 123 (1896). – *Monelasmum nutans* (Hiern) Tiegh., Ann. Sci. Nat., Bot. 16, sér. 8: 328 (Dec. 1902). – *Ouratea nutans* (Hiern) Exell, J. Bot. 65, Suppl. 1: 59 (1927). – Type: *Welwitsch 4606* (holotype: BM!; isotype: K!), Sao Tomé and Príncipe, Insula Principes, Pico de Papagais, September 1853.

*Monelasmum henriquesii* Tiegh., Ann. Sc. Nat., ser. 8, Bot. 16: 335 (Dec. 1902). Type: *Henriques 36* (holotype: COI!), Sao Tomé, August 1903. **syn. nov.**

*Treelet*, up to 4 m tall, with branched stem; twigs with whitish bark. *Stipules* caduous, triangular. *Leaf*: petiole 3–5 mm long, sometimes canaliculate; leaf blade narrowly elliptic, **8–19 x 2–5 cm**, ratio **3.5–5**, base cuneate, apex acuminate, **papyraceous**, not bullate, upper surface slightly glossy dark green, lower surface dull green, margin regularly serrulate; venation: midrib **prominent above, slightly prominent below**, main lateral veins **12–15 on either side, 6–16 mm apart**, prominent on both sides, at a ± right angle with the midrib but curved upwards to run parallel to the margin, intermediate lateral veins 0–1 in between each pair of main laterals, tertiary venation **scalariform**, perpendicular to the midrib, **very distinct on both sides**. *Inflorescence* terminal or rarely axillary, branched, lax, its main axis 15–20 cm long; pairwise scales at the base of the peduncle absent; bracts absent; racemes 1–3, 5–14 cm long, **lax and wiry**; cymules 0.5–2 cm apart, 1–8-flowered. *Flower*: pedicel **15–20 mm long, articulated at (4–)6–10 mm** from the base; sepals narrowly ovate, 5–8 x 2 mm in flower, in fruit 6–8 x 3–4 mm, apex acute; petals obovate, 6–10 x 4–6 mm, base cuneate, apex rounded to slightly emarginate; stamens: anthers 3.5–5 mm long; ovary c. 1 mm

high; style 4–8 mm long. *Fruit*: receptacle 2–4 mm wide; drupelets 1–2 well developed per receptacle, ellipsoid or ellipsoid-ovate to globose, 7–10 x 5–8 mm; cotyledons incumbent, dissimilar in size with a small outer cotyledon.

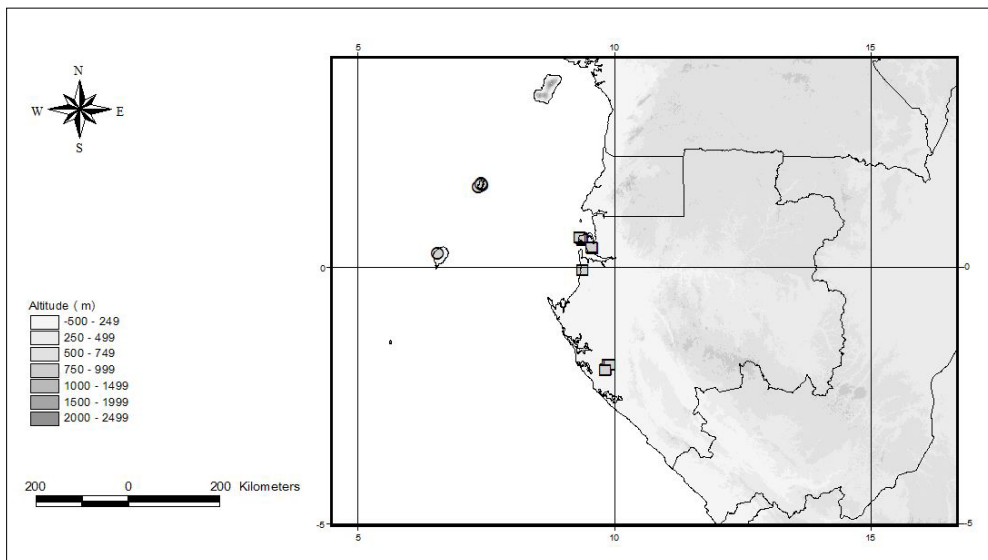
**Notes:** This species is known from only 11 specimens. Although it is close to *C. reticulatum*, and has originally been described as a variety of that species, I agree with Exell (1927, 1944) that it is sufficiently distinct to be regarded as a separate species. It differs from *C. reticulatum* by having a scalariform tertiary venation, papyraceous leaves and a pedicel articulating further up. Finally, true *C. reticulatum* seems to be absent from Sao Tomé and Príncipe, adding a geographical distinction to the whole.

**Distribution:** endemic to Sao Tomé and Príncipe (**Map 23**).

**Ecology:** in primary and secondary forest; at 150–670 m altitude.

**Phenology:** flowering in February, March, May, September and December; fruits observed in February, May, September and December.

**IUCN conservation status:** EN B1/B2(i,ii). EOO=386 km<sup>2</sup>, AOO=1,266 km<sup>2</sup>, locations=8 (cell width=18 km). This species is only known from 11 collections and its most recent collection is from 1999. Occurring on only two small islands (Príncipe and Sao Tomé), its area of occurrence and occupancy are very small, but it does seem to be present in protected areas such as Zona Ecológica in Príncipe. Therefore, the category of Endangered seems most suitable.



**Map 23.** Distribution of *Campylosperrum nutans* (○) and *Campylosperrum occidentale* (□)

**Specimens examined:**

**SAO TOMÉ & PRINCIPE, Príncipe Island:** Príncipe Island. 1°37'N 7°24'E, August 1903 (st), *Henriques, J.A. 36* (COI); Pico de Príncipe. 1°35'N 7°23'E, 2 September 1999 (fl), *Joffroy 215* (BRLU); Barriga Brauca 3 km SSW of Maria Correia. 1°34'N 7°21'E. Alt: 300m, 5 February 1980 (fl), *Wilde (WALG), J.J.F.E. de 362*



(BR,FR,MO,STOME,TI,WAG); Oque Pipi. 1°36'N 7°25'E. Alt: 305m, 10 December 1932 (fl), *Exell 555* (COI); between Oque Pipi and Morro de Este. 1°36'N 7°25'E. Alt: 366m, 11 December 1932 (fl), *Exell 560* (BM,BR,COI); Summit of Papagaio. 1°37'N 7°24'E. Alt: 671m, 29 December 1932 (fl), *Exell 708* (BM,BR,COI); Príncés Island. 1°37'N 7°24'E, 1853 (fl), *Welwitsch, F.M.J. 4606* (K); Pico Papagaio. 1°37'N 7°24'E. Alt: 500m, 16 May 1996 (fl, fr), *Matos 7749* (LIISC); N face of Pico. 1°36'N 7°23'E. Alt: 244m, 30 August 1956 (st), *Monod, A.T. 12141* (COI); Pico Mesa. 1°34'N 7°21'E. Alt: 600m, 25 March 1998 (fl), *Oliveira (Faustino), F. de 98/ 550* (BRLU); Cimo de Morro Funduo. 1°37.7'N 7°24.1'E. Alt: 280m, 25 March 1998 (fl), *Oliveira (Faustino), F. de 98/ 577* (BRLU).

**Key literature:** Exell (1927, 1944).

### **Campylospermum occidentale** Biss.

*Campylospermum occidentale* Biss., *Blumea* 58: 6 (2013). – Type: *Haegens & v.d. Burgt 106* (holotype: WAG!; isotype: LBV), Gabon, Ogooué-Maritime, Rabi-Kounga, road to Divangui, 1°54'S, 9°55'E, December 6<sup>th</sup>, 1993.

*Treelet* up to 4 m tall, with branched stem; twigs with brownish bark. *Stipules* caducous, triangular, 2–3 mm long. *Leaf*: petiole 2–5 mm long; leaf blade narrowly elliptic to narrowly elliptic-obovate, **6–16 x 1.5–4.5 cm**, ratio **3–4**, base cuneate, apex slightly acuminate, **papery**, not bullate, margin entire to serrulate, glossy dark green above, paler green below; venation: midrib slightly prominent above, prominent below, main lateral veins 7–11 on either side, 9–20 mm apart, curved upward to run parallel to the margin, prominent on both sides, intermediate lateral veins 0(–1) but the scalariform tertiary venation producing a series of weaker veins connecting to the midrib, tertiary venation scalariform, perpendicular to the midrib, very distinct on both sides. *Inflorescence* terminal, branched, lax, its main axis slender, 4–8(–12) cm long; racemes 1–4(–6), 1–7(–11) cm long, held ± horizontally, **not seldom with secondary or even tertiary branches rendering the inflorescence a corymbose shape**; pairwise scales at the base of peduncle absent; bracts early caducous; cymules (5–)10–15 mm apart, 1–2(–3)-flowered. *Flower*: pedicel 4–10(–15) mm, articulated at 1–6 mm from the base; sepals ovate, in flower 5–7 x 2–3 mm, greenish-yellow, in fruit 6–7 by 3–3.5 mm, red, apex blunt; petals obovate, 5–11 x 4–7 mm, cuneate at base, rounded to emarginate at apex; stamens: anthers 3–4 mm long; ovary c. 2 mm wide; style c. 4 mm long. *Fruit*: receptacle c. 3 mm wide, red; drupelets 1–3 well developed per receptacle, ellipsoid, 8 x 5–6 mm, orange to orange-red at maturity; cotyledons incumbent, similar in size.

**Notes:** *C. occidentale* is close to *C. nutans*, but it differs by having fewer lateral veins and by having branched racemes that give the inflorescence a corymbose appearance. The only sheet available with fruiting material seems to present mature drupelets, and the label says these (as well as the sepals) are orange, instead of the normal black condition. Future observations need to confirm this aberrant feature.

**Distribution:** endemic to Gabon, only found in the coastal plain, in the Ogooué-Maritime (Rabi-Kounga) and Estuaire (Mondah forest and Bikele) provinces (**Map 23**).

**Ecology:** primary and secondary, moist forest, near swampy areas; on sandy soil; at 5–30 m altitude.

**Phenology:** flowers collected from August to November; fruits observed from November to December.

**IUCN conservation status:** VUB1ab(ii, iii, iv). EOO = 5959 km<sup>2</sup>, AOO = 3388 km<sup>2</sup>, locations = 4 (cell width = 29.10 km). This species seems to have a disjunct distribution, but this is uncertain because the area between the two occupied areas is not well explored. In a situation involving a disjunct distribution the sliding scale grid size method leads to an overly large estimation of especially the AOO. Some of the occurrences in the vicinity of the capital Libreville are under threat of habitat destruction due to urbanization and overexploitation. This is likely to lead to a decline in the area of occupancy and/or number of populations or even extent of suitable habitat and hence we propose the category Vulnerable.

**Specimens examined:**

**GABON, Estuaire:** 25 km along the road Libreville-Cap Esterias. 0°32'N 9°23'E. Alt: 5m, 2 September 1978 (fl), *Breteler*; *Wilde 386* (BR,C,K,LBV,MO,P,PRE,SRGH,WAG); Mondah forest, parcelle des conservateurs. 0°35'N 9°20'E, 10 November 2009 (fl), *Bissengou 815* (LBV,WAG); 17 km E. of Libreville, S. of Bikelé village. 0°23'N 9°35'E, 7 December 1983 (fr), *Louis, A.M. 1201* (WAG); between Cap Santa Clara and Cap Esterias. 0°34'N 9°22'E, 15 August 1985 (fl), *Reitsma, J.M. 1328* (MA,WAG); Forêt de Mondah. 0°35'N 9°20'E, 16 September 1987 (fl, fr), *Wilks 1632* (MO,WAG); 18 km E de Libreville. 0°24'N 9°34'E, October 1961 (fl), *Saint Aubin 2076* (P); Nyonyie survey, around 1600 m on transect S. 0°02.9'S 9°23.0'E, 3 July 1990 (fr), *Wilks 2090* (LBV,MO,P,WAG); Nyonyie survey, 2710m on transect S. 0°03.5'S 9°23.0'E, 4 July 1990 (fl), *Wilks 2097* (MO,WAG); **Moyen-Ogooué:** Mabounié, à 45 km au sud-ouest de Lambaréné. 0°45.02'S 10°32.48'E. Alt: 24m, 12 October 2012 (fl), *Bidault 782* (BRLU,LBV,MO,P,WAG); Mabounié. 0°47.48'S 10°30.05'E, 2 November 2012 (st), *Boupouya-Mapikou 833* (BRLU,LBV,MO,P,WAG); **Ogooué-Maritime:** Rabi-Kounga, 4.5km on road to Divangui. 1°54'S 9°55'E. Alt: 30m, 6 December 1993 (fl), *Haegens 106* (E,LBV,MO,WAG); Rabi-Kounga. Direction Echira. 1°59'S 9°51'E, 11 November 1991 (fl), *Schoenmaker, J. 135* (WAG); 1 km on the road Rabi-Divangui. 1°54'S 9°53'E, 25 November 1989 (fr), *Wilde, J.J.F.E. de 9725* (BR,E,HUJ,K,MO,PE,WAG); Rabi-Kounga, Echira road. 2°00'S 9°50'E, 27 October 1991 (fl), *Breteler 10161* (BR,LBV,MO,WAG).

**Key literature:** Bissengou et al. (2013).

**CampylospERMUM oliveri** (Tiegh.) Farron

**Fig. 21**

Bull. Jard. Bot. État 35: 400 (1965). – *Notocampylum oliveri* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 311 (Dec. 1902). – *Ouratea oliveri* (Tiegh.) Keay, Kew Bull. 1953: 81 (1953). – Type: *Thomson 15* (holotype: K!; isotype: E!), Nigeria, Old Calabar, 1862.

*Gomphia mannii* Oliv. var. *brachypoda* Oliv., Fl. trop. Afr. 1: 322 (1868). – *Ouratea mannii* (Oliv.) Engl. ex Gilg var. *brachypoda* (Oliv.) Gilg, Bot. Jahrb. Syst. 38: 258 (1893). – Type: *Thomson 15* (holotype: K!; isotype: E!), Nigeria, Old Calabar, 1862.

*Diphyllopodium zenkeri* Tiegh., Bull. Mus. Hist. Nat. (Paris) 8: 376 (June 1902). – *CampylospERMUM zenkeri* (Tiegh.) Farron, Bull. Jard. Bot. État 35: 404 (1965). – Type: *Zenker 1001* (holotype: P!; isotype: E!, GOET!, HBG!, K!, L!, S!, WAG!), Cameroon, Bipindi, Urwaldgebiet, 1896. **syn. nov.**

*Ouratea zenkeri* Engl. & Gilg in Gilg, Bot. Jahrb. Syst. 33: 258 (1904). – Type: *Zenker 1001* (holotype: B†; isotype: E!, GOET!, HBG!, K!, L!, P!, S!, WAG!), Cameroon, Bipindi, Urwaldgebiet, 1896. **syn. nov.**

*Exomicrum oliveri* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 338 (Dec. 1902). – *Ouratea*

*ambacensis* Hutch. & Dalz., Fl. W. trop. Afr., ed. 1, 1: 192–193 (1927), nom. nov. – Type: *Mann 12* (holotype: K!), Nigeria, Ambas bay, February 1861.

*Campylospermum letouzeyi* Farron, Adansonia n.s. 9: 117 (1969). – Type: *Letouzey 1595* (holotype: P!; isotype: NEU!, SRFK!, YA!), Cameroon, forêt du Mélong près Bouda, March 1953. **syn. nov.**

*Treelet*, up to 8 m tall, with branched stem; twigs with whitish-brownish bark. *Stipules* persistent, triangular, 4–6 mm long. *Leaf*: petiole 0–11 mm long, stout; leaf blade narrowly elliptic-obovate, 16–31(–41) x 4–10(–13) cm, ratio **3–4.4**, base **rounded to cordate**, apex acute to slightly acuminate, papyraceous to coriaceous, not bullate, margin serrulate in the distal  $\frac{1}{4}$ , upper side slightly glossy dark green, lower side glossy medium green; venation: midrib **flattened, slightly prominent to sunken above**, prominent below, main lateral veins **30–50 on either side, 5–25 mm apart**, not prominent above, prominent below, making a slight angle with the midrib and curved upwards to run parallel to the margin, intermediate lateral veins 0–1 in between each pair of main laterals, distinct, tertiary venation **scalariform**, perpendicular to the main lateral veins, distinct on both sides. *Inflorescence* terminal or rarely axillary, **when axillary composed of a woody peduncle carrying 2 subopposite leafy bracts or reduced leaves at the apex from which a raceme emerges, unbranched or rarely with 1–2 racemes, dense**, its main axis (7–)11–27(–40) cm long, slender; generally naked in its lower third; racemes **0(–2), 14–15 cm long**; pairwise scales **persistent at the base of peduncle**, triangular, 3–4 mm long; cymules 1–10 mm apart, 2–10-flowered, **typically elongated when mature** (up to 10 mm long), sometimes supported by a bract of up to 6 mm. *Flower*: pedicel 6–12 mm long, **supported by c. 3 imbricate tiny bracts**, articulated at 1–2 mm from the base; sepals elliptic to oblong, in flower 4–6 x 2–3 mm, in fruit 7 x 2 mm, apex obtuse; petals broadly obovate, 6–10 x 5–8 mm, base **truncate**, apex **emarginate**; stamens: anthers 2–4 mm long; ovary c. 1 x 1 mm; style c. 3 mm long. *Fruit*: receptacle c. 1 mm thick in flower, 3 x 3 mm in fruit; drupelets 1 to 3 well developed per receptacle, ellipsoid to broadly ellipsoid, 7–8 x 5–6 mm; **cotyledons incumbent, similar in size.**

**Notes:** *C. zenkeri* and *C. letouzeyi* are here regarded as synonyms of *C. oliveri*. *C. oliveri* was previously only known from the type specimen collection which was collected during a stage where the inflorescence was old enough to evolve into a new twig thus carrying some leaves. This feature was the only morphological character that distinguished *C. oliveri* from *C. zenkeri* and *C. letouzeyi*. The phenomenon was also studied in the field (in *C. elongatum* and former *C. zenkeri* and *C. letouzeyi*), where it could be observed that in over-mature plants the old and formerly pendulous inflorescence axis curves up to form a leafy twig. The terminal growth of the primary branch being continued by an axillary bud. This phenomenon is apparently rare, but does not indicate any taxonomic distinction but rather a developmental stage.

*C. oliveri* resembles *C. elongatum* because of the large leaves with a rounded to cordate

base and unbranched inflorescence. However, *C. oliveri* is a branched shrub or treelet (not monocaulous) with not all leaves crowded apically, has a cylindrical peduncle (flattened in *C. elongatum*), pedicels articulating at 1–2 mm from the base and characteristic shortly elongated cymules with numerous bracts supporting the flowers.

**Distribution:** south-eastern Nigeria and Cameroon (South and South-west provinces) (**Map 24**).

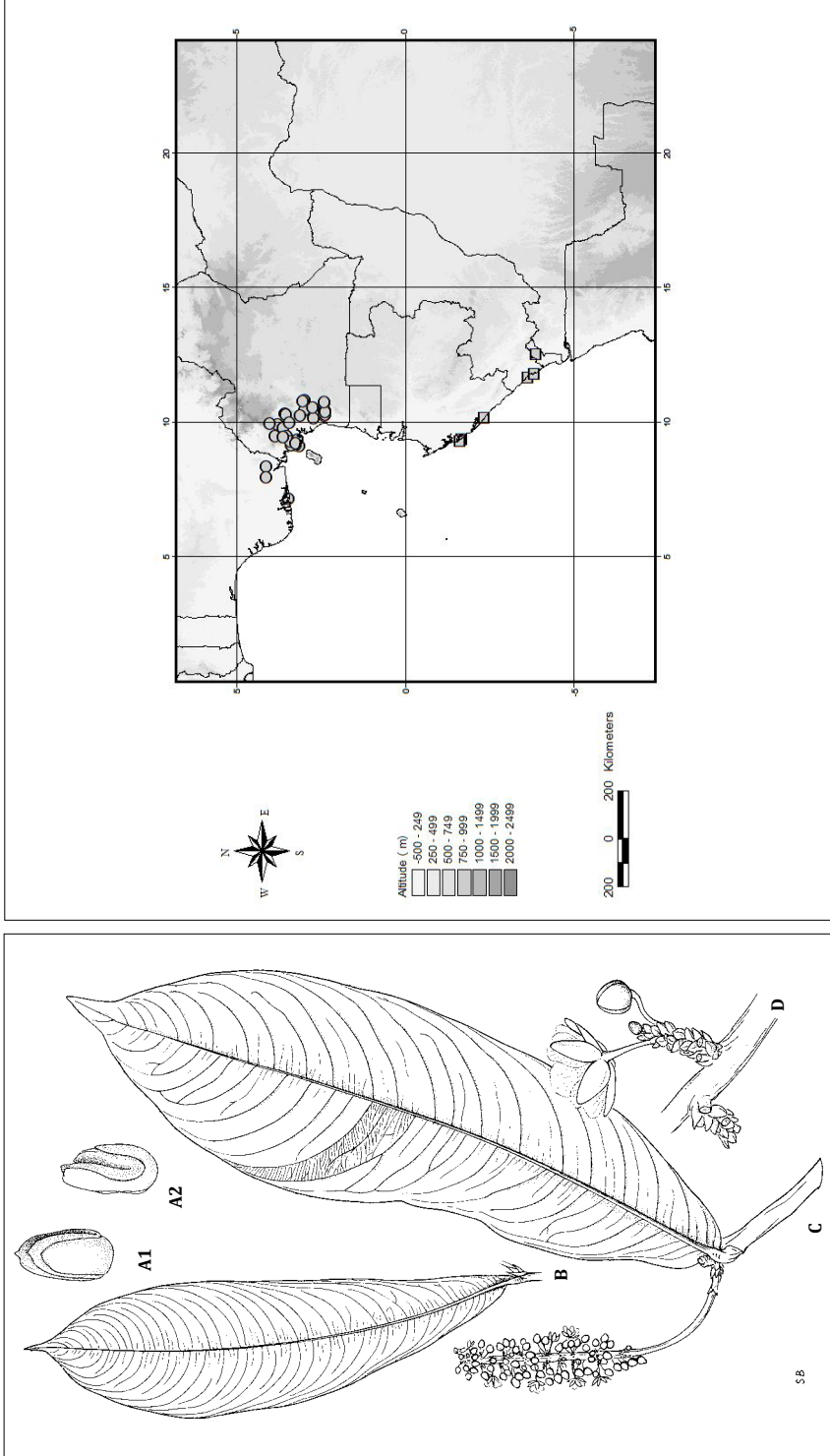
**Ecology:** in primary and secondary forest, on forested slopes, in riverine rain forest; on marshy, sandy and clayish soils; at 20–1000 m altitude.

**Phenology:** flowering from January to June and from October to December; fruits observed in March, April and June.

**IUCN conservation status:** NT B1/B2(iii,iv). EOO=58,611 km<sup>2</sup>, AOO=37,722 km<sup>2</sup>, locations=39 (cell width=42 km). This species is fairly often collected, especially in comparison to its rather small area of distribution and so appears not to be rare. However, it occurs mainly outside of any protected area. Therefore, it is reasonable to apply the category of Near Threatened.

### **Specimens examined:**

**CAMEROON, Central Province:** c. 40 km SSW. of Eséka, S. of Badjob. 3°32'N 10°34'E. Alt: 200m, 9 November 1964 (st), *Wilde, W.J.J.O. de 3805* (WAG); Right bank Kélé R., left bank tributary, 30 km N. of Eséka, E. of road to Mbanga. 3°50'N 10°49'E, 5 January 1966 (st), *Leeuwenberg 7463* (WAG); Mambe près de Boga, 30 km N. Eseka. (feuille IGN 1/200 000 Edea). 3°54'N 10°47'E, 8 December 1973 (fl), *Letouzey 12280* (P); **Littoral:** 50 km NW. of Eséka, W. of Yaoundé. On opposite of the Kelè river. 3°50'N 10°27'E. Alt: 100m, 21 November 1963 (st), *Wilde, W.J.J.O. de 1259* (BR,P,WAG,YA); près de Melong, près Nkonsou. 5°07'N 9°57'E, 15 March 1953 (fr), *Letouzey 1586* (P); 17 km E. of Kopongo, along road to Masok, right bank Bolobo R. 4°00'N 10°15'E. Alt: 250m, 15 October 1965 (st), *Leeuwenberg 7000* (P,WAG); route de Douala à Yabassi, 30 km au N. de la bifurcation pour Edéa. 4°24'N 10°00'E, 12 May 1970 (st), *Farron 7276* (P); Bakaka, 8 km E. of Ekomtolo (a village 8 km E. of km 11 Nkongsamba-Loum road). 4.50 N 9.56 E. 4°50'N 9°56'E. Alt: 450m, 28 December 1971 (st), *Leeuwenberg 9008* (BR,K,WAG); Km 20 Loum-Yabassi, 2 km N. of Solé. 4.37 N 9.48 E. 4°37'N 9°48'E. Alt: 150m, 3 January 1972 (st), *Leeuwenberg 9053* (WAG); Km 1 Solé-Loum. 4.37 N 9.48 E. 4°37'N 9°48'E. Alt: 150m, 4 January 1972 (st), *Leeuwenberg 9066* (WAG); près Yingui II, à 5 km à l'ENE de Yingui. (35 km E. de Yabassi); (Feuille IGN. 1/200 000 Ndikimimeki). 4°32.0'N 10°18.0'E, 8 January 1972 (fl), *Letouzey 10927* (K,P); près Bandem, à 5 km au NE de Yangui (35 km Est de Yabassi). (feuille IGN 1/200 000 Ndikimimeki). 4°34'N 10°20'E, 10 January 1972 (fl), *Letouzey 10954* (K,P); **South Province:** Ebom C2. 3°06.0'N 10°44.6'E. Alt: 690m, March 1997 (st), *Gemerden 93* (WAG); Ebimimbang, Otombokum. 3°02.3'N 10°28.0'E. Alt: 55m, 13 July 1999 (fl), *Smits, A.P. 182* (KRIBI,WAG); Mimfia, 3°04'N 10°23'E, June 1913 (fl), *Zenker 348* (B,C,G,L,D,LX,U,US,WAG); About 1 km along transect, some km E of village Ebimimbang. 3°03'N 10°26'E. Alt: 100m, 20 November 1998 (st), *Burgt, X.M. van der 526* (KRIBI,MO,WAG,YA); In the Tropenbos research area. Block 12. 3°06'N 10°44'E. Alt: 550m, 10 April 1997 (fl), *Elad 605* (KRIBI,WAG); 3°05'N 10°25'E, 1896 (fl), *Zenker 1001* (E,G,K,L,P,WAG); route Kribi-Bidou I, environ 6 km après village Ndtoua. 3°03.39'N 10°16.69'E. Alt: 94m, 30 March 2010 (fl), *Bissengou 1237* (LBV,WAG,YA); route Kribi-Bidou I, environ 6 km après village Ndtoua. 3°03.39'N 10°16.69'E. Alt: 94m, 30 March 2010 (st), *Bissengou 1238* (LBV,WAG,YA); route Kribi-Bidou I, environ 6 km après village Ndtoua. 3°03.39'N 10°16.69'E. Alt: 94m, 30 March 2010 (fl), *Bissengou 1239* (LBV,WAG,YA); route Kribi-Bipindi, PK7.3 avant Bipindi. 3°04.38'N 10°22.94'E. Alt: 79m, 30 March 2010 (st), *Bissengou 1247* (LBV,WAG,YA); route Bipindi-Bidjouka, village Log Ndiga environ 2 km de Bipindi. 3°05.30'N 10°25.12'E. Alt: 227m, 31 March 2010 (fl), *Bissengou 1252* (LBV,WAG,YA); route Bipindi-Bidjouka, village Log Ndiga environ 2 km de Bipindi. 3°05.34'N 10°25.10'E. Alt: 230m, 31 March 2010 (fr), *Bissengou 1253* (LBV,WAG,YA); route Bipindi-Bidjouka, village Log Ndiga environ 2 km de Bipindi. 3°05.34'N 10°25.10'E. Alt: 230m, 31 March 2010 (fr), *Bissengou 1254* (LBV,WAG,YA); Est. 5 km SSE of Bipindi. 3°04'N 10°25'E. Alt: 120m, 14 January 1987 (fl, fr), *Manning, S.D. 1321* (K,MO,WAG); Bipindi, Mimfia mountain. 3°03'N 10°23'E. Alt: 300m, 22 February



**Figure 21.** *Campylosperrum oliveri*. **A1 & A2.** Incubent cotyledons. **B.** Leaf blade. **C.** flowering branch. **D.** Persistent bracts. Drawings by Sabine Bousani  
**Map 24.** Distribution of *Campylosperrum oliveri* (○) and *Campylosperrum paucinervatum* (□)

1994 (fl), *Wieringa, J.J. 2305* (WAG); Bipinde, Urwaldgebiet. 3°05'N 10°25'E, 1904 (fl), *Zenker 2733* (G); Left bank Nyong River, 30 km S. of Edea, near bridge in road to Kribi. 3°30'N 10°10'E. Alt: 50m, 26 April 1965 (st), *Leeuwenberg 5569* (WAG); 59 km from Kribi, Lolodorf road, 8 km W. of Bipindi, near Madoungo. 3°04'N 10°20'E, 16 February 1970 (st), *Bos, J.J. 6358* (WAG); 6 km N. of km 46 Kribi-Lolodorf. 3°05'N 10°15'E, 12 March 1970 (st), *Bos, J.J. 6520* (WAG); 65 km NE de Kribi. 3°04'N 10°24'E, 27 April 1970 (st), *Farron 7173* (P); **South-West Province:** Ambas Bay. 4°10'N 9°10'E, February 1861 (fl), *Mann, G. 12* (K,P); environ Bouéa. 4°09'N 9°14'E. Alt: 1000m, February 1918 (fl), *Annet 25* (P); Tiko. 4°05'N 9°22'E. Alt: 18m, 5 January 1926 (fl), *Dunlap 171* (K); Limbe, Northern border, just inside Mabeta-Moliwe reserve. 4°08'N 9°16'E. Alt: 180m, 24 January 1994 (fl), *Wieringa, J.J. 1994* (MO,SCA,WAG); Kurume, W of mungo River. 4°55'N 9°29'E. Alt: 250m, January 1986 (fl), *Thomas, D.W. 5460* (BR,MO,WAG); Kumba, South Bakundu. 4°38'N 9°27'E, 15 May 1970 (st), *Farron 7304* (P); Kumba, South Bakundu. 4°38'N 9°27'E, 15 May 1970 (st), *Farron 7309* (P); Likomba-Pflanzung. 15-35 km N. E. von Victoria. 4°01'N 9°08'E, 19 October 1928 (fl), *Mildbraed 10520* (A,K); along the inspection path following River Kindong N.A.F.R., 4°30'N 9°30'E, 16 January 1956 (fl), *Binuyo FHI 35060* (B,FHO,K); Bambuko F.R., northern part near Kuke Bova; Line 2. 4°20'N 9°10'E, 27 January 1958 (fl), *Keay FHI 37401* (FHI,K); Victoria Distr., NE. of Bafia. 4°21'N 9°18'E, 6 February 1958 (fl), *Keay FHI 37537* (FHI,K). **NIGERIA, Cross River State:** Old Calabar. 4°57'N 8°19'E, 1862 (fl, fr), *Thomson, W.C. 15* (E,K); near Awi village 18 miles N of Calabar. 5°15'N 8°22'E, 14 June 1971 (fl, fr), *Meer, P.P.C. van 1616* (WAG); lower Enyong. Atan area. 5°16'N 7°57'E, 19 May 1953 (fl), *Onochie FHI 33208* (K).

**Key literature:** Farron (1963, 1969, 1985), Hawthorne & Jongkind (2006), Hutchinson, Dalziel & Keay (1954).

### ***CampylospERMUM paucinervatum* Sosef**

*Blumea* 52: 15 (2007). – Type: *Harris 8338* (holotype: WAG!; isotype: E!, K!, LBV!, MO!), Gabon, Ogooué-Maritime Province, Loango National Park, Nick's camp, by Louri lagoon, c. 12 km south of Iguela, May 3<sup>rd</sup>, 2005.

*Shrub* or *treelet* up to 2 m tall, with branched stem; twigs with whitish bark. *Stipules* caducous, narrowly triangular, **3–5 mm long**. *Leaf:* petiole 0–2 mm long; leaf blade **narrowly elliptic or sometimes very narrowly elliptic, 3–9.5(–13) x 0.7–2(–3) cm**, ratio **2.5–8**, base **attenuate**, apex acute to slightly acuminate, **the very top apiculate, coriaceous**, not bullate, upper side glossy, dark green, lower side slightly paler, green, margin entire in the lower half to lower third, distal part distantly serrulate; venation: midrib slightly prominent on both sides, main lateral veins **0–2(–5) on either side, 10–35 mm apart**, prominent on both sides, **branching off in the lower part of the leaf and strongly curved upwards to form a prominent marginal vein which runs just inside the margin of the blade**, intermediate lateral veins absent, tertiary venation scalariform, perpendicular to the midrib, forming a series of numerous veins connecting to the midrib, **distinct on both sides**. *Inflorescence* terminal, branched, lax, its main axis **2–5(–10) cm long**; racemes 1–3, **up to 3 cm long, ending with persistent bracts at the tip**; pairwise scales at the base of the peduncle absent or few; **bracts persistent at the base of each cymule**, triangular, **up to 1.5 mm long**; cymules **3–5 mm apart, 1–2-flowered**. *Flowers:* pedicel 7–12 mm long, articulated at 1–3 mm from the base; sepals elliptic-ovate, c. 5 x 2 mm in flower, 7 x 3 mm in fruit, rounded at apex, cunuate at base; petals **broadly spatulate, 6–8 x 3.5–5 mm**, base attenuate, apex rounded; stamens: anthers c. 4 mm long; ovary 1–2 mm long; style c. 4 mm long. *Fruit:* receptacle

± globose, c. 1 mm wide in flower, enlarged to 3–5 mm wide in fruit; drupelets 1–2 well-developed per receptacle, ± **reniform**, 5–6 mm in diameter; **cotyledons** incumbent, **dissimilar in size with a small external cotyledon**.

**Notes:** After publication of this species in 2007, additional specimens from the Republic of the Congo and north-western Angola (Cabinda) have been located. In addition to what Sosef et al. (2007) wrote about affinities with other *Campylospermum* species (notably *C. glomeratum*), it is also similar to *C. plicatum*, which has similar racemes carrying persistent bracts at the top.

**Distribution:** Gabon, Republic of the Congo and north-western Angola (Cabinda) (**Map 24**).

**Ecology:** in forest, forest-savanna edges, coastal thicket; on white sand; at 10–40 m altitude.

**Phenology:** flowers observed in May and November; fruits observed in May, June and August.

**IUCN conservation status:** VU B1/B2(ii,iii). EOO=12,084 km<sup>2</sup>, AOO=9,064 km<sup>2</sup>, locations=7 (cell width=48 km). This is a recently described and rare species with a restricted distribution and habitat. Its oldest record is from 1959 (Angola); its most recent one from 2012. It is known from only 7 herbarium specimens, 3 of which originate from within Loango National Park in Gabon. It is a coastal species and thus subject to habitat loss due to human activities. Therefore, the category of Vulnerable has been assigned.

**Specimens examined:**

**ANGOLA, Cabinda:** Maiombe, buco Zau. 4°45'S 12°34'E, 19 June 1959 (fr), *Missão de Estudos Florestais a Angola 479* (LISC);

**CONGO (BRAZZAVILLE), Kouilou:** along coast just northwest of Pointe Noire, near Pointe Indienne. 4°41.23'S 11°48.87'E. Alt: 20m, 15 February 2012 (st), *M'Boungou 660* (B,BR,IEC,K,MO,P,WAG); Bas-Kouillou, après le pont sur le Kouillou. 4°28'S 11°42'E, 2 July 1986 (fr), *Foresta 1022* (P); Pointe Noire, along coast just northwest of Pointe Noire, near Pointe Indienne. 4°41.62'S 11°48.93'E. Alt: 20m, 24 November 2011 (fl), *Kami, T. 1244* (BR,G,IEC,K,MO,P,US,WAG);

**GABON, Nyanga:** 16 km ESE of Gamba airport. 2°49'S 10°12'E. Alt: 40m, 9 August 1992 (fr), *Wieringa, J.J. 1372* (C,FHO,LBV,MO,WAG); **Ogooué-Maritime:** Loango National Park, Nick's camp, by Louré lagoon 12 km south of Iguela. 2°00'S 9°23'E. Alt: 10m, 3 May 2005 (fl, fr), *Harris, D.J. 8338* (E,IG,LBV,WAG); Loango National Park 1.5 km southeast of Iguela lodge. 1°55.83'S 9°19.77'E. Alt: 10m, 21 May 2005 (fr), *Harris, D.J. 8781* (E,IG,LBV,WAG).

**Key literature:** Sosef et al. (2007).

**Campylospermum plicatum** (Tiegh.) Biss.

**Fig. 22**

Blumea 58: 7 (2013). – *Monelasmum plicatum* Tiegh., J. Bot (Morot) 16: 202 (June 1902).

– Type: *Griffon du Bellay 296* (holotype: P!), Gabon, Pyrat, October 1863.

*Monelasmum strictum* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 330 (Dec. 1902). –

*Campylospermum strictum* (Tiegh.) Farron, Bull. Jard. Bot. État Bruxelles 35: 402 (1965).

– Type: *Guiral s.n.* (holotype: P!), Equatorial Guinea, exploration du Benito, 1885. **syn. nov.**

*Monelasmum engleri* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 335 (Dec. 1902). – Type: *Welwitsch s.n.* (holotype: COI!), Angola. **syn. nov.**

*Exomicrum kouiloui* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 339 (Dec. 1902). – Type: *Lecomte B.110* (holotype: P!), Democratic Republic of the Congo, bords du Kouilou, January 3<sup>rd</sup>, 1894. **syn. nov.**

*Exomicrum pseudospicatum* (Gilg) Tiegh., Ann. Sci. Nat., sér. 8, Bot. 18: 38 (June 1903). – *Ouratea pseudospicata* Gilg, Bot. Jahrb. Syst. 33: 263 (1904). – Type: *Vanderyst s.n.* (holotype: BR!), Democratic Republic of the Congo, Moanda, 1891. **syn. nov.**

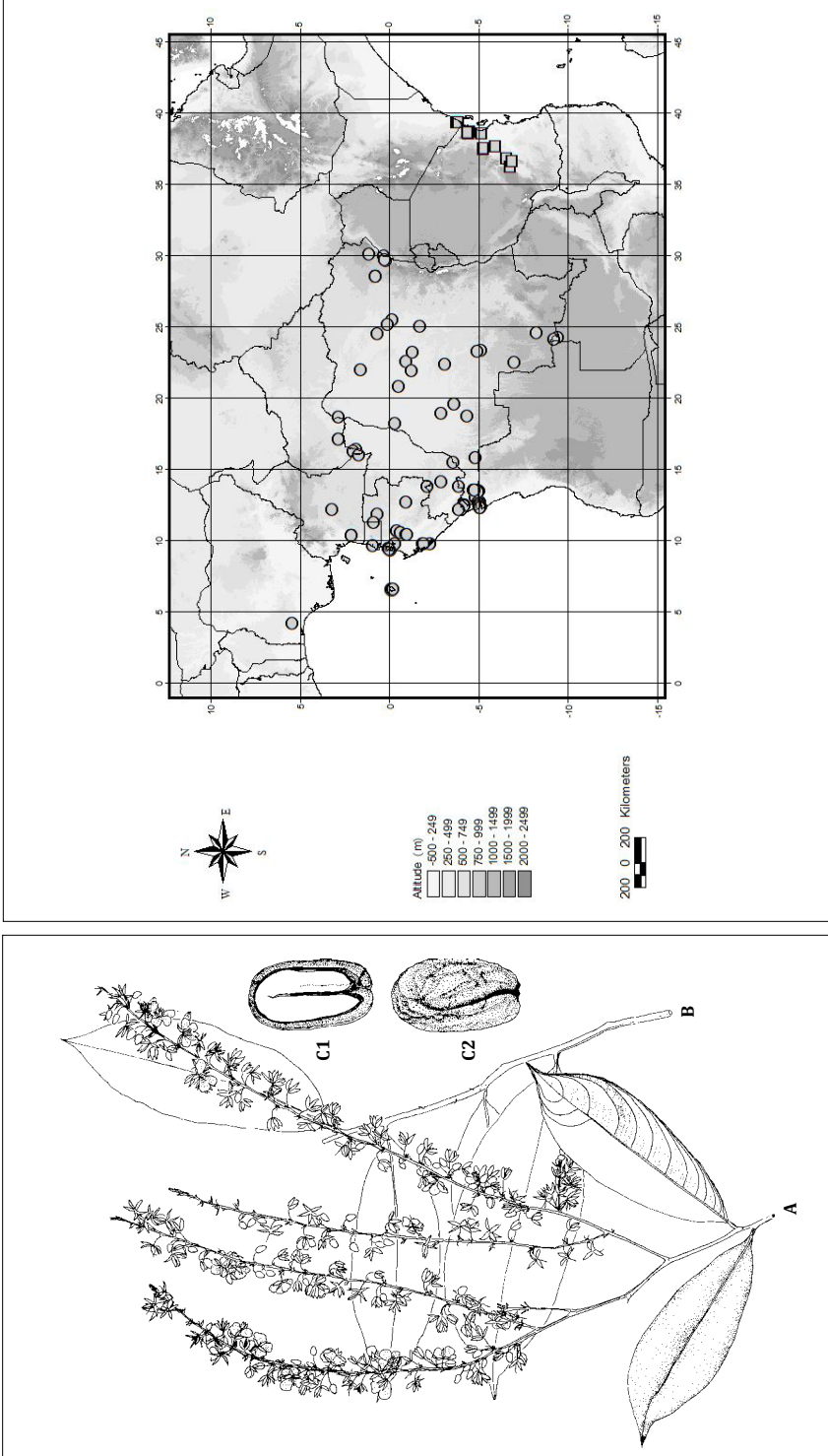
*Ouratea gymnoura* Gilg & Mildbr., Wiss. Erg. deut. Zentr.-Afr. Exped., Bot. 6: 559 (1913). – Type: *Zenker 4682* (holotype: P!; isotype: BR!, MO!, P!, S!), Cameroon, Bipinde, 1913.

*Ouratea goossensii* De Wild., Pl. Bequaert. 4: 476 (1929). – Type: *Goossens 1657* (holotype: BR!; isotype: BR!), Democratic Republic of the Congo, Yambuya, May 1921.

**Tree up to 5 m** tall, with branched stem; twigs with pale brown bark. *Stipules* caducous, triangular, 3–4(–6) mm long. *Leaf*: petiole 3–6(–10) mm long; leaf blade narrowly elliptic to elliptic or narrowly elliptic-obovate **(7–)9–18(–22) x (2–)3–6(–7) cm**, ratio **2.5–4**, base cuneate or sometimes obtuse, **apex slightly to distinctly acuminate and then with a 8–15 mm long acumen, papyraceous to parchmentaceous**, not bullate, dark green above, paler green below, glossy on both sides, margin almost smooth to very shallowly serrulate, the teeth with a black tip; venation: midrib slightly prominent on both sides, main lateral veins **(5–)7–11** on either side, **7–26 mm apart**, prominent on both sides, more or less at a right angle with the midrib but **strongly curved upward** to run parallel to the margin for a long stretch, intermediate lateral veins **0–3 between each pair of main laterals**, prominent on both sides, tertiary venation **scalariform, joined with cross veinlet**, reticulate towards the midrib, distinct above, very distinct below. *Inflorescence* terminal, branched, lax, its main axis **(7–)19–30(–41) cm long**; pairwise scales at the base of peduncle caducous, triangular; racemes (1–)4–10, **erectopotent**, (3–)6–17(–22) cm long, **terminating in few persistent bracts**; cymules 0.5–1 cm apart, 1–7-flowered, **each cymule with a persistent, sometimes leafy, triangular, 2–6(–8) mm long bract at its base**. *Flower*: pedicel (6–)8–13(–15) mm long, articulated at 2–5 mm from the base; sepals narrowly ovate to ovate, in flower 5–7 x 2–3 mm, in fruit 7–10 x 3–5 mm, base truncate, apex rounded; petals obovate, 7–9 x 4–6 mm, **cuneate** at base, **rounded** at apex; stamens: anthers 4–5 mm long; ovary c. 1–2 mm long; style 5–6 mm long. *Fruit*: receptacle enlarged in fruit up to 4–5 mm; drupelets 2 to 3 well developed per receptacle, **ellipsoid-oblong**, 8–14 x 5–6 mm; cotyledons incumbent, dissimilar in size, with a small outer cotyledon.

**Notes:** *C. plicatum* is readily distinguished by its leaves with a long acumen. It shares the presence of persistent bracts at the tip of each raceme with *C. paucinervatum*. *Ouratea pseudospicata* was considered to be a synonym of *C. reticulatum* by Farron (1965), who gave no reason for his choice. After having studied the type specimen, we conclude that





**Figure 22.** *Campylosperrum plicatum*. **A.** Flowering branch. **B.** Sterile branch. **C1** Seed, longitudinal section. **C2.** Seed, longitudinal section. Drawings by Sabine Bousani

**Map 25.** Distribution of *Campylosperrum plicatum* (○) and *Campylosperrum sacleuxii* (□)

this name indicates the same taxon as *C. plicatum*.

**Distribution:** Cameroon, southern Central African Republic, Sao Tomé and Príncipe, Equatorial Guinea, Gabon, Republic of the Congo, Angola (Cabinda), Democratic Republic of the Congo, and north-western Zambia (**Map 25**).

**Ecology:** primary and secondary rain forest, gallery forest, swamp forest, along mangroves; on sandy and brown clay soils; at up to 940 m altitude.

**Phenology:** flowering and fruiting all year around.

**Vernacular names:** **Democratic Republic of the Congo:** Amamambamamba (Bila), Iliangeta (Kirega), Kosaka (Lingala), Nkolos (Lombole) and Waka (Yambata); **Angola:** Libambo, Tchitunga.

**IUCN conservation status:** LC. EOO=3,201,990 km<sup>2</sup>, AOO=2,859,950 km<sup>2</sup>, locations=84 (cell width=304 km). This species is widespread in Central Africa and well represented in herbaria indicating it is not uncommon. It is found in National Parks such as Loango and Pongara in Gabon, Monte Alèn in Equatorial Guinea, Dzanga-Sangha in the Central African Republic and the Okapi Forest Reserve in the Democratic Republic of the Congo. Therefore, the category of Least Concern is most appropriate.

#### **Specimens examined:**

**ANGOLA, UNKNOWN:** (fl), *Welwitsch, F.M.J. s.n.* (COI); **Cabinda:** Cabinda-Buco Zau, talhão permanente da Chiaca. 4°49'S 12°33'E, 9 March 1959 (fl, fr), *Murta 3* (COI); Cabinda-Buco Zau, Chiaca, picada de Mizundungo. 4°50'S 12°30'E, 11 September 1958 (fr), *Monteiro, R.F.R. 304* (COI); Maiombe. 4°45'S 12°34'E, 22 July 1960 (fr), *Missão de Estudos Florestais a Angola 754* (LISC); Maiombe. 4°45'S 12°34'E, 28 November 1963 (fl, fr), *Teixeira, J.M.L.B. 7640* (COI, LUA); Cabinda, Chiaca. 4°50'S 12°34'E, 24 November 1964 (fl, fr), *Teixeira, J.M.L.B. 7650* (LISC, LUA).

**CAMEROON, Central Province:** Membine, feuille ING 1/200 000 Nanga Eboko. 4°25'N 12°13'E, 9 May 1959 (fr), *Letouzey 1892* (P); **South Province:** Mimfia. 3°04'N 10°23'E, September 1912 (fl), *Zenker s.n.* (G); Bipindi. 3°05'N 10°25'E, (fl), *Zenker 85* (B,C,HUH,LD,WAG); Bipinde. 3°05'N 10°25'E, 1896 (st), *Zenker 1077* (G); Bipinde. 3°05'N 10°25'E, 1904 (fr), *Zenker 2999* (BM,COI,G,K,LY,MA,S,W,WAG,Z); Bipindi. 3°05'N 10°25'E, 1912 (fl), *Zenker 4389* (B,BM,COI,E,G,K,LY,MA,S,W,Z); Urwaldgebiet. 3°05'N 10°25'E, 1912 (fr), *Zenker 4438* (BM,E,G,K,W); Urwaldgebiet. 3°05'N 10°25'E, 1913 (fl), *Zenker 4682* (BM,E,G,K,P,W).

**CENTRAL AFRICAN REPUBLIC, Lobaye:** Ngotto, layon L6(5-6 km). 3°58'N 17°10'E, 29 November 1999 (fr), *Yongo 279* (BRLU); Ngotto, layon L6(3.5-4.5 km). 3°59'N 17°09'E, 14 December 1999 (fl), *Yongo 299* (BRLU); **Sangha-Mbaéré:** Kongana camp, GHI transect 1 km west of camp. 2°47'N 16°25'E, 15 December 1993 (st), *Harris, D.J. 3990* (E,WAG); 14 km S of Lidjombô. 2°34'N 16°05'E, 26 March 1994 (fl), *Harris, D.J. 4813* (E); Madibwé, close to St. Francois road 12 km NE of Bayanga. 2°58'N 16°18'E, 6 May 2001 (fr), *Harris, D.J. 7576* (BR,E,WAG).

**CONGO (BRAZZAVILLE), Kouilou:** 4°29'S 12°15'E, March 1894 (fl), *Lecomte, P.H. 110* (P); **Lékoumou:** Région de Kindamba, environs de Kikouimba sur piste de Mâ-Kinzona à 1 km de Mâ. 3°14'S 14°10'E, 4 December 1971 (fr), *Sita 3170* (WAG); **Pool:** Plateau de Cataractes; région de Boko. 4°27'S 13°52'E, 4 August 1963 (fl, fr), *Néré de 387* (P); Plateau bateké, piste km 46-Maloukou-Tréchet, Mandielé. 4°03'S 15°31'E, 22 October 1968 (fr), *Sita 2735* (WAG).

**CONGO (KINSHASA), UNKNOWN:** Environ de Congo. 1921 (fl), *Claessens 129* (BR); **Bandundu:** Kikwit. 5°02'S 18°48'E, 12 April 1992 (fr), *Masens, B. 561* (BRLU); Buna. 3°14'S 18°59'E, February 1944 (fr), *Flamigni 6370* (BR); Ipamu. 4°07'S 19°37'E, 1921 (fr), *Vanderyst 10817* (BR); Ipamu. 4°07'S 19°37'E, October 1922 (fl), *Vanderyst 12306* (BR); entre Popokabaka et la Mfidi. 5°36'S 15°50'E, September 1925 (fl), *Vanderyst 15135* (BR); entre Popokabaka et la Mfidi. 5°36'S 15°50'E, September 1925 (fl), *Vanderyst 15170* (BR); **Bas-Congo:** Moanda. 5°56'S 12°21'E, April 1913 (fl, fr), *Vanderyst s.n.* (BR); Moanda. 5°56'S 12°21'E, 1891 (fr), *Vanderyst s.n.* (BR); environ de Moanda. 5°56'S 12°21'E, June 1903 (fl, fr), *Gillet, J. s.n.* (BR); Moanda, Boma. 5°56'S 12°21'E, February 1933 (fl), *Bittremieux 42* (BR,K); Leopoldville. 5°49'S 13°28'E, April 1932 (fl), *Dacremont*

161 (BR,K,WAG); près Inga, Tsheke-Banza. 5°31'S 13°34'E, 26 November 1966 (fl), *Breyne, H. 240* (BR,WAG); 5 km au Sud d'Inga. 5°32'S 13°34'E, 11 September 1959 (fl, fr), *Compère 313* (BR); Leopoldville. 5°49'S 13°28'E, 10 November 1932 (fl), *Dacremont 339* (BR,EA,WAG); Banane. 6°00'S 12°24'E, April 1913 (fr), *Verschueren, R.C.M. 448* (BR,BRLU,BRU); 5°46'S 13°37'E, 8 November 1979 (fl), *Nsimundele 645* (BR); Nyololo, route des caravanes. 5°51'S 13°33'E, 16 September 1980 (fr), *Nsimundele 690* (BR); Kanzi. 5°49'S 12°46'E, 8 November 1980 (fr), *Nsimundele 795* (BR); Route Pala Bala. 5°50'S 13°33'E, 18 July 1982 (fl, fr), *Nsimundele 1078* (BR); village de Kai Ku Buku sur la grande route de Boma-Moanda. 5°51'S 12°37'E, 2 December 1956 (fl), *Wagemans 1208* (BR); Le long de la nouvelle route Boma et Banane. 5°55'S 12°44'E, 2 February 1957 (fr), *Wagemans 1367* (BR,WAG); Route Boma-Banane. 5°55'S 12°44'E, 10 March 1957 (st), *Wagemans 1449* (BR,WAG); Vallée de la M'Boma plantation Sté A.D.C. 5°58'S 12°37'E, 30 August 1957 (fl), *Wagemans 1686* (BR,K,WAG); Tshikai, route de Boma-Banane. 5°52'S 12°27'E, 13 April 1960 (fr), *Compère 1859* (BR); Sydelco, route qui va vers le fleuve depuis le poste d'Inga vers le point 25. 5°31'S 13°34'E, 14 September 1958 (fr), *Wagemans 2022* (BR); Luki. 5°38'S 13°04'E, 27 November 1948 (fl), *Donis 2120* (BR,K,WAG); environ de Moanda. 5°56'S 12°21'E, January 1907 (fl), *Gillet, J. 3986* (BR); Matadi. 5°49'S 13°28'E, 2 March 1948 (st), *Duvigneaud, P.A. 4120* (BRLU); Moanda. 5°56'S 12°21'E, 16 November 1930 (fl), *Vanderyst 27835* (BR); Moanda. 5°56'S 12°21'E, 17 November 1930 (fl), *Vanderyst 27870* (BR); **Equateur:** Boende. 0°13'S 20°52'E, 10 August 1941 (fr), *Hulstaert 404* (BR); Ikela. 1°11'S 23°16'E, April 1939 (fl), *Dubois, L. 1031* (BR); Botsima, station de recherche. 1°09'S 21°57'E, 28 March 1991 (fr), *Dhetchuvi Matchu-Mandje 1059* (BR); Wangata (Coquilhatville). 0°03'N 18°15'E, August 1930 (fl), *Lebrun 1119* (US,WAG); entre Libenge et Zongo. 4°00'N 18°43'E, (st), *Hauman 1664* (BRLU); Yambata. 2°26'N 22°02'E, January 1914 (fl), *Giorgi 1676* (BR); Yalikungu-Yongo. 0°44'S 22°38'E, 18 November 1958 (fl), *Evrard, C.M. 5159* (BR,K); **Kasai-Occidental:** lac Foa. 5°44'S 23°20'E, 24 September 1904 (fl), *Lescauwert 216* (BR); Dibaya, rivière Mullenda. 6°00'S 23°25'E, 24 October 1956 (fl, fr), *Liben 1797* (BR,G,WAG); **Kasai-Oriental:** Kole. 3°29'S 22°27'E, October 1963 (fl), *Claessens 263* (BR); **Katanga (Shaba):** Sokele. 9°55'S 24°36'E, April 1950 (fr), *Desenfans 92* (BR,BRLU); Kapanga. 8°21'S 22°34'E, October 1933 (fl, fr), *Overlaet 862* (BR); **Nord-Kivu:** Semuliki-Virunga. 0°45'N 29°45'E. Alt: 802m, 25 January 2008 (fl), *Kirunda 748* (WAG); Lesse. 0°45'N 29°46'E, 24 March 1914 (fl), *Bequaert 3173* (BR); Parc National Albert, rive gauche Semliki. 0°50'N 30°00'E. Alt: 700m, 8 July 1954 (fl, fr), *Witte, G.F. de 10849* (BR); Parc National Albert, Abyalosa (riv) affluent Djuma, affluent Semliki. 0°42'N 29°42'E. Alt: 750m, 18 March 1955 (fl, fr), *Witte, G.F. de 11902* (BR); **Oriental:** Stanleyville. 0°31'N 25°11'E, 15 January 1904 (fr), *Laurent, É. s.n.* (BR); station d'Epulu. 1°25'N 28°35'E. Alt: 750m, 25 March 1981 (fl), *Hart, T.B. 18* (BR); Station d'Epulu. 1°25'N 28°35'E. Alt: 750m, 4 April 1981 (fr), *Hart, T.B. 26* (BR,K); station d'Epulu. 1°25'N 28°35'E. Alt: 750m, 6 April 1981 (fl), *Hart, T.B. 29* (BR); Lenda. 1°24'N 28°34'E. Alt: 750m, 25 January 2001 (fl), *Mokbondo 379* (MO,WAG); Lenda. 1°24'N 28°34'E. Alt: 750m, 26 January 2001 (fl), *Mokbondo 381* (MO,WAG); Epulu. 1°25'N 28°35'E. Alt: 750m, 10 March 1983 (fl), *Hart, T.B. 436* (BR); Beondo Lomami riv. 1°42'S 25°03'E, 18 April 1999 (st), *Bamps 549* (BR,K); Ituri forest. Epulu. Mont Mbia. 1°25'N 28°35'E. Alt: 750m, 21 February 2001 (fl), *Bujo Dhego 591* (BR,EPU,K,MO,WAG); Wanié-Rukula, île sur le fleuve Zaïre. 0°13'N 25°33'E, 12 December 1976 (st), *Lejoly 798* (BRLU); Haut Uele (région de Kilo). 1°50'N 30°09'E, June 1921 (fr), *Claessens 944* (BR); Epulu. 1°25'N 28°35'E. Alt: 750m, 4 March 1991 (fl), *Hart, T.B. 1086* (K); zone de Mambasa, Ituri Forest. 1°25'N 28°35'E, 15 February 1991 (st), *Hart, T.B. 1210* (BR); Yambuya. 1°16'N 24°33'E, May 1921 (fr), *Goossens 1657* (BR).

**EQUATORIAL GUINEA, Rio Muni, Litoral:** exploration du Benito. 1°34'N 9°42'E, 29 July 1885 (fr), *Guiral s.n.* (P); **Rio Muni, Wele Nzaz:** région continentale, inserberg Assoc. 1°31'N 11°18'E, 17 January 1998 (fl), *Obama 495* (BRLU).

**GABON, UNKNOWN:** 1864 (fl), *Duparquet 59* (P); **UNKNOWN:** l'Ogooué, (st) *Klaine 398* (P); **Estuaire:** Billagone. 0°01'N 9°48'E. Alt: 30m, (st), *Thomson, A.P. 3* (K); Pyrat. 0°20'N 9°21'E, October 1863 (fl, fr), *Griffon du Bellay 296* (P); Mangrove edge 1 km N. of the landing stage of Ovang. 0°29'N 9°31'E. Alt: 5m, 15 February 1985 (fl, fr), *Reitsma, J.M. 833* (WAG); tanne à partir du débarcadère d'Ovang. 0°30'N 9°31'E, 15 February 1985 (fl, fr), *Louis, A.M. 1722* (LBV,MO,WAG); Ile de Coniquet. 0°15.97'N 9°33.48'E. Alt: 50m, 11 December 2010 (fl, fr), *Sosef 2744* (LBV,WAG); S of Estuaire du Gabon along Remboué River; British Gas site; along newly built road to drill-hole number 2. 0°00'N 9°50'E. Alt: 10m, 23 October 1991 (fl), *McPherson, G.D. 15434* (MO,WAG); environ de Libreville. 0°25'N 9°26'E, October 1912 (fr), *Chevalier, A.J.B. 27147* (P); **Haut-Ogooué:** Parc National des Plateaux Batéké. 1 km du Bai de Jobo. 2°12.95'S 13°51.28'E, 5 June 2005 (st), *Niangadouma 507* (MO,WAG); **Moyen-Ogooué:** Mabounié, à 45 km au sud-ouest de Lambaréné, lac près de la rivière Ngounié. 0°50.05'S 10°31.67'E. Alt: 9m, 18 October 2012 (fl, fr), *Bidault 933* (BRLU,LBV,MO,P,WAG); Mabounié, à 45 km au sud-ouest de Lambaréné, près de la rivière Ngounié. 0°48.80'S 10°29.75'E. Alt: 32m, 24 October 2012 (fl, fr), *Bidault 983* (BRLU,LBV,MO,P,WAG); zone de Mabounié, à 45 km au sud-ouest de

Lambaréné, rive sud de la rivière Ngounié. 0°46.97'S 10°28.60'E. Alt: 58m, 2 February 2013 (fl, fr), *Bidault 1036* (BRLU, LBV, MO, P, WAG); Ayem, SW de Ndjolé. 0°22'S 10°35'E, 12 April 1963 (st), *Hallé, N. 1643* (P); Ayem, SW de Ndjolé. 0°22'S 10°35'E, 25 April 1963 (st), *Hallé, N. 1873* (P); zone de Mabounié, à environ 45 km au sud-est de Lambaréné, rive Est de la Ngounié. 0°49.92'S 10°31.65'E. Alt: 25m, 1 November 2012 (fr), *Dauby 3048* (BRLU, LBV, MO, WAG); Mabounié Mine. 0°46.43'S 10°28.18'E. Alt: 22m, 4 May 2012 (fr), *Stévert, TOBEB 4162* (LBV, MO); Mabounié Mine, near the Ngounié River. 0°48.83'S 10°29.88'E. Alt: 37m, 11 May 2012 (fl), *Stévert, TOBEB 4530* (LBV, MO); border of Missanga River near Ndjolé. 0°07'S 10°45'E, 9 May 1992 (fr), *Breteler 11397* (LBV, MO, WAG); **Ngounié**: Mabounié, le long de la rivière Ngounié. 0°49.97'S 10°33.50'E. Alt: 86m, 12 October 2012 (st), *Sonké 5989* (MO); along stream Ngounié. 0°39.37'S 10°22.93'E. Alt: 22m, 17 October 2012 (st), *Sonké 6082* (MO); 0°48.98'S 10°30.40'E. Alt: 49m, 18 October 2012 (st), *Sonké 6093* (MO); **Ogooué-Lolo**: 10.5 km from Lastoursville Railway Bridge, E-W road, Chantier SBL. 0°47'S 12°45'E. Alt: 300m, 18 November 1988 (fl), *Maesen, L.J.G. van der 5588* (BR, G, LBV, MO, WAG); **Ogooué-Maritime**: Koumaga. 2°26.5'S 9°50.7'E, 21 November 1990 (st), *Nek 386* (BR, LBV, MO, WAG); Rabi, near Echira River. 1°55'S 9°50'E, 2 April 1990 (fl), *Breteler 9734* (BR, LBV, MO, WAG); Rabi-Kounga, Echira road. 2°00'S 9°50'E, 27 October 1991 (fl), *Breteler 10162* (WAG); **Woleu-Ntem**: Bordamur concession area, some 48 km NE of Mitsic. 1°15'N 11°54'E. Alt: 550m, 22 October 2002 (fl, fr), *Strijk 247* (LBV, WAG).

**NIGERIA, Ogun State**: S.W. of Osho enclave, site of E.B. 31. In Yng HF W. 7°16'N 4°12'E, 3 April 1946 (fl), *Jones, A.P.D. FHI 17354* (FHO, K).

**SAO TOMÉ & PRINCIPE, Sao Tomé Island**: chemin sommet Pequeno. 0°15'N 6°38'E, 21 July 1999 (fr), *Joffroy 36* (BRLU); Saõ José. 0°18'N 6°38'E, 1 August 1999 (fl), *Joffroy 116* (BRLU); Base Pico Maria Fernandes. 0°10.3'N 6°38.5'E. Alt: 350m, 26 February 2003 (fl), *Ogonovszky 287* (BRLU); Pico Cabumbé. 0°12'N 6°33'E. Alt: 940m, 13 March 2003 (fr), *Ogonovszky 410* (BRLU); Pico Cabumbé. 0°12'N 6°33'E, 14 March 2003 (fl), *Ogonovszky 414* (BRLU); Monte café entre Esperanca e Lagoa Amélia. 0°17'N 6°36'E, 18 August 1959 (fl), *Espirito Santo 4054* (COI, LISC); A'gua d'Agí. 29 July 1968 (fl), *Espirito Santo 4674* (LISC); Cabumbé. 0°12'N 6°33'E, 8 November 1998 (fl), *Oliveira (Faustino), F. de 98/128* (BRLU).

**ZAMBIA, North-Western**: Zambia rapids. 11°08'S 24°12'E, 18 May 1969 (fl), *Mutimushi 3280* (K); source of R. Zambezi. 11°23'S 24°20'E, 13 December 1963 (fr), *Robinson, E.A. 6134* (K).

**Key literature**: Bamps & Farron (1967), Farron (1963, 1985).

### **CampylospERMUM reticulatum** (P.Beauv.) Farron

**Fig. 23**

Bull. Jard. Bot. État Bruxelles 35: 400 (1965). – *Gomphia reticulata* P.Beauv., Fl. Oware 2(12): 22, t. 72 (1810). – *Ouratea reticulata* (P.Beauv.) Engl. ex Gilg, in Engl. & Prantl., Nat. Pflanzenfam. ed. 1, III, 6: 142 (1893). – *Monelasmum reticulatum* (P.Beauv.) Tiegh., Bull. Mus. Hist. Nat. Paris 8: 216 (1902). – Type: *Palisot de Beauvois s.n.* (holotype: G!; isotype: G (2x)!), Nigeria, Oware, 1805.

*Gomphia turnerae* Hook.f. ex Planch., London J. Bot. 6: 2 (1847). – *Monelasmum turnerae* (Hook.f.) Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 327 (Dec. 1902). – *Ouratea turnerae* (Hook.f.) Hutch. & Dalz., Fl. W. trop. Afr., ed. 1, 1: 193 (1927). – *CampylospERMUM reticulatum* (P.Beauv.) Farron var. *turnerae* (Hook.f.) Farron, Bull. Jard. Bot. État Bruxelles 35: 400 (1965). – Type: *Turner s.n.* (holotype: K!; isotype: K!), Sierra Leone. **syn. nov.**

*Gomphia micrantha* Hook.f., J. Proc. Linn. Soc. Bot. 6: 8 (1862). – *Ouratea micrantha* (Hook.f.) Hutch. & Dalziel, Fl. W. trop. Afr., ed. 1, 1: 193 (1927). – Type: *Mann 568* (holotype: K!; isotype: P!), Equatorial Guinea, Fernando Po, Clarence Peak (1860).

*Ouratea pellucida* De Wild. & T.Durand in T.Durand & De Wild., Bull. Soc. Roy. Bot. Belgique 38(2), Comp. Rend.: 35 (1899). – *Exomicrum pellucidum* (De Wild. & T.Durand) Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 339 (Dec. 1902). – *Monelasmum pellucidum* (De Wild. & T.Durand) Tiegh., Ann. Sci. Nat., sér. 8, Bot. 18: 35 (June 1903). – Type: *Dewèvre 1159*

(holotype: BR!; isotype: BR!), Democratic Republic of the Congo, environ de Stanleyville, December 24<sup>th</sup>, 1896.

*Monelasmum afzelii* (Gilg) Tiegh., Ann. Sci. Nat., sér. 8, Bot. 18: 36 (June 1903). – *Ouratea afzelii* Gilg, Bot. Jahrb. Syst. 33: 267 (1904). – Type: *Afzelius s.n.* (holotype: BM!), Congo.

*Monelasmum brunneo-purpureum* (Gilg) Tiegh. Ann. Sci. Nat., sér. 8, Bot. 18: 36 (June 1903). – *Ouratea brunneo-purpurea* Gilg, Bot. Jahrb. Syst. 33: 266 (1904). – Lectotype (designated here): *Buchholz s.n.* (holotype: B†; isotype: A!), Cameroon, Abo, March 1874.

*Monelasmum unilaterale* (Gilg) Tiegh., Ann. Sc. Nat. sér. 8, Bot. 18: 36 (June 1903). – *Ouratea unilateralis* Gilg, Bot. Jahrb. Syst. 33: 268 (1904). – Lectotype (designated here): *Conrau 68* (B†; isotype: A! E! P!), Cameroon, Bangwa, 1899. **syn. nov.**

*Ouratea intermedia* De Wild., Plant. thonn. congol. II: 232, tab. II (1911). – Type: *Thonner 180* (holotype: BR!; isotype: BR(2x)!, K!), Democratic Republic of the Congo, Mongende near Dundusana (Mongola), February 12<sup>th</sup>, 1909.

*Ouratea divergentiflora* De Wild., Pl. bequaert. 4: 462 (1929). – Type: *Vanderyst 10817* (holotype: BR!), Democratic Republic of the Congo, region d'Ipamu (Lukumu), October 1921.

*Ouratea divergentiflora* De Wild. var. *brevipedicellata* De Wild., Pl. bequaert. 4: 465 (1929). – Type: *Lescauwaert 216* (holotype: BR!), Democratic Republic of the Congo, Lac Fao, September 24<sup>th</sup>, 1904.

*Ouratea luanoensis* De Wild., Pl. bequaert. 4: 493 (1929). – Type: *Vanderyst 2672* (holotype: BR!; isotype: EA!, K!), Democratic Republic of the Congo, Luano, November 28<sup>th</sup>, 1913.

*Ouratea variifolia* De Wild., Pl. bequaert. 4: 516 (1929). – Type: *Bates 504* (holotype: BM!; isotype: BR!), Gabon, Como R., 60 mi above Gaboon, 1896.

*Ouratea sp.*, Consp. Fl. Angolensis: 297 (1951). – Type: *Gosswailer 9015* (holotype: LISC!; isotype: BM!), Angola, Cabinda, N'Baco, rio Luali-Chiloango, 1923

*Tree or treelet, up to 20 m tall, bole up to 35 cm*, with branched trunk; twigs with whitish brown bark. *Stipules* caducous, **triangular, 2–13 mm** long. *Leaf*: petiole 2–10 mm long; leaf blade **narrowly elliptic or sometimes narrowly elliptic-obovate, (5–)10–17(–23) x (1.5–)3–5(–8) cm**, ratio **(2.5–)3.0–6.8**, base cuneate, **apex acute to slightly acuminate**, papyraceous to coriaceous, not or rarely slightly bullate, **margin serrulate, often indistinctly so**, sometimes entire towards the base, slightly glossy dark green above, glossy medium green below; venation: midrib prominent on both sides, main lateral veins **7–17 on either side, 6–22 mm apart**, prominent above, slightly to not prominent below, at a ± right angle with the midrib but curved upwards to run parallel to the margin, intermediate lateral veins 0 to 2, distinct on both surfaces, **tertiary venation scalariform along the margin but reticulate towards the midrib, usually very distinct on both sides and below markedly darker than the surrounding leaf mass**. *Inflorescence* terminal, occasionally 3 to 4 panicles grouped together, branched

or rarely unbranched, lax, its main axis **(4–)11–17(–28) cm long**; pairwise scales at the base of the peduncle absent or rarely persistent; racemes (0–)1–5, (1.5–)4–13(–21) cm long, **erecto-patent**; cymules 0.5–3 cm apart, 1–8-flowered; bracts caducous, triangular, up to 4 mm long. *Flower*: pedicel **(3–)6–10(–18) mm** long, articulated at **1–3 mm** from the base; sepals narrowly ovate, (4–)6–8 x 2–4 mm in flower, (5–)6–9 x 2–5 mm in fruit, apex acute; petals obovate, 5–13 x 3–10 mm, base cuneate, apex rounded to slightly emarginate; stamens: anthers 3–6 mm long; ovary c. 1 mm high; style 3–5 mm long. *Fruit*: receptacle c. 1 mm high in flower, 3–5 x 3–5 mm in fruit; drupelets **3 to 4** well developed per receptacle, **ellipsoid**, 6–9 x 5–6 mm; cotyledons **incumbent, dissimilar in size with a small outer cotyledon**.

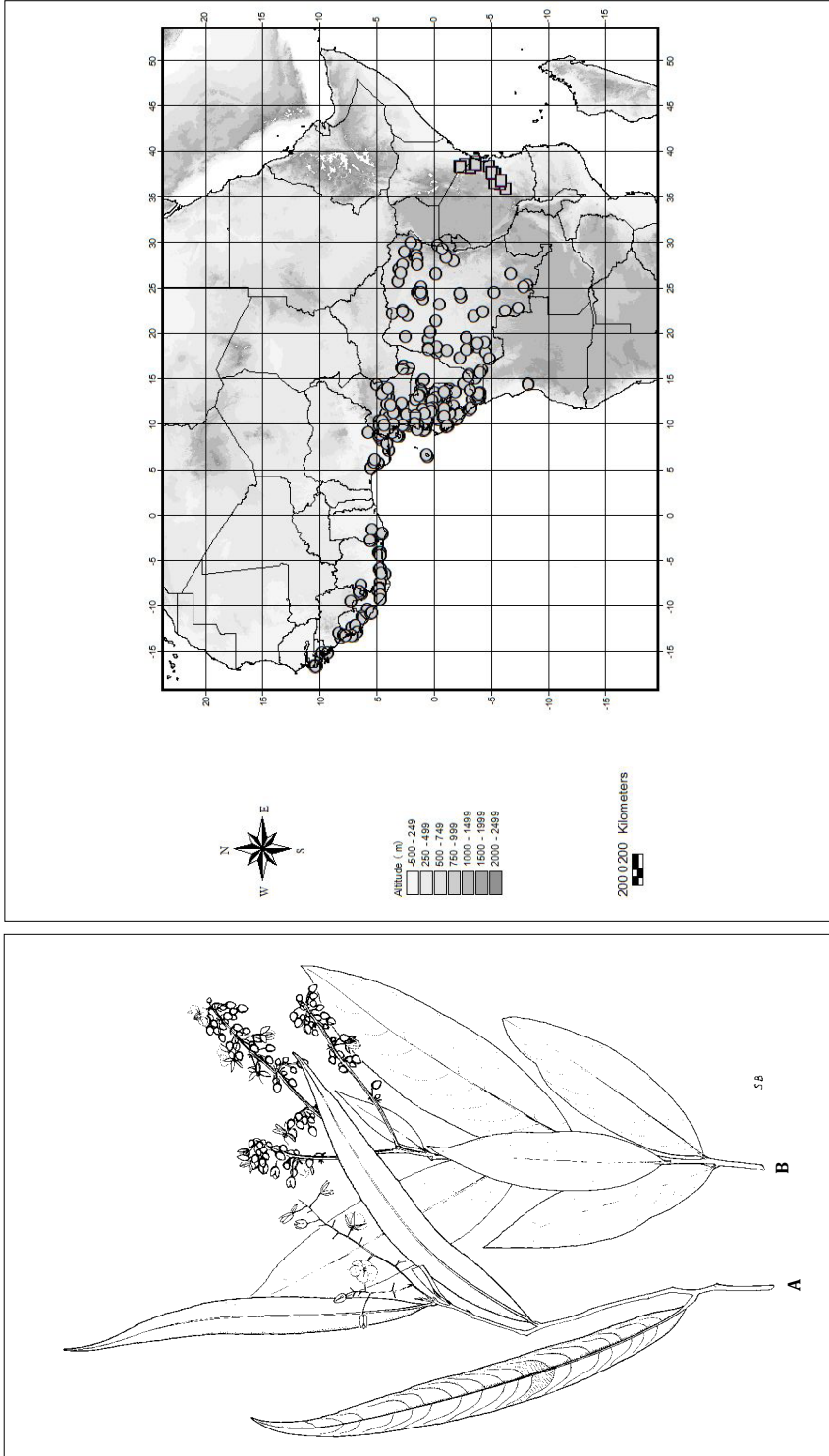
**Notes:** Farron (1965) treats the taxon described as *Gomphia turnerae*, and recognized as a distinct species in for example the Flora of West tropical Africa, as a variety of *C. reticulatum* without providing a foundation for this transfer. In his contribution to the Flore du Congo, du Rwanda et du Burundi (Farron, 1967), he provides a key to the two varieties showing they are distinguished mainly by the coloration of the leaves when dried. Those of var. *reticulatum* stay more or less green after drying, whereas those of var. *turnerae* turn brownish. We think, however, that the coloration of the leaves may, amongst others, depend on the way in which the plants are dried (quickly or after having been preserved using the Schweinfurth method) and thus on its own this cannot be considered as a good character to distinguish taxa. Then, Bamps & Farron (1967), provide an additional character: leaves of var. *reticulatum* are papyraceous and those of var. *turnerae* are papyraceous to coriaceous, so no clear difference either. Finally, from a comparison of the two descriptions it seems that var. *reticulatum* has stipules of 1–3 mm long, while those of var. *turnerae* are 5–6 mm, but again, we observed stipule length to be highly variable and not related to the other characters mentioned. Therefore, we decided not to recognize the two varieties distinguished by Farron.

*C. reticulatum* is a widespread and highly variable species. According to the information on herbarium labels, it can be a treelet or a big tree with boles up to 30 cm dbh. The leaves can vary from narrowly elliptic to elliptic (ratio (2.5–)3.0–6.8) and the inflorescence varies from robust to slender. *C. reticulatum* is especially similar to *C. laxiflorum* and *C. warneckei*; see below those species for the distinctive characters.

**Distribution:** from Senegal to south-western Ghana and in southern Nigeria, Cameroon, southern Republic of Central Africa, Equatorial Guinea, Gabon, Republic of the Congo, Democratic Republic of the Congo, Angola (Cabinda and northern) and southern Uganda (**Map 26**).

**Ecology:** in primary and secondary rain forest, gallery forest, along streams, and in swamp forest; predominantly on sandy, lateritic, clayey or clayish-loamy soil; at 0–1750 m altitude.

**Phenology:** flowering and fruiting all year round.



**Figure 23.** *Campylosperrum reticulatum*. **A.** Flowering branch. **B.** Flowering branch with flower buds. Drawings by Sabine Bousani  
**Map 26.** Distribution of *Campylosperrum reticulatum* (○) and *Campylosperrum scheffleri* (□)

**Vernacular names:** **Central African Republic:** Mo Engé (Bambenjele). **Democratic Republic of the Congo:** Amamambamamba (Bila), Akpala (Yambata); Bolili bo kikereke, Inaolo a olili, Bompompongo, Yeka olili ikekereke (turumbu); Egboru (Mangbetu); Kanko, Luhaha, Ndando, Nawarubanda (Kitembo); Kalenge (Kinyanga); Lofanzandzuku (Lokundu); Lukako (Kinande); Ngulu (Kirega); Payagu (Mungutu); Soti (Kibubu); Bonion (Boyeka); Dande (Dundusana); Ebombo kasa sisi, Egbogbo, Kpoyo na mai, Ngeba na mai (Babua); Kamasonge (Lulua); Kimbengi (vallée de la Singa); Lopalilondjo (Lac Tumba); Lufete (Djombo); Luvamba, Tumbu ya maza (Luki); Muliangulu (Tshiluba); Tumbulabenzo (Dima).

**Uses:** The bole is used as fire wood and timber (Farron 1967).

**IUCN conservation status:** LC. EOO=6,235,480 km<sup>2</sup>, AOO=7,676,810 km<sup>2</sup>, locations=367 (cell width=533 km). This species is widely distributed and has been frequently collected so seems to be fairly common. It occurs both within and outside protected areas. Therefore, the category of Least Concern has been assigned.

### **Specimens examined:**

**ANGOLA, Cabinda:** nos arlas da floresta de Buco Zan-Maiombo. 4°46'S 12°33'E, 14 October 1916 (fl, fr), *Gossweiler 6741* (COI,LISC); Belize. 4°39'S 12°46'E, 23 November 1918 (fl, fr), *Gossweiler 7570* (BM,COI,K,LISC); Maiombe, Nkanda Mbaku, proximum Flumem, Luali-Chiloango. 4°47'S 12°32'E, 1923 (fl), *Gossweiler 9015* (BM,LISC); **Cuanza Sul:** Cuanza Sul. Fundaò-amboim. 10°51'S 14°22'E. Alt: 900m, 11 July 1937 (fl), *Exell 3168* (BM,COI); Cuanza Sul. Fundaò-amboim. 10°51'S 14°22'E. Alt: 900m, 11 July 1937 (fr), *Exell 3169* (COI); Zôa-Amboim. 10°56'S 14°29'E, 3 July 1908 (fl), *Gossweiler 4472* (BM,COI,K).

**CAMEROON, Central Province:** Mont Kala, 18 km route Younde-Edea. 3°52'N 11°21'E, 31 December 1969 (fl, fr), *Mezili 164* (K); Massif du Mbam Minkom à l'est de Nkolakié (20-25 km NW de Yaoundé). 3°57.60'N 11°22.22'E. Alt: 788m, 27 May 2009 (fl, fr), *Lachenaud 869* (BR,WAG,YA); Mont Meza. 4°17'N 12°08'E, 12 May 1959 (fl, fr), *Letouzey 1950* (P); E of Libamba College, approximately 9 km E of Makak. 3°33'N 11°07'E. Alt: 600m, 9 June 1987 (fl, fr), *Manning, S.D. 1999* (K,MO,WAG); Eloumden mountain, 9 km SW. of Yaoundé. 3°49'N 11°26'E. Alt: 1165m, 29 December 1961 (fl), *Breteler 2333* (BR,K,LISC,P,U,WAG,YA); Eloumden mountain, 9 km SW. of Yaoundé. 3°49'N 11°26'E. Alt: 1165m, 29 December 1961 (fl), *Breteler 2334* (A,BR,FI,K,LISC,M,P,SL,U,UC,WAG,YA,Z); Nkolbisson, 7 km W. of Yaoundé. 3°53'N 11°27'E. Alt: 800m, 3 March 1965 (st), *Leeuwenberg 5008* (WAG); 60 km SW of Eséka, 12 km W. of Songbong. 3°26'N 10°24'E. Alt: 200m, 10 March 1965 (st), *Leeuwenberg 5077* (BAS,WAG); 49 km SW of Eséka, right bank Nyong R. 1 km N. of Songbong. 3°28'N 10°30'E. Alt: 200m, 12 March 1965 (st), *Leeuwenberg 5135* (WAG); 13 km N. of Lobo, 40 km NW of Yaoundé. 4°00'N 11°14'E. Alt: 700m, 13 April 1965 (st), *Leeuwenberg 5433* (BAS,BR,P,WAG,YA); Hill near Nkolbisson, 7 km W. of Yaoundé. 3°52'N 11°27'E. Alt: 1000m, 6 July 1965 (st), *Leeuwenberg 6054* (WAG); M'Bafia. 4°45'N 11°14'E, 19 December 1957 (fl, fr), *Wit, H.C.D. de 7193* (WAG); 3°52'N 11°31'E, January 1914 (fl), *Mildbraed 7887* (K); Sanaga und Djerem. Etwa 115 Km NO Jaunde. 4°37'N 12°15'E, February 1914 (fl), *Mildbraed 8252* (K); Youngue près Ndom, à 40 km au Sud de Ndikinimeki (feuille IGN. 1/200000 Ndikinimeki). 4°25'N 10°49'E, 10 December 1971 (fl), *Letouzey 10734* (K,P); **East Province:** Bertoua-Batouri. 4°30'N 14°00'E, 1960 (fl), *Vroumsia 60* (P); Along Sanaga river S. of Goyoum, 20 km W. of Deng-Deng. 5°12'N 13°23'E. Alt: 635m, 27 January 1961 (fl), *Breteler 945* (WAG); Road from Bangbel to Badzéré, near Bouba. 5°46'N 14°23'E. Alt: 980m, 1 March 1961 (fl), *Breteler 1178* (BR,K,LISC,P,WAG); Bertoua, 5 km along road to Batouri, junction of road to Bétaré Oya. 4°35'N 13°44'E. Alt: 670m, 14 March 1961 (fl, fr), *Breteler 1195* (BR,FI,K,LISC,M,P,WAG,YA); 2 km from Nguélémendouka, along road to Bika, near river Bamo. 4°24'N 12°56'E. Alt: 700m, 15 November 1961 (fr), *Breteler 2035* (WAG); rive de la Sanaga, près Goyoum. Feuille IGN. 1/200 000 Deng Deng. 5°12'N 13°22'E, 27 January 1961 (fl), *Letouzey 3272* (P); Bertoua to Betare Oya. 36 miles from Bertoua. 4°56'N 13°50'E, 11 March 1969 (fl), *Sanford, W.W. 6154* (K); Dengdeng. 5°10'N 13°35'E, (fl), *Mildbraed 8818* (BM,K); **Littoral:** Abo. 4°11'N 9°45'E, 1874 (fr), *Buchholz s.n.* (HUH); 5km S of Nkongsamba, W slope of Mt. Nlonako. 4°55'N 9°56'E. Alt: 1000m, 17 December 1980 (fl), *Beentje 1478* (BR,MO,WAG); Mont Nlonako, flanc NW. 4°55'N 9°57'E. Alt: 1400m, 25 December 1967 (fl, fr), *Bamps 1571* (BR); route Douala-Edea, près du km 28. 3°58'N



9°57'E, 18 January 1962 (fl), *Letouzey 4017* (P); 8 km W. of Masok. 4°08'N 10°24'E. Alt: 400m, 27 March 1965 (st), *Leeuwenberg 5228* (WAG); on Dicam trail from Bekob camp. 4°21.04'N 10°24.90'E. Alt: 910m, 10 March 2007 (fl), *Wieringa, J.J. 5888* (K,MO,WAG); Mt. Nlonako, near Nkongsamba. 4°55'N 9°57'E. Alt: 1400m, 3 December 1971 (st), *Leeuwenberg 8795* (BR,K,WAG); Manengouba Mts., 4 km WNW of Nkongsamba. 4.58 N 9.53 E. 4°58'N 9°53'E. Alt: 1200m, 4 April 1972 (fr), *Leeuwenberg 9548* (BR,FHI,HBG,K,LISC,MO,P,PRE,UPS,WAG,YA); près Lafi (=Ndocksamba) sur route Bafang-Yabassi, à 12 km au NNE de Nkondjok. 3°58'N 10°37'E, 6 February 1972 (fl), *Letouzey 11139* (BR,K,WAG); 8 KM Est de l'embourchure de la Sanaga (Sud de Ngola). 4°46'N 13°10'E, 5 January 1974 (fl), *Letouzey 12568* (BR,K); **South Province**: Kribi. 2°57'N 9°54'E, 14 March 1928 (fl), *Hédin, L. 5* (P); 4 km NE Ebimimbang. 3°05'N 10°32'E. Alt: 500m, 27 February 1997 (fl), *Gemerden 19* (WAG); Ngongonjje hill, near Akonetye S of Ebolowa. 2°30'N 11°08'E. Alt: 730m, 16 January 1978 (fr), *Koufani 51* (P); Mimfia. 3°04'N 10°23'E, August 1913 (fl), *Zenker 367* (B,C,G,H,UH,LD,LY,WAG); Efulen, Bule country. 2°50'N 10°35'E, October 1895 (fl), *Bates, G.L. 410* (E,G,K); Bitya, near the River Ja. 3°01'N 12°22'E, (fr), *Bates, G.L. 1741* (K); 31 km ESE of Kribi, 1 km N of Ndjantom. 2°49.3'N 10°09.6'E. Alt: 100m, 15 February 1994 (fl), *Wieringa, J.J. 2221* (WAG); 2 km S of Kribi, Grand Batanga road. 2°55'N 9°54'E, (st), *Bos, J.J. 2994* (WAG); Campo-Ma'an area, Mabiogo, Dipikar Island, along transect T1. 2°15.3'N 9°52.8'E. Alt: 20m, 18 September 2000 (fl), *Tchouto Mbatchou 3051* (KRIBI,SCA,WAG,YA); Campo-Ma'an area, Massif des Mamelles. 2°34.0'N 9°57.0'E. Alt: 280m, 23 April 2001 (fl, fr), *Tchouto Mbatchou 3255* (KRIBI,SCA,WAG); Elephant Mont, near clearing made by loggers. 2°48'N 10°01'E. Alt: 180m, 17 April 2001 (fl), *Andel, T.R. van 3368* (KRIBI,WAG,YA); Urwaldgebiet. 3°05'N 10°25'E, 1911 (fr), *Zenker 4177* (COI,E,G,K,LY,S,W); 7 km S. of Kribi, Lobé river, N. bank above falls. 2°52'N 9°54'E, 31 March 1969 (fl), *Bos, J.J. 4227* (B,BAS,BR,K,LD,LMA,M,MO,P,PRE,UPS,WAG,YA); 6 km E. of km 58 of road Edéa-Kribi, N. of road to Mboké. 3°20'N 10°12'E. Alt: 100m, 2 May 1965 (st), *Leeuwenberg 5683* (PWAG); 26 km S. of Kribi, Campo road. 2°46'N 9°53'E, 21 August 1970 (st), *Bos, J.J. 7206* (BAS,BR,K,P,WAG,YA); 28 km S. of Kribi, Campo road. 2°46'N 9°53'E, 21 August 1970 (fl), *Bos, J.J. 7221* (AAU,BAS,BR,C,K,MA,MO,P,PRE,SRGH,WAG); Hill facing N'Kolandom. 2°48'N 11°10'E. Alt: 700m, 17 January 1975 (st), *Wilde, J.J.FE. de 7908* (WAG); collines à 5km au SW d'Ebionéméyong près Nyabessan (60 km à l'Est de Campo). 2°24'N 10°24'E, 10 April 1968 (fl), *Letouzey 9321* (P); Campo Ma'an area, Bifa, in the National Park. 2°39.5'N 10°17.0'E. Alt: 120m, 12 October 2001 (fl), *Tchouto Mbatchou BIFAX 102* (WAG); **South-West Province**: 4°13'N 8°59'E, January 1891 (fl), *Jungner, J.R. s.n.* (UPS); near Baseng and Ngombombeng, north of Nyassosso. 4°55'N 9°45'E. Alt: 600m, 14 May 1986 (fr), *Etuge 128* (BR,MO); near Mbu-Bakundu village. 5°01'N 9°18'E. Alt: 900m, 12 November 1986 (fl), *Mambo 245* (MO,WAG); Bucas. 4°09'N 9°14'E. Alt: 914m, January 1929 (fl), *Maitland, T.D. 298* (K); ancienne réserve du South Bakundu, 15 km Ouest du village Small Ekomba. 4°30.64'N 9°22.82'E. Alt: 131m, 2 April 2010 (fl, fr), *Bissiegou 1269* (LBV,WAG,YA); along path from Mapanja to Likombe. 1 km NE of Mapanja. 4°05'N 9°11'E. Alt: 760m, 6 January 1987 (fl), *Manning, S.D. 1275* (K,MO,WAG); ancienne réserve du South Bakundu, 15 km Ouest du village Small Ekomba. 4°31'N 9°23'E. Alt: 131m, 2 April 2010 (fr), *Bissiegou 1276* (LBV,WAG,YA); ancienne réserve du South Bakundu, 15 km Ouest du village Small Ekomba. 4°30.69'N 9°23.35'E. Alt: 106m, 3 April 2010 (fl, fr), *Bissiegou 1282* (LBV,WAG,YA); on NE slope of Mt Etinde (=Small Mt. Cameroon). 4°05'N 9°07'E. Alt: 1600m, 29 January 1994 (fl, fr), *Wieringa, J.J. 2060* (BR,E,K,MO,SCA,WAG); Rumpi Hills near Dikome Balue. 4°54.05'N 9°16.20'E, 19 April 2009 (fr), *Dessein 2594* (BR,YA); Above Batoke. 4°05'N 9°06'E. Alt: 500m, 29 December 1983 (fl), *Thomas, D.W. 2788* (BR,K,MO); Mount Etinde, above etome. 4°04.00'N 9°06.94'E. Alt: 1682m, 28 April 2009 (fl, fr), *Dessein 2834* (BR,WAG,YA); above small Koto village. 4°18'N 9°06'E. Alt: 1000m, 6 March 1985 (fl), *Thomas, D.W. 4456* (B,BR,K,MO); West of Bangem. 5°05'N 9°42'E. Alt: 1600m, 3 January 1986 (fl), *Thomas, D.W. 5332* (MO,P,WAG); Ndiian Div., Rumpi hills 3.5 km E of Dikome Balue on foot path to Ifanga Nalende. 4°54.6'N 9°17.2'E. Alt: 1070m, 10 December 1994 (fl), *Gereau 5656* (BR,MO,WAG); forest around Masaka-Batanga. 5°06'N 9°10'E. Alt: 500m, 24 March 1988 (fl), *Thomas, D.W. 7733* (MO,WAG); Fontem. 5°28'N 9°53'E. Alt: 1000m, 1 March 1967 (fl), *Meurillon CNAD 608* (BR); S. Bakundu F.R. near Sawyers' Camp. 4°30'N 9°30'E, 10 April 1951 (fl), *Ejiofor FHI 29339* (FHI,K); Bera. Northern Korup F. R. 5°19'N 8°58'E, 8 July 1951 (fr), *Olorunfemi FHI 30676* (FHI,K); Kumba Distr., N. slopes of Mt. Cameroon. 4°12'N 9°11'E. Alt: 1750m, 2 February 1958 (fl), *Keay FHI 37496* (FHI,K,P); Bakundu N.A. F/R. along the cutline when going to the Northern boundary of Investigation 290. 4°33'N 9°26'E, 4 April 1960 (fl), *Adebusuyi FHI 44010* (FHO); **West Province**: Bangwa Station. 5°12'N 10°28'E, March 1899 (fl), *Conrau 68* (A,E,P); piste de Bandoumkassa à Balan. 12 km ESE of Bafang. 5°29'N 10°24'E. Alt: 1150m, 24 November 1974 (fl, fr), *Letouzey 13311* (K,WAG).

**CENTRAL AFRICAN REPUBLIC, Sangha-Mbaéré:** Ndanka, gorilla study area Njéké stream from M5400 north. 2°23'N 16°12'E. Alt: 350m, 13 January 1988 (fl, fr), *Harris, D.J. 126* (BR,E,MO,WAG); Kongana Camp, 22 km SE of Bayanga. 2°47'N 16°26'E, 13 April 1996 (fl), *Fangounda 525* (E,WAG); Dzanga-Sangha Reserve,

NDAKAN gorilla study area. 2°22'N 16°10'E. Alt: 350m, 23 September 1988 (fl), *Harris, D.J. 1180* (E); 1 km E of Bayanga on side of Kenie stream. 2°53'N 16°07'E, 5 May 1990 (fl), *Harris, D.J. 2287* (K,MO); Dzangha saline, 11 km NE of Bayanga., 2°57'N 16°21'E, 27 October 1993 (st), *Harris, D.J. 3619* (E); 25 km SE of Bayanga, Kongana research camp. 2°47'N 16°25'E, 15 February 1994 (fl, fr), *Harris, D.J. 4618* (E,WAG); 25 km SE of Bayanga, Kongana research camp. 2°47'N 16°25'E, 19 February 1994 (fl), *Harris, D.J. 4703* (E,WAG); Kongana research camp, 25 km SE of Bayanga. 2°47'N 16°25'E, 5 June 1994 (fr), *Harris, D.J. 5086* (E,WAG); Safari camp at the mouth of Babongo stream. 2°59'N 16°13'E, 13 February 1998 (fl), *Harris, D.J. 5790* (E,WAG); Kongana camp, 25 km SE of Bayanga. 2°48'N 16°25'E, 23 May 2001 (fr), *Harris, D.J. 7812* (E).

**CONGO (BRAZZAVILLE), Cuvette:** Odzala N.P. 0°50'N 14°45'E, 19 January 1994 (fl), *Dowsett-Lemaire 1604* (BR); Odzala N.P. environ 2 km SW du camp Mboko. 0°35'N 14°53'E, 20 December 1994 (fl), *Champluvier 5142* (BR); Odzala N.P. environ 2 km SW du camp Mboko. 0°36'N 14°54'E. Alt: 400m, 20 December 1994 (fl), *Champluvier 5143* (BR); Odzala N.P. environ 2 km SW du camp Mboko. 0°35'N 14°53'E, 20 December 1994 (fr), *Champluvier 5144* (BR); Odzala N.P. environ 2 km SW du camp Mboko. 0°35'N 14°53'E, 27 December 1994 (fl), *Champluvier 5194* (BR); **Kouilou:** Menengué, NE de Kayes. 4°26'S 11°41'E, 24 September 1990 (fl), *Dowsett-Lemaire 1309* (K); Loango. 4°36'S 11°51'E, September 1888 (fl), *Thollon 1342* (P); **Lékoumou:** Zanaga Project, Moussaou, en route to farms E of ridge. Plot 10. 2°53.27'S 13°36.64'E. Alt: 602m, 1 April 2009 (fl), *Cheek 14798* (IEC,K,P,WAG); **Niari:** Chaillu, N. de Divenié. 2°41'S 12°05'E, December 1983 (st), *Sita 5357* (BR,WAG); **Pool:** Plateau des cataractes, région de kindamba, Léfini. 3°44'S 14°31'E, 11 October 1968 (fl), *Sita 2673* (WAG); près de Brazzaville. 4°16'S 15°17'E, September 1958 (fl), *Koechlin 5266* (P); **Sangha:** Makamba Bai. 2°09.61'N 16°15.29'E, 27 June 2007 (fl), *Harris, D.J. 9467* (E,IEC); 2.5 km NNE of Bomassa village. 2°13.94'N 16°12.22'E. Alt: 350m, 22 March 2010 (fl), *Harris, D.J. 9677* (E,IEC); 2.5 km NNE of Bomassa village. 2°13.51'N 16°11.72'E. Alt: 350m, 22 March 2010 (fr), *Harris, D.J. 9687* (E,IEC).

**CONGO (KINSHASA), Bandundu:** Bondo. 6°07'S 19°06'E, September 1907 (fl), *Sapin s.n.* (BR); Lukombe. 4°16'S 18°22'E, October 1910 (fr), *Sapin s.n.* (BR); Kiyaka-Kwango. 5°19'S 18°56'E, 12 July 1955 (fl), *Devred 2143* (BR); Kiyaka. 5°19'S 18°56'E, 6 August 1955 (fl, fr), *Devred 2266* (BR,WAG); Luano. 4°07'S 18°18'E, 28 November 1913 (fl), *Vanderyst 2672* (BR,EA,K); Djuma. 3°23'S 17°21'E, July 1902 (fl), *Gillet, J. 2747* (BR); Kwango. 5°20'S 18°32'E, 25 February 1956 (fr), *Devred 2820* (BR,K); Djuma. 3°23'S 17°21'E, July 1902 (fl), *Gillet, J. 2896* (BR); Kingulu. 6°37'S 17°16'E, 15 September 1953 (fl), *Callens 4306* (BR); Selenge. 1°58'S 18°10'E, July 1929 (fl), *Goossens 4988* (BR); Ipamu. 4°07'S 19°37'E, (fr), *Vanderyst 10488* (BR); Ipamu. 4°07'S 19°37'E, September 1921 (fl), *Vanderyst 10765* (BR); Ipamu. 4°07'S 19°37'E, September 1922 (fl), *Vanderyst 12122* (BR); Ipamu. 4°07'S 19°37'E, September 1922 (fl), *Vanderyst 12126* (BR); Ipamu. 4°07'S 19°37'E, September 1922 (st), *Vanderyst 12166* (BR); Ipamu. 4°07'S 19°37'E, September 1922 (fl), *Vanderyst 12199* (BR); Ipamu. 4°07'S 19°37'E, September 1922 (fl), *Vanderyst 12203* (BR); entre Panzi et Kipopo. 6°13'S 17°55'E, (fr), *Vanderyst 14467* (BR); **Bas-Congo:** Kisantu. 5°08'S 15°06'E, 1908 (st), *Gillet, J. s.n.* (BR); Kisantu. 5°08'S 15°06'E, 1908 (fl), *Gillet, J. s.n.* (BR); Kingoyi. 4°28'S 13°50'E, 1930 (fl), *Hakanson s.n.* (S); Luki, route de Boma. 5°38'S 13°04'E, 19 September 1952 (fl), *Hombert 37* (BR); Popokabaka. 5°43'S 15°58'E, 1 October 1958 (fl), *Pauwels 59* (K,WAG); Gimbi. 5°31'S 13°22'E, 9 August 1948 (fl), *Toussaint, L. 504* (BR); Sanda. 5°39'S 13°27'E, December 1913 (fl), *Verschueren, R.C.M. 892* (BR); Sanda. 5°39'S 13°27'E, December 1913 (fl), *Verschueren, R.C.M. 937* (BR); Sanda. 5°39'S 13°27'E, December 1913 (st), *Verschueren, R.C.M. 945* (BR); Luki. 5°38'S 13°04'E, 30 September 1957 (fl), *Wagemans 1790* (BR); Luki, vallée de la N'Kaya. 5°23'S 12°57'E, 27 November 1948 (fl), *Donis 2137* (BR); Luki. 5°38'S 13°04'E, 14 January 1949 (fr), *Donis 2315* (BR); Luki. 5°38'S 13°04'E, 14 February 1947 (fr), *Devred 3209* (BR); Tau. 5°39'S 15°45'E, October 1955 (fl), *Callens 4757* (BR); Benga. 5°50'S 16°00'E, (fl), *Vanderyst 15761* (BR); **Equateur:** Lac Tumba. 0°50'S 18°00'E, 1 October 1957 (fl), *Thonet 4* (BR); Dundusana. 2°53'N 22°23'E, 1913 (fl), *Mortehan 36* (BR); Ikela. 1°11'S 23°16'E, October 1910 (fr), *Jespersen, K. 37* (BR); Yambata. 2°26'N 22°02'E, 28 February 1914 (fl), *Vermoesen 51* (BR); Bokondji. 0°43'S 21°26'E, 2 June 1959 (fr), *Wanckel de 82* (BR); Dundusana. 2°53'N 22°23'E, November 1913 (fl), *Mortehan 82* (BR); Eala. 0°03'N 18°19'E, 1903 (fl), *Laurent, M.D.J. 92* (BR); Dundusana. 2°53'N 22°23'E, February 1913 (fl), *Reygaert 99* (BR); Yambata. 2°26'N 22°02'E, 2 December 1913 (fr), *Montchal 124* (BR); Boyeka. 0°03'N 18°20'E, 31 August 1914 (fl), *Nannan 138* (BR); Mongende near Dumdusana (Mongala), 430 m undulating plain. 2°57'N 22°37'E, 12 February 1909 (fl), *Thonner 180* (BR,K,W); Mabali, Lac Tumba. 0°53'S 18°07'E. Alt: 350m, 15 September 1955 (st), *Deuse 407* (BR); Eala. 0°03'N 18°19'E, 3 October 1906 (fl), *Pynaert 496* (BR); Eala. 0°03'N 18°19'E, 1925 (fl), *Robyns, FHEAW 573* (BR,K); Dundusana. 2°53'N 22°23'E, November 1913 (fl), *Mortehan 672* (BR); Lusangania. 0°04'N 19°21'E, June 1934 (fr), *Dubois, L. 803* (BR); 0°05'N 18°16'E, June 1930 (fl), *Louis, J.L.P. 809* (BR); Eala. 0°03'N 18°19'E, 26 May 1905 (fl), *Laurent, M.D.J. 891* (BR); Eala. 0°03'N 18°19'E, 22 January 1907 (fl), *Pynaert 947* (BR); Bokote. 0°06'S 20°08'E, 1943 (st),

*Hulstaert 1221* (BR); environ d'Eala. 0°03'N 18°19'E, September 1930 (fl), *Lebrun 1231* (BR); Eala. 0°03'N 18°19'E, March 1907 (fl), *Pynaert 1238* (BR); 0°03'N 18°19'E, 10 January 1906 (fl), *Laurent, M.D.J. 1462* (BR,S); environ de Bikoro. 0°45'S 18°07'E, December 1920 (fl), *Goossens 1598* (BR); environ de Bikoro. 0°45'S 18°07'E, December 1920 (fl), *Goossens 2311* (BR); Eala. 0°03'N 18°19'E, 20 March 1958 (fl, fr), *Evrard, C.M. 3734* (BR); route Itipo-Iboko. 0°50'S 18°35'E, 28 March 1958 (fr), *Evrard, C.M. 3819* (BR); Budjala. 2°39'N 19°42'E, March 1924 (fr), *Goossens 4340* (BR,S); Eala et Bokele. 0°03'N 18°19'E, 26 May 1909 (fl), *Laurent, M.D.J. 4891* (BR,K); **Kasai-Occidental**: Kakenge. 4°51'S 21°55'E, November 1937 (fl, fr), *Gillardin 297* (BR,K); Luluabourg. 5°54'S 22°25'E, 21 July 1930 (fl), *Vanderyst 24079* (BR); Luluabourg. 5°54'S 22°25'E, 21 July 1930 (fl), *Vanderyst 24141* (BR); Luluabourg. 5°54'S 22°25'E, 21 July 1930 (fl), *Vanderyst 24142* (BR); **Kasai-Oriental**: Katoko-kombe. 3°25'S 24°25'E, January 1910 (fl), *Claessens 396* (BR); Entre Katoke-Kombe et Lodja. 3°27'S 24°00'E, September 1932 (fl), *Lebrun 6188* (K,WAG); **Katanga (Shaba)**: Kapanga. 8°21'S 22°34'E, August 1933 (fl), *Overlaet 857* (BR); Lualu (Kabinda). 7°05'S 24°34'E, November 1931 (fl), *Quarré, P. 2807* (K,WAG); région du Slaba. 10°46.4'S 25°18.8'E. Alt: 1425m, 11 May 1986 (fl), *Schajies 2900* (BR); 60 Km NO de Kolwezi. 10°23'S 25°08'E, 25 August 1950 (fl), *Schmitz, A. 3016* (BR); région du Slaba. 10°47.0'S 25°18.7'E, 10 August 1986 (fl), *Schajies 3025* (BR); Parc National Upemba (Mitwaba). 8°55'S 26°35'E, 20 June 1948 (fl), *Witte, G.F. de 4026* (BR,WAG,Z); Kabelenge, 12 km de Sandoa vers Dilolo. 9°46'S 22°50'E, 7 November 1962 (fr), *Schmitz, A. 8023* (BR); **Kinshasa**: Pic Mense (Mangengense). 4°26'S 15°31'E, 9 March 1965 (fl), *Pauwels 4916* (WAG); **Maniema**: route Lubutu Km 45. 0°44'S 26°35'E, 15 June 1981 (fr), *Ndjele 278* (BR); route Lubutu Km 44. 0°44'S 26°35'E, (fl), *Ndjele 445* (BR); route Lubutu Km 44. 0°44'S 26°35'E, (fl), *Ndjele 446* (BR); Walikale-Lubutu. 0°44'S 26°35'E, 12 January 1915 (fr), *Bequaert 6589* (BR); **Nord-Kivu**: Mt Hongo, 15 km from Komanda to Beni. 1°23'N 29°46'E. Alt: 1500m, 23 February 1986 (fl), *Linder, D.H. 3528* (K); Kikomero, Parc national Albert. 1°26'S 29°20'E, (fl), *Lebrun 8491* (BR); **Oriental**: Yambuya. 1°16'N 24°33'E, 3 March 1906 (fl), *Laurent, É. s.n.* (BR); Epulu 200 miles east of Stanleyville. 1°23'N 28°36'E, 1935 (fl), *Putman 13* (BR); Afarama. 1°33'N 28°32'E, 12 October 1996 (fl), *Amsini 24* (BR,K,WAG); station d'Epulu. 1°25'N 28°35'E, 4 April 1981 (fl), *Hart, T.B. 25* (BR); Amamambamanba (Kibila), zone de Mambasa (Ituri Forest), Epulu. 1°25'N 28°35'E. Alt: 750m, 24 November 1997 (fl), *Amsini 52* (BR); Yambuya. 1°16'N 24°33'E, 1906 (fl), *Solheid 62* (BR); Yambuya. 1°16'N 24°33'E, 1906 (fl), *Solheid 72* (BR); Yangambi. 0°46'N 24°27'E, October 1957 (fl, fr), *Léonard, A. 113* (K,WAG); Mambasa (Afarama). 1°33'N 28°32'E. Alt: 800m, 27 February 1996 (fl), *Liengola 133* (WAG); Mambasa (Afarama). 1°33'N 28°32'E. Alt: 800m, 12 March 1995 (fl), *Liengola 216* (WAG); Lenda. 1°24'N 28°34'E. Alt: 750m, 25 January 2001 (fr), *Mokondo 380* (BR,MO,WAG); Epulu. 1°25'N 28°35'E. Alt: 750m, 31 January 1986 (fl), *Hart, T.B. 472* (BR); Yangambi, Km 6 route de Ngazi. 0°48'N 24°28'E. Alt: 470m, 28 October 1935 (fl, fr), *Louis, J.L.P. 488* (BR); Bambesa. 3°28'N 25°43'E, 11 February 1953 (fl), *Gérard, P. 550* (BR); Mambasa (Afarama). 1°33'N 28°32'E. Alt: 800m, 21 February 1996 (fl), *Ewango 574* (BR,WAG); Nala. 2°52'N 27°38'E, 1907 (fl, fr), *Seret 749* (BR); Uele. 4°06'N 22°23'E, 14 April 1935 (fl), *Dewulf 817* (BR); Yangambi. 0°46'N 24°27'E, 10 July 1958 (fl), *Léonard, A. 902* (K,WAG); Jambuya. 1°16'N 24°33'E, 8 March 1906 (fl), *Laurent, M.D.J. 949* (BR); Yangambi Isangi. 0°46'N 24°27'E, 29 July 1958 (fl), *Léonard, A. 1030* (BR,WAG); Likiliki (région de Gombari). 2°43'N 29°03'E, July 1921 (fl), *Claessens 1062* (BR); Yangambi, plateau de la Lusambila à 8 km au N. de Yaosuka. 0°49'N 24°27'E. Alt: 470m, 26 January 1936 (fr), *Louis, J.L.P. 1124* (BR,K); Yangambi, Km 6. 0°48'N 24°27'E. Alt: 470m, 26 January 1936 (fr), *Louis, J.L.P. 1147* (BR); Bambesa. 3°28'N 25°43'E, April 1934 (fl), *Brédo, HJAER 1196* (BR); affluent "Yondo" et Jubilaya N.W. de Yangambi. 0°46'N 24°27'E, 16 February 1936 (fr), *Louis, J.L.P. 1272* (BR,EA); Yangambi, Km 7. 0°48'N 24°27'E. Alt: 470m, 26 February 1937 (fl), *Louis, J.L.P. 1387* (BR); Bambesa. 3°28'N 25°43'E, 20 May 1954 (st), *Gérard, P. 1423* (BR); 0°46'N 24°27'E, 8 April 1936 (fl), *Louis, J.L.P. 1614* (B,BM,BR,C,EA,K); Bambesa. 3°28'N 25°43'E, 26 April 1955 (fr), *Gérard, P. 1816* (BR); Avakubi. 1°20'N 27°35'E, 16 January 1914 (fr), *Bequaert 1991* (BR); Bengamisa, Km 62. 0°56'N 25°09'E, 2 June 1936 (fl), *Gilbert, G.C.C. 2364* (BR); Epulu (Penghe). 1°20'N 28°09'E, 21 February 1914 (fl), *Bequaert 2601* (BR); Entre Amadi et Poko. 3°21'N 27°05'E, June 1931 (fl), *Lebrun 3067* (K,WAG); Yangambi, plateau de la Lusambila à 8 km au N. de Yaosuka. 0°49'N 24°27'E, 25 February 1937 (fl), *Louis, J.L.P. 3341* (BR,K,P); 3°28'N 25°43'E, 2 May 1958 (fr), *Gérard, P. 3858* (WAG); Yangambi, Km 8.4. 0°48'N 24°27'E. Alt: 470m, 14 June 1937 (fl, fr), *Louis, J.L.P. 4152* (BR); Basse Lilanda, 20 km W de Yangambi. 0°52'N 24°16'E. Alt: 470m, 15 December 1937 (fl), *Louis, J.L.P. 7019* (BR); Ligasa. 0°42'N 23°50'E, 6 November 1953 (st), *Germain, R.G.A. 8453* (BR); 0°45'N 24°31'E, 6 May 1938 (st), *Louis, J.L.P. 9257* (BR,EA); 0°46'N 24°27'E, 10 May 1938 (fr), *Louis, J.L.P. 9301* (C); Yalibwa, 22km au N de Yangambi. 0°56'N 24°30'E, 16 June 1938 (st), *Louis, J.L.P. 10004* (BR,C); 20 km W de Yangambi. 0°56'N 24°18'E. Alt: 470m, 14 August 1938 (fl), *Louis, J.L.P. 10803* (BR); Yangole, à 20 km W de Yangambi. 0°50'N 24°16'E, 26 October 1938 (fl), *Louis, J.L.P. 12070* (BR,K,P); entre Ngazi et l'Aruwimi. 1°10'N 24°29'E. Alt: 470m, 31 October 1938 (fr), *Louis, J.L.P. 12222* (BR); Yalibwa, 22 km

au N. de Yangambi sources. 0°56'N 24°30'E. Alt: 470m, October 1938 (fl), *Louis, J.L.P. 13255* (BR); Yangambi. 0°46'N 24°27'E. Alt: 470m, 10 February 1939 (fl), *Louis, J.L.P. 13651* (BR); Lodjo Camp. pt 095 to 096. 2°02.89'N 29°59.45'E, 28 October 2010 (st), *Luke 14750* (BR,EA,EPU,K); Lengi. 3°06'N 26°40'E, April 1921 (fl), *Claessens A 459* (BR); **Sud-Kivu:** Bulumbu. 2°42'S 27°57'E, 9 April 1959 (fl, fr), *Léonard, A. 3775* (BR,K); Kalehe, route Kavumu-Walikale, vers Km 110, Irangi. 1°53'S 28°27'E, 21 July 1960 (fl), *Troupin 12544* (BR); Kalehe, route Kavumu-Walikale, vers Km 110, Irangi. 1°53'S 28°27'E, 5 August 1960 (fl), *Troupin 12609* (BR); Kalehe, route Kavumu-Walikale, vers Km 110, Irangi. 1°53'S 28°27'E, 19 August 1960 (fl), *Troupin 12646* (BR).

**EQUATORIAL GUINEA, Bioco (Fernando Poo):** Bioko. 3°21'N 8°40'E, (fl), *Lope del Val 247* (MA); Bioko. 3°21'N 8°40'E, (fl), *Lope del Val 248* (MA); Bioko. 3°21'N 8°40'E, (fl), *Lope del Val 249* (MA); Bioko. 3°21'N 8°40'E, (fl), *Lope del Val 250* (MA); Clarence peak. 3°30'N 8°42'E. Alt: 1524m, November 1860 (fl), *Mann, G. 568* (K,P); Bioko, Riosaka. 3°21'N 8°40'E, 25 April 1939 (fl), *Lope del Val 603* (MA); Pico de Clarence (Sta Irael). 3°21'N 8°40'E, 27 February 1947 (fl), *Guinea 2602* (MA); carretera del pico Basilé, km 4-5. 3°41'N 8°52'E. Alt: 900m, 25 November 1990 (fl), *Carvalho, M.F. de 4572* (K,MA,WAG); **Rio Muni:** West-Afrika: Spanisch-Guinea; (fl), *Tessmann 677* (K); **Rio Muni, Centro Sur:** SO du parc National de Monte Alen, 2 km au NE du site de traversée du Rio Oulo pour aller aux cataractes. 1°37.13'N 10°04.69'E. Alt: 440m, 12 February 2002 (st), *Senterre 2278* (BRLU); Parc National de Monte Alen, à 8.5 km à l'Est de la cabana de Mosumo. 1°36.55'N 10°07.19'E. Alt: 940m, 4 July 2003 (fr), *Senterre 3999* (BRLU); **Rio Muni, Litoral:** Sanje, river Benito. 1°35'N 9°50'E, 4 September 1897 (fl), *Bates, G.L. 569* (US,Z); Bata-Niefang: Estrada km 40 povoação de Adjape con Río Sama. 1°53'N 10°01'E, 14 June 1994 (fl), *Carvalho, M.F. de 5551* (MA,WAG); Bata-Mbini: Estrada Km 27.

EXFOA. Antigua exploración de la empresa maderera. 1°38.5'N 9°47.1'E, 2 November 1996 (fr), *Carvalho, M.F. de 6062* (MA); Estuaire, village Mayang au bord de la rivière Mitong. 1°10'N 9°56'E, 14 September 1997 (fl), *Lisowski 794* (BRLU); Ndote Sud, près d'Embue. 1°16'N 9°25'E, 7 September 1997 (fl), *Lisowski 1128* (BRLU); **Rio Muni, Wele Nzaz:** Inselberg de Piedra Nzaz. 1°27'N 11°02'E. Alt: 725m, 27 May 1999 (st), *Parmentier 396* (BRLU); inselberg de Piedra Nzaz, à 6 h de marche du village d'Acoaseng, à 9 km d'Aconibe, ou de celui de Afaanam, à 5 km d'Aconibe. 1°27'N 11°02'E. Alt: 640m, 27 May 1999 (st), *Parmentier 397* (BRLU).

**GABON, Estuaire:** Bouet Mont. 0°26'N 9°28'E, 1895 (fl), *Le Roy s.n.* (P); environs de Libreville 0°25'N 9°27'E, 1895 (fl, fr), *Klaine 48* (P); Libreville. Parcelle 1: Arboretum de Sibang. 0°25'N 9°29'E. Alt: 50m, 17 November 1999 (st), *Simons, E.L.A.N. 54* (LBV); Guégué. 0°26'N 9°25'E, 1882 (fl), *Thollon 161* (P); forêt classée de la Mondah: site combat 2. 0°34'N 9°20'E, 16 October 2009 (fl), *Bissengou 285* (LBV,WAG); Como river, 60 mi above Gaboon. 0°17'N 10°34'E, July 1896 (fl), *Bates, G.L. 504* (G,K); Mfoa, 85 mi. E. of Gaboon. 0°24'N 10°18'E, September 1896 (st), *Bates, G.L. 506* (BM,K); Mondah forest, parcelle des conservateurs. 0°35'N 9°20'E, 10 November 2009 (fl), *Bissengou 827* (LBV,WAG); near Cap Esterias, ± 28 km N.W. of Libreville. 0°36'N 9°20'E. Alt: 5m, 20 November 1983 (fr), *Louis, A.M. 838* (WAG); route Malibé à 2,5 km de la route goudronnée. 0°32'N 9°23'E, 8 January 2004 (fr), *Bouroubo 1030* (LBV,WAG); Près de Mviadi. Chantier SOFOR. 0°36'N 10°00'E, 23 September 1983 (fl), *Floret 1406* (LBV,WAG); Malibé-mangrove. 0°36'N 9°26'E, 2 October 1985 (fl), *Louis, A.M. 1833* (BR,K,LBV,MO,WAG); Libreville-Cap Esterias, near Moka. 0°35.7'N 9°25.6'E. Alt: 1m, November 1987 (fl), *Louis, A.M. 2622* (LBV,WAG); Monts de Cristal, chutes Kingué. 0°27'N 10°17'E, 21 January 1968 (st), *Hallé, N. 4658* (P); 8 km E of Libreville, Sibang Arboretum. 0°25'N 9°29'E. Alt: 20m, 8 November 1988 (fr), *Maesen, L.J.G. van der 5379* (LBV,WAG); 8 km E of Libreville, Sibang Arboretum. 0°25'N 9°29'E. Alt: 20m, 8 November 1988 (fl), *Maesen, L.J.G. van der 5386* (WAG); 8 km E of Libreville, Sibang Arboretum. 0°25'N 9°29'E. Alt: 20m, 9 November 1988 (fl), *Maesen, L.J.G. van der 5413* (WAG); Cap Estérias. 0°36'N 9°20'E, 22 February 1968 (st), *Hallé, N. 5435* (P); Road to Cap Esterias 2 km N. of Santa Clara offroad. 0°33'N 9°22'E. Alt: 10m, 12 November 1988 (fr), *Maesen, L.J.G. van der 5448* (WAG); Cap Estérias. 0°36'N 9°20'E, 24 February 1968 (st), *Hallé, N. 5522* (P); Libreville, Santa Clara road. 0°29'N 9°28'E. Alt: 1m, 16 September 1986 (fl), *Breteler 7770* (WAG); 10 km N. of Kango. 0°15'N 10°05'E, 1 October 1986 (fl), *Breteler 8290* (WAG); Barrage de Kingué, downstream of the hydroelectric power station. 0°28'N 10°17'E. Alt: 100m, 19 November 1986 (fr), *Wilde, J.J.F.E. de 8830* (BR,LBV,MA,MO,P,PRE,WAG); Barrage de Kingué, downstream of the hydroelectric power station. 0°26'N 10°16'E. Alt: 100m, 20 November 1986 (fl), *Wilde, J.J.F.E. de 8861* (WAG); Sibang Arboretum. 0°25'N 9°29'E. Alt: 30m, 2 December 2001 (fr), *Breteler 15804* (MO,WAG); **Haut-Ogooué:** Franceville. 1°38'S 13°35'E, (fl), *Thollon 518* (P); Parc National des Plateaux Batéké. Savane du Nord-Est du Bai Jobo. Canopé très haute. 2°12'S 13°52'E, 7 June 2005 (st), *Niangadouma 569* (MO); Batéké Plateau National Park, Bai Djobo. 2°13.3'S 13°50.5'E. Alt: 450m, 8 September 2006 (fr), *Nguema Ekomo 760* (LBV,WAG); Batéké Plateau National Park, Bai Djobo. 2°13.4'S 13°54.0'E. Alt: 400m, 11 September 2006 (fr), *Nguema Ekomo 800* (LBV); 30 km route Moanda to Bakoumba. 1°45'S 13°05'E, 3 October 1970 (fl), *Breteler 6757* (P,WAG); near Okondja. 0°37'S 13°31'E, 29 September 1997 (st), *Breteler 14114* (WAG); **Moyen-Ogooué:** Mabounié, à 45 km au sud-ouest de

Lambaréné, près de la rivière Ngounié. 0°44.43'S 10°33.67'E. Alt: 100m, 9 October 2012 (fl), *Bidault 714* (LBV,MO); Mabounié, à 45 km au sud-ouest de Lambaréné, près de la rivière Ngounié. 0°43.70'S 10°33.63'E. Alt: 24m, 11 October 2012 (fl), *Bidault 752* (BRLU,LBV,MO,P,WAG); zone de Mabounié, à environ 45 km au sud-est de Lambaréné, rive est de la Ngounié. 0°44.18'S 10°33.55'E. Alt: 67m, 28 October 2012 (fl), *Dauby 2994* (BRLU,LBV,MO,WAG); Mabounié. 0°45.22'S 10°32.37'E. Alt: 35m, 10 October 2012 (fl), *Sonké 5939* (MO); Missanga, 10-20 km N of Ndjolé. 0°05'S 10°45'E, 14 November 1991 (fl, fr), *Breteler 10467* (WAG); 10 km NNW of Ndjolé. 0°04'S 10°47'E. Alt: 150m, 25 September 1994 (fl), *Breteler 13004* (MO,WAG); **Ngounié**: St Martin. 1°41'S 10°56'E, November 1938 (fl), *Walker, A.A. s.n.* (P); Waka forest exploitation road. 1°18'S 10°57'E. Alt: 380m, 24 November 1984 (fr), *Arends 436* (WAG); Waka River. 1°13'S 10°52'E. Alt: 330m, 25 November 1984 (fl, fr), *Arends 443* (WAG); 45 km along the road M'Bigou-Lebamba. 2°03'S 11°38'E. Alt: 540m, 14 February 1983 (fl), *Wilde (WALK-B) 574* (BR,C,LBV,MO,P,WAG); Massif du Chaillu, near Guévédy village, ± 40 km N. of Lébamba. 1°55'S 11°25'E. Alt: 350m, 30 November 1983 (fr), *Louis, A.M. 1065* (MA,WAG); 20 km de Fougamou. 1°21.77'S 10°37.75'E. Alt: 93m, 21 June 2011 (st), *Bissiengou 1416* (LBV,WAG); 20 km de Fougamou. 1°21.77'S 10°37.75'E. Alt: 93m, 21 June 2011 (st), *Bissiengou 1417* (LBV,WAG); 23 km de Fougamou. 1°22.46'S 10°37.13'E. Alt: 100m, 21 June 2011 (st), *Bissiengou 1420* (LBV,WAG); 23 km de Fougamou. 1°22.46'S 10°37.13'E. Alt: 100m, 21 June 2011 (st), *Bissiengou 1422* (LBV,WAG); 23 km de Fougamou. 1°22.46'S 10°37.13'E. Alt: 100m, 21 June 2011 (st), *Bissiengou 1424* (LBV,WAG); Fougamou, village Nzemba route du chantier forestier EGBD. 0°55.47'S 10°33.05'E. Alt: 104m, 23 June 2011 (st), *Bissiengou 1444* (LBV,WAG); Fougamou, village Nzemba route du chantier forestier EGBD, entrée école. 1°03.06'S 10°30.37'E. Alt: 97m, 24 June 2011 (st), *Bissiengou 1449* (LBV,WAG); 45 km de Fougamou. 1°33.80'S 10°42.33'E. Alt: 83m, 25 June 2011 (st), *Bissiengou 1466* (LBV,WAG); 45 km de Fougamou. 1°32.59'S 10°45.68'E. Alt: 113m, 25 June 2011 (fr), *Bissiengou 1467* (LBV,WAG); 45 km de Fougamou. 1°33.07'S 10°44.33'E. Alt: 115m, 25 June 2011 (st), *Bissiengou 1474* (LBV,WAG); Bouvala hills. Lower slope. 1°37.7'S 11°45.1'E. Alt: 800m, 7 October 2007 (fr), *Leal, M.E. 1919* (LBV,MO,WAG); E of Waka National Park, along the road from Mimongo village heading in SE direction. 1°09.5'S 11°19.9'E. Alt: 830m, 26 March 2007 (fl), *Sosef 2572* (LBV,MO,WAG); Forêt sur la rive gauche (sud) de l'lkoy, à environ 10 km de l'embouchure avec la Ngounié. 0°48.93'S 10°37.37'E. Alt: 108m, 26 October 2012 (fr), *Dauby 2941* (LBV); 13½ km on the road Moukabou to Mbigou. 1°40.36'S 11°45.19'E. Alt: 840m, 13 March 2013 (fr), *Wieringa, J.J. 7394* (WAG); c. 40 km Mouila to Yeno. 1°45'S 11°21'E. Alt: 400m, 23 September 1986 (fl), *Breteler 8149* (WAG); c. 5 km on road from Yombi to Mandji. 1°25'S 10°35'E, 17 September 1997 (st), *Breteler 13946* (MO,WAG); **Nyanga**: village Dougni, 7 km de Malounga 1. 3°06.8'S 10°41.5'E, 22 October 2009 (st), *Bissiengou 441* (LBV,WAG); village Tchi Gay May, 62 km de Tchibanga. 3°06.8'S 10°41.5'E, 23 October 2009 (st), *Bissiengou 476* (LBV,WAG); on a road to the South from Moignigni village (on road Tchibanga-Moulengui Binza). 3°16.5'S 11°09.0'E. Alt: 275m, 26 October 2009 (fl, fr), *Bissiengou 547* (LBV,WAG); on a road to the South from Moignigni village (on road Tchibanga-Moulengui Binza). 3°16.5'S 11°09.0'E. Alt: 275m, 26 October 2009 (fl), *Bissiengou 556* (LBV,WAG); on a road to the South from Moignigni village (on road Tchibanga-Moulengui Binza). 3°15.4'S 11°07.9'E. Alt: 256m, 26 October 2009 (fl, fr), *Bissiengou 563* (LBV,WAG); on a road to the South from Moignigni village (on road Tchibanga-Moulengui Binza). 3°15.4'S 11°07.9'E. Alt: 256m, 26 October 2009 (fr), *Bissiengou 564* (LBV,WAG); on a road to the South from Moignigni village (on road Tchibanga-Moulengui Binza). 3°15.4'S 11°07.9'E. Alt: 256m, 26 October 2009 (fr), *Bissiengou 566* (LBV,WAG); 14 km de Ndendé (route Ndende-Mouila). 2°16.0'S 11°16.1'E. Alt: 116m, 27 October 2009 (fl), *Bissiengou 583* (LBV,WAG); 14 km de Ndendé (route Ndende-Mouila). 2°16.0'S 11°16.1'E. Alt: 116m, 27 October 2009 (fl), *Bissiengou 584* (LBV,WAG); 14 km de Ndendé (route Ndende-Mouila). 2°16.0'S 11°16.1'E. Alt: 116m, 27 October 2009 (fl), *Bissiengou 585* (LBV,WAG); Tchibanga area, Mongonyanga. 2°55'S 10°30'E, September 1908 (fl), *Le Testu 1401* (BM,P); chantier SFN, Igotchi. 2°38.95'S 10°30.76'E. Alt: 340m, 23 November 2003 (fl), *Valkenburg 2597* (BR,K,LBV,MO,P,WAG); **Ogouou-Ivindo**: Chantier Koumameyong. 0°31'N 11°55'E, March 1987 (fl), *Dibata 115* (MO,WAG); Bélinga, mines de fer, route du pt. B3. 1°06'N 13°12'E, 25 July 1966 (st), *Hallé; Le Thomas 150* (P); Lopé Reserve. 0°15'S 11°30'E, 1985 (fl), *Williamson, E.A. 201* (K); Chantier Lutexfo, Ofoué. 0°12'S 11°53'E, 13 July 1987 (st), *Dibata 213* (MO,WAG); near Nvadin, at the other side of the river Ivindo. 0°30'N 12°45'E, 2 January 1980 (fl), *Hijman 375* (B,U,WAG); Near Achouka. 0°06'S 11°46'E, 10 November 1983 (fl), *Louis, A.M. 571* (WAG); Mayibout I, on the Ivindo River. 1°07'N 13°06'E. Alt: 470m, 14 September 1978 (fl), *Breteler; Wilde 607* (C,K,WAG); route Lopé-Mikongo, après carrefour vers Gongué (village PK0). 0°27'S 11°52'E. Alt: 280m, 5 March 2010 (fr), *Bissiengou 1029* (LBV,WAG); Nord-Est du Parc de la Lopé, ancienne route Lopé qui mène à Bououé. 0°07.56'S 11°46.63'E. Alt: 211m, 6 March 2010 (st), *Bissiengou 1045* (LBV,WAG); route Bélinga, 34 km après village Zadié. 4 km du carrefour qui mène au chantier Sunli. 0°58.0'N 13°12.5'E. Alt: 851m, 11

March 2010 (fl, fr), *Bissiegou 1143* (LBV,WAG); route Belinga, 9 km après entrée Belinga- Mayibout. 1°02.15'N 13°11.74'E. Alt: 870m, 12 March 2010 (fl), *Bissiegou 1158* (LBV,WAG); route Belinga, 14 km après entrée Belinga-Mayibout. 1°02.91'N 13°12.10'E. Alt: 894m, 12 March 2010 (fl), *Bissiegou 1164* (LBV,WAG); route Belinga, 14 km après entrée Belinga-Mayibout. 1°03'N 13°12'E. Alt: 894m, 12 March 2010 (fl), *Bissiegou 1166* (LBV,WAG); entrée Belinga-Mayibout. En dessous de la montagne à l'entrée de la piste qui mène à l'antenne Celtel. 1°03.34'N 13°12.09'E. Alt: 981m, 12 March 2010 (fl, fr), *Bissiegou 1176* (LBV,WAG); Mt. Sassamongo, rocky plateau W of Sassamongo village. 0°49.75'N 13°27.67'E. Alt: 488m, 14 May 2003 (fl, fr), *Ngok Banak 1733* (LBV,WAG); Mt. Sassamongo, rocky plateau W of Sassamongo village. 0°49.70'N 13°27.52'E. Alt: 486m, 16 May 2003 (fl, fr), *Ngok Banak 1800* (LBV,WAG); au pied de la Montagne du Casque (Est). 0°01'S 11°49'E, 10 October 1983 (fl, fr), *Floret 1819* (MA,P,WAG); Babiël-Nord, eastern escarpment, 4 km from camp Bélinga. 1°07'N 13°10'E. Alt: 900m, October 1987 (fl), *Louis, A.M. 2324* (BR,E,K,MO,WAG); 11 km E of Batouala. 0°49'N 13°29'E, 15 October 1964 (st), *Hallé, N. 2631* (P); Lopé Reserve. Chantier SOFORGA. 0°30'S 11°33'E, 29 November 1986 (fr), *Reitsma, J.M. 2654* (WAG); Bélinga. 1°05'N 13°08'E. Alt: 950m, 29 October 1964 (st), *Hallé, N. 2899* (P); 20 km NE of Koumameyong. 0°19'N 11°56'E, 18 May 1987 (fl), *Reitsma, J.M. 3448* (WAG); Ivindo National Park. 3 km W of Langoué Bai at WCS camp. Savanna-edge habitat. 0°10.92'S 12°32.70'E, 26 November 2002 (fl), *Stone, J.R. 3496* (LBV,MO,WAG); Ivindo National Park. 3 km W of Langoué Bai at WCS camp. 0°10.92'S 12°32.70'E, 26 November 2002 (fl), *Stone, J.R. 3497* (LBV,MO,WAG); 3 km NW of Ikei-Bokaboka, Bongoué Mountain. 0°56.5'N 13°41.4'E. Alt: 880m, 7 January 2001 (fl, fr), *Wieringa, J.J. 3988* (LBV,MO,WAG); 5 km SE. of Koumémayong. 0°12'N 11°53'E. Alt: 350m, 23 April 1988 (fl, fr), *Breteler 8908* (MA,WAG); 18 km along the governmental road Lopé to Ayem and then c 89 km along a forest exploitation track in S direction. 0°40'S 11°33'E. Alt: 360m, 27 November 1995 (fr), *Wilde, J.J.F.E. de 11472* (BR,K,LBV,MO,WAG); Station de la Makandé, Layon 12, 0°41'S 11°54'E, 26 July 1993 (st), *Lejoly 93/ 294* (BRLU); **Ogooué-Lolo:** Milolé, route première zone d'exploitation de CEB. 0°16'S 12°42'E, 14 November 2009 (fl), *Bissiegou 845* (LBV,WAG); route vers Milolé. 0°18'S 12°40'E. Alt: 457m, 16 November 2009 (fl), *Bissiegou 883* (LBV,WAG); 2 km E of railway bridge at Lastoursville. 0°44.5'S 13°01.1'E. Alt: 350m, 29 October 2005 (fl), *Sosef 2068* (LBV,WAG); 13 km SE of confluence Gongue-Offoue; 0°50'S 11°58'E, 2 August 1993 (fl), *Wilks 2710* (MO,WAG); sur sommet Mont Iboundji, piste vers chûtes Moughoungoulou, ± 10 km. 1°10'S 11°49'E. Alt: 850m, 16 February 1988 (fl), *Louis, A.M. 2790* (LBV,WAG); Chantier SFM. 10 km E off main road, 51 km Lastoursville to Moanda. 1°10'S 13°00'E, 28 November 1988 (fr), *Maesen, L.J.G. van der 5903* (WAG); region de Lastoursville. 0°50'S 12°42'E, March 1929 (st), *Le Testu 7095* (BM,P); region de Lastoursville. 0°50'S 12°42'E, April 1929 (st), *Le Testu 7146* (BM,P); 55km E of Lastoursville. 0°50'S 13°15'E, 22 November 1993 (fr), *Breteler 12257* (BR,LBV,MO,WAG); 70km E of Lastoursville, E of Ndambi. 0°47'S 13°22'E, 27 November 1993 (fr), *Breteler 12381* (BM,BR,BRLU,C,G,K,LBV,MA,MO,P,PRE,WAG); **Ogooué-Maritime:** Rabi-Kounga, Rabi, next to DPR camp. 1°56'S 9°53'E. Alt: 30m, 21 September 1992 (fl), *Wieringa, J.J. 1621* (WAG); Rabi-Shell concession, just SW of Rabi oil field. 1°58.9'S 9°51.1'E. Alt: 106m, 26 January 2010 (fl, fr), *Dauby 2197* (BRLU,LBV,MO); 15 km NW of Shell oil exploitation Rabi. 1°50'S 9°46'E. Alt: 25m, 23 November 1989 (fr), *Wilde, J.J.F.E. de 9685* (WAG); 35 km S of Rabi. Along the Echira river. 2°05'S 9°51'E. Alt: 13m, 27 November 1989 (fr), *Wilde, J.J.F.E. de 9785* (LBV,MO,WAG); Rabi, Shell/Gabon, oilfield, well no 7. 1°56'S 9°52'E. Alt: 90m, 23 January 1993 (fl), *Wilde, J.J.F.E. de 10919* (LBV,MO,WAG); **Woleu-Ntem:** 6 km SSW of Mitzi, FOREENEX forest exploitation. 0°43.8'N 11°32.1'E. Alt: 508m, 6 November 2009 (fl), *Bissiegou 697* (LBV,WAG); 13 km SE of Mitzi, FOREENEX forest exploitation, road from FOREENEX forestry camp to Madouaka village. 0°42.1'N 11°38.8'E. Alt: 490m, 7 November 2009 (fr), *Bissiegou 728* (LBV,WAG); chantier Rougier du Haut-Abanga, Oveng. 0°52'N 11°10'E, 7 May 1985 (fl), *Reitsma, J.M. 875* (WAG); concession Rougier du Haut-Abanga, Sud-Est de Mikongo, partie Nord des montagnes Mekié. 0°26.2'N 11°13.5'E. Alt: 953m, 18 July 2008 (fl), *Dauby 1076* (BRLU,LBV,MO); RN 2, S of Mitzi, FOREEX-concession. 0°42.8'N 11°38.9'E. Alt: 503m, 30 October 2011 (fl), *Maas, P.J.M. 10051* (LBV,WAG); Minkébé area, 10 x 10 m inventory plot S, placed 2-12 m north at 360-370 m on transect A. 1°30'N 12°48'E, 14 March 1990 (st), *Minkébé Series S 171* (WAG); Minkébé area, near plot R. 1°30'N 12°48'E, 6 April 1990 (fl), *Minkébé Series W 95* (WAG).

**GHANA, Ashanti Region:** Pompo head Waters Reserve. 6°15'N 1°34'W, May 1931 (fr), *Jackson, S.T. 2251* (BR,FHO); **Western Region:** Atabuka. 6°14'N 2°44'W, November 1927 (fl), *McAins 16* (FHO); Subiri FR (Benso). 5°09'N 1°54'W, September 1951 (fl, fr), *Andoh 5574* (K); Bonsa Su. 5°12'N 2°02'W. Alt: 46m, May 1930 (fl), *Vigne FH 1980* (EA,FHO); Krokosua Hills F.R. 6°29'N 2°48'W, 18 May 1972 (fr), *Hall, J.B. GC 43309* (K).

**GUINEA, Kindia:** Friguigbé. 9°57'N 12°56'W, 30 July 1939 (st), *Chillou 1640* (BR,P); environ de Benty. 9°10'N

13°14'W, June 1937 (fl), *Jacques-Félix 1710* (P); Basse-Guinée, région de Forécariah. 9°26'N 13°06'W, May 1950 (st), *Schnell 5503* (P); Kakoulima. 9°46'N 13°27'W, 30 April 1955 (fl), *Roberty 17685* (G); **Nzérékoré**: Macenta. 8°33'N 9°28'W, 31 January 1949 (fl), *Adam, J.-G. 3528* (P); Mt. Nimba. 7°41'N 8°19'W, 30 April 1949 (fr), *Adam, J.-G. 4881* (K,P,SERG,WAG); Nimba Mountains, Zié River valley. 7°40.5'N 8°22.4'W. Alt: 1230m, 3 December 2006 (fl), *Jongkind 7454* (FHO,P,WAG); Nimba, village Nzo-Miwula. 7°40'N 8°19'W, 11 May 1973 (fl), *Adam, J.-G. 27520* (BR,WAG); Nimba mountains, plot WHSL20 close to the road uphill from main SMFG camp. 7°41.50'N 8°23.35'W. Alt: 855m, 1 July 2008 (fr), *Nimba Botanic Team WD 22* (WAG); Nimba mountains, plot WHSL29, near pumping station. 7°40.37'N 8°22.42'W. Alt: 1310m, 13 July 2008 (fr), *Nimba Botanic Team WE 573* (WAG).

**GUINEA-BISSAU, Bijagós**: Fulacunda, Bubatabom. 11°46'N 15°10'W, 22 October 1945 (fl), *Espirito Santo 2222* (COI,WAG); **Tombali**: Cacine. 11°08'N 15°10'W, August 1933 (fl, fr), *Espirito Santo 627* (COI); environs Bemberem. 11°10'N 15°08'W, 27 January 1995 (fl, fr), *Malaisse 14706* (BR).

**IVORY COAST, Abidjan**: Banco Forest Reserve, near Abidjan. 5°23'N 4°03'W. Alt: 50m, 24 January 1970 (fl), *Koning, J. de 97* (BR,E,MO,WAG); 5°23'N 4°03'W, 20 May 1930 (fl), *Martineau 236* (B); Forêt du Anguédedou. 5°24'N 4°07'W, 27 August 1969 (fl, fr), *Thijssen, M.T. 260* (MO,WAG); Banco. 5°23'N 4°03'W, 16 October 1930 (fr), *Martineau 282* (A); Forêt du Banco. 5°24.50'N 4°04.00'W, 28 November 1978 (fr), *Knecht 465* (G); Banco Forest Reserve. 5°25'N 4°03'W, 21 December 1972 (fr), *Koning, J. de 980* (MO,WAG); near river, in centre of the forest. Banco Forest Reserve. 5°25'N 4°03'W, 16 February 1973 (fl, fr), *Koning, J. de 1141* (BR,MO,WAG); Banco Forest Reserve. 5°25'N 4°03'W, 22 February 1973 (fl), *Koning, J. de 1153* (BR,E,G,MA,MO,WAG); in the north-west part of Banco Forest Reserve. 5°25'N 4°03'W, 2 March 1973 (fl), *Koning, J. de 1178* (BR,E,MO,WAG); Banco Forest Reserve, on the west-north side of the forest. 5°25'N 4°03'W, 2 March 1973 (fl), *Koning, J. de 1188* (BR,E,G,MA,MO,WAG); Banco Forest Reserve, near main road. 5°23'N 4°03'W, 24 April 1973 (fl, fr), *Koning, J. de 1534* (BR,E,MA,MO,WAG); Abidjan, in southern part of Banco Forest Reserve. 5°22'N 4°03'W, 13 June 1973 (fr), *Koning, J. de 1790* (WAG); Banco Forest Reserve, north of Arboretum. 5°24'N 4°03'W, 17 November 1973 (fl), *Koning, J. de 2748* (BR,E,G,MA,MO,WAG); Banco Forest Reserve. Route de la Montagne, at lefthand side of stream. 5°22'N 4°03'W, 20 March 1974 (fl), *Koning, J. de 3448* (BR,E,MA,MO,WAG); Banco Forest Reserve. 5°23'N 4°03'W, 4 December 1974 (fl), *Koning, J. de 4966* (BR,C,E,EA,FR,G,IAGB,K,MA,MO,P,RE,WAG); Adiopodoumé, 17 km à l'W. d'Abidjan. 5°20'N 4°20'W, 5 April 1970 (fl), *Farron 7016* (P); Banco. 5°23'N 4°03'W, 28 December 1957 (fl), *Wit, H.C.D. de 7192* (WAG); In woodlands of Banco, near Abidjan. 5°23'N 4°03'W, 2 March 1962 (fl, fr), *Bernardi, L. 8074* (G,K,US,WAG); De Banco per iter versus Avodiré. 5°24'N 4°05'W, 22 February 1962 (fl), *Bernardi, L. 8164* (G,K); Village le Banco. 5°23'N 4°04'W, 15 May 1949 (fl), *Adam, J.-G. 8945* (C); Marais de l'Agneby. 5°19'N 4°20'W, 3 April 1968 (fl), *Aké Assi 10025* (G); Abidjan. 5°19'N 4°02'W, 11 June 1928 (fl), *Aubréville SF 22* (A,K); **Agboville**: Bébasso. 5°36'N 4°06'W, March 1970 (fl), *Bamps 2548* (K,WAG); **Man**: near top of Mt Tonkoui. 7°27'N 7°38'W. Alt: 1000m, 29 March 2000 (fl), *Jongkind 4820* (FHO,OXF,WAG); **San-Pédro**: Classified forest of Monogaga. 4°48'N 6°26'W. Alt: 350m, 26 April 1997 (fl), *Breteler 13762* (WAG); **Sassandra**: 79km NNE Sassandra, Lagako-Tokpeko, along path. 5°20'N 5°50'W. Alt: 5m, 7 May 1975 (fl, fr), *Beentje 47* (MO,UCJ,WAG); 79 km NNE of Sassandra, Lagako-Tokpeko. 5°27'N 5°52'W, 7 May 1975 (fr), *Burg, W.J. van der 132* (BR,E,FR,G,GH,IAGB,MA,MO,WAG); 56 km N. of Sassandra, E. of Béyo. 5°18'N 6°20'W. Alt: 90m, (fr), *Leeuwenberg 2536* (WAG); **Tabou**: Djiroutou. 5°22'N 7°17'W, 9 April 1986 (fr), *Poilecot 1161* (G).

**LIBERIA, Bong**: Bong Range, 32 km N of Kakata. 6°48'N 10°21'W. Alt: 250m, 13 August 1962 (fr), *Leeuwenberg 4963* (WAG); **Grand Cape Mount**: 3 miles N of Settlement of MMAL mine company. 7°21'N 11°07'W, 12 February 1970 (st), *Jansen, J.W.A. 1797* (WAG); **Grand Gedeh**: Eastern Province. Putu district. Village: Kanweake 70 km S of Chiehn (Zwedru village). 5°30'N 8°03'W, 26 March 1962 (fl, fr), *Wilde, J.J.F.E. de 3641* (A,B,BR,EA,K,P,WAG); north-south ridge of the Putu Hills East Range west of Tiama Town. 5°38.3'N 8°11.1'W. Alt: 820m, 22 May 2005 (fl), *Jongkind 6308* (BR,G,K,P,WAG); **Montserrado**: Duport. 6°16'N 10°40'W, 15 November 1926 (fl), *Linder, D.H. 1486* (K); Duport. 6°16'N 10°40'W, 18 November 1926 (fl), *Linder, D.H. 1500* (K); Montserrado CO, near Monrovia. 6°19'N 10°48'W, 5 June 1947 (fl), *Baldwin jr 5901* (K); **Nimba**: Bilimu. 7°24'N 8°36'W, 21 June 1958 (fr), *Harley, W.J. 2183* (K); Lamco. 7°30'N 8°30'W, 1 April 1959 (fl), *Harley, W.J. 2215* (K,P); East slope of Nimba Mountains. 7°31.4'N 8°30.6'W. Alt: 1310m, 8 April 2010 (fr), *Jongkind 9572* (BR,G,MO,P,WAG); **Sino**: County 51 km N. of Greenville. 5°22'N 8°52'W, 10 April 1962 (st), *Wilde, J.J.F.E. de 3782* (K,WAG); Sapu NP, buffer zone, just east of Sinoe River. 5°20'N 8°48'W. Alt: 110m, 28 November 2002 (fl), *Jongkind 5516* (BR,WAG); inside Sapu National Park near Camp 6. 5°18.28'N 8°44.83'W. Alt: 198m, 16 November 2010 (fl), *Jongkind 9733* (WAG); Sapu National Park not far from Camp 6. 5°18.5'N 8°44.9'W. Alt:

220m, 23 November 2010 (fr), *Jongkind 9855* (WAG); Sinoe CO. Truo. 5°20'N 9°18'W, 12 March 1948 (fl), *Baldwin jr 11389* (K).

**NIGERIA, UNKNOWN:** 14 October 1964 (fl), *Tuley 913* (K); 17 March 1966 (fr), *Ariwaado ARS 1178* (K); **Akwa-Ibom State:** 30 km E. of Eket. 4°36'N 8°16'E, 6 April 1971 (fl), *Meer, P.P.C. van 1172* (WAG); South Eastern State. Stubbs creek forest reserve 30 km E. of Eket. 4°36'N 8°16'E, 6 April 1971 (fl), *Meer, P.P.C. van 1184* (WAG); Eket district, Southern Nigeria. 4°39'N 7°56'E, 1912 (st), *Talbot, P.A. 3271* (BR); Uyo distr. Eket. 4°39'N 7°56'E, 3 October 1964 (fl), *Daramola, B.O. FHI 55278* (FHO,K); **Cross River State:** Old Calabar. 4°57'N 8°19'E, 1862 (fl, fr), *Thomson, W.C. 95* (E,K); Ekinta River Forest Reserve 20 km ENE of Calabar. 5°00'N 8°30'E, 3 April 1971 (fl), *Meer, P.P.C. van 1156* (WAG); Oban Group Forest Reserve, east Block. 5°08'N 8°34'E. Alt: 150m, 15 April 1971 (fl), *Meer, P.P.C. van 1291* (WAG); Oban Group Forest Reserve, West Block. Cut line from pillar 51. 5°25'N 8°37'E. Alt: 150m, 19 April 1971 (fl), *Meer, P.P.C. van 1363* (WAG); road from Calabar to Oban 2 miles N of Calabar. 4°58'N 8°23'E, 6 May 1971 (fl, fr), *Meer, P.P.C. van 1516* (WAG); Oban, S of Mbarakom. 5°13'N 8°20'E, 15 May 1971 (fr), *Meer, P.P.C. van 1645* (WAG); Old Ndebiji. 5°35'N 8°50'E, 11 February 1946 (st), *Aninze FHI 15408* (K); Obudu div. of Ogoja Province. Afi River Forest Reserve. N. boundary near pillar 44. 6°40'N 9°10'E, 1 June 1946 (fl), *Jones, A.P.D. FHI 18954* (FHO); 56-57 miles posts, Osomba on Calabar-Mamfe road. 5°27'N 8°39'E, 20 February 1964 (fl), *Onyeachusim FHI 54037* (K); **Delta State:** Oware. 5°31'N 5°45'E, 1805 (fl), *Palisot de Beauvois s.n.* (G); Bendel State. N. of Efferun, NE of Warri, first junction in Benin City Road. 5°34'N 5°47'E. Alt: 10m, 30 March 1977 (st), *Leeuwenberg 11293* (BR,E,MA,MO,WAG); **Edo State:** Abe taungya, near Sapoba (SE of Benin). 6°06'N 5°53'E, 27 March 1969 (fl, fr), *Lowe, J. 1715* (K); Okomu Forest Reserve, Compartment No. 6°20'N 5°15'E, 24 January 1948 (fl), *Brenan 8921* (FHO,K); Okomu Forest Reserve, Compartment No. 55. 6°20'N 5°15'E, 11 February 1948 (fl, fr), *Brenan 8994* (FHO); Okomu Forest Reserve, Compartment No. 6°20'N 5°15'E, 21 February 1948 (fr), *Brenan 9094* (FHO,K); Usonigbe. 5°59'N 6°11'E, 19 October 1949 (fr), *Ujor FHI 15286* (K).

**SAO TOMÉ & PRINCIPE, Sao Tomé Island:** Boca, Mponts, Hafé. (districto Novo Destino). 0°18'N 6°39'E. Alt: 600m, May 1885 (fl), *Moller, A.F. 1* (BM,COI); Juliana de Sousa. 0°11'N 6°28'E. Alt: 600m, 31 July 1959 (fl), *Espirito Santo 3974* (COI,LISC).

**SENEGAL, Casamance:** Région d'Oussouye: Kaeme. 12°31'N 16°33'W, 26 April 1963 (fl), *Berhaut 5863* (BR); Région d'Oussouye: Diantheme. 12°29'N 16°37'W, 1 August 1963 (fl), *Berhaut 6235* (BR); Région d'Oussouye: Boukitingo. 12°27'N 16°35'W, 4 August 1963 (st), *Berhaut 6295* (BR); Région d'Oussouye: Santiaba mandjac. 12°33'N 16°33'W, 20 March 1964 (fl), *Berhaut 7246* (BR); Région d'Oussouye: Boukitingo. 12°27'N 16°35'W, 22 November 1968 (fl), *Berhaut 7697* (BR); **Ziguinchor:** Boukitingo près d'Oussouye. 12°27'N 16°35'W. Alt: 8m, 1 August 1982 (fl), *Vanden Berghen 5302* (BR); Boukitingo près d'Oussouye. 12°27'N 16°35'W, 1 August 1982 (fl), *Vanden Berghen 5308* (BR); région d'Oussouye: Oussouye. 12°29'N 16°33'W, 23 April 1963 (fl), *Berhaut 5743* (BR); Santiaba-Mandjak. 12°22'N 16°33'W. Alt: 8m, 21 September 1985 (fr), *Vanden Berghen 7544* (BR); région d'Oussouye: Oukout. 12°28'N 16°33'W, 3 October 1961 (fr), *Adam, J.-G. 18227* (BR).

**SIERRA LEONE, UNKNOWN:** (fl), *Afzelius, A. s.n.* (UPS); (fl), *Afzelius, A. s.n.* (UPS); (fl), *Afzelius, A. s.n.* (UPS); (fl), *Afzelius, A. s.n.* (C); (fl), *Turner (Sierra Leone 1826- Miss) s.n.* (K); 1867 (fl), *Vogel, J.R.T. 104* (K); 1867 (fr), *Vogel, J.R.T. 134* (K); (fl), *Wallace, C.V. 182* (FHO); **Eastern Province:** 1960 (fl), *Bakshi 189* (K); **Northern Province:** Namaka. 8°31'N 12°17'W, 1914 (fl), *Thomas, N.W. 4573* (K); **Southern Province:** Lake Mabesi (Pukumu Krim). 7°56'N 12°49'W, 10 January 1954 (fl), *Jackson, W. 24* (K); Boma (Pukumu Krim). 7°56'N 12°49'W, 10 January 1954 (fr), *Jackson, W. 26* (K); Gola forest reserve. 7°16'N 11°18'W, 9 April 1952 (fl), *Small, D. 603* (K,P); Njala. 8°07'N 12°05'W, 12 July 1951 (fl), *Deighton 5558* (K,P); Njala. 8°07'N 12°05'W, 23 July 1951 (fl), *Deighton 5568* (K); Njala. 8°07'N 12°05'W, 17 September 1951 (fl), *Deighton 5592* (K,P); **Western Area:** 8°29'N 13°13'W. Alt: 274m, 12 August 1958 (fl), *Melville, F.A. 16* (K,P); Havelock. 8°29'N 13°14'W, April 1957 (fl), *Gledhill 20* (K); Very near top of Sugar Loaf Mont. 8°25'N 13°14'W. Alt: 716m, 13 August 1958 (fr), *Melville, F.A. 75* (K); Heddles Farm (Colomguli). 8°30'N 13°15'W, May 1912 (fl), *Lane-Poole 117* (K); 8 March 1930 (fl), *Nielsen, E. 1661* (C); Leicester, above Freetown. 8°27'N 13°13'W, 29 March 1958 (fl), *Hepper 2488* (K); On way to Lester peak. 8°27'N 13°13'W, 5 December 1891 (fl), *Scott Elliot 3834* (K); Bay on South Side of Wale River. 8°17'N 13°11'W, 21 June 1967 (fl), *Morton, J.K. SL 4318* (K).

**UGANDA, Western Province:** Ishasha Gorge. 0°54'S 29°42'E, 22 February 1998 (fl), *Hafashimana 479* (K); Bwindi Impenetrable National Park, (Kayonza). 0°54'S 29°42'E. Alt: 1400m, 25 February 1995 (fl), *Nkuutu BW95U 004* (C).

**Key literature:** Bamps & Farron (1967), Cheek et al. (2004), Farron (1963, 1985),



Hawthorne & Jongkind (2006), Hooker & Bentham (1849), Hutchinson, Dalziel & Keay (1954), Tieghem (1902).

**Campylospermum sacleuxii** (Tiegh.) Farron

**Fig. 24**

Bull. Jard. Bot. État Bruxelles 35: 401 (1965). – *Cercanthemum sacleuxii* Tiegh., J. Bot. (Morot) 16: 198 (June 1902). – *Ouratea sacleuxii* (Tiegh.) Beentje, Utafiti 1(2): 70 (1988). – *Gomphia sacleuxii* (Tiegh.) Verdc., Fl. trop. E. Africa, Ochnac.: 50 (2005). – Type: *Sacleux 1551* (holotype: P!; isotype: P!), Tanzania, Zanzibar, Ngourou, September 1894.

*Tree* up to 15 m tall, with branched trunk; twigs with brownish bark. *Stipules* **persistent, fused and present on internode**, triangular, **5–8 mm long**. *Leaf*: petiole **3–6 mm long**; leaf blade obovate to narrowly elliptic-obovate or narrowly elliptic-obspathulate, **(12–)16–30(–33) x (4–)6–10(–13) cm**, ratio **2.2–4.0**, base **cuneate to rounded** or **subcordate**, apex **acute to acuminate**, parchmentaceous, slightly bullate, medium green above, paler green below, dull on both sides, margin **serrate, teeth ending in a dark tip**; venation: midrib flattened to slightly prominent above, sometimes sunken in the basal half, prominent below, main lateral veins 13–25 on either side, **6–25 mm apart**, above prominent but often running through a gully due to the bullateness of the leaf, prominent below, making a slight angle with the midrib, **parallel at first but towards the margin slightly curved upward and often splitting into two nerves before reaching the margin**, intermediate lateral veins **0–2** in between each pair of main lateral veins, prominent on both sides, tertiary venation **scalariform, perpendicular to the main lateral veins**, distinct on both sides. *Inflorescence* **axillary** (sometimes subterminal and just below the small terminal bud), **unbranched**, lax, its main axis **flattened**, (7–)9–28(–39) cm long; pairwise scales at the base of peduncle persistent; cymules 0.5–1(–2) cm apart, 1–8-flowered; bracts **persistent**, triangular, **2–3 mm long**. *Flower*: pedicel 5–15(–20) mm long, articulated at 1–2 mm from the base; sepals **ovate**, in flower 6–7 x 2–3 mm, in fruit 7–8 x 2–4 mm, base **rounded**, apex **acute**; petals **obovate**, (8–)10–12 x 4–6 mm, cuneate at base, **rounded** at apex; stamens: anthers 6–7 mm long; ovary 1–2 mm long; style 7–10 mm long. *Fruit*: receptacle c. 1 mm thick in flower, in fruit 2–3 mm; drupelets 1 to 2 well developed per receptacle, **obovoid**, 5–6 x 4–5 mm; cotyledons accumbent, similar in size.

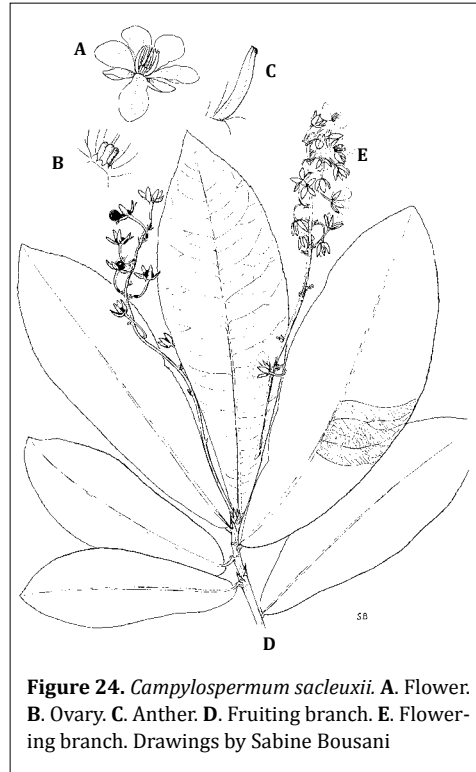
**Notes:** This species is only known from southernmost Kenya and Tanzania and has the same distribution area as *C. scheffleri* (Engl. & Gilg) Farron. These two species also share a close resemblance in terms of leaf venation pattern and the axillary, unbranched and flattened peduncle. *C. sacleuxii* differs from *C. scheffleri* by its generally much longer inflorescence and broader leaves with an acute to acuminate (not rounded to obtuse) apex and scalariform (not mainly reticulate) tertiary venation being perpendicular to the main laterals.

**Distribution:** southern Kenya and Tanzania (Map 25).

**Ecology:** lowland forest, dry evergreen forest, riparian forest; at 40–1400 m altitude.

**Phenology:** flowers observed in January, April and from July to December; fruits observed from January to April, in June and from September to December.

**IUCN conservation status:** LC. EOO=29,114 km<sup>2</sup>, AOO=29,458 km<sup>2</sup>, locations=16 (cell width=54 km). Although this species has a comparatively limited area of distribution, there is a fair amount of herbarium specimens (30) which suggests it is not rare. Although we have not seen specimens collected in the last decade, several others originate from Forest Reserves such as Lunguza, Lukoga, Mtibwa in Tanzania and Shimba in Kenya. Therefore, the category of Least Concern seems most appropriate.



**Figure 24.** *CampylospERMUM sacleuxii*. A. Flower. B. Ovary. C. Anther. D. Fruiting branch. E. Flowering branch. Drawings by Sabine Bousani

**Specimens examined:**

**KENYA, Coast:** Shimba Hills. 4°14'S 39°25'E, (fl, fr), *Ross, K.S. s.n.* (EA); Shimba Hills (Longomwagandi area). 4°14'S 39°25'E. Alt: 1400m, 10 February 1968 (fr), *Magogo 52* (BR,K); Shimba Hills (Longomwagandi area). 4°14'S 39°25'E. Alt: 442m, 21 February 1968 (fr), *Magogo 166* (BR,EA,K,UPS); Shimba Hills, Longo Mwagandi. 4°14'S 39°25'E. Alt: 381m, 12 April 1968 (fr), *Magogo 808* (K); Shimba Hills. 4°14'S 39°25'E. Alt: 304m, December 1977 (fl), *Sturrock 2309* (EA); Shimba Hills Game Reserve. 1 mile east of junction with main road; on road to Geriama Point. 4°14'S 39°25'E. Alt: 304m, 7 December 1972 (fl, fr), *Spjut 2728* (EA,K); Shimba Hills, Longomagandi. 4°14'S 39°25'E. Alt: 390m, 18 March 1991 (st), *Luke 2735* (EA,K); Longo Magandi Forest or Makadara forest. 4°14'S 39°25'E. Alt: 480m, 9 December 1975 (fr), *Kokwaro 4009* (EA); Gangari Forest. 4°23'S 39°28'E. Alt: 40m, 28 November 1996 (fl), *Luke 4542* (K); Gogoni. 4°25'S 39°28'E, June 1962 (fr), *Birch 62/62* (EA); Shimba Hills, Longo Magandi. 4°14'S 39°25'E. Alt: 380m, 7 April 1969 (fl, fr), *Faden 69/491* (EA).

**TANZANIA, Morogoro:** Kilombero West Scarp Forest Reserve, T7. 8°03'S 36°20'E. Alt: 400m, 6 March 1996 (fr), *Frimodt-Møller 160* (K); Turiani. 6°09'S 37°35'E, November 1953 (fr), *Paulo, S. 196* (EA,K); Mtibwa Forest Reserve. 6°07'S 37°39'E, August 1952 (fl), *Semsei 913* (EA,K); Matundu, Ifakara. 8°08'S 36°41'E, 17 September 1994 (fl, fr), *Kisena 1438* (K); Matundu, Ifakara. 8°08'S 36°41'E, 17 September 1994 (fr), *Kisena 1442* (K); Turiani. 6°09'S 37°35'E, November 1953 (fl), *Semsei 1471* (EA,K); Lukoga Forest Reserve. 8°08'S 36°41'E, 6 November 1961 (fr), *Semsei 3391* (EA,K); Sanje Falls. 7°46'S 36°54'E. Alt: 750m, 23 July 1983 (fl), *Polhill, R.M. 5122* (K); Turiani falls. 6°09'S 37°35'E, 8 December 1935 (fl), *Burt, B.D. 5406* (BM,EA,K); Eastern province. 6°08'S 37°35'E, 4 November 1947 (fl), *Brenan 8284* (FHO,K,WAG); Ngambaula forest reserve. 6°59'S 37°44'E. Alt: 300m, 22 August 2000 (fl, fr), *Mhoro, E.B. UMBCP 409* (C,MO); **Tanga:** Amani. 5°06'S 38°38'E, January 1951 (st), *Paol, S. 1* (EA,K); Sigi valley, 8 miles below Amani, c 1500 ft., 457m, 5°06'S 38°39'E. Alt: 457m, 29 December 1956 (fl, fr), *Verdcourt 1750* (BR,EA,K); Longuza at 170 m.a.s.l. 5°03'S 38°42'E, 7 October 1986 (st), *Ruffo 1867* (C,K); Longuza. 5°03'S 38°42'E, 20 October 1986 (fr), *Ruffo 1933* (K); Lunguza Forest, Zamaa forest. 5°10'S 38°48'E, 19 January 1978 (fl, fr), *Kibuwa 2998* (EA); Muheza, Zamaa Sigi river. 5°10'S 38°48'E,

16 November 1981 (fl), *Kibuwa 5487* (UPS); Korogwe by Sigi R. below Longuza Hill. 5°06'S 38°42'E, 19 November 1947 (fl), *Brenan 8348* (C,FHO,K); East Usambara Mts along the Sigi river between Mangubu and Fanusi villages. 5°08'S 38°39'E. Alt: 200m, 29 October 1986 (fr), *Borhidi 86/ 294* (UPS).

**Key literature:** Beentje (1994), Farron (1965), Tieghem (1902c), Verdcourt (2005).

### **Campylospermum scheffleri (Engl. & Gilg) Farron**

Bull. Jard. Bot. État Bruxelles 35: 401 (1965). – *Exomicrum scheffleri* (Engl & Gilg) Tiegh., Ann. Sci. Nat., sér. 8, Bot. 18: 38 (June 1903). – *Ouratea scheffleri* Engl. & Gilg, Bot. Jahrb. Syst., 33: 262 (1904). – *Gomphia scheffleri* (Gilg) Verdc., Fl. trop. E. Africa, Ochnac.: 48 (2005). – Type: *Scheffler 189* (holotype: B†; isotype: E!, EA!, K!, Z!), Tanzania, Derema, Ugamba, 1899.

*Ouratea schusteri* Gilg ex Engl., Pflanzenw. Afr. 3, 2: 389 (1921). – *Gomphia scheffleri* subsp. *schusteri* (Engl.) Verdc., Fl. trop. E. Africa, Ochnac.: 49 (2005). – Neotype (designated here): *Schlieben 2825* (holotype: B!; isotypes: G!, LISC!, MA!, P!, Z!), Tanzania, Bezirk Morogoro, Uluguru Gebirge, NW side, October 18<sup>th</sup> 1932. **syn. nov.**

*Gomphia scheffleri* subsp. *taitensis* Verdc., Fl. trop. E. Africa, Ochnac.: 49 (2005). – Type: *Drummond & Hemsley 4342* (holotype: K!; isotype: EA!), Kenya, Taita Hills, 8 km NNE of Ngerenyi, Ngangao, September 15<sup>th</sup>, 1953. **syn. nov.**

*Tree* up to 25 m tall, with branched stem; twigs with brownish bark. *Stipules* **persistent**, triangular, 2–3 mm long. *Leaf*: petiole 5–10 mm long; leaf blade elliptic to oblong-elliptic or oblong, **(4–)6–15(–20) x (2–)3–5(–7) cm**, ratio **2–4.5**, base **cuneate to rounded**, apex **obtuse to rounded**, parchmentaceous to coriaceous, not bullate, glossy green above, paler green below, margin serrulate to shallowly so; venation: midrib flattened above, prominent below, main lateral veins 13–20 on either side, 5–12 mm apart, slightly prominent above, prominent below, more or less at an oblique to right angle with the midrib and curved upwards toward the margin, intermediate lateral veins 0–1 in between each pair of main laterals, prominent on both sides, tertiary venation with few scalariform veins perpendicular to the midrib but otherwise reticulate, distinct on both sides. *Inflorescence* **axillary, unbranched**, lax, its main axis 3–15 cm long, **flattened**; pairwise scales at the base of peduncle absent; cymules 1–2 cm apart, 2–6-flowered; bracts persistent, triangular, c. 1 mm long. *Flower*: pedicel 6–11 mm long, articulated at 1–3 mm from the base; sepals elliptic, 3–5 x 2–4 mm in flower, 3–6 x 2–5 mm in fruit, base cuneate, apex acute; petals oblanceolate-oblong to obovate, 4–10 x 1–6 mm, base shortly clawed, apex obtuse to rounded; stamens: anthers 4–5 mm long; ovary c. 1 x 1 mm, style c. 4 mm long. *Fruit*: receptacle c. 1 mm high in flower, 3 x 3 mm in fruit; drupelets 1 to 3 well developed per receptacle, obovoid, c. 7 x 6 mm; **cotyledons accumbent, similar in size.**

**Notes:** Verdcourt (2005) distinguished three subspecies based on the shape and size of the petals and the distinctness of the tertiary venation. After having studied all material available, we conclude that both characters are too variable, not constant even within

a subspecies, to be able to make a clear distinction within the material. The tertiary venation can even vary between duplicates of the same collection. Thus, we decided not to recognize Verdcourt's subspecies.

The name *Ouratea schusteri* was published without a reference to a specimen that could serve as the type. It does give "Uluguru, Lupanga" as the origin, but no specimen could be traced that bears this indication and was collected before 1921. We conclude that the original material was most likely destroyed during World War II in Berlin and were forced to select a Neotype. We opted for *Schlieben 2825* because it originates from the same mountain ridge, duplicates are present in at least six herbaria, and it comprises complete flowering material.

*C. scheffleri* is close to *C. sacleuxii*; see below that species for the distinctive characters.

**Distribution:** southern Kenya and Tanzania (**Map 26**).

**Ecology:** evergreen and deciduous forest, montane forest, swampy forest, on steep slopes, along streams and on shallow rocky soil; at 1400–2150 m altitude.

**Phenology:** flowering all year round; fruits observed from January to April and from September to December.

**IUCN conservation status:** LC. EOO=66,024 km<sup>2</sup>, AOO=59,201 km<sup>2</sup>, locations=34 (cell width=63 km). Although this species has a comparatively limited area of distribution, there is a fair amount of herbarium specimens (47) which suggests it is not uncommon. It is found in Udzungwa National Park in Tanzania in Forest Reserve such as Shagayu Uluguru, Ndundulu, Lutindi, Shagai in Tanzania and Taita hills in Kenya, and its most recent collection dates from 2011. Therefore, the category of Least Concern seems most appropriate.

### **Specimens examined:**

**KENYA, Coast:** Taita Hills. 3°25'S 38°20'E, 2011 (fl), *Roelen 105* (BR); Mbololo Forest. 3°19'S 38°27'E. Alt: 1850m, 13 May 1985 (fl), *Taita Hills Expedition 407* (K,US); Ngangao Forest. 3°22'S 38°20'E. Alt: 1875m, 17 May 1985 (fl), *Taita Hills Expedition 571* (BR,US); Western side of Mbololo Hill forest. 3°17'S 38°28'E. Alt: 1750m, 7 July 2000 (fl), *Kamau Wakanene 638* (EA,K); Ngangao Forest. 3°22'S 38°20'E. Alt: 1875m, 19 May 1985 (fl), *Taita Hills Expedition 758* (K); Mbololo Forest. 3°19'S 38°27'E. Alt: 1850m, 28 May 1985 (fl), *Taita Hills Expedition 952* (US); Ngangao, 5 miles N.N.E. of Ngerenyi Teita Hill. 3°25'S 38°20'E. Alt: 1850m, 15 September 1953 (fl), *Drummond, R.B. 4342* (B,EA,K); Kisigau, Rukanga route-false peak. 3°50'S 38°40'E. Alt: 1480m, 1 June 1998 (fl), *Luke 5364* (EA,K); Taita Hills, Mbololo Hill (Mraru ridge). 3°21'S 38°27'E. Alt: 1850m, 17 October 1970 (st), *Faden 70/724* (EA); Mt Kasigau, route from Rukanga to summit. 3°50'S 38°40'E. Alt: 1645m, 5 April 1983 (st), *Faden 71/183* (B,EA); Taita hills, Mbololo Hill. 3°20'S 38°27'E. Alt: 1600m, 29 December 1971 (fl), *Faden 71/977* (EA,K,UPS); Taita hills, Mbololo Hill (Mraru Ridge). 3°19'S 38°27'E. Alt: 1750m, 28 May 1972 (fl), *Faden 72/278* (EA,K,UPS).

**TANZANIA, Iringa:** Uzungwa Mountain NP. Sonjo-Mwanihana Route. 7°49'S 36°51'E, 8 November 1997 (fr), *Luke 5075* (EA,K); Udzungwa Mountain National Park, Pt 224. 7°46'S 36°50'E. Alt: 1500m, 28 September 2001 (fl), *Luke 7907* (BR,EA,K,MO,NHT,US); Ndundulu Forest Reserve, ridge N. of Camp 590. 7°47'S 36°30'E. Alt: 1460m, 9 September 2004 (fr), *Luke 10423* (EA,K); Udzungwa Scarp F.R. 8°23'S 35°58'E. Alt: 1950m, 18 December 1997 (fl), *Frimodt-Møller TZ 686* (C,K); **Morogoro:** Uluguru South forest reserve, Morogoro region. 1.8 km southeast of Kimhandu hill. 7°11'S 37°41'E. Alt: 2154m, 16 October 1993 (fr), *Høst 107* (C); Lupanga Peak. 6°52'S 37°42'E. Alt: 1700m, 6 August 1981 (fl), *Lovett, J.C. 143* (K); Lupanga Peak. 6°52'S 37°43'E. Alt: 1800m, 6 August 1981 (fl), *Lovett, J.C. 144* (K); Uluguru, burdiku. 7°10'S 37°40'E. Alt: 1859m, 27 January 1935 (fl), *Bruce 672* (BM,K); N.W. Uluguru N. forest Reserve; rigde to the east of Mwere Valley. 6°55'S 37°40'E. Alt: 1650m, 22 July 1972 (fl), *Mabberley 1257* (K); Morogo: Uluguru-Gebirge NW seite. 6°55'S 37°50'E, 18 October

1932 (fl), *Schlieben 2825* (B,G,LISC,MA,P,Z); Mwanihana F.R. above Sanje village. 7°50'S 36°55'E. Alt: 1700m, 10 October 1984 (fl), *Thomas, D.W. 3834* (K); Bez. Morogoro, Uluguru-Geb. NW side. 6°55'S 37°50'E. Alt: 1700m, 21 June 1933 (fl), *Schlieben 4011* (B,BM,G,K,MA,US,Z); Lupanga, N.W slope; Uluguru, near Morogoro. 6°52'S 37°43'E, 14 February 1970 (fl, fr), *Harris, B.J. 4098* (EA); Lupanga Peak. 6°52'S 37°42'E. Alt: 1800m, 26 June 1983 (fl), *Polhill, R.M. 4921* (K); Morogoro-Lupanga peak. 6°52'S 37°43'E, 16 August 1951 (fl), *Greenway 8620* (B,EA,FHO,K); Bondwa road. 6°49'S 37°49'E. Alt: 1646m, 22 January 1976 (fl), *Cribb, P.J. 10393* (K); Rubeho: Ukwiva FR pt 17-pt 18. 7°07'S 36°39'E. Alt: 2030m, 1 June 2005 (fl), *Luke 11079* (EA,NHT); **Tanga**: Shagayu forest. 4°30'S 38°18'E. Alt: 1981m, April 1953 (fl), *Procter 161* (EA,K); Usambara, Derema. 5°05'S 38°38'E, 1899 (fr), *Scheffler 189* (BM,E,EA,FHO,K,WAG,Z); 4°30'S 38°18'E. Alt: 1981m, (fl), *Procter 217* (EA,K); Amani. 5°06'S 38°38'E, April 1926 (fl), *Burt, B.D. 446* (K); 5°06'S 38°38'E, 7 March 1906 (fl), *Zimmermann, N. 1100* (EA); S.W. Shagai forest, 2 km S.E. Sunga, West Usambaras. 4°32'S 38°14'E, 2 March 1953 (fl, fr), *Drummond, R.B. 1414* (B,EA,K); 5°06'S 38°38'E, 7 October 1905 (fr), *Braun, K.P.J.G. 3426* (EA); 5°06'S 38°37'E, 1 March 1913 (fr), *Amani 3886* (FHO); 5°06'S 38°38'E, March (fr), *Grote 3886* (EA,K); 5°06'S 38°38'E, 18 April 1922 (fr), *Dancarlos 6049* (EA,K); Shagai Forest Reserve. 4°31'S 38°18'E, June 1951 (fl), *Eggeling 6152* (EA,K); Sangarawe, E. Usambaras. 5°90'S 38°29'E, 21 November 1947 (fl), *Brenan 8359* (FHO); West Usambara Mts. Shagayu F.R. NW slope of the summit 2.5 km ENE of Shagayu Sawmill. 4°30'S 38°18'E. Alt: 1950m, 14 March 1984 (fl), *Borhidi 84/ 854* (UPS); West Usambara Mts. Shagayu F.R. SE ridge of Shagein peak. 4°58'S 39°00'E. Alt: 1930m, 22 October 1986 (fl), *Borhidi 86/ 102* (K,UPS); East Usambara Mts, Lutindi Forest Reserve, Nilo peak area. 4°53'S 38°38'E. Alt: 1440m, 11 May 1987 (fl), *Iversen, S.T. 87/ 468* (K); Amani. 5°06'S 38°38'E, 1903 (fl), *Warnecke Amani 245* (BM,E,EA,K,Z); Sangarawe. 5°08'S 38°37'E, 9 November 1916 (fr), *Zimmermann, N. g 6665* (EA); 5°05'S 38°36'E, 27 February 1917 (fr), *Zimmermann, N. g 6666* (EA).

**Key literature:** Dale & Greenway (1961), Farron (1963, 1985), Verdcourt (2005).

***Campylospermum schoenleinianum* (Klotzsch) Farron.**

**Fig. 25**

Bull. Jard. Bot. Etat Bruxelles 35: 402 (1965). – *Gomphia schoenleiniana* Klotzsch, Abhandl. Kön. Akad. Wiss. Berlin, 1856, Phys. Abhandl.: 238, tab. IV (1857). – *Monelasmum schoenleinianum* (Klotzsch) Tiegh., Ann. Sci. Nat., sér. 8, Bot. 18: 35 (June 1903). – *Ouratea schoenleiniana* (Klotzsch) Gilg, Bot. Jahrb. Syst. 33: 264 (1904). – Type: *Schoenlein s.n.* (holotype: B†). Lectotype (designated here): Tab. IV in Klotzsch, Abhandl. Kön. Akad. Wiss. Berlin, 1856, Phys. Abhandl.: 238 (1857).

*Tree* up to 10 m tall, rarely scrambling, with branched stem; twigs with brownish bark. *Stipules* **persistent**, triangular, 2–4 mm long. *Leaf*: petiole 0–5 mm long, stout; leaf blade elliptic-obovate to narrowly so or narrowly elliptic-spathulate, **(8–)12–33 x (2–)3–10.5 cm**, ratio **(2.3–)2.7–5.5** base **cordate to auriculate**, apex acute to acuminate, coriaceous to papery, not bullate, margin entire to serrulate, upper side glossy dark green, lower side bright green; venation: midrib flattened above, prominent in the basal half below, main lateral veins 20–30 on either side, **5–10(–15) mm apart, prominent to slightly so above, not prominent below**, at a ± right angle with the midrib and curved upwards, intermediate lateral veins **0–2 in between subsequent main ones**, not or slightly prominent above, tertiary venation scalariform and perpendicular to oblique to the main lateral veins, but reticulate towards the midrib, **distinct on both sides**. *Inflorescence* terminal, branched or rarely unbranched, **lax, slender, pendulous**, its main axis (10–)12–27(–39) cm long, cylindrical; pairwise scales persistent at the base of the peduncle, few, triangular, 2–5 mm long; racemes **(0–)1–7, (3–)13–20(–27) cm long**; cymules **5–20 mm apart, 1–6-flowered**; bracts persistent, c. 1 mm long. *Flower*:

pedicel 5–10 mm long, articulated at c. 2 mm from the base; sepals **ovate to narrowly ovate**, in flower 5–7 x 2–3 mm, in fruit 6–7 x 3, apex acute; petals **broadly obovate to broadly spatulate, 6–9 x 5–6 mm, truncate** at base, **rounded** at apex; stamens: anthers 4–5 mm long; ovary c. 1 mm long; style c. 4 mm long. *Fruit*: receptacle 5 mm thick; drupelets 2 to 5 well developed per receptacle, **broadly ellipsoid to globose, 6–8 x 6–7 mm**; cotyledons **incumbent, similar in size**.

**Notes:** The lax inflorescence carrying well-developed racemes readily distinguishes this species from the rest of the West African ones with a cordate to auriculate leaf base. Since the holotype has been destroyed in Berlin and no duplicates or other original plant material could be traced, we are forced to designate the accompanying plate, which should also be regarded as part of the original material (McNeill, 2012 (Melbourne Code): Art. 9.3), as the lectotype (McNeill, 2012 (Melbourne Code): Art. 9.12).

**Distribution:** Guinea, Sierra Leone, Liberia, Ivory Coast and south-western Ghana (**Map 27**).

**Ecology:** in primary and secondary forest, on gentle slopes, in inundated forest, in riverine and gallery forest; on sandy, loamy and lateritic soil; at 20–680 m altitude.

**Phenology:** mature flowers and fruits collected almost all year round.

**Vernacular names:** **Ivory Coast:** abbey (Naé).

**Uses:** In Ivory Coast, a decoction of the root-bark is taken in very small doses as a strong purgative (Burkill 1997)

**IUCN conservation status:** LC. EOO=346,655 km<sup>2</sup>, AOO=424,416 km<sup>2</sup>, locations=94 (cell width=117 km). This species is well represented in herbaria suggesting it is not uncommon. It is found inside and outside protected areas and has numerous recent collections. Therefore, the category of Least Concern has been assigned.

### **Specimens examined:**

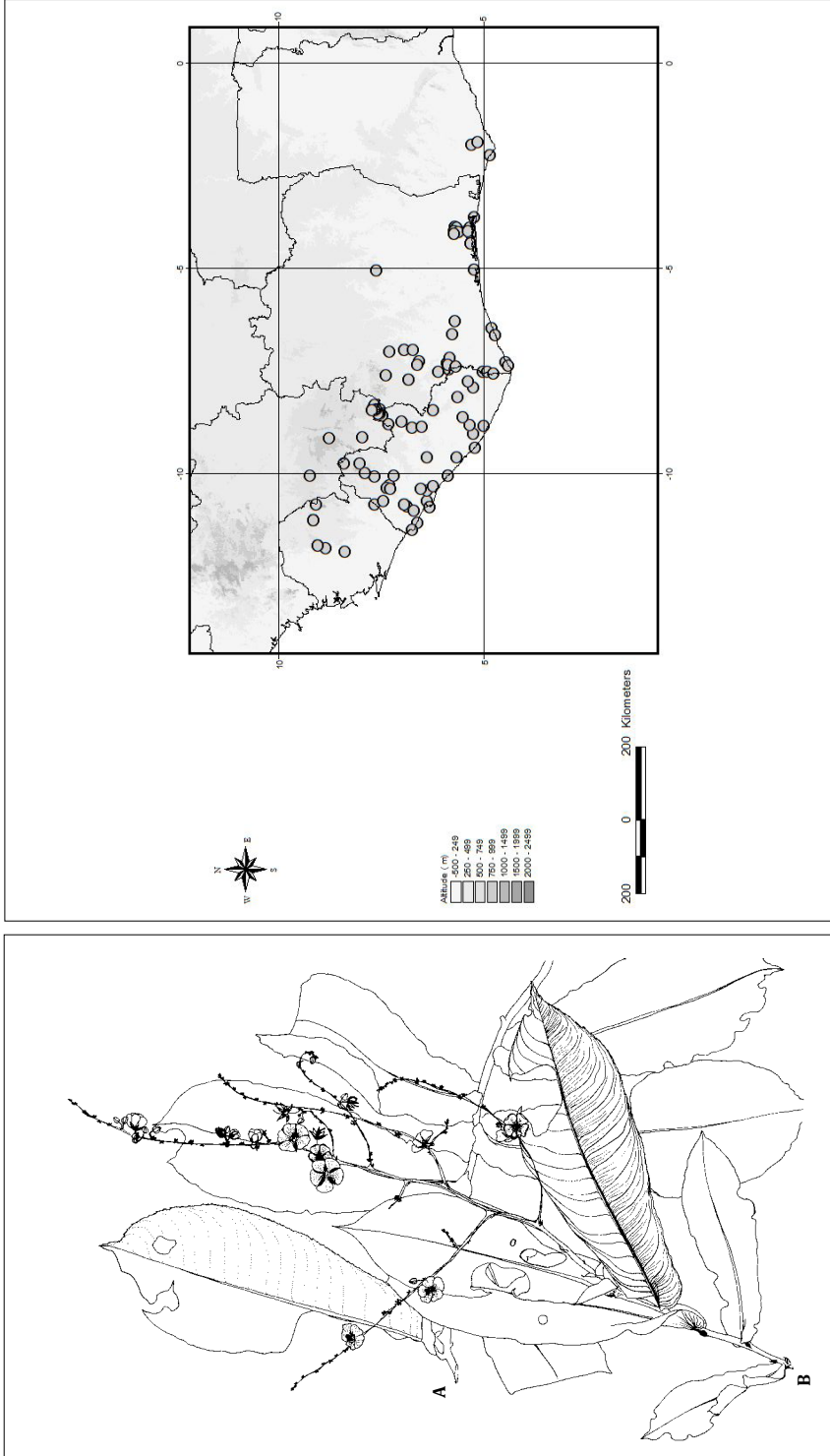
**CONGO (BRAZZAVILLE), UNKNOWN:** 28 September 1965 (fr), *Farron 4627* (P).

**GHANA, Western Region:** near Axim. 4°52'N 2°14'W, February 1934 (fl), *Irvine, F.R. 2209* (E,K); Subiri F.R. on boundary. 5°18'N 1°59'W, 13 December 1947 (fl), *Foggie 5119* (FHO); Subiri F.R. (Benso). 5°09'N 1°54'W, September 1951 (fl), *Andoh FH 5573* (K,P).

**GUINEA, Faranah:** région de Kissidougou (Sangalibadou). 9°14'N 10°02'W, February 1950 (st), *Schnell 4625* (P); Cercle de Faranah. Timbikounda. 9°05'N 10°45'W, 31 January 1909 (fl), *Chevalier, A.J.B. 20614* (K,P);

**Nzérékoré:** Ténémadou. 8°46'N 9°08'W, 1949 (st), *Adam, J.-G. 3395* (BR); Nimba Mountain. 7°37'N 8°25'W, 29 September 1949 (fl), *Adam, J.-G. 6327* (P); Nimba Mountains, Gba River valley. 7°41.5'N 8°24.7'W. Alt: 590m, 6 December 2006 (fl), *Jongkind 7510* (WAG); Nimba Mountains, forest on low altitude N of Mifergui Camp. 7°42.8'N 8°23.6'W. Alt: 530m, 20 November 2007 (fl), *Jongkind 8077* (P,WAG); Nimba Mountains, E of Nion. 7°35.7'N 8°28.0'W. Alt: 665m, 11 December 2007 (fl), *Jongkind 8197* (WAG); Forêt Classée de Mt Yonon. 7°58.4'N 9°06.8'W. Alt: 640m, 14 May 2011 (st), *Jongkind 10800* (BR,MO,WAG); Nimba Mountains, Cavally River West of Mt Leclerc. 7°39.63'N 8°25.99'W. Alt: 595m, 22 September 2011 (fl), *Jongkind 11180* (MO); Cavally River west of the Nimba mountains. 7°43.76'N 8°26.26'W. Alt: 527m, 10 July 2012 (st), *Jongkind 11450* (MO); NW of Nzo. B19.11Bd. 7°40'N 8°19'W, 17 December 1954 (fl), *Roberty 16052* (G).

**IVORY COAST, Abidjan:** Campus. 5°21'N 4°00'W, December 1972 (fr), *Frédoux 162* (G); Banco. 5°23'N 4°03'W, 19 September 1956 (fl), *Wilde, J.J.F.E. de 533* (WAG); P.N. Banco. 5°24'N 4°05'W, 2 January 1985 (st), *Poilecot 633* (G); Grand Bassam. 5°14'N 3°45'W, December 1949 (st), *Schnell 3932* (P); Abidjan, Banco Forest Reserve. 5°23'N 4°03'W, 11 October 1974 (fl, fr), *Koning, J. de 4080* (BR,MO,WAG); Adjopé-Azaguié. 5°38'N 4°06'W, 7



November 1950 (fl, fr), *Roberty 12620* (G,Z); Dabou. 5°20'N 4°23'W, 1905 (fl), *Chevalier, A.J.B. 15261* (LY); Adiopodoumé, B.30.8 Ef. 5°19'N 4°08'W, 3 November 1954 (fl), *Roberty 15388* (G); Dabou. 5°20'N 4°23'W, 1905 (fl), *Chevalier, A.J.B. 15465* (LY); Forêt de Banco. 5°23'N 4°03'W, 27 April 1981 (fl), *Aké Assi 15862* (G); Dabou. 5°19'N 4°23'W, 1905 (fl), *Chevalier, A.J.B. 19261* (P); Dabou. 5°19'N 4°23'W, 1905 (fl), *Chevalier, A.J.B. 19469* (P); **Agboville**: 3 km north of Abbé 50 km north of Abidjan, along road to Abengourou. 5°42'N 3°59'W. Alt: 50m, 21 January 1970 (fl), *Koning, J. de 28* (WAG); Yapo. 5°44'N 4°05'W, 26 July 1956 (fl), *Wilde, J.J.F.E. de 144* (WAG); Yapo. 5°44'N 4°05'W, 28 September 1956 (fl), *Wilde, J.J.F.E. de 584* (WAG); Forêt de l'Abbé. relevé 32. 5°40'N 4°00'W, 13 November 1991 (fl), *Chatelain 772* (G); Agboville, forêt de Yapo, relevé 43. 5°44'N 4°08'W, 18 January 1992 (fr), *Chatelain 950* (G); Yapo. 5°44'N 4°08'W, 4 December 1981 (fr), *Stäuble 1050* (G); Yapo. 5°44'N 4°08'W, 22 September 1950 (fl), *Roberty 12126* (G,Z,Z); **Bouaké**: Kokondekro. 7°38'N 5°02'W, 10 October 1991 (st), *Téré 1956* (G); **Daloa**: F.C. du Haut-Sassandra, Sud. Piste de V12, layon 28. 6°56'N 6°59'W, 14 February 1994 (st), *Kouamé 1086* (CSRS,G); Forêt classée du Haut Sassandra. 6°56'N 6°59'W, 14 February 1994 (st), *Kouamé 1086* (G); **Danané**: 1 km N. OF Yeale. 7°33'N 8°25'W, 17 December 1967 (fl), *Geerling 1824* (K,WAG); **Duékoué**: Plantation planche, Pinhou. 6°37'N 7°20'W, 27 January 1969 (fr), *Bamps 1950* (BR); Guesabo. 6°44'N 6°59'W, 3 August 1954 (st), *Jaeger, P. 4508* (P); **Grand-Lahou**: Nzida. 5°15'N 5°01'W, August 1955 (fl), *Nozeran s.n.* (P); **Guiglo**: Releve 15; Champ de riz, W of Gouléako. 5°51'N 7°25'W, 24 July 1983 (fl, fr), *Rouw, A. de 25* (WAG); Releve 77; Gouléako. 5°51'N 7°25'W, 5 December 1984 (fl, fr), *Rouw, A. de 107* (WAG); P.N. Tai. 5°50'N 7°10'W, 21 September 1986 (fl, fr), *Gautier, L. 400* (CSRS,G); Tai. 5°52'N 7°27'W, 4 December 1979 (fr), *Knecht 979* (G); Tiencoula 30 km N. of Tai. 6°07'N 7°30'W, 9 October 1963 (fl, fr), *Wilde, W.J.J.O. de 1034* (WAG); Parc National de Tai, 7 km E of Station de Recherche. 5°54'N 7°18'W. Alt: 200m, 15 November 1986 (st), *Maesen, L.J.G. van der 5277* (BR,MO,WAG); bassin du Cavally: pays des Yaba, village de Tébo et environs. 5°41'N 7°23'W, 10 July 1907 (fl), *Chevalier, A.J.B. 19391* (P); Tai. 5°52'N 7°27'W, 2 March 1981 (fl, fr), *Stäuble 1/15* (G); Tai. 5°52'N 7°27'W, 27 December 1981 (fr), *Stäuble 13/447* (G); Tai. 5°52'N 7°27'W, March 1982 (fl), *Stäuble 14/485* (G); Tai. 5°52'N 7°27'W, 20 November 1981 (fr), *Stäuble 2/362* (G); Tai. 5°52'N 7°27'W, 20 November 1981 (fr), *Stäuble 23/362* (G); Tai. 5°52'N 7°27'W, 4 March 1981 (fl), *Stäuble 25/37* (G); Tai. 5°52'N 7°27'W, 21 March 1982 (fl), *Stäuble 5/485* (G); **Man**: F.C. Scio, Pinhou, Lobykro à 5 km, bloc 30 Parcelle 143 de la Sodefor, à 200 m de la piste principale. 6°50'N 7°42'W, 7 October 2001 (fl), *Nusbaumer 766* (G); F.C. Scio, Pinhou, Lobykro à 5 km, bloc 28 Parcelle 141 de la Sodefor, près d'un champ à 200 m de la piste principale. 6°50'N 7°42'W, 13 October 2001 (fl), *Nusbaumer 783* (G); Man. 7°24'N 7°35'W, 14 March 1931 (fr), *Aubrèville SF 1057* (P); **San-Pédro**: 4°44'N 6°37'W, 6 September 1900 (fl, fr), *Thoiré 63* (P); San Pedro. 4°44'N 6°37'W, 16 September 1900 (fr), *Thoiré 101* (P); Forêt Classée de Monogaga. 4°48.70'N 6°26.20'W. Alt: 20m, 3 December 1997 (fr), *Jongkind 4128* (WAG); **Soubré**: Soubré. 5°47'N 6°36'W, 14 March 1979 (fl), *Knecht 688* (G); Duekoué-buyo 15 km à l'E de bahé. 6°35'N 7°15'W, 1 March 1969 (fl), *Bamps 2168* (BR,WAG); 43 km E. of Soubré 4 km S.E. of Guédéyo. 5°42'N 6°16'W. Alt: 150m, 16 December 1958 (fr), *Leeuwenberg 2176* (B,EA,K,WAG,Z); **Tabou**: Tabou. 4°25'N 7°21'W, 26 November 1961 (fr), *Unknown s.n.* (G); 20 km NE of Tabou, Ironia 200 m from the sea. 4°29'N 7°16'W, 1 September 1975 (fl), *Burg, W.J. van der 871* (BR,FR,MO,WAG); 17 km N of Grabo. 5°02'N 7°30'W, 14 April 1974 (st), *Breteler 7420* (BR,MO,WAG); Grabo. 4°55'N 7°30'W, 28 July 1907 (fl), *Chevalier, A.J.B. 19628* (P); pays des Tépo, village de Taté. 4°47'N 7°33'W, 7 August 1907 (fl), *Chevalier, A.J.B. 19798* (P); **Vavoua**: F.C. du Haut-Sassandra, Nord, relevé FNK15, 7°18'N 7°01'W, 22 February 1995 (fl, fr), *Kouamé 1408* (CSRS,G).

**LIBERIA, Gbarpolu**: Kpelle Forest. North of Gainkpa. 7°22.0'N 10°20.8'W. Alt: 350m, 13 December 2010 (fl), *Jongkind 10121* (BR,MO,WAG); Kpelle Forest. South of Gainkpa. 7°17.3'N 10°21.2'W. Alt: 340m, 17 December 2010 (fr), *Jongkind 10218* (WAG); **Grand Bassa**: Buibu, Bassa County. 9 September 1960 (fl), *Voorhoeve 65* (WAG); Bassa no. IV. 5°40'N 9°35'W, 2 December 1961 (fl), *Voorhoeve 700* (WAG); 5°53'N 10°03'W, 10 October 1897 (fl, fr), *Dinklage 1849* (B); 5°53'N 10°03'W, 24 October 1897 (fl), *Dinklage 1856* (B); Zolotown. 6°24'N 9°35'W, 13 December 1958 (fl), *Adam, J.-G. 16404* (P); **Grand Cape Mount**: Near Bendu, 6°38'N 11°11'W, 26 August 1968 (fl), *Breteler 5448* (WAG); Robertsport 6°45'N 11°22'W, 28 December 1947 (st), *Baldwin jr 10924* (K); **Grand Gedeh**: east of Tiama Town. 5°38.3'N 8°07.7'W. Alt: 280m, 30 May 2005 (fr), *Jongkind 6530* (WAG); Webo, Gwabia 5°16'N 7°53'W, 26 July 1947 (st), *Baldwin jr 6710* (K); Grebo Forest. 5°24'N 7°44'W. Alt: 200m, 10 December 2005 (fl), *Jongkind 7253* (WAG); Monroviatown 6°14'N 8°26'W, 10 August 1947 (st), *Baldwin jr 8005* (K); **Lofa**: 8 miles W of Peahatah across St Pauls River 7°12'N 10°02'W, 11 October 1926 (st), *Linder, D.H. 1009* (K); North Lorma National Forest. 8°02'N 9°44'W, 20 November 2005 (fl), *Jongkind 6700* (BR,G,K,WAG); Gola Forest. 7°27'N 10°40'W, 2 December 2005 (fl), *Jongkind 7102* (WAG); Vonjama. 8°25'N 9°45'W, 22 October 1947 (st), *Baldwin jr 9918* (K); Genna Loffa 7°54'N 9°59'W, 2 November 1947 (st), *Baldwin jr 10078* (K); Tawata 7°18'N 10°17'W, November 1947 (st), *Baldwin jr 10285* (K); near



Kondessu. 7°40'N 10°04'W, 15 December 1947 (st), *Baldwin jr 10670* (K); Ba, Mano River, near boundary with Grand Cape Mount. 7°40'N 10°45'W, 18 December 1947 (st), *Baldwin jr 10702* (K); **Montserrado**: Within 20 miles of Kakatow. 6°32'N 10°21'W, 1904 (fl, fr), *Whyte, A. s.n.* (K); Monrovia. 6°19'N 10°48'W, August 1898 (fl), *Delafosse s.n.* (P); Banks of Farmington River. 6°14'N 10°18'W, 23 December 1943 (st), *Bequaert (Liberia series) 5* (K); 1 mile east of Kle. 6°42'N 10°53'W, 7 October 1972 (fl), *Lemckert 7* (WAG); Firestone Plantation, Division 13. 6°23'N 10°24'W, 14 May 1970 (fl, fr), *Stoop - v.d. Kasteele 159* (MO,WAG); Gola National Forest, Bomi Hills. 6°56'N 10°45'W, 16 October 1965 (fl, fr), *Meer, P.P.C. van 187* (WAG); Gola National Forest, Bomi Hills. 6°56'N 10°45'W, 16 October 1965 (fl), *Meer, P.P.C. van 188* (WAG); University Forest 16 miles N. of Monrovia. 6°24'N 10°39'W, 14 November 1969 (fr), *Jansen, J.W.A. 1689* (WAG); Bomi Hills. (High forest. Lowland). 6°53'N 10°47'W, 9 October 1970 (fl), *Jansen, J.W.A. 2232* (WAG); Monrovia. 6°19'N 10°48'W, 22 September 1923 (fl), *Dinklage 2869* (Z); **Nimba**: National Forest, 18 miles N. of Tapeta. 6°45'N 8°52'W, 15 February 1961 (fr), *Voorhoeve 175* (WAG); Nimba County. Road from Tappeta to Ganta 2.5 km N. of Tappeta. Along the road. 6°31'N 8°51'W, 20 February 1966 (fl), *Meer, P.P.C. van 457* (WAG); SW of LAMCO Hq Camp. 7°29'N 8°34'W. Alt: 500m, 3 October 1964 (fl), *Adames 618* (K,UPS); Gbau 7°01'N 8°43'W, 22 September 1947 (fl), *Baldwin jr 9418* (K,US); Saniquellie. 7°19'N 8°47'W, March 1959 (fl), *Adam, J.-G. 13716* (C); Mont Nimba. 7°32'N 8°32'W. Alt: 500m, 15 December 1964 (fl), *Adam, J.-G. 20114* (K,UPS); Mt Nimba. 7°35'N 8°32'W. Alt: 500m, 5 January 1965 (fl, fr), *Adam, J.-G. 20428* (UPS); Yekepa. 7°35'N 8°32'W, 13 October 1969 (fl), *Adam, J.-G. 24224* (C); Mt Nimba-granfield. Yekepa. 7°35'N 8°32'W, 8 November 1969 (fl), *Adam, J.-G. 24757* (C); Jéképa. Mt Nimba. Jiti river. 7°35'N 8°32'W, 2 December 1969 (fl, fr), *Adam, J.-G. 25153* (C,P,UPS,WAG); **Sino**: 20 miles N. of Sinoe. 5°16'N 9°01'W, 16 January 1969 (fr), *Jansen, J.W.A. 1087* (WAG); Sapu NP, buffer zone, around Safari Camp on short distance of Sinoe River. 5°20.7'N 8°48.0'W. Alt: 115m, 22 November 2002 (fr), *Jongkind 5291* (BR,WAG); Babooni road not too far from main road. 5°31'N 8°37'W. Alt: 160m, 12 March 2009 (fl), *Jongkind 8953* (WAG); Sinoe Co. Sangwin 5°13'N 9°21'W, 9 March 1948 (st), *Baldwin jr 11312* (K); Kulo. 5°00'N 8°50'W, 13 March 1948 (fl), *Baldwin jr 11399* (K).

**SIERRA LEONE, UNKNOWN**: (fl), *Marmo 220* (K); **Northern Province**: Bumbuna. 9°03'N 11°44'W. Alt: 650m, 14 October 1914 (fl), *Thomas, N.W. 3118* (K); mabonto. 8°52'N 11°49'W, 20 October 1914 (fl), *Thomas, N.W. 3494* (K); Bumbuna. 9°03'N 11°44'W. Alt: 650m, 20 October 1914 (fl), *Thomas, N.W. 3817* (K); Bumbuna. 9°03'N 11°44'W, 20 October 1914 (fl), *Thomas, N.W. 3828* (K); Roniester. 8°23'N 11°54'W. Alt: 76m, 17 November 1914 (fl), *Thomas, N.W. 5287* (FHO); Loma. 9°10'N 11°07'W. Alt: 400m, 18 September 1964 (st), *Jaeger, P. 7524* (P); Loma. 9°10'N 11°07'W. Alt: 400m, 18 September 1964 (st), *Jaeger, P. 7538* (P); Loma. 9°10'N 11°07'W, 24 December 1965 (st), *Jaeger, P. 8675* (P); Loma. 9°10'N 11°07'W, 26 May 1966 (fr), *Jaeger, P. 9068* (G,P); Loma. 9°10'N 11°07'W. Alt: 540m, 26 March 1966 (st), *Jaeger, P. 9623* (P); **Southern Province**: (fl), *Thomas, D.G. 117* (FHO).

**Key literature**: Farron (1963, 1985), Hawthorne & Jongkind (2006), Hutchinson, Dalziel & Keay (1954).

### *Campylospermum squamosum* (DC.) Farron

**Fig. 26**

Bull. Jard. Bot. État Bruxelles 35: 402 (1965). – *Gomphia squamosa* DC., Ann. Mus. Natl. Hist. Nat. 17: 418 (1811). – *Oureatea squamosa* (DC.) Engl., Fl. Bras. 12(2): 318 (1876). – *Monelasmum squamosum* (DC.) Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 327 (1902). – Type: *Hb Lamarck s.n.*, P00295250 (holotype: P!), Tabago [erroneous origin].

*Monelasmum spiciforme* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 333 (1902). – *Oureatea spiciforme* (Tiegh.) Chev., Explor. Bot. Afrique Occ. Franc. 109 (1920). – Type: *Chevalier 551* (holotype: P!), Soudan, Mouquénéiba, Mars 1899.

*Exomicrum djallonense* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 340 (1902). – Type: *Paroisse 211* (holotype: P!), Guinea, Fouta Djallon, Bramayr, aux bords du Koukouri, 1893.

*Monelasmum djallonense* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 329 (1902). – Type: *Heudelot 945* (holotype: P!; isotype K!), Sénégal, près du Fouta Djallon, 1837.

*Monelasmum discolor* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 329 (1902). – Type: *Morson*

*s.n.* (holotype: not located, apparently «in Herb. Brown»), Sierra Leone.

*Monelasmum flexuosum* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 332 (1902). – Type: *Paroisse 149* (holotype: P!), Guinée, 1893.

*Monelasmum heudelotii* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 329 (1902). – Type: *Heudelot 745* (holotype: P; isotype: FHO!, G!, K(2x)!), Sénégal, près du Fouta Djallon, février 1837.

*Monelasmum konakrense* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 332 (1902). – Type: *Maclaud s.n.* (holotype: P!), Guinée, Konakry, 1897.

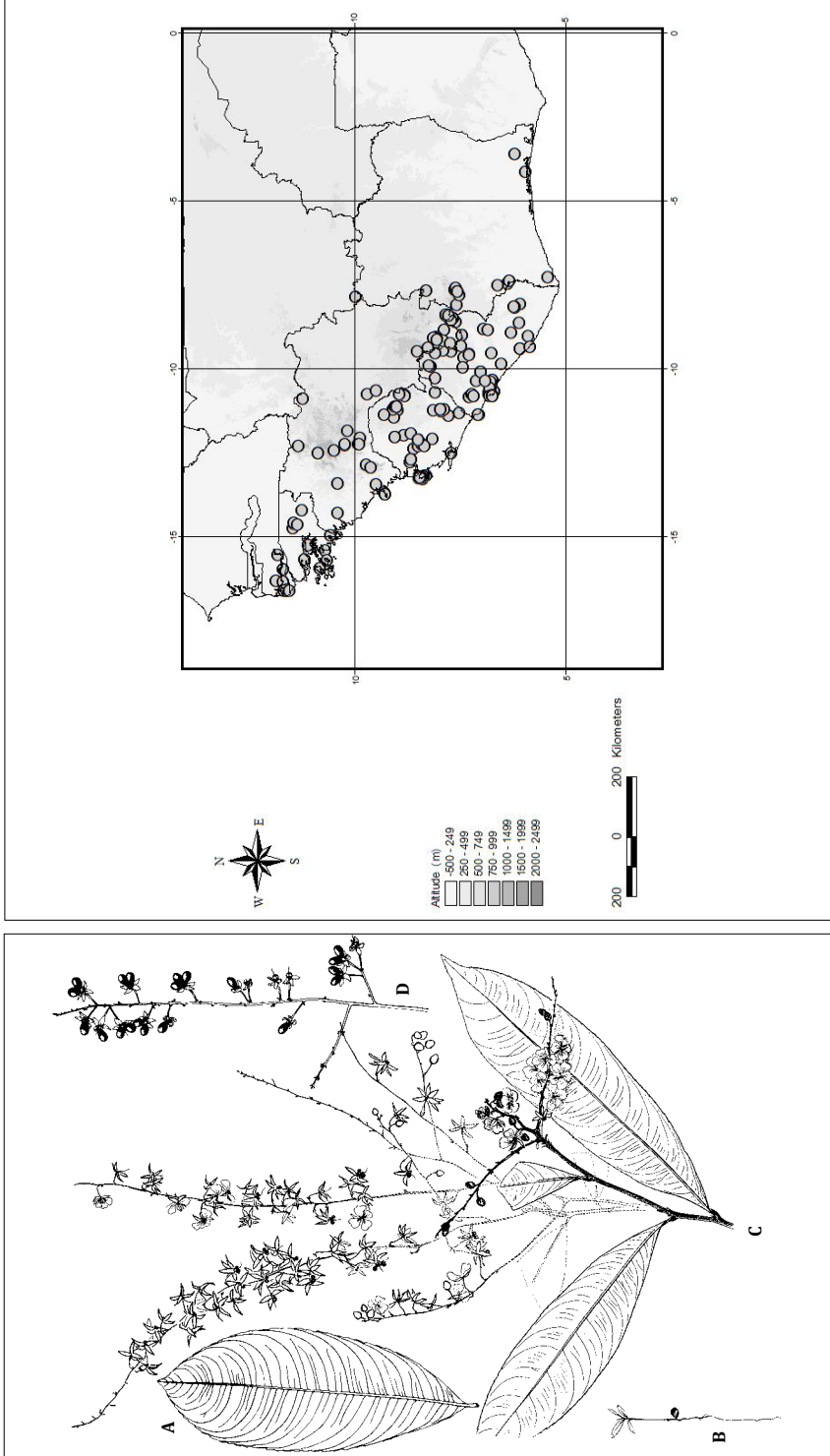
*Monelasmum maclaudii* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 332 (1902). – Type: *Maclaud s.n.* (holotype: P!), Guinée, Konakry, 1897.

*Monelasmum paroissei* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 332 (1902). – Type: *Paroisse 43* (holotype: P!), Guinée, Bogoutigny, 1893.

*Monelasmum persistens* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 331 (1902). – Type: *Pobeguain 28* (holotype: P!), Ivory Coast, Petit-Lahon, janvier 1895.

*Tree*, rarely scandent, **up to 10 m tall**, with branched stem; twigs with brownish bark. *Stipules* persistent, triangular, 1–3 mm. *Leaf*: petiole **2–7 mm** long, slender to fairly stout; leaf blade narrowly elliptic to elliptic or sometimes narrowly elliptic-ovate, **(5–)10–17(–21) x (2–)3–4.5(–5.5) cm**, ratio **2.4–3.7**, **base cuneate, apex acute to slightly acuminate**, parchmentaceous to coriaceous, not or rarely slightly bullate, margin **serrulate but entire toward the base**, glossy medium to dark green above, glossy paler green below; venation: midrib **prominent or slightly so on both sides**, main lateral veins 9–16 on either side, **4–15 mm apart**, prominent above, not prominent below, at a ± right angle with the midrib and curved upward, intermediate lateral veins 0–1 in between each pair of main laterals, tertiary venation scalariform or sometimes reticulate along the midrib, perpendicular to the midrib, **distinct on both sides**. *Inflorescence* **terminal** or rarely axillary, branched, lax, its main axis **(5–)10–19(–26) cm long**; pairwise **scales minute, persistent at the base of the peduncle**; racemes **1–5, 2–15(–26) cm long, held ± horizontally**; cymules **0.5–1 mm apart, 1–3-flowered**; bracts **persistent**, triangular, 1–2 mm long. *Flower*: pedicel 4–13(–18) mm long, articulated at **1–3(–5) mm from the base**; sepals narrowly ovate, in flower 5–8 x 1.5–2.5 mm, in fruit 6–9 x 3–4 mm, coriaceous, base truncate, apex acute; petals **obovate, 6–11(–13) x 5–7(–11) mm, shortly clawed at base, rounded** at apex; stamens: anthers 3–6 mm; ovary c. 1 mm long; styles 4–6 mm long. *Fruit*: receptacle 3–5 mm wide; drupelets 1–3 per receptacle, ± **reniform to subglobose**, 5–6 x 4–5 mm; cotyledons **incumbent**, ± similar **in size**.

**Notes:** At first glance, *C. squamosum* specimens with poorly developed inflorescences may resemble *C. congestum* (which normally has unbrached inflorescences) in having an elliptic leaf blade, a serrulate margin and prominent main lateral veins. However, *C. congestum* can be easily distinguished because of its peculiar, very fine and parallel



**Figure 26.** *CampylospERMUM squamosum*. **A.** Leaf blade. **B.** Young plant. **C.** Flowering and fruiting branch. **D.** Fruiting branch. Drawings by Sabine Bousani  
**Map 28.** Distribution of *CampylospERMUM squamosum*

tertiary venation. It also resembles *C. reticulatum*, but that species has dissimilar cotyledons (small outer cotyledon), a tertiary venation that is markedly darker than the surrounding leaf mass and caducous stipules that are generally much longer.

**Distribution:** from Senegal, Gambia, Guinea, Sierra Leone, Liberia and western Ivory Coast (**Map 28**).

**Ecology:** in primary and secondary forest, in gallery forest or rarely in palm tree forest, on slopes or along streams; on rocky and lateritic soil; at 15–1615 m altitude.

**Phenology:** flowering and fruiting all year round.

**Vernacular names:** **Sierra Leone:** Bunje, Etorai, Goboë, Yonibaua.

**Uses:** The young saplings are strong and very flexible. In Liberia, they are used to bind the drum-head on to hollow log drums, while the bark is used in poultices for topical application to areas of pain in the body (Burkill 1997).

**IUCN conservation status:** LC. EOO=605,770 km<sup>2</sup>, AOO=629,176 km<sup>2</sup>, locations=164 (cell width=162 km). This species is found inside National Parks such as Lofa and Sapo in Liberia and Taï in Ivory Coast. It is well represented in herbaria, suggesting it is not uncommon, and has several recent collections. Thus the category of Least Concern seems the most appropriate.

### **Specimens examined:**

**GUINEA, UNKNOWN:** 1895 (fl), *Maclaud 34* (P); Guinée Française. 1893 (fl), *Paroisse 149* (P); french Guinea. (fl), *Farmar 209* (BM,K); (fl), *Farmar 227* (BM,K); **Boké:** 10°56'N 14°18'W, April 1899 (fr), *Paroisse 45* (P); **Conakry:** surroundings Konakry. 9°31'N 13°43'W, (fl), *Lecerf s.n.* (P); Conakry. 9°31'N 13°43'W, (fl), *Maclaud s.n.* (P); Conakry. 9°32'N 13°41'W. Alt: 5m, 17 March 1902 (fl), *Debeaux 309* (BM,K,P,US); Iles de Los. 9°31'N 13°43'W, February 1905 (fl), *Chevalier, A.J.B. 12085* (LY); Ile de Los. 9°31'N 13°43'W, February 1905 (fl), *Chevalier, A.J.B. 12103* (P); Ile de Los. 9°31'N 13°43'W, February 1905 (fl), *Chevalier, A.J.B. 12117* (P); **Dingiraye:** Sankaran. 11°58'N 10°53'W, (fl), *Pobéguin (Guinea series) 827* (K,P); **Faranah:** Afrique occidentale, source du Niger. 9°05'N 10°45'W, 15 October 1944 (fl), *Jaeger, P. 105* (P); Afrique occidentale, source du Niger. 9°05'N 10°45'W, 18 October 1944 (fr), *Jaeger, P. 149* (P); Faranah ESE. 10°02'N 10°45'W, 30 March 1955 (fl), *Roberty 17246* (G); cercle de Faranah. 9°47'N 10°38'W, 22 January 1909 (fl), *Chevalier, A.J.B. 20479* (P); **Kindia:** Plantation de la Ouatama, bord de la Ouatamba (Friguiagbé). 9°57'N 12°56'W, 29 March 1937 (fr), *Chillou 97* (WAG); Dalaba. 29 March 1939 (fr), *Chillou 1205* (COI,K); French guinea: Friguiagbe. 9°57'N 12°56'W, 26 April 1939 (st), *Chillou 1292* (BR,P); Kakoulima. 9°46'N 13°27'W, February 1945 (st), *Schnell 2460* (P); cercle de Kindia. 10°04'N 12°51'W, March 1905 (fr), *Chevalier, A.J.B. 13109* (LY); Telimélé W. 10°56'N 13°25'W, 26 April 1955 (fr), *Roberty 17627* (G); Telimélé W. 10°56'N 13°25'W, 26 April 1955 (fl), *Roberty 17629* (G); **Labé:** Senegambia. 11°30'N 12°30'W, 1838 (fl), *Heudelot 741* (BM,K); près de Fouta Djallon. 11°30'N 12°30'W, 1837 (fl), *Heudelot 745* (BM,FHO,G,K,P); Senegambia. 11°30'N 12°30'W, 1837 (st), *Heudelot 948* (K); Fouta Djallon. 12°05'N 12°18'W, December 1944 (st), *Schnell 2326* (P); **Mamou:** Timbo. 10°38'N 11°50'W, February 1910 (fr), *Boué 78* (G); environ de Pita. 11°02'N 12°26'W, December 1935 (fl), *Jacques-Félix 674* (P); Konkouré. 10°17'N 12°14'W, 29 January 1885 (fl), *Pobéguin 1140* (P); Fouta Djallon, 17 km of Dalaba. 10°43'N 12°16'W. Alt: 1006m, 6 March 1962 (fl, fr), *Langdale-Brown 2630* (BR,K); Fouta Djallon, near Dalaba. 10°43'N 12°16'W. Alt: 1036m, 8 March 1962 (fl), *Langdale-Brown 2637* (BR,K); Dalaba. 10°42'N 12°15'W, March 1950 (fl), *Schnell 4658* (P); Mamou. 10°15'N 12°03'W, 10 February 1948 (fl), *Roberty 10646* (G); Kouria. 10°19'N 12°15'W, 2 February 1906 (fl), *Chevalier, A.J.B. 18196* (P); **Nzérékoré:** Bac du Diani. 7°45'N 8°49'W, 16 December 1957 (fl), *Bouquet, A. s.n.* (NEU); c. 2 km N of Kpaya 35 km NW of N'zérékoré. 7°59.78'N 9°02.34'W. Alt: 525m, 25 April 2011 (fl), *Koenen 132* (WAG); 1.5 km N of Kpaya 35 km NW of N'zérékoré. 7°58.49'N 9°02.53'W. Alt: 530m, 25 April 2011 (fl, fr), *Koenen 133* (WAG); 1.5 km N of Bowé. 7°47.52'N 9°09.92'W. Alt: 400m, 27 April 2011 (fr), *Koenen 135* (WAG); East of Yomou. 7°34.6'N 9°14.6'W. Alt: 390m, 18 February 2012 (fl), *Yonon Botanic Team 163* (WAG); Mt. Yonon. 8°04.01'N 9°03.68'W. Alt: 560m, 5 February 2012 (fr), *Simons, E.L.A.N. 820* (MO,WAG); Mt. Yonon. 7°58.0'N 9°06.9'W. Alt: 681m, 6 February

2012 (fl), *Simons, E.L.A.N. 824* (WAG); Ziama. 8°14'N 9°22'W, May 1945 (fl), *Schnell 2627* (P); Nzérékoré, Mts Nimba. 7°37'N 8°25'W. Alt: 1250m, 7 January 1949 (fl), *Adam, J.-G. 3131* (P); Macenta. 8°33'N 9°28'W, 13 January 1949 (fl), *Adam, J.-G. 3276* (P); Nimba Mountains, between Camp 1 (Mifergui) and Zougoué River. 7°41.8'N 8°23.8'W. Alt: 760m, 29 November 2006 (fl), *Jongkind 7368* (WAG); Nimba Mountain. 7°37'N 8°25'W, 13 December 1949 (fl), *Adam, J.-G. 7458* (P); Nimba Mountains, east slope of range. 7°39.25'N 8°22.58'W. Alt: 1475m, 16 June 2007 (fr), *Jongkind 7692* (P,WAG); Forêt Classée de Mt Yonon. 7°59.6'N 9°05.1'W. Alt: 760m, 6 May 2011 (fr), *Jongkind 10627* (WAG); Forêt Classée de Mt Yonon. 7°58.4'N 9°06.8'W. Alt: 640m, 14 May 2011 (fr), *Jongkind 10789* (BR,WAG); Forêt Classée de Mt Yonon. 7°59.0'N 9°06.1'W. Alt: 770m, 21 May 2011 (fl), *Jongkind 10896* (BR,G,MO,P,WAG); Nimba. 7°32'N 8°32'W. Alt: 1200m, 20 May 1970 (fl), *Adam, J.-G. 25583* (K); Nimba Mountains, plot JRTH01, both sides of the road between Mifergui cité 1 and cité 2. 7°41.82'N 8°23.62'W. Alt: 763m, 4 December 2007 (fl, fr), *Nimba Botanic Team JR 1180* (WAG); Nimba mountains, plot WHHG20. 7°39.76'N 8°22.31'W. Alt: 1615m, 9 July 2008 (fl, fr), *Nimba Botanic Team WD 733* (WAG).

**GUINEA-BISSAU, Bafatá:** Dandum. 12°13'N 14°35'W, March 1933 (fl), *Espirito Santo 464* (COI); Bafatá, Dandum. 12°07'N 14°38'W, 21 April 1961 (fl), *Alves Pereira 1810* (C,MA); Bafatá, Madina de Mamadú Alfa. 12°14'N 14°36'W, 3 December 1955 (fl), *Espirito Santo 3748* (B,COI,K,WAG); Bafatá, entre Bafatá e Galo Maro. 12°15'N 14°45'W, 12 December 1955 (fl), *Espirito Santo 3806* (COI,K,LISC,WAG); **Bijagós:** Arguipélago dos Bijagós, ilha de Canhabaque, ancoradouro da tabanca Indena. 11°17'N 15°49'W, 9 December 1995 (fl), *Vidigal 265* (LISC); Bolama, sector de caravela. Ilha Formosa. Perto de Abu. 11°28'N 15°56'W, 26 April 2000 (fl), *Catarino 759* (LISC,WAG); Bubaque-Pavaação. 11°17'N 15°50'W, 4 May 1945 (fl, fr), *Espirito Santo 2015* (COI,K,WAG); environ du village Meneque. 11°14.00'N 15°42.30'W, 3 March 2004 (fl), *Malaisse 15946* (BR); **Biombo:** Bissau, entro vóre Bijimita. 11°54'N 15°41'W, 29 March 1945 (fl), *Espirito Santo 1900* (COI,K,WAG); **Bissau:** Prabis. 11°48'N 15°14'W, 3 March 1945 (fl), *Espirito Santo 1851* (COI); 11°48'N 15°14'W, 9 March 1945 (fl), *Espirito Santo 1859* (K,WAG); **Gabu:** entre Canjadudi et Ichetche. 12°00'N 14°12'W, 21 February 1951 (fl), *Espirito Santo 2904* (COI); **Tombali:** Cantanhez, Mata de Cassacunda. 11°18'N 15°25'W, 2 June 1995 (fl), *Martins, E.S. 1066* (LISC); Cacine. 11°08'N 14°57'W, 19 January 1962 (fl), *Alves Pereira 2860* (MA).

**IVORY COAST, Abidjan:** Forêt Classée de la Yaya. 5°39'N 3°35'W. Alt: 80m, 27 November 1997 (fl), *Jongkind 4084* (B,PFHO,IAGB,MO,WAG); Adiopodoumé. 5°20'N 4°07'W, 5 April 1970 (fr), *Farron 7012* (P); **Danané:** Mont Nimba. au campement, 7°37'N 8°25'W, 7 February 1989 (fl, fr), *Gautier, L. 1170* (CSRS,G); Mount Nimba. 7°37'N 8°25'W. Alt: 1250m, 13 December 1967 (fl, fr), *Geerling 1688* (C,K,WAG); Sangouiné. 7°18'N 7°48'W, 22 January 1970 (fl), *Bamps 2355* (BR); Momy, Mts des Dans, 40 km N of Danané. 7°23'N 8°05'W. Alt: 1100m, 30 January 1984 (fl), *Hepper 7926* (K); **Guiglo:** Zagné. 6°09'N 7°31'W, 18 February 2001 (fl), *Bakayoko 55* (G,WAG); 10 km S of Tai, E of Pauléoula. 5°49'N 7°23'W. Alt: 130m, 8 March 1959 (fl, fr), *Leeuwenberg 3021* (K,WAG); Tai. 5°52'N 7°27'W, 17 March 1982 (fl), *Stäuble 210/ 3* (G); Tai. 5°52'N 7°27'W, 4 March 1982 (fl), *Stäuble 26/ 38* (G); Tai. 5°52'N 7°27'W, 6 March 1982 (fl, fr), *Stäuble 67/ 75* (G); **Man:** Mont Tonkoui (Man). 7°27'N 7°39'W, 26 November 1956 (fl), *Wilde, J.J.F.E. de 913* (WAG); Mont Tonkoui. 7°27'N 7°39'W, 18 January 1970 (fl), *Bamps 2327* (BR); Mont Tonkoui, SW of Man. 7°27'N 7°38'W. Alt: 750m, 4 March 1959 (fl), *Leeuwenberg 2950* (K,WAG,Z); Toukoui. 7°22'N 7°42'W, January 1950 (fl), *Schnell 4150* (P); Toukoui. 7°22'N 7°42'W, January 1950 (fl), *Schnell 4186* (P); Mont Tonkoui. 7°22'N 7°42'W, 14 August 1954 (fr), *Jaeger, P. 4761* (P); MT. Tonkkoui, near Man. 7°27'N 7°39'W. Alt: 1100m, 25 January 1984 (fl, fr), *Hepper 7776* (BR,K,WAG); Mont Tonkoui (Man). 7°27'N 7°38'W, 9 February 1961 (fl), *Wit, H.C.D. de 9148* (WAG); Le Tonkorey. 7°27'N 7°39'W, 13 December 1954 (fl), *Roberty 15822* (G); mont Tonkoui. 7°25'N 7°35'W, 9 March 1932 (fl), *Aubréville SF 1017* (P); **Tabou:** 3 km E. de Saksé. 4°41'N 7°16'W, 3 June 1973 (fl), *Aké Assi 12080* (K); **Touba:** Yo près de Touba. 8°18'N 7°40'W, March 1958 (fl), *Bouquet, A. BD s.n.* (NEU).

**LIBERIA, UNKNOWN:** June 1877 (fr), *Carder s.n.* (K); Kasia, 4 March 1944 (st), *Bequaert (Liberia series) 118* (K); 1895 (fl, fr), *Cook, O.F. 129* (US); **Bong:** Sgt. Kollietown. 7°01'N 9°34'W, 2 March 1952 (fl, fr), *Blickenstaff 7* (C,COI,G,K,UPS,US); hill north-east of Gbarnga, close to Farvay. 7°14.4'N 9°18.6'W. Alt: 420m, 31 May 2011 (fr), *Yonon Botanic Team 11* (WAG); Gibi. 6°40'N 10°05'W, 1 June 1969 (fl, fr), *Stoop-v.d. Kasteele 25* (LIB,MO,WAG); Gibi. 6°40'N 10°05'W, 1 June 1969 (fl, fr), *Stoop-v.d. Kasteele 26* (LIB,MO,WAG); 3 miles NE of Suacoco. 7°01'N 9°33'W, 7 March 1951 (st), *Konneh 136* (K); Peahtah. 7°12'N 9°57'W, 7 October 1926 (st), *Linder, D.H. 945* (A,K); Bong Range, 32 km N of Kakata. 6°48'N 10°21'W. Alt: 250m, 11 August 1962 (fl, fr), *Leeuwenberg 4936* (B,K,MO,P,WAG); Geo. 7°11'N 9°40'W, 7 December 1947 (st), *Baldwin jr 10558* (K); **Grand Bassa:** near Yazoo Town, St. John River drainage. 6°21'N 9°32'W, 10 February 1949 (fl), *Mayer, K.R. 225* (US); 22 miles N. of Buchanan, along road. 6°04'N 9°51'W, 19 February 1970 (fl, fr), *Jansen, J.W.A. 1864* (WAG); Cestos-Sanguin area, Logging Concession of the Cooper's, Sudan Section. 5°29.4'N 9°23.0'W. Alt: 60m, 6 December 2002 (fl), *Jongkind 5640* (WAG); Cestos-Sanguin area, Logging Concession of the Cooper's, Sudan Section. 5°29.4'N

9°23.0'W. Alt: 60m, 6 December 2002 (fr), *Jongkind 5651* (WAG); **Grand Cape Mount:** Robertsport 2 miles east of Hotel Victoria, Grand Cape Mount County. 6°44'N 11°21'W, 11 January 1978 (st), *Gier 108* (MO,WAG); Grand Cape Mountains near Robertsport. 6°44.91'N 11°21.90'W. Alt: 130m, 28 July 2004 (st), *Jongkind 6139* (BR,WAG); Grand Cape Mountains near Robertsport. 6°45'N 11°22'W. Alt: 60m, 28 July 2004 (st), *Jongkind 6164* (BR,G,WAG); **Grand Gedeh:** Grand Gedeh county, south of Putu, near Kanweake. 5°30'N 8°03'W, 19 January 1967 (fl), *Bos, J.J. 2902* (BAS,BR,K,LIB,MO,WAG); east slope of the Putu Hills East Range west of Tiama Town. 5°39'N 8°09'W. Alt: 250m, 20 May 2005 (fr), *Jongkind 6242* (WAG); Putu Hills, East Range, East slope. 5°39.3'N 8°10.5'W. Alt: 490m, 17 January 2010 (fl), *Jongkind 9093* (MO,WAG); Putu Hills, East Range. 5°41.1'N 8°08.2'W. Alt: 275m, 20 January 2010 (fl), *Jongkind 9154* (BR,COI,G,K,MA,MO,WAG); **Lofa:** Top of Mount Wutivi. 8°09'N 9°56'W. Alt: 1340m, 12 February 1962 (fl), *Dillewijn, F.J. van 7* (MO,SL,WAG); Zorzor area. 7°47'N 9°26'W, 5 March 1969 (st), *Woelfel 34* (MO,SL,WAG); Kailahun 8°01'N 10°16'W, 17 February 1944 (st), *Bequaert (Liberia series) 63* (K); Top of Mt Wolawisi, near Pandamai. 8°13'N 9°54'W, 2 March 1944 (st), *Bequaert (Liberia series) 107* (K); Zorzor-Gbarnga road, W of St. Paul's river. 7°32'N 9°29'W, 27 July 1966 (fl, fr), *Bos, J.J. 2159* (K,LIB,WAG); between Ziggida and Mt Wonegisi. 8°01.7'N 9°31.6'W. Alt: 540m, 10 February 2010 (fl), *Jongkind 9421* (WAG); **Montserrat:** Within 20 miles of Kakatown. 6°32'N 10°21'W, 1904 (fl), *Whyte, A. s.n.* (K); Within 6 miles of Monrovia. 6°20'N 10°47'W, 1904 (fl), *Whyte, A. s.n.* (K); 6°19'N 10°48'W (fl), *Straub, F.C. 9* (US); Firestone Plantation Div. 33. 6°19'N 10°21'W, 13 June 1969 (fl, fr), *Stoop - v.d. Kastele 41* (BR,LIB,MO,SL,WAG); New University Site, Careysburgh, 35 km of Monrovia. 6°24'N 10°34'W, 13 September 1963 (st), *Harten 78* (WAG); Dukwia River, 6°23'N 10°22'W, 14 February 1929 (fl), *Cooper, G.P. 182* (BM,FHO,K,US); Bomi Hills. Gola N. Forest. 6°56'N 10°45'W, 24 August 1970 (fl, fr), *Stoop - v.d. Kastele 206* (MO,WAG); Du River, Firestone plantation No.3. 6°20'N 10°20'W, 8 August 1926 (fl), *Linder, D.H. 285* (K); Ganta University Plantation. 6°26'N 10°42'W. Alt: 50m, 8 May 1970 (fl, fr), *Koning, J. de 408* (BR,MO,WAG); (fl), *Straub, F.C. 440* (US); Bromley. 6°25'N 10°45'W, 23 February 1952 (st), *Barker, A.J.D. 1210* (K); Bomi Hills. 6°52'N 10°49'W, 10 February 1969 (fl, fr), *Jansen, J.W.A. 1444* (K,WAG); Place 20 miles W. of Bomi Hills, road to Mano. 7°00'N 10°50'W, 12 February 1969 (fl), *Jansen, J.W.A. 1505* (WAG); Duport, 8 miles E. of Monrovia, former Porrobush. 6°16'N 10°40'W, 16 April 1966 (fr), *Bos, J.J. 1871* (BR,HUJ,K,LIB,MO,P,PRE,WAG); Duport, 8 miles E. of Monrovia, former Porrobush. 6°16'N 10°40'W, 23 April 1966 (fl, fr), *Bos, J.J. 1883* (K,LIB,WAG); Bomi Hills. 6°52'N 10°49'W, 23 February 1972 (fl, fr), *Blyden 2066* (BR,MO,WAG); 6°19'N 10°48'W, 6 May 1910 (fr), *Dinklage 2696* (B,C); 6°19'N 10°48'W, January 1935 (fl), *Dinklage 3378* (A); 6°24'N 10°48'W, January 1935 (fl), *Dinklage 3382* (A,BM,BR); "Devil Bush" 15 km E. of Monrovia, between Paynesville and Duport. (Relic of coastal forest). 6°16'N 10°40'W, 22 March 1962 (fl, fr), *Wilde, J.J.F.E. de 3638* (B,EA,K,WAG); near Monrovia 6°19'N 10°48'W, 5 June 1947 (st), *Baldwin jr 5900* (K); Montserrat: near Monrovia. 6°19'N 10°48'W, 15 February 1948 (fl, fr), *Baldwin jr 11086* (K,US,WAG); **Nimba:** In low bush near Ganta. 7°14'N 8°59'W, 12 June 1960 (fr), *Louis s.n.* (WAG); In low bush near Ganta. 7°14'N 8°59'W, 12 June 1960 (fr), *Louis s.n.* (WAG); Ono Kpo gele la (Santo). 10 May 1932 (fl), *Harley, G.W. s.n.* (K); Mt Nimba, point 35. 7°30'N 8°30'W. Alt: 1300m, 7 December 1964 (fl), *Adames 819* (K,UPS); 2 miles S. of Tapita, along road. 6°28'N 8°50'W, 18 July 1968 (fl, fr), *Jansen, J.W.A. 893* (WAG); Mt Bili 7°24'N 8°36'W, 25 December 1951 (st), *Barker, A.J.D. 1180* (K); 28 May 1939 (fl, fr), *Harley, W.J. 1197* (WAG); 1 June 1939 (fl, fr), *Harley, W.J. 1213* (WAG); Ganta 160 miles N. of Monrovia. 7°14'N 8°59'W, 27 January 1969 (fl, fr), *Jansen, J.W.A. 1354* (WAG); Lamco. 7°30'N 8°30'W, 21 January 1959 (fl), *Harley, W.J. 2202* (K); Upper edge of the forest on Mount Nimba. 7°28'N 8°32'W. Alt: 1000m, 14 December 1966 (fl), *Bos, J.J. 2402* (LIB,WAG); Forest on Mount Nimba. 7°30'N 8°30'W. Alt: 800m, 14 December 1966 (fl), *Bos, J.J. 2405* (K,LIB,WAG); Tapita area, along the road to Ganta. 6°36'N 8°49'W, 10 January 1967 (fl), *Bos, J.J. 2631* (LIB,WAG); Nimba Mts. Near Iron mine of Lamco. 7°34'N 8°30'W. Alt: 900m, 29 July 1962 (fl), *Leeuwenberg 4718* (WAG); Mont Nimba. 7°32'N 8°32'W. Alt: 500m, 18 December 1964 (fl), *Adam, J.-G. 20159* (UPS); Mont Nimba. 7°32'N 8°32'W. Alt: 1350m, 19 December 1964 (fl), *Adam, J.-G. 20173* (UPS); Mont Nimba. 7°32'N 8°32'W. Alt: 1300m, 19 December 1964 (fl), *Adam, J.-G. 20183* (K,UPS); Mont Nimba. 7°32'N 8°32'W. Alt: 1350m, 17 January 1965 (fl), *Adam, J.-G. 20653* (K,UPS); Mont Nimba, Mt Alpha. 7°35'N 8°32'W, 1 December 1969 (fl), *Adam, J.-G. 25140* (C); **Sino:** Krahn Bassa. 5°45'N 8°55'W, 26 January 1964 (st), *Harten 269* (K,WAG); 20 miles N. of Sinoe, 5°16'N 9°01'W, 16 January 1969 (fl), *Jansen, J.W.A. 1091* (WAG); First part of Babooni road walking in the direction of Sapo NP. 5°31'N 8°38'W. Alt: 140m, 5 March 2009 (fr), *Jongkind 8809* (BR,WAG); Sangwin 5°13'N 9°21'W, 9 March 1948 (st), *Baldwin jr 11316* (K).

**MALI, Sikasso:** Dianguemerila, Galerie Kaniko. 10°23'N 7°50'W. Alt: 359m, 16 June 2008 (fr), *Birnbaum 1326* (BRLU,IFAN,K,P).

**SENEGAL, Casamance:** Brin. 12°32'N 16°21'W, 5 June 1982 (fl), *Vanden Berghen 5217* (BR); Boukitingo, près d'Oussouye. 12°27'N 16°36'W, 1 August 1982 (fr), *Vanden Berghen 5309* (BR); Bissine. 12°32'N 15°58'W, 1

May 1963 (fl), *Berhaut 5916* (BR); Mendimann (Bignona). 12°46'N 16°18'W, 11 March 1964 (fl), *Berhaut 7201* (BR); **Ziguinchor**: région d'Oussouye: Loudia. 12°31'N 16°36'W, 30 July 1963 (fr), *Berhaut 6199* (BR); Boukitimgo. 12°27'N 16°35'W, 17 February 1964 (fr), *Berhaut 7017* (BR); région de Sédhio. 12°42'N 15°33'W, 1 March 1964 (fl), *Berhaut 7155* (BR); région d'Oussouye: kaème. 12°21'N 16°36'W, 19 March 1964 (fl), *Berhaut 7236* (BR).

**SIERRA LEONE, UNKNOWN:** (st), *Afzelius, A. s.n.* (UPS); (fl), *Afzelius, A. s.n.* (UPS); (fl), *Afzelius, A. s.n.* (UPS); (fl, fr), *Afzelius, A. s.n.* (UPS); (fl, fr), *Afzelius, A. s.n.* (UPS); (fl, fr), *Afzelius, A. s.n.* (UPS); 1867 (fl, fr), *Whitefield, T. s.n.* (K); 1843 (fr), *Vogel, J.R.T. 86* (K); 27 June 1955 (fl), *Marmo 219* (K); 1892 (fr), *Scott Elliot 5811* (HUH); 1915 (fl), *Thomas, N.W. 8838* (K); 1915 (fl), *Thomas, N.W. 8877* (K); 1915 (st), *Thomas, N.W. 8932* (K); 1915 (fl), *Thomas, N.W. 8965* (K); 1915 (fl), *Thomas, N.W. 8986* (K); 1915 (fl), *Thomas, N.W. 9175* (K); 1915 (fl, fr), *Thomas, N.W. 9193* (FHO); 1915 (fl), *Thomas, N.W. 9219* (K); 14 August 1926 (fl, fr), *Thomas, N.W. T 98* (FHO); **Eastern Province:** 20 August 1906 (fl), *Smythe, C.W. 15* (K); Nongowa Chiefetow. 7°38'N 11°24'W, 9 February 1956 (fl, fr), *Pyne 92* (B,K); Kambui Hills (Nongowa). 7°50'N 11°15'W, 24 May 1960 (fl), *Bakshi 189* (K); Lower Neaboi valley, Kambui Hills Forest Reserve. Line 8 lower Neaboi Block. 7°50'N 11°15'W, 13 April 1967 (fl, fr), *Samai 510* (K); Kambui hills. 7°50'N 11°15'W, 12 March 1952 (fl), *Small, D. 511* (K,P); Nongowa. 7°52'N 11°12'W, 10 March 1955 (fl), *Jordan, H.D. 1006* (K); Baoma. 8°05'N 11°14'W, 14 December 1937 (fl), *Deighton 3472* (K); Kennema. 7°52'N 11°12'W, 20 January 1914 (fl), *Thomas, N.W. 7504* (K); Kennema. 7°52'N 11°12'W, 20 January 1914 (fr), *Thomas, N.W. 7561* (K); Kennema. 7°52'N 11°12'W, 20 January 1915 (fl), *Thomas, N.W. 7613* (K); Kennema. 7°52'N 11°12'W, 1915 (fl), *Thomas, N.W. 7696* (K); Tingi Mountains, to the W. of and below the camp. 8°55'N 10°47'W, 13 April 1965 (st), *Morton, J.K. SL 1936* (K,WAG); **Northern Province:** Talaba. 8°02'N 10°42'W, 18 March 1914 (fl), *Aylmer 15* (K); Bintumane peak. 9°13'N 11°07'W. Alt: 1225m, 10 January 1951 (fl), *Jones, T.S. 118* (K); Makump. 8°20'N 12°18'W, 25 January 1929 (fl), *Glanville 141* (K); Sankan Biriwa massif (SE Prov.). 8°56'N 10°48'W. Alt: 1372m, 6 January 1960 (fl), *Cole, N.H.A. 160* (K,P); Rokupr. 8°40'N 12°23'W, 17 March 1949 (fl), *Jordan, H.D. 207* (K); Pendambu. 7°45'N 11°12'W. Alt: 91m, 3 July 1914 (fr), *Thomas, N.W. 782* (K); Rowalla. 8°44'N 11°55'W. Alt: 152m, 23 July 1914 (fl, fr), *Thomas, N.W. 1093* (K); Loma. 9°10'N 11°07'W, 29 August 1945 (st), *Jaeger, P. 1291* (P); Loma. 9°10'N 11°07'W, 6 September 1945 (st), *Jaeger, P. 1489* (P); Loma. 9°10'N 11°07'W. Alt: 1600m, 8 September 1945 (st), *Jaeger, P. 1543* (P); Loma. 9°10'N 11°07'W. Alt: 1300m, 8 September 1945 (st), *Jaeger, P. 1560* (P); Loma. 9°10'N 11°07'W, 11 September 1945 (st), *Jaeger, P. 1603* (P); binkolo. 8°57'N 11°59'W. Alt: 158m, 25 August 1914 (fl), *Thomas, N.W. 1784* (K); Loma. 9°10'N 11°07'W. Alt: 800m, 21 January 1952 (fl), *Jaeger, P. 4000* (P); , 8°26'N 12°14'W, 30 October 1914 (fl, fr), *Thomas, N.W. 4094* (K); Mont Loma. 9°10'N 11°07'W, 26 January 1952 (fl), *Jaeger, P. 4144* (P); 8°26'N 12°14'W, 30 October 1914 (st), *Thomas, N.W. 4196* (K); 8°26'N 12°14'W, 30 October 1914 (fl), *Thomas, N.W. 4219* (K); 8°31'N 12°17'W, 2 November 1914 (fr), *Thomas, N.W. 4620* (K); , 8°26'N 12°14'W, 11 November 1914 (fl), *Thomas, N.W. 4669* (K); 8°26'N 12°14'W, 12 November 1914 (fl), *Thomas, N.W. 4823* (K); Yoni Bana. 8°26'N 12°14'W. Alt: 98m, 11 November 1914 (fr), *Thomas, N.W. 5199* (K); Magbile. 8°44'N 12°42'W, (fl), *Thomas, N.W. 6007* (K); Magbile. 8°44'N 12°42'W. Alt: 30m, 8 December 1914 (fl), *Thomas, N.W. 6298* (K); Magbile. 8°44'N 12°42'W. Alt: 30m, 8 December 1914 (fr), *Thomas, N.W. 6382* (K); Port Lokoh. 8°46'N 12°47'W. Alt: 15m, 15 December 1914 (fl), *Thomas, N.W. 6590* (K); Kumrabai. 8°32'N 12°06'W. Alt: 15m, (fl), *Thomas, N.W. 6744* (K); Kumrabai BS. 8°32'N 12°06'W. Alt: 15m, (st), *Thomas, N.W. 6841* (K); Mont Loma. 9°10'N 11°07'W. Alt: 1300m, 25 July 1964 (fl), *Jaeger, P. 6867* (P); Loma. 9°10'N 11°07'W. Alt: 1600m, 2 August 1964 (st), *Jaeger, P. 7014* (P); Kumrabai. 8°32'N 12°06'W. Alt: 15m, 31 December 1914 (fl), *Thomas, N.W. 7105* (K); Loma. 9°10'N 11°07'W. Alt: 1550m, 14 August 1964 (st), *Jaeger, P. 7138* (P); Loma Mountains. 9°32'N 11°22'W. Alt: 1600m, 15 August 1964 (fl), *Jaeger, P. 7147* (K,P); Loma. 9°10'N 11°07'W. Alt: 1600m, 15 August 1964 (fl), *Jaeger, P. 7148* (P); Loma. 9°10'N 11°07'W, 18 September 1964 (st), *Jaeger, P. 7536* (P); Loma. 9°10'N 11°07'W. Alt: 1400m, 27 September 1964 (st), *Jaeger, P. 7662* (P); Loma. 9°10'N 11°07'W. Alt: 1100m, 10 October 1964 (st), *Jaeger, P. 7794* (P); Da gulu, Mts Loma. 9°10'N 11°07'W, 11 December 1965 (fl), *Jaeger, P. 8447* (G); Mont Loma. 9°16'N 11°12'W, 22 January 1966 (fl), *Adam, J.-G. 23237* (WAG); Mont Loma. 9°16'N 11°12'W, 27 January 1966 (fl), *Adam, J.-G. 23390* (C); Mt Loma. 9°16'N 11°12'W. Alt: 460m, 8 February 1966 (fl, fr), *Adam, J.-G. 23616* (C); Loma mountains, near camp 1 on slopes above Kurubonla. 9°09'N 11°13'W, 29 December 1964 (fl), *Morton, J.K. SL 354* (K,WAG); Foraya village, near Lake Sonfon. 9°15'N 11°27'W, 27 March 1966 (fl), *Morton, J.K. SL 3448* (K,WAG); **Southern Province:** Njala. 8°07'N 12°05'W, 21 December 1955 (fl), *Pyne 75* (K); Zimi-Ba road. 7°19'N 11°18'W, 1 December 1933 (fl), *Thomas, D.G. 125* (FHO); Sendugu. 9°14'N 12°02'W. Alt: 107m, 22 June 1914 (fl), *Thomas, N.W. 579* (K); Sendugu. 9°14'N 12°02'W. Alt: 107m, 22 June 1914 (fr), *Thomas, N.W. 659* (K); 1915 (fl), *Thomas, N.W. 8599* (K); 1915 (fl), *Thomas, N.W. 9249* (K);

1915 (fl), *Thomas, N.W. 9284* (K); 1915 (fl), *Thomas, N.W. 9573* (K); 1915 (fl), *Thomas, N.W. 10254* (K); 1915 (fl), *Thomas, N.W. 10260* (K); Mamaya near Bonthe. 7°32'N 12°31'W, 23 July 1966 (fl), *Morton, J.K. SL 3720* (WAG); **Western Area:** 8°25'N 13°14'W, 8 May 1857 (fl, fr), *Barter s.n.* (K); Freetown, Guma Dam. 8°22'N 13°12'W. Alt: 152m, 20 February 1963 (fl), *Head, D. 1* (K); Brookfields. 8°28'N 13°14'W, 20 October 1926 (fl), *Deighton 4* (K); Sugar loaf mountains (Freetown). N. side near summit. 8°25'N 13°14'W, 14 October 1951 (fl), *Tindall 14* (K); Colony: Kortright. 8°29'N 13°13'W. Alt: 320m, 12 August 1958 (fl, fr), *Melville, F.A. 28* (K); near Battrust. 8°26'N 13°12'W, 21 February 1883 (fl), *Johnston, H.H. 92* (E,K); Heddles Farm (Colomguli). 8°30'N 13°15'W, May 1912 (fl), *Lane-Poole 117* (K); Freetown. 8°29'N 13°13'W, February 1915 (fl), *Dalziel 999* (K); 8°25'N 13°14'W, September 1857 (fl, fr), *Barter 2017* (HUH); Hill station. 8°27'N 13°15'W, 12 March 1935 (fl), *Deighton 2970* (K,P); Regent. 8°26'N 13°13'W, 8 December 1911 (fl), *Scott Elliot 4010* (HUH); freetown, Leicester Peak. 8°27'N 13°13'W. Alt: 457m, 24 April 1948 (fl), *Brenan 9620* (BM,FHO,K); Sugar Loaf. 8°25'N 13°14'W, 5 April 1955 (fl), *Roberty 17307* (G); Freetown. 8°27'N 13°14'W, 1 April 1965 (fl), *Adam, J.-G. 21288* (C,UPS,WAG); between Hamilton & Sussex where river crosses road, Peninsula. 8°23'N 13°16'W, 26 January 1964 (fl, fr), *Morton, J.K. SL 681* (K,WAG); Havelock. 8°29'N 13°13'W, 14 February 1964 (fl), *Morton, J.K. SL 777* (K,WAG); Havelock to Leicester, Freetown. 8°28'N 13°13'W, 9 March 1964 (fl), *Morton, J.K. SL 944* (K,WAG); Leicester Village, Freetown. 8°28'N 13°13'W, 15 March 1964 (fl, fr), *Morton, J.K. SL 975* (WAG); Guma dam. 8°22'N 13°12'W, 23 March 1964 (fl), *Morton, J.K. SL 1190* (K); Fourah Bay College. 8°30'N 13°15'W, 3 July 1964 (fl, fr), *Morton, J.K. SL 1375* (K,WAG); Guma. 8°22'N 13°12'W, 19 May 1966 (fr), *Morton, J.K. SL 3508* (K); On coast at Kent, Peninsula. 8°17'N 13°11'W, 30 August 1966 (fl), *Morton, J.K. SL 3837* (K,WAG); slopes of Leicester peak. 8°27'N 13°14'W. Alt: 457m, 24 February 1944 (fl, fr), *Jones, A.P.D. SLFD 627* (FHO).

**Key literature:** Farron (1963, 1985), Hawthorne & Jongkind (2006), Hutchinson, Dalziel & Keay (1954).

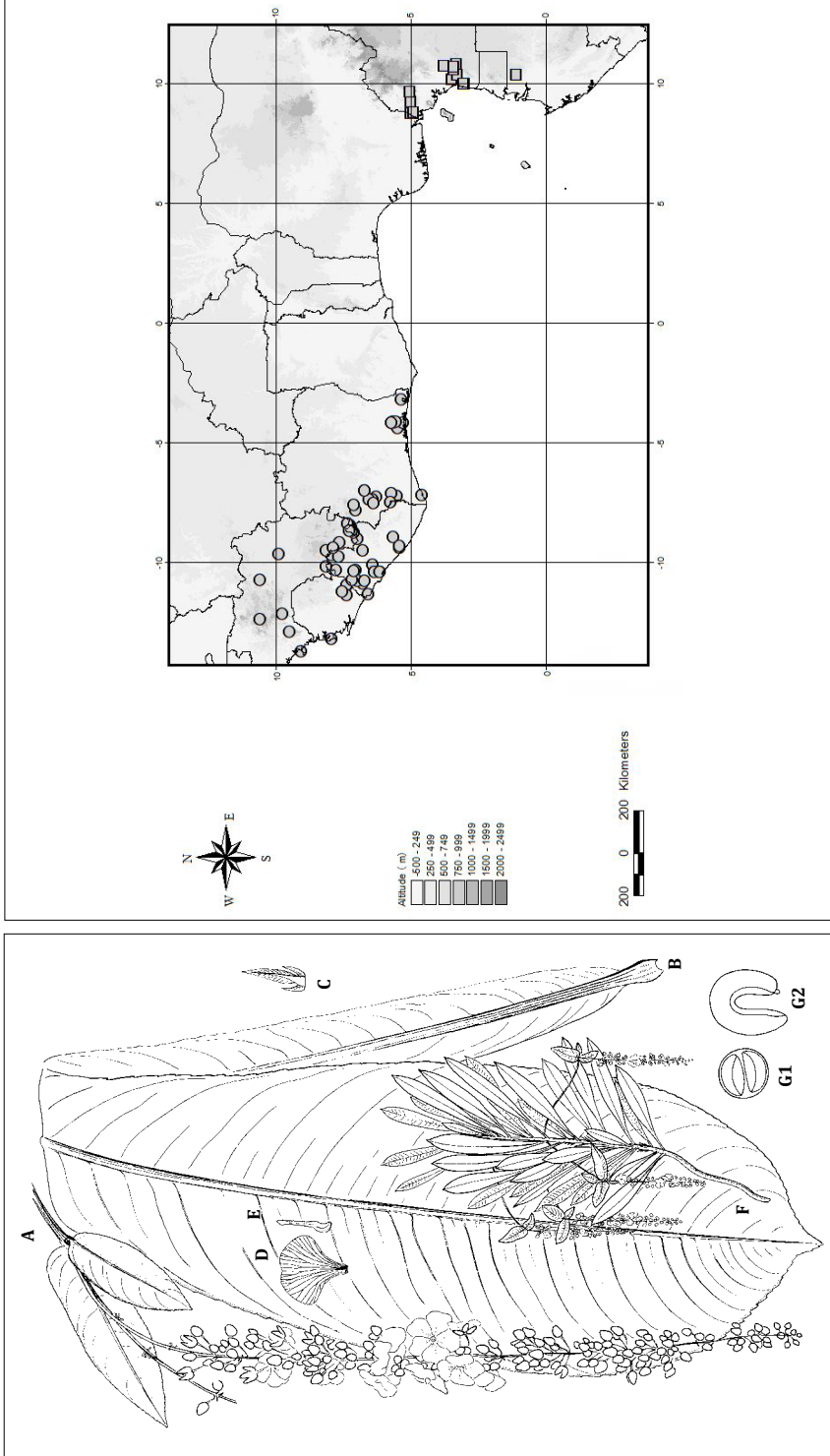
### ***CampylospERMUM subcordatum* (Stapf) Farron**

**Fig. 27**

Bull. Jard. Bot. État Bruxelles 35: 402 (1965). – *Gomphia subcordata* Stapf, J. Linn. Soc., Bot. 37: 88 (1905). – *Ouratea subcordata* (Stapf) Engl., Pflanzenw. Afr. 3, 2: 489 (1921). – Type: *A. Whyte s.n.* (holotype: K!), Liberia, Montserrado, Kakata, within 20 miles of Kakatown, 1904.

*Treelet* of up to 5 m tall, **monocaulous** or stem sparingly branched; bark brownish. *Stipules* caducous, triangular, 3–5 mm long. *Leaf:* petiole 0–5 mm; leaf blade **narrowly spathulate to narrowly elliptic-spathulate, 18–62 x 5–14 cm**, ratio **4.0–5.6**, base narrowly cuneate to subcordate, apex blunt to shortly acuminate, not or slightly bullate, coriaceous, margin serrulate, the teeth with a black tip, glossy dark green above, paler green beneath; venation: midrib prominent on both surfaces, main lateral veins **25–35 on either side, 7–20 mm apart**, prominent above, not prominent below, making a slight angle with the midrib, straight at first and near the margin curved upwards, intermediate lateral veins 0–2 in between the main ones, prominent or slightly so above, tertiary venation scalariform, **perpendicular to the mains lateral veins**, distinct to slightly so on both sides. *Inflorescence* **axillary**; peduncle **22–42 cm long, flattened, woody, carrying 2(–4) subopposite leafy bracts at its apex from which 2–5 racemes emerge**; leafy bracts oblong, 6–12 x 2–5 cm, base cordate to subcordate, apex acute; racemes **(3–)13–28(–35) cm long**; pairwise scales persistent at the base of the raceme, 2–3 mm long; cymules 3–18 mm apart, **1–8(–12)-flowered**; bracts absent. *Flower:* pedicel 5–20 mm long, articulating at 2–5 mm from its base; sepals ovate, in flower 7–8 x 3–4 mm, in fruit 9–11 x 4–7 mm, apex rounded; petals **broadly obovate**,





**Figure 27.** *Campylospermum subcordatum*. A. Racemes and leafy bracts. B. Leaf blade. C. Stipule. D. Petals. E. Anther. F. Flowering branch. G1. Seed, cross section. G2. Incumbent cotyledon. Drawings by Sabine Bousani

**Map 29.** Distribution of *Campylospermum subcordatum* (○) and *Campylospermum umbricola* (□)

9–12 x 7–10 mm, **cuneate at base, rounded at apex**; stamens: anthers 4–6 mm long; ovary 1–2 high; style 5–6 mm long. *Fruit*: receptacle 5–8 mm wide; drupelets 2–4 well developed per receptacle, broadly ellipsoid, 6–8 x 5–7 mm; cotyledons **incumbent, dissimilar in size, with a small inner cotyledon**.

**Notes**: This is a very distinctive species, readily recognized by the long to very long leaves and peduncle carrying two apical leafy bracts and a small bundle of racemes. It is also reminiscent of *C. elongatum* and *C. klainei* by having a flattened peduncle, but it differs from both species by for example having leaves with a cuneate to sometimes subcordate base and the inflorescence being composed of a bundle of racemes.

**Distribution**: from Guinea, Sierra Leone, Liberia and southern half of Ivory Coast (**Map 29**).

**Ecology**: primary and secondary forest, swamp forest, along forest edges, lagoons and rivers; on sandy and loamy soil; at up to 715 m altitude.

**Phenology**: flowering all year round; fruits observed in January, February, May, July and from October to December.

**IUCN conservation status**: LC. EOO=416,074 km<sup>2</sup>, AOO=357,017 km<sup>2</sup>, locations=64 (cell width=124 km). This species has numerous recent collections that are found in Forest Reserves such as Yapo in Ivory Coast, Gola in Liberia and in the Nimba Mountains and classified Forest of Mont Yonon, both in Guinea. It is fairly well represented in herbaria suggesting it is not uncommon and thus the category of Least Concern seems justified.

### **Specimens examined:**

**GUINEA, UNKNOWN**: 21 May 1898 (fl), *Maclaud 16* (P); Bogoutigny. 1893 (fl), *Paroisse 43* (P); **Conakry**: Ragbané. 9°35'N 13°40'W, (fl), *Paroisse 73* (P); **Dinguiraye**: 11°18'N 10°43'W, (fr), *Vuillet 80* (P); **Kankan**: Morikéniéba. 10°31'N 9°37'W, 6 March 1899 (fl), *Chevalier, A.J.B. 551* (P); **Kindia**: 10°04'N 12°51'W, (fl), *Jacques-Félix 19* (P); **Labé**: Fouta Djallon. 11°19'N 12°20'W, 1837 (fl), *Heudelot 945* (P); **Mamou**: 10°22'N 12°06'W, 8 January 1909 (fl), *Chevalier, A.J.B. 20366* (P); **Nzérekoré**: Nimba Mountains, Gbié, near Guégué river. 7°38.77'N 8°20.16'W. Alt: 573m, 17 December 2008 (fl), *Haba, O-O. 22* (BR,WAG); Nimba Mountains, Forêt de Gbié. 7°38.83'N 8°20.02'W. Alt: 579m, 17 December 2008 (fl), *Haba, O-O. 23* (FHO,WAG); Guékédon. 8°33'N 10°08'W, 14 October 1949 (st), *Schnell 2556* (P); Ziama. 8°14'N 9°22'W, May 1945 (st), *Schnell 2662* (P); Macenta. 8°33'N 9°28'W, 31 January 1949 (fr), *Adam, J-G. 3505* (P); Forêt Classée de Mt Yonon, not far from the Diane River. 7°59.0'N 9°07.3'W. Alt: 480m, 7 May 2011 (fr), *Jongkind 10658* (BR,MO,P,WAG); Nimba Mountains, plot WHFL04, 500 m to Ecogarde building. 7°38.67'N 8°20.10'W. Alt: 575m, 2 December 2007 (st), *Nimba Botanic Team WH 1430* (WAG).

**IVORY COAST, Abidjan**: Adiopodoumé, 17 km W of Abidjan, botanical garden ORSTOM. 5°20'N 4°08'W, 8 July 1978 (fl, fr), *Dekker, A.J.F.M. 86* (WAG); km 45 new road Abidjan-Ndouci. 5°34'N 4°22'W, 9 October 1979 (fl), *Kruif, A.P.M. de 406* (UC,WAG); **Aboisso**: 6 km on Aboisso-Maféré road. 5°24'N 3°11'W, 8 November 1968 (fr), *Breteler 5959* (WAG); **Agboville**: Yapo forest 5°44'N 4°07'W, 28 September 1956 (fl), *Wilde, J.J.F.E. de 582* (WAG); Forêt du Yapo. 5°45'N 4°10'W, 10 October 1991 (st), *Téré 1998* (G); Yapo forest. 5°44.5'N 4°07.7'W. Alt: 100m, 31 August 2001 (fl), *Wieringa, J.J. 4278* (MO,WAG); Yapo forest. 5°48'N 4°08'W, 30 July 1954 (st), *Jaeger, P. 4431* (P); Yapo. 5°44'N 4°05'W, 28 October 1954 (fl), *Roberty 15340* (G,K); sur le chemin de fer, km 44, environs d'Azaguié. 5°38'N 4°05'W, 14 September 1909 (fl), *Chevalier, A.J.B. B 22278* (P); Yapo. 5°48'N 4°08'W, 19 December 1931 (fr), *Aubrèville SF 602* (P); **Daloa**: F.C. du Haut-Sassandra, Sud. Piste de Belleville, layon 24, 6°56'N 6°59'W, 12 February 1994 (fr), *Kouamé 1054* (CSRS,G); Forêt classée du Haut Sassandra. 6°56'N 6°59'W, 14 February 1994 (fl, fr), *Kouamé 1086* (G); **Danané**: 1 km N of Yéalé. 7°32'N 8°25'W, 17 December 1967 (fl, fr), *Geerling 1825* (WAG); **Duékoué**: Plantation Planche, Pinhou. 6°37'N 7°20'W, 27 January 1969 (fr), *Bamps 1951* (BR); Duékoué-Buyo, forêt au N du Nzo. 6°27'N 7°15'W, 28 February 1969 (fr), *Bamps 2151*

(BR); Duekoué. 6°44'N 7°21'W, 12 December 1954 (fr), *Roberty 15939* (G); **Guiglo**: Toulepleu. 6°33'N 7°29'W, May 1942 (st), *Schnell 1268* (P); Tai. 5°36'N 7°11'W, 4 August 1954 (st), *Jaeger, P. 4601* (P); Tai. 5°52'N 7°27'W, 13 April 1970 (st), *Farron 7070* (P); entre le moyen Sassandra et le moyen Cavally. 5°50'N 7°05'W, 27 June 1907 (fl), *Chevalier, A.J.B. 19209* (P); **Man**: Forêt de Sangouiné, 7°18'N 7°48'W, 25 January 1969 (fr), *Bamps 1935* (BR); Man. 7°24'N 7°35'W, July 1949 (st), *Bégué SF 3261* (P); **San-Pédro**: from Tabou 30 km to Béréby, along the road. 4°34'N 7°10'W, 11 October 1973 (fl), *Koning, J. de 2351* (BR,E,MO,WAG).

**LIBERIA, Bong**: Gbanga. 7°00'N 9°29'W, 14 September 1926 (fl), *Linder, D.H. 614* (K); **Gbarpolu**: Kpelle Forest. North of Gainkpa. 7°21.9'N 10°20.7'W. Alt: 350m, 13 December 2010 (fl), *Jongkind 10111* (BR,MA,MO,WAG); **Grand Bassa**: Cestos-Sanguin area, Logging Concession of the Cooper's, Sudan Section. 5°29.9'N 9°22.2'W. Alt: 80m, 6 December 2002 (fl), *Jongkind 5656* (BR,WAG); **Grand Cape Mount**: north of Lake Piso. 6°48.17'N 11°17.27'W. Alt: 20m, 21 July 2004 (st), *Jongkind 6048* (BR,G,K,WAG); Grand Cape Mount. Genna Tanyehun. 7°15'N 10°44'W, 21 December 1947 (fl), *Baldwin jr 10759* (K); **Lofa**: North Lorma National Forest. 8°02'N 9°44'W, 20 November 2005 (fl, fr), *Jongkind 6701* (BR,WAG); Gola Forest. 7°27.1'N 10°41.5'W, 29 November 2005 (fr), *Jongkind 7001* (WAG); Western Province, Vonjama District, Soplma. 8°20'N 9°40'W, 1 November 1947 (fl), *Baldwin jr 10110* (K); Western Province, Kolahun District, Karmadhun. 8°08'N 10°18'W, 6 November 1947 (fl), *Baldwin jr 10224* (K); Western Province, Boporo District, Tawata. 7°18'N 10°17'W, 15 November 1947 (fr), *Baldwin jr 10293* (K); **Montserratado**: Within 20 miles of Kakatown. 6°32'N 10°21'W, 1904 (fl), *Whyte, A. s.n.* (K); Dukwia River, Monrovia, near Firestone Plantations. 6°23'N 10°22'W, October 1928 (fl), *Cooper 30* (BM,FHO,K); Firestone Plantation, division 33. 6°19'N 10°21'W, 3 January 1970 (fr), *Stoop-v.d. Kastele 129* (MO,WAG); Bomi Hills, 100 km from Monrovia. Along road. 7°01'N 10°51'W, 18 October 1963 (fl), *Harten 159* (K,WAG); Dukwia River. 6°23'N 10°22'W, 7 February 1929 (fl, fr), *Cooper, G.P. 166* (BM,FHO,K,US); Gola National Forest, Bomi Hills. 6°56'N 10°45'W, 16 October 1965 (fl, fr), *Meer, P.P.C. van 187* (WAG); Firestone Plantation, Division 33. "The waterfall". 6°19'N 10°21'W, 18 October 1970 (fl, fr), *Stoop-v.d. Kastele 226* (MO,WAG); Gibi Mountain, 5-10 miles SE of Salala (nearly whole mountain covered by high evergreen rainforest). 6°35'N 10°04'W. Alt: 500m, 15 January 1970 (fr), *Jansen, J.W.A. 1709* (WAG); **Nimba**: Nimba Reserve. 7°30'N 8°30'W. Alt: 550m, 20 November 1964 (fl), *Adames 771* (K,UPS); Ganta. 7°14'N 8°59'W, 16 December 1951 (fl), *Barker, A.J.D. 1137* (K); near Mt Tokadeh. 7°27.2'N 8°39.3'W. Alt: 510m, 12 November 2007 (fl), *Jongkind 7987* (BR,WAG); Sanokwele (Central Province, Sanokwele District). 7°22'N 8°43'W, 1 October 1947 (fl), *Baldwin jr 9644* (K); Central Province, Sanokwele District, Ganta. 7°14'N 8°59'W, 1 February 1948 (fr), *Baldwin jr 11024* (K); Mont Nimba. 7°32'N 8°32'W, 15 December 1965 (fl), *Adam, J-G. 20126* (UPS); Jéképa. Mt Nimba. Jiti river. 7°35'N 8°32'W, 31 October 1969 (fl), *Adam, J-G. 24556* (C,UPS,WAG); Mont Nimba, Jiti river. 7°35'N 8°32'W, 6 October 1969 (fl), *Adam, J-G. 25009* (C); between Mt Gangra and Mt Yuelliton, plot SNLF01. 7°33.36'N 8°38.02'W. Alt: 715m, 13 January 2009 (fr), *Nimba Botanic Team NS 41* (WAG); **Sino**: Krahn Bassa forest. 5°45'N 8°55'W, 26 January 1964 (fl, fr), *Harten 261* (K,WAG); South-west of Togba Ville. 5°28.4'N 9°15.9'W. Alt: 80m, 29 November 2010 (fl), *Jongkind 9898* (BR,WAG).

**SIERRA LEONE, Eastern Province**: W Laoma. 7°41'N 11°19'W, November 1906 (fl), *Smythe 11* (K); Guara Chiefdom, Lulahun. 7°41'N 10°58'W, 25 December 1950 (fr), *King, E.L. 87* (K); Kenema. 7°52'N 11°12'W, 29 October 1949 (fl), *Deighton 5205* (K); **Southern Province**: Gola North Forest Reserve. 7°40'N 10°55'W, 9 December 1965 (fl), *Samai 259* (K); Gola North Forest Reserve, Gbahama Block. 7°40'N 10°55'W, (fl), *Samai 375* (K); **Western Area**: Colony:Sussex. 8°20'N 13°10'W. Alt: 15m, 30 August 1958 (fl), *Melville, F.A. 511* (K,P).

**Key literature**: Farron (1965, 1968, 1985), Hawthorne & Jongkind (2006), Hutchinson & Dalziel (1928), Hutchinson, Dalziel & Keay (1954), Poorter et al. (2004).

### **Campylosperrum sulcatum** (Tiegh.) Farron

**Fig. 28**

Bull. Jard. Bot. État Bruxelles 35: 403 (1965). – *Exomicrum sulcatum* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 340 (1902). – *Ouratea sulcata* (Tiegh.) Keay, Kew Bull. 1953: 81 (1953). – Type: *Staudt 606* (holotype: P!; isotype: COI!, G!, K!, S!, Z!), Cameroon, Johann-Albrechtshöhe, 1896.

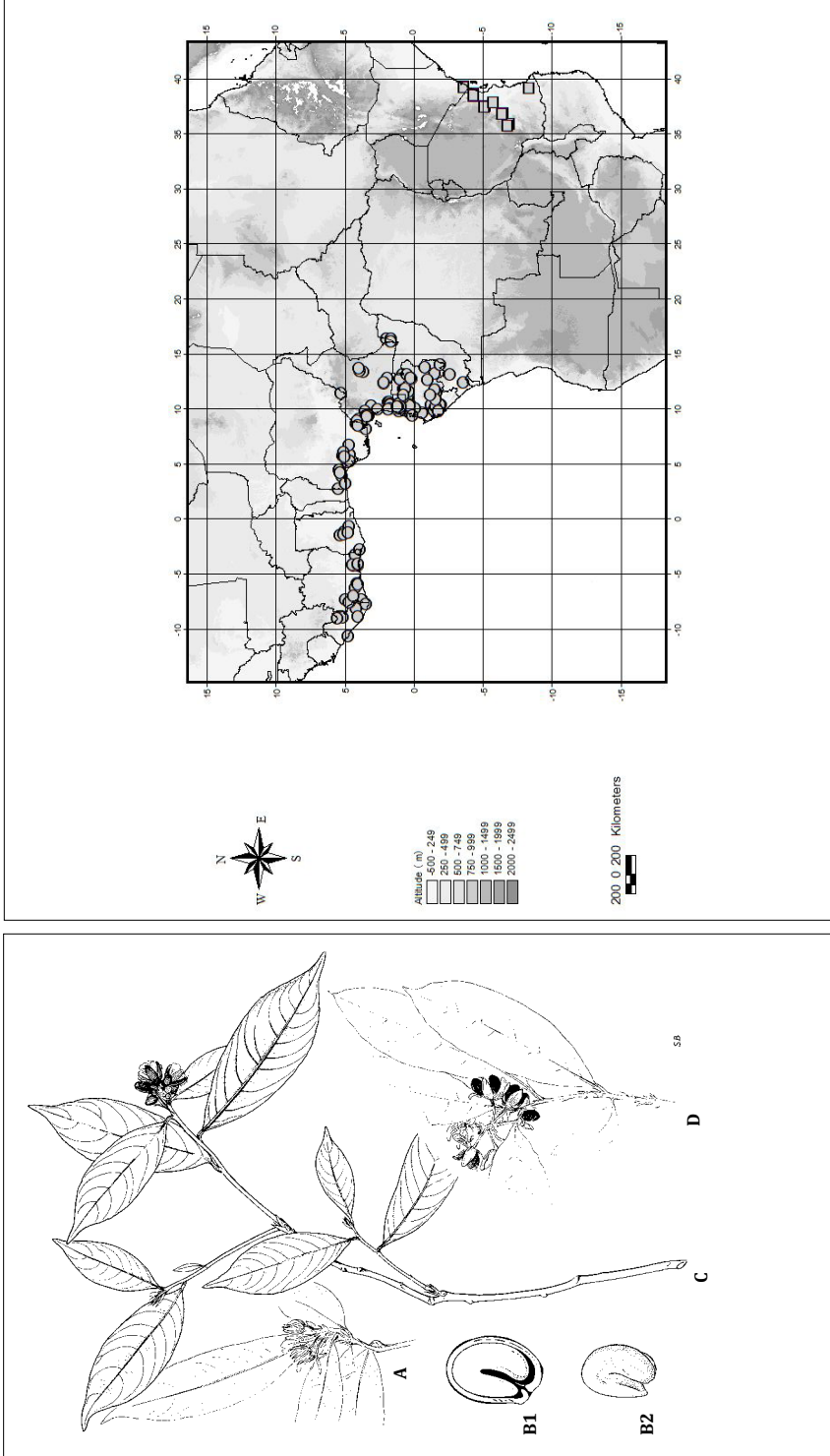
*Ouratea oliveriana* Gilg, Bot. Jahrb. Syst. 33: 261 (1904). – *Campylosperrum oliverianum* (Gilg) Farron, Bull. Jard. Bot. État Bruxelles 35: 400 (1965). –Type: *Johnston s.n.* (holotype: B†; isotype: K!), Nigeria, Cross River, January 1888. syn. nov.

*Tree* up to 9 m tall, with branched stem; twigs with brownish white bark. *Stipules* **persistent**, triangular, 4–13 mm long. *Leaf*: petiole 3–6(–7) mm long; leaf blade narrowly elliptic to narrowly elliptic-ovate or sometimes elliptic-ovate, **(6–)9–17(–21) x (2–)3–6(–7) cm**, ratio **2.3–4.2**, base narrowly cuneate to attenuate, apex acuminate, coriaceous to papyraceous, distinctly to slightly bullate, margin **serrulate to entire**, teeth without a black tip, dark green above, paler green below, glossy on both sides; venation: midrib **strongly prominent above, prominent below**, main lateral veins 10–16 on either side, **9–14 mm apart, generally sunken above**, prominent below or sometimes shallowly sunken, more or less at a right or slight angle with the midrib but curved upward to run parallel to the margin, intermediate lateral veins 0–1 between each pair of main laterals, tertiary venation **scalariform**, perpendicular to the midrib, **distinct above, less distinct below**. *Inflorescence* terminal, **unbranched or rarely with 1 raceme, compact**, its main axis 1–5(–8) cm long; pairwise scales at the base of peduncle persistent, often numerous, narrowly triangular, up to 12 mm long; cymules 3–7 mm apart, 1–7-flowered; bracts persistent, triangular, 2–3(–5) mm long. *Flower*: pedicel 7–13 mm long, articulated at 2–3 mm from the base; sepals ovate, in flower 8–10 x 3–4 mm, in fruit 10–12 x 5–6 mm and curved over the drupelets, coriaceous, base truncate, apex acute; petals elliptic to obovate, 10–13 x 3–8 mm, truncate at base, rounded or emarginate at apex; stamens: anthers 4–7 mm long; ovary c. 1–2 mm long; style 4–7 mm long. *Fruit*: receptacle in fruit 3–6 mm wide, red; drupelets 1 to 2 well developed per receptacle, ellipsoid to broadly so, 7–9 x 4–7 mm; **cotyledons incumbent, dissimilar in size with a small outer cotyledon**.

**Notes:** *C. oliverianum* is lumped into *C. sulcatum*. Both species share the bullate leaves and an unbranched, compact inflorescence. Farron (1985) already noted their close similarity, but kept them apart, using the petal shape to separate them. He describes *C. oliverianum* as having leaves with 10–15 pairs of main lateral veins, an inflorescence which is longer than wide and elliptic petals, whereas in *C. sulcatum* there are 6–10 pairs of veins, an inflorescence as long as wide and obovate petals. Since in fact the two states of all three characters are observed in specimens from both species identified by himself, we started to have serious doubts about their distinction. From a closer study of the variability we concluded the two taxa can not be separated. Therefore, the two are united here under the name *C. sulcatum*, the oldest one.

*C. sulcatum* is a very distinct species with its short, compact inflorescence and a bullate leaf surface. As such, it is highly reminiscent of some forms of *C. excavatum*, but that species often has a branched inflorescence, much narrower sepals and a much more pronounced tertiary venation.

**Distribution:** Liberia, Ivory Coast, Ghana, Nigeria, Cameroon, southernmost Central African Republic, Equatorial Guinea, Gabon and the Republic of the Congo (**Map 30**).



**Figure 28.** *Campylospermum sulcatum*. **A.** Flowering branch. **B1.** Seed, longitudinal section. **B2.** Sincumbent cotyledon. **C.** Flowering branch. **D.** Fruiting branch. Drawings by Sabine Bousani

**Map 30.** Distribution of *Campylospermum sulcatum* (○) and *Campylospermum warneckeii* (□)

**Ecology:** primary and secondary forest, gallery forest, swamp forest, along rivers and streams; on clayey and sandy soils; at up to 960 m altitude.

**Phenology:** flowering and fruiting all year round.

**Vernacular names:** Benin: Agbda, Ishan-urohi (Urohi-Ogwa).

**Uses:** This is a decorative plant (Burkill 1997).

**IUCN conservation status:** LC. EOO=2,050,430 km<sup>2</sup>, AOO=2,111,970 km<sup>2</sup>, locations=161 (cell width=303 km). This species has a wide distribution and is found outside and inside National Parks such as Loango, Pongara, Minkebe in Gabon, Monte Alèn in Equatorial Guinea, Dzanga-Sangha in Central African Republic and also inside Forest Reserves such as Ekinta, Shasha and Urehi. It has numerous recent collection and thus the category Least Concern has been assigned.

### Specimens examined:

**CAMEROON, East Province:** Road from Ndjangané NE. to Bombi, up to river Diezé. 46 km NW. of Bertoua. 4°53'N 13°24'E. Alt: 700m, 18 May 1961 (st), *Breteler 1359* (BR,K,LISC,M,P,WAG,YA); Weit nach Norden bis in den Bogen des Lom (Sanaga) 250 km N. Jaunde. 5°12'N 13°31'E, March 1914 (fl), *Mildbraed 8611* (K); 5°18'N 13°45'E, April 1914 (fl), *Mildbraed 8926* (BM,K); **Littoral:** 10 km W. of Masok. 4°08'N 10°23'E. Alt: 400m, 3 April 1965 (st), *Leeuwenberg 5352* (BAS,BR,K,P,WAG,YA); 5 km NE of Dibombé, a village on km 11 of Loum-Yabassi road. 4.43 N 9.50 E. 4°43'N 9°50'E. Alt: 200m, 16 March 1972 (st), *Leeuwenberg 9477* (BR,K,WAG,YA); **South Province:** Mvini, 35 km E. of Campo. 2°22'N 10°06'E, 20 September 1983 (fl), *Kaji 11* (P); bank of Mboro near Akonetye. 2°40'N 12°52'E, 5 September 1978 (fl), *Koufani 230* (P); réserve de la Faune de Campo. 2°23'N 10°06'E, 28 March 1983 (fl), *Nkongmeneck 489* (P); Elephant Mont. 2°34'N 9°59'E, 5 March 1987 (fl), *Huber, H.F.J. 1055* (P); Bitye. 3°01'N 12°22'E, 1919 (st), *Bates, G.L. 1229* (BM); route Kribi-Londji, 30 km de Kribi, après village pygmée. 3°35.28'N 9°59.29'E. Alt: 79m, 29 March 2010 (st), *Bissiengou 1231* (LBV,WAG,YA); Bitya near the River Ja. 3°01'N 12°26'E, (fl), *Bates, G.L. 1810* (P); collines à 5km au SW d'Ebionéméyong près Nyabessan (60 km à l'Est de Campo). 2°24'N 10°24'E, 10 April 1968 (fr), *Letouzey 9322* (P); 12 km E Nyabesan. 2°25'N 10°32'E, 4 March 1963 (fr), *Raynal, J. 10212* (P); Campo Ma'an area, Nvini, around river Kom in the National Park. 2°28.0'N 10°08.8'E. Alt: 100m, 10 December 2001 (fr), *Tchouto Mbatchou KOMX 28* (WAG); Campo Ma'an area, Onoyong, in the National Park. 2°37.2'N 10°38.1'E. Alt: 500m, 22 March 2001 (fl), *Tchouto Mbatchou ONOX 32* (WAG); Onoyong, forest between plots ONO1 and 10. 2°31.7'N 10°41.8'E. Alt: 360m, 18 March 2001 (fl), *Tchouto Mbatchou ONOX 155* (KRIBI,WAG); **South-West Province:** Johann-Albrechtshöhe, Urwaldgebiet. 4°38'N 9°25'E, 1896 (fl, fr), *Staudt 606* (COI,G,K,Z); ancienne réserve du South Bakundu, 15 km Ouest du village Small Ekomba. 4°30.64'N 9°23.15'E. Alt: 87m, 3 April 2010 (fr), *Bissiengou 1281* (LBV,WAG,YA); village Mafoko-Kindongi, 8 km Ouest du village Small Ekomba. 4°33.34'N 9°23.33'E. Alt: 180m, 4 April 2010 (fr), *Bissiengou 1290* (LBV,WAG,YA); village Mafoko-Kindongi, 8 km Ouest du village Small Ekomba. 4°33.02'N 9°23.27'E. Alt: 167m, 4 April 2010 (fr), *Bissiengou 1295* (LBV,WAG,YA); 1 km W. of Bombe-Bakundu, 20 km S of Kumba. 4°27'N 9°28'E. Alt: 75m, 30 January 1987 (fl), *Manning, S.D. 1513* (MO,WAG); 1 km SW of Bombe, Bakundu, 20 km S of Kumba. 4°26'N 9°27'E. Alt: 75m, 12 May 1987 (fl, fr), *Manning, S.D. 1803* (K,MO,WAG); Korup National Park, between the Ndian River at PAMOL field and 2.5 km on transect "P". 5°01'N 8°50'E. Alt: 50m, 12 April 1985 (fl), *Thomas, D.W. 4760* (K,MO); between Baro and Ikenge villages, along foot path, in the Korup National Park. 5°15'N 9°09'E. Alt: 250m, 1 April 1988 (fl), *Thomas, D.W. 7532* (BR,MO,WAG); S. Bakundu F.R. Banga. 4°24'N 9°27'E, 11 March 1948 (fl), *Brenan 9268* (BM,FHO,K); 55 km SW Mamfé à l'Est de la piste Abakpa-Mbiofong. 5°24'N 8°56'E, 26 May 1975 (st), *Letouzey 13627* (P).

**CENTRAL AFRICAN REPUBLIC, Sangha-Mbaéré:** Ndakan. 2°21'N 16°09'E. Alt: 350m, 19 April 1994 (st), *Kuroda 42* (E); Ndakan. 2°21'N 16°09'E. Alt: 350m, 19 April 1994 (st), *Kuroda 43* (E); Ndakan, gorilla study area. M1670R. 2°22'N 16°09'E. Alt: 350m, 17 April 1988 (fr), *Harris, D.J. 525* (K,MO,WAG); Ndakan, Gorilla study, Dzanga-Sangha Reserve. 2°22'N 16°10'E. Alt: 350m, 23 September 1988 (fr), *Harris, D.J. 1181* (K,MO); 25 km SE of Bayanga, Kongana research camp. 2°47'N 16°25'E, 11 February 1994 (fr), *Harris, D.J. 4571* (E,WAG).

**CONGO (BRAZZAVILLE), Kouilou:** Dimonika. 4°14'S 12°26'E, 31 January 1986 (fr), *Foresta 801* (P); **Lékoumou:** village de Moukina, route Komono-Moetché. 3°01'S 13°11'E, 25 January 1965 (fr), *Bouquet, A. 1096* (P); **Sangha:** within 200 m of Issimbi Camp, Nouabalé-Ndoki National Park. 2°22.55'N 16°27.08'E, 4 May 2007 (fr), *Harris, D.J. 9075* (E,IEC).

**EQUATORIAL GUINEA, Rio Muni, Centro Sur:** SE du parc National de Monte Alen, sur le transect ECOFAC de Nkumekie, 3000 m du début du layon. 1°28.77'N 10°17.66'E. Alt: 610m, 2 February 2001 (fr), *Senterre 3* (BRLU); Monte Alen. 1°40'N 10°17'E, 28 May 1997 (fr), *Ngomo 181* (BRLU); Monte Alèn, transect Nkumekie. 1°29'N 10°18'E, 10 April 2001 (fl), *Ngomo 875* (BRLU); Monte Alèn, transecto Monte Alén. 1°39'N 10°18'E, 19 April 2012 (fl), *Ngomo 928* (BRLU); parque Nacional de Monte Alèn: Ayangtang, camino hacia el río Laña. 1°33'N 10°25'E, 8 April 1999 (fl), *Pérez Viso 962* (MA); SO du parc National de Monte Alen, 2 Km au NE du site de traversée du rio Uolo pour aller aux cataractas. 1°37.22'N 10°04.87'E. Alt: 410m, 16 February 2002 (st), *Senterre 2348* (BRLU); SO du parc National de Monte Alen, 2 Km au NE du site de traversée du rio Uolo pour aller aux cataractas. 1°36.56'N 10°05.55'E. Alt: 750m, 25 June 2002 (st), *Senterre 3024* (BRLU); près du village de Bicurga. 1°35'N 10°28'E. Alt: 680m, 24 May 2002 (fr), *Parmentier 3126* (BRLU); inselberg de Bicurga, près du village de Bicurga. 1°35'N 10°28'E. Alt: 710m, 24 May 2002 (fl, fr), *Parmentier 3163* (BRLU); inselberg de Bicurga, près du village de Bicurga. 1°35'N 10°28'E. Alt: 760m, 20 May 2002 (fl), *Parmentier 3225* (BRLU); inselberg de Bicurga, près du village de Bicurga. 1°35'N 10°28'E. Alt: 715m, 22 May 2002 (st), *Parmentier 3273* (BRLU); Parc national de Monte Alen, transect de Monte Chocolate. 1°46'N 10°16'E, 10 October 1994 (fl), *Lejoly 94/ 214* (BRLU); **Rio Muni, Litoral:** Sanye, river Benito. 1°35'N 9°50'E, 4 September 1897 (fl), *Bates, G.L. 570* (G,Z); Monts de Cristal. 10 km ENE d'Okuamkos. 1°09'N 10°14'E, 22 August 1988 (fl), *Wilks 1815* (LBV,WAG); **Rio Muni, Wele Nzaz:** Obamico (Parc National de Nsork). 1°14'N 11°02'E, 3 September 1998 (fl, fr), *Nguema Miyona 305* (BRLU); Parc national de Nsork, Obamicu, Rio Abang. 1°14'N 11°20'E. Alt: 500m, 26 July 1998 (fr), *Lejoly 98/ 39* (BRLU).

**GABON, Estuaire:** 7 km E. of M'Voum, 24 km NE of Ntoum. 0°33'N 9°52'E. Alt: 60m, 1 November 1983 (fl), *Louis, A.M. 262* (WAG); Libreville. 0°25'N 9°26'E, 28 November 1898 (fl), *Klaine 397* (P); Kango, proche de village au S du pont de rivière Komo et avant pont de rivière Bokoué. 0°11.0'N 10°07.3'E, 5 November 2009 (fr), *Bissengou 654* (LBV,WAG); 5 km au Sud de Noayong. 0°37'N 9°43'E, 23 September 1983 (fl), *Floret 1422* (LBV,WAG); Barrage de Kingué, downstream of the hydroelectric power station. 0°26'N 10°16'E. Alt: 100m, 20 November 1986 (fr), *Wilde, J.J.F.E. de 8859* (LBV,MO,WAG); Parc National de Monts de Cristal, road L108 from Tchimbélé to Kingué. 0°37.8'N 10°21.7'E. Alt: 394m, 25 October 2011 (fr), *Maas, P.J.M. 9985* (LBV,MO,WAG); Crystal Mountains; Tchimbélé Dam region; 0°37'N 10°21'E. Alt: 550m, 23 September 2000 (fl), *McPherson, G.D. 17970* (LBV,MO); Crystal Mountains, 49040m on transect G. 0°31'N 10°25'E, 3 May 2001 (fr), *Wilks AP 3447* (LBV,WAG); **Haut-Ogooué:** Batéké Plateau, Station of the Projet de Protection des Gorilles. 2°07'S 14°04'E. Alt: 400m, 21 November 2001 (fl), *Walters, G.M. 904* (MO,WAG); après pont de la rivière Sebe. 0°43'S 13°49'E. Alt: 453m, 18 November 2009 (fl), *Bissengou 916* (LBV,WAG); East of Gorilla Research Station along Mpassa River. 2°06.78'S 14°04.02'E. Alt: 444m, 5 December 2001 (fl), *Bradley, A.F. 1167* (MO,WAG); village Moyabi, ca 23 km road Moanda to Franceville. 1°39'S 13°17'E, 5 October 1970 (fl), *Breteler 6770* (B,C,MA,WAG); **Moyen-Ogooué:** Eastern part of the Presidential Reserve Wonga-Wongué 100 km S of Libreville. 0°30'S 9°40'E. Alt: 100m, 1 March 1983 (fl), *Wilde (WALK-B) 826* (BR,C,LBV,MO,P,WAG); **Ngounié:** St Martin. 1°41'S 10°56'E, October 1938 (fl), *Walker, A.A. s.n.* (P); Est du Parc National de Waka, à ± 5 km au Sud de la rivière Mayi. 1°13.7'S 11°17.0'E. Alt: 647m, 19 February 2008 (fl), *Dauby 689* (BRLU,LBV,MO,WAG); Massif du Chaillu, near Mouyanama, ± 27 km E. of Mimongo. 1°39'S 11°46'E. Alt: 800m, 26 November 1983 (fl, fr), *Louis, A.M. 898* (WAG); Divinde. 1°02.03'S 11°09.37'E. Alt: 444m, 16 October 2012 (fl), *Towns 1343* (LBV,WAG); Bouvala hills. Upper slope of ridge. 1°37.3'S 11°45.5'E. Alt: 960m, 5 October 2007 (fl), *Leal, M.E. 1868* (LBV,MO,WAG); Bouvala hills. Midslope. 1°37.8'S 11°46.6'E. Alt: 820m, 10 October 2007 (fl), *Leal, M.E. 2002* (LBV,MO,WAG); Rive gauche (sud) de l'Ikoy, à environ 10 km de l'embouchure avec la Ngounié. 0°48.53'S 10°37.12'E. Alt: 68m, 24 October 2012 (fl), *Dauby 2895* (BRLU,LBV,MO,P,WAG); entre Boudyangoula & Nombou. 1°50'S 11°33'E, September 1925 (st), *Le Testu 5520* (BM,BR,P); forest south of 8½ km on road Moukabou to Koulamoutou. 1°36.49'S 11°43.22'E. Alt: 650m, 16 March 2013 (fl), *Wieringa, J.J. 7479* (WAG); 35 km Mouila to Yeno. 1°45'S 11°20'E. Alt: 350m, 25 September 1986 (fl), *Breteler 8216* (C,K,WAG); 50 km on road Mouila to Yeno. 1°45'S 11°22'E. Alt: 500m, 26 September 1986 (fl), *Breteler 8252* (C,K,WAG); road from Mandji into CBG concession, 18 km W of Mandji, Sentier Botanique. 1°45.0'S 10°16.9'E. Alt: 108m, 11 November 2011 (fr), *Maas, P.J.M. 10236* (LBV,UC,WAG); road from Mandji to Rabi, 18 km W of Mandji, Sentier

Botanique. 1°45.1'S 10°16.3'E. Alt: 140m, 14 November 2011 (fl), *Maas, P.J.M. 10322* (LBV,MO,UC,WAG); Massif de Koumounabwali 21 km along the Bondola river, counting from road Lambaréné-Fougamou. 1°18'S 10°26'E. Alt: 250m, 14 December 1995 (fr), *Wilde, J.J.F.E. de 11600* (LBV,MO,WAG); **Ogooué-Ivindo**: M'passa. 0°30'N 12°45'E, 10 March 1977 (st), *Florence 33* (P); Bélinga 2 km along the lower track of Babel Nord. 1°05'N 13°11'E. Alt: 675m, 19 September 1978 (fl), *Breteler; Wilde 724* (C,WAG); Parc d'Ipassa makokou, après château d'eau. 0°31'N 12°48'E, 10 March 2010 (fr), *Bissiegou 1103* (LBV,WAG); route Bélinga, 5 km après village Mbondo. 0°53'N 13°10'E. Alt: 586m, 12 March 2010 (st), *Bissiegou 1157* (LBV,WAG); Makokou, plateau d'Ipassa. 0°34'N 12°52'E, 24 June 1970 (fl), *Farron 7503* (P); Makokou, plateau d'Ipassa. 0°34'N 12°52'E, June 1970 (st), *Farron 7553* (P); Makokou, vers le plateau Ipassa. 0°32'N 12°49'E, 30 June 1970 (fr), *Farron 7590* (P); Makokou, plateau d'Ipassa. 0°31'N 12°48'E, 3 July 1970 (fl), *Farron 7649* (P); Makokou, non loin de la nouvelle mission biologique du CNRS. 0°31'N 12°48'E, 3 July 1970 (st), *Farron 7660* (P); **Ogooué-Lolo**: region de Lastoursville, Ngoma. 1°01'S 12°43'E, December 1929 (st), *Le Testu 7779* (BM,BR,P); **Ogooué-Maritime**: Rabi, 3.6km on road from Rabi to Divangui. 1°54'S 9°54'E. Alt: 30m, 10 November 1993 (fl, fr), *Haegens 35* (LBV,MO,WAG); Rabi, 4.5km on road from Rabi to Divangui. 1°54'S 9°54'E. Alt: 30m, 10 November 1993 (fl), *Haegens 36* (BR,E,HBG,K,LBV,LD,MA,MO,WAG); Rabi, in hectare plot of J.J. Wieringa. 1°55'S 9°53'E. Alt: 30m, 17 November 1993 (fr), *Haegens 72* (LBV,MO,WAG); Rabi-Kounga, road to Divangui. 1°54'S 9°55'E. Alt: 30m, 6 December 1993 (fr), *Haegens 109* (E,LBV,MO,WAG); Rabi-E, N of Pechoud Camp. 1°56.5'S 9°52.9'E, 26 October 1990 (fl), *Nek 116* (BR,C,E,G,M,MA,MO,PRE,WAG); Rabi-NE, at logging site of CBG, ca 5 km beyond checkpoint Divangui. 1°50'S 10°00'E, 29 October 1990 (fl), *Nek 149* (WAG); Rabi-E, near junction Camp Shell/Pechaud. 1°56.6'S 9°52.7'E, 5 November 1990 (fl), *Nek 197* (BR,E,MO,WAG); Rabi-NW, near Rembo Rabi, NW of Rabi site. 1°53.7'S 9°50.7'E, 13 November 1990 (fr), *Nek 288* (WAG); N of Yéno, next to débarcadère of Forester 150 m from Fouanou village. 1°35.0'S 9°57.8'E. Alt: 15m, 12 February 2010 (fr), *Bissiegou 988* (LBV); Rabi-Kounga, N of airport (in 1-ha plot). 1°55.7'S 9°52.5'E. Alt: 45m, 27 September 1992 (fl), *Wieringa, J.J. 1647* (C,LBV,MO,WAG); Rabi-Shell concession, N of airport. 1°55.7'S 9°52.4'E. Alt: 56m, 24 January 2010 (fl), *Dauby 2138* (BRLU,LBV,MO); Rabi-Shell concession, just SW of Rabi oil field. 1°58.9'S 9°51.1'E. Alt: 106m, 26 January 2010 (fl), *Dauby 2184* (BRLU,LBV,MO); Doudou Mountains National Parc 5 km S of Camp Peny (CBG). 2°03.1'S 10°27.9'E. Alt: 100m, 14 November 2005 (fr), *Sosef 2289* (LBV,MO,WAG); Doudou Mountains National Parc 50 km S of Mandji. 2°08.2'S 10°23.1'E. Alt: 575m, 17 November 2005 (fl), *Sosef 2365* (LBV,WAG); Rabi, N of airstrip, 1 ha-plot. 1°55.7'S 9°52.5'E. Alt: 40m, 27 March 1994 (fl, fr), *Wieringa, J.J. 2593* (WAG); 44 km along a track leading in a western direction into the Doudou Mountains from Doussala. 2°14'S 10°25'E. Alt: 150m, 3 December 1986 (fr), *Wilde, J.J.F.E. de 9134* (MO,WAG); Rabi. 1°55'S 9°50'E, 26 March 1990 (fr), *Breteler 9517* (WAG); 1 km on the road Rabi-Divangui. 1°54'S 9°53'E, 25 November 1989 (fl, fr), *Wilde, J.J.F.E. de 9724* (BR,K,MO,WAG); Rabi, Divangui Rd. 1°55'S 9°50'E, 3 April 1990 (fl), *Breteler 9764* (WAG); Rabi-Kounga, Divangui Rd. 1°55'S 9°55'E, 26 October 1991 (fl), *Breteler 10147* (BR,LBV,MO,WAG); Rabi-Kounga, Divangui road. 1°55'S 9°55'E, 30 October 1991 (fl), *Breteler 10224* (BR,E,HUJ,K,LBV,MO,WAG); **Woleu-Ntem**: Inselberg Milobo. 0°56'N 10°30'E. Alt: 700m, 10 July 2001 (fl), *Ngok Banak 60* (BRLU,LBV,WAG); Bordamur concession area, some 48 km from WWF-station, on large Inselberg near logging road construction site. 1°14'N 11°53'E. Alt: 590m, 14 October 2002 (fl), *Strijk 156* (BR,LBV,MO,WAG); Inselberg Milobo. 0°56.9'N 10°31.9'E. Alt: 660m, 28 October 2001 (fl), *Ngok Banak 264* (BRLU,LBV,MO,WAG); 11 km SE of Mitzic, bridge over Okano river at FOREENEX forestry camp. 0°42.9'N 11°37.8'E. Alt: 488m, 7 November 2009 (st), *Bissiegou 765* (LBV,WAG); 48 km NE of Mitzic, forestry road in Bordamur forest exploitation. 1°04.8'N 11°52.2'E. Alt: 560m, 8 November 2009 (fl, fr), *Bissiegou 809* (LBV,WAG); Parc des Monts de cristal, environ du Plot II, Smithsonian. 0°37.1'N 10°24.6'E, 11 February 2010 (fr), *Bissiegou 932* (LBV,WAG); Parc des Monts de cristal, le long de la rivière Mbé, piste après la case picnic sur la droite. 0°37'N 10°24'E, 13 February 2010 (fl), *Bissiegou 966* (LBV,WAG); Chantier Rougier Ocean, Oveng; 40 km NW of Oveng. 0°46'N 11°06'E, 20 September 1985 (fr), *Reitsma, J.M. 1520* (MA,WAG); forestry concession Bordamur 40 km NE of Mitzic. 1°04.8'N 11°52.4'E. Alt: 500m, 6 February 2003 (fr), *Sosef 1869* (LBV,MO,WAG); Minkébé area, at 1100 m from the camp. 1°30'N 12°48'E, 29 March 1990 (fl), *Minkébé Series AM 66* (WAG); Minkébé area, footpath between camp and transect A. 1°30'N 12°48'E, 8 March 1990 (fl), *Minkébé Series W 41* (WAG); Minkébé area, side plot R. 1°30'N 12°48'E, 31 March 1990 (fl), *Minkébé Series W 85* (WAG); Minkébé area. 1°30'N 12°48'E, 6 April 1990 (fr), *Minkébé Series W 94* (WAG); river Ivindo. 1°15'N 13°12'E, 13 September 1990 (fl), *Minkébé Series W 570* (K,LBV,MAKOK,MO,P,WAG).

**GHANA, Ashanti Region**: Mrenya ashanti. 6°13'N 1°10'W, (fl), *Irvine, F.R. 493* (FHO); Pra-Anum Forest



Reserve. 6°15'N 1°10'W, March 1937 (fl, fr), *Andoh 4338* (BM); Juaso (Ash). 6°35'N 1°07'W, February 1930 (fl), *Vigne FH 1819* (FHO); Ofin Head Waters. 7°00'N 1°27'W, April 1930 (fr), *Vigne FH 1911* (A,BM,FHO,K); Bobiri F.R. 6°40'N 1°20'W, May 1951 (fr), *Enti FH 6717* (K,P); **Eastern Region:** Atewa Range Forest Reserve. 6°09'N 0°36'W, 18 April 1970 (fl), *Hall, J.B. GC 40169* (K); **Western Region:** Tano River. 5°13'N 2°45'W, 19 September 1912 (fl), *Chipp 384* (K).

**IVORY COAST, Abidjan:** Adiopodoumé, Botanical gardens. 5°19'N 4°08'W, 1 March 1972 (fl), *Doorn 77* (BR,MO,WAG); Jardin Botanique d'Adiopodoumé. 5°20'N 4°09'W, 20 October 1960 (fl), *Aké Assi 6757* (G); Adiopodoumé. 5°20'N 4°07'W, 6 April 1970 (fr), *Farron 7026* (P); Banco. 5°23'N 4°03'W, May 1949 (fr), *Bégué SF 3146* (P); **Aboisso:** Ayamé-Ganviéssou. 5°37'N 3°11'W, 12 May 1965 (fr), *Miège s.n.* (G); Ayamé. 5°37'N 3°11'W, 12 May 1965 (fr), *Aké Assi s.n.* (G); **Agboville:** Forêt du Yapo. 5°44'N 4°10'W, 11 March 1964 (fl), *Oldeman, R.A.A. 998* (K,MO,WAG); Azaguié. 5°38'N 4°06'W, 19 December 1991 (fr), *Chatelain 1000* (G); 40 km N of Abidjan. Forêt de Yapo. 5°44'N 4°07'W. Alt: 100m, 29 October 1958 (fl, fr), *Leeuwenberg 1817* (K,WAG,Z); Yapo forest. 5°44.5'N 4°07.7'W. Alt: 100m, 31 August 2001 (fl), *Wieringa, J.J. 4276* (WAG); In vicinioribus Yapo-Nord. 5°46'N 4°07'W, March 1962 (fl, fr), *Bernardi, L. 8664* (G,K,US); Yapo. 5°48'N 4°08'W, 15 November 1954 (fr), *Roberty 15475* (G,K); Yapo. 5°48'N 4°08'W, April 1949 (fl), *Bégué SF 3147* (P); **Duékoué:** Duekoué-Buyou, N. du Nzo. 6°27'N 7°15'W, 27 February 1969 (fl), *Bamps 2143* (BR); **Guiglo:** Djiloubaye. 6°06'N 7°30'W, 22 March 2002 (fl), *Bakayoko 95* (G,WAG); Tai. 5°52'N 7°27'W, February 1982 (fl), *Stäuble 684* (G); Tienkoula. 6°07'N 7°30'W, 1 March 1962 (fl), *Bernardi, L. 8347* (K); Ad occidentem miserrimi oppidi Tai nuncupati, ultra flumen Cavali, id est in territorio reipublicae Liberiae. 5°50'N 7°10'W, 3 March 1962 (fl), *Bernardi, L. 8437* (G,K); **Sassandra:** near the road to Sassandra, near Lagako, 8.1km, near piste. 5°25'N 5°50'W. Alt: 5m, 7 May 1975 (fl), *Beentje 26* (UC,WAG); 70 km of Sassandra, direction Lokata. 5°20'N 5°55'W, 1 May 1962 (fr), *Leeuwenberg 4079* (B,K,L,WAG); **Soubré:** P.N. de Tai, zone Est, secteur Soubré, groupe de transect VI. 5°42.7'N 6°58.7'W, 24 March 2010 (st), *Scoupe 277* (G,WAG); 25 km SW of Guéyo. 5°36'N 6°12'W. Alt: 100m, 24 March 1962 (fl), *Leeuwenberg 3723* (B,BR,FHI,HBG,K,MO,P,PRF,SL,UC,WAG); **Tabou:** FC de la Ht Dodo, close to Kouadjokro. 5°00'N 7°18'W. Alt: 150m, 3 May 1999 (fr), *Jongkind 4457* (WAG).

**LIBERIA, Grand Gedeh:** Eastern Province, Putu District. New road from Chien to Cape Palmas. 5 km N of Kanweake, a small village situated 70 km S of Chien. 5°30'N 8°03'W, 29 March 1962 (st), *Wilde, J.J.FE. de 3710* (B,EA,K,WAG); **Maryland:** 20 miles N of Harper, along secondary road. 4°39'N 7°41'W, 22 July 1971 (fr), *Jansen, J.W.A. 2500* (WAG); **Montserrado:** Between Robertsfield and Monrovia, road to Caesar's Beach. 6°13'N 10°35'W, 19 April 1970 (fr), *Stoop-v.d. Kastele 152* (WAG); **Nimba:** Losseh Pah. 6°46'N 8°47'W. Alt: 200m, 5 June 1960 (st), *Voorhoeve 3* (WAG); National Forest, 18 miles N of Tapeta. 6°45'N 8°52'W, 15 February 1961 (st), *Voorhoeve 174* (WAG); Ganta. 7°14'N 8°59'W, June 1943 (fl), *Harley, W.J. 1295* (K); **Sino:** at the Jalays Town-entrance of Sapo National Park, along the Sinoe river. 5°20'N 8°48'W, 19 March 2001 (fl), *Parren 517* (WAG); Inside Sapo NP close to cano crossing of the Sinoe River. 5°20'N 8°48'W. Alt: 100m, 11 March 2009 (fl), *Jongkind 8933* (BR,WAG).

**NIGERIA, UNKNOWN:** probably in Western or South-Eastern State. 14 November 1968 (fl), *Meer, P.P.C. van 1047* (BR,BUC,K,MO,POZG,WAG,YA); **Akwa-Ibom State:** South Eastern State. Stubbs Creek Forest Reserve 30 km E of Eket. 4°36'N 8°16'E, 6 April 1971 (fl), *Meer, P.P.C. van 1181* (WAG); **Cross River State:** Oban. 5°19'N 8°34'E, 1911 (st), *Talbot, P.A. 426* (BM); Ekinta River Forest Reserve 20km ENE of Calabar. 5°00'N 8°30'E, 1 April 1971 (fl, fr), *Meer, P.P.C. van 1109* (MO,WAG); Ekinta River Forest Reserve 20 km ENE of Calabar. 5°00'N 8°30'E, 2 April 1971 (fl), *Meer, P.P.C. van 1136* (WAG); South Eastern State. Oban Group Forest Reserve. East Block. 5°31'N 8°41'E. Alt: 200m, 21 April 1971 (fr), *Meer, P.P.C. van 1410* (WAG); Oban. 5°19'N 8°34'E, 1912 (st), *Talbot, P.A. 1746* (BM); **Edo State:** Ehor and Ibekwe. 6°35'N 5°45'E, 1934 (fr), *Fairbarn s.n.* (BM); Ibekwe, near Benin. 6°35'N 5°45'E. Alt: 121m, April 1934 (fl, fr), *Fairbarn 49* (BM); Sapoba. 6°06'N 5°53'E, (fl), *Kennedy, J.D. 172* (FHO,K); 1965 Abe Taungya, nr Sapoba (SE of Benin). 6°06'N 5°53'E, 27 March 1969 (fl), *Lowe, J. 1702* (FHO,K); Abe Taungya, near Sapoba (SE of Benin). 6°06'N 5°53'E, 27 March 1969 (fl), *Lowe, J. 1713* (WAG); Sapoba. 6°06'N 5°53'E, (fr), *Kennedy, J.D. 2104* (FHO); Sapoba. 6°06'N 5°53'E, (fl, fr), *Kennedy, J.D. 2251* (EA,FHO); Jamieson River Sapoba. 6°06'N 5°53'E, (fl), *Kennedy, J.D. 3048* (FHO); Asaba. 6°11'N 6°45'E, March 1948 (fl), *Irvine, F.R. 3610* (K); Owam F.R. by road between Uyere and Oke. 6°45'N 5°46'E, 11 February 1948 (fl, fr), *Brenan 8986* (K); Okomu Forest Reserve, Compartment No 86. 6°20'N 5°15'E, 27 December 1947 (fl, fr), *Brenan FHI 8612* (K); Urehi, N.A forest Reserve. 6°37'N 6°06'E, 15 March 1948 (fl), *Hnuigboje FHI 21491* (K); Iyekusulu distr. Gilli-Gilli reserve. 6°05'N 5°20'E, 19 March 1961 (fl), *Ogbeni FHI 43370* (K); Iyekusulu distr. in field 8 at W.A.I.F.O.R. 6°28'N 5°31'E, 7 December 1961 (fl), *Daramola FHI 45665*

(K); **Lagos State**: c. 3/4 mile south west of Osho enclave. 6°29'N 3°19'E, 2 April 1946 (fl), Jones, A.P.D. FHI 17257 (FHO,K); **Ogun State**: Shasha forest reserve, Baba Eku. 7°00'N 4°15'E, 2 March 1935 (fr), Ross, R. 57 (BM); Shasha forest reserve. 7°00'N 4°15'E, 20 April 1935 (fl, fr), Ross, R. 238 (BM); 3 km S. of Aberu; 10 Km S. of Omo Sawmill. 7°00'N 4°15'E, 14 May 1980 (fl), Pilz 2391 (B); 3 km S. of Aberu; 10 Km S. of Omo Sawmill. 7°00'N 4°15'E, 14 May 1980 (fl), Pilz 2444 (B,K,US); Eluju. 7°05'N 4°30'E, 8 March 1935 (fl, fr), Richards, P.W. 3210 (BM,S); Shasha forest reserve. 7°05'N 4°30'E, 6 April 1935 (fr), Richards, P.W. 3330 (BM); Shasha forest reserve. 7°05'N 4°30'E, 22 April 1935 (st), Richards, P.W. 3389 (BM); 4 miles south of Okoigbo at pathside in H2F/BF. 7°09'N 2°47'E, 9 February 1946 (fl), Jones, A.P.D. FHI 14722 (BR,FHO,K); in HF near compt 53. 6°49'N 3°56'E, 8 April 1946 (fl), Tamajong FHI 16839 (FHO); **Taraba State**: Gongola State, Sadauna Local govt Area, Gashaka Gangumi Forest Reserve. 6°55'N 11°30'E. Alt: 229m, 20 May 1977 (fr), Chapman, J.D. 4987 (FHO,K).

**Key literature**: Farron (1963, 1985), Harris & Wortley (2008), Hawthorne & Jongkind (2006), Hutchinson, Dalziel & Keay (1954).

**Campylosperrum umbricola** (Tiegh.) Farron

**Fig. 29**

Bull. Jard. Bot. État Bruxelles 35: 403 (1965). – *Monelasmum umbricola* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 333 (Dec. 1902). – *Ouratea umbricola* (Tiegh.) Engl., Bot. Jahrb. Syst. 33: 259 (1904). – Type: *Zenker 1792* (holotype: P!; isotype: E!, G!, K!, P(2x)!, S!, WAG!, Z!), Cameroon, Bipindi, 1898.

*Monelasmum macrophyllum* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 334 (1902). – Type: *Zenker 1848* (holotype: P!; isotype: E!, G!, K!, Z!), Cameroon, Bipindi, 1898.

**Tree up to 15 m tall, bole up to 20 cm**, with branched trunk; twigs with brownish white bark. *Stipules* caducous, leaving a conspicuous scar at the base of the petiole, c. 10 mm long. *Leaf*: petiole 10–13(–15) mm long, **stout, canaliculate**; leaf blade obovate, **(24–)28–45(–53) x (8–)11–14(–17) cm**, ratio **2.5–3.9**, base cuneate, apex acute to shortly acuminate, **coriaceous**, not to slightly bullate, glossy green above, paler green and less glossy below, margin regularly serrulate, entire toward the base; venation: midrib flattened above, prominent beneath, **2–3 mm wide towards the petiole**, main lateral veins (16–)23–26 on either side, 15–35 mm apart, slightly prominent but often running in a depression above, not to slightly prominent below, at a right to slight angle with the midrib but curved upward to run parallel to the margin, intermediate lateral veins 1–4 between each pair of main lateral veins, prominent on both sides, tertiary venation scalariform, perpendicular to oblique to the main lateral veins, indistinct above, slightly distinct below. *Inflorescence* terminal, branched, lax, its main axis (19–)22–40(–48) cm long, cylindrical; **pairwise scales at the base of peduncle absent**; racemes (3–)5–9, (9–)12–26(–30) cm long; cymules 0.5–3.5 cm apart, **1–12-flowered**; bracts caducous. *Flower*: pedicel (8–)10–15 mm long, articulated at 1–5 mm from the base, **strongly inflated in fruit**; sepals **ovate**, in flower 9–10 x 6–7 mm, **in fruit (20–)25–30(–35) x (10–)13–20(–25) mm**, **coriaceous**, base truncate, apex rounded, enclosing the drupelets; petals broadly obovate, **13–19 x 7–10 mm**, clawed at base, rounded at apex; stamens: anthers 5–6 mm long; ovary c. 2–3 mm long; style 5–6 mm long. *Fruit*: receptacle enlarged in fruit up to 4–5 mm thick; drupelets 2 to 3 well developed per receptacle, **ellipsoid**, 7–11 mm long, immature ones red, mature ones black; cotyledons

**accumbent, more or less similar in size.**

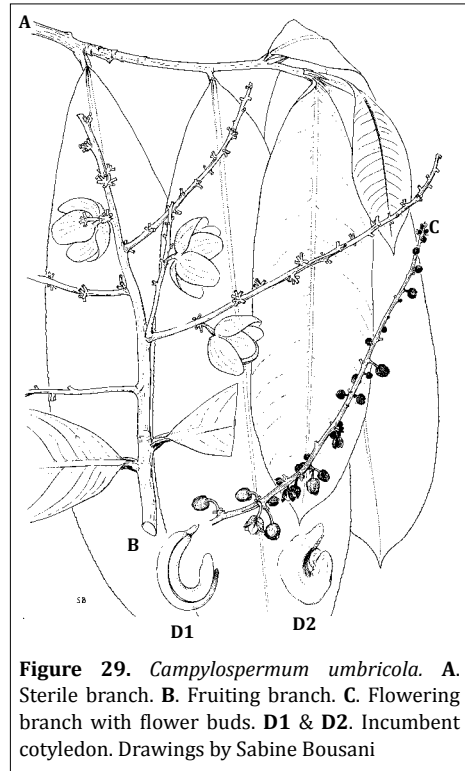
**Notes:** This species was previously only known from south-western Cameroon, but has now also been collected in the Crystal Mountains National Park, north-western Gabon. It is to be expected in Equatorial Guinea as well. *C. umbricola* is a distinct species, easily distinguished by the large and coriaceous leaves and by the sepals that are strongly enlarged in fruit.

**Distribution:** south-western Cameroon and north-western Gabon (Crystal Mountains) (Map 29).

**Ecology:** primary and secondary coastal forest, along streams; at 50–1000 m altitude.

**Phenology:** flowering from April to August; fruiting from June to July.

**IUCN conservation status:** NT B1/B2(iii,iv). EOO=51,361 km<sup>2</sup>, AOO=26,892 km<sup>2</sup>, locations=17 (cell width=52 km). This species has a disjunct distribution in Cameroon. Most of its locations are found outside of protected areas, some of which are under heavy environmental pressure of human populations and logging. Only one collection is from a protected area (Crystal Mountains National Park in Gabon). Therefore, the category of Near Threatened seems justified.



**Figure 29.** *Campylospermum umbricola*. A. Sterile branch. B. Fruiting branch. C. Flowering branch with flower buds. D1 & D2. Incumbent cotyledon. Drawings by Sabine Bousani

**Specimens examined:**

**CAMEROON, Central Province:** Eseka. 3°39'N 10°46'E, 8 June 1955 (fl), *Mbarga 21* (P); **South Province:** Path to Mont d'Elephant, 6 km S of Bidou III. 2°48'N 10°02'E. Alt: 150m, 24 August 1997 (fr), *Burgt, X.M. van der 119* (BR,K,KRIBI,MA,MO,NY,P,WAG,YA); Lolodorf, Ngowayang. 3°15'N 10°37'E, 14 June 1918 (st), *Annet 258* (P); Lolodorf, Urwaldgebiet. 3°14'N 10°43'E, 1896 (fr), *Staudt 260* (COI,P,S); Lolodorf. 3°14'N 10°44'E, 16 June 1918 (st), *Annet 355* (P); Lolodorf. 3°14'N 10°44'E, 16 June 1918 (fl), *Annet 362* (P); Kribi, piste menant au Mont éléphant, 7 km après village Bidou III. 2°48.17'N 10°01.61'E. Alt: 73m, 27 March 2010 (st), *Bissiengou 1213* (LBV,WAG,YA); Bipinde. 3°05'N 10°25'E, 1898 (fl), *Zenker 1792* (BM,E,G,K,S,W,Z); Bidou, Mont d'Elephant, along the path to the summit. 2°47.9'N 10°01.1'E. Alt: 200m, 13 August 2002 (st), *Tchouto Mbatchou 3385* (WAG); Urwaldgebiet. 3°05'N 10°25'E, 1911 (fr), *Zenker 4054* (BM,COI,E,G,K,LY,S,W,Z); 6 km E. of km 58 of road Edéa-Kribi, N. of road to Mboké. 3°20'N 10°12'E. Alt: 100m, 2 May 1965 (st), *Leeuwenberg 5677* (BAS,BR,K,P,WAG,YA); SE. of Kribi, E. of Mt. Elephant. 2°47'N 10°01'E, 30 June 1970 (fr), *Bos, J.J. 7000* (BR,K,L,LD,LMA,M,MO,PSRGH,UPS,WAG,YA); Kribi, 15 km au SE du Mont Eléphant. 2°49'N 10°01'E, 28 April 1970 (st), *Farron 7194* (P); 47 km on the road from Ebolowa to Lolodorf, just past Mengele. 3°07'N 10°51'E. Alt: 640m, 25 July 1975 (st), *Wilde, J.J.F.E. de 8388* (BR,MO,P,WAG); **South-West Province:** near Mbu village, 10 kms west of Wone which is on the Kumba-Mamfe road. 5°03'N 9°18'E. Alt: 500m, 15 April 1986 (fl), *Mambo 7*

(MO,P,WAG); path from Ndibise to Mejelet, west of Bangem Bakossi. 5°04'N 9°42'E. Alt: 1000m, 9 June 1987 (fl, fr), *Etuge 521* (BR,MO); Korup National Park, P transect, NE corner of plot 25G. 5°01'N 8°47'E. Alt: 100m, 31 May 2000 (st), *Burgt, X.M. van der 604* (G,SCA,WAG); Buea-Douala. South Korup Reserve, rocky river banks of Mana River; & oil palms. 4°55'N 8°50'E. Alt: 50m, 6 July 1983 (fl, fr), *Thomas, D.W. 2271* (MO,WAG).

**GABON, Woleu-Ntem:** Parc des Monts de cristal, environ du Plot III, Smithsonian. 0°37.0'N 10°24.0'E. Alt: 432m, 14 March 2010 (st), *Bissiengou 977* (LBV,WAG); Mbe National Park. Monts de Cristal. Follow road at base of Tchimbele Dam towards picnic area. At curve in road follow stream to left. 0°37'N 10°24'E. Alt: 500m, 1 February 2005 (st), *Walters, G.M. 1532* (MO).

**Key literature:** Farron (1963, 1985).

### **Campylosperrum vogelii** (Hook.f. ex Planch.) Farron

**Fig. 30**

Bull. Jard. Bot. État Bruxelles 35: 403 (1965). – *Gomphia vogelii* Hook.f. ex Planch., Lond. Journ. Bot. 6: 2 (1847). – *Ouratea vogelii* (Hook.f. ex Planch.) Engl. ex Gilg, in Engl. & Prantl, Nat. Pflanzenfam. ed. 1, III, 6: 142 (1893). – *Monelasmum vogelii* (Hook.f. ex Planch.) Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 327 (1902). – Type: *Vogel 53* (holotype: K!; isotype: P!), Liberia, Grand Bassam, July 1841.

*Ouratea reticulata* (P.Beauv.) Engl. ex Gilg var. *poggei* Engl., Bot. Jahrb. Syst. 17: 81 (1893). – *Monelasmum poggei* (Engl.) Tiegh., Ann. Sc. Nat., sér. 8, Bot. 16: 328 (Dec. 1902). – *Ouratea poggei* (Engl.) Gilg., Bot. Jahrb. Syst. 33: 272 (1904). – *Campylosperrum vogelii* (Hook.f. ex Planch.) Farron var. *poggei* (Engl.) Farron, Bull. Jard. Bot. État Bruxelles 35: 404 (1965). – Lectotype (here designated): *Pogge 684* (holotype: B†; isotype: COI!), Democratic Republic of the Congo, Mukenge, March 12<sup>th</sup>, 1881.

*Ouratea dewevrei* De Wild. et Th.Dur., Ann. Mus. Congo, Bot., sér. 3, 1: 37 (1901). – *Exomicrum dewevrei* (De Wild. et Th.Dur.) Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 339 (1902). – *Monelasmum dewevrei* (De Wild. et Th.Dur.) Tiegh., Ann. Sci. Nat., sér. 8, Bot. 18: 35 (1903). – Type: *Dewèvre 744* (holotype: BR!; isotype: BR(2x)!), Democratic Republic of the Congo, 1896.

*Exomicrum foliosum* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 340 (1902). – Type: *Staudt 268* (holotype: COI!; isotype: G!, S!), Cameroon, Lolodorf, 1896.

*Exomicrum lolodorfense* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 340 (1902). – Type: *Staudt 129* (holotype: COI!; isotype: G!, K!, S!), Cameroon, Lolodorf, 1896.

*Monelasmum hiernii* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 328 (1902). – *Gomphia hiernii* (Tiegh.) Lye, Lidia 4(3): 92 (1998). – Type: *Welwitsch 4605* (holotype: COI!; isotype: BM!, G!, K!), Angola, Malanje, Pungo, Andongo.

*Monelasmum mollerii* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 335 (1902). – *Campylosperrum vogelii* (Hook.f. ex Planch.) Farron var. *mollerii* (Tiegh.) Farron, Bull. Jard. Bot. État Bruxelles 35: 404 (1965). – Type: *Moller s.n.* (holotype: COI!; isotype: BM!), Sao-Tomé, Boca (dstricto Novo Destino), May 1885.

*Monelasmum thomense* Tiegh., Ann. Sci. Nat., sér. 8, Bot. 16: 335 (1902). – Type: *Moller s.n.* (holotype: COI!), Sao-Tomé, July 1885.

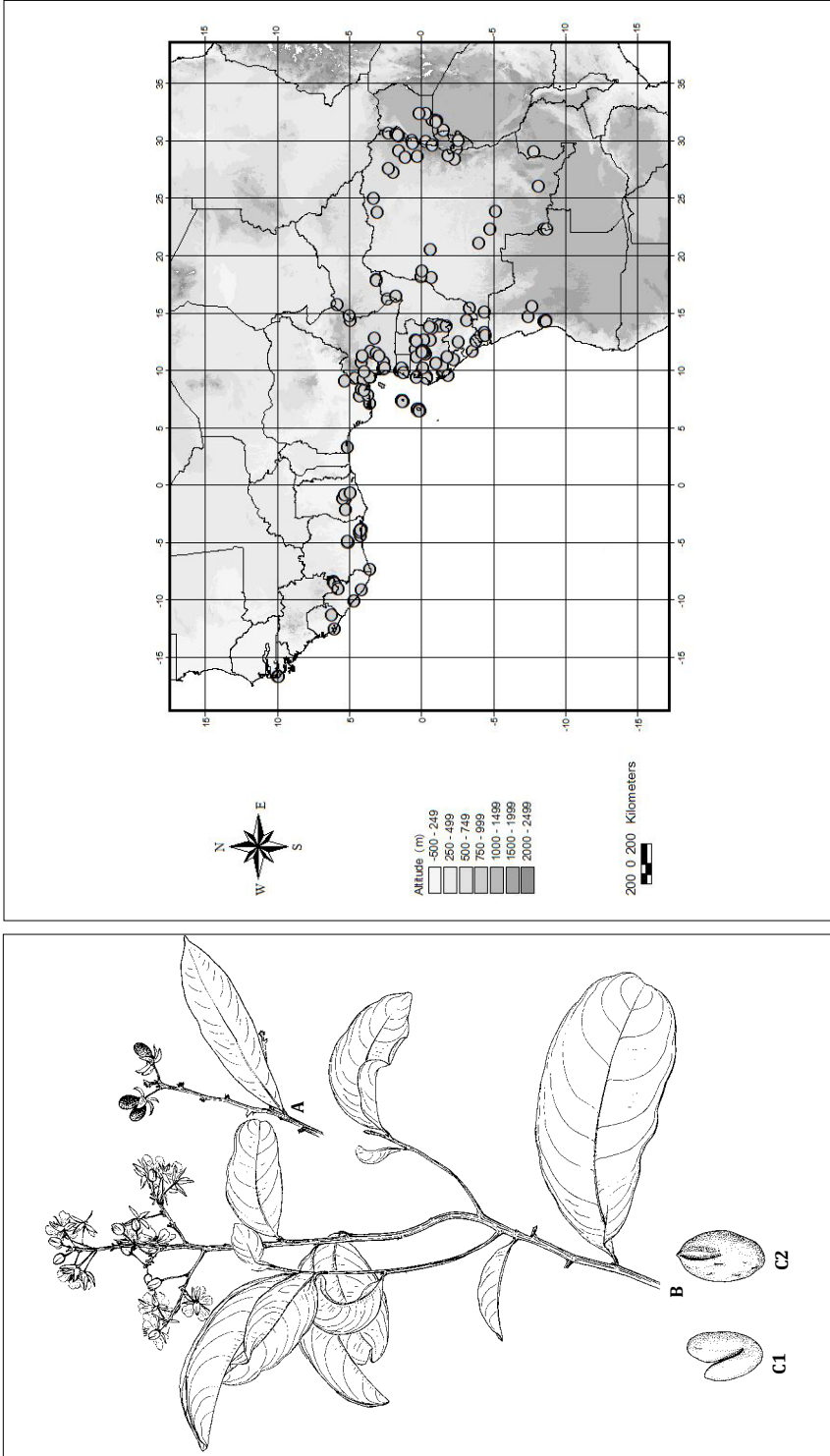
*Ouratea dinklagei* Gilg, Bot. Jahrb. Syst. 33: 265 (1904). – Type: *Dinklage 945* (holotype: B†; isotype: WAG!), Cameroon, Gross Batanga.

*Monelasmum jollyanum* Tiegh., Ann. Sci. Nat., sér. 9, Bot. 10: 168 (1907). – Type *Jolly s.n.* (holotype: P!), Ivory Coast, 1895-1896.

*Tree* up to 13 m tall, bole up to 7(-10) cm in diameter, with branched trunk; twigs with brownish white bark. *Stipules* caducous, **leaving a conspicuous scar at the base of the petiole**, triangular, 1-5 mm long. *Leaf*: petiole 2-5 mm long; leaf blade narrowly elliptic to narrowly elliptic-obovate or sometimes elliptic, **(7-)9-23(-27) x (2-)3-9(-10) cm**, ratio **(2.2-)2.4-3.7**, base cuneate to attenuate, apex acute to acuminate, coriaceous to papyraceous, not to slightly bullate, margin **serrate to serrulate**, medium green above, paler green below, glossy to dull on both sides; midrib prominent above, prominent to slightly so below, main lateral veins 10-25 on either side, 8-16(-20) mm apart, prominent on both sides, more or less at a right angle with the midrib but curved upward to run parallel to the margin, intermediate lateral veins 0-2 in between each pair of main laterals, prominent on both sides, tertiary venation **scalariform, perpendicular to the midrib, joined by cross veinlets**, distinct to slightly so above, distinct below. *Inflorescence* terminal, branched, lax, its main axis 3-14(-22) cm long, **compressed to flattened, zigzag**; pairwise scales at the base of peduncle absent; racemes **(1-)3-7, (2-)5-7(-13) cm long**; cymules **1-2 cm apart**, 2-7-flowered; bracts caducous, triangular, c. 1 mm long. *Flower*: pedicel 6-13 mm long, articulated at **3-7 mm from the base**; sepals narrowly ovate, in flower 5-8 x 1.5-3 mm, in fruit 10-15 x 5-6 mm and enveloping the drupelets, base rounded, apex acute; petals obovate, 3-10 x 3-6 mm, truncate at base, rounded to slightly emarginated at apex; stamens anthers 4-6 mm long; ovary c. 1 mm long; style 5-6 mm long. *Fruit*: receptacle c. 1 mm thick in flower, in fruit c. 3 mm; drupelets 1 to 4 well developed per receptacle, **ellipsoid to ellipsoid-oblong**, 7-10 x 5-6 mm; cotyledons **incumbent, dissimilar in size, with a small outer cotyledon**.

**Notes:** The varieties *C. vogelii* (Hook. f) Farron var. *poggei* (Engl.) Farron and *C. vogelii* (Hook. f) Farron var. *molleri* (Tiegh.) Farron are lumped into *C. vogelii*. Farron (1965) does not state why he recognized these varieties, nor does he explain that in his 1967 or 1985 publications. From material identified by him, we conclude that var. *molleri* has a more lax and slender inflorescence, a characteristic that we think is related to the environmental conditions in which the plant grows. Then, from the fact that in his Flore du Congo, du Rwanda et du Burundi treatment he only treats var. *poggei* (along with var. *costatum*, but see *C. costatum*) and writes this is found from Angola to Uganda, Kenya and Tanzania, we conclude that Farron treats the Central and East African material as being distinct from the typical West African var. *vogelii*. However, we failed to identify consistent characters to distinguish these geographical populations and thus decided not to recognize any varieties within *C. vogelii*.

*C. vogelii* can be easily confused with *C. reticulatum*, but it differs by having a compressed to flattened peduncle and inflorescence axis. *C. vogelii* has a scalariform tertiary venation



**Figure 30.** *Campylospermum vogelii*. **A.** Fruiting branch. **B.** Flowering branch. **C1 & C2.** Cotyledon. Drawings by Sabine Bousani  
**Map 31.** Distribution of *Campylospermum vogelii*

which is perpendicular to the midrib and joined by cross veinlets.

**Distribution:** Sierra Leone, Guinea, Liberia, Ivory Coast, Ghana, Nigeria, Cameroon, southern Central African Republic, Equatorial Guinea, Sao Tomé & Príncipe, Gabon, Republic of the Congo, Angola, Democratic Republic of Angola, Uganda, Burundi, western Tanzania and northern Zambia (**Map 31**).

**Ecology:** primary or secondary forest, open understory forest, gallery and swamp area, forest, forest edges, coastal forest; on rocks along the sea-shore and white sandy soil; at up to 1800 m altitude.

**Phenology:** flowering and fruiting all year round.

**Vernacular names:** **Cameroon:** Okoga (Yaounde); **Central African Republic:** Mabungu (Lissongo); **Sao Tomé & Príncipe:** Café bravo; **Sierra Leone:** Tongane-le or Bue-le (Sherbro).

**Uses:** A decorative shrub with yellow flowers (Burkill 1997). The wood is reported to be used as firewood and timber (Farron 1967).

**IUCN conservation status:** LC. EOO=7,108,140 km<sup>2</sup>, AOO=8,866,260 km<sup>2</sup>, locations=179 (cell width=563 km). This species is widespread from West to Central and eastern Africa. It occurs in numerous protected areas, and therefore the category of Least Concern has been applied.

#### **Specimens examined:**

**ANGOLA, Cabinda:** Caio. 4°46'S 12°36'E, 8 April 1919 (fl), *Gossweiler 7986* (BM,COI,K,LISC); **Cuanza Norte:** de Monte Lau-Monte Belo (Cazengo). 9°18'S 14°43'E, December 1912 (fr), *Gossweiler 5434* (COI,LISC); **Cuanza Sul:** Gabela, Roça Bôa Entrada. 10°52'S 14°20'E. Alt: 1093m, 22 June 1955 (fr), *Caldas 836* (LUA); Cuanza Sul, Amboim, capir. 10°45'S 14°18'E. Alt: 850m, 10 October 1932 (fl), *Gossweiler 9961* (BM,COI,K); Gabela, Roça Pombal, Mário Cunha. 10°51'S 14°22'E. Alt: 1050m, 17 November 1967 (fl), *Teixeira, J.M.L.B. 11696* (LUA); Gabela, Roça Pombal, Mucuco. 10°51'S 14°22'E. Alt: 1050m, 28 November 1967 (fl, fr), *Teixeira, J.M.L.B. 11781* (LUA); Gabela, Estrada entre a Roça Luciflia e Roça Africana. 10°51'S 14°22'E. Alt: 1050m, 2 December 1967 (fr), *Teixeira, J.M.L.B. 11839* (LUA); **Malanje:** Pungo, Andongo. 9°40'S 15°35'E, (fl), *Welwitsch, F.M.J. 4605* (BM,COI,G,K).

**BURUNDI, Bubanza:** Route de Butara, pont de la Kagunuzi. 3°03'S 29°20'E. Alt: 1200m, 17 December 1967 (fr), *Lewalle 2550* (BM,BR,K); **Gitega:** confluent de Karuzi-Ruvuvu. 3°15'S 30°02'E, 25 June 1958 (fl), *Ben 2113* (K); Confluent Karuzi-Ruvuvu. 3°15'S 30°02'E, 18 December 1958 (fl, fr), *Ben 2388* (EA,K).

**CAMEROON, Central Province:** près de l'étang Atemengue (Melen), station de pêche et pisciculture de Yaounde. 3°52'N 11°31'E, 1 August 1960 (fl), *Endengle 179* (P); près de Banda, à 56 km SW de Linte. 5°08'N 11°21'E, 19 April 1982 (fl), *Nkongmeneck 290* (P); Mbomba. 4°03'N 12°53'E, 25 April 1959 (fl), *Letouzey 1780* (P); near ferry Nachtigal 20 km N. of Obala. 4°21'N 11°38'E. Alt: 400m, 11 June 1964 (st), *Wilde, W.J.J.O. de 2665* (WAG); Nachtigal. 4°21'N 11°41'E. Alt: 450m, 26 February 1978 (fl), *Lowe, J. 3548* (K); Nachtigal. 4°21'N 11°41'E. Alt: 450m, 13 February 1979 (fr), *Lowe, J. 3756* (K,OXF); 40 km de Yaounde sur la route ancienne de Kribi. 3°40'N 11°20'E, 5 May 1970 (st), *Farron 7268* (P); pentes Orientales du Mt Yangba (1473 m) près Nyafianga (42 km NNE de Bafia). Feuille IGN 1/200 000 Linte. 5°06'N 11°15'E, 9 September 1966 (fl), *Letouzey 7830* (P); rive de la Sanaga, au confluent de l'Asamba, près de Ndjore (45 km NE d'Obala). 4°10'N 11°32'E, 26 December 1969 (fl, fr), *Letouzey 9780* (BR,K); **East Province:** Km 55 of road Meiganga-Garoua Boulai. 6°10'N 14°22'E, 2 February 1966 (st), *Leeuwenberg 7694* (BAS,BR,P,WAG); **Littoral:** près de Lafi (Ndocksamba), sur Mfang-Yabassi à 12 km au NNE de Nkondjok (feuille 1/200 000. Ndikiniméki). 4°57'N 9°56'E, 9 February 1972 (fl), *Letouzey 11175* (K,P); **South Province:** Urwaldgebiet. 3°14'N 10°43'E, 1896 (fl), *Staudt 129* (COI,G,K,S); Urwaldgebiet. 3°14'N 10°43'E, 1896 (fr), *Staudt 268* (COI,G,S); 18 km NW Bipinde, près Gouep. 3°10'N 10°17'E, 24 April 1974 (fr), *Villiers, J.F. 869* (P); près de Bella, 45 km NE de Kribi. 3°15'N 10°12'E, 25 January 1962 (fl), *Letouzey 4175* (P); 60 km S. of Edéa, S. of Mboké, 11 km E. of km 58 of road Edéa-Kribi. 3°21'N 10°10'E. Alt: 100m, 22 April 1965 (st), *Leeuwenberg 5509* (B,BAS,BR,C,EA,FHI,GC,K,LISC,

MO,P,PRE,SRGH,UC,WAG,YA); **South-West Province**: near Mbu village, 10 kms west of Wone which is on the Kumba-Mamfe road. 5°03'N 9°18'E. Alt: 500m, 15 April 1986 (fl, fr), *Mambo 17* (MO,P,WAG); Mamfe town, on the north side of the two German suspension bridges. 5°46'N 9°20'E. Alt: 100m, 22 April 1987 (fl), *Thomas, D.W. 7306* (BR,K,MO,WAG); Kumba Distr. S. Bakundu F.R. from the footpath leading to the T.S.S. Experimental plot 1. 4°30'N 9°25'E, 7 April 1951 (fl), *Olorunfemi FHI 30501* (FHI,K); **West Province**: Noun river 21 km NNE of Tonga. 5°10'N 10°45'E. Alt: 600m, 5 May 1964 (fl, fr), *Wilde, W.J.J.O. de 2459* (BAS,BR,P,WAG,YA).

**CENTRAL AFRICAN REPUBLIC, Lobaye**: Boukoko. 3°54'N 17°55'E, 20 March 1948 (fl), *Tisserant (Équipe) 785* (P); Boukoko. 3°54'N 17°56'E, 22 March 1948 (fl), *Tisserant (Équipe) 799* (G); Boukoko. 3°54'N 17°55'E, 9 May 1952 (fr), *Tisserant (Équipe) 2423* (P); **Nana-Mambéré**: environ de Baboua, 3 km sur la piste de Besson. 6°15'N 14°50'E, 15 January 1964 (fl, fr), *Descoings 12704* (P); **Ouham-Pendé**: region de Bocaranga au bord de la Nyémé entre le villages Kounnang et Mbum (Oubangui-Chari). 7°20'N 15°46'E, 2 March 1937 (fl, fr), *Eckendorf 97* (BR); **Sangha-Mbaéré**: Bayanga. 2°54'N 16°16'E. Alt: 350m, May 1987 (fr), *Harris, D.J. s.n.* (E,WAG).

**CONGO (BRAZZAVILLE), Kouilou**: Région de Kouilou, Mayombe à Goumina (près de Sounda). 4°29'S 11°43'E, 20 October 1990 (fl), *Dowsett-Lemaire 1315* (BR); **Niari**: région de Kibangou, along affluents of Ngokango River. 3°16'S 12°33'E, 17 September 1965 (fl), *Sita 1197* (WAG); **Pool**: île M'Bamou. 4°13'S 15°25'E, 13 October 1967 (fl), *Sita 1831* (WAG); île M'Bamou, près de Moutou ya N'Gombé. 4°13'S 15°25'E, 3 November 1967 (fl), *Sita 1917* (WAG); Bangou. 3°56'S 14°25'E, 27 September 1968 (fl), *Sita 2577* (BR); île M'Bamou, environs de Moutouyangombé. 4°13'S 15°25'E, 29 October 1968 (fl, fr), *Sita 2774* (BR); **Sangha**: Nouablé-Ndoki National Park, Goulougo Study Site, 37.38 km E-SE de Bomassa. 2°11.0'N 16°31.3'E. Alt: 377m, 15 March 2008 (fl), *Ndolo Ebika 306* (E,WAG); Nouablé-Ndoki National Park, Goulougo Study Site, 36.99 km E-NE de Bomassa. 2°12.7'N 16°31.1'E. Alt: 379m, 31 March 2008 (fl), *Ndolo Ebika 314* (E,WAG).

**CONGO (KINSHASA), Bandundu**: Lulua, 6°s. Br. 5°02'S 21°07'E, 24 November 1881 (st), *Pogge 673* (US); **Bas-Congo**: Gimbi, vallée de la Fouka. 5°31'S 13°22'E, 5 November 1948 (fl, fr), *Toussaint, L. 624* (BR,K); Leopoldville (Kinganga). 5°33'S 15°10'E, 27 October 1959 (fl), *Compère 666* (EA,K); Gimbi, parc de la Fuka. 5°29'S 13°22'E, 2 November 1953 (fr), *Wagemans 710* (EA,K,US,WAG); 6°30'S 23°55'E, 23 September 1981 (fl, fr), *Nsimundele 923* (BR); Luki. 5°38'S 13°04'E, 8 August 1957 (fl), *Wagemans 1618* (BR,K); Luki. 5°38'S 13°04'E, 27 December 1948 (fr), *Donis 2131* (K,WAG); **Equateur**: Lac Tumba. 0°52'S 18°08'E, 21 September 1958 (fl), *Thonet 253* (K); Equateurville. 0°00'N 18°14'E, 17 February 1896 (fl), *Dewèvre 744* (BR); Bokuma. 0°06'S 18°41'E, 9 May 1942 (fr), *Hulstaert 785* (BR); Watsi-Kengo (Boende). 0°48'S 20°33'E, 14 November 1957 (fl), *Evrard, C.M. 2956* (K,WAG); **Kasai-Occidental**: Bachwald bei Mukenge. 6°00'S 22°20'E, 12 March 1881 (fl), *Pogge 684* (COI); **Katanga (Shaba)**: Dilolo. 10°41'S 22°21'E, 23 July 1932 (fl), *Young, R.G.N. 221* (BM,COI,US); Dilolo, 29 km S. 10°56'S 22°21'E, 23 August 1956 (fl), *Duvigneaud, P.A. 2451* (BRLU); Bianco Hotel. 10°15'S 26°03'E. Alt: 1520m, 27 October 1962 (fl), *Schmitz, A. 7802* (WAG); **Nord-Kivu**: PNA sect. Watalinga. 0°45'N 29°50'E, 19 November 1948 (fl, fr), *Wilde, JMHR de 189* (BR); Rivière Lenda. 0°20'N 28°40'E, 8 June 1956 (fr), *Christiaensen 1767* (K,WAG); **Orientale**: Djugu. 1°56'N 30°30'E, 8 August 1951 (fl, fr), *Smeyers 1* (WAG); Djugu. 1°56'N 30°30'E, 1 October 1957 (fl), *Devillé, A. 129* (K,WAG); Lekwa-Djugu. 2°02'N 30°32'E, 2 June 1957 (fr), *Froment 184* (BR,K); Lekwa-Djugu. 2°02'N 30°32'E, 2 March 1959 (fl), *Devillé, A. 200* (BR,K,WAG); Mont Hawa. 2°50'N 30°43'E, 13 December 1951 (fr), *Smeyers 211* (WAG); Epulu. 1°25'N 28°35'E. Alt: 750m, 5 May 1982 (st), *Hart, T.B. 275* (BR); Menge. 2°25'N 27°18'E, 1921 (fl), *Claessens 517* (BR,S); In rocky place. 1°55'N 29°10'E. Alt: 1000m, 8 September 1990 (fl, fr), *Terashima, H. 667* (BR); Environ Wala. 2°52'N 27°38'E, 1907 (fl), *Seret 799* (BR,K); Bas-Uele. 4°06'N 22°23'E, 16 April 1935 (st), *Dewulf, A. 834* (BR); Djugu. 1°56'N 30°30'E. Alt: 1800m, 25 September 1955 (fl), *Christiaensen 1116* (BR); Epulu. 1°25'N 28°35'E. Alt: 750m, 7 April 1996 (fl), *Hart, T.B. 1677* (BR); Sekwa. 2°10'N 30°40'E, April 1939 (fl), *Gilbert, G.C.C. 2346* (BM,K); Bili (Uélé Itimbiri). 4°09'N 25°04'E, May 1931 (fl), *Lebrun 2827* (WAG); Djugu-Kibali. 1°56'N 30°30'E, 7 September 1931 (fl), *Lebrun 3885* (K,WAG); **Sud-Kivu**: Busangania. 2°21'S 28°48'E, 18 January 1939 (fr), *Rossignol 178* (BR); Mulungu. 2°20'S 28°47'E, 23 September 1952 (fl), *Pierlot 395* (BR,K); Igande, Mwenga (Kivu). 2°57'S 28°27'E, 15 July 1959 (fl), *Léonard, A. 5004* (WAG).

**EQUATORIAL GUINEA, Rio Muni, Centro Sur**: Mundung 'Les 4 montagnes'. 1°38'N 10°11'E. Alt: 1000m, 8 January 2003 (st), *Desmet, G. 241* (BRLU); Parc national de Monte Alen, à 1h30 de marche du site ECOFAC. 1°40'N 10°17'E. Alt: 1110m, 15 May 2002 (fl), *Parmentier 3057* (BRLU); **Rio Muni, Litoral**: Bata-Niefang: Estrada km 35. Entre Río Sama e Río Comayá. 1°51'N 10°03'E, 27 August 1994 (fl), *Carvalho, M.F. de 5660* (MA,WAG); district Mbini, près du village Sendje. 1°34'N 9°50'E, 1 September 1997 (fl), *Lisowski 583* (BRLU). **GABON, Estuaire**: environ de Libreville. 0°23'N 9°27'E, (fl), *Klaine s.n.* (FHO,K); brigade forestière de Ekouk (nouvelles parcelles). 0°10'S 10°15'E, 27 September 1983 (fl), *Floret 1480* (LBV,WAG); S of Estuaire du



Gabon along British Gas oil exploration site. 0°00'N 9°50'E. Alt: 10m, 24 October 1991 (fl), *McPherson, G.D. 15449* (MO,WAG); **Haut-Ogooué**: Parc National des Plateaux Batéké. Bai Jobo. 2°12.53'S 13°52.45'E, 4 June 2005 (st), *Niangadouma 501* (MO,WAG); 20 km E de Lelama. 1°00'S 13°43'E. Alt: 441m, 17 November 2009 (st), *Bissiengou 896* (LBV,WAG); nouvelle exploitation CEB, vers Okondja. 0°45.4'S 13°50.8'E. Alt: 457m, 18 November 2009 (fl), *Bissiengou 921* (LBV,WAG); Plateau Batéké, 37 km E de Franceville as the crow flies. 1°37'S 13°57'E. Alt: 600m, 7 December 1989 (fl), *Wilde, J.J.F.E. de 9982* (WAG); **Moyen-Ogooué**: Mabounié, à 45 km au sud-ouest de Lambaréné, près de la rivière Ngounié. 0°43.78'S 10°33.57'E. Alt: 52m, 11 October 2012 (st), *Bidault 771* (BRLU,LBV,MO); Eastern part of the Presidential Reserve Wonga-Wongué; c. 100 km S of Libreville; forest path leading to what is locally called "Little Bambam". 0°30'S 9°33'E. Alt: 160m, 2 March 1983 (fr), *Wilde (WALK-B) 869* (LBV,MO,P,WAG); **Ngounié**: route Fougamou-Yombi, 4 km du village Mandilou. 1°19.16'S 10°38.03'E. Alt: 70m, 21 June 2011 (st), *Bissiengou 1402* (LBV,WAG); route Fougamou-Yombi, 4 km du village Mandilou. 1°19.16'S 10°38.03'E. Alt: 70m, 21 June 2011 (st), *Bissiengou 1403* (LBV,WAG); route Fougamou-Yombi, 4 km du village Mandilou. 1°19.16'S 10°38.03'E. Alt: 70m, 21 June 2011 (st), *Bissiengou 1404* (LBV,WAG); route Fougamou-Yombi, 4 km du village Mandilou. 1°19.16'S 10°38.03'E. Alt: 70m, 21 June 2011 (st), *Bissiengou 1405* (LBV,WAG); route Fougamou-Yombi, 4 km du village Mandilou. 1°19.21'S 10°38.09'E. Alt: 92m, 21 June 2011 (st), *Bissiengou 1412* (LBV,WAG); Dououd Mountains National Parc 20 km S of Mandji, E of Mont Igoumbi. 1°51.9'S 10°25.1'E. Alt: 90m, 18 November 2005 (fr), *Sosef 2389* (BR,K,LBV,MO,WAG); **Nyanga**: 14 km de Ndendé (route Ndende-Mouila). 2°16.0'S 11°16.1'E. Alt: 116m, 27 October 2009 (fl), *Bissiengou 590* (LBV,WAG); Tchibanga 2°50'S 11°00'E, November 1907 (st), *Le Testu 1239* (BR,P); **Ogooué-Ivindo**: Lopé 2 km SW of the village, gallery forest next to a tributary of the Ogooué river. 0°06.70'S 11°36.22'E. Alt: 125m, 28 March 2009 (fl), *Koenen 13* (LBV,WAG); Lopé 2 km SW of the village. 0°06.68'S 11°36.17'E. Alt: 125m, 28 March 2009 (fl, fr), *Koenen 16* (LBV,WAG); Station d'études des Gorilles et Chimpanzé. 0°10'S 11°35'E, 8 April 1993 (fl), *McDonald, K.E. 34* (E); Réserve de la Lopé, 0°07'S 11°37'E. Alt: 100m, 4 July 1986 (fl), *Alers, M.P.T. 85* (LBV,WAG); Réserve de Lopé-Okanda. 0°25'S 11°30'E. Alt: 200m, 1989 (fl, fr), *White (series 1) 234* (MO); CIRMF (Lopé). 0°18'S 11°40'E, 26 October 1987 (fl, fr), *Dibata 333* (LBV,WAG); Lopé-Okanda Reserve. Banks of Ogooué River, Lopé Hotel. 0°06.0'S 11°35.9'E. Alt: 122m, 29 October 2000 (fl, fr), *Walters, G.M. 436* (MA,MO,WAG); Lopé-Okanda Reserve. 2.6 km E along road from Kazamabika to Offoué River. 0°07.3'S 11°43.5'E. Alt: 290m, 31 October 2000 (fl), *Walters, G.M. 467* (MA,MO); Near Achouka, along Offoué River. 0°06'S 11°46'E, 10 November 1983 (fl), *Louis, A.M. 583* (WAG); Lopé-Okanda Game Reserve, between Achouka and Kongo-Boumba, ± 1 km S. of camp. 0°06'S 11°30'E. Alt: 200m, 10 November 1983 (fr), *Louis, A.M. 609* (WAG); Lope. 0°06.32'S 11°35.62'E. Alt: 131m, 9 September 2012 (fr), *Towns 977* (LBV,WAG); Lopé hotel. 0°06'S 11°36'E. Alt: 102m, 4 March 2010 (fl), *Bissiengou 991* (LBV,WAG); Nord-Est du Parc de la Lopé, ancienne route Lopé qui mène à Bououé. 0°07.56'S 11°46.63'E. Alt: 211m, 6 March 2010 (st), *Bissiengou 1046* (LBV,WAG); Nord-Est du parc de la Lopé, route Lopé-Kassamabika, 5 km après village Kassamabika. 0°07.14'S 11°44.45'E. Alt: 281m, 6 March 2010 (fl), *Bissiengou 1058* (LBV,WAG); Nord-Est du parc de la Lopé, route Lopé-Kassamabika, 5 km après village Kassamabika. 0°07.22'S 11°44.15'E. Alt: 265m, 6 March 2010 (fl), *Bissiengou 1063* (LBV,WAG); Nord-Est du parc de la Lopé, route Lopé-Kassamabika, 3 km après village Kassamabika. 0°07.4'S 11°44.1'E. Alt: 306m, 8 March 2010 (fl, fr), *Bissiengou 1069* (LBV,WAG); Nord-Est du parc de la Lopé, route Lopé-Kassamabika, 3 km après village Kassamabika. 0°07.4'S 11°44.1'E. Alt: 306m, 8 March 2010 (fl, fr), *Bissiengou 1071* (LBV,WAG); Nord-Est du parc de la Lopé, route Lopé-Kassamabika, 3 km après village Kassamabika. 0°07'S 11°44'E. Alt: 306m, 8 March 2010 (st), *Bissiengou 1075* (LBV,WAG); Nord-Est du parc de la Lopé, route Lopé-Kassamabika, 3 km après village Kassamabika. 0°07.26'S 11°44.05'E. Alt: 290m, 8 March 2010 (fl, fr), *Bissiengou 1078* (LBV,WAG); Lope. 0°06.38'S 10°02.42'E. Alt: 120m, 17 August 2012 (fl, fr), *Towns 1116* (LBV,WAG); 9 km après l'entrée du Parc de l'Ivindo. 0°31'N 12°40'E. Alt: 560m, 14 March 2010 (fl), *Bissiengou 1195* (LBV,WAG); Ivindo National Park, village Mbés. 0°22.0'N 12°37.1'E. Alt: 400m, 14 March 2010 (st), *Bissiengou 1203* (LBV,WAG); Lope. 0°06.87'S 11°34.78'E. Alt: 122m, 7 October 2012 (fl, fr), *Towns 1379* (LBV,WAG); Lope. 0°05.03'S 11°36.57'E. Alt: 130m, 8 October 2012 (fl), *Towns 1381* (LBV,WAG); Département de Bououé, Parc National de la Lopé, Gallery of the Mingumé. 0°07.07'S 11°35.94'E, 29 August 2012 (fl), *Quiroz-Villarreal 1474* (WAG); Koumameyong. 0°30'N 11°55'E, November 1987 (fl), *Louis, A.M. 2586* (LBV,MO,WAG); Réserve de la Lopé près du centre d'études des gorilles et chimpanzé (CEGC). 0°07'S 11°37'E, 14 July 1993 (st), *Lejoly 93/102* (BRLU); Réserve de la Lopé près du centre d'études des gorilles et chimpanzé (CEGC). 0°07'S 11°47'E, 19 July 1993 (fl), *Lejoly 93/189* (BRLU); **Ogooué-Lolo**: Milolé, route première zone d'exploitation de CEB. 0°16'S 12°42'E, 14 November 2009 (fl), *Bissiengou 844* (LBV,WAG); Milolé, route première zone d'exploitation de CEB. 0°16'S 12°42'E, 14 November 2009 (fr), *Bissiengou 846* (LBV,WAG); Milolé, route première zone d'exploitation de CEB. 0°16'S 12°42'E, 14 November 2009 (fr), *Bissiengou 848*

(LBV,WAG); region de Lastoursville. 0°50'S 12°42'E, March 1929 (fl, fr), *Le Testu 7125* (BM,LISC,P); region de Lastoursville. 0°50'S 12°42'E, November 1929 (st), *Le Testu 7612* (BM,P); **Ogoué-Maritime**: Petit Loango national park. Transect B2., 2°20'S 9°36'E, 31 October 1998 (fl), *Leal, M.E. 86* (BR,E,K,MO,WAG); road to Divangui 7 km from eastern Rabi road. 1°54'S 9°56'E, 25 October 1990 (fl), *Nek 111* (BR,E,MA,MO,WAG); 10km au N.E de Sangatanga. 0°28.40'S 9°21.30'E. Alt: 100m, 24 May 2001 (fl, fr), *Sosef 1701* (LBV,WAG); Rabi-area, NE Divangui. 1°54.8'S 10°03.1'E. Alt: 40m, 2 October 1994 (fl), *Wieringa, J.J. 2839* (LBV,WAG); **Woleu-Ntem**: concession Rougier du Haut-Abanga, Sud-Est de Mikongo, partie Nord des montagnes Mekié. 0°26.2'N 11°13.5'E. Alt: 953m, 18 July 2008 (st), *Dauby 1028* (BRLU).

**GHANA, Ashanti Region**: Aduamo. 6°38'N 0°45'W. Alt: 457m, 20 April 1936 (fl, fr), *Beveridge, J.A. 109* (FHO); Nyinahim range, around edge of meadow. 6°36'N 2°07'W. Alt: 610m, 7 June 1958 (fr), *Morton, J.K. A 3383* (K); Agogo, Ashanti. 6°48'N 1°05'W. Alt: 396m, April 1928 (fl), *Vigne FH 1117* (BM,FHO); Juaso. 6°35'N 1°07'W, April 1930 (fr), *Vigne FH 1902* (FHO,K,US); **Eastern Region**: Aduamo. 6°38'N 0°45'W, 20 April 1936 (fr), *Beveridge, J.A. 4197* (K); Atewa Range Forest Reserve. 6°09'N 0°36'W. Alt: 792m, 15 May 1967 (fr), *Enti 36530* (K).

**GUINEA, Nzérékoré**: Nimba, Nzo. 7°40'N 8°19'W. Alt: 1100m, 11 May 1973 (fl, fr), *Adam, J.-G. 27514* (BR,WAG).

**IVORY COAST, UNKNOWN**: 6 September 1895 (fr), *Jolly s.n.* (P); April 1949 (fl), *Bégué SF 3149* (P); **Abidjan**: Parc Lalanne, Santé. 5°20'N 4°03'W, 9 June 1974 (fl), *Frédoux 153* (G); c. 4 km W. of ORSTOM. 17 km W. of Abidjan, near the lagune of Ebrié. 5°18'N 4°08'W, 29 June 1963 (fl), *Wilde, W.J.J.O. de 331* (K,WAG); 20 km W of Grand Bassam; between Port Bouet and Grand Bassam. 5°16'N 3°50'W, 1 July 1963 (fl), *Wilde, W.J.J.O. de 350* (WAG); Grand Bassam. 5°14'N 3°50'W, 14 October 1956 (fl), *Wilde, J.J.F.E. de 721* (WAG); Abouabou, between Abidjan and Grand Bassam. 5°17'N 3°54'W. Alt: 2m, 8 January 1959 (fr), *Leeuwenberg 2398* (FHO,WAG); Grand Bassam. 5°14'N 3°45'W, December 1949 (fr), *Schnell 3952* (K,P); Centre Suisse d'Adiopodoumé. 5°20'N 4°07'W, 5 April 1970 (fr), *Farron 7013* (BR); Abidjan. 5°20'N 4°02'W, (fr), *Aubréville SF 1350* (P); Dabou. 5°19'N 4°23'W, June 1949 (fr), *Bégué SF 3046* (P); Port Bouet. 5°15'N 3°55'W, May 1949 (fl, fr), *Bégué SF 3150* (P); **Danané**: Mont Nimba., 7°37'N 8°25'W, 1932 (fl), *Aubréville SF 1140* (BR); **Tabou**: Boubele. 4°29'N 7°15'W, 18 February 1970 (fl), *Bamps 2446* (BR); **Toumodi**: Mt. Oroumbo Bocca 25 km SE of Toumodi. 6°23'N 4°54'W. Alt: 500m, 15 May 1963 (fl), *Oldeman, R.A.A. 47* (K,MO,P,WAG); Oroumbo Boka. 6°22'N 4°54'W, 3 October 1956 (fl), *Wilde, J.J.F.E. de 643* (WAG); Oroumbo. 6°23'N 4°53'W, 20 August 1954 (st), *Jaeger, P. 4838* (P).

**LIBERIA, UNKNOWN**: 1895 (fl), *Cook-Carter 127* (US); **Grand Bassa**: Grand Bassa. 5°53'N 10°03'W, July 1841 (fr), *Vogel, J.R.T. 53* (K,P); Fishtown. 5°53'N 10°03'W. Alt: 10m, 12 April 1896 (fl), *Dinklage 1638* (B,W); **Nimba**: Ganta. 7°14'N 8°59'W, 19 April 1946 (fl), *Harley, W.J. 1398* (K); Jéképa. Mt Nimba. 7°35'N 8°32'W, 25 November 1969 (fl, fr), *Adam, J.-G. 25129* (C,P,WAG); Grassfield 7°29'N 8°34'W, 16 May 1970 (fr), *Adam, J.-G. 25520* (C,K); Nimba. 7°32'N 8°32'W. Alt: 1100m, 19 May 1970 (fr), *Adam, J.-G. 25561* (K); crête plateau. 7°32'N 8°32'W. Alt: 1100m, 30 May 1970 (fl, fr), *Adam, J.-G. 25700* (C,K,P); 7°35'N 8°32'W, 20 May 1973 (fr), *Adam, J.-G. 27640* (K,P,UPS); **Sino**: Sinoe basin. 5°10'N 9°02'W, 1904 (fl), *Whyte, A. s.n.* (K).

**NIGERIA, Akwa-Ibom State**: Eket district, Southern. 4°39'N 7°56'E, (fl), *Talbot, P.A. s.n.* (BM); **Cross River State**: 4°57'N 8°19'E, 1862 (fl), *Thomson, W.C. 96* (E); Calabar. 4°59'N 8°19'E, 28 May 1983 (fl), *John, D. 389* (K); Lower Enyong Forest Reserve, 33 km NNW of Uyo. 5°20'N 7°50'E, 8 April 1971 (fl, fr), *Meer, P.P.C. van 1234* (WAG); Oban Group Forest Reserve, West Block. E of pillar 139. 5°13'N 8°22'E, 8 May 1971 (fl, fr), *Meer, P.P.C. van 1530* (WAG); 3 km E of Obudu Cattle Ranch (Obudu), along trail to River Gafunde. 6°40'N 9°06'E, 24 April 1977 (fl), *Pilz 1976* (B,K,WAG); Northern ranges, Obudu Ranch, S.E. State. 6°40'N 9°09'E, January 1973 (fl), *Lock GC 43567* (K); **Lagos State**: near Lagos. 6°27'N 3°23'E, December 1979 (fr), *Sharland 991* (K).

**SAO TOMÉ & PRINCIPE, Principe Island**: NW of Island, Cocoa and coffee plantation Sundry. 1°40'N 7°23'E. Alt: 50m, 21 November 1978 (fl), *Groenendijk, E.M.C. 123* (BR,MO,WAG); Pico Yola. 1°38'N 7°22'E. Alt: 250m, 11 December 1998 (fr), *Oliveira (Faustino), F. de 216* (BRLU); Pico A Mesa 2 km S of plantation Maria Correia. 1°35'N 7°21'E. Alt: 400m, 7 February 1980 (fl, fr), *Wilde (WALG) de 412* (BR,FHO,FR,MO,STOME,TI,WAG); ôque, Pipi. 1°36'N 7°25'E. Alt: 305m, 10 December 1932 (fl, fr), *Exell 543* (BM,COI); (fl, fr), *Exell 545* (BM,COI); (fl, fr), *Exell 549* (BM); Sundi. 1°40'N 7°23'E. Alt: 450m, 17 December 1932 (fl), *Exell 609* (BM,COI); Summit of Pico Papagaio. 1°37'N 7°24'E. Alt: 671m, 29 December 1932 (fl), *Exell 706* (BM,COI); entre St Miguel et Pico Zagaia. 0°10'N 6°31'E, 3 April 1994 (fl), *Matos de 7246* (BRLU); Da somidade do Morro ao longo do percurso até o riacho. 1°38'N 7°23'E, 9 December 1998 (fl), *Oliveira (Faustino), F. de 98/182* (BRLU); **Sao Tomé Island**: May 1885 (fl), *Moller, A.F. 3* (COI); Chemin de Lagoa Amélia. 0°17'N 6°37'E, 16 July 1999 (fr), *Joffroy, G. 6* (LISC); San Thomé, roça Ledroma. 0°12'N 6°39'E, 1899 (fl), *Mocquerys 48* (G); S. Vicente. 0°12'N 6°39'E. Alt: 200m, 10 January 1949 (fr), *Espirito Santo 108* (BM,COI); Vanhulst (Macambará). 0°16'N 6°38'E. Alt: 1219m, 30 October 1932 (fl), *Exell 147* (BM); descente Rio Lemba avant Agua Cabumbé. 0°12'N 6°33'E. Alt: 240m, 3

February 2003 (fl), *Ogonovszky 173* (BRLU); SE coast. between Monte Mário and Porto Alegre. 0°04'N 6°32'E. Alt: 25m, 23 January 1980 (fl), *Wilde (WALG)250* (BR,FR,HUJ,MO,STOME,TI,WAG); Base Pico Maria Fernandes. 0°10.3'N 6°38.5'E. Alt: 460m, 27 February 2003 (fl), *Ogonovszky 304* (BRLU); between Vanhulst and S. Nicolau. 0°16'N 6°38'E. Alt: 1066m, 8 November 1932 (fl), *Exell 308* (BM,COI); Bemposta. 0°19'N 6°38'E. Alt: 600m, June 1885 (fl), *Moller, A.F. 359* (COI); Pico Cabumbé. 0°12'N 6°33'E. Alt: 380m, 11 March 2003 (fl), *Ogonovszky 378* (BRLU); Vanhulst (Macambrará). 0°16'N 6°38'E. Alt: 1219m, 22 November 1932 (fl), *Exell 422* (BM,COI); Vanhulst (Macambrará). 0°16'N 6°38'E. Alt: 1219m, 24 November 1932 (fl), *Exell 453* (BM,COI); Pico Maria Fernandes. 0°10.3'N 6°38.5'E. Alt: 100m, 18 March 1998 (fl), *Oliveira (Faustino), F. de 510* (BRLU); Alt: 1250m, June 1885 (fl), *Moller, A.F. 538* (COI); Bate-pá. Alt: 500m, June 1885 (fl), *Moller, A.F. 618* (BM,COI); Baté-pa. 0°18'N 6°40'E. Alt: 500m, (fl), *Exell 618* (BM); entre Pico de Sao Tomé Castro, 6 km au Sud de Ponta Figo. 0°17'N 6°33'E. Alt: 1800m, 1 January 1995 (fl, fr), *Lejoly 95/20* (LISC).

**SENEGAL, Casamance:** Région d'Oussouye: Dianthème. 12°29'N 16°37'W, 1 August 1963 (fl), *Berhaut 6232* (BR); **Ziguinchor:** Parc National de la Basse Casamance. 12°24'N 16°36'W, 11 August 1982 (fr), *Vanden Berghen 5464* (BR).

**SIERRA LEONE, UNKNOWN:** (fl), *Afzelius, A. s.n.* (UPS); (fr), *Pelly 409* (FHO); **Eastern Province:** Kambui F.R. Wanji valley. 7°50'N 11°15'W, 25 May 1951 (fl), *Small, D. 56* (K); **Southern Province:** Alt: 400m, March 1923 (fl), *Dawe 443* (K); Yoni, Bonthe Island. 7°32'N 12°30'W, 19 March 1932 (fl), *Deighton 2473* (K).

**TANZANIA, Kagera:** Lake province. Itara Minziro forest Reserve, Bukoba. 1°00'S 31°50'E. Alt: 1158m, 9 February 1955 (fl, fr), *Benedicto 33* (EA,FHO,K); Mwiganshanzi, Kihaya. 1°55'S 31°00'E, (fl), *Pitt-Schenkel 265* (FHO); Kaigi. 1°23'S 31°49'E, May 1935 (fr), *Gillman 275* (EA,K); Rwasima. 1°20'S 31°42'E. Alt: 1219m, December 1925 (fr), *Wigg, L.T. 317* (K); Kaigi. 1°23'S 31°49'E, 30 September 1935 (fr), *Gillman 351* (EA,K); Rubare Forest Reserve. 1°23'S 31°49'E. Alt: 1219m, October 1957 (fl), *Procter 711* (EA,K); Bukoba Prov. Mwiganshanzi (Luziba). Rubare reserve. 1°55'S 31°00'E, 27 August 1931 (fl), *Wigg, L.T. 718* (FHO,K); Rubare Forest Reserve, Lake Province. 1°23'S 31°49'E. Alt: 1219m, February 1958 (fl), *Procter 834* (EA,K); Rubare Forest Reserve. 1°23'S 31°49'E. Alt: 1219m, November 1958 (fr), *Procter 1057* (EA,K); near Bukoba. 1°23'S 31°49'E. Alt: 1189m, August 1931 (fr), *Haarer 2131* (EA,G,K); 15 km from Bukoba, along the road to the N. 1°12'S 31°50'E. Alt: 1240m, 30 October 1992 (fl), *Breteler 11623* (BR,MO,S,WAG); Katoma 10 km W of Bukoba. 1°18'S 31°45'E. Alt: 1140m, 3 November 1992 (fl), *Breteler 11714* (BR,MO,PR,S,WAG).

**UGANDA, Buganda:** Nkole Island. 0°25'S 32°25'E. Alt: 1134m, 21 January 1956 (fl), *Dawkins 855* (BM,FHO,K); Masaka district. Malabigambo forest, 4 miles SSW of Katera. 0°50'N 30°06'E, 2 October 1953 (fl), *Drummond, R.B. 4544* (B,BR,EA,K,S); 1158m 0°08'N 32°24'E. Alt: 1158m, June 1948 (fl), *Maitland, T.D. Uganda 796* (K); **Southern Province:** Kalinzu forest. 0°25'S 30°00'E, June 1948 (fl), *Jasi, R.A. 51* (K); **Western Province:** Bwindi forest. 0°59'S 29°41'E, 15 May 1992 (fl), *Cunningham, A.B. 3096* (K).

**ZAMBIA, Luapula:** Mukabi, Kawambwa. 9°48'S 29°08'E, 6 December 1961 (fr), *Lawton 807* (FHO).

**Key literature:** Bamps & Farron (1967), Exell & Mendonça (1951), Farron (1963, 1965, 1985), Hawthorne & Jongkind (2006), Hooker & Bentham (1849), Johnston & Stapf (1906), Robson (1963).

### ***Campylospermum warnecke* (Gilg ex Engl.) Biss.**

Blumea 58: 7 (2013). – *Ouratea warnecke* Gilg ex Engl., Veg. der Erde 9, Die Pflanzenw. Afr. 3, 2: 490 (1921). – Type: *Warnecke 468* (holotype: B, probably destroyed; isotype: BM!, E!, EA!, K!, Z!), Tanzania, Amani, 1907.

*Tree to treelet*, rarely scandent shrub, **up to 15 m tall**, with branched stem; twigs with whitish bark. *Stipules* caducous, triangular, 2–5 mm long. *Leaf:* petiole 2–5 mm long; leaf blade narrowly elliptic, **(9–)11–25 x (2–)3–6 cm**, ratio **2.9–5.7**, base attenuate, apex acute to slightly acuminate, **often with a sharp or mucronate tip**, papyraceous to coriaceous, not bullate, dark green above, medium green below, dull on both sides, margin serrulate but entire towards the base; venation: midrib prominent on both sides, main lateral veins 8–21 on either side, 7–15 mm apart, prominent above, slightly

prominent below, at a  $\pm$  right angle with the midrib but curved upwards to run parallel with the margin, intermediate lateral veins 0–2 in between each pair of main laterals, less distinct, **tertiary venation scalariform, perpendicular to the midrib, with a pattern of very closely spaced cross-veinlets also predominantly perpendicular to the midrib**, distinct above, less distinct beneath. *Inflorescence* terminal or rarely axillary, branched, lax, its main axis (3–)11–19 cm long; pairwise scales at the base of peduncle absent; racemes 2–6, 3–13 cm long, **horizontal or slightly erecto-patent, thin but woody**; cymules 0.5–1 cm apart, 1–7-flowered; bracts triangular, c. 1 mm long. *Flower*: pedicel 8–15 mm long, articulated at 1–3 mm from the base; sepals ovate, 5–8 x 2–3 mm in flower, 6–8 x 3–4 mm in fruit, base rounded, apex acute; petals obovate, 5–13 x 5–8 mm, base cuneate, apex rounded to slightly emarginate; stamens: anthers 4–6 mm long; ovary c. 1 mm long; style 4–5 mm long. *Fruit*: receptacle enlarged to 5 x 4 mm in fruit; drupelets 1 to 4 well developed per receptacle, **ellipsoid to subglobose**, 7–8 x 5–6; cotyledons incumbent, cotyledons more or less similar in size.

**Notes:** We do not agree sinking this species into *C. reticulatum*, as suggested by Farron (1965) and Verdcourt (2005). *C. warnecke* has a typical scalariform tertiary venation, easily distinguished from the reticulate venation in the latter. Moreover, the cotyledons of *C. reticulatum* are distinctly unequal in size, with a much smaller outer cotyledon, while those of *C. warnecke* are always more or less similar in size. This, in combination with the non-overlapping distribution of the two taxa, gives sufficient ground to recognize the taxon as distinct at species level. *C. warnecke* is also close to *C. lunzuense* which differs in having spinulose-serrate leaves and pedicels generally articulating much further from the base.

Finally, Gilg (1921) does not refer to a specimen to serve as the obvious type of his name, but the text on the label of *Warnecke 468* matches the data given in the protologue, making it clear that it should be regarded as the type.

**Distribution:** southernmost Kenya and Tanzania (**Map 30**).

**Ecology:** primary and secondary rain forest, moist submontane rain forest; at 250–1100 m altitude.

**Phenology:** flowering and fruiting from January to May and from September to December.

**Uses:** Food plant of *Hypolycaena buxtoni* (a butterfly; data from Congdon 569)

**IUCN conservation status:** LC. EOO=132,681 km<sup>2</sup>, AOO=39,219 km<sup>2</sup>, locations=21 (cell width=66 km). This species is represented in herbaria by a fair amount of specimens, suggesting it is not rare. It has numerous recent collections occurring in Forest Reserves such as Kwamkoro, Luhega, Magombera, Nkungwe, Udzungwa Scarp all in Tanzania, and Mwele and Shimba Hills in Kenya. Therefore, the category of Least Concern seems most appropriate.

**Specimens examined:**

**KENYA, Coast:** Shimba Hills, Longo Mwangandi. 4°14'S 39°25'E. Alt: 426m, 10 February 1968 (fl), *Magogo 53* (EA,K); Shimba Hills, Mwele Forest. 4°16'S 39°22'E, 18 February 1987 (fl, fr), *Luke 229* (EA); Shimba Hills, Longo Mwangandi. 4°14'S 39°25'E. Alt: 365m, 16 April 1969 (fl, fr), *Magogo 898* (EA,K); Shimba Hills, Mwele Forest. 4°16'S 39°21'E. Alt: 300m, 2 May 1989 (fl), *Luke 1845* (EA,K); Longomagandi. 4°14'S 39°25'E. Alt: 390m, 18 March 1991 (st), *Luke 2736* (EA,K,MO); Shimba hills N.R. Mwele F.R. 4°15'S 39°22'E. Alt: 350m, 10 October 2001 (fl), *Robertson, S.A. 7392* (K).

**TANZANIA, Iringa:** Luhega Forest Reserve, Iringa District, T7. 8°21'S 35°58'E. Alt: 800m, 24 February 1997 (fl, fr), *Horlyck TZ 388* (C); Udzungwa Scarp Forest Reserve. 8°23'S 35°58'E. Alt: 1100m, 15 December 1997 (fl, fr), *Frimodt-Møller TZ 545* (C,K); **Lindi:** Mchinjiri. face of Rondo escarpment. 10°12'S 39°15'E. Alt: 701m, December 1951 (fl), *Eggeling 6425* (EA,FHO,K); **Morogoro:** Udzungwa Mountains, sanje. 7°46'S 36°54'E. Alt: 910m, 2 November 1983 (fl), *Lovett, J.C. 214* (K); Mkungwe, slopes NW of the ridge. 6°53'S 37°55'E, 25 January 2001 (fr), *Jannerup 276* (K); Udzungwa Mountains National Park, above sanje. 8°15'S 35°50'E. Alt: 700m, 22 February 2000 (fl), *Congdon, T.C.E. 569* (K); Manyangu forest reserve. 6°09'S 37°35'E, 18 September 1960 (fl), *Paulo, S. 796* (BR,EA,K); Manyangu forests, Nguru mountains, Turiani. 6°07'S 37°34'E, April 1953 (fl), *Semsei 1165* (EA,K); T.6- Magombera Forest Reserve. 7°48'S 37°00'E. Alt: 250m, 9 February 1977 (fl), *Vollesen MRC 4458* (C,WAG); Nkungwe forest reserve, FTEA region T6. 6°53'S 37°55'E, 8 October 2000 (fl), *Mhoro UMBCP 318* (C,MO); **Tanga:** Sangarawe, Kwamkoro. 5°08'S 38°37'E, 7 March 1906 (fr), *Zimmermann, N. 1101* (EA); Kwamkoro Forest Reserve. 5°10'S 38°48'E, 18 November 1986 (fl, fr), *Ruffo 1997* (C,K,WAG); Kwamkoro Forest Reserve. 5°10'S 38°48'E, 6 January 1987 (fl, fr), *Ruffo 2014* (C,K); Kidada (Kishamb), Uberi. 5°07'S 38°33'E. Alt: 1067m, 16 January 1933 (fl), *Greenway 3326* (EA,FHO,K); East Usambara Mts. Kwamkoro Forest Reserve. 5°10'S 38°48'E. Alt: 940m, 18 November 1986 (fl, fr), *Ruffo 86825* (K,UPS); Amani-Sigi Forest Reserve at the Sigi headwaters S. of Amani near Kwamkoro sawmills. 5°06'S 38°38'E. Alt: 1000m, 19 February 1982 (fl, fr), *Borhidi 82/25* (UPS); East Usambara Mts. Kwamkoro Forest Reserve S.E of Kwamkoro Tea Estate. 5°08'S 38°39'E. Alt: 980m, 28 October 1986 (fl), *Borhidi 86/226* (K,UPS); East Usambara Mts. Kwamkoro F.R. 5°10'S 38°48'E. Alt: 1000m, February 1987 (fl, fr), *Pócs, T. 87/32* (UPS); East Usambara. Kwamkoro Forest Reserve, near the Kwamkoro Sawmill. 5°10'S 38°36'E. Alt: 900m, 5 May 1987 (fl, fr), *Iversen, S.T. 87/213* (K,UPS); Amani. 5°06'S 38°38'E, September 1903 (fl, fr), *Warnecke Amani 468* (BM,EA,FHO,WAG,Z); Monga. 5°06'S 38°37'E, 28 December 1916 (fr), *Zimmermann g 6667* (EA); Monga. 5°06'S 38°37'E, 8 December 1916 (fl), *Zimmermann g 6668* (EA); Monga. 5°06'S 38°37'E, 24 November 1916 (fl), *Zimmermann g 6669* (EA); Sangarawe, Kwamkoro. 5°08'S 38°37'E, 9 November 1916 (fl), *Zimmermann g 6670* (EA).

**Key literature:** Farron (1965), Verdcourt (2005).

### **Campylospermum spec.**

The following specimens could be assigned to the genus *Campylospermum*, but were generally too scanty to identify them down to the species level. For the sake of completeness, these are cited below:

**CAMEROON, East Province:** 34 km à l'WNW de Mopwo (village situé au km 22 de la route Yokadouma-Batouri) feuille IGN 1/200000. Medoum. 3°48'N 14°53'E, 6 June 1963 (fr), *Letouzey 5245* (K,P).

**CONGO (BRAZZAVILLE), Cuvette:** Alima-Likouala, route Kellé-Obeli. 0°13'S, 14°20'E, 13 December 1970 (st), *Sita 2976* (WAG).

**EQUATORIAL GUINEA, Rio Muni, Centro Sur:** Parc National de Monte Alen, 2 km au NE du site de traversée du Rio Uolo pour aller aux cataractes. 1°37.1'N 10°04.7'E, 12 February 2002 (st), *Senterre 2303* (BRLU).

**GABON, Estuaire:** Mfoa, 85 mi. E. of Gaboon. 0°24'N 10°18'E, October 1896 (fl), *Bates, G.L. 541* (BM); **Moyen-Ogooué:** Mabounié, à 45 km au sud-ouest de Lambaréné, près de la rivière Ngounié. 0°43.68'S, 10°33.65'E. Alt: 33m, 11 October 2012 (fr), *Bidault. 753* (LBV,MO); **Ngounié:** vieux chantier forestier. 2°18.85'S, 11°55.70'E.

Alt: 356m, 19 June 2011 (st), *Bissiengou 1389* (LBV,WAG); Agouma. 1°36'S, 10°10'E, December 1925 (st), *Le Testu 5832* (BR,P); **Ogooué-Ivindo:** 0°10'S, 11°35'E, 27 October 1992 (fl), *McDonald, K.E. 11* (E); Lopé Reserve, near the base-camp for Chimpanze and Gorilla research. 0°10'S, 11°35'E, 2 May 1988 (fl), *Jongkind 714* (BR,WAG); Nord-Est du parc de la Lopé, 35½ km sur la route Lopé-Kassamabika. 0°07.38'S, 11°40.73'E. Alt: 204m, 5 March 2010 (st), *Bissiengou 1038* (LBV,WAG); route Makokou-Mekambo. 0°45'N 13°14'E. Alt: 619m, 13 March 2010 (st), *Bissiengou 1180* (LBV,WAG); **Ogooué-Lolo:** 10.5 km from Lastoursville Railway Bridge, E-W road, Chantier SBL. 0°47'S, 12°45'E. Alt: 300m, 18 November 1988 (fl), *Maesen, L.J.G. van der 5594* (LBV,WAG).



# Chapter 4

## Phylogenetics, ancestral state reconstruction, and a new intrafamilial classification of the pantropical Ochnaceae (Medusagynaceae, Ochnaceae s.str., Quiinaceae) based on five DNA regions

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## Abstract

Ochnaceae s.str. (Malpighiales) are a pantropical family of about 500 species and 27 genera of almost exclusively woody plants. Intrafamilial classification and relationships have been controversial partially due to the lack of a robust phylogenetic framework. Including all genera except *Indosinia* and *Perissocarpa* and DNA sequence data for five DNA regions (ITS, *matK*, *ndhF*, *rbcl*, *trnL-F*), we provide for the first time a nearly complete molecular phylogenetic analysis of Ochnaceae s.l. resolving most of the phylogenetic backbone of the family. Based on this, we present a new classification of Ochnaceae s.l., with Medusagynoideae and Quiinoideae included as subfamilies and the former subfamilies Ochnoideae and Sauvagesioideae recognized at the rank of tribe. Our data support a monophyletic Ochnae, but Sauvagesieae in the traditional circumscription is paraphyletic because *Testulea* emerges as sister to the rest of Ochnoideae, and the next clade shows *Luxemburgia* + *Philacra* as sister group to the remaining Ochnoideae. To avoid paraphyly, we classify Luxemburgieae and Testuleeae as new tribes. The African genus *Lophira*, which has switched between subfamilies (here tribes) in past classifications, emerges as sister to all other Ochnae. Thus, endosperm-free seeds and ovules with completely, partly or for most of their length united integuments (resulting in an apparently single integument) are characters that unite all members of that tribe. The relationships within its largest clade, Ochnineae (former Ochnae), are poorly resolved, but former Ochninae (*Brackenridgea*, *Ochna*) are polyphyletic. Within Sauvagesieae, the genus *Sauvagesia* in its broad circumscription is polyphyletic as *Sauvagesia serrata* is sister to a clade of *Adenarake*, *Sauvagesia* spp., and three other genera. Within Quiinoideae, in contrast to former phylogenetic hypotheses, *Lacunaria* and *Touroulia* form a clade sister to *Quiina*. Ancestral state reconstructions showed that monosymmetric flowers with adaptations to buzz-pollination (poricidal anthers), a syncarpous gynoecium (a near-apocarpous gynoecium evolved independently in Quiinoideae and Ochninae), numerous ovules, septicidal capsules, and winged seeds with endosperm are the ancestral condition in Ochnoideae. Although in some lineages poricidal anthers were lost secondarily, the evolution of poricidal superstructures secured the maintenance of buzz-pollination in some of these genera, indicating a strong selective pressure on keeping that specialized pollination system.

**Keywords:** Ancestral state reconstruction, Bayesian hypothesis testing, classification, ITS, Malpighiales, plastid markers





## 4.1 Introduction

The Malpighiales are one of the largest orders of flowering plants and are an important component of tropical rainforests worldwide (e.g., Gonmadje et al., 2011; Stropp et al., 2011). Its rapid diversification during the mid-Cretaceous made the order one of the phylogenetically most recalcitrant angiosperm groups (Davis et al., 2005; Wurdack and Davis, 2009). Additionally, the morphological foundation for patterns of relationships has been poor, following the massive restructuring that Malpighiales have undergone since the resurrection of the order as a consequence of molecular phylogenetics (e.g., Savolainen et al., 2000; Davis and Chase, 2004; APG III, 2009; Endress et al., 2013). Only recently, with the advent of phylogenomics (Xi et al., 2012) and the availability of extensive floral morphological data (Endress et al., 2013), could major progress in our understanding of the phylogenetic backbone and familial relationships be achieved. Nonetheless, some relationships still remain unresolved. One clade identified as in strong need for comprehensive molecular phylogenetic studies are Ochnaceae (Matthews et al., 2012; Endress et al., 2013).

In higher-level molecular phylogenetic studies, Ochnaceae s.str. form a well-supported clade together with the monotypic Medusagynaceae – an endemic of the Seychelles – and the Neotropical Quiinaceae (Fay et al., 1997; Davis et al., 2005; Schneider et al., 2006; Korotkova et al., 2009; Bell et al., 2010; Soltis et al., 2011). In the most recent APG classification (APG III, 2009), all three were united to form an expanded Ochnaceae s.l. (if not specified, from here we refer to Ochnaceae s.str.). Nonetheless, some more recent studies keep all three as separate families because they form distinct clades that are also morphologically well-characterized (Wurdack and Davis, 2009, Matthews et al., 2012; Xi et al., 2012; Endress et al., 2013). The position of Ochnaceae s.l. within Malpighiales has been unclear until recently, when Xi et al. (2012) inferred that they are sister to the clusioid clade, though with low support (Bayesian posterior probability = 0.81). While higher-level relationships became clearer, molecular evidence for infrafamilial relationships of Ochnaceae is still wanting.

Ochnaceae in the traditional circumscription (Amaral, 1991; Amaral and Bittrich, in press) are a largely woody pantropical family, comprising ~500 species and 27 genera. The highest number of species is found in the Neotropics with 15 genera and about 300–350 species; Africa has nine genera and about 150 species, and the lowest diversity is observed in Southeast Asia, which is home to ~20 species and eight genera (Kanis, 1968; Sastre, 2003; Verdcourt, 2005). Ochnaceae occur in rain forests, dry forests and savannas, and some taxa develop fire-adapted forms (Kanis, 1968). Most Ochnaceae are shrubs or small trees and only few are herbaceous (species of *Sauvagesia* L.) or large trees of the canopy strata (e.g., *Brackenridgea* A. Gray, *Lophira* Banks ex C.F. Gaertn. and *Testulea* Pellegr.). The African genus *Lophira*, and to a lesser extent also *Testulea*, provide

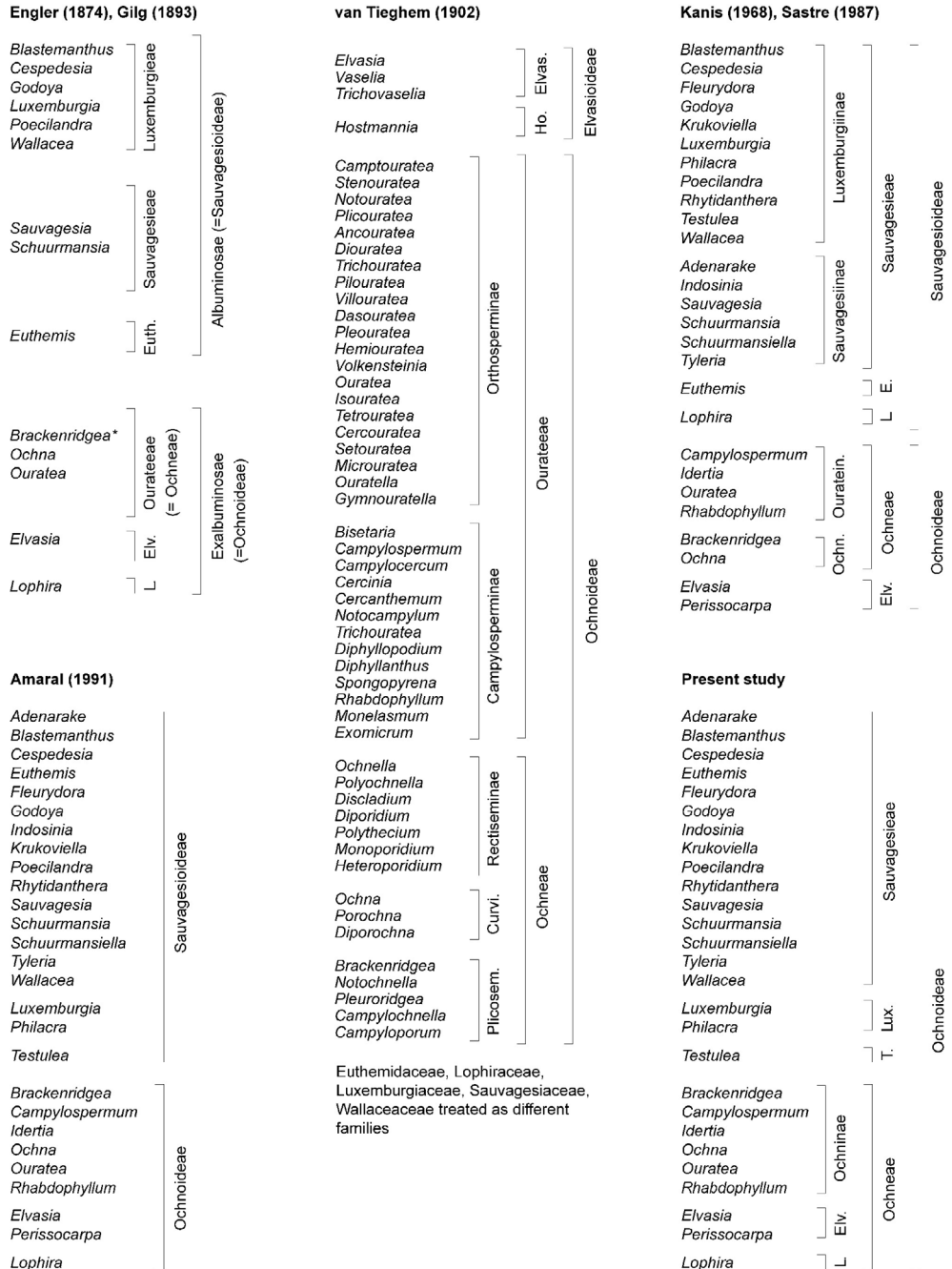


valuable timber (azobé and izombé, respectively; Doumenge and Séné, 2012; Oduro, 2012). An important diagnostic character is the leaf venation with many Ochnaceae possessing rather densely spaced parallel secondary veins and the tertiary veins perpendicular to these. The number of sepals, petals, and stamens varies drastically across the family, but flowers are basically pentamerous. Potential synapomorphies of the family are poricidal anthers, stamen filaments with an abruptly narrow attachment zone of the anthers, and the crystal layer in the endostesta (Amaral, 1991; Matthews et al., 2012). The common poricidal anthers or the poricidal system (i.e., the pore is formed by the staminodes enveloping the functional anthers) are interpreted as adaptations to buzz-pollination (Kubitzki and Amaral, 1991). The best known feature, although only present in part of the family, are the fruits consisting of a swollen red receptacle bearing free black drupelets (resulting in the family's nick name, Mickey Mouse plants), but fruit type is widely variable in Ochnaceae s.str. (see, e.g., Dwyer, 1946).

Ochnaceae have traditionally been divided into subfamilies Ochnoideae and Sauvagesioideae – corresponding to Engler's "Exalbuminosae" and "Albuminosae" (Fig. 1), respectively – on the basis of the absence (Ochnoideae) or presence (Sauvagesioideae) of endosperm in the seeds (Engler, 1874; Kanis, 1968; Amaral, 1991). In most classifications, both subfamilies are subdivided into tribes and subtribes, but the concepts and circumscriptions have been controversial (Fig. 1). The majority of the genera of Sauvagesioideae are species-poor. The largest and morphologically most heterogeneous genus is *Sauvagesia* with about 35 species. By far the highest diversity is observed in tribe Ochneae which makes up more than two thirds of the species richness of the family, comprising the three most species-rich genera *Ouratea* Aubl. (~200 spp.; Sastre, 2003), *Ochna* L. (~80 spp.; Verdcourt, 2005), and *Campylospermum* Tiegh. (~50 spp.; Farron, 1985; Bissiengou et al., 2013) and the smaller *Brackenridgea* (9 spp.; Kanis, 1968; Callmander et al., 2010), *Rhabdophyllum* Tiegh. (8 spp.; Sosef, 2008), and *Idertia* Farron (4 spp.; Farron, 1985).

Ochnaceae are noteworthy for their complex biogeographical history with radiations in the Old and New World. The occurrence of both forest and savanna species in several genera also make Ochnaceae an excellent system for the study of forest-savanna transitions which have recently been used to address responses of rainforests to climate change and of climatic tipping points for tropical rainforests versus savannas (Hirota et al., 2011) or the reconstruction of the origin of these major tropical and subtropical biomes (Simon et al., 2009). Additionally, recent efforts to gain insights into the evolution of Ochnaceae using new floral morphological data (Matthews et al., 2012; Endress et al., 2013) further highlight the need for a sound molecular basis and an updated and stable classification of the family. The shifting circumscriptions and infrafamiliar classifications of Ochnaceae (s.str. and s.l.) hamper communication due to frequent changes and inconsistencies in floras and standard taxonomic and floristic databases worldwide.





**Figure 1.** Important classifications of Ochnaceae in a historical context, including the classification of the present study, showing the ranks of subfamily, tribe and subtribe. Asterisks indicate new additions or changes. <sup>a</sup> *Gomphia* is a synonym of *Ouratea*, but in Kanis (1968) it was used for the palaeotropical Ourateinae: *Campylospermum*, *Idertia* and *Rhabdophyllum*. Van Tieghem's (1902) classification, did not include "Sauvagesioideae". Curvi. = Curviseminae; Elv. = Elvasiaeae or Elvasiinae; E. or Euth. = Euthemideae; Ho. = Hostmannieae; L. = Lophireae or Lophirinae; Lux. = Luxemburgiaceae; T. = Testuleae.

Our study aims at providing for the first time a molecular phylogenetic framework for a modern classification of Ochnaceae based on near-complete taxon sampling at the genus level and multiple DNA regions. Additionally, we examined evolutionary hypotheses for taxonomically important characters.

## 4.2 Materials and Methods

### 4.2.1 Taxon sampling

Plant material was obtained during field excursions, from herbarium specimens, or from the DNA banks at Kew (K), the Missouri Botanical Garden (MO), and the National Herbarium of the Netherlands (Wageningen branch, WAG). Our final taxon sampling contains 93 accessions of Ochnaceae s.l. (Table 1), comprising all genera of Ochnaceae s.str. – following the generic circumscriptions of Amaral (1991) –, except *Indosinia* J.E. Vidal and *Perissocarpa* Steyerl. & Maguire. In addition, the monotypic Medusagynaceae and all genera of Quiinaceae were included. Based on Xi et al. (2012), three representatives of the clusioid clade were chosen as outgroups. For the pantropical *Sauvagesia* and especially the genera of Ourateinae (*Campylospermum*, *Idertia*, *Ouratea*, *Rhabdophyllum*), several species per genus were sampled.

### 4.2.2 Character sampling

For the taxa mentioned in the previous section, we produced sequence data for five loci, viz. the plastid loci *matK*, *ndhF*, *rbcL*, *trnL-trnF* (including the *trnL* intron, *trnL* 3' exon and *trnL-trnF* intergenic spacer), and the nuclear ribosomal internal transcribed spacer (including ITS 1, 5.8 S, ITS 2).

For most taxa only herbarium specimens were available. Amplification and sequencing of samples from herbarium specimens often fails due to the highly degraded nature of the DNA (Särkinen et al., 2012). Thus, taxa represented only by such specimens may contain missing data. Excluding taxa, however, regrettably reducing taxon sampling, would negatively impact phylogenetic analyses as in general a reduced taxon sampling decreases phylogenetic accuracy, is more likely to introduce systematic error, and leads to a deterioration in parameter estimation in model-based methods (e.g. Rannala et al., 1998; Heath et al., 2008). In particular, our data set represents only 20% of the species diversity in Ochnaceae, and pruning incompletely sampled terminals might give rise to systematic error known as long branch attraction (Felsenstein, 1978; Graybeal, 1998; Kück et al., 2012). On the other hand, it has been shown that the accuracy of phylogenetic analyses is robust to the inclusion of incomplete taxa – even those with large amounts of missing data (Cho et al., 2011; Wiens and Morrill, 2011). Therefore, taxa with incomplete sequence data were included in our data set. In a few cases, adequate representation of taxa of interest was achieved by the combination of data from different collections

**Table 1.** Taxon list with information on herbarium vouchers (herbarium acronym), geographic location and GenBank accession numbers for five DNA regions. Data from additional accessions used in composite taxa are in parentheses; for cultivated material from Botanic Gardens (BG), the garden accession numbers are given.

Taxon	Voucher	Locality	ITS	Accession numbers		
				<i>matK</i>	<i>ndhF</i>	<i>trnL-F</i>
Outgroups						
<i>Clusia rosea</i> Jacq.			--	HQ331588	JX662746	HQ332043 AY144069/ AY144095
<i>Garcinia mangostana</i> L.			--	JX661944	JX662752	JX664049 GQ456077
<i>Hypericum</i> spp.			--	HM850929	JX662756	JX664053 KF267872
Quinoideae						
<i>Froesia diffusa</i> Gereau & Vásquez	Villa & Alvia 256 (MA)	Ecuador: Río Tiputini	KF263222	KF263287	KF263336	KF263409 KF263479
<i>Froesia venezuelensis</i> Steyerf. & G.S. Bunting	Schneider 2 (FR)	Venezuela: Cerro La Chapa	KF263223	KF263288	KF263337	KF263410 KF263480
<i>Lacunaria macrostachya</i> (Tul.) A.C.Sm.	Zárate 16751 (HH)	Peru: Iquitos	KF263169	KF263232	KF263297	KF263346 KF263420
<i>Lacunaria oppositifolia</i> (Pires) Pires	Schneider 11 (FR)	Venezuela: La Esmeralda	KF263224	KF263289	KF263338	KF263411 KF263481
<i>Quiina amazonica</i> A.C.Sm.	Zárate 16753 (HH)	Peru: Iquitos	KF263170	KF263233	KF263298	KF263347 KF263421
<i>Quiina pteridophylla</i> (Radlk.) Pires	Schneider 22 (FR)	Venezuela: Pto. Ayacucho	KF263213	KF263291	KF263340	KF263412 KF263483
<i>Quiina tinifolia</i> Planch. & Triana	Schneider 7 (FR)	Venezuela: La Esmeralda	KF263226	KF263280	KF263328	KF263402 KF263471
<i>Touroultia guianensis</i> Aubl.	Prévost et al. 4595 (FR)	French Guiana: Montagnes Plomb	KF263214	KF263281	KF263329	KF263403 KF263472
Medusagynoideae						
<i>Medusagyne oppositifolia</i> Baker	RBGE 20030393 (ITS, <i>ndhF</i> ); GenBank ( <i>matK</i> , <i>rbcl</i> , <i>trnL-F</i> )	Seychelles	KF263188	JX661953	KF263309	JX664059 AY763244/ AY763259

Ochnoideae									
<i>Adenarake muriculata</i> Maguire & Wurdack	Maguire et al. 60447 (NY) (Kew DNA bank #3146)	Brazil: Serra da Neblina	--	KF263231	--	KF263345	KF263419		
<i>Blastemanthus sprucei</i> Tiegh.	Amaral s.n. (Kew DNA bank #2987)	Brazil	--	KF263229	KF263295	KF263343	KF263416		
<i>Brackenridgea palustris</i> Bartell. (subsp. <i>kjellbergii</i> Kanis)	Aiyen Tjoa 25/S25 (L) ( <i>rbcl</i> : Niyomdham 1102 [LJ])	Indonesia: S-Sulawesi (Thailand: Tak Bai)		KF263182	KF263240	KF263304	KF263376	KF263430	
<i>Brackenridgea zanguebarica</i> Oliv.	Schultka K147 (FR) ( <i>rbcl</i> : Reitsma 225 [WAG])	Kenya: Coast		KF263225	KF263290	KF263339	KF263389	KF263482	
<i>Campylospermum duparquetianum</i> (Baill.) Tiegh.	Dauby 2135 (WAG)	Gabon: Ogooué-Maritime		KF263195	KF263252	KF263317	KF263370	KF263443	
<i>Campylospermum dybovskii</i> Tiegh.	Wieringa 5455 (WAG)	Gabon: Cap Esterias	--	KF263196	KF263253	--	KF263371	KF263444	
<i>Campylospermum excavatum</i> (Tiegh.) Farron	Bissioungou 1230 (WAG)	Cameroun: South Province	--	KF263205	KF263266	--	KF263387	KF263459	
<i>Campylospermum flavum</i> Farron	RBGE 19697363A	RBG Edinburgh		KF263191	KF263247	KF263313	--	KF263438	
<i>Campylospermum gabonensis</i> Biss.	Bissioungou 627 (WAG)	Gabon: Ngounié	--	KF263273	KF263325	KF263394	KF263464		
<i>Campylospermum glaucifolium</i> Biss.	Bissioungou 1326 (WAG)	Congo (Brazzaville): Niari		KF263210	KF263271	--	KF263393	--	
<i>Campylospermum glaucum</i> Farron	Bissioungou 1255 (WAG)	Cameroun: Bipindi		KF263207	KF263268	KF263322	KF263390	KF263461	
<i>Campylospermum glomeratum</i> (Tiegh.) Biss.	Bissioungou 1008 (WAG)	Gabon: Lopé		KF263201	KF263261	KF263319	KF263382	KF263454	
<i>Campylospermum klainei</i> (Tiegh.) Farron	Bissioungou 1299 (WAG)	Gabon: Libreville		KF263209	KF263270	KF263324	KF263392	KF263463	
<i>Campylospermum laeve</i> Farron	Bissioungou 1067 (WAG)	Gabon: Ogooué-Ivindo	--	KF263263	KF263320	KF263384	KF263456		
<i>Campylospermum laxiflorum</i> (De Wild. & T. Durand) Farron	Wieringa 6156 (WAG)	Gabon: Ogooué-Lolo		KF263197	KF263254	KF263318	KF263372	KF263445	
<i>Campylospermum louisii</i> Biss. & Sosef	Bissioungou 1154 (WAG)	Gabon: Ogooué-Ivindo		KF263203	KF263264	KF263321	KF263385	KF263457	
<i>Campylospermum oliveranum</i> Farron	Bissioungou 1239 (WAG)	Cameroun: South Province	--	KF263206	KF263267	--	KF263388	KF263460	
<i>Campylospermum schoenleinianum</i> [Klotzsch] Farron	Jongkind et al. 8077 (WAG)	Guinea: Nimba Mountains	--	KF263200	KF263260	--	KF263381	KF263453	

<i>Campylospermum</i> spec.	Bissiegou 1038 (WAG)	Gabon: Lopé	KF263202	KF263262	--	KF263383	KF263455
<i>Campylospermum strictum</i> Farron	Sofer 2744 (WAG)	Gabon: Estuaire	--	KF263245	KF263310	KF263365	KF263435
<i>Campylospermum umbricola</i> (Tiegh.) Farron	Bissiegou 1213 (WAG)	Cameroon: Elephant Mont	KF263204	KF263265	--	KF263386	KF263458
<i>Cespedesia spathulata</i> (Ruiz & Pav.) Planch.	Pérez et al. 1407 (MO) ( <i>ndhf</i> : Panama-Exkursion 2012 no. 107 [FR])	Panamá: Sherman (Panamá: Bocas del Toro)	KF263171	KF263234	KF263316	KF263348	KF263422
<i>Ehvasia capixaba</i> Fraga & M. M. Saavedra	Zamborlini 27 (MO)	Brazil: Espirito Santo	KF263172	--	KF263299	KF263349	KF263423
<i>Ehvasia calophyllea</i> DC.	Amaral s.n. (Kew DNA bank #2986)	Brazil	--	KF263228	KF263294	KF263342	KF263415
<i>Ehvasia elvasioides</i> (Planch.) Gilg	Hurtado 136 (MO)	Costa Rica: Corcovado	--	--	KF263300	KF263350	KF263424
<i>Euthemis leucocarpa</i> Jack	Djungai 028 (K) (Kew DNA bank #21769)	Brunei: Burkit Teraja	KF263167	KF263227	KF263293	KF263341	KF263414
<i>Euthemis minor</i> Jack	Beaman 8418 (L)	Malaysia: Sabah	--	KF263235	--	KF263351	--
<i>Fleurydora felcis</i> A. Chev.	Farron s.n. (WAG) (ITS: Adam 11940 [MO])	Guinea: Kindia	KF263173	--	--	KF263401	KF263470
<i>Godoya obovata</i> Ruiz & Pav.	Weigend et al. 5695 (MO)	Peru: Monobamba	KF263174	KF263236	KF263301	KF263352	KF263425
<i>Idertia axillaris</i> (Oliv.) Farron	Bissiegou 1291 (WAG)	Cameroon: Mafoko-Kindongi	KF263208	KF263269	KF263323	KF263391	KF263462
<i>Idertia morsonii</i> (Hutch. & Dalziel) Farron	Jongkind et al. 6618 (WAG)	Liberia: Geeblo Town	KF263211	KF263276	--	KF263397	KF263466
<i>Krukoviella disticha</i> (Tiegh.) Dwyer	Neill et al. 15849 (MO)	Ecuador: Cordillera del Condor	KF263194	KF263250	KF263315	KF263368	KF263441
<i>Lophira alata</i> Banks ex C.F. Gaertn.	RBGE 20110701A (matK: Bissiegou 1409 [WAG])	Gabon: Ngounié	KF263190	KF263272	KF263312	KF263367	KF263437
<i>Lophira lanceolata</i> Tiegh. ex Key	GenBank (ITS: Schmidt et al. 1902 [FR])	Ghana	KF263215	FJ670029	--	FJ670172	--
<i>Luxemburgia ciliosa</i> (Mart.) Planch.	Arbo et al. 4114 (Kew DNA bank #2326) ( <i>matk</i> : Irwin et al. 20041 [L])	Brazil (Brazil: Serra do Cipó)	KF263216	KF263256	KF263330	KF263404	KF263473

<i>Luxemburgia damazioana</i> Beauverd	Feres et al. 98/37 (MO)	Brazil: Serra do Cipo	KF263175	KF263237	--	KF263353	KF263426
<i>Luxemburgia schwackeana</i> Taub.	Vita s.n. (NY) (Kew DNA bank #3212)	Brazil	KF263217	KF263282	KF263331	--	KF263474
<i>Ochna afzelii</i> R. Br. ex Oliv.	Mwangoka et al. 4849 (MO)	Tanzania: Ntakata	KF263176	KF263238	KF263302	KF263354	KF263427
<i>Ochna integerrima</i> (Lour.) Merr.	ITS: Svengsuksa et al. BT 225 (L); <i>rbcL</i> & <i>trnL-F</i> : Newman et al. LA056 (L)	Laos: Khammouan	KF263177	--	--	KF263355	KF263449
<i>Ochna macrantha</i> Baker	Jongkind et al. 3479 (WAG)	Madagascar: Tsingy de Bemaraha	--	KF263279	--	KF263400	KF263469
<i>Ochna membranacea</i> Oliv.	Jongkind et al. 9584 (WAG)	Liberia: Nimba	KF263212	KF263278	KF263327	KF263399	KF263468
<i>Ochna mossambicensis</i> Klotzsch	Schultka K35 (FR)	Kenya	KF263218	KF263283	--	KF263405	--
<i>Ochna multiflora</i> DC.	Schneider 3077 (LZ)	BG Leipzig	--	KF263284	KF263332	KF263406	KF263475
<i>Ochna natalitia</i> (Meisn.) Walp.	RBGE 19490083B	RBG Edinburgh	KF263189	KF263246	KF263311	KF263366	KF263436
<i>Ochna polycarpa</i> Baker	Phillipson et al. 2869 (WAG)	Madagascar: Toliara	--	KF263277	--	KF263398	KF263467
<i>Ochna serrulata</i> Walp.	FHK46M (BG Utrecht University 0G1984GR00402)	South Africa	--	KF263251	--	KF263369	KF263442
<i>Ouratea erecta</i> Sastre	Jansen-Jacobs et al. 6712 (L)	Suriname: Lely Mountains	--	KF263255	--	KF263374	KF263447
<i>Ouratea lucens</i> (Kunth.) Engl.	Stevens & Montiel 27915 (MO)	Nicaragua: Cuapa	KF263193	KF263249	KF263314	--	KF263440
<i>Ouratea polyantha</i> (Triana & Planch.) Engl.	Davidse 2773 (L)	Venezuela: Pto. Ayacucho	KF263198	--	--	KF263373	KF263446
<i>Ouratea schomburgkii</i> (Planch.) Engl.	Jansen-Jacobs et al. 6775 (L)	Suriname: Lely Mountains	--	--	--	KF263375	KF263448
<i>Ouratea scottii</i> Sastre	Chatrou 405 (WAG)	Bolivia: Riberalta	--	KF263257	--	KF263377	KF263450
<i>Ouratea spec.</i>	Lachenaud 1044 (BR)	French Guiana: Saut Takari Tante	KF263199	KF263259	--	KF263380	KF263452
<i>Ouratea striata</i> (Tiegh.) Urb.	Kuba-Exkursion 144 (FR)	Cuba	KF263219	--	KF263333	KF263407	KF263476



<i>Ouratea vaccinioides</i> Engl.	Seele 736 (LZ)	Brazil: Teresópolis	KF263220	KF263285	KF263334	--	KF263477
<i>Philactra auriculata</i> Dwyer	Amaral 9/96	Brazil	KF263221	KF263286	KF263335	KF263408	KF263478
<i>Philactra auriculata</i> Dwyer	Pipoly & Samuels 6867 (MO)	Brazil	KF263178	--	KF263303	KF263356	KF263428
<i>Pocilandra retusa</i> Tul.	Kelloff et al. 1049 (MO)	Guyana: Kaieteur National Park	KF263179	--	--	KF263357	--
<i>Rhabdophyllum arnoldianum</i>	Sosef 2239 (WAG)	Gabon: Ogooué-Ivindo	--	KF263258	--	KF263378	KF263451
<i>Rhabdophyllum calophyllum</i> (De Wild. & T. Durand) Tiegh.	Bissiegou 767 (WAG)	Gabon: Woleu-Ntem	--	KF263274	--	KF263395	--
<i>Rhabdophyllum leteistui</i> Farron	Bissiegou 807 (WAG)	Gabon: Woleu-Ntem	--	KF263275	KF263326	KF263396	KF263465
<i>Rhytidanthera splendida</i> (Planch.) Tiegh.	Steyermark & Liesner 119012 (MO)	Venezuela: Cerro Las Minas	KF263180	--	--	--	--
<i>Sauvagesia erecta</i> L.	Nikolov 1846 (MO) ( <i>rbcl</i> : Lachenaud 1018 [BR])	Madagascar: Analanjirofo (French Guiana: Savanes de Combi)	KF263192	KF263248	--	KF263379	KF263439
<i>Sauvagesia fruticosa</i> Mart. & Zucc.	Zarucchi & Ballick 1780 (MO)	Colombia: Mitu	KF263181	KF263239	--	KF263358	KF263429
<i>Sauvagesia serrata</i> (Korth.) Sastre	Pater Agatho Elsener H205 (L)	Indonesia: West Borneo	KF263183	KF263241	--	KF263359	KF263431
<i>Sauvagesia tafelbergensis</i> Sastre	de Granville et al. 14953 (L)	French Guiana: Mont Bakra	KF263184	KF263242	--	KF263360	KF263432
<i>Schuurmansia elegans</i> Blume	Johns 9814 (K) (Kew DNA bank #18433) ( <i>rbcl</i> : Yumte 229 [L])	Indonesia: Irian Yaya	KF263166	--	KF263292	KF263361	KF263413
<i>Schuurmansiella angustifolia</i> (Hook.f.) Hallier.f.	van Balgooy 7344 (L)	Malaysia: Sarawak	--	--	--	KF263362	--
<i>Testulea gabonensis</i> Pellegr.	Wieringa 6171 (WAG)	Gabon: Ogooué-Ivindo	KF263187	KF263244	KF263308	KF263364	KF263434
<i>Tyleria silvana</i> Maguire	Chase 3086 (Kew DNA bank #3086)	Brazil: Amazonia	KF263168	KF263230	KF263296	KF263344	KF263418
<i>Wallacea insignis</i> Spruce ex Benth. & Hook.f.	Berry et al. 5926 (MO) ( <i>trnL-F</i> : Amaral s.n., Kew DNA bank #2994)	Venezuela: Laja Suiza (Brazil: Amazonas)	KF263185	KF263243	KF263306	KF263363	KF263417

(Campbell and Lapointe, 2009), thus forming composite terminals (but only combining sequences of different individuals of the same species; not forming composite genera, with the exception of the outgroup genus *Hypericum*; see Table 1).

### 4.2.3 DNA isolation, PCR, and sequencing

Genomic DNA was isolated from leaves of herbarium specimens or silica gel-dried leaves using different methods: (1) the DNeasy Plant Mini Kit (Qiagen) according to the manufacturer's protocol; (2) the CTAB method (Doyle and Doyle, 1987) with a precipitation time of up to one week for herbarium specimens; (3) the AnaP method with PTB (*N*-phenacylthiazolium bromide) as an additive as described in Telle and Thines (2008). Tissue (~2-20 mg dry weight; if available, also up to 100 mg) was ground to a fine powder by a Mixer Mill MM200 (Retsch, Haan, Germany).

Amplifications were carried out in 25 µl volumes with 1.25 U of MyTaq DNA polymerase (Bioline, London, UK), 1x MyTaq reaction buffer (containing 3 mM MgCl<sub>2</sub>, 1 mM of each dNTP, stabilizers and enhancers), 0.3 µM of each primer, and undetermined quantities of genomic DNA template in a Mastercycler S (Eppendorf, Hamburg, Germany). Alternatively, amplifications were performed using MangoTaq of the same manufacturer as described previously (Telle and Thines, 2008). The following primer combinations were used initially: ITS-F1 & -R1; ITS 1/.Leu & ITS 4; *matK*-400F & *trnK*-2R; *ndhF*-310F/331F & 2110R; *rbcL* aF & aR; *trnL-F* c & f (Table 2). If necessary, internal primers were used, and for some of the regions new primers were designed (Table 2). After initial denaturation (4:00 min at 94°C), polymerase chain reaction (PCR) was performed for 35 cycles of denaturation (0:20 min at 94°C), primer annealing (0:20 min at 54°C [ITS], 52°C [*matK*], 48°C [*ndhF*, *trnLF*], 55°C [*rbcL*]), and primer extension (0:30 min at 72°C). The reactions ended with an elongation period of 7 min at 72°C. PCR products were electrophoresed on 1% agarose gels in Tris-borate-EDTA buffer and stained with ethidium bromide. Afterwards, PCR bands were excised and purified with the Qiaquick gel extraction kit (Qiagen). Alternatively, unincorporated dNTPs and leftover PCR primers were directly removed in 20 µl reactions using 10 µl of the PCR product, 0.2 U Exonuclease I (New England Biolabs), 0.5 U Shrimp alkaline phosphatase (USB). This reaction mix was incubated for 20 min at 37°C and deactivated for 20 min at 80°C in a thermocycler. PCR products were mostly bidirectionally sequenced using the forward and reverse PCR primers (5 pmol) and the BigDye® Terminator v.3.1 Cycle Sequencing Kit (Applied Biosystems, Inc.) on an ABI 3730 xl capillary sequencer following the manufacturer's instructions. The edited DNA sequences were submitted to GenBank and accession numbers are listed in Table 1.



**Table 2.** List of PCR primers used in the present study.

Primer name	Primer sequence (5'-3')	Reference
<i>ITS</i>		
ITS F1	GATCGCGGGACTTGGGCGGTTTC	Muellner et al. (2005)
ITS R1	GGTAGTCCCGCCTGACCTGGG	Muellner et al. (2005)
ITS.Leu	GTCCACTGAACCTTATCATTTAG	Vargas et al. (1998)
ITS 1	TCCGTAGGTGAACCTGCGG	White et al. (1990)
ITS 2	GCTGCGTTCATCATGATGC	White et al. (1990)
ITS 3b	GCATCGATGAAGAACGTAGC	White et al. (1990)
ITS 4	TCCTCCGCTTATTGATATGC	White et al. (1990)
<i>matK</i>		
400F	CCCTAATTTACGATCAATTCATTCAAT	Cameron (2001)
472F	AAATTGGTTCAAACCTTCGCTACTCG	this study
825F	CATTATGTTAGATATCAAGGA	this study
1039F	GTACGGAGTCAAATGCTAG	this study
781R	TTAACA(M)AGACTTCTGCA	this study
887R	TTCATCAGAAGAGGCGTATCC	this study
1166R	TGGGATTACTAATGGGATG	this study
1184R	TGGGATTACTAATGGGATG	this study
1616R	TACTCGTATACTGCATGAGCA	this study
trnK2R	AACTAGTCGGATGGAGTAG	Johnson & Soltis (1995)
<i>ndhF</i>		
310F	GCCTTTTATATGTTTCGA	this study
331F	TATTTACTTACTTTTGAAGGG	this study
Och637F	CCTATACTTGTTTTAGTACTA	this study
Qui637F	CCTATACTTGTTTTAGCACTA	this study
838R	AATAAGCTATACTGACTGA	this study
2110R	CCCCCTAYATATTTGATACCTTCTCC	Olmstead & Swears (1994)
<i>rbcl</i>		
aF	ATGTCACCACAAACAGAGACTAAAGC	CBOL Working Group (2009)
aR	GTAAATCAAGTCCACCRGC	CBOL Working Group (2009)
<i>trnL-F</i>		
c	CGAAATCGGTAGACGCTACG	Taberlet et al. (1991)
d	GGGGATAGAGGGACTTGAAC	Taberlet et al. (1991)
e	GGTTCAAGTCCCTCTATCCC	Taberlet et al. (1991)
f	ATTTGAACTGGTGACACGAG	Taberlet et al. (1991)

#### 4.2.4 Sequence alignment and phylogenetic analysis

Sequence alignment was done with the program MAFFT, version 7.015b (Kato et al., 2002; Kato et al. 2009), using the L-INS-I algorithm with “maxiterate” set to 1000 (for ITS, the Q-INS-I algorithm); if necessary, the obtained alignment was subsequently adjusted manually. Alignment gaps (indels) were treated as missing data. The alignment was generally straightforward, except for the ITS region which contained several

highly variable parts. Ambiguous or hypervariable alignment positions were excluded manually (for the *trnL-F* region) or, for the ITS region, using the software Gblocks 0.91b (Castresana, 2000; Talavera and Castresana, 2007) with default settings.

Because of the large proportion of unequal taxon sampling between the five regions, topology-based incongruence tests (Shimodaira-Hasegawa test; Shimodaira and Hasegawa, 1999) are either impossible or, as in the case of the incongruence length difference test (Farris et al., 1994), prohibitively time-consuming. Instead, we performed ML analyses for each region separately as outlined below and searched for well-supported significant incongruence (e.g. Couvreur et al., 2010). Due to the lack of incongruence, the regions were combined following a supermatrix or total evidence approach (Eernisse and Kluge, 1993; de Queiroz and Gatesy, 2007). Data concatenation was done with the program SequenceMatrix, version 1.78 (Vaidya et al., 2011).

Tree searches were performed using maximum likelihood and Bayesian approaches. Prior to these analyses, the optimal substitution model was determined using Modeltest 3.7 (Posada and Crandall, 1998). Based on the Akaike Information Criterion (AIC), different substitution models were suggested for each of the analyzed regions: TrN+I+G for ITS, GTR+G for *matK*, TVM+I+G for *ndhF*, GTR+G for *rbcl*, and TVM+G for *trnLF*. Maximum likelihood analyses were carried out using RAxML (Stamatakis, 2006) and the raxmlGui 1.3 (Silvestro and Michalak, 2012), setting partitions for each region, the model to GTRGAMMA and the bootstrap (BS) analysis to 1000 replicates.

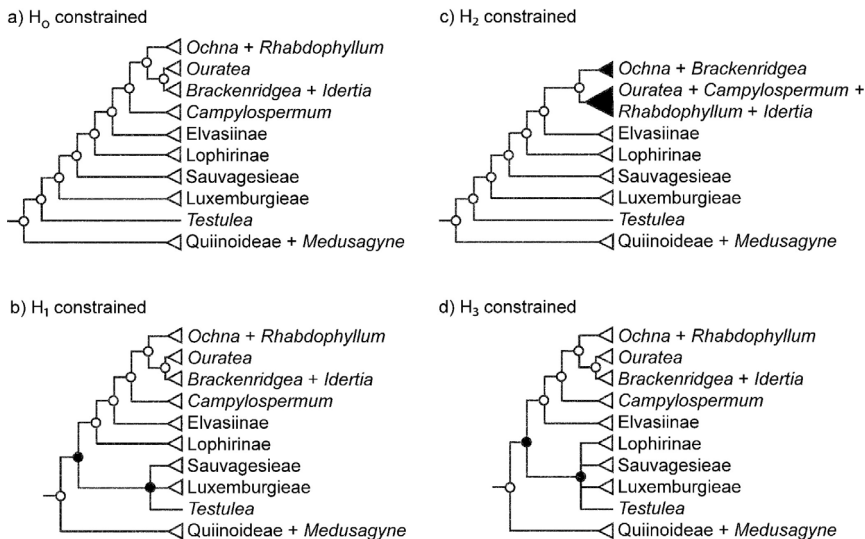
For the Bayesian analysis of the concatenated data, the same partitions were defined as for the RAxML analysis. Analyses were performed with MrBayes, version 3.1.2 (Huelsenbeck and Ronquist, 2001; Ronquist et al., 2012), employing a Markov chain Monte Carlo (MCMC) procedure in order to simultaneously estimate an optimal phylogenetic tree and the posterior probabilities (PP) of interior branches (Rannala and Yang, 1996; Li et al., 2000). Four parallel Markov chains, incrementally heated by a temperature of 0.2, were run for 10 million generations, sampling every five hundredth generation. Convergence of runs was tested by inspecting whether the standard deviation of split frequencies of the runs was < 0.01 and by using the effective sample sizes (ESS) as calculated with Tracer 1.4 (Rambaut and Drummond, 2007), considering ESS values >200 as good evidence. The first 2,500,000 generations were discarded, and a consensus tree calculated from the remaining trees.

Analyses were partially run on the Cyberinfrastructure for Phylogenetic Research (CIPRES Science Gateway; <http://www.phylo.org/index.php/portal/>; Miller et al., 2010). Phylogenetic trees were visualized in FigTree, version 1.4 (<http://tree.bio.ed.ac.uk/software/figtree/>).



### 4.2.5 Hypothesis testing

For a statistically based comparison between competing phylogenetic hypotheses and their associated classifications (i.e., the phylogenetic hypothesis based on the present study compared with those following previous classifications as outlined in Fig. 1), we used Bayesian inference. To test whether one phylogenetic hypothesis is strongly preferred over an alternative phylogenetic hypothesis, we estimated the marginal likelihoods of the different hypotheses, i.e., the models  $M_0$ ,  $M_1$ , etc., using the stepping stone sampling approach (Xie et al., 2011) implemented in MrBayes, version 3.2.1 (Ronquist et al., 2012). For each model, we used an informed prior (i.e., monophyly constraints), following the “preferred” strategy of Bergsten et al. (2013). Thus, for each hypothesis we defined hard constraints for all major clades (see Fig. 2). For the stepping stone approach we set the number of generations to 7,500,000, the alpha-shape parameter to 0.3 – a value within the range Xie et al. (2011) found optimal –, the sampling frequency to 500, nsteps to 50, and the default for the burn-in (i.e., there are 147,000 generations per step). Convergence was assessed based on the standard deviation of split frequencies. According to Kass and Raftery (1995), there is strong support for a phylogenetic hypothesis if the  $2\ln$  Bayes factor ( $2\ln B_{10}$ ) – resulting from the difference between the marginal likelihoods of both hypotheses – is  $> 10$ .



**Figure 2.** Phylogenetic hypotheses used for Bayesian hypothesis testing. The null hypothesis  $H_0$ , which corresponds to the phylogeny obtained in the present study, is compared to three alternative phylogenetic hypotheses ( $H_1$ - $H_3$ ) that represent assumptions about phylogenetic relationships from previous classifications of Ochnaceae. Monophyly constraints are defined for all major clades (open circles and triangles). Solid circles and triangles indicate different constraints compared to  $H_0$ .

### 4.2.6 Ancestral state reconstruction

Eight morphological characters, which identify major groups of Ochnaceae in premolecular classifications, were selected for the reconstruction of their evolution. Characters were scored for all taxa included in the molecular phylogeny following Amaral (1991) and Amaral & Bittrich (in press) for Ochnaceae s.str., Schneider and Zizka (in press) for Quiniaceae, and Dickison (1990) for *Medusagyne*. Two characters, carpel number and anther dehiscence, partially show considerable intrageneric variability. To reflect that variability (which is not fully covered by the taxon sampling), all congeners were assigned a genus-level score which covers the range of character states. All characters are binary or multistate (for character states of terminals see Table S1 and Fig. 4).

Ancestral state reconstructions were performed using BayesTraits, version 2.0 (beta) (Pagel et al., 2004; Pagel & Meade, 2006). Pooled trees from independent runs of Bayesian analysis (see above) were loaded in Mesquite, version 2.75 (Maddison and Maddison, 2011) specifying a burn-in fraction of 0.25, as in the Bayesian analysis above. Trees were rooted with the outgroup taxa using the “Root tree with selected taxa as outgroup” option of the Alter/Transform module. Subsequently, the outgroups were pruned and a subsample of 1000 post-burnin trees produced with the option “sample trees from separate NEXUS file”. Based on the Bayesian consensus tree, well-supported nodes of the major taxonomic lineages were selected for ancestral state reconstruction. The command lines for the specified nodes as required by the addMRCA command in BayesTraits were generated with the program BayesTrees, version 1.3 (Meade and Pagel, 2011). Ancestral state reconstructions were performed for each character separately using the module MultiState as implemented in BayesTraits (Pagel et al., 2004; Pagel and Meade, 2006) and the sample of 1000 post-burnin trees. Initially, a maximum likelihood analysis was run to derive an empirical prior. Preliminary Bayesian analyses were run with a reverse jump Markov chain Monte Carlo approach, an exponential hyperprior with its mean seeded from a uniform distribution of 0-20,  $10 \times 10^6$  generations, sampling every 1,000<sup>th</sup> generation, discarding the first 2,500,000 iterations as burnin, and varying RateDev parameters until acceptance rates reached values of 20 to 40% to ensure adequate mixing. Finally, ancestral states were reconstructed for the selected nodes with the adjusted RateDev parameter and the same settings as before but running the analysis for  $50 \times 10^6$  generations and sampling every 10,000<sup>th</sup> generation. Three independent runs were performed to check for stationarity of the harmonic means. If probability values for a given state were  $< 0.70$ , alternative states were tested using the fossil command in BayesTraits and calculating the Bayes factor (BF) as described in the programs manual. A BF of two to five indicates positive, and a BF of greater than five indicates strong support.



## 4.3 Results

### 4.3.1 Sequences/matrices

Our concatenated data set contained 3932 nucleotide sites after the exclusion of ambiguous characters. All 63 ITS and 69 *matK*, 49 *ndhF*, 75 *rbcL*, and 72 *trnL-F* sequences were newly obtained for this study. For 33 taxa all five gene regions were successfully sequenced, for 28 taxa only four regions, for 15 taxa three regions, for four taxa two regions, and for two taxa only one region could be obtained (in some cases only partially). Important characteristics of the sequences and the alignment are summarized in Table 3.

**Table 3.** Alignment characteristics according to region.

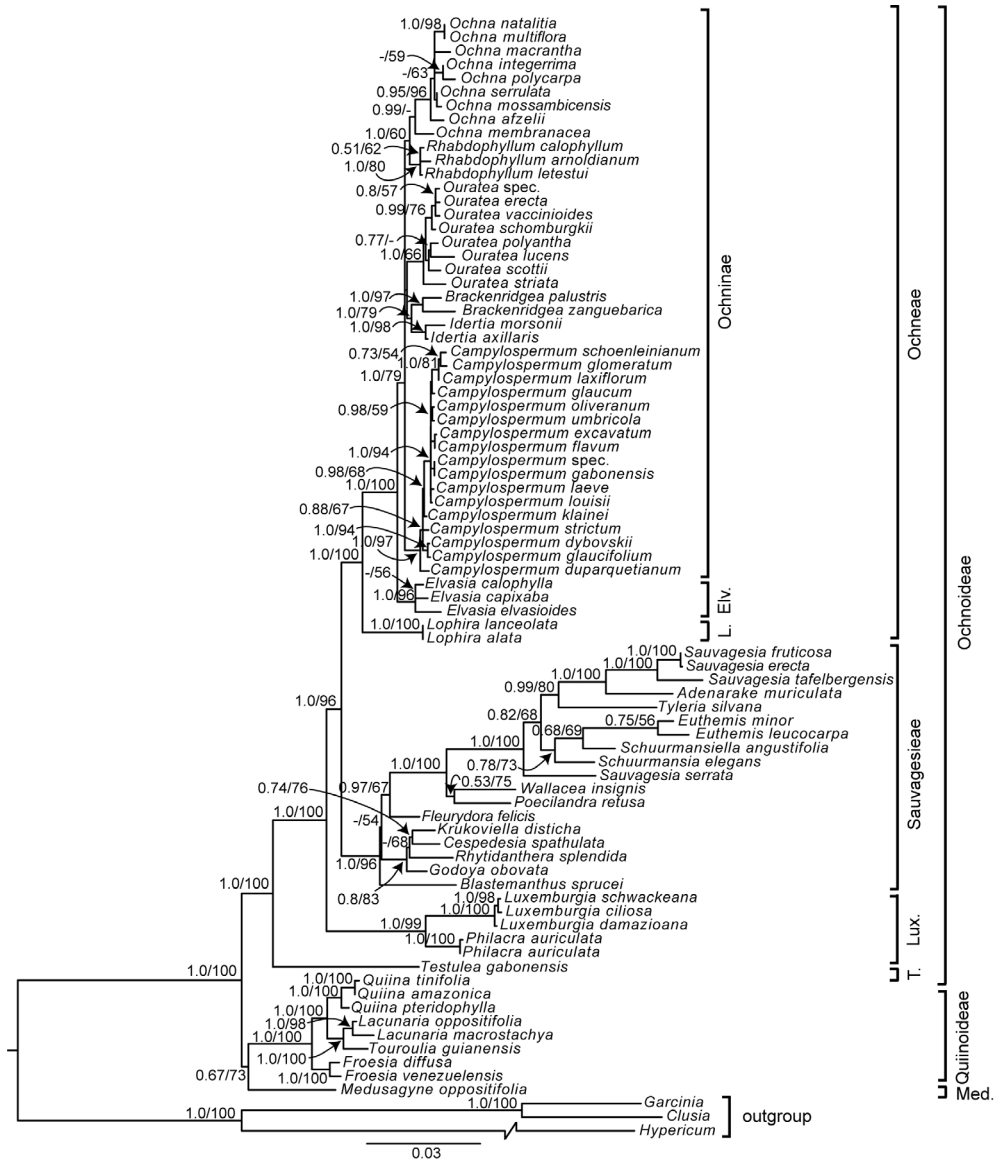
	ITS	<i>matK</i>	<i>ndhF</i>	<i>rbcL</i>	<i>trnL-F</i>
Alignment length	626	1315	858	552	1048
#characters excluded	273	21	--	--	173
#variable characters	135	517	250	80	333
#constant characters	218	777	608	472	542

### 4.3.2 Phylogenetics of Ochnaceae s.l.

Maximum likelihood and Bayesian analyses of the combined data produced largely congruent trees and contained no well-supported incongruences. The names of suprageneric taxa used in this section follow the new classification presented here (see discussion). Ochnaceae were maximally supported as monophyletic (100% BS, 1.0 PP), and Ochnoideae were inferred as sister to a clade of Medusagynoideae and Quiinoideae, though with only weak support (Fig. 3). *Testulea* emerged as sister to the rest of Ochnoideae (100% BS, 1.0 PP). Within Quiinoideae all nodes received maximum support: *Froesia* Pires is sister to the rest of Quiinoideae, and *Quiina* Aubl. is sister to a clade of *Touroulia* Aubl. and *Lacunaria* Ducke. The clade of *Luxemburgia/Philacra* (99% BS, 1.0 PP) formed the sister clade to the remaining genera of Ochnoideae (100% BS, 1.0 PP). The clades of tribes Sauvagesieae (96%, 1.0 PP) and Ochneae (100% BS, 1.0 PP) – the former Sauvagesioideae *pro parte* and Ochnoideae – are monophyletic and sister to each other (96% BS, 1.0 PP). Within Sauvagesieae, *Blastemanthus* is sister to the rest of this tribe (with low support), and a clade uniting *Cespedesia* Goudot, *Godoya* Ruiz & Pav., *Krukoviella* A.C. Sm. and *Rhytidanthera* Tiegh. is sister to the remaining genera, although with weak support. *Wallacea* Spruce ex Benth. & Hook.f./*Poecilandra* Tul. are sister to a clade comprising *Adenarake* Maguire & Wurdack, *Euthemis* Jack, *Sauvagesia*, *Schuurmansia* Blume, *Schuurmansiella* Hallier f., and *Tyleria* Gleason (100% BS, 1.0 PP). *Sauvagesia* is polyphyletic when including the Old World species *Sauvagesia serrata* (Korth.) Sastre, as this species is sister to a clade consisting of *Adenarake*, the New World species of *Sauvagesia*, and the clade of *Euthemis*, *Schuurmansia*, *Schuurmansiella*, and *Tyleria*. The clade of *Euthemis* and *Schuurmansiella* is sister to *Schuurmansia*, but

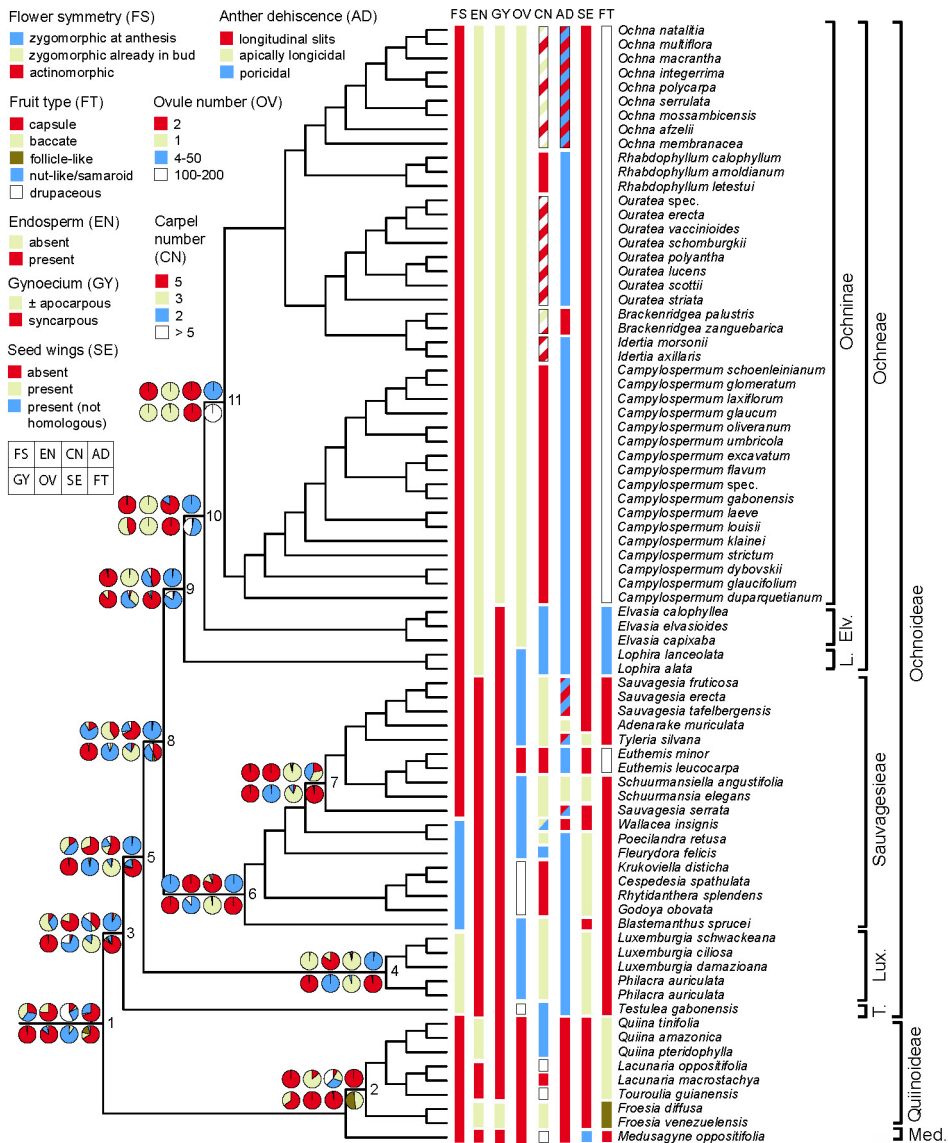


their relationships are poorly supported. Within Ochnaceae, *Lophira* and *Elvasia* DC. are strongly supported as subsequent sister lineages to the clade composed of the remaining genera (100% BS, 1.0 PP) as is *Elvasia* to the remaining genera of the tribe (96% BS, 1.0 PP). The relationships within Ochninae are less clear due to low support values, although the analyses infer each of the genera as monophyletic.



**Figure 3.** Maximum likelihood tree of Ochnaceae s.l. based on the combined DNA regions with posterior probabilities obtained from Bayesian Inference and bootstrap support from RAxML analysis (only values  $\geq 0.5$  [PP] or 50% [BS] are shown). The ranks and suprageneric names are according to the new classification presented here; Ochnaceae, Medusagynaceae and Quinaceae are accepted at the rank of subfamily, in accordance with APG III (2009). Elv. = Elvasiinae; L. = Lophirinae; Lux. = Luxemburgiidae; Med. = Medusagynoideae; T. = Testuleae.





**Figure 4.** Ancestral state reconstructions for eight taxonomically important morphological characters of well-supported major clades of Ochnaceae. The proportions of the posterior probabilities (see also Table S2) are displayed as pie charts (for arrangement of characters see the rectangular scheme). Node numbers refer to nodes analyzed in BayesTraits. Character scores are color-coded. To represent intragenetic variability in carpel number and anther dehiscence, all congeners were assigned a genus-level score which covers the range of the character states (see bars with mixed colors; including states not covered by the taxon sampling of the phylogeny). For the classification, see Fig. 3 (outgroups not shown).

Maximum likelihood analyses of each of the five regions separately (topologies not shown) did not show significant differences compared to the analysis of the combined

data with the exception that *Idertia* changed the position with *Elvasia* as sister to the rest of Ochneae (without *Lophira*; 100% BS) in the *trnL-F* tree.

### 4.3.3 Hypothesis testing

A comparison of the marginal likelihoods obtained from the stepping stone approach revealed that the null hypothesis ( $H_0$ ; see Fig. 2), which corresponds to the tree obtained from Bayesian inference, is strongly preferred over each of the alternative phylogenetic hypotheses  $H_1$ - $H_3$ . The mean log likelihood of  $H_0$  was  $-20436.85$ , whereas  $H_1$  (enforcing a clade of Sauvagesieae, *Testulea*, *Luxemburgia* and *Philacra*) received a log likelihood of  $-20532.21$ . The hypothesis  $H_2$ , enforcing Ochninae (*Brackenridgea*, *Ochna*) and Ourateinae (*Campylospermum*, *Idertia*, *Ouratea*, *Rhabdophyllum*) as circumscribed in previous classifications to be monophyletic, received a log likelihood of  $-20452.31$ . The log likelihood for the hypothesis ( $H_3$ ) enforcing *Lophira* to be included in a clade of Sauvagesieae, *Testulea*, *Luxemburgia* and *Philacra* was  $-20557.48$ . Thus, the Bayes factors ( $2\ln B_{10}$ ) for the comparisons between  $H_0$  with each of the alternative hypotheses are  $> 10$ .

### 4.3.4 Ancestral state reconstruction

Character state reconstructions showed that zygomorphic flowers are ancestral and actinomorphic flowers derived in Ochnoideae, with the presence of zygomorphy already at early stages of flower development receiving higher PP compared to zygomorphy that develops only at anthesis (Fig. 4, node 3; PP 0.57 [BF 3.0] versus 0.33; see also Table S2). Actinomorphic flowers arose independently in Ochneae (node 9, PP 0.97) and the clade uniting *Sauvagesia* s.l. and related genera (node 7, PP 0.98). The lack of endosperm is probably ancestral in Quiinoideae (node 2, PP 0.86), but derived in Ochnoideae (node 3, PP 0.8). A syncarpous gynoecium is ancestral in Ochnaceae (node 1, PP 0.99), and it was most likely present in the most recent common ancestors (MRCA) of Quiinoideae (node 2, PP 0.66, BF 5.8) and Ochnoideae (node 3, PP 0.98) too. A near-apocarpous gynoecium evolved twice, once in Quiinoideae (*Froesia*) and once in Ochnineae. Ovule numbers of 4-50 are probably the ancestral condition in Ochnoideae (node 3, PP 0.71), whereas two ovules per carpel is ancestral for Ochnaceae (node 1, PP 0.85). A single ovule per carpel is a derived state that emerged early in the evolution of Ochneae, somewhere along the branch of Elvasiinae + Ochninae (nodes 9-10). The evolution of carpel number along the backbone of Ochnaceae is unclear due to the lack of strong support for single states. However, two or five carpels is inferred as the ancestral condition in Ochnoideae (e.g. nodes 3, 5, 8), whereas three carpels is ancestral in *Sauvagesia* s.l. and related taxa (node 7, PP 0.95). For Quiinoideae (node 2), the ancestral condition remains undetermined. Anther dehiscence was poricidal in the MRCA of Ochnoideae (node 3, PP 0.91) and in all other major clades of that subfamily. Only in *Sauvagesia* s.l. and related

taxa (node 7), the ancestral state is unclear. Therefore, dehiscence by longitudinal slits, either over most of the length of the anther or confined to the apical zone, is a derived state in Ochnoideae. Septicidal capsules are ancestral in Ochnaceae (node 1, PP 0.67, BF 1.54) and Ochnoideae (node 3, PP 0.84). Nut-like to samaroid fruits are the ancestral condition in Ochnaceae (node 9, PP 0.80). Seeds with wings is probably ancestral in Ochnoideae (node 3, PP 0.84). In contrast, the loss of wings in the MRCA of Ochnaceae is well supported (node 9, PP 0.92). In Sauvagesiaceae the loss of wings is also derived.

## 4.4 Discussion

### 4.4.1 Relationships and circumscription of Ochnaceae

Molecular phylogenetics revealed that Medusagynaceae, Ochnaceae, and Quiinaceae form a well-supported clade within Malpighiales, but relationships between all three have long been unclear due to the lack of support in earlier molecular phylogenetic studies (Fay et al., 1997; Savolainen et al., 2000; Davis and Chase, 2004). This phylogenetic uncertainty together with the opportunity to eliminate a monogeneric family Medusagynaceae led APG III (APG, 2009) to unite the three families, forming a broadly defined Ochnaceae. In contrast, in some more recent studies all three families are kept separate because they form distinct clades that are also morphologically well characterized (Wurdack and Davis, 2009; Matthews et al., 2012; Xi et al., 2012; Endress et al., 2013). As inferred from a phylogenomic study, Ochnaceae are sister to a clade of Medusagynaceae and Quiinaceae (Xi et al., 2012). In the present study, which is based on the most complete taxon sampling of Ochnaceae to date, the relationships between the three families remain poorly supported, but each family forms a well-supported clade.

There are several potential synapomorphies in support of a broadly defined Ochnaceae including, for example, nectarless flowers, sepals often being of different size within flowers and with more than three vascular traces, petals reflexed over the sepals and directed toward the pedicel, anthers basifixed or almost basifixed, and the presence of a short gynophore (Matthews et al., 2012; Endress et al., 2013). However, the families in the narrow sense are also morphologically well characterized by a set of potential apomorphies. Ochnaceae s.str. share adaptations to buzz-pollination with poricidal anthers, the stamen filaments with an abruptly narrow attachment zone of the anthers, and a crystal layer in the endostesta (Amaral, 1991; Matthews et al., 2012). The alternate phyllotaxis and the often fimbriate or intrapetiolarly fused stipules also distinguish them from Medusagynaceae and Quiinaceae; phyllotaxis is opposite or whorled in the last two families and stipules are interpetiolar (Quiinaceae) or absent (Medusagynaceae). The formation of morphologically and/or functionally unisexual flowers characterizes Medusagynaceae and Quiinaceae (only lacking in *Froesia*), whereas in Ochnaceae,



this is restricted to *Euthemis*, *Schuermansia*, and *Schuermansiella* in Sauvagesioideae (Kanis, 1968; Amaral, 1991). Potential apomorphies of Quinaceae are a floral cup, a conspicuously ribbed ovary at anthesis with the ribs being not transversally subdivided, but vascularized, and in each locule there are two superimposed (collateral in *Froesia*) ovules that face in the same direction (Matthews et al., 2012), whereas in Medusagynaceae there are also two superimposed ovules in each locule but the micropyles of the ovules are directed towards each other, and the ovary ribs are transversally subdivided, but not vascularized.

Leaf venation is an important character that unites Medusagynaceae, Ochnaceae and Quinaceae (e.g., Hickey and Wolfe, 1975), but it also distinguishes Quinaceae from the other two. In both Quinaceae and Ochnaceae there is a tendency for parallel and densely spaced secondary and/or tertiary veins. However, the extremely dense and parallel tertiary veins of Quinaceae that are perpendicular to the secondary veins are unique and also a potential apomorphy (Schneider et al., 2002, 2006). Shared features of a clade uniting Medusagynaceae and Quinaceae are, for example, extreme polystemony, a massive thecal septum that persists after anther dehiscence, styles radiating outward from the ovary, two lateral superimposed ovules per carpel, and conspicuous lateral ribs on the ovary wall at anthesis (Matthews et al., 2012). Vestured pits, which have been supposed to contain a strong phylogenetic signal (Jansen et al., 2001), may be a synapomorphy of Ochnaceae s.l.: they characterize Ochnaceae (except *Sauvagesia*) and Medusagynaceae (Jansen et al., 2001), and Gottwald and Parameswaran (1967) also reported them for Quinaceae, but Jansen et al. (2001) could not confirm their presence in that family.

In summary, there are good arguments from anatomy, morphology and molecular phylogenetics for both a narrow as well as a broad circumscription of Ochnaceae. Which one to choose is therefore a rather subjective decision. However, there are some additional points to consider. First, because stability of classifications is desirable (Godfray and Knapp, 2004) and because APG III (2009), with a broadly defined Ochnaceae, is now widely accepted and adapted in recent flora works, classifications and databases (e.g., Fiaschi et al., 2010; Stevens, 2001 onwards; Tropicos, 2013), keeping Ochnaceae s.l. is preferable. Second, elimination of monogeneric families is also a desirable goal of modern classifications (e.g., APG III, 2009). Here, the question is whether the monogeneric Medusagynaceae are sufficiently distinct from the other two families to merit recognition at family rank as, for example, Platanaceae are (see APG III, 2009). Medusagynaceae is a widely-used name, supported by numerous potential apomorphies, and easily distinguished from Ochnaceae and Quinaceae. Nonetheless, compared to Platanaceae, distinction of Medusagynaceae is not strong. Thus, given the basic similarity of the three families with numerous potential synapomorphies for the Ochnaceae s.l. clade and the arguments outlined above, we agree with the classification of APG III (2009) in merging all three families. To avoid confusion, however, we suggest



that Ochnaceae s.l. should be used for the broader circumscription until this use has become widely established.

#### 4.4.2 Intrafamilial relationships and classification

Accepting a broadly defined Ochnaceae has immediate consequences for infrafamilial classification. Because Medusagynaceae and Quiinaceae are recognized at the rank of subfamily, infrafamilial names of previous classifications of Ochnaceae have to be accommodated accordingly. For example, subfamily Ochnoideae sensu Amaral (1991) will here be recognized at the rank of tribe. Thus, Ochneae and Sauvagesieae correspond to the Sauvagesioideae and Ochnoideae of pre-molecular classifications and to Engler's (1874) "Exalbuminosae" and "Albuminosae."

The separation into infrafamilial groups based on the absence (= Ochneae; Exalbuminosae) or presence of endosperm (= Sauvagesieae; Albuminosae) as suggested by Engler (1874) finds partial support in the monophyletic Ochneae in the present analysis. However, Sauvagesieae in their traditional circumscription (including *Testulea*, *Luxemburgia*, and *Philacra*) are paraphyletic because *Testulea* is the sister group of the rest of Ochnoideae and a clade with *Luxemburgia* and *Philacra* is the next sister group to the rest of the subfamily (Fig. 3). Therefore, it is necessary to elevate *Testulea* and *Luxemburgia* + *Philacra* to tribal rank. There are morphological characters (probably apomorphic) supporting tribes Luxemburgieae and Testuleeae: *Testulea* differs from the rest of Ochnoideae in having tetramerous flowers with only one bracteole, a single fertile stamen and the staminodes fused into a column up to two thirds of their length, besides leaves with brochidodromous venation; *Luxemburgia* and *Philacra* differ in flowers that are obliquely zygomorphic already in bud with the stamens surrounding the ovary only adaxially and filaments that are basally or completely fused. Thus, in our new classification Ochnoideae (former Ochnaceae s.str.) contain tribes Ochneae, Sauvagesieae, Luxemburgieae and Testuleeae.

The fact that Sauvagesioideae sensu Amaral (1991; including *Testulea*, *Luxemburgia* and *Philacra*) is not monophyletic is unexpected and it would hardly be inferred by the analysis of morphological characters alone, as both the former subfamilies Ochnoideae (Ochneae in the new classification) and Sauvagesioideae were apparently supported by synapomorphies (Amaral, 1991). The synapomorphies for Ochnoideae (now Ochneae) are the indehiscent fruits, ovules with united integuments for most of their length or completely so (see Matthews et al. 2012), and seeds with a strongly simplified testa and without endosperm. On the other hand, the supposed synapomorphies for the former Sauvagesioideae were zygomorphic flowers (with reference to the androecium at least), seeds with wings formed by the exotesta, and the presence of a crystal layer in the endotesta. An explanation for the unexpected result of a paraphyletic Sauvagesioideae may be found by re-evaluating the synapomorphies.

The fruits of *Medusagyne* and the clusioid clade as circumscribed in Xi et al. (2012) open, when dehiscent, along the septal radius (Stevens, 2001 onwards). The presence of septicidal capsules that occur in Testuleeae, Luxemburgieae and Sauvagesieae (with the exception of *Euthemis*) is therefore probably a symplesiomorphic character. On the other hand, the winged seeds and the presence of a crystal layer in the endotesta might be apomorphic characters by comparison with the outgroups (but see below). The seeds of Quiinoideae are wingless, and the wings of the seeds of *Medusagyne* are probably not homologous to those of Testuleeae, Luxemburgieae and Sauvagesieae, because they include a chalazal vascular bundle and have several cell layers (Dickison, 1990; Amaral, pers. obs.).

The presence of winged seeds and the crystalliferous endotesta is correlated with the capsular fruits that occur in the current tribes Testuleeae, Luxemburgieae and Sauvagesieae. Only in *Wallacea* and *Blastemanthus* both the wings and the crystalliferous layer are reduced and their relatively large seeds are water-dispersed in riverine environments in the Amazon region. In other genera of Sauvagesieae with wingless seeds (e.g., *Indosinia*, *Adenarake*, *Sauvagesia* s.l.) the crystalliferous layer is present, even in the genus *Euthemis* with its indehiscent, drupaceous fruits. Indehiscent fruits occur in all genera belonging to tribe Ochneae and this, accompanied by the more or less complete fusion of the integuments, apparently led to a simplification of the seed coat including the reduction of the seed wings and crystal layer. Another character that, according to Amaral (1991), could be synapomorphic for former Sauvagesioideae is the presence of zygomorphic flowers. However, the zygomorphy arises in different ways: the flowers of *Testulea* and *Luxemburgia* + *Philacra* are zygomorphic already in the floral bud as the stamen and staminodes (in *Testulea*) or the stamens (in *Luxemburgia* + *Philacra*) are situated at the adaxial side of the flower (in *Luxemburgia* the stamen primordia are already asymmetrically arranged at the early stages of the flower development; Amaral and Bittrich, 1998). In the early branching genera of Sauvagesieae the development of the zygomorphy occurs only during the anthesis with the stamina shifting to the adaxial and the gynoecium to the abaxial region of the flower. If zygomorphic flowers are ancestral in Ochnoideae as now recognized, actinomorphic flowers arose twice in the subfamily: in subtribe Ochninae and in *Sauvagesia* and related genera of Sauvagesieae, many of them with petaloid staminodes around or enveloping the fertile stamens and gynoecium. Additionally, the flowers becoming zygomorphic by shifting stamens and gynoecium only during the anthesis are also derived.

Thus, most of the supposed synapomorphies for the former subfamily Sauvagesioideae, uniting *Testulea*, *Luxemburgia* + *Philacra* and the genera that now belong to Sauvagesieae, are probably synapomorphies for the whole subfamily Ochnoideae (as now recognized) as is largely confirmed by the ancestral state reconstructions.



Quiinoideae (former Quiinaceae) are not subdivided further (Schneider and Zizka, in press). They form a well supported monophyletic group as in previous studies (Schneider et al., 2002, 2006). *Froesia* is sister to the rest of Quiinaceae, as observed in former studies (Schneider et al., 2002, 2006), but the clade of *Lacunaria* and *Touroulia*, sister to *Quiina*, has not been retrieved previously. *Lacunaria* and *Touroulia* share a similar leaf venation pattern, petals with three vascular traces, a polymerous gynoeceium with (4-)5-16 carpels (3 in *Froesia*, 2[-5] in *Quiina*), a deep ovary roof, a distinctive epidermis with radially elongate, potentially secretory cells in the furrows between the ovary ribs, and a synascidiate placental zone (Zizka and Schneider, 1999; Schneider et al., 2002, 2006; Matthews et al., 2012; Schneider and Zizka, 2012), most of them being potential synapomorphies.

#### 4.4.3 Relationships below the rank of tribe

Ochneae (former Ochnoideae) are a rather homogeneous group and the circumscription has been clear for a long time with the exception of the odd genus *Lophira*, which was included in Ochnaceae for the first time by Gilg (1893a, 1893b). This genus shares the non-distichous leaves and a two-carpelled, one-celled, many-ovuled ovary with Sauvagesieae (former Sauvagesioideae), whereas the lack of endosperm and unitegmic ovules agree with Ochneae. Here, the molecular data strongly support its inclusion in Ochneae, which in turn also corroborate the taxonomic importance of the endosperm character. Furthermore, the arguments used by Kanis (1968) for its inclusion in Sauvagesioideae (here Sauvagesieae) are weak because a two-carpelled ovary is not an exclusive feature of Sauvagesioideae/Sauvagesieae (see below) and the phyllotaxis is taxonomically problematic (Amaral, 1991). In the morphology-based cladistic analysis of Amaral (1991) without character weighting, *Lophira* formed a clade with *Elvasia* and *Perissocarpa*. However, such a relationship is most likely an artifact caused by homoplastic characters because after downweighting these characters (using the “weighting procedure” suggested by Farris, 1969) *Lophira* emerged as sister to the rest of the subfamily (Amaral, 1991). Although its inclusion in Ochneae is well-supported, the odd gynoeceium as described above and the fruit with the outer two sepals being extremely accrescent, wing-forming (the outermost sepal increasing by a factor 10-12, attaining a length of up to 13 cm) clearly separate *Lophira* from the rest of the tribe. Therefore, it seems appropriate to recognize subtribe Lophirinae, following Gilg (1893a), who was the first to suggest its formal separation from the remaining genera.

Besides former Ochneae (here Ochninae) and Lophireae (here Lophirinae), many of those who studied the family also recognized a third tribe, Elvasieae, within Ochnoideae (Engler, 1874; Gilg, 1893a; Dwyer, 1943; Kanis, 1968; Sastre and Lescure, 1978). Elvasieae were monotypic until Steyermark and Maguire (Steyermark, 1984) segregated the new genus *Perissocarpa*. Both are morphologically similar (Wallnöfer, 1998) and

differ from the rest of the family in a 2(-7)-celled ovary with a single ovule per cell and a globose, thin-walled, usually one-seeded indehiscent fruit that in *Elvasia* often possesses aerenchyma. In the present study, *Elvasia* (*Perissocarpa* was not included) is sister to the rest of Ochneae (without *Lophira*). Thus, combining morphological and molecular evidence and applying our criteria for recognizing subtribe Lophirinae, *Elvasia* and *Perissocarpa* are segregated as subtribe Elvasiinae.

The rest of Ochneae, namely Ochninae (= Ourateae sensu Engler, 1874; Farron, 1963), are monophyletic in the present study and differ from the remaining tribes by a five-parted perianth, gynobasic styles, almost free carpels that are postgenitally fused, and an accrescent and usually red receptacle that bears one to several black drupelets. Several authors proposed a further subdivision of former Ochneae – which correspond to our Ochninae – into subtribes Ochninae and Ourateinae (Farron, 1963, 1985; Kanis, 1968; Sastre, 1988; Sosef, 2008), the first comprising *Ochna* and *Brackenridgea*, the second *Campylospermum*, *Idertia*, *Ouratea* and *Rhabdophyllum*. *Ouratea* is clearly distinct from the rest in having free stipules, straight cotyledons, and generally caducous sepals (Sastre, 1988; Sosef, 2008). Additionally, it is the only Neotropical genus. The African genera of Ourateinae sensu Kanis (1968) all have stipules that are intrapetiolarly fused at the base, persistent sepals and curved cotyledons; *Idertia* is an exception in having straight cotyledons. All four genera of Ourateinae have 10 sessile to shortly stalked stamens with poricidal anthers. In contrast, the two genera of Ochninae generally have more than 10 stamens, and the anthers open by longitudinal slits or pores, but with the filaments well developed, attaining a length of at least one third the length of the anther. Sosef (2008), based on Farron's (1963) and his own observations, suggested that *Ouratea* and *Idertia* are the “basal” genera of Ourateinae, whereas *Rhabdophyllum* is nested in an paraphyletic *Campylospermum*. Although there are good morphological characters supporting the relationships outlined above, our molecular data do not support such relationships or classification. Here, *Campylospermum* is sister to the rest of Ochneae, *Brackenridgea* forms a clade with *Idertia*, and *Ochna* with *Rhabdophyllum*. This also contradicts the assumption that *Brackenridgea* is closely related to or even congeneric with *Gomphia* (= *Ouratea*) (van Tieghem, 1902; Ridley, 1922). However, several of the intergeneric relationships of Ochninae as circumscribed here require corroboration by additional data because the branch support, especially in the Maximum Likelihood analysis, is rather low. Additionally, the short branches suggest a rather recent diversification of the whole clade. For these reasons we decided not to recognize formal groups within subtribe Ochninae.

Sauvagesioideae in their traditional circumscription were generally subdivided into tribes Sauvagesieae (=Luxemburgieae sensu Gilg, 1893a) and the monogeneric Euthemideae (Kanis, 1968; Sastre, 1987). However, a segregation of *Euthemis* as a subtribe in our classification lacks support from morphological (Amaral, 1991) or molecular data (this



study), because *Euthemis* is embedded within Sauvagesieae. In the present study, *Euthemis* groups with *Schuermansiella*, *Schuermansia*, *Tyleria*, *Adenarake* and *Sauvagesia*. Thus, the five-carpelled, five-locular ovary and the baccate fruit with five usually one-seeded pyrenes that distinguish *Euthemis* from the rest are derived (autapomorphic) characters and there is no reason to infer a sister group relationship to the rest of Sauvagesieae. The grouping of *Euthemis* with *Schuermansiella* and *Schuermansia*, the only strictly SE Asian genera of Sauvagesieae, points to a common origin of that clade in this region. The pantropical *Sauvagesia* is the only other member of this subfamily with SE-Asian representatives, but it is polyphyletic according to our molecular data because the Asian *S. serrata* is sister to a clade composed by *Adenarake*, the rest of *Sauvagesia* spp., and three other genera. *Sauvagesia serrata* has been considered to represent a separate monotypic genus – *Neckia* – by Kanis (1968) and predecessors. Sastre (1970, 1971) included *Neckia*, the Neotropical genera *Lavradia* Vell. ex Vand., *Leitgebia* Eichler, *Pentaspattella* Gleason, and *Roraimanthus* Gleason and the African *Vausagesia* Baill. in *Sauvagesia*, considering it – i.e., *S. serrata* – the species with the highest number of putative ancestral characters. Subsequent classifications (Amaral, 1991, 2006) agreed with that of Sastre and also put two other monotypic E- to SE-Asian genera in synonymy of *Sauvagesia* (*Indovethia*, *Sinia*; not included in our molecular study). *Sauvagesia* s.l. (but not including *Adenarake*) is in many characters polymorphic, but has persistent stipules (deciduous in *S. nudicaulis* Maguire & Wurdack) with long marginal cilia, globose or ovoid seeds without wings, and the testa has a conspicuous pattern of flattened hexagonal cells. Now, with the phylogenetic relationships at hand, a critical revision of the broadly circumscribed *Sauvagesia* as established by Sastre (1971) and Amaral (1991, 2006) seems to be highly desirable.

A clade uniting *Cespedesia*, *Godoya*, *Krukoviella* and *Rhytidanthera* was also found in the morphological cladistic analysis of Amaral (1991; as sister group of *Testulea*). All of them are Neotropical and characterized by a scalariform tertiary leaf venation, long stipules that leave an elongate scar, five carpels, high numbers of ovules, sessile stigmas, a capsular fruit that dehisces from the base upwards, and long-winged seeds. *Godoya* and *Rhytidanthera* additionally share the unique club-shaped trichomes at the sepals. *Cespedesia* and *Krukoviella* both have comparatively short sepals, which from an early stage of flower development do not envelop the flower bud. All four genera were part of tribe Luxemburgiinae of Kanis (1968) and Sastre (1987), but in the present study Luxemburgieae form a different clade, only comprising the genera *Luxemburgia* and *Philacra*.

Our finding of a clade uniting *Poecilandra* and *Wallacea* confirms former phylogenetic hypotheses by Engler (1874) and Amaral (1991). Both genera share retuse to emarginate leaves with closely parallel secondary veins, many leaf traces, and anthers covered with wax crystals. These are potential synapomorphies although they occur in some other genera as well (Amaral 1991).

Some names of tribes and subtribes have yet to be validly published. Therefore, new names and diagnoses are provided below.

Elvasiinae Schneider, subtrib. nov., based on Elvasieae Engl. in Nova Acta Acad. Caes. Leop.-Carol. German. Nat. Cur. 37: 20. 1875. – Type: *Elvasia* DC.

Lophirinae Schneider, subtrib. nov., based on Lophireae Baill., Hist. Pl. 4: 210, 218. 1872. – Type: *Lophira* Banks ex C.F. Gaertn.

Ochninae Kanis ex Schneider, subtrib. nov. – Type: *Ochna* L.

Shrubs or trees; gynoecium almost apocarpous; style gynobasic; receptacle accrescent in fruit, red, bearing usually black drupelets.

Testuleeae Schneider, trib. nov. – Type: *Testulea* Pellegr.

Tree; perianth 4-parted; one fertile stamen, staminodes fused into a column; endosperm present.

#### 4.4.4 Character evolution

Polysymmetric, i.e. actinomorphic, flowers were supposed to be the ancestral condition in angiosperms from which monosymmetry (= zygomorphy) originated several times independently, and reversals from monosymmetric flowers to polysymmetric ones were considered rare (Stebbins, 1974; Cronquist, 1988; Takhtajan, 1991). More recent evidence from molecular phylogenies revealed that shifts between both states occurred in both directions in different lineages and that changes to polysymmetry are much more frequent than assumed earlier. Genetic and developmental factors rather favor transitions to polysymmetry (Donoghue et al., 1998). In asterids, for example, actinomorphic flowers were ancestral and zygomorphy arose several times independently. However, reversals to actinomorphic flowers were also frequent (Donoghue et al., 1998). This corresponds with the ancestral state reconstruction in Ochnaceae. Although the ancestral condition of the family is ambiguous, zygomorphic flowers are ancestral in Ochnoideae and actinomorphic flowers evolved secondarily in Sauvagesieae and Ochneae. These reversals are partially associated with a reduction in flower size (Amaral, 1991), a phenomenon known also from other angiosperm groups (Donoghue et al., 1998). In Ochnoideae two types of monosymmetry are distinguished, one that is present early in flower development and one that arises just at anthesis, a difference that may be due to a different evolutionary age and differential depth of rooting in the genetic system (Endress, 2011). Here, the presence of monosymmetry already early in bud is reconstructed as the state originating earlier in the evolution of Ochnoideae.



Floral monosymmetry is a means of precise positioning of the pollinators on the flower and generally leads to more efficient pollination and pollinator specificity (Sargent, 2004). Thus, zygomorphy might have a selective advantage. Most Ochnoideae, including all monosymmetric taxa except *Wallacea*, possess a specialized pollination system because of their poricidal anthers or poricidal system (see below). The pollinators are pollen-collecting bees capable of vibrational, i.e. buzz, foraging (Kubitzki and Amaral, 1991). However, this adaptation to buzz-pollination is independent of flower symmetry because it is present in actinomorphic and zygomorphic flowers. Nonetheless, the ancestral condition of Ochnoideae was a combination of monosymmetry and specialized pollination system that probably had been advantageous for the nectarless plants (see De Luca and Vallejo-Marín, 2013).

Poricidal anthers are ancestral in Ochnoideae and are widely distributed across the subfamily. In Ochneae, only *Ochna* (partial) and *Brackenridgea* show dehiscence by longitudinal slits. In Sauvagesieae, several genera exhibit dehiscence by longitudinal slits that either extend along the anther or are confined to the apical part. Especially interesting is the case of *Sauvagesia*, in which several species have anthers with longitudinal slits (e.g. former *Lavradia*), but the androecium is completely enveloped by petaloid staminodes that leave only a small apical pore for pollen transmission. In a similar way, the poricidal system is established in *Tyleria* and *Adenarake*: in the first, the staminodes are only basally fused but are stabilized by ventral keels, whereas in the latter, they are free but still constitute a poricidal superstructure (Kubitzki and Amaral, 1991). Thus, although anther opening reversed to longitudinal dehiscence in these taxa, buzz-pollination was maintained through the poricidal system, suggesting that there was a strong selective pressure on keeping this pollination type. Once buzz-pollination is established, plants will hardly be able to escape from this rigid pollination type (Kubitzki and Amaral, 1991).

The great majority of the core eudicots are syncarpous and secondary apocarpous arose only in few clades of rosids (e.g. Rosaceae, Sapindales, Malvales) and asterids (Apocynaceae) (Endress, 2011). Syncarpy is considered a key innovation and its evolutionary success is supposed to be linked with the novel intragynoecial compitum which allows an increased offspring quality and quantity (Armbruster et al., 2002). In spite of the overall benefits from syncarpy, Ochnaceae reveal two independent reversals to a near-apocarpous gynoecium (see Matthews et al., 2012), one in the MRCA of *Froesia* (Quiinoideae) and one in Ochninae. *Froesia* had long been considered apocarpous (e.g. Schneider and Zizka, 1997) and only recently it was detected that the carpels are united over a short zone at the base (Matthews et al., 2012). Ochninae had long been considered apocarpous too (e.g. Gilg, 1893a; but see Baum, 1951), but are syncarpous at the base of the ovary. In contrast to *Froesia*, in which the free parts remain free, these parts are united postgenitally in Ochninae (Matthews et al., 2012). Both groups



also differ strongly in their gynoecium structure. *Froesia* has three carpels that in fruit resemble a follicle with the fibrous pericarp characteristic of Quiinoideae (Schneider and Zizka, in press); it is doubtful, if a compitum is present (Matthews et al., 2012). Ochninae have a short compitum, bulging ovaries, variable carpel numbers (3-15) and carpels that develop into indehiscent drupelets. In spite of their structural differences, the independent reversal to apocarpny in both lineages might have been facilitated by a predisposition for variable and higher carpel numbers in the family (in Ochnoideae and Quiinoideae; see Fig. 4). According to Endress (2006), it is architecturally more difficult to allow an efficient compitum with more than five carpels. Hence, there is less constraint for carpel position in such multicarpellate gynoecia.

The presence versus absence of endosperm has long been used to subdivide Ochnaceae into subfamilial clades (e.g. Engler, 1874; Amaral, 1991). However, the presence of endosperm was reconstructed as plesiomorphic in Ochnaceae and thus it is not suitable for uniting taxa in Ochnoideae. In contrast, the early absorption of the endosperm is a derived state in Ochnaceae and confirms Engler's "Exalbuminosae". For Quiinoideae, in turn, the early absorption of endosperm was inferred as the ancestral state. Thus, the reversal to endosperm unites *Touroulia* and *Lacunaria*. The number of ovules varies between one and up to 200. High ovule numbers were reconstructed as the ancestral condition in Ochnoideae, whereas a single ovule is derived and unites Ochninae and Elvasiinae.

Seeds with wings and, thus, wind-dispersal are ancestral in Ochnoideae and Ochnaceae (however, it is unclear if the wings of *Medusagyne* are homologous to those of Ochnoideae). Winged seeds are therefore not suited for grouping the early branching taxa. Within Sauvagesieae, the loss of wings occurred independently in *Blastemanthus*, *Wallacea*, *Euthemis*, and in the clade of *Adenarake* and *Sauvagesia*. The loss of wings in *Blastemanthus* and *Wallacea* is probably related to their occurrence in inundated forests with the fruits being adapted to hydrochory. In *Euthemis*, the loss is coupled with the evolution of indehiscent fruits and the different dispersal mode. The same is true for unwinged seeds of Ochnaceae.



## 4.5 Conclusion

Our molecular data provide for the first time a robust phylogenetic framework for the evaluation of previous phylogenetic assumptions and a modern classification of Ochnaceae s.l. Ochnaceae comprise the subfamilies Ochnoideae Burnett, Quiinoideae Luer., and Medusagynoideae Reveal. The long-standing subdivision of Ochnoideae into Ochneae and Sauvagesieae (=Ochnoideae and Sauvagesioideae in traditional classifications) was basically confirmed, except that the latter is paraphyletic in its traditional circumscription due to the position of *Testulea* as sister to the rest of Ochnaceae. To avoid paraphyly, we segregate here tribes Luxemburgieae (*Luxemburgia*, *Philacra*) and Testuleae (*Testulea*) and redefine the circumscription of Sauvagesieae. Within the Ochneae, we corroborated the inclusion of *Lophira*, thus recognizing the subtribes Ochninae (*Brackenridgea*, *Campylospermum*, *Idertia*, *Ochna*, *Ouratea*, *Rhabdophyllum*), Elvasiinae (*Elvasia*, *Perissocarpa*), and Lophirinae (*Lophira*). Ochninae comprise all six genera which had formerly been partitioned between Ochninae and Ourateinae, a concept that could not be confirmed in the present study. In contrast to previous classifications, Sauvagesieae (*Adenarake*, *Blastemanthus*, *Cespedesia*, *Euthemis*, *Fleurydora*, *Godoya*, *Indosinia*, *Krukoviella*, *Poecilandra*, *Rhytidanthera*, *Sauvagesia*, *Schuermansia*, *Schuermansiella*, *Tyleria*, *Wallacea*) are not further subdivided here. Especially the circumscription of *Sauvagesia* and the unclear subdivision of and relationships within Ochninae require further investigation using additional molecular data and/or a more comprehensive taxon sampling. Ancestral state reconstructions confirmed the taxonomic value of most characters used in previous classification for defining major clades. However, some states previously considered synapomorphic turned out to be plesiomorphic (e.g. zygomorphic flowers for Sauvagesieae). It was shown that zygomorphic flowers, poricidal anthers, a syncarpous gynoecium, numerous ovules, septicidal capsules, and winged seeds with endosperm are the ancestral condition in Ochnoideae. It is noteworthy that although poricidal anthers reversed to longicidal in several lineages, buzz-pollination was maintained by the evolution of poricidal superstructures, indicating a strong selective pressure on keeping that specialized pollination system. Now that a molecular framework is available, we are looking forward to resolving also pending issues such as the timing of the diversification process and the reconstruction of the complex biogeographic history of Ochnaceae.

**Note:** For acknowledgements see Schneider et al 2014. *Molecular Phylogenetics and Evolution* 78:199-214.



## 4.6 Supplementary data

**Table S1.** Character state coding for eight morphological characters: flower symmetry (FS; 0 = actinomorphic, 1 = zygomorphic at anthesis, 2 = zygomorphic already in bud); endosperm (EN; 0 = present, 1 = absent); seed wings (SW; 0 = wanting, 1 = present, 2 = present, but not homologous); anther dehiscence (AD; 0 = by longitudinal slits, 1 = longitudinal slits confined to apical part, 2 = poricidal); gynoeceium (GY; 0 = syncarpous, 1 = near-apocarpous); carpel number (CN; 0 = 5 carpels, 1 = 3 carpels, 2 = 2 carpels, 3 = > 5 carpels); ovule number (OV; 0 = 2 ovules, 1 = 1 ovule, 2 = 4-50 ovules, 3 = 100-200 ovules); fruit type (FT; 0 = capsule, 1 = baccate, 2 = follicle-like, 3 = nut-like/samaroid, 4 = drupaceous).

Taxon	FS	EN	SW	AD	GY	CN	OV	FT
Ochnoideae								
<i>Adenarake muriculata</i>	0	0	0	1	0	1	2	0
<i>Blastemanthus sprucei</i>	1	0	0	2	0	1	2	0
<i>Brackenridgea palustris</i>	0	1	0	0	1	013	1	4
<i>Brackenridgea zanguearica</i>	0	1	0	0	1	013	1	4
<i>Campylospermum duparquetianum</i>	0	1	0	2	1	0	1	4
<i>Campylospermum dybovskii</i>	0	1	0	2	1	0	1	4
<i>Campylospermum excavatum</i>	0	1	0	2	1	0	1	4
<i>Campylospermum flavum</i>	0	1	0	2	1	0	1	4
<i>Campylospermum gabonensis</i>	0	1	0	2	1	0	1	4
<i>Campylospermum glaucifolium</i>	0	1	0	2	1	0	1	4
<i>Campylospermum glaucum</i>	0	1	0	2	1	0	1	4
<i>Campylospermum glomeratum</i>	0	1	0	2	1	0	1	4
<i>Campylospermum klainei</i>	0	1	0	2	1	0	1	4
<i>Campylospermum laeve</i>	0	1	0	2	1	0	1	4
<i>Campylospermum laxiflorum</i>	0	1	0	2	1	0	1	4
<i>Campylospermum louisii</i>	0	1	0	2	1	0	1	4
<i>Campylospermum oliveranum</i>	0	1	0	2	1	0	1	4
<i>Campylospermum schoenleinianum</i>	0	1	0	2	1	0	1	4
<i>Campylospermum spec.</i>	0	1	0	2	1	0	1	4
<i>Campylospermum strictum</i>	0	1	0	2	1	0	1	4
<i>Campylospermum umbricola</i>	0	1	0	2	1	0	1	4
<i>Cespedesia spathulata</i>	1	0	1	2	0	0	3	0
<i>Elvasia calophyllea</i>	0	1	0	2	0	0	1	3
<i>Elvasia capixaba</i>	0	1	0	2	0	2	1	3
<i>Elvasia elvasioides</i>	0	1	0	2	0	2	1	3
<i>Euthemis leucocarpa</i>	0	0	0	2	0	0	0	4
<i>Euthemis minor</i>	0	0	0	2	0	0	0	4
<i>Fleurydora felicis</i>	1	0	1	2	0	0	2	0
<i>Godoya obovata</i>	1	0	1	2	0	0	3	0
<i>Idertia axillaris</i>	0	1	0	2	1	03	1	4
<i>Idertia morsonii</i>	0	1	0	2	1	03	1	4
<i>Krukoviella disticha</i>	1	0	1	2	0	0	3	0
<i>Lophira alata</i>	0	1	0	2	0	2	2	3
<i>Lophira lanceolata</i>	0	1	0	2	0	2	2	3
<i>Luxemburgia ciliosa</i>	2	0	1	2	0	1	2	0
<i>Luxemburgia damazioana</i>	2	0	1	2	0	1	2	0



<i>Luxemburgia schwackeana</i>	2	0	1	2	0	1	2	0
<i>Ochna afzelii</i>	0	1	0	02	1	013	1	4
<i>Ochna integerrima</i>	0	1	0	02	1	013	1	4
<i>Ochna macrantha</i>	0	1	0	02	1	013	1	4
<i>Ochna membranacea</i>	0	1	0	02	1	013	1	4
<i>Ochna mossambicensis</i>	0	1	0	02	1	013	1	4
<i>Ochna multiflora</i>	0	1	0	02	1	013	1	4
<i>Ochna natalitia</i>	0	1	0	02	1	013	1	4
<i>Ochna polycarpa</i>	0	1	0	02	1	013	1	4
<i>Ochna serrulata</i>	0	1	0	02	1	013	1	4
<i>Ouratea erecta</i>	0	1	0	2	1	03	1	4
<i>Ouratea lucens</i>	0	1	0	2	1	03	1	4
<i>Ouratea polyantha</i>	0	1	0	2	1	03	1	4
<i>Ouratea schomburgkii</i>	0	1	0	2	1	03	1	4
<i>Ouratea scottii</i>	0	1	0	2	1	03	1	4
<i>Ouratea spec.</i>	0	1	0	2	1	0	1	4
<i>Ouratea striata</i>	0	1	0	2	1	03	1	4
<i>Ouratea vaccinioides</i>	0	1	0	2	1	03	1	4
<i>Philacra auriculata</i>	2	0	1	2	0	1	2	0
<i>Poecilandra retusa</i>	1	0	1	2	0	1	2	0
<i>Rhabdophyllum arnoldianum</i>	0	1	0	2	1	0	1	4
<i>Rhabdophyllum calophyllum</i>	0	1	0	2	1	0	1	4
<i>Rhabdophyllum letestui</i>	0	1	0	2	1	0	1	4
<i>Rhytidanthera splendens</i>	1	0	1	2	0	0	3	0
<i>Sauvagesia erecta</i>	0	0	0	02	0	1	2	0
<i>Sauvagesia fruticosa</i>	0	0	0	02	0	1	2	0
<i>Sauvagesia serrata</i>	0	0	0	02	0	1	2	0
<i>Sauvagesia tafelbergensis</i>	0	0	0	02	0	1	2	0
<i>Schuermansia elegans</i>	0	0	1	1	0	1	2	0
<i>Schuermansiella angustifolia</i>	0	0	1	1	0	1	2	0
<i>Testulea gabonensis</i>	2	0	1	2	0	2	3	0
<i>Tyleria silvana</i>	0	0	1	02	0	1	2	0
<i>Wallacea insignis</i>	1	0	0	0	0	12	2	0
Medusagynoideae								
<i>Medusagyne oppositifolia</i>	0	0	2	0	0	3	0	0
Quiinoideae								
<i>Froesia diffusa</i>	0	1	0	0	1	1	0	2
<i>Froesia venezuelensis</i>	0	1	0	0	1	1	0	2
<i>Lacunaria macrostachya</i>	0	0	0	0	0	3	0	1
<i>Lacunaria oppositifolia</i>	0	0	0	0	0	0	0	1
<i>Quiina amazonica</i>	0	1	0	0	0	2	0	1
<i>Quiina pteridophylla</i>	0	1	0	0	0	2	0	1
<i>Quiina tinifolia</i>	0	1	0	0	0	2	0	1
<i>Touroulia guianensis</i>	0	0	0	0	0	3	0	1



**Table S1.** Bayesian posterior probabilities for reconstructed states of selected morphological characters at internal nodes (see Figure 4 for node numbers) of the Ochnaceae phylogeny inferred using Bayesian (MCMC) inference. Posterior probabilities were averaged across 3 independent runs, and PP values < 0.7 and marked with an asterisk received strong support from Bayes Factor test (BF > 5). Flower symmetry (FS; 0 = actinomorphic, 1 = zygomorphic at anthesis, 2 = zygomorphic already in bud); endosperm (EN; 0 = present, 1 = absent); seed wings (SW; 0 = wanting, 1 = present, 2 = present, but not homologous); anther dehiscence (AD; 0 = by longitudinal slits, 1 = longitudinal slits confined to apical part, 2 = poricidal); gynoeceium (GY; 0 = syncarpous, 1 = near-apocarpous); carpel number (CN; 0 = 5 carpels, 1 = 3 carpels, 2 = 2 carpels, 3 = > 5 carpels); ovule number (OV; 0 = 2 ovules, 1 = 1 ovule, 2 = 4-50 ovules, 3 = 100-200 ovules); fruit type (FT; 0 = capsule, 1 = baccate, 2 = follicle-like, 3 = nut-like/samaroid, 4 = drupaceous).

Node	FS		EN		SW		AD		GY		CN		OV			FT											
	0	1	2	0	1	0	1	2	0	1	2	0	1	2	3	0	1	2	3	4							
1	0.27	0.33	0.40	0.76	0.24	0.01	0.09	0.90	0.70	0.03	0.27	0.99	0.01	0.13	0.05	0.25	0.57	0.85	0.00	0.11	0.04	0.67	0.12	0.16	0.04	0.01	
2	0.99	0.00	0.00	0.14	0.86	0.98	0.01	0.01	1.00	0.00	0.00	0.66*	0.34	0.08	0.22	0.32	0.38	1.00	0.00	0.00	0.00	0.00	0.00	0.47	0.51	0.01	0.00
3	0.09	0.33	0.57	0.80	0.20	0.02	0.84	0.14	0.04	0.04	0.91	0.98	0.02	0.39	0.09	0.37	0.15	0.04	0.02	0.71	0.23	0.84	0.03	0.04	0.08	0.01	0.00
4	0.00	0.02	0.98	0.85	0.15	0.00	0.96	0.04	0.01	0.01	0.97	1.00	0.00	0.02	0.94	0.02	0.02	0.00	0.00	0.99	0.00	0.98	0.01	0.01	0.01	0.01	0.00
5	0.15	0.45	0.40	0.70	0.30	0.03	0.88	0.09	0.01	0.01	0.98	0.99	0.01	0.56	0.16	0.19	0.09	0.01	0.01	0.95	0.03	0.75	0.02	0.03	0.17	0.02	0.00
6	0.00	1.00	0.00	1.00	0.00	0.01	0.98	0.02	0.00	0.00	0.99	1.00	0.00	0.81	0.14	0.03	0.03	0.01	0.00	0.87	0.12	1.00	0.00	0.00	0.00	0.00	0.00
7	0.98	0.01	0.01	0.99	0.01	0.05	0.86	0.09	0.22	0.35	0.43	1.00	0.00	0.02	0.95	0.02	0.02	0.00	0.00	0.99	0.00	0.98	0.01	0.01	0.01	0.01	0.00
8	0.17	0.75	0.08	0.41	0.59	0.07	0.79	0.14	0.01	0.01	0.98	0.98	0.02	0.69	0.04	0.22	0.06	0.01	0.05	0.89	0.05	0.43	0.03	0.05	0.42	0.07	0.00
9	0.97	0.02	0.01	0.01	0.99	0.92	0.04	0.04	0.01	0.01	0.97	0.89	0.11	0.47	0.02	0.44	0.08	0.03	0.33	0.59*	0.04	0.01	0.01	0.02	0.80	0.16	0.00
10	1.00	0.00	0.00	0.00	1.00	0.99	0.00	0.00	0.00	0.00	1.00	0.45	0.55	0.84	0.00	0.15	0.01	0.00	1.00	0.00	0.00	0.01	0.01	0.01	0.51	0.46	0.00
11	1.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00



# Chapter 5

## Phylogeny of the Ochnaceae, with emphasis on the subtribe Ochninae, based on three plastid DNA regions

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## Abstract

Ochnaceae is a pantropical family in the order Malpighiales. A recently published molecular phylogeny of the Ochnaceae identified three subfamilies, viz. Medusagynoideae, Quiinoideae and Ochnoideae. Clades within the latter were classified at tribal and subtribal level. The palaeotropical genus *Campylospermum* is placed in the tribe Ochneae, subtribe Ochninae, together with the genera *Brackenridgea*, *Idertia*, *Ochna*, *Ouratea*, and *Rhabdophyllum*. We reconstructed the phylogenetic relationships of the family using three chloroplast markers (*matK*, *rbcl*, *trnLF*) with intensified taxon sampling for the Ochninae, so as to focus on the relationships within this subtribe with special emphasis on the genus *Campylospermum*. Our maximum likelihood and Bayesian analyses corroborate the phylogenetic backbone previously recognized while two clades could be distinguished within the genus *Campylospermum*. The first comprises the West/Central African *Campylospermum* species while the second includes the West/Central African *C. elongatum* and all East African and Malagasy species. The latter clade is retrieved as sister to *Idertia* in both analyses. In general, however, phylogenetic relationships within the Ochninae are poorly supported, which points to the need of additional data to further resolve relationships within Ochnaceae in general and Ochninae in particular.

**Keywords:** Africa, biogeography, *Campylospermum*, chloroplast markers, Madagascar, Ochnaceae, Ochninae, Ochnoideae, phylogeny, rain forest.

## 5.1 Introduction

Ochnaceae is a family of trees, shrubs or rarely herbs (species of *Sauvagesia* L.) widely distributed in tropical and subtropical forests and savannas of the Old and New World. The family contains about 500 species in 27 genera (Amaral 1991; Amaral and Bittrich 2014). The Neotropics comprise the highest number of species: about 300-350 in 15 genera. In Africa, including Madagascar, 150 species and nine genera occur while the lowest diversity is observed in South-East Asia, hosting 20 species in eight genera (Kanis 1968; Sastre 2003; Verdcourt 2005; Amaral and Bittrich 2014).

Ochnaceae have adaptations for buzz-pollination, notably the long, apically poricidal anthers (Kubitzki and Amaral 1991; Matthews et al. 2012), which also act as a synapomorphy for the Ochnoideae (Schneider et al. 2014). Ochnaceae are characterised by filaments that are abruptly narrowed where they attach to the anthers, the branching of the ovule bundle into the (outer) integument from the raphe (Matthews et al. 2012), and the densely spaced parallel secondary veins and the tertiary veins perpendicular to these (Amaral and Bittrich 2014). Flowers are actinomorphic or zygomorphic, and are basically pentamerous even though the number of sepals, petals and stamens is not constant within the family (Matthews et al. 2012; Amaral and Bittrich 2014). Bayesian ancestral state reconstructions showed that zygomorphic flowers are ancestral in Ochnoideae and actinomorphic flowers evolved secondarily in Sauvagesieae and Ochneae (Schneider et al. 2014). Several genera have winged seeds, which are probably wind-dispersed (Amaral and Bittrich 2014). Winged seeds with endosperm are a synapomorphy of the Ochnoideae and Ochnaceae (Schneider et al. 2014).

Molecular phylogenetic studies within the Malpighiales often recognized the current subfamilies as families, placed the Ochnaceae (now Ochnoideae Burnett) as sister to both the Medusagynaceae (now Medusagynoideae Reveal), a monotypic family from the Seychelles (Dickison 1990; Fay et al. 1997), and Quiinaceae (now Quiinoideae Luer), a tropical American family. The three groups form a distinctive clade (Nandi et al. 1998; Savolainen, Chase, et al. 2000; Davis et al. 2005; Schneider et al. 2006; Korotkova et al. 2009; Soltis et al. 2011). Recently, the first comprehensive molecular phylogeny of Ochnaceae was inferred from combined plastid loci (*matK*, *ndhF*, *rbcl*, *trnLF*) and nuclear ribosomal sequences (ITS1, 5.8S, ITS2) (Schneider et al. 2014). This study presented a new subfamilial and tribal classification for the family, directed by the recognition of monophyletic groups. The Ochnoideae were divided into four tribes (Luxemburgieae, Ochneae, Sauvagesieae and Testuleeae), the Ochneae contain three subtribes (Elvasiinae, Lophirinae and Ochninae). Some of the formal and informal pre-molecular classifications before the advent of phylogenetics, for instance those of Engler (1874) and Gilg (1893), recognized a main division of Ochnaceae into the Albuminosae (presence of endosperm) and Exalbuminosae (absence of endosperm). Schneider

et al. (2014), found that the presence of endosperm is a shared derived character for Ochneae, but in the larger context of the family is a homoplasious character.

The subtribe Ochninae (Schneider et al. 2014) is the most species-rich clade of the family. It comprises the genera *Brackenridgea* A.Gray (c. 9 spp.), *Campylospermum* Tiegh. (c. 55 spp.), *Idertia* Farron (1 spp.), *Ochna* L. (c. 80 spp.), *Ouratea* Aubl. (c. 200 spp.) and *Rhabdophyllum* Tiegh. (8 spp.) (chapter 2 and 3). Previous classifications grouped the African genera *Campylospermum*, *Idertia*, *Rhabdophyllum* and the Neotropical genus *Ouratea* into the subtribe Ourateinae while *Brackenridgea* and *Ochna* were grouped into Ochninae, all sensu Kanis (1968). The latter two genera have even been treated as synonyms, for example by Bamps & Farron (1967). While the Ourateinae have ten sessile to shortly stalked stamens with poricidal anthers, the Ochninae generally have more than ten stamens, anthers that open by longitudinal slits or pores, and filaments attaining a length of at least one third the length of the anthers. The phylogeny presented by Schneider et al. (2014) demonstrated that both subtribes as historically delimited are non-monophyletic, and retrieved *Idertia* as sister to *Brackenridgea* with maximum support from Bayesian analyses (Schneider et al. 2014). Species of *Idertia* have cotyledons that are similar in size, straight and accumbent (cotyledons lying edgewise to the radicle), which are regarded as 'primitive' features (Farron 1985) and shares these features with the Neotropical genus *Ouratea*. *Idertia* is also distinct from other African Ochninae by the few, straight secondary nerves and the setose leaf margin (Sosef 2013). Actually, within Ochneae, Schneider et al. (2014) retrieve *Campylospermum* as a clade sister to the rest of Ochneae while *Rhabdophyllum* forms a clade with *Ochna*.

Species of *Campylospermum* are trees or treelets with various architecture, and have been subject to recent taxonomic revision (Bissiengou et al. 2013). Before that, the genus was taxonomically studied in detail by Farron (1985) who subdivided it into six sections: *Bisetaria* (Tiegh.) Farron, *Cercanthemum* (Tiegh.) Farron, *Campylospermum* Tiegh., *Diphyllopodium* (Tiegh.) Farron, *Notocampylum* (Tiegh.) Farron and *Monelasmum* (Tiegh.) Farron. He mainly used characters of the cotyledons and embryo as well as those related to the position of the inflorescence to distinguish between these sections. In the genus *Campylospermum* cotyledons can be either of similar size and incumbent (sections *Notocampylum* and *Diphyllopodium*) or accumbent (sections *Campylospermum* and *Cercanthemum*), or dissimilar in size and incumbent (section *Monelasmum*). The monotypic section *Bisetaria* is characterized by unique features of the leaf and stipules. These sectional names were based on genera already established by (Van Tieghem 1902b, d, c). On the basis of the cotyledon characters, Farron (1985) suggested that the more derived species tend to have heterocotyledonous seeds (*Rhabdophyllum*, *Campylospermum* section *Monelasmum*) while the ancestral state would be isocotyledonous. The Malagasy species were not included in this sectional delimitation, which was only restricted to the continental Africa. The cotyledons of

Malagasy species are similar in size and accumbent (Perrier de la Bâthie 1941, 1951), characters corresponding to the sections *Campylospermum* and *Cercanthemum*.

East African or Malagasy *Campylospermum* species are absent in the phylogeny produced by Schneider et al. (2014). Inclusion of these species would be pivotal for explaining their ecological preference for humid forests, similar to that of the West/Central African representatives. During the Eocene African rain forests occupied a continuous surface extending from west to east coast (Burgess et al. 1998; Burgess et al. 2007), which explains the floristic affinities between the East and West/Central African regions (White 1979; Burgess and Clarke 2000), and phylogenetic patterns within *Campylospermum* could corroborate those found in other groups (Lovett and Wasser 1993; Jacobs 2004; Couvreur et al. 2008). Furthermore, the Malagasy species are still in desperate need of a taxonomic revision. The last revisions were those from Perrier de la Bâthie (1941, 1951) and we are almost sure that several undescribed species lie hidden amongst the herbarium collections. But, before someone can embark on a taxonomic revision of the Malagasy *Campylospermum* species, it seems best to first infer the phylogenetic relationships within the subtribe Ochninae, to test whether the genera as delimited at present are monophyletic.

This study presents the phylogeny of Ochnaceae including an intensified sampling within the subtribe Ochninae with special emphasis on the East African and Malagasy species of *Campylospermum*. We aim at:

- (1) conducting a molecular phylogenetic study of the Ochnaceae based on chloroplast markers (*matK*, *rbcl*, *trnLF*) in order to investigate whether the previous phylogeny based on combined chloroplast and nuclear gene regions can be confirmed,
- (2) assessing whether *Campylospermum* is monophyletic, and whether or not the previously proposed sectional subdivision can be corroborated by our phylogeny.

## 5.2 Materials and Methods

### 5.2.1 Taxon sampling

Voucher information for all accessions is provided in Table 1. Representatives of all currently recognized subfamilies Medusagynoideae, Quiinoideae and Ochnoideae were included in the study. DNA material of all genera of Ochnaceae, except *Indosinia*, *Perissocarpa*, and *Rhytidanthera*, was obtained. In total, 28 out of about 55 *Campylospermum* species occurring in Africa and Madagascar were sampled. These include 20 West/Central African, four East African and four Malagasy species. Two species of Malpighiaceae, *Heteropterys chrysophylla* (Lam.) Kunth and *Acridocarpus longifolius* (G. Don.) Hook. f., were selected to serve as outgroups.

**Table 1.** Taxon list with information on herbarium vouchers (herbarium acronym), geographic location and GenBank accession numbers for three DNA regions. Data from additional accessions used in composite taxa are in parentheses; for cultivated material from Botanic Gardens (BG), the garden accession numbers are given.

Taxon	Voucher	Locality	matK	rbcl	trnLF
<b>Outgroups</b>					
<i>Acridocarpus longifolius</i> (G. Don) Hook. f.	Bissiangou 1460 (WAG)	Gabon: Ngounie	KP196832		KP196882
<i>Heteropterys chrysophylla</i> Kunth	Genbank		HQ247289.1	HQ247500.1	AY947403.1
<b>Quinaeaceae</b>					
<i>Froesia diffusa</i> Gereau & Vásquez	Villa & Alvía 256 (MA)	Ecuador: Río Tiputini	KF263287	KF263409	KF263479
<i>Lacunaria macrostachya</i> (Tul.) A.C. Sm.	Zárate 16751 (HH)	Peru: Iquitos	KF263232	KF263346	KF263420
<i>Lacunaria oppositifolia</i> (Pires) Pires	Schneider 11 (FR)	Venezuela: La Esmeralda	KF263289	KF263411	KF263481
<i>Touroullia guianensis</i> Aubl.	Prévost et al. 4595 (FR)	French Guiana: Montagnes Plomb	KF263281	KF263403	KF263472
<i>Quiina amazonica</i> A.C. Sm.	Zárate 16753 (HH)	Peru: Iquitos	KF263233	KF263347	KF263421
<b>Medusagynaceae</b>					
<i>Medusagyne oppositifolia</i> Baker	RBGE 20030393 (ITS, <i>ndhF</i> ); GenBank ( <i>matK</i> , <i>rbcl</i> , <i>trnL-F</i> )	Seychelles	JX661953	JX664059	AY763244/ AY763259
<b>Ochnaceae</b>					
<i>Adenarake muriculata</i> Maguire & Wurdack	Maguire et al. 60447 (NY) (Kew DNA bank # 3146)	Brazil: Serra da Neblina	KF263231	KF263345	KF263419
<i>Blastemanthus sprucei</i> Tiegh.	Amaral s.n (Kew DNA bank # 2987)	Brazil	KF263229	KF263343	KF263416
<i>Brackenridgea arenaria</i> (De Wild. & T. Durand) N. Robson	Leteinturier 253 (BR)	Zambia: Chibuli Hill	KP196833		KP196883
<i>Brackenridgea arenaria</i> (De Wild. & T. Durand) N. Robson	Bingham MG 8564 (WAG)	Zambia, Southern Mazabuka district, Mbuyu Farm	KP196834	KP196855	KP196884
<i>Brackenridgea zanguibarica</i> Oliv.	Schultka K147 (FR) ( <i>rbcl</i> : Reitsma 225 [WAG])	Kenya: Coast	KF263290	KF263389	KF263482

<i>CampylospERMUM ampletens</i> (Stapf) Farron	Jongking 6043	Liberia: Grand Cape Mount	KP196856	KP196885
<i>CampylospERMUM anceps</i> (Baker) H. Perrier	Hoffmann 277 (WAG)	Madagascar: Fianarantsoa	KP196857	KP196886
<i>CampylospERMUM auriculatum</i> Biss.	Bissiengou 667 (WAG)	Gabon: Woleu-Ntem	KP196858	KP196887
<i>CampylospERMUM calanthum</i> (Gilg) Farron	Bissiengou 1384 (WAG)	Gabon: Ngounié	KP196835	KP196888
<i>CampylospERMUM congestum</i> (Oliv.) Farron	Jongking 9158 (WAG)	Liberia: Grand Gedeh	KP196837	KP196889
<i>CampylospERMUM costatum</i> (Tiegh.) Biss	Bissiengou 831 (WAG)	Gabon: Ogooué-Lolo	KP196838	KP196890
<i>CampylospERMUM dependens</i> (DC.) H. Perrier	Andrianarisata 32 (G)	Madagascar: Antsiranana	KP196839	KP196891
<i>CampylospERMUM dybovskii</i> Tiegh.	Wieringa 5455 (WAG)	Gabon: Cap Esterias	KF263253	KF263444
<i>CampylospERMUM elongatum</i> (Oliv.) Tiegh.	Bissiengou 514AT (WAG)	Gabon: Nyanga	KP196840	KP196860
<i>CampylospERMUM engama</i> (De Wild.) Farron	Bissiengou 912 (WAG)	Gabon: Haut-ogououé	KP196841	KP196892
<i>CampylospERMUM gabonensis</i> Biss	Bissiengou 627 (WAG)	Gabon: Ngounié	KF263273	KF263464
<i>CampylospERMUM glaucifolium</i> Biss.	Bissiengou 1326 (WAG)	Congo (Brazzaville): Niari	KP196842	KP196893
<i>CampylospERMUM glomeratum</i> (Tiegh.) Biss	Bissiengou 1008 (WAG)	Gabon: Lopé	KF263261	KF263454
<i>CampylospERMUM klainei</i> (Tiegh.) Farron	Bissiengou 1299 (WAG)	Gabon: Libreville	KF263270	KF263463
<i>CampylospERMUM lanceolatum</i> (Baker) H. Perrier	Rakotonandrasana 371	Madagascar: Toamasina		KP196894
<i>CampylospERMUM laxiflorum</i> (De Wild. & T. Durand) Tiegh.	Wieringa 6156 (WAG)	Gabon: Ogooué-Lolo	KF263254	KF263445
<i>CampylospERMUM lecomtei</i> (Tiegh.) Farron	Dechamps 13205 (WAG)	Republic of the Congo: Kouilou	KP196861	KP196895
<i>CampylospERMUM longestipulatum</i> (De Wild.) Biss.	Bissiengou 1215 (WAG)	Cameroon: South province	KP196843	KP196896
<i>CampylospERMUM louisii</i> Biss & Sosef	Bissiengou 1154 (WAG)	Gabon: Ogooué-Ivindo	KF263264	KF263457
<i>CampylospERMUM lutambensis</i> (Sleumer) Biss.	Eggeling 6416 (BR)	Tanzania: Lindi	KP196862	KP196897
<i>CampylospERMUM obtusifolium</i> (Lam.) Tiegh.	Hoffmann 206 (G)	Madagascar: Toliara		KP196898
<i>CampylospERMUM plicatum</i> (Tiegh.) Biss.	Sosef 2744 (WAG)	Gabon: Estuaire	KF263245	KF263435
<i>CampylospERMUM reticulatum</i> (P.Beauv.) Farron	Bissiengou 697 (WAG)	Gabon: Woleu-Ntem		
<i>CampylospERMUM sacleuxii</i> Farron	Mhoro UMBCP409 (BR)	Tanzania: Morogoro		KP196899
<i>CampylospERMUM scheffleri</i> Farron	Luke 7907 (BR)	Tanzania: Udzungwa Mountain National Park		KP196900

Campylospermum schoenleinianum (Klotzsch) Farron	Jongkind et al. 8077 (WAG)	Guinea: Nimba Mountains	KF263260	KF263381	KF263453
Campylospermum vogelii (Hook. f.) Farron	Bissiegou 1404 (WAG)	Gabon: Ngounié	KP196845		KP196901
Campylospermum warneckeii (Gilg ex Engl.) Biss.	Vollesen MRC4458 (BR)	Tanzania: Morogoro	EF135518.1	KP196863	KP196902
Cespedesia bonplandii Goudot	Genbank			AJ420168.1	
Elvasia calophyllea DC.	Amaral s.n. (Kew DNA bank #2986)	Brazil	KF263228	KF263342	KF263415
Elvasia elvasioides (Planch.) Gilg	Hurtado 136 (MO)	Costa Rica: Corcovado		KF263350	KF263424
Elvasia essequiubensis Eng.	Kramer 3315 (L)	Suriname: Tafelberg		KP196864	KP196903
Elvasia macrostipularis Sastre & Lescure	Mori 25388	Brazil: Cruzeiro do Sul		KP196865	KP196904
Euthemis leucocarpa Jack	Djungai 028 (K) (Kew DNA bank #21769)	Brunei: Burkit Teraja	KF263227	KF263341	KF263414
Euthemis minor Jack	Beaman 8418 (L)	Malaysia: Sabah	KF263235	KF263351	
Fleurydora felicis A. Chev.	Farron s.n. (WAG)	Guinea: Kindia		KF263401	KF263470
Godoya obovata Ruiz & Pav.	Weigend et al. 5695 (MO)	Peru: Monobamba	KF263236	KF263352	KF263425
Idertia axillaris (Oliv.) Farron	Bissiegou 1291 (WAG)	Cameroon: Mafoko-Kindongi	KF263269	KF263391	KF263462
Idertia axillaris (Oliv.) Farron	Jongkind et al. 6618 (WAG)	Liberia: Geeblo Town	KF263276	KF263397	KF263466
Krukoviella disticha (Tiegh.) Dwyer	Neill et al. 15849 (MO)	Ecuador: Cordillera del Condor	KF263250	KF263368	KF263441
Lophira alata Banks ex C.F. Gaertn.	RBGE 20110701A (matk: Bissiegou 1409 [WAG])	Gabon: Ngounié	KF263272	KF263367	KF263437
Lophira lanceolata Tiegh. ex Keay	GenBank (ITS: Schmidt et al. 1902 [FR])	Ghana	FJ670029	FJ670172	
Luxemburgia ciliosa (Mart.) Planch.	Arbo et al. 4114 (Kew DNA bank #2326) (matk: Irwin et al. 20041 [LJ])	Brazil (Brazil: Serra do Cipó)	KF263256	KF263404	KF263473
Luxemburgia damazioana Beauverd	Feres et al. 98/37 (MO)	Brazil: Serra do Cipo	KF263237	KF263353	KF263426



<i>Luxemburgia polyandra</i> A. St.-Hil.	Irwin et al. 22844 (L)	Brazil: Espinhaco	KP196867	KP196905
<i>Ochna afzelii</i> R. Br. ex Oliv.	Mwangoka et al. 4849 (MO)	Tanzania: Ntakata	KF263238	KF263427
<i>Ochna atropurpurea</i> DC.	Stoffers 450 (WAG)	Netherlands Antilles: Curacao	KP196846	KP196906
<i>Ochna holstii</i> Engl.	Hafashimana 662 (WAG)	Uganda: Bushenyi	KP196869	KP196907
<i>Ochna membranacea</i> Oliv.	Jongkind et al. 9584 (WAG)	Liberia: Nimba	KF263278	KF263468
<i>Ochna multiflora</i> DC.	Schneider 3077 (LZ)	BG Leipzig	KF263284	KF263475
<i>Ochna natalitia</i> (Meisn.) Walp.	RBGE 19490083B	RBG Edinburgh	KF263246	KF263436
<i>Ochna puberula</i> N. Robson	Nkhoma 53 (WAG)	Zambia: Northern	KP196847	KP196908
<i>Ochna pulchra</i> Hook.	Silver SIL29 (WAG)	Namibia: Omaheke	KP196848	KP196909
<i>Ouratea angulata</i> (DC.) Baill.	Halle Francis 4515 (WAG)	French Guiana: Bassin du Maroni	KP196872	KP196910
<i>Ouratea castaneifolia</i> (DC.) Engl.	Jansen-Jacobs et al. 1364 (L)	Guyana: Nappi Village	KP196873	KP196911
<i>Ouratea erecta</i> Sastre	Jansen-Jacobs et al. 6712 (L)	Suriname: Lely Mountains	KF263255	KF263447
<i>Ouratea floribunda</i> Engl.	Oldenburger 1601 (L)	Brazil: Cerrado	KP196874	KP196912
<i>Ouratea melinonii</i> (Tiegh.) Lemée	Prevost 3482 (L)	French Guiana: Station de la piste de Ste Elie	KP196875	KP196913
<i>Ouratea rupunniensis</i> Klotzsch ex Engl.	Maas PJM et al. 7353 (L)	Guyana: SW of Mt Makarapan		KP196914
<i>Ouratea</i> spec.	Lachenaud 1084 (BR)	French Guiana: Route Cayenne Regina, km 43	KP196851	KP196917
<i>Ouratea</i> spec.	Lachenaud 1008 (BR)	French Guiana: Vaca Diez	KP196849	KP196915
<i>Philacra auriculata</i> Dwyer	Pipoly & Samuels 6867 (MO)	Brazil	KF263356	KF263428
<i>Rhabdophyllum affine</i> Tiegh.	Bissiengou 555 (WAG)	Gabon: Nyanga	KP196852	KP196878

Rhabdophyllum arnoldianum (De Wild. & T. Durand) Tiegh.	Sosef 2239 (WAG)	Gabon: Ogooué-Ivindo	KF263258	KF263378	KF263451
Rhabdophyllum calophyllum (Hook. f.) Tiegh.	Bissiegou 767 (WAG)	Gabon: Woleu-Ntem	KF263274	KF263395	
Rhabdophyllum letestui Farron	Bissiegou 807 (WAG)	Gabon: Woleu-Ntem	KF263275	KF263396	KF263465
Sauvagesia aliciae Sastre	Mori 25374	French Guiana: Nouragues Field Station			KP196918
Sauvagesia erecta L.	Nikolov 1846 (MO) ( <i>rbcl</i> : Lachenaud 1018 [BR])	Madagascar: Analanjirifo (French Guiana: Savanes de Combi)	KF263248	KF263379	KF263439
Sauvagesia rubiginosa A. St.-Hil.	Jansen-Jacobs 38 (L)	Guyana: Rupunumi	KP196853	KP196879	KP196919
Sauvagesia spec.	Lachenaud 1027 (BR)	French Guiana: Savanes de Combi, route de la pepiniere du CIRAD	KP196854	KP196880	KP196920
Sauvagesia sprengelii A. St.-Hil.	Jansen-Jacobs 1383 (L)	Guyana: Essequibo		KP196881	KP196921
Schuurmansia elegans Blume	Johns 9814 (K) (Kew DNA bank #18433) ( <i>rbcl</i> : Yumte 229 [L])	Indonesia: Irian Yaya		KF263361	KF263413
Tyleria silvana Maguire	Chase 3086 (Kew DNA bank #3086)	Brazil: Amazonia	KF263230	KF263344	KF263418
Wallacea insignis Spruce ex Benth. & Hook.	Berry et al. 5926 (MO) ( <i>trnL-F</i> : Amaral s.n., Kew DNA bank #2994)	Venezuela: Laja Suiza (Brazil: Amazonas)	KF263243	KF263363	KF263417

### 5.2.2 Character sampling

The dataset was composed of three chloroplast markers: the tRNA intron (*trnL*) and intergenic spacer (*trnL-F*), and two coding regions (*matK* and *rbcL*). The advantage of using these markers is that they all represent single-copy regions. Moreover, several amplification and sequencing primers were developed for these regions and used successfully throughout the dicots. At least at family level, the evolutionary rates of these genes have proven appropriate for resolving relationships.

The universal primers C/D and E/F were used to amplify *trnL-F* (Taberlet et al. 1991). Partial *matK* sequences were amplified and sequenced using primers 400F (Cameron et al. 2001) and 1159R (Wurdack and Davis 2009). Additional newly designed primers were used: *matK-OCH-F* CAT CCA TAT AGA AAA ATT GGT TC and *matK-OCH-R* CGC CAA AGT TTT AAC ACA AGA. Amplification of partial *rbcL* was mostly done in BOLD ([www.barcodinglife.org](http://www.barcodinglife.org)), a web-based service provided by the Canadian Centre for DNA Barcoding. Primer *rbcLa-F* (Levin et al. 2003) and *rbcLa-R* (Kress and Erickson 2007) were used. In addition, new primers were designed to sequence degraded samples from herbarium material: 1F-ACTCCTCAACCTGGAGTTCC and 1R-GGATTCGCAAATCCTCCAGGC; 2F-GCCTGGAGGATTTGCGAATCC and 2R-GGGAGTTCACATTCTCATC.

DNA material was extracted from herbarium or silica dried material following an adapted protocol from the cetyltrimethylammonium bromide (CTAB) method (Doyle and Doyle 1987) described in Bakker et al. (1998). Leaf material was ground to a fine dust-like powder using an electric bead mortar. The powder was mixed with the CTAB buffer and incubated at 56 °C before DNA isolation. Isolation was done with chloroform/isoamylalcohol alcohol (24:1). DNA was precipitated in ice-cold isopropanol after been left overnight in the freezer at -20 °C. For herbarium material, with degraded DNA, precipitation time took at least 2 weeks. DNA pellets were washed with a wash buffer (76% ETOH and 10 mM NH<sub>4</sub>Ac), air-dried, and resuspended in resuspension buffer (10 mM NH<sub>4</sub>Ac and 0.25 mM EDTA). The DNA was precipitated again in a solution containing MQ water, 7.5 µl of NH<sub>4</sub>Ac (2.5 M) and cold 96% ETOH (2.5 Vol.). The mixture was left overnight in the freezer at 20 C. DNA pellets were washed in 70% ethanol, air-dried and resuspended in TE (10 mM Tris, 1 mM EDTA).

PCR reactions were performed with 1-2 µl of DNA template; 1 µl of MgCl<sub>2</sub>; 1 µl of BSA; 0.4 µl of dNTP; 0.35 µl of each primer; 0.08 µl of Taq polymerase (Fermentas). For amplification of *trnL-F*, the PCR program was set as: 30 thermal cycles of 94 °C: 50 sec; 53 °C: 50 sec of annealing temperatures; 72 °C: 1.5 min of first extension, with the initial denaturation for 50 sec at 94 °C and the final extension for 7 min at 72 °C. Amplification of *matK-OCH* as: 98 °C: 45 min; 35 cycles of 98 °C:10 sec; 72 °C: 40 sec; final extension 72 °C: 10 min. Amplification of *rbcLa* was as follow: 94 °C: 4 min; 35 cycles of 94 °C: 30

sec; 55 °C: 30 sec; final extension 72 °C: 10 min.

PCR products were cleaned using the MinElute® PCR purification kit (Qiagen), and then sequenced using the Dye ET terminator sequencing kit (Amersham Pharmacia Biotech), running on the ABI Prism 3700 (Greenomics, Wageningen).

Sequences were edited using Staden version 1.7.0 (<http://staden.sourceforge.net/>) and aligned with CodonCode Aligner version 3.7.1 software. Subsequent alignment was done manually when necessary, following the view presented in Kelchner and Clark (1997). Missing characters, indels, microsatellites, and characters the alignment of which was ambiguous were excluded from all analyses.

### 5.2.3 Phylogenetic analyses

#### ***Maximum parsimony (MP)***

MP analyses were performed on each of the three markers separately and on the combined dataset using PAUP\* version 4.0b10 (Swofford 2003). To search for optimal trees, heuristic searches were done with 100 random sequence addition iterations, saving 10 trees per iteration. Trees resulted from this search were used as starting trees for another round during which they were swapped with a limit of 5000 trees. The strict consensus tree was computed from trees resulting from this search. Support for each node was assessed by performing 1000 bootstrap replications for individual markers. For the combined dataset, support for each node was assessed by performing 2000 replications, 50 random sequence addition replicates, saving no more than 5 trees per replicate. For all parsimony searches the branch-swapping option was set to tree bisection-reconnection (TBR).

The topologies of the bootstrap consensus trees for the three markers were compared by eye. No well-supported incongruences were found, hence the sequence data were concatenated and analysed simultaneously.

#### ***Maximum likelihood (ML)***

Maximum likelihood analyses were conducted using the RAxML web-server program available at the CIPRES portal V1.0 in San Diego, CA, USA (Cipres Science Gateway; <<http://www.phylo.org/index.php/portal/>>; Miller et al., 2010). RAxML is a sequential and parallel programme for inference of large phylogenies (Stamatakis 2006), and implements efficient and rapid bootstrap heuristics (Stamatakis et al. 2008). Rapid bootstrap analyses and search for the best-scoring ML tree in one single program run was conducted with a random seed value set to default and with 1000 bootstrap iterations.

#### ***Bayesian inference***

Bayesian analyses were performed using MrBayes version 3.2.1 (Ronquist and

Huelsenbeck 2003) available at the CIPRES portal V1.0. The data matrix was divided into three partitions according to the markers. The *trnL* intron and *trnL-F* spacer were combined as a single partition. The most likely evolutionary model for each partition was identified under AIC scores using FindModel <http://www.hiv.land.gov/content/sequence/findmodel/findmodel.html>. The General Time Reversible plus Gamma (GTR+G) substitution model was selected for *trnL-F*. The Kimura 2-parameter plus Gamma (K80+G) substitution model was selected for *matK* and *rbcl*.

Four MCMC runs were made with two independent chains per run, for ten million generations. The default prior settings were used, with a temperature of 0.25. The unlink command was set to allow rates and substitution models to vary across partitions. Trees of all parameter values were sampled every 1000<sup>th</sup> generation. Convergence of the runs was checked using both the values for effective sample sizes (ESS) using Tracer version 1.5 (Rambaut and Drummond 2013) and the cumulative clade posterior probabilities (PP) using the online programme AWTY (J. A.A. Nylander et al. 2008). The initial 25% of generations were discarded as burn-in and a consensus tree was generated from the remaining trees.

### 5.3 Results

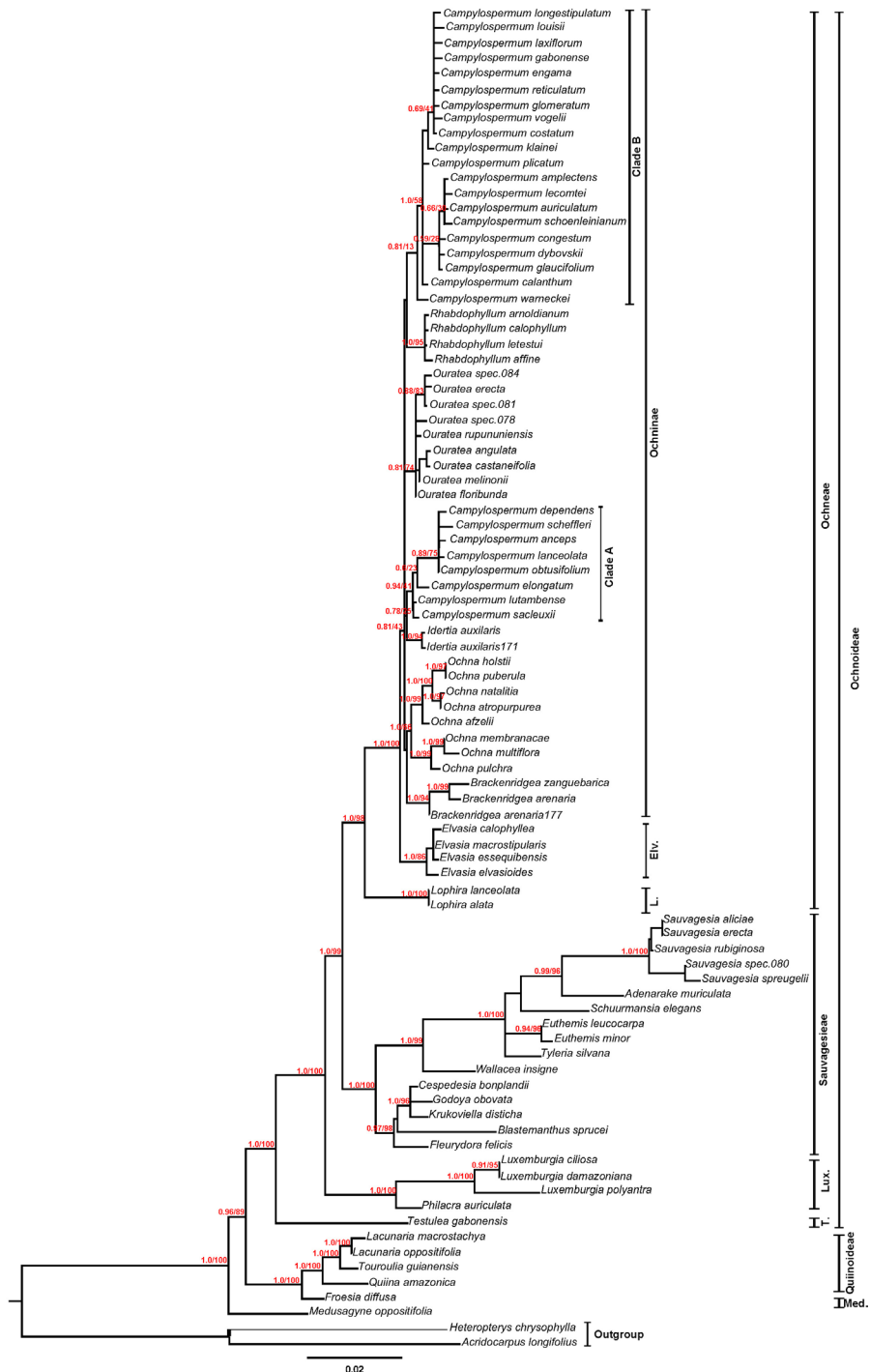
*Poecilandra* and *Schuurmansiella* could not be amplified due to poor quality of their DNA extractions. A total of 87 terminal taxa were aligned including two outgroup taxa. The combined data matrix produced 2287 sites.

Table 2 summarizes the tree statistics for the MP analysis. The MP tree topology was not resolved and showed several big polytomies. ML and Bayesian analyses yielded highly similar results revealing the monophyly of the Ochnaceae (BS 100%; PP=1). The only incongruence between the two topologies was that a clade comprising *Ochna* and *Brackenridgea* taxa was retrieved (Fig. 2) in the ML analysis, although with weak support (BS 38%). This clade was not recovered in the Bayesian analysis. The backbone of the tree is strongly supported in all analyses. The three subfamilies Ochnoideae, Quiinoideae and Medusagynoideae are retrieved as clades with good support. The tree topology shows that Medusagynoideae is sister to the two other subfamilies. Quiinoideae is well supported with 89% BS and 0.96 PP (Fig. 2). *Froesia* is inferred as sister to a well-supported clade of *Quiina*, *Touroulia* and *Lacunaria* (100% BS, 1 PP).

*Testulea gabonensis* Pellegr. is sister to the rest of the Ochnoideae, which is overall well resolved with the exception of the clade including the Ochninae species, which received only 43% bootstrap support and 0.80 Bayesian probability (Fig. 2).

The tribes Luxemburgieae and Sauvagesieae as well as the subtribes Lophirinae and Elvasiinae are resolved and well-supported (100% BS and 1 PP) (Fig. 2).





**Figure 2.** Maximum likelihood tree of Ochnaceae based on the combined DNA regions with posterior probabilities obtained from Bayesian inference and bootstrap support from RAxML analysis. Elv. = Elvasiinae; L. = Lophirinae; Lux. = Luxemburgieae; T. = Testuleae (sensu to Schneider et. al 2014).

Within the subtribe Ochninae, the genera *Brackenridgea*, *Idertia*, *Ochna* and *Rhabdophyllum* are all well-supported (PP = 1.0), while *Ouratea* receives 74% BS and 0.81 PP. However, relationships among these genera are mostly unresolved; most strikingly the genus *Campylopermum* is split into two clades. One clade comprises the Malagasy and East African *Campylopermum* spp. plus *C. elongatum* from West/Central Africa (clade A) and retrieved in the ML analysis with weak support (41% BS) but with good support in the Bayesian analyses (0.94 PP). This clade is sister to *Idertia*, though with weak support (25% BS, 0.78 PP). The second clade groups the West/Central African *Campylopermum* species (except *C. elongatum*) (clade B) as sister to either *Rhabdophyllum* in the ML tree or in a polytomy with the remainder of the Ochninae in the Bayesian tree.

**Table 2:** Tree statistics of both individual and combined markers. CI = consistency index; RI = retention index. Outgroup taxa were included in the calculations.

Marker	matK	rbcLa	trnL-F	Combined
# of taxa	63	120	99	91
# of characters in the aligned matrix	760	551	986	2287
# of excluded characters in the aligned matrix	12		18	30
CI	0.69	0.44	0.73	0.65
RI	0.79	0.69	0.85	0.77
#constant characters	464	438	538	1579
# of parsimony-informative characters (%)	153 (20.13%)	68 (12.34%)	195 (19.77%)	374 (16.35%)

## 5.4 Discussion

This discussion will follow the recent circumscription of Ochnaceae based on Schneider et al. (2014), given the need of a stable classification (Godfray and Knapp 2004), and the fact that the APG III classification (APG III 2009) is widely accepted and adapted in recent flora works (Fiaschi et al. 2010), classifications (Maddison and Schulz 2007) and databases such as .

The present study confirms the backbone of the phylogeny presented by Schneider et al. (2014), which was based on a combined data set of chloroplast and nuclear DNA. Not surprisingly, this combined data set gives a better-resolved tree than ours that was derived from chloroplast data only. In general, the addition of characters has a beneficial effect on phylogenetic inference (Hillis et al. 2003; Rosenberg and Kumar 2003) but when the additional marker has a different phylogenetic history there is no relationship between the addition of characters and an increase of support values (Wiens 1998).



Therefore, we conclude that within Ochnaceae the maternally inherited chloroplasts share their history with the nuclear material, indicating that hybridization has not played a major role in the evolutionary history of the extant main clades.

From the tree topology and support values we conclude that the Ochnaceae is a monophyletic family, which is congruent with the results of Schneider et al. (2014). A significant incongruence is that the current study infers Medusagynoideae as sister to the rest of the family, whereas it is closely related to the Quiinoideae in Schneider et al. (2014), but with low support (73% BS, 0.67 PP). Our analyses show high support at the relevant nodes. This would imply that the nuclear (ribosomal) sequences are not congruent with the pattern provided by the chloroplast DNA. The second subfamily, the Neotropical Quiinoideae, is well resolved.

Our results inferred from the MP analysis show a large polytomy at the base of the subfamily Ochnoideae. This is unexpected, regarding the high support in both the ML and Bayesian analyses for the vast majority of the major Ochnoideae clades. However, branch lengths are very short and, apparently, the MP analysis yielded several other tree topologies that were equally short in terms of number of character state changes. We decided not to analyse all other topologies, but simply discard the MP results and continue with the ML and Bayesian tree topologies.

Well-supported clades inferred by Schneider et al. (2014), and recognized as tribes and subtribes, are also retrieved by the current study. The tribe Luxemburgieae consists of the Neotropical genera *Philacra* Dwyer (4 spp.) and *Luxemburgia* A.St.-Hil. (18 spp.) and was treated as a subtribe of the Sauvagesioideae by Kanis (Kanis 1968). We thus confirm the recognition of this clade as a tribe within the subfamily Ochnoideae, following Schneider et al. (2014). Well-supported relationships are also found within the tribe Sauvagesieae, which comprises species from the Old and New World tropics as well as South-East Asia. The position of *Fleurydora* (a monotypic genus endemic to the tip of West Africa), however, as sister to a clade composed of the Neotropical genera *Blastemanthus* Planch., *Cespedesia* Goudot, *Godoya* Ruiz & Pav. and *Krukoviella* A.C.Sm. conflicts with Schneider et al. (2014). It should be noted, however, that relationships among the early-diverging lineages in the Sauvagesieae are generally poorly supported in Schneider et al. (2014). Moreover, the sampling in Schneider et al. (2014) of these lineages is slightly larger than ours, further confounding comparison. The latter genera share several features such as the same texture and shape of the sepals and anthers, pistil position at anthesis and the intrusive T-shaped parietal placentae bearing several imbricate ovules (Dwyer 1944). *Fleurydora*, in turn, is morphologically related to these New World genera through the placentation pattern (Dwyer 1944), although other characteristics place *Fleurydora* closer to *Poecilandra* (not sampled here). The leaf blades of *Fleurydora* and *Poecilandra* are similar in shape, and have a retuse apex, the

sepals are similarly disposed, the style is subulate (Dwyer 1944). This conflict between the outcomes of the two studies regarding the position of *Fleurydora* suggests that the markers do not yield sufficient variation, or that the different partitions carry conflicting evidence. A more detailed study on these aspects is advised.

Within the tribe Ochneae, the position of the subtribes Elvasiinae, Lophirinae and Ochninae strongly agree with the topology presented by Schneider et al. (2014). In the subtribe Ochninae relationships are poorly resolved. *Brackenridgea* and *Ochna*, which share a number of morphological characters (see above), formed a single clade in the ML tree but both genera appear in two different clades in the Bayesian tree (Fig. 2). They formed the subtribe Ochninae sensu Kanis, based on pollen and flower characters. Their alleged close relationship is not supported by the analyses of Schneider et al. (2014), which showed *Brackenridgea* being sister to *Idertia*. Although morphological characters support a relationship of *Brackenridgea* with *Ochna* and not with *Idertia*, for now, we adopt the generic configuration of the study of Schneider et al. (2014)

Although relations within the subtribe Ochninae are generally not well resolved, our extended sampling of *Campylosperrum* species has led to the retrieval of two distinct clades within this genus. The first (clade A) groups the East African and Malagasy *Campylosperrum* species, together with *C. elongatum* from West/Central Africa, while a second clade (clade B) comprises all other West/Central African species (Fig. 2). Clade B is, depending on analysis, retrieved as sister to *Rhabdophyllum* or grouped along in a polytomy with the rest of the Ochninae genera. Clade A, however, is sister to *Idertia* rather than to the *Campylosperrum* species in clade B. This split of *Campylosperrum* species into two clades might be the result of speciation via long distance dispersal facilitated by the presence of the Comores and Seychelles/Mascarenes, that could have acted as stepping-stones for dispersal between Africa and Madagascar and between Madagascar and Asia, respectively (Warren et al. 2010; Buerki et al. 2013). Moreover, members of clade A share a distinct reticulate tertiary leaf venation, and accumbent embryos that are similar in size. They generally have (except for *C. lutambense*, which is only known from four specimens) an axillary inflorescence. The latter character might indeed link *Idertia* to this clade and therefore could represent a potential synapomorphy of clade A plus *Idertia*. Members of clade B have a terminal inflorescence (except for *C. oliveri*, *C. subcordatum*, *C. duparquetianum*) while the embryos can be similar/dissimilar in size and accumbent/incumbent. However, most of the above remains speculative, since the relevant nodes have only weak support and branch lengths are very short. To test these hypotheses, an even more extensive sampling of African, Malagasy and Asian species (absent from both studies) and additional gene sequences would be required. This would, firstly, provide phylogenetic support for the recognition of different clades within *Campylosperrum*, and for the establishment of new nomenclatural combinations when necessary. Secondly, this phylogeny would serve as a framework to test which historical events have affected the current distribution of *Campylosperrum* clades and species.

## 5.5 Conclusion

We confirm the recognition of the three subfamilies Medusagynoideae, Quiinoideae and Ochnoideae as distinct clades, as well as do the tribes Luxemburgieae, Ochneae, Sauvagesieae and Testuleeae. The markers *matK*, *rbcL* and *trnL-F* appear to be less suitable to depict evolutionary relationships of Ochnaceae at the genus level. The backbone phylogeny within the subtribe Ochninae is poorly resolved, impeding further biogeographical and evolutionary studies. Additional taxa and sequence data are required to further resolve the phylogenetic relationships within Ochninae, notably the interesting split of the genus *Campylopermum* into an East Africa/Madagascar and a West/Central Africa clade.



# Chapter 6

## Divergence times and historical biogeography of the pantropical Ochnaceae

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## Abstract

Ochnaceae is a family of trees, shrubs or rarely herbs, widely distributed in tropical and subtropical forests and savannas of the Old and New World, and comprises about 500 species in 27 genera. The family is divided into Medusagynoideae, endemic to the Seychelles, the Neotropical Quiinoideae, and the pantropical Ochnoideae. Whether the distributional disjunctions within the Ochnaceae are consistent with an early-Cretaceous Gondwanan break-up scenario or with one involving more recent long distance dispersal has not yet been tested. In general, three routes have been documented for the dispersal of taxa between the Palaeotropic and Neotropic regions: via the North Atlantic Land Bridge, via the Bering Land Bridge and from America directly to Africa, or vice versa, involving long distance dispersal. Dating analyses were performed using five DNA sequence regions (ITS, *matK*, *ndhF*, *rbcL*, *trnLF*), a secondary calibration, and relaxed molecular clock models. The historical biogeography of Ochnaceae was reconstructed using Dispersal-Vicariance Analysis and Bayesian Binary MCMC. We inferred a mean age of crown group Ochnaceae of 77.7 Ma. The Neotropics were inferred as the origin of the family (83.5 % marginal probability) and the Old World was most likely colonized via the North Atlantic Land Bridge when climatic conditions allowed establishment of a boreotropical flora. Subsequently, migrations back to South America (*Ouratea*) and independent dispersal of Sauvagesieae and Ochnaeae lineages to Africa and Asia occurred. According to our age estimates, vicariance can be ruled out as a mechanism to explain the transoceanic disjunctions.

**Keywords:** biogeography, dispersal, Malpighiales, molecular clock, Ochnaceae, vicariance

## 6.1 Introduction

Angiosperm biogeography and past continental movement have been the subject of many studies that involve patterns of species distribution across the globe (Tiffney and Manchester 2001; Donoghue and Moore 2003; Wiens and Donoghue 2004; Renner 2005; Nathan et al. 2008; Antonelli et al. 2009). With the advancement of molecular analyses and fossil evidence, increasing numbers of continental disjunctions have been analyzed (Tiffney & Manchester 2001, Richardson et al. 2004; Nicolas & Plunkett 2014). These generally propose vicariance and long distance dispersal as the two hypotheses that can explain these disjunctions. In Myrtaceae, for example, it has been postulated that this family has an Australian origin and migrated to South America through the Australasia-Antarctica-South America land mass (Sytsma et al. 2004). Likewise, the diversification of major clades of Apiales seems to be affected by vicariance events (Nicolas and Plunkett 2014), because the divergence time at the split between Torricelliaceae from Griselinaceae and Apiineae nicely coincides with the break-up of Africa and Australasia (Nicolas and Plunkett 2014). On the other hand, age estimates of many angiosperm clades are relatively young (Wikström et al. 2001; Magallón et al. 2005; Bell et al. 2010), dating back to at least after the complete separation of landmasses that have led to the current position of the earth's continents. This suggests that disjunct distribution patterns of such clades cannot exclusively be explained by vicariance and one has to consider long distance dispersal as an alternative explanation. Although, for example, the disjunct distribution of Annonaceae and Myristicaceae may have involved vicariance events (Doyle et al. 2004), most clades within Annonaceae are too young (Richardson et al. 2004), for instance *Guatteria* (Erkens et al. 2009) and *Anaxagorea* (Scharaschkin and Doyle 2005), and their distribution patterns therefore invoked long distance dispersal. (Morley 2003) has reviewed dispersal routes that may have played a role in many tropical intercontinental disjunctions. Most of these routes existed in the Late Cretaceous and Late Tertiary. Examples are the North Atlantic Land Bridge (NALB) connecting Europe and North America, or the Bering Land Bridge (BLB) connecting Asia and North America. Renner (2004) nicely pointed out the role of sea currents and prevailing wind directions as being the vectors responsible of the trans-oceanic disjunct distribution of genera occurring on both sides of the tropical Atlantic. She listed about 110 genera with a transatlantic distribution, and hypothesize that trans-oceanic dispersal from South America to Africa was influenced by wind, while dispersal from Africa to South America involved sea currents.

A third hypothesis to explain the disjunct distribution ranges of extant taxa is the boreotropical scenario, which hypothesizes that some tropical disjunctions may have arisen as a result of boreotropical migration. The boreotropical flora was hypothesized to extent across the northern hemisphere its climate supported tropical vegetation

(Wolfe 1975; Tiffney 1985). This took place during the episodes of global warming from 59 Ma to 52 Ma, with a peak around 50 Ma in the Early Eocene Climatic Optimum/EECO (Zachos et al. 2001). The EECO was followed by a period with slowly decreasing temperature, which lasted for about 17 mya (Zachos et al. 2001). The further cooling of global climate forced the boreotropical vegetation to move to lower latitudes to finally form tropical and subtropical disjunction pattern of taxa extant today. This hypothesis was proposed to explain the disjunctive distribution pattern of, among others, Annonaceae (Richardson et al. 2004), Magnoliaceae (Nie et al. 2008) and Malpighiaceae (Davis et al. 2002).

Ochnaceae s.str. is, like most of the families within the order Malpighiales, widely distributed in tropical and subtropical forests and savannas of the Old and New World (Amaral and Bittrich 2014). It is a family of trees and shrubs or rarely herbs and consists of about 500 species in 27 genera. The highest species richness is found in the Neotropics, where 250–300 species and 15 genera are present (Schneider et al. 2014). In Africa, including Madagascar, about 150 species and nine genera occur, while the lowest diversity is observed in Southeast Asia, hosting only 20 species and 8 genera (Kanis 1968; Verdcourt 2005). The majority of the genera is confined to a single continent, exceptions being *Campylopermum* and *Ochna*, both with an Old World distribution (Bissiengou et al. 2013), and the pantropical *Sauvagesia*, although the latter is demonstrably non-monophyletic in its current delimitation (Schneider et al. 2014).

Phylogenetic studies based on DNA sequence data placed Ochnaceae s.str. in the order Malpighiales as a sister family to both Medusagynaceae and Quinoaceae (Fay et al. 1997; Davis et al. 2005; Korotkova et al. 2009; Wurdack and Davis 2009; Xi et al. 2012). A recently published comprehensive molecular phylogenetic analysis and updated classification of Ochnaceae (Schneider et al. 2014) united the three families to form an expanded Ochnaceae s.l. (from now on referred to as Ochnaceae), which consists of three subfamilies: Medusagynoideae Reveal, Quiinoideae Luer and Ochnoideae Burnett. Medusagynoideae are monotypic and endemic to the Seychelles. Quiinoideae comprise only Neotropical species. Ochnoideae contain species from both the New and Old World tropics.

The historical biogeography of Ochnaceae has never been the subject of a detailed study because a comprehensive molecular phylogenetic hypothesis was lacking. Yet, the family contains many interesting distribution patterns. In the Neotropics, Ochnaceae are distributed in Central and South America; while Central America is poor in species, many endemic species, mainly of the genus *Ouratea*, are found in northern South America (Sastre 1987). In Africa, Ochnaceae are found in the tropical regions of West, Central, East and South Africa (though not in the southern part of South Africa where a Mediterranean climate prevails). Only few species occur in Madagascar and



surrounding islands (Seychelles and Mascarenes) as well as in the Indo-Pacific region and Southeast Asia. In the subfamily Ochnoideae, the tribe Ochneae is divided into the subtribe Ochninae and the monogeneric subtribes Elvasiinae and Lophirinae from America and Africa respectively. Ochninae comprises the strictly African genera *Idertia*, *Rhabdophyllum*, the palaeotropical genera *Campylospermum*, *Brackenridgea* and *Ochna*, and the neotropical genus *Ouratea*, depicting an amphi-Atlantic relationship within Ochninae. In the tribe Sauvagesieae, however, the majority of genera are from the Neotropics while few are found in tropical Asia, one in Africa (*Fleurydora*) and *Sauvagesia* which is present on three continents. Kanis (1968) hypothesized that its subfamily Sauvagesoideae (now tribe Sauvagesieae) originated in the Neotropics, and that the occurrence of Asian taxa within this clade depicted amphi-pacific relationships rather than a migration via Africa. We would probably not arrive at the same conclusions now that the African genus *Fleurydora* has been included in the Sauvagesieae.

Davis et al. (2005) estimated the age of the stem node of the Ochnaceae ranging from 98.8 to 116.6 Ma. Their sampling was limited to single species of the genera *Quiina*, *Medusagyne*, *Ochna* and *Cespedesia*, which together were retrieved as a clade, sister to a clade uniting Phyllanthaceae and Picrodendraceae, without any data support, however. Xi et al. (2012) inferred the ages of nodes in Malpighiales and the following Ochnaceae genera were included: *Medusagyne*, *Froesia*, *Touroulia*, *Quiina*, *Luxemburgia*, *Sauvagesia*, *Cespedesia*, *Lophira*, *Elvasia*, *Ochna*. The mean crown node age of the Ochnaceae was estimated at 77.8 Ma. The lower end of the 95% highest posterior density interval of the Ochnaceae crown node age extends back to 90.5 Ma. As discussed above, three hypotheses account for many of the present-day disjunctions seen in various groups of tropical flowering plants. Given the separation of the Madagascar-Antarctica-India landmass from the Africa-South America landmass (around 135Ma) and the break-up of Africa and South America (around 100 Ma), vicariance, does not seem very likely in view of the age of the Ochnaceae crown node (Davis et al. 2005; Xi et al. 2012). We therefore hypothesize that boreotropical migration and long distance dispersal has been the major driving force for the contemporary cross-continental distribution patterns in Ochnaceae.

In the present study, the comprehensive molecular phylogeny of Ochnaceae s.l. (Schneider et al. 2014) is used to (1) investigate its area of origin, and (2) test which of the above mentioned scenarios could be postulated to explain the present disjunct distributions in Ochnaceae.

## 6.2 Material and Methods

### 6.2.1 Taxon sampling

The dataset used in this study is similar to that used by Schneider et al. (2014) and includes all genera of Ochnaceae s.l. except *Indosinia* and *Perissocarpa*. Our final taxon sampling includes 78 accessions (see Table 1 in Schneider et al. 2014).

### 6.2.2 DNA sequencing

The DNA sequences of the gene regions ITS, *matK*, *ndhF*, *rbcL* and *trnLF* were obtained from Schneider et al. (2014). DNA extraction, PCR and sequencing, and alignment methods are all as described in that paper.

### 6.2.3 Dating analysis

#### *Taxon sampling strategy*

Molecular dating analyses can be subjected to many sources of error. It has been demonstrated that increasing or decreasing the number of taxa in a dataset can result in different time estimates, being the result of the combined effect of under-sampling and either distance from the calibration node (Linder, Hardy, et al. 2005) or positions of calibration points (Xiang et al. 2011). A further problem, and therefore a possible source of error, is the way dating analyses model substitution rate heterogeneity, i.e. the extent to which substitution rates depart from a strict molecular clock, and how this heterogeneity is distributed over different data partitions and/or different lineages. There have been several analytical approaches to dealing with heterogeneous rate distribution among sites and data partitions. One commonly used approach has been the assumption of autocorrelation, viz. the inheritance of substitution rates from parent to daughter lineages (Sanderson 1997; Drummond and Suchard 2010). In cases where the assumption of rate autocorrelation is violated, Bayesian relaxed clock models perform better (Drummond et al. 2006). These methods reduce the stringency of autocorrelation by drawing substitution rates from a continuous prior distribution (Drummond et al. 2006). Relaxed clock methods, however, have been shown to be incapable of modelling substitution rate heterogeneity over lineages (Dornburg et al. 2012; Wertheim et al. 2012). For an entire dataset this may result in posterior substitution rate distributions showing a multimodal pattern. A possible signature of this problem in phylogenetic trees is the clade-specific distribution of branch lengths, visible in plant groups such as Annonaceae (Chatrou, Erkens, et al. 2012; Chatrou, Pirie, et al. 2012) and Lentibulariaceae (Jobson et al. 2003). Such a clade-specific distribution of branch lengths also appears from phylogenetic analyses of Ochnaceae (Schneider et al. 2014), with the Ochnaeae being characterized by distinctly shorter branch lengths than the Sauvagesieae. We hypothesize that this tree shape and branch length distribution

is caused by clade-specific differences in substitution rates, and here investigate its possible effect on the estimation of node ages in Ochnaceae. To test this we analyzed three data sets. Node ages were estimated analyzing the entire data set as well as two smaller subsets: a long-branch and short-branch one. The long-branch subset kept two of Sauvagesieae accessions and included all Ochnaeae. The short branch subset kept two of Ochnaeae accessions and included all Sauvagesieae. This was done to have the crown nodes of both clades included in the analysis, whilst minimizing the effect of the minimal represented clade on the estimation of substitution rates. The two accessions of both clades were chosen in such a way that the crown node was bracketed. The long-branch subset comprises 61 accessions and the short-branch 38. Data sets were compiled using the programme Mesquite version 2.75 (Maddison and Maddison 2011). Each subset used the same alignment as in the complete matrix of 78 accessions, but gaps were removed so as not to bias the estimation of branch lengths by the presence of missing data.

### **Fossils**

Unfortunately, there are no fossil records of Ochnaceae. Pigg et al. (2005) report on a fossil fruit of uncertain age that resembles *Ochna*. However, comparing their fossil to modern Ochnaceae, notably the presence of a scar/groove on the fossil and way the nutlets/drupelets are attached and compacted is not reminiscent of Ochnaceae. Therefore, we reject this fossil as belonging to Ochnaceae. Furthermore, Danehy et al. (2007) described fossil Ochnaceae leaves from Mississippi as *Rhabdophyllites diapyros*. Based on the combination of the type of leaf venation and a toothed margin, they suggested the fossil would be similar to the genera *Rhabdophyllum*, *Philacra*, and *Schuermansiella*. Having studied the taxonomy of Ochnaceae extensively in the field and in herbaria, we note that closely spaced secondary veins are always connected by percurrent tertiary veins in the family, while the fossil shows a reticulate pattern of tertiary venation. In *Rhabdophyllum*, to which the fossil has been linked by Danehy et al. (2007), the secondary veins run almost straight to or only slightly curved/oblique to the margin, in which they terminate, while the margin itself is thickened and produces small setae. So, laterals do not, as in the fossil, peter out toward the margin, eventually running almost parallel to it, and do not end in an actual tooth. The marginal teeth in *Rhabdophyllum* are in fact more rounded. Therefore, we also discarded *Rhabdophyllites diapyros* as being a close relative of *Rhabdophyllum*.

### **Divergence times**

Divergence time estimations were performed using the BEAST (Bayesian Evolutionary Analysis Sampling Trees) software package, version 1.7.5 (Drummond et al. 2012). The dataset was partitioned according to the gene regions. Clock and substitution models were estimated separately for each of the five regions. The substitution model was set to

GTR, the site heterogeneity model to Gamma, which allows rate variation between sites in the alignment (Drummond et al. 2012). To estimate the clock rates and divergence times, the uncorrected lognormal clock model and the calibrated Yule model was specified as the tree prior.

In order to estimate the divergence times within Ochnaceae, we calibrated the crown node of the Ochnaceae with a mean age of 77.8 Ma (from Xi et al. 2012), a normal prior distribution and a standard deviation of 0.5. This results in a range of possible ages from 90.5 to 61.3 Ma, which corresponds to the confidence interval reported by Xi et al. (2012) for the crown node of the Ochnaceae. Age estimates of the clade Ochnoideae were not used because of incongruence between their data and ours in terms of taxon sampling.

During the MCMC analysis, three independent chains of 35 million generations were run, sampling trees and parameters every 1000 generations. Convergence of the model parameters among the three chains was checked by visual inspection of the trace plots of LnL, by assessing the effective sampling size (ESS) for all parameters using Tracer versions 1.6 (Rambaut and Drummond 2013), and by visual inspection of cumulative clade posterior probabilities using AWTY (J. A.A. Nylander et al. 2008). The mean node ages and highest posterior density interval (HPD) of divergence time estimates were summarized using TreeAnnotator v1.7.5 (Drummond et al. 2012). The results were visualized using Figtree v1.4.0 (Rambaut 2012).

### ***Ancestral area reconstruction analyses***

In the phylogeny of Ochnaceae derived from Schneider et al. (2014) several relationships remain unclear due to low support values. For example, Ochnoideae were inferred as sister to a clade of Medusagynoideae and Quiinoideae with weak support values, and hypotheses about the relationships within Ochninae received only low support. To accommodate these uncertainties, the software Reconstruct Ancestral State in Phylogenies (RASP) developed by Yu et al. (2013) was used to reconstruct the ancestral ranges of Ochnaceae. RASP implements three methods, Statistical Dispersal-Vicariance Analysis (S-DIVA), Bayesian binary MCMC (BBM) and maximum parsimony (MP) analysis. S-DIVA and BBM determine alternative ancestral ranges at each node and calculated posterior probabilities for each ancestral range at each node. This approach is advantageous compared to DIVA developed by Ronquist (1997, 2001), which reconstructs ancestral ranges onto a fixed phylogenetic tree assuming to be without error (J. A. A. Nylander et al. 2008). Furthermore, although Nylander et al. (2008) showed the utility of a non-parametric empirical Bayesian approach to DIVA (Bayes-DIVA), RASP has the advantage to evaluate alternative ancestral range in a probabilistic framework and thus complements DIVA and Bayes-DIVA. In conclusion, we prefer to use RASP.

Most of the distribution area of Ochnaceae is covered by the taxa we sampled. The distribution areas were based on the current distribution of the terminal taxa and were circumscribed using geological criteria as defined in other studies (such as (Sanmartín and Ronquist 2004; Buerki et al. 2011; Smedmark et al. 2014). Different micro-continents were included within a larger landmass when they shared a similar biota or relatively recent land connections. Four geographical areas were defined (Fig. 1): (A) America, including tropical South America, Central America and the Caribbean region, (B) Africa (continental sub-Saharan Africa), (C) Asia (comprising including South and Southeast Asia, from India/Sri Lanka to Thailand, Malaysia and Indonesia to New Guinea), (D) Madagascar (including the Comoro islands, Mascarene Islands and the Seychelles). Since the Precambrian, the Mascarenes and Seychelles have been connected, in the Indian Ocean, by a contiguous block of thick crust (Torsvik et al. 2013).

Distribution areas of the outgroups were not coded because they are widely distributed (Europe, Australia and North America) also in regions where the ingroup is not present. In the BBM analyses, the outgroups were therefore coded under the wide distribution. This allows RASP to virtually assign an outgroup to any distribution area occupied by the ingroup. To account for phylogenetic uncertainty, 6001 trees from the BEAST output were used. The number of maximum areas was kept at six. The MCMC chains were set to 10 and ran for 50,000 generations. The state was sampled every 100 generations under the fixed Jukes-Cantor+Gamma (JC+G) model. All distribution states are listed in Table 1.

**Table 1.** Distribution areas of Ochnaceae and outgroup species. America (A); Africa (B); Asia (C); Madagascar (D); and outgroup distribution (?).

<i>Adenarake muriculata</i> Maguire & Wurdack	A	<i>Luxemburgia ciliosa</i> Gardner	A
<i>Blastemanthus sprucei</i> Tiegh.	A	<i>Luxemburgia damazioana</i> Beauverd	A
<i>Brackenridgea palustris</i> Bartell.	C	<i>Luxemburgia schwackeana</i> Taub.	A
<i>Brackenridgea zanguibarica</i> Oliv.	B	<i>Medusagyne oppositifolia</i> Baker	D
<i>Campylospermum duparquetianum</i> Tiegh.	B	<i>Ochna afzelii</i> R.Br. ex Oliv.	B
<i>Campylospermum dybowskii</i> Tiegh.	B	<i>Ochna integerrima</i> (Lour.) Merr.	C
<i>Campylospermum excavatum</i> (Tiegh.) Farron	B	<i>Ochna macrantha</i> Baker	D
<i>Campylospermum flavum</i> (Schumach.) Farron	B	<i>Ochna membranacea</i> Oliv.	B
<i>Campylospermum gabonensis</i> Biss.	B	<i>Ochna mossambicensis</i> Klotzsch	B
<i>Campylospermum glaucifolium</i> Biss.	B	<i>Ochna multiflora</i> DC.	B
<i>Campylospermum glaucum</i> (Tiegh.) Farron	B	<i>Ochna natalitia</i> (Meisn.) Walp.	B
<i>Campylospermum glomeratum</i> (Tiegh.) Biss.	B	<i>Ochna polycarpa</i> Baker	D
<i>Campylospermum klainei</i> (Tiegh.) Farron	B	<i>Ochna serrulata</i> Walp.	B
<i>Campylospermum laeve</i> (De Wild. & T.Durand) Farron	B	<i>Ouratea erecta</i> Sastre	A
<i>Campylospermum laxiflorum</i> Tiegh.	B	<i>Ouratea lucens</i> Engl.	A
<i>Campylospermum louisii</i> Biss. & Sosef	B	<i>Ouratea polyantha</i> Engl.	A
<i>Campylospermum oliveri</i> (Tiegh.) Farron	B	<i>Ouratea schomburgkii</i> Engl.	A

<i>Campylosperrum plicatum</i> (Tiegh.) Biss.	B	<i>Ouratea scottii</i> Sastre	A
<i>Campylosperrum schoenleinianum</i> (Klotzsch) Farron	B	<i>Ouratea striata</i> (Tiegh.) Urb.	A
<i>Campylosperrum umbricolum</i> (Tiegh.) Farron	B	<i>Ouratea vaccinioides</i> Engl.	A
<i>Cespedesia spathulata</i> Planch.	A	<i>Philacra auriculata</i> Dwyer	A
<i>Clusia rosea</i> Jacq.	?	<i>Poecilandra retusa</i> Tul.	A
<i>Elvasia calophyllea</i> DC.	A	<i>Quiina amazonica</i> A.C.Sm.	A
<i>Elvasia capixaba</i> Fraga & Saavedra	A	<i>Quiina pteridophylla</i> (Radlk.) Pires	A
<i>Elvasia elvasioides</i> Gilg	A	<i>Quiina tinifolia</i> Planch. & Triana	A
<i>Euthemis leucocarpa</i> Jack	C	<i>Rhabdophyllum arnoldianum</i> Tiegh.	B
<i>Euthemis minor</i> Jack	C	<i>Rhabdophyllum calophyllum</i> Tiegh.	B
<i>Fleurydora felicitis</i> A.Chev.	B	<i>Rhabdophyllum letestui</i> Farron	B
<i>Froesia diffusa</i> Gereau & Vásquez	A	<i>Rhytidanthera splendida</i> Tiegh.	A
<i>Froesia venezuelensis</i> Steyerem. & G.S.Bunting	A	<i>Sauvagesia erecta</i> L.	ABCD
<i>Garcinia mangostana</i> L.	?	<i>Sauvagesia fruticosa</i> Mart.	A
<i>Godoya obovata</i> Ruiz & Pav.	?	<i>Sauvagesia serrata</i> (Korth.) Sastre	C
<i>Hypericum</i> L.	?	<i>Sauvagesia tafelbergensis</i> Sastre	A
<i>Idertia axillaris</i> (Oliv.) Farron	B	<i>Schuermansia elegans</i> Blume	C
<i>Krukoviella disticha</i> (Tiegh.) Dwyer	A	<i>Schuermansiella angustifolia</i> Hallier f.	C
<i>Lacunaria macrostachya</i> (Tul.) A.C.Sm.	A	<i>Testulea gabonensis</i> Pellegr.	B
<i>Lacunaria oppositifolia</i> Pires	A	<i>Touroulia guianensis</i> Aubl.	A
<i>Lophira alata</i> Banks ex C.F.Gaertn.	B	<i>Tyleria silvana</i> Maquire	A
<i>Lophira lanceolata</i> Tiegh. ex Keay	B	<i>Wallacea insignis</i> Spruce ex Benth. & Hook.f.	A

## 6.3 Results

### 6.3.1 Dating analysis

#### *Taxon sampling*

Age estimates from the two subsets show no significant difference compared to estimates from the main dataset. The 95% confidence intervals of age estimates for the major clades overlap (Table 2). Hence, we assume no effects of long or short branches on the divergence time estimations (see supplements S1 and S2).

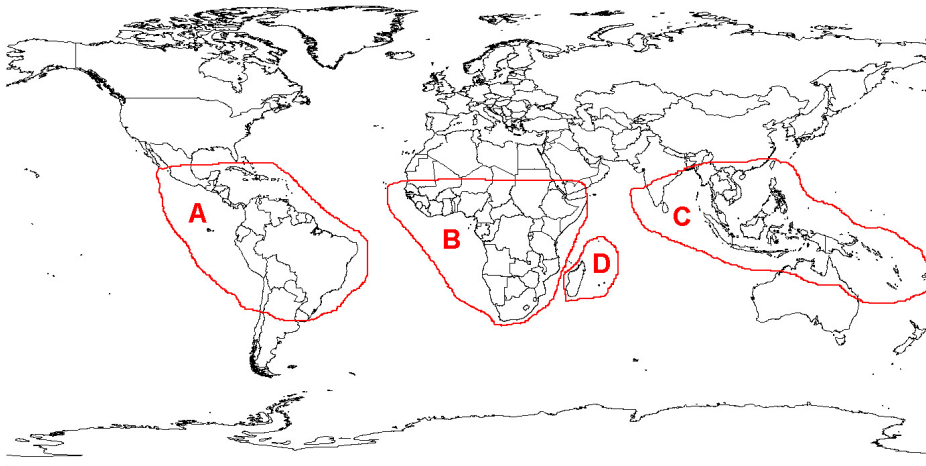
**Table 2.** Mean nodal ages and their 95% confidence intervals of major Ochnaceae taxa. Column two and three provide the figures for the analyses on the two subsets (explanation see text).

Clade	Matrix		
	78 accessions	61 accessions	38 accessions
Medusagynoideae-Quiinoideae	64.7(42.6-77.5)	67.8(54.8-77.7)	67.9(49.4-78.2)
Quiinoideae	19.1(11.7-27.2)	21.6(14.3-29.4)	17(10.6-24.1)
Ochnoideae	69.5(63.5-74.6)	68.1(60.1-75.2)	69.3(62.1-75.5)

Luxemburgieae	20.1(11.1-29.6)	21.7(12.5-31.4)	19.4(10.6-29.6)
Sauvagesieae	41.8(29.7-49.4)	32.6(23.1-43.0)	43.5(35.9-51.5)
Ochneae	36.3(22.5-48.4)	35.3(27.0-44.3)	33.3(19.7-47.8)
Elvasiinae	9.1(2.6-15.5)	10.2(5-15.9)	Pruned
Ochninae	15.0(11-20.6)	16.5(12.5-20.3)	Pruned

### ***Divergence times***

All BEAST MCMC runs yielded values for effective sampling sizes  $>200$  for all parameters, indicating convergence. All runs converged on a tree topology highly congruent with the phylogenetic tree of Ochnaceae s.l. recently obtained by Schneider et al. (2014). With the mean age of the Ochnaceae crown node set at 77.8 Ma (95% confidence interval: 76.8–78.7 Ma), the mean age estimate for the clade comprising Medusagynoideae and Quiinoideae is 64.7 Ma (95% confidence interval: 42.6–77.5 Ma; Fig. 2, node 2). The origin of Ochnoideae has an age estimate of 69.5 Ma (95% CI: 63.5–74.6 Ma; Fig. 2, node 4). The split between the clade Luxemburgieae and the rest of the Ochnoideae is dated around 55.1 Ma (95% CI: 42.3–63.8 Ma) whereas the Luxemburgieae are dated around 20.1 Ma (95% CI: 11.0–29.6 Ma; Fig. 2, node 5). Sauvagesieae have an estimated age of 41.8 Ma (95% CI: 29.7–49.4 Ma; Fig. 2, node 6). The Ochneae clade has an estimated age of 36.3 Ma (95% CI: 22.5–48.4 Ma; Fig. 2, node 9).



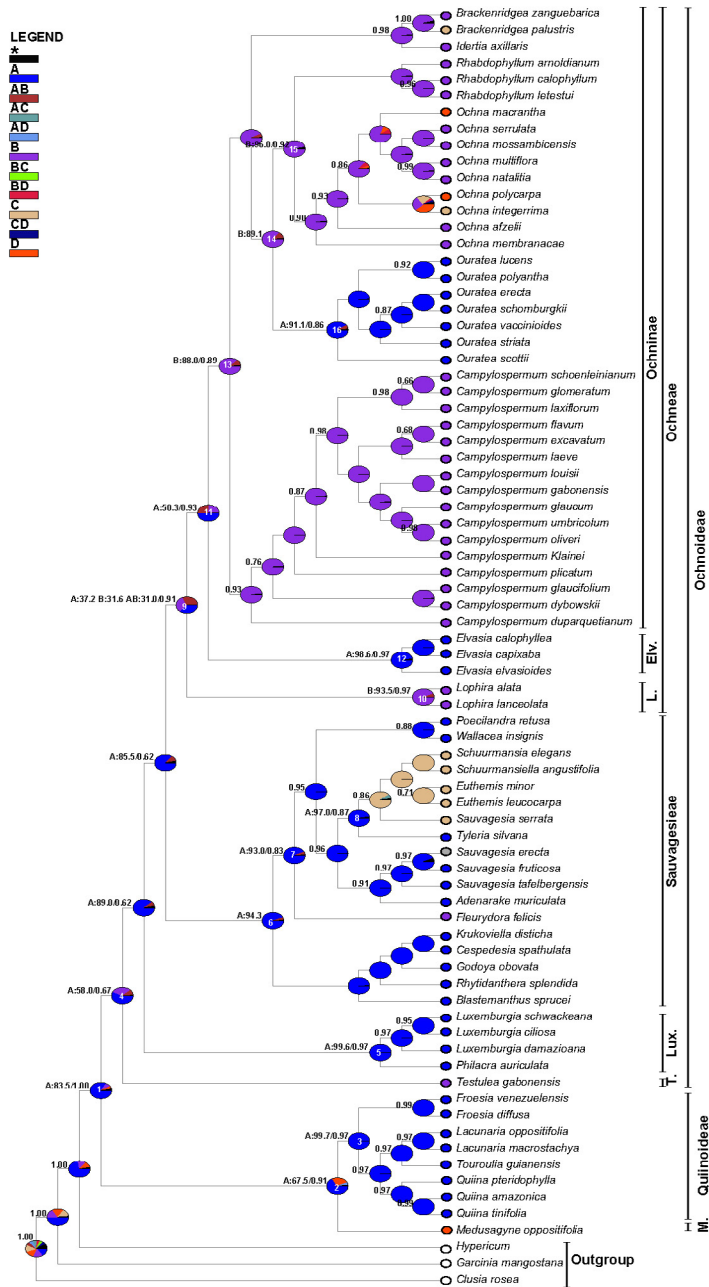
**Figure 1:** Biogeographical regions.





### Ancestral area reconstruction

The results of the biogeographic analyses suggested a minimum of 28 dispersal and 14 vicariance events to explain the current distribution of Ochnaceae (Fig. 3). RASP inferred that the modern Ochnaceae originated in America (A) with a marginal probability of 83.5 % (Fig. 3, node 1).



**Figure 3:**

Cladogram showing the ancestral distributions at each node of the phylogeny of Ochnaceae obtained by BMM. Letters indicate ancestral ranges at different nodes follow by their support values. Numbers at the right side of the slash are posterior probabilities (PP above 0.6) of Bayesian inference. Numbers inside the pie correspond to node numbers in figure 2. The pie chart colours indicate the marginal probabilities of different ancestral areas at each node. The distribution area of each taxon is indicated at their branch tips. Geographical areas not covered by Ochnaceae are in black (\*).

All backbone nodes are also inferred with an origin in America (A). Node 2 is the crown node of Medusagynoideae and Quiinoideae, has a marginal probability of 67.5% and the RASP analysis indicates that a vicariance event took place at this node. The MRCA of Ochnoideae (Node 4) has a marginal probability of only 58.0 %. The RASP analysis suggests a vicariance event has also taken place at this node. Node 5 represents members of Luxemburgieae and the ancestor at this node originated in America (A) with a probability of 99.6 %. The ancestral reconstruction at node 9 (clade Ochneae) is ambiguous; three ranges, A (37.2 %), B (31.6 %) and AB (31.0 %), are reconstructed. The ancestral areas of the most important nodes in terms of taxonomic classification are represented in table 3.

**Table 3.** Marginal probability of reconstructed ancestral areas for selected nodes in the phylogeny of the Ochnaceae. Node numbers correspond to those in Figure 3.

Node number	Clade	Ancestral area	Marginal probability (%)
(1)	Crown Ochnaceae	Neotropics	83.5
(2)	Medusagynoideae-Quiinoideae	Neotropics	67.5
(3)	Quiinoideae	Neotropics	99.7
(4)	Ochnoideae	Neotropics	58.0
(5)	Luxemburgieae	Neotropics	99.6
(6)	Sauvagesieae	Neotropics	94.3
(9)	Ochneae	Neotropics/Africa/ Neotropics-Africa	37.2/31.6/31.0
(10)	Lophirinae	Neotropics	93.5
(12)	Elvasiinae	Neotropics	98.6
(13)	Ochninae	Africa	88.0

## 6.4 Discussion

Age estimates can be influenced by different sources of errors potentially present at many of the steps in the process of molecular dating. Our dating analyses are not exempted from these potential problems. For example, fixing the calibration point at the crown node (node 1) resulted in an estimation of the age of the root node at around 150 Ma, which is comparatively old as the first appearance of Angiosperms is between 141 and 154 Ma (Bell et al. 2010). Although molecular dating methods tend to overestimate divergence times (Rodríguez-Trelles et al. 2002), this age estimate obviously seems an indication of the presence of bias and may imply that the dating of other nodes may also be skewed. Moreover, the long branch between the stem node and the Ochnaceae crown node reflects some 30 million years of absent branching events, either caused by an actual lack of divergences or by extinction events. This is a fundamental problem with no obvious solutions (Givnish and Renner 2004) hindering

the reconstruction of the biogeographic history of the family with confidence, i.e. with high support values, especially to satisfy our interest in the ancestral area of the family. As such, the distribution data of the outgroup was not relevant in our analyses because of the uncertain affiliations and unknown events that may have occurred on the long branch between the stem and crown group of Ochnaceae.

Nevertheless, there is strong support for the hypothesis that Ochnaceae originated in America (A, Fig. 3). All backbone nodes of the phylogenetic tree have their inferred origin in the Neotropics, strongly suggesting this is the ancestral area of the family. Early dispersal to Africa led to the development of Testuleeae, around 69 Ma, in the late Cretaceous. Later on, other dispersal events to Africa and beyond took place (discussed above).

As for the questions related to the dispersal routes Ochnaceae used to move between continents, one hypothesis is that the Ochnaceae disjunction is the result of a boreotropical migration. This would imply that Ochnaceae were part of a boreotropical flora present in the Northern Hemisphere during periods when climate supported tropical forest in the late Cretaceous and early Palaeogene. During that time, the global climate was warm (Zachos et al. 2001) and tropical vegetation was present at much higher latitudes than today (Wolfe 1975; Tiffney 1985). The cooling of the climate during the late Eocene (Zachos et al. 2001) caused the tropical taxa to move south toward the equator or to go extinct. It has been suggested that this flora was replaced by a frost-tolerant temperate flora around 40 Ma (Wolfe 1975, 1980; Morley 2000). Being frost-intolerant plants and knowing that phylogenetic biome shifts are rare (Crisp et al. 2009), it is more likely that Ochnaceae would have retained their ancestral ecological preferences and receded into the southern Hemisphere toward more suitable, warm habitats. Therefore, the absence of specific Ochnaceae fossil evidence from the boreotropical region does not preclude the assumption that this family was once part of that flora.

The early divergence events in crown group Ochnaceae fall in a period around the K-T boundary (66 Mya), suggesting that most of the Cretaceous representatives of Ochnaceae had gone extinct during the mass extinction event and that all of the crown group taxa originated thereafter. Such a scenario would also explain the long branch between stem and crown group Ochnaceae.

For American organisms, the North Atlantic Land Bridge (NALB) has been postulated as a potential dispersal route towards the Old World. Examples, based on molecular and fossil data, to support that the NALB may have been available to many angiosperm plants are found, for example, in Annonaceae and Rhamnaceae (Richardson et al. 2004), Malpighiaceae (Davis et al. 2002), Lauraceae (Chanderbali et al. 2001), and Rubiaceae (Smedmark et al. 2010). This route has also been viewed as a key to the understanding of disjunct distribution patterns between eastern Asian and eastern North American taxa (Tiffney 1985).

For Ochnaceae, dispersal from America to Africa should have started with migration from northern South America to North America via the oceanic Caribbean plate, the proto Greater Antilles (early Eocene, about 57-48 Ma) and/or GAARlandia (the Greater Antilles and a now submerged Aves Ridge connecting Cuba, Hispanolia and Puerto Rico to mainland South America) that was available during the Eocene-Oligocene (Graham 2003a, b; Ali 2012). After passing the NALB, migration from Europe into Africa may have followed the Tethyan dispersal route, which existed until the Late Eocene (Morley 2003).

An alternative explanation for the migration of Ochnaceae to be explored is long distance dispersal (LDD) from South America directly to Africa across the Atlantic, or vice versa (e.g. (Givnish and Renner 2004; Renner 2004; De Queiroz 2005). During the Tertiary, Africa and South America were not connected by land. However, a series of islands may have acted as stepping-stones throughout the late Cretaceous and the beginning of the Tertiary (Parrish 1993; Morley 2003). Those land connections were possibly located in the region of the Walvis Ridge (a stretch from Angola to Brazil/Rio-Grande), and the Sierra Leone Ridges (Morley 2003). This would have allowed proximity of land masses between the east coast of South America and the west coast of Africa. Evidence of plant as well as vertebrate dispersal across the Atlantic by wind and sea currents was reported in Renner (2004). She states that vertebrates (rodents and monkeys) must have travelled between continents and it is not excluded that Ochnaceae could have rafted along as well. LDD is thought to be an event of rare occurrence (Nathan 2006) predictable if knowledge of dispersal mode (wind, birds, oceanic drift or rafting) and other factors such as the organism's natural environment and biology are known (Gillespie et al. 2012). Ochnaceae are probably dispersed by wind or birds (Amaral and Bittrich 2014) but, unfortunately, evidence on the exact dispersal vector (wind or bird type) is not available making it difficult to state that LDD across the Atlantic has played a role in the distribution of Ochnaceae. Due to these limitations and our current data, LDD across the Atlantic is weakly tenable as a hypothesis to explain the disjunct distribution of Ochnaceae.

By consequence, we postulate that Ochnaceae colonized the Old world through the NALB. This route may have served as a migration route of Ochnaceae lineages at different times. *Testulea*, and *Fleurydora* independently dispersed into Africa and could have used the NALB, which according to dating analysis was available for all two (late Cretaceous to early Oligocene).

This same dispersal route might have been taken by the Medusagynoideae to arrive in the Seychelles Island, which is estimated to have originated around 85 Mya (Braithwaite 1984). Time estimates suggest that Medusagynoideae originated in the early Paleocene. The ancestral lineages of modern Medusagynoideae could have migrated, along with

the boreotropical flora, between North America and Eurasia via the NABL or the Bering Land Bridge (BLB) connecting Asia and North America (Tiffney and Manchester 2001). During the cooling period in the late Eocene, the ancestral lineages of Medusagynoideae could have moved toward south Asia as a response to the cooling. It is more likely, that these ancestral lineages migrated from South Asia to the Seychelles via the collision of Indian Plate with Asia, which happened around 50-39 Ma (Morley 2003). The separation of India and the Seychelles was completed around 62 Ma (Collier et al. 2008). This suggests that few dispersal events happened to explain the current occurrence of the Medusagynoideae in the Seychelles. The presence of islands such as Maldives, Chagos archipelago and Saint Brandon between India and Seychelles (Warren et al. 2010) could have facilitated dispersal of Medusagynoideae between India and the Seychelles.

Finally, it is noteworthy to mention the amphi-pacific relationships observed in the Ochninae and Sauvagesieae clades. Within Sauvagesieae, our molecular dating analyses inferred the age of the split between the Asian species (*Schuurmansia*, *Schuurmansielli*, *Sauvagesia* and *Euthemis*) and their neotropical sister (*Tyleria*) in the Early Miocene, around 21.4 Ma (Fig. 2, node 8). This amphi-pacific split is too young and could not result from the disruption of the boreotropical ranges during the mid/late Eocene (Wolfe 1975; Tiffney 1985). However, one possible explanation for this disjunctive distribution is LDD involving the BLB. Based on marine data, this route was available from at least the early Paleogene (c. 60 Ma) until its closure between 7.4 and 4.8 Ma. However, Tiffney and Manchester (2001) doubt that the BLB was available as a migration route for tropical taxa. It may have been located too far north, between 69° and 75°, where a long period of winter darkness would have posed a barrier for evergreen angiosperms to cross. Moreover, fossil evidence showing that tropical taxa have existed in the region is scarce and questioned (Tiffney and Manchester 2001). A second alternative explanation is LDD dispersal through the Pacific Ocean. Examples of clades that display amphi-pacific distribution are reported by (Givnish and Renner 2004; Qian and Ricklefs 2004; Davis et al. 2005). The red drupes of *Euthemis* are probably ornithochorous whereas the seeds in capsular fruits of *Schuurmansia*, *Schuurmansielli*, and *Sauvagesia* are probably dispersed by wind. The latter may thus allow LDD, although some seeds can be dispersed by mechanisms for which they do not show any adaptation (Higgins et al. 2003). Still, LDD seems a likely hypothesis explaining the distribution pattern within Sauvagesieae.

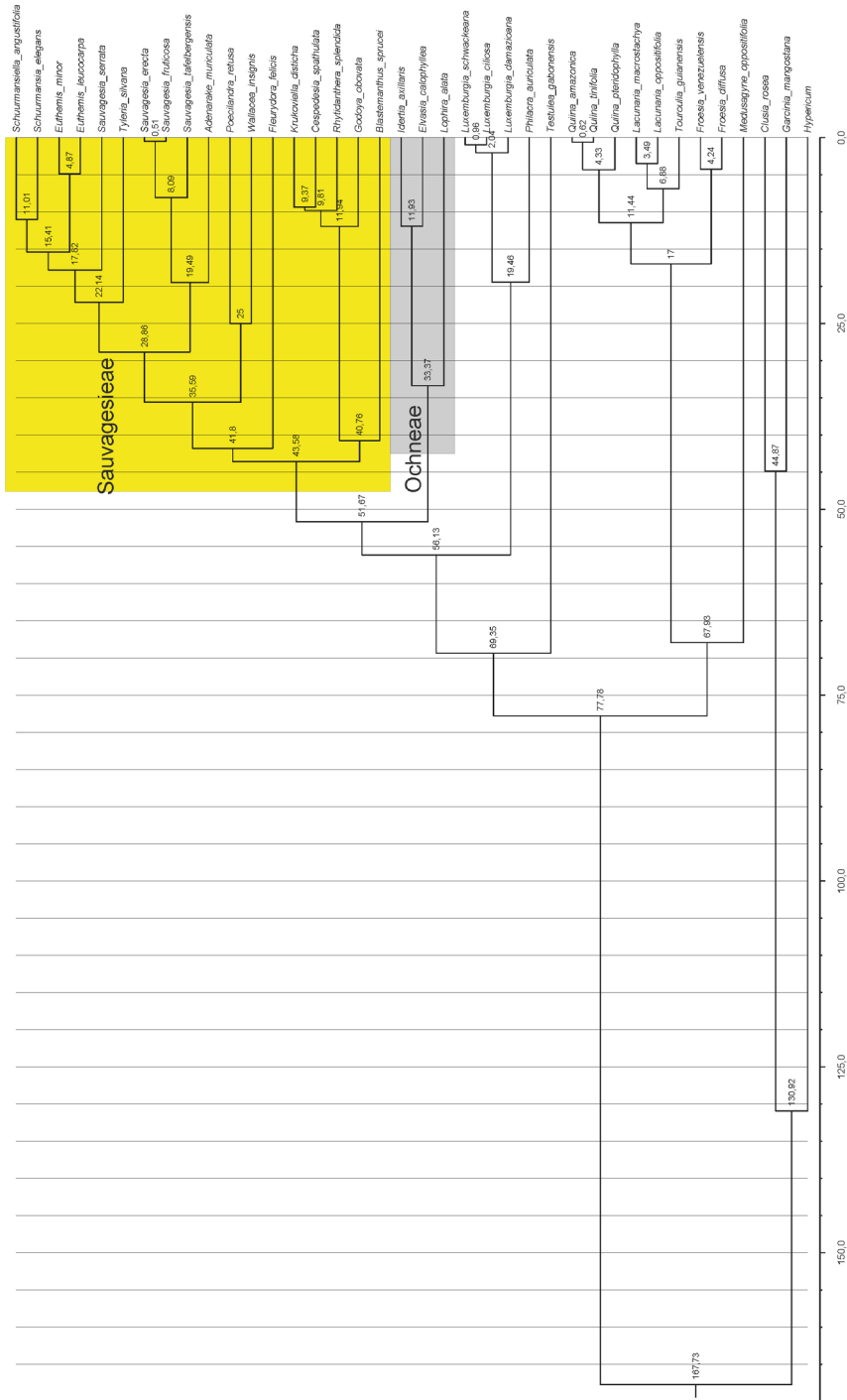
LDD might also be involved in shaping the observed distribution pattern of Ochninae (node 13). Time estimates suggest that the Ochninae diverged in the mid to late Miocene. Although the Ochninae backbone is poorly resolved, most likely explanation for the occurrence of a Neotropical clade *Ouratea* (node 16) in an otherwise African-Asian subtribe is dispersal back to America. Here, again, the NALB seems to have been available as a conduit for the migration of the ancestor of *Ouratea* in the mid-Miocene

since their MRCA originated in Africa around 15 Ma (95% HPD: 11–20.6 Ma). The NALB was hypothesized to have facilitated range expansion of some Malpighiaceae lineages with Miocene divergence times (Davis et al. 2002). Of course, long distance dispersal right across the southern Atlantic Ocean cannot be ruled out. Finally, subsequent oceanic dispersals out of Africa to Madagascar, and India to Southeast Asia occurred and explained the distribution patterns of *Brackenridgea*, *Campylospermum* and *Ochna*. During the late Miocene, Comoros might have facilitated dispersals between Madagascar and Africa, and via Mascarene and Seychelle islands for dispersal between Madagascar and India to Southeast Asia (Warren et al. 2010; Buerki et al. 2013).

## 6.5 Conclusion

Our study indicates that Ochnaceae originated in the Neotropics and started to expand their range to the Palaeotropics during the late Cretaceous and early Paleocene. Its present-day distribution pattern is likely to be mainly the result of boreotropical migration through the NALB. Our study on Ochnaceae adds to the growing body of evidence for tropical plant groups using the NALB to spread between Old and New World continents during post-Gondwanan times. Further, Ochnaceae genera are generally restricted to a particular continent. The distribution pattern of most of its extant taxa is unlikely to have been influenced by transatlantic long-distance dispersal. However, the distribution patterns observed for the Ochninae and Sauvagesieae, although their divergence time estimations may not be accurate because of the weak phylogenetic support, would be best explained by LDD. Finally, suggestions to improve our dating results may come from the use of different dating analyses, choice of calibration point, improved taxon and gene sampling, and most importantly a proper Ochnaceae fossil.

## 6.6 Supplementary data



**Figure 4.** Chronogram of the long-branch (LB) Sauvagesieae as inferred by BEAST.





# Chapter 7

General discussion



## 7.1 Introduction

The natural world and our human society are often considered as opposing entities with competing claims for natural resources (Giller et al. 2008). However, they are heavily intertwined, evolving side by side since they coexist on the same planet, Earth. Hence, they should better be considered as parallel and/or complementary worlds and it is important, also for our own well-being, to know what nature encompasses and may have to offer both in direct benefits (medicine and food, resistance genes, building materials, etc.) as well as indirect ones (mind-relaxing experiences, carbon storage, etc.).

Systematists have set out to understand the complexity of our natural world. Their mission is to discover, describe and inventory species diversity (Daly et al. 2012), to increase our knowledge of earth's species (Pitman and Jørgensen 2002; Chapman 2009; Stuart et al. 2010; Mora et al. 2011), to understand the origin of the biogeographic and evolutionary patterns of this diversity (Sanmartín and Ronquist 2004; Buerki et al. 2013), to identify biodiversity hotspot (Myers et al. 2000; Küper et al. 2004; Joppa et al. 2010), and to define specific approaches to setting conservation priorities (Mittermeier et al. 1998; Myers et al. 2000; Brooks et al. 2006). These goals have entered various work programmes of the Convention on Biological Diversity (<http://www.cbd.int>) and are pivotal for the realisation of the goals of the United Nations Decade on Biodiversity 2011-2020 (<http://www.cbd.int/2011-2020>).

Within this broader framework, we may ask what this thesis contributes in terms of species discovery, description and our understanding of nature. Below, this is discussed for the different components of the thesis, along with suggestions for further improvement and extension.

## 7.2 Molecular phylogeny of the pantropical family Ochnaceae

When aiming at understanding how earth's biodiversity has evolved, we need to unravel phylogenetic relationships; a huge task indeed. A phylogenetic tree represents a hypothesis about the relationships between taxa that diversified at a specific time as a result of a historical event. Since theoretically the correctness of such a hypothesis cannot be tested using experiments (see (Cleland 2001) we need to obtain as much data as possible from our objects, species, clades, individuals, etc. to find out what is their most likely diversification pattern. The available information is fed into phylogenetic analyses and the results are graphically represented in a phylogenetic tree. The likeliness of the correctness of the hypotheses about the evolution within the group concerned is then obtained. By providing our hypothesis on the evolution within the Ochnaceae, we thus provide a small contribution that adds up to our knowledge about the origin of the present-day natural diversity.

The family Ochnaceae belongs to the order Malpighiales, which is one of the most diverse orders among the Rosids. It includes a wide range of ecological diversity such as the odd aquatic family Podostemaceae, holoparasites (Rafflesiaceae) and cactus-like succulent plants (within Euphorbiaceae). At the onset of this study, the molecular phylogenetic relationships among the families of Malpighiales, including those of the Ochnaceae, were not well supported (APG III 2009). To date, there seems to be good support for the position of Ochnaceae being sister to a clade including amongst others the Clusiaceae (=Guttiferae) and Hypericaceae (Xi et al. 2012). The relationships within Ochnaceae were equally unresolved or even unknown, which formed the cause and justification for our choice to study this group.

A first prerequisite to resolve phylogenetic relationships at a given taxonomic level is to provide a sufficiently large taxon sampling for that group. We provided for the first time a comprehensive taxon sampling of Ochnaceae, covering nearly 94% of the genera to resolve relationships and circumscription of Ochnaceae which consists of three subfamilies: Medusagynoideae Reveal, Quiinoideae Luer and Ochnoideae Burnett. Species-level relationships and diversification patterns are still in need of further investigations since only 14% of the species were included.

Second, the choice of appropriate DNA markers is crucial for phylogenetic inference. At the onset of this study, the chloroplast *trnL-F* region had proven to be an appropriate marker in the molecular phylogenetic study of Quiinaceae (Schneider et al. 2006), and we decided to use this marker along with several others. This resulted in the construction of two data sets. The first one was produced in cooperation with the Senckenberg Research Institute at Frankfurt (Schneider et al. 2014) and contained sequence data for four plastid markers (*matK*, *ndhF*, *rbcl*, *trnL-F*) and part of the nuclear ribosomal DNA cistron (including ITS1, 5.8S, ITS2). It contains 79 terminal taxa and three representatives of the closely related clusioid clade, which were chosen as outgroups. The resulting phylogeny was presented in Chapter 4. The second data set had a taxon sampling focussing on Ochninae and was composed of three plastid gene regions (*matK*, *rbcl* and *trnL-F*). It had a total of 87 terminal taxa, including two relevant outgroups from the Malpighiaceae. Results of the analysis of this set were presented in Chapter 5.

Regarding the choice of markers, our analyses based on combined chloroplast and nuclear markers showed better resolution than those based on chloroplast markers alone. This is not surprising because, due to the higher substitution rate, ITS adds a large number of variable sites and is thus better suited to provide resolution at lower taxonomic levels. However, some chloroplast genes, such as *atpB*, *matK*, *ndhF* and *ycf1*, also contain high levels of genetic variation capable of resolving intergeneric as well as inter-specific relationships (Neubig et al. 2009; Soltis et al. 2011). Unfortunately, using

*matK* and *rbcL* failed to produce strong support values for clades within the Ochnaceae (chapter 5) as the variability of those markers is insufficient. Furthermore, the difficulty in resolving relationships within Ochnaceae might be attributed to a relatively recent and explosive radiation given the age estimates and species-richness of several of its clades. Unfortunately, not all commonly used angiosperm genetic markers are able to resolve such radiation. However, genomic-based approaches have proved to yield significant resolution in both recent and ancient rapid radiations (Parks et al. 2009; Xi et al. 2012; Nadeau et al. 2013). Within Malpighiales, Xi et al. (2012) sampled several plastid genes from *Medusagyne* (71), *Ouratea* (79) and *Quiina* (52) with plastid genome coverage of 89, 93 and 73% respectively. These data already provide a variable repertoire of genomic sequences that might well be able to further refine the phylogenetic tree and/or provide stronger support of some of the clades within Ochnaceae. This will require generating a huge amount of genomic sequences, which can nowadays be delivered fast and at comparatively low cost using next-generation sequencing technologies (Davey et al. 2011; Stull et al. 2013).

### 7.2.1 Phylogeny of the subtribe Ochninae

One of the research questions of the current study was to clarify the phylogenetic position of the genus *Campylospermum* within the Ochnaceae. In chapter 4 and 5 we presented the results of the molecular phylogenetic analyses, which have positioned *Campylospermum*, along with the genera *Brackenridgea*, *Idertia*, *Ochna*, *Ouratea* and *Rhabdophyllum*, in the subfamily Ochnoideae, tribe Ochneae, subtribe Ochninae. The six genera resolved into six different clades, though with weak support values. This is probably due to a low level of DNA sequence divergence of the markers we used, or for reasons discussed further in this section. The trees generated in chapter 4 and 5 were based on concatenation methods. All genes and data partitions were combined into single supermatrix prior to the analyses. This was done in order to obtain a total evidence tree of the Ochnaceae phylogeny, as advocated by (Kluge 1989; Kluge 2004). Studies using this procedure have proved to perform well because they resolve shallow and deep branches in the tree (Chen and Li ; Rokas et al. 2003). However, the correctness of concatenating all types of DNA sequences has been questioned, especially those from rapidly divergent clades (Kubatko and Degnan 2007). For instance, Degnan and Rosenberg (2006) have shown that for any species tree of five or more taxa, there exist branch lengths in species trees for which gene trees that do not concord the species tree are more common than gene trees matching the species tree. It is obvious that, as commented by Edwards (2009), gene trees will always differ from one another, even when topologically congruent. Phylogenetic analysis of concatenated sequences is thus more likely to mislead inference of species relationships (Kubatko and Degnan 2007). The cause of conflict between gene trees and the species tree is

known to molecular systematics and well-reviewed, for example by (Maddison 1997; Degnan and Rosenberg 2009). One of the causes, which could be related to our data, is deep coalescence. Indeed, the uncertain relationships among the Ochninae and the short branches observed in the phylogenetic tree could be viewed as a problem of deep coalescence, also called incomplete lineage sorting (Maddison 1997; Nichols 2001). Deep coalescence is the failure of gene copies to coalesce (when travelling backwards in time) within the lifetime of a species, but instead coalesce in an ancestral species (Pamilo and Nei 1988; Maddison 1997; Nichols 2001). Evidence for deep coalescence is very common in many phylogenetic trees, particularly those depicting sufficiently short branch lengths (Jennings and Edwards 2005; Pons et al. 2006; Hobolth et al. 2007; Xi et al. 2013).

This highlights the need to account for gene tree/species tree conflicts when reconstructing the Ochnaceae phylogeny. As such, coalescence based phylogeny, as an alternative to concatenation methods, could represent an option for further study. Models to estimate phylogenetic trees under coalescence have emerged (Liu and Pearl 2007; Liu et al. 2009; Xi et al. 2014) and have broad attention from the systematic community (Edwards 2009; Wu et al. 2013; Springer and Gatesy 2014). In general, the phylogenetic tree of species contains smaller gene trees within its branches (Maddison 1997), and, as a consequence, phylogenetic reconstruction of species based on multiple genes should incorporate the probability distribution of each gene tree given the phylogeny of the species (Maddison and Knowles 2006; Liu and Pearl 2007; Liu 2008; Degnan and Rosenberg 2009; Kubatko et al. 2009). Thus, for future investigations in the Ochninae phylogeny it might be necessary to combine all of these elements to arrive at a good estimate of its phylogenetic tree.

### 7.2.2 Biogeography of Ochnaceae

Estimating the divergence time of a taxon may offer explanations from the geological or palaeoclimatological domain to uncover and understand the patterns of diversification within that group. This requires a well-supported phylogenetic tree, as well as inferences of ancestral areas and assumptions on the direction of movement of taxa (Smith 2009; Smedmark et al. 2010; Bartish et al. 2011; Li et al. 2011; Smedmark et al. 2014).

#### *Species diversification*

Our molecular age estimates for Ochnaceae have shown that early diverging branches, *Testulea* and *Medusagyne*, respectively, have an age of around 69–64 Ma, corresponding to the late Cretaceous-early Paleocene. Most of the genera have diverged in the Eocene and Oligocene or late Miocene. The genera as well as species richness are not evenly distributed across the various main clades of the family. *Medusagynoideae* is a monotypic subfamily, thus includes a single species. The *Quinoideae* include 55 species in four

genera, whereas the Ochnoideae comprise about 500 species in 27 genera. The latter does not only include the three most species-rich genera *Campylospermum* Tiegh. (c. 50 spp.), *Ochna* L. (c. 80 spp.) and *Ouratea* Aubl. (c. 200 spp.) but also the monogeneric tribe Testuleeae, two subtribes Lophirinae, Elvasiinae and one monotypic genus *Fleurydora*. Such unequal distribution of genera and species over clades has generally been explained by a combination of continental drift, dispersal events, climatic changes, geological activity as well as diversification processes (speciation and extinction rate) in time and space (Plana 2004; Ricklefs 2004; Alfaro et al. 2009; Baker and Couvreur 2013). Within Burmanniaceae (Merckx et al. 2008), Brassicaceae (Couvreur et al. 2010), Proteaceae (Sauquet et al. 2009), and Rosid clades (Wang et al. 2009) species diversification rates were hypothesized to first have had an early and rapid increase followed by a decrease. In palms however, show increased diversification rates in recent times (Baker and Couvreur 2013), whereas within Annonaceae clades, a constant rate model of diversification was suggested (Couvreur et al. 2011). This makes us wonder what rate changes took place during the evolutionary history of the Ochnaceae. It was postulated that the diversification rate in Medusagynoideae has slowed down (Xi et al. 2012). In contrast, species richness in Ochnoideae may be attributed to an acceleration of the diversification rate. However, for a full understanding of their phylogeny, it seems worth to investigate whether the diversification rate within this subfamily steadily increased, or whether there were diversification peak moments. A stepwise approach based on the Akaike Information Criterion (AIC) implemented in MEDUSA (Alfaro et al. 2009) could be used to detect such shifts of diversification rate. MEDUSA is a comparative method that integrates phylogenetic information about the timing of splits along the backbone of the tree with taxonomic richness data to estimate rates of speciation and extinction and it is suited for incompletely resolved phylogenies (Alfaro et al. 2009). An analysis of the patterns of Ochnaceae diversification using MEDUSA will require the integration of the approximate number of accepted species for each subfamily and genus with the time-calibrated tree. This analysis will generate the Ochnaceae diversity tree in which shifts in birth (speciation) and death (extinction) rates would be identified. Investigating the changes in tempo of Ochnaceae diversification would provide a framework for assessing hypothetical explanations of Ochnaceae radiation and help to understand the drivers behind speciation processes within this family and its clades.

### **Ancestral area reconstruction**

Chapter 6 provides strong support for the hypothesis that Ochnaceae originated in South America. The program BBM was preferred instead of S-DIVA, and used trees generated in BEAST. Our reconstructed ancestral area analysis has recovered 28 dispersal and 14 vicariance events using BBM implemented in RASP. One could question whether similar figures could be reached using the maximum likelihood framework Lagrange (Ree et al.

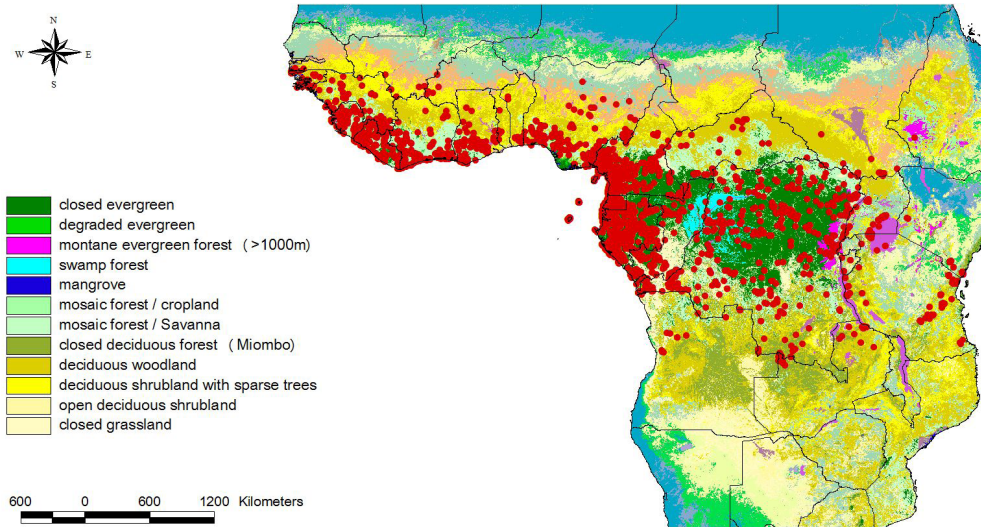
2005; Ree and Smith 2008) which, in addition to the geographic areas occupied by the extant taxa, defines area ranges on the basis of adjacency or connection of these areas at different time periods. With Lagrange, a connection can be modeled as a function describing the probability of dispersal success between two areas through time (Ree et al. 2005). As such, two connectivity scenarios could be considered. The first would require a probability function of allowing any movement between areas at any time. The second would constrain movement between North America and Europe across the NALB after the Eocene, 34 Ma (Tiffney and Manchester 2001). The analysis would estimate the probability of successful dispersal between areas and allow to not invoke unsuccessful dispersal scenarios.

- Biogeography of *Campylospermum* and its centre of diversity in tropical Africa

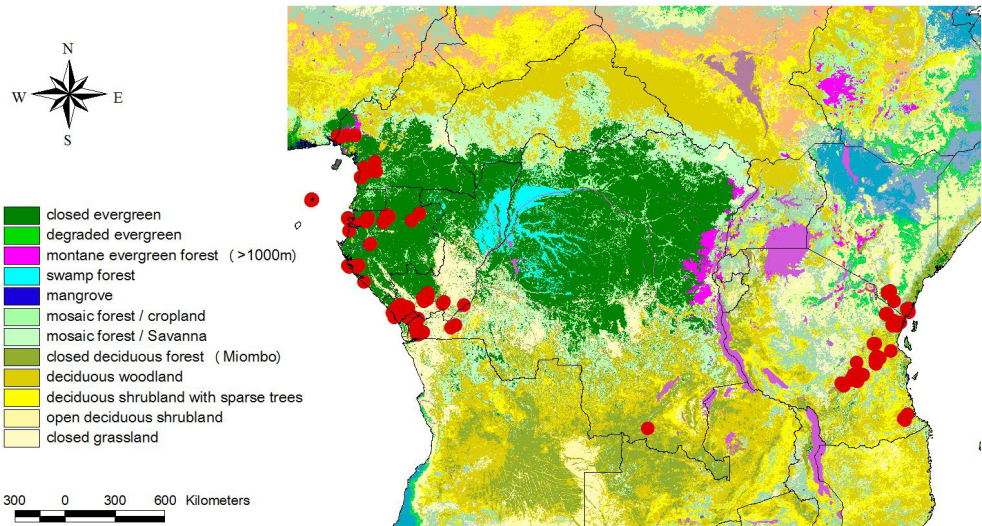
The continental African species of the genus *Campylospermum* occur from Senegal to Angola and from Ethiopia to Zambia (Fig. 1), with highest diversities in regions covered by evergreen forest. They are distributed within three biogeographic areas, the Congolian region, the Sudanian region and the Zambezan region, all sensu (Linder et al. 2012). Widespread species such as *C. reticulatum* and *C. vogelii* are found in all three biogeographic regions, but most are restricted to only one. No species is restricted to the Sudanian region; the occurrences there all relate to outlier populations of more drought-resistant species that have their main distribution centre within the Congolian region. Relatively few species, such as *C. bukobense*, *C. lunzuensis* and *C. plicatum*, are distributed across the Congolian and Zambezan region. Five species (*C. andongensis*, *C. lutambensis*, *C. sacleuxii*, *C. scheffleri*, *C. warneckeri*) are endemic to the Zambezan region while the majority (38 species, about 81%) of *Campylospermum* species is restricted to the Congolian region. The latter is subdivided into three subregions: Guinea, Congo and Shaba. Eighteen species are restricted to the Congo subregion while three species (*C. amplexens*, *C. congestum* and *C. schoenleinianum*) are endemic to the Guinea subregion. No endemics are known to occur in the Shaba subregion. Species such as *C. calanthum*, *C. duparquetianum*, *C. dybovskii*, *C. elongatum*, *C. flavum* and *C. sulcatum* are more widely distributed and found in both the Guinea and Congo subregions.

The highest concentration of political endemics (species occurring within the borders of a single country) of *Campylospermum* is found in Gabon (four species: *C. gabonensis*, *C. klainei*, *C. louisii*, *C. occidentalis*). *C. nutans* is an endemic of Sao Tomé and Príncipe while *C. claessensii* is endemic to the Democratic Republic of the Congo. In other words, all endemic *Campylospermum* are only known from the Congolian region. Striking is the absence of species endemic to Cameroon, because that country normally has a high percentage of endemics in other plant groups (Cheek et al. 2011). Besides the political endemics, a total of eleven other continental African *Campylospermum* species have a restricted distribution. Eight of them are found in the Congolian region along the coast

of the Atlantic Ocean from the area around the border between Nigeria and Cameroun to Angola (Cabinda) and three from the Zambezi region, mainly from the Eastern Arc mountain range in Kenya and Tanzania (Fig. 2).



**Figure 1.** Distribution map of all herbarium specimen records of continental African *Campylospermum* species, overlaid with the vegetation cover map of Africa.



**Figure 2.** As Figure 1, but restricted to all political endemics and species with a restricted distribution.

From the distribution of the genus *Campylospermum* some general facts can be drawn about its centre of diversity, although the pattern could be affected by possible bias related to the rarity of species, number of collection trips, and collecting strategies of botanists (Haripersaud 2009). Indeed, it is known that estimating species richness is statistically



challenging because it is almost impossible to know how many individuals or samples should be collected to cover all species that are present (Gotelli and Colwell 2001). For the fact that many species may remain undiscovered to any survey of diversity, methods of estimating species diversity have incorporated species accumulation measurements, rarefactions, species richness and density to correct these biases (Chao et al. 2009) and tend to work well when dealing with herbarium specimens (Droissart et al. 2012).

Further analyses of the patterns of *CampylospERMUM* diversity in which these biases are taken into account are needed so that proper reliable areas of diversity and endemism are determined. Nevertheless, the three biogeographic regions show a clear patterning in both species richness and endemism. Our study provides additional support for the Congolian as being a region of high-level diversity and endemics (Linder 2001). This biogeographic region approximately corresponds to the Guineo-Congolian phytochorion delimited by White (1979). The majority of species as well as the majority of endemic species are distributed in the Congo subregion. Even more specific, the actual centre is situated in the Lower Guinea phytoregion as defined by White (1979), which covers the area from south-eastern Nigeria to northern Angola, and as such this area should be regarded as the main centre of diversity of *CampylospERMUM*. Many other genera having species practically confined to rain forest habitats have their centre of diversity in the same area, for instance, *Isolona* Engl. and *Monodora* Dunal (Couvreur et al. 2008). *Anthonotha* P. Beauv and *Isomacrolobium* Aubrév. & Pellegr. (Breteler 2010; Frans J. Breteler 2011); *Octoknema* Pierre (Gosline and Malécot 2011); *Dacryodes* Vahl (Onana 2008); *Heckeldora* Pierre (Wilde 2007) and *Trichoscypha* Hook.f. (Breteler 2001, 2004). Moreover, this region has some endemic genera such as *Aucumea* Pierre (Burseraeae), *Lecomtedoxa* (Pierre ex. Engl.) Dubard (Sapotaceae) and *Testulea* Pellegr. (Ochnaceae). It is worthy to note that, within the Congo subregion, Gabon is the most diverse country because of the exclusively occurrence of endemic *CampylospERMUM* species (Fig. 2). The high diversity of this subregion might be explained by its rather heterogeneous hilly topography and comparatively high rainfall. A second explanation might come from historical factors. In the evolutionary history of the tropical forest of Africa, during the Pleistocene, the various glacial periods may have led to forest fragmentation, isolation and subsequent diversification of its inhabitants (Bush 1994). It is argued that signatures of these historical events are captured in areas identified as potential refugia (Sosef 1994; Robbrecht 1996). It is also suggested that these refugia acted as reservoirs of ancient diversity during glacial periods (Evans et al. 2004), while many species went extinct elsewhere. These refugia may also have played a role in shaping genetic diversity of other organisms, such as the gorilla (Anthony et al. 2007) and montane birds (Bowie et al. 2006). In Gabon, potential refugia are likely located in upland areas such as Massif du Chaillu, Mont Doudou (southern Gabon) and Monts de Cristal in the north-western Gabon and adjacent Equatorial Guinea (Sosef 1994; Maley 1996). The distribution pattern of most endemic *CampylospERMUM* species indeed follows these areas.

The second centre of *Campylospermum* diversity is found in Guinea subregion, separated from the Congo by the boundary placed at the Sanaga River (Cameroon) to the east of Mount Cameroon (Linder et al. 2012). Support for this boundary comes from studies on vascular plants (Lawson 1996), primates (Anthony et al. 2007) and mammals (Kreft and Jetz 2010). Three species are strictly endemic to Guinea: *C. amplexens*, *C. congestum* and *C. schoenleinianum*. The rain forest of the Guinea subregion is divided into two blocks by the so-called Dahomey Gap, a dry area covering Benin, Togo and eastern of Ghana. In our study, the Dahomey Gap is evident from the distribution of *C. calanthum*, *C. laxiflorum*, *C. reticulatum*, *C. sulcatum* and *C. vogelii*, while the species *C. flavum* and *C. glaberrimum* do have some records from within this dryer zone.

The third centre of diversity is found in the Zambezi region, which includes a total of eight species of *Campylospermum*, five of which are strictly endemic. The distribution of these endemic species is confined to coastal and montane East Africa rain forests, except for the interior species *C. andongense*. They were all assessed as being of Least Concern according to the IUCN criteria (Chapter 3), but are located in the two known hotspots from East Africa (Küper et al. 2004; Mittermeier 2005). Thus, knowing that these hotspots were identified based on their high diversity combined with a high threat level (Burgess and Clarke 2000), one may expect this status to change in the near future.

### 7.2.3 Taxonomic revision of the continental African species of *Campylospermum*

In our revision of the continental African species we have recognized 47 species with one species comprising two subspecies. Farrons sectional arrangement based on embryo type was not recognized since different types of embryos appeared to be present within a section (Chapter 3).

Quite a number of new species have been recognized lately (Sosef et al. 2007; Bissiengou and Sosef 2008; Bissiengou et al. 2013), some of which were based on rather recently collected herbarium specimens. Because of that, it is likely to assume that more new species remain to be discovered. Although herbaria generally act as the major facilities for species discovery (Bebber et al. 2010), we expect such species to be discovered from new field work since the collections from almost all relevant herbaria have been studied for the present revision of *Campylopermum*.

There are likely to be  $\sim 5 \pm 3$  million species on Earth (Costello et al. 2013). Estimates of the number of described species vary between 1.4 (Pennisi 2003) and 1.9 million (Chapman 2009). Approximately 390,000 species of plants are thought to occur on our planet, of which about 310,000 have been described (Chapman 2009). Thus, there are still many more species out there that await their discovery and description. As long as these species remain unknown to science, their extinction will not be notified. This

should not be taken lightly, firstly because even unknown species may already provide valuable resources for our human society. For example, even the flower parts and nectar of many plant listed in (Lim 2014) provide conventional or functional food and may also serve as a source of food colorant, additive or nutraceuticals. If unknown species go extinct, we will not be able to know what resources they could have provided. Secondly, species serve as a measurement of biodiversity. They help to distinguish different sorts of habitats and identify areas that are taxonomically under-explored or form a biodiversity hotspot under threat. In Gabon, such areas have been identified by (Sosef et al. 2006; Walters et al. 2011; Lachenaud et al. 2013). Moreover, species are part of an ecosystem, interacting with other living organisms and thus creating interdependencies. The survival of one species may well depend on the presence of one or several others. Members of the Poales for example dominate many terrestrial and aquatic ecosystem (Bouchenak-Khelladi et al. 2014). They have influenced the evolution of hominids, mammals and provide the basis for most human diets (Janis 1993; Bouchenak-Khelladi et al. 2009; Givnish et al. 2010). When a larger number of species go extinct, it will cause disturbance or even the collapse of the entire ecosystem, similar to the collapse of coastal ecosystems due to overfishing (Jackson et al. 2001). Furthermore, species discovery is also important in the light of conservation. The more complete our knowledge is about which species occur in a certain area, the more effective conservation measures will be. Gabon has created 13 National Parks (NPs), representing 11% of its landmass, for conservation (Sosef et al. 2006). Unfortunately, full inventories or even estimates of species richness within these parks are often non-existing for many groups of organisms including plants. The danger of this situation is that, especially in periods of economic crisis, NPs could have their limits reduced because of ignorance about their actual value. The Sierra San Pedro Màrtir National Park in California (Mexico) faced some ambiguity in the park boundaries. About 3000 ha of its landmass, which encompasses mixed conifer stands of high commercial value, was excluded from the park. However, because of habitat loss species occurring within the park boundaries can become threatened or even go extinct (Bojórquez-Tapia et al. 2004). Finally, some claim that the full discovery of Earths species is achievable within 50 years depending on the focus of all taxonomists worldwide and the extinction rate (Costello et al. 2013). Therefore, by unravelling the taxonomy of *Campylospermum*, this study also contributes to this general goal.

- Diagnostic characters

In general, characteristics of the leaf shape and venation, and inflorescence structure are used to tell the species of *Campylospermum* apart. In contrast to many other plant groups, flowers are fairly uniform and do not provide many diagnostic features. Sargent (2004) suggested that flower morphology plays a key role in angiosperm speciation and is correlated with an increase of the diversification rate driven by selection through

pollinator specialization. If such is the case, then floral morphology in *Campylospermum* may not be tightly associated with the formation of new species indicating the absence of a tight relationship with pollinators. It is known, however, that selection by specialized pollinator alone may not be consistent and strong enough to drive adaptive divergence of floral forms (Waser 1998).

- Species identification using DNA barcoding

Species identification and description is generally still achieved through comprehensive taxonomic work (Will and Rubinoff 2004). Within *Campylospermum*, species delimitation was difficult particularly for *C. laxiflorum*, *C. reticulatum* and *C. vogelii* which are considered here as species complexes. The latter two species were previously subdivided into varieties that are not accepted here because there were no clear distinctions between them. All three are widespread and common species, thus occurring in different environmental conditions where they may show slightly different morphological features, rendering the delimitation of these species extremely complicated. Species delimitation can also be addressed by applying phylogeography or population genetics, as is demonstrated by (Dauby et al. 2010; Duminil et al. 2010; Ley and Hardy 2010; Duminil et al. 2012). DNA barcodes rapidly gain interest as an alternative to facilitate the process of species delimitation (Hebert et al. 2004; Barrett and Hebert 2005; Hajibabaei et al. 2006; Smith et al. 2006). A DNA barcode is a short DNA sequence from a standardized part of a specific gene region (Hebert, Cywinska, et al. 2003; Kress et al. 2005). This involves choosing one or a few standard loci that can be sequenced routinely and reliably in a wide diversity of sample sets (Hollingsworth 2011). For animal groups, the mitochondrial gene CO1 is selected as the universal barcode (Hebert, Ratnasingham, et al. 2003). However, the low substitution rate of this mitochondrial DNA hampers its use in plants. Hence, the use of the 2-locus combination of *rbcL* and *matK* (CBOL Plant Working Group 2009) and additional barcodes such as the internal transcribed spacer ITS, *trnH-psbA*, *atpF-atpH*, *psbK-psbI* intron and *trnL* intron are recommended for plant (Kress and Erickson 2007; Hollingsworth 2011; Hollingsworth et al. 2011). For the highly variable species *C. laxiflorum*, *C. reticulatum* and *C. vogelii* DNA barcode sequences could be generated at relatively low cost (Hajibabaei et al. 2005; Ivanova et al. 2006). This should involve the sampling of as many individuals as possible per species, especially from different geographical locations. The resulting DNA barcode sequences might then assist to sort specimens into genetically distinct taxonomic groups (Smith et al. 2005). Specimens that thus do not fit the DNA barcode of a taxonomic species would be subjected to a thorough morphological study. When differences can be detected, one could proceed in describing a new species. However, when a DNA barcode difference cannot be backed up by morphology, this might indicate the presence of a cryptic species and further study is advisable. In conclusion, the use of DNA barcodes is highly advisable for taxonomic studies on species complexes.

- Habit and architecture

Species of *Campylopermum* are small or occasionally larger trees. The majority of them are branched, but some are unbranched (monocaulous). While the inflorescence is generally terminal, they are mostly axillary in monocaulous species. Field observations on two species with axillary inflorescences, the monocaulous *C. elongatum* showed that after fruiting, the old and formerly pendulous inflorescence axis curves up to form a leafy twig. This might indicate that the apparent axillary inflorescences in fact represent terminal inflorescences on axillary twigs. This will need further verification.

Some species of *Campylopermum* act as 'litter-bin' species. Their broader spatulate and cordate leaf bases allow them to collect plant debris fallen from the canopy while often roots are formed which tap into the collected litter. Most of these species are monocaulous (*C. amplexans*, *C. duparquetianum*, *C. elongatum*, *C. klainei*, *C. mannii* and *C. subcordatum*) but some have a normal branched trunk (*C. auriculatum*, *C. oliveri* and *C. schoenleinianum*). While the first carry their leaves crowded at the top of the stem, the latter have relatively well-spaced internodes and litter is collected by only a part of the individuals.

The monocaulous litter-bin species are slow-growing plants; the average growth in height is estimated to be around 5 cm per year (Blanc 2002). As such, the presence of a population of monocaulous *Campylopermum* trees might be a good indicator of the age of the forest (Blanc 2002). The same author suggests monocaulous trees have a smaller change of being damaged by falling branches or trees and thus form a good adaptation to life in the understorey.

A liana-like habit is reported on the labels of some herbarium sheets while few specimens are labelled as being scandent. However, it is difficult to judge the value of these statements, since such a habit could not be confirmed during one of our field trips.

- Ecology and phenology

In continental Africa, species of *Campylopermum* occupy a wide variety of habitats, but most species are found in the understorey of lowland evergreen or sometimes semi-deciduous forest or in forest edges and mixed savannah / forest vegetation. They are often found along rivers and streams, sometimes in swampy or flooded areas, but are absent from open savannah. Their occurrence thus seems to be related to two factors: light and humidity.

The vast majority of the continental African species is found in the lowlands, with only 10 out of the 48 species (21%) occurring at altitudes above 1500 m. The only truly montane species is *C. scheffleri* with an altitudinal distribution of 1400–2150 m. The close association of *Campylopermum* with lowland rain forest may be interpreted as an indication of niche conservatism (NC). This concept is applied when closely related

species share ecological similarities (Ricklefs 2010) and is defined as the retention of niche-related ecological traits over time (Wiens et al. 2010). Moreover, Ochnaceae species with winged seeds occur in open vegetation whereas, species with drupelets are generally found in closed-canopy forest, except for some *Ouratea* spp. and most *Ochna* spp. which occur in savannah-like vegetation (Amaral and Bittrich 2014). Ochnaceae species possibly retained their habitats from those of the ancestral tropical forest species that most likely occurred in warm, wet, closed or open canopy forest in the Mid-Cretaceous (Davis et al. 2005). In Africa, the tropical rainforest was fragmented several times during the Pleistocene glaciations (Sosef 1994; Couvreur et al. 2008). The exclusively occurrence of *Campylopermum* in these forests may be regarded as further evidence of NC. In order to test this hypothesis, environmental niche models that are able to statistically quantify niche (Warren et al. 2008) are required. NC may be an important concept to study speciation, historical biogeography and patterns of species richness (Wiens and Graham 2005). Moreover, understanding which factors control the distribution limits of *Campylopermum* species is crucial to be able to predict their responses to future global climate change.

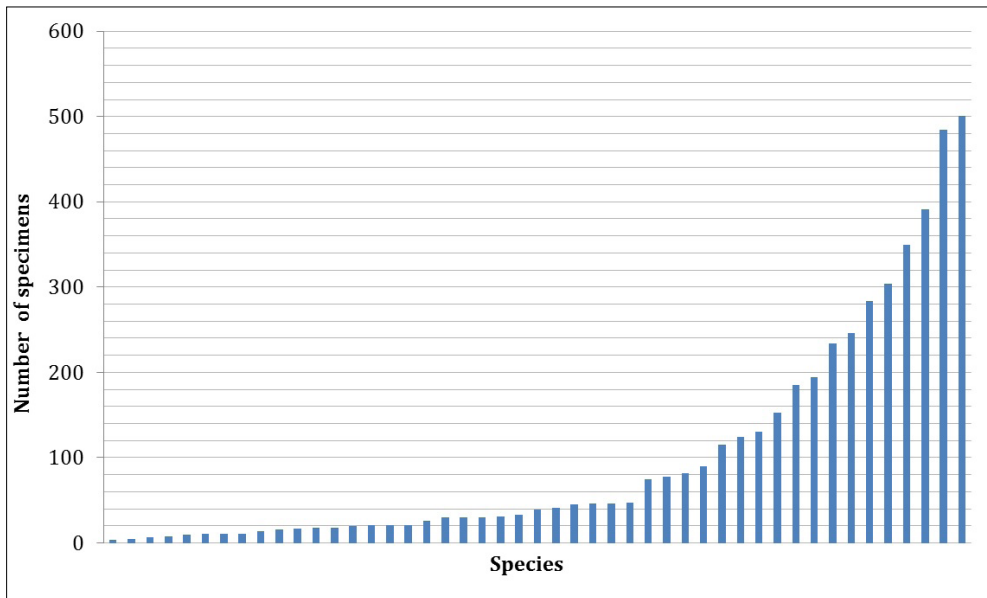
In terms of phenology, flowering and fruiting of *Campylopermum* seems to take place all year round, but the peak flowering period is generally at the start of the rainy season, for instance September to October in Gabon or April to May in Cameroon. Individual flowers are open only during a short period of time, because the petals fall off quickly. Consequently, flowers and fruits from the same individual are rarely collected at the same time.

- IUCN conservation status

In *Campylopermum*, the number of known herbarium specimens per species ranges from only 4 (*C. lutambensis*) to 501 (*C. reticulatum*; Fig. 3). Some 17% of the continental African species of *Campylopermum* are only known from up to twenty specimens (*C. auriculatum*, *C. cabrae*, *C. descoingsii*, *C. klainei*, *C. louisii*, *C. lutambensis*, *C. nutans*, *C. paucinervatum*, *C. occidentalis*, *C. gabonensis*, *C. mannii* and *C. claessensii*). The average number of collections per species is 95. These figures show that the genus is well collected, but discoveries of new populations and even new species are to be expected on a regular basis.

In Chapter 3, a preliminary IUCN conservation status was assigned to all continental African *Campylopermum* species. The assessments were performed based on herbarium specimen data, supplemented with data on protected areas and a limited number of field observations. Most of the conservation assessments fall in the category of Least Concern except for fifteen species that have been assigned to the categories Vulnerable (*C. auriculatum*, *C. gabonense* (subsp. *gabonense* and subsp. *australe*), *C. louisii*, *C. occidentale* and *C. paucinervatum*), Endangered (*C. cabrae*, *C. descoingsii*, *C.*

*klainei*, *C. lutambense* and *C. nutans*) and Near Threat (*C. lecomtei*, *C. longestipulatum*, *C. mannii*, *C. oliveri* and *C. umbricola*). The species from the Vulnerable category are exclusively or partly known from areas exposed to mining and/or logging activities rendering a decline in their AOO and most likely the quality of their habitats plausible. The species categorized as Endangered are known from less than twelve collections and mostly found in unprotected areas. The Near Threat species have been assigned to this category because they are only known from old collections, and so their occurrence needs confirmation. In addition, they have a fairly small distribution area where some of the populations occur outside protected areas.



**Figure 3.** Number of herbarium specimens available per species. Each bar represents a single species of *Campylospermum*.

These assessments provided here can only serve as guidelines indicating areas where specific conservation efforts could be affected. For instance, *Campylospermum* species are relatively well distributed in areas with closed forest (Fig. 1). Species that occur in degraded forest of the Guinean face the largest threats of extinction. Those forests are most severely subjected to anthropogenic actions. Moreover, they are located near the Atlantic coast and outside mountain range, thus they are exposed to easy access by man, suggesting that conservation efforts should be prioritised in that region.

Furthermore, the assessments of the IUCN Red List categories of threat followed the IUCN guidelines (IUCN Standards and Petitions Subcommittee 2013). These guidelines advise to have a cell width of 2 km, but this turns out to be useless when working with herbarium records (Moat 2007) and a grid size of 2 km is often considered as being

too small. However, by using larger grid cells, the AOO of a species known from a single population could easily exceed 10 km<sup>2</sup>. This will then never allow such a species to be assessed as Critically Endangered under criterion B2. Still, we agree with Moat (2007) and others (for example Sosef 2014) and deem the selection of an appropriate cell size for each individual species to estimate their AOO and EOO as the preferred method when using herbarium specimen data.



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## Summary

**Chapter 1** provides an introduction to the organisms studied and the general aims of the project. The family Ochnaceae (Malpighiales) is divided into the three subfamilies Medusagynoideae, Quiinoideae and Ochnoideae, together comprising 32 genera and about 500 species. Ochnaceae are widely distributed in tropical and subtropical forests and savannas of the Old and New World. Medusagynoideae is a monotypic subfamily from the Seychelles Island, Quiinoideae occur in tropical America and Ochnoideae is a pantropical subfamily and includes one of the most species-rich genera: *Campylospermum* with about 55 species.

The goal of this PhD project was to unravel the evolutionary history and the historical biogeography of the family Ochnaceae, with special emphasis on the genus *Campylospermum* and its relationship with sister genera. Because the taxonomy of the species within this genus is unclear, a taxonomic revision was foreseen.

**Chapter 2** presents the taxonomic novelties encountered within the genus *Campylospermum*. These comprise the description of five new taxa: *C. auriculatum*, *C. gabonense*, *C. gabonense* subsp. *australe*, *C. glaucifolium* and *C. occidentale*. Distribution maps of these taxa as well as preliminary assessments of their threat status following the IUCN criteria and guidelines are provided. In addition, new combinations were necessary for nine species: *C. andongense*, *C. costatum*, *C. glomeratum*, *C. longestipulatum*, *C. lunzuense*, *C. lutambense*, *C. nutans*, *C. plicatum*, and *C. warneckeii*, which were formerly assigned to the genera *Ouratea* and *Gomphia*.

**Chapter 3** presents the taxonomic revision of the continental African species of the genus *Campylospermum*. It comprises 48 species, with *C. auriculatum*, *C. gabonense*, *C. louisii* and *C. occidentale* being strictly endemic to Gabon. A key to all taxa was constructed. Vegetative characters such as the leaf shape and venation, as well as inflorescence structure proved most useful to distinguish between species. Each taxon treatment comes with a detailed description, synonyms, typification (occasionally a lecto- or neotype had to be designated), distribution (including a map), habitat, uses, vernacular names, the citation of all specimens studied, and key literature. Additionally, the preliminary assessment of the IUCN conservation status of all species led to the assignment of a level of threat to 14 species. The remainder was categorized as Least Concern.

**Chapter 4** presents a molecular phylogenetic analysis of Ochnaceae s.l. (with 94% of the generic diversity sampled), using four plastid markers (*matK*, *ndhF*, *rbcl*, *trnL-F*) and three parts of nuclear ribosomal DNA (ITS-1, 5.8S, ITS-2). The result of the Maximum Likelihood and Bayesian analyses generally showed strong support for the phylogenetic backbone of the family. A new classification of Ochnaceae, comprising the

subfamilies Medusagynoideae Reveal, Quiinoideae Luer. and Ochnoideae Burnett is presented. The relationships between the monotypic Medusagynoideae and the other two subfamilies are poorly supported, but Ochnoideae and Quiinoideae form strongly supported clades. The analyses show support for a subdivision of the Ochnoideae into four tribes (Luxemburgieae, Ochneae, Sauvagesieae and Testuleae), while within the tribe Ochneae three monophyletic subtribes (Elvasiinae, Lophirinae and Ochninae) can be recognized. The relationships between the genera of the Ochninae are poorly supported. Within Quiinoideae, the genera *Lacunaria* and *Touroulia* formed a clade sister to *Quiina*. A reconstruction of the ancestral character states using Bayesian approaches shows that zygomorphic flowers with adaptations to buzz-pollination, a syncarpous gynoecium, numerous ovules, septicial capsules, and winged seeds with endosperm are the ancestral condition in Ochnoideae.

**Chapter 5** provides a reconstruction of the phylogeny of Ochnaceae s.l., with emphasis on the subtribe Ochninae which contains the genus *Campylospermum*. We used three plastid DNA regions (*matK*, *rbcl*, *trnL-F*) and an intensified taxon sampling for the Ochninae. Our Maximum Likelihood and Bayesian analyses corroborate the phylogenetic backbone previously recognized in Ochnaceae. Within the genus *Campylospermum* two clades can be distinguished. The first comprises the West/Central African *Campylospermum* species while a second includes all East African and Malagasy species along with the West/Central African *C. elongatum*. Thus, there seems to be support for the recognition of subgenera, but we refrained from formalizing this because no Asian and only few of the Malagasy taxa were included in our sampling.

**Chapter 6** aims to explore the possible historical biogeographic events that are responsible for the disjunct distribution of extant Ochnaceae species. To achieve this objective, divergence times within Ochnaceae are estimated and its biogeographic history reconstructed. Using five DNA sequence regions (ITS, *matK*, *ndhF*, *rbcl*, *trnL-F*), a secondary calibration, and relaxed molecular clock models provided by the software BEAST, divergence time estimations are obtained. Subsequently, Dispersal-Vicariance Analysis and Bayesian Binary MCMC implemented in RASP are used to reconstruct the biogeographic history of Ochnaceae. Divergence time estimates indicate that the Ochnaceae originated in the New World while the Old World was most likely colonized via the North Atlantic Land Bridge during periods when climatic conditions allowed the establishment of a boreotropical flora.

**Chapter 7** highlights the main outcomes of all chapters of this thesis and puts them in the perspective of their contribution to society and to the science of systematics in particular. Various suggestions to explore different angles in future investigation are provided. The phylogenetic results presented in this thesis were based on concatenation methods and show that parts of the phylogenetic trees remain poorly supported.

Furthermore, the short internal branches observed may be interpreted as evidence of deep coalescence which can yield misleading results. This implies that further molecular phylogenetic studies are needed. It is also proposed to incorporate phylogenomics (using next generation sequencing data) and coalescent analyses to resolve these weakly supported parts and to reach a reliable estimate of Ochnaceae phylogeny. Species richness is unevenly distributed among the Ochnaceae subfamilies. Ochnoideae have by far the highest species richness, whereas Quiinoideae have relatively few species and Medusagynoideae only one. It is suggested to investigate whether the diversity patterns could be the result of a difference in underlying evolutionary processes influencing diversification rates.

The taxonomic revision provides insight into the biogeographic patterns of the genus *Campylopermum*. The highest level of diversity and endemic species is found in the Congolian biogeographic region, especially in Gabon, where they are located in upland area identified as potential rain forest refugia. The Zambeziian biogeographic region is less diverse and has few endemic species that are mainly found in the Eastern Arc mountain range in Kenya and Tanzania. Most of the *Campylopermum* species occur in lowland, only few are found at altitudes above 1500m.

The distribution of more fine-scale centers of diversity and endemism for the genus *Campylopermum* concur nicely with those postulated for other groups and might be related to Pleistocene climatic fluctuations and their major impact on the extent of lowland rain forest. It could be, however, that these patterns are affected by a collecting bias and further analyses should be performed taking these into account.



## Samenvatting

**Hoofdstuk 1** geeft een inleiding op de bestudeerde organismen en de algemene doelstellingen van het project. De familie Ochnaceae (Malpighiales) is opgedeeld in de drie onderfamilies Medusagynoideae, Quiinoideae en Ochnoideae, die tezamen 32 geslachten en ongeveer 500 soorten omvatten. Ochnaceae zijn wijd verbreid in tropische en subtropische bossen en savannes van de Oude en Nieuwe wereld. Medusagynoideae is een monotypische onderfamilie van de Seychellen, Quiinoideae komen voor in tropisch Amerika en Ochnoideae is een pantropische onderfamilie met daarin één van de meest soortenrijke geslachten: *Campylospermum* met ongeveer 55 soorten.

Het doel van dit PhD project was om de evolutionaire geschiedenis en de historische biogeografie van de familie Ochnaceae te ontwarren, met speciale aandacht voor het geslacht *Campylospermum* en haar relatie met andere zuster-geslachten. Omdat de taxonomie van de soorten binnen dit geslacht onduidelijk is, was een taxonomische revisie voorzien.

**Hoofdstuk 2** presenteert de taxonomische nieuwigheden die we binnen dit genus aantreffen. Deze omvatten de beschrijving van vijf nieuwe taxa: *C. auriculatum*, *C. gabonense*, *C. gabonense* subsp. *australe*, *C. glaucifolium* en *C. occidentale*. Verspreidingskaarten van deze taxa als ook voorlopige beoordelingen van hun bedreigings-status volgens de IUCN criteria en richtlijnen worden gegeven. Daarboven waren nieuwe combinaties noodzakelijk voor negen soorten: *C. andongense*, *C. costatum*, *C. glomeratum*, *C. longestipulatum*, *C. lunzuense*, *C. lutambense*, *C. nutans*, *C. plicatum*, en *C. warneckeii*, welke voorheen waren toegewezen aan de geslachten *Ouratea* en *Gomphia*.

**Hoofdstuk 3** presenteert de taxonomische revisie van de continentaal Afrikaanse soorten van het geslacht *Campylospermum*. Dit omvat 48 soorten, met *C. auriculatum*, *C. gabonense*, *C. louisii* en *C. occidentale* strikt endemisch voor Gabon. Een sleutel tot alle taxa werd vervaardigd. Vegetatieve kenmerken zoals bladvorm en nervatuur, alsook de structuur van de bloeiwijze bleken het meest nuttig bij het onderscheid tussen de soorten. Elke taxon behandeling gaat vergezeld van een gedetailleerde beschrijving, synoniemen, typificatie (soms moest een lecto- of neo-type worden aangewezen), verspreiding (inclusief een kaart), habitat, gebruik, inlandse namen, de citatie van alle bestudeerde exemplaren, en belangrijkste literatuur. Bovendien leidde de voorlopige beoordelingen van de IUCN beschermingsstatus van alle soorten tot de toekenning van een bedreigingsstatus aan 14 soorten. The rest werd ingedeeld in de categorie Least Concern.

**Hoofdstuk 4** geeft een moleculair fylogenetische analyse van de Ochnaceae s.l. (met 94% van de generische diversiteit bemonsterd), gebruik makend van vier plastide merkers (*matK*, *ndhF*, *rbcl*, *trnL-F*) en drie delen van kern ribosomaal DNA (ITS-1, 5.8S, ITS-2).

De resultaten van de Maximum Likelihood en Bayesiaanse analyses tonen doorgaans sterke ondersteuning voor de fylogenetische ruggegraad van de familie. Een nieuwe classificatie van Ochnaceae, met daarin de onderfamilies Medusagynoideae Reveal, Quiinoideae Luerss. en Ochnoideae Burnett wordt gepresenteerd. De relaties tussen de monotypische Medusagynoideae en de andere twee subfamilies zijn zwak ondersteund, maar Ochnoideae en Quiinoideae vormen sterk ondersteunde claden. De analyses tonen steun voor een onderverdeling van de Ochnoideae in vier triben (Luxemburgieae, Ochneae, Sauvagesieae en Testuleeae), terwijl binnen het tribus Ochneae drie monofyletische ondertriben (Elvasiinae, Lophirinae and Ochninae) kunnen worden herkend. De relaties tussen de geslachten van de Ochninae worden zwak ondersteund. Binnen de Quiinoideae vormen de geslachten *Lacunaria* en *Touroulia* een zusterclade van *Quiina*. Een reconstructie van de voorouderlijke kenmerktoestanden middels een Bayesiaanse benadering toont aan dat zygomorfe bloemen met aanpassingen voor “buzz” bestuiving, een syncarpe stamper, veel zaadknoppen, met kleppen openspringende doosvruchten, en gevleugelde zaden met endosperm de voorouderlijke toestand zijn binnen Ochnoideae.

**Hoofdstuk 5** geeft een reconstructie van de fylogenie van Ochnaceae s.l., met nadruk op het ondertribus Ochninae welke het geslacht *Campylosperrum* bevat. We gebruiken drie plastide DNA regio's (*matK*, *rbcl*, *trnL-F*) en een geïntensiverde taxon bemonstering voor de Ochninae. Onze Maximum Likelihood en Bayesiaanse analyses ondersteunen de fylogenetische ruggengraat eerder herkend binnen Ochnaceae. Binnen het geslacht *Campylosperrum* kunnen twee clades worden onderscheiden. De eerste omvat de West/Centraal Afrikaanse soorten van *Campylosperrum* terwijl de tweede alle Oost Afrikaanse en Madagassische soorten bevat samen met de west/Centraal Afrikaanse *C. elongatum*. Dus, er lijkt ondersteuning te zijn voor het herkennen van ondergeslachten, maar we onthouden ons van een formalisatie hiervan, omdat er geen Aziatische en slechts enkele Madagassische soorten in onze bemonstering waren opgenomen.

**Hoofdstuk 6** heeft als doel het ontdekken van mogelijke historisch biogeografische gebeurtenissen die verantwoordelijk zijn voor de disjuncte verspreiding van nu levende Ochnaceae soorten. Om deze doelstelling te bereiken worden divergentietijden binnen Ochnaceae geschat en haar biogeografische geschiedenis gereconstrueerd. Met behulp van vijf DNA sequentie regio's (ITS, *matK*, *ndhF*, *rbcl*, *trnL-F*), een secundaire calibratie, en “relaxed molecular clock” modellen voorzien binnen het programma BEAST, werden schattingen van divergentietijden verkregen. Vervolgens zijn Dispersal-Vicariance Analysis en Bayesian Binary MCMC geïmplementeerd in RASP gebruikt om de biogeografische geschiedenis van de Ochnaceae te reconstrueren. Schattingen van divergentietijden geven aan dat de Ochnaceae in de Nieuwe Wereld zijn ontstaan, terwijl de Oude Wereld hoogst waarschijnlijk werd gekoloniseerd via de North Atlantic Land



Bridge in tijden dat klimatologische condities de ontwikkeling van een boreotropische flora toelieten.

**Hoofdstuk 7** belicht de belangrijkste resultaten van alle hoofdstukken van dit proefschrift en zet die in een perspectief van hun bijdrage aan de gemeenschap en aan systematische wetenschap in het bijzonder. Diverse suggesties om verschillende invalshoeken te exploreren tijdens toekomstige onderzoeken worden gegeven. De in dit proefschrift gepresenteerde fylogenetische resultaten waren gebaseerd op samenvoegende methodes en laten zien dat delen van de fylogenetische boom slecht ondersteund blijven. Bovendien, de waargenomen korte interne takken kunnen geïnterpreteerd worden als bewijs voor diepe coalescentie die misleidende resultaten kan opleveren. Dit impliceert dat verdere moleculair fylogenetische studies nodig zijn. Het wordt ook voorgesteld om fylogenomica (gebruik makend van next generation sequentie data) te incorporeren en coalescentie analyses om deze zwak ondersteunde delen op te lossen en een betrouwbare schatting van de Ochnaceae fylogenie te verkrijgen. Binnen de Ochnaceae onderfamilies is er een ongelijke verdeling van de soortenrijkdom. Ochnoideae hebben veruit de hoogste soortenrijkdom, terwijl Quiinoideae relatief weinig soorten hebben en Medusagynoideae slechts één. Het wordt gesuggereerd om te onderzoeken of deze diversiteitspatronen het resultaat kunnen zijn van een verschil in onderliggende evolutionaire processen die de snelheid van diversificatie beïnvloeden.

De taxonomische revisie geeft inzicht in de biogeografische patronen van het geslacht *Campylopermum*. Het hoogste niveau van diversiteit en aantal endemische soorten wordt gevonden in de Congolian biogeografische regio, vooral in Gabon, waar deze voorkomen in heuvelland dat geïdentificeerd is als potentieel regenbos refugium. De Zambesische biogeografische regio is minder divers en heeft minder endemische soorten, die vooral in de Eastern Arc bergen van Kenia en Tanzania worden gevonden. De meeste *Campylopermum* soorten komen voor in het laagland, slechts enkele worden gevonden op hoogtes boven de 1500 m.

De verspreiding van meer fijschalige centra van diversiteit en endemisme van het geslacht *Campylopermum* komen fraai overeen met die gepostuleerd voor andere groepen en zouden gerelateerd kunnen zijn aan Pleistocene klimaatfluctuaties en hun grote impact op de verbreiding van laagland regenbos. Het zou echter kunnen zijn dat deze patronen beïnvloed zijn door een ongelijke verzamelintensiteit en verdere analyse dient uitgevoerd te worden die daar rekening mee houdt.



## Résumé

**Le Chapitre 1** présente d'une part, le groupe taxonomique étudié et ses sous-groupes, et d'autre part, les objectifs généraux de la thèse. La famille des Ochnaceae (Malpighiales) se subdivise en trois sous-familles, Medusagynoideae, Quiinoideae, Ochnoideae, réparties en 32 genres et 500 espèces. Les Ochnaceae sont répandues dans les forêts et savanes des zones tropicales de l'Ancien et du Nouveau Monde. La sous-famille des Medusagynoideae est monotypique et endémique des Seychelles alors que celle des Quiinoideae est uniquement trouvée en Amérique tropicale. Les Ochnoideae, par contre, sont pantropicales, incluant l'un des genres les plus riches en espèce, le genre *Campylospermum*.

Cette étude a pour objectif de reconstituer l'histoire évolutive et la biogéographie de la famille des Ochnaceae en mettant un accent particulier sur le genre *Campylospermum*, à travers notamment sa relation avec les genres voisins et une révision taxonomique permettant d'améliorer la délimitation de ses espèces.

**Le Chapitre 2** décrit cinq nouveautés taxonomiques rencontrées dans le genre *Campylospermum*: *C. auriculatum*, *C. gabonense*, *C. gabonense* subsp. *australe*, *C. glaucifolium* et *C. occidentale*. Pour chaque taxon, des cartes de distribution ont été réalisées. Le statut de conservation de chaque espèce a fait l'objet d'une évaluation préliminaire selon les critères de l'UICN. De nouvelles combinaisons sont proposées pour neuf espèces: *C. andongense*, *C. costatum*, *C. glomeratum*, *C. longestipulatum*, *C. lunzuense*, *C. lutambense*, *C. nutans*, *C. plicatum* et *C. warneckeii*, qui étaient autrefois classées dans les genres *Gomphia* et *Ouratea*.

**Le Chapitre 3** présente la révision taxonomique du genre *Campylospermum* pour l'Afrique continentale. Le genre comprend 48 espèces africaines, avec *C. auriculatum*, *C. gabonense*, *C. louisii* et *C. occidentale* strictement endémiques du Gabon. Pour chaque taxon sont présentés une description détaillée, une liste des synonymes avec citation des types, la répartition, l'écologie, les usages, les noms vernaculaires, et une liste des spécimens étudiés, et références bibliographiques. Les caractères végétatifs tels que la forme des feuilles et la nervation, ainsi que la structure des inflorescences, sont prépondérants dans la délimitation des espèces. Une clé d'identification des espèces est également proposée. L'analyse du statut de conservation de toutes les espèces a permis d'identifier 14 espèces menacées suivant les critères de l'UICN.

**Le Chapitre 4** présente l'analyse phylogénétique de la famille des Ochnaceae s.l. (94% des genres ont été séquencés), basée sur quatre marqueurs chloroplastiques (*matK*, *ndhF*, *rbcl*, *trnL-F*) et trois nucléaires (ITS-1, 5.8S, ITS-2). Il en ressort que, les résultats du Maximum de Vraisemblance et Bayésiennes montrent un support solide de l'arbre phylogénétique. Une nouvelle classification des Ochnaceae, comprenant les

sous-familles Medusagynoideae Reveal, Quiinoideae Luer. et Ochnoideae Burnett, est présentée. La sous-famille Medusagynoideae est monotypique et occupe une position basale. Les Ochnoideae et Quiinoideae forment un clade robuste. Les analyses montrent également une subdivision des Ochnoideae en quatre tribus que sont: Luxemburgieae, Ochneae, Sauvagesieae et Testuleae. La tribu des Ochneae se subdivise en trois sous-tribus monophylétiques, Elvasiinae, Lophirinae et Ochninae. Les relations de parenté entre les genres de la sous-tribu des Ochninae sont faiblement supportées. Dans la sous-famille des Quiinoideae, les genres *Lacunaria* et *Touroulia* forment un clade qui s'apparente aux *Quiina*. L'inférence des états de caractères ancestraux, en utilisant des méthodes Bayésiennes, suggère que les fleurs zygomorphes, adaptées à la pollinisation par vibration, ayant un gynécée syncarpe, plusieurs ovules, des capsules septicides, et des graines albuminées ailées, sont des caractères ancestraux chez les Ochnoideae.

**Le Chapitre 5** traite de la phylogénie des Ochninae, comportant le genre *Campylopermum*. Trois marqueurs chloroplastiques, *matK*, *rbcl*, *trnL-F* et un fort échantillonnage des Ochninae ont été utilisés. Les analyses de Maximum de Vraisemblance et Bayésienne corroborent l'arbre phylogénétique précédemment reconnu. Deux clades se distinguent chez les *Campylopermum*: le premier comprend les *Campylopermum* de l'Afrique de l'ouest et centrale; le deuxième est constitué des espèces d'Afrique de l'est et de Madagascar ainsi que d'une espèce d'Afrique centrale, *C. elongatum*. Il semble ainsi avoir un support pour reconnaître des sous-genres au sein des *Campylopermum*. Nous n'avons toutefois pas étudié les espèces asiatiques, et seulement quelques-unes des espèces malgaches.

**Le Chapitre 6** explore les possibles événements historiques ayant contribué à la distribution géographique actuelle des Ochnaceae. A cet effet, les âges de divergences chez les Ochnaceae ont été estimés et l'histoire biogéographique reconstruite. L'estimation des âges de divergence est réalisée en utilisant cinq régions de séquence d'ADN (ITS, *matK*, *ndhF*, *rbcl*, *trnL-F*), la calibration secondaire, et le modèle des horloges assouplies implémentées dans le logiciel BEAST. Les analyses de vicariance et Bayésiennes MCMC binaires implémentées dans le logiciel RASP ont été utilisées pour reconstruire l'histoire biogéographique des Ochnaceae. L'estimation des âges de divergence indique que les Ochnaceae sont originaires du Nouveau Monde et que l'Ancien Monde a été colonisé via le Pont terrestre nord Atlantique lorsque les conditions climatiques permettaient l'établissement d'une flore boréale tropicale.

**Le Chapitre 7** présente les différents résultats de ce travail et met en perspective leurs contributions dans la société et la science, particulièrement en systématique. Différentes suggestions sont faites pour explorer d'autres champs de recherches. Les résultats phylogénétiques présentés sont basés sur la méthode de concaténation et montrent que certaines parties de l'arbre phylogénétique sont faiblement résolues.

De plus, les courtes branches observées dans l'arbre peuvent être interprétées comme résultant d'une «deep-coalescence» qui peut conduire à une mauvaise interprétation des résultats. Cela implique que d'autres études phylogénétiques doivent être faites, intégrant notamment des données génomiques (utilisant les données des séquences du **séquençage haut débit** et des analyses de coalescence). La prise en compte de ces données devrait permettre d'obtenir une phylogénie plus fiable et mieux résolue des Ochnaceae

La richesse spécifique est très inégale entre les sous-familles des Ochnaceae. Les Ochnoideae ont le plus grand nombre d'espèces alors que les Quiinoideae en contiennent peu et les Medusagynoideae, une espèce uniquement. De nouvelles recherches sont proposées afin de voir si cette inégale répartition de diversité peut résulter d'un processus évolutif non connu, influençant le taux de diversifications.

La révision taxonomique a fourni des éléments sur la biogéographie du genre *Campylopermum*. La diversité et le taux d'endémisme sont élevés dans le domaine biogéographique Congolais, particulièrement au Gabon, où les espèces endémiques sont localisés dans les zones de montagnes identifiées comme potentiels refuges des forêts humides. En revanche, la région biogéographique Zambézienne ne compte que peu d'espèces endémiques, localisées principalement dans les montagnes de l'Arc oriental au Kenya et en Tanzanie. La plupart des *Campylopermum* se rencontrent à basse altitude, quelques-uns seulement dépassent 1500 m. La distribution des espèces de *Campylopermum* à une échelle plus fine correspond avec celle postulée dans d'autres groupes et peut être liée aux effets de fluctuations climatiques du Pléistocène et de leurs impacts sur l'extension de la forêt dense humide. Cependant, des sources de biais, telle que la densité des récoltes, peuvent affecter cette répartition et d'autres analyses doivent être faites pour prendre en compte ces biais.



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I performed several field trips in Gabon, one with Dr. Frans J. Breteler from the NHN Wageningen whom I thank for his guidance. I also thank him for the many invitations for dinner at his place. It liked talking about our African experiences and play "Pétanque" with his wife Nardie to whom I also express my warm thanks. For their highly useful assistance during fieldwork, my thanks go to Valentin Boulanga, Jean Noel Boussiengui, Estelle Pauline Ngombou Mamadou, Raoul Nyangadouma, Christelle Roseline Nyangala and Thomas Nzabi all from the National Herbarium of Gabon.

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My late father François d'Assises Bissiengou used to tell me when I was complaining about the load of my work that “ça va aller” meaning that everything is going to be all right. I guess he was right! I am so glad to have come to the end of this PhD road. My greatest thoughts go to him who provided constant encouragement and support during my entire educational process.

## **Curriculum vitae**

Pulcherie Bissiengou was born on the 12th of November 1973 in Libreville, Gabon. She started her secondary education at “College Notre Dame de Quaben” and then, in 1997, went to complete her high school education in general science at the private school “Lycée Djoue Dabany” in Libreville, Gabon. In 1998, she moved to Franceville, Gabon, to start her university studies in General Science option Biology at the “Université des Sciences et Techniques de Masuku”, where she entered the three year Bsc program “Biology and Chemistry”. During the last year of the BSc programme, she undertook a practical course called “Bio-Traversal”, where she got the opportunity to learn about Gabon’s unique biodiversity by travelling from the South-East to the North of Gabon in order to study different types of ecosystems encountered in Gabon. Her passion to learn more about plants started at that period. In 2001, the Gabonese government granted her a scholarship to continue her studies in Stellenbosch, South Africa. After a year and half of learning English at Stellenbosch, she registered in the Department of Botany and entered a Master Degree course “Plant systematics and Biodiversity”. She first worked on a mini-thesis entitled “A morphological and anatomical comparison and profiling of selected *Agathosma betulina* and *A. crenulata* populations in the western Cape (South Africa)” then continued a major thesis on the “Taxonomic assessment of *Oxalis furcillata* (Oxalidaceae)”. She obtained her Master of Science degree in 2005. From 2006 up to now, she works at the National Herbarium of Gabon as a scientific staff member and has been involved in the production of the “Flore du Gabon” series. Her first work in that series is the treatment of the family Oxalidaceae, which was published in 2009. From 2009 to 2011, she coordinated the project Sud-Expert Plant 335: “Prospections botaniques et reliance du traitement des familles de la Flore du Gabon”. In August 2008, she obtained a sandwich grant from Wageningen University allowing her to start her PhD project at the Nationaal Herbarium Nederland – Wageningen branch on the systematics of Ochnaceae. In 2010, she undertook several field trips in Gabon and one in Cameroon for which she obtained an ACP-FORENET grant. Currently, she is aiming to publish, together with her promotor, the family treatment of the Ochnaceae in Flore du Gabon series, and also started to look at the Violaceae for the same purpose.

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## PE&RC Training and Education Statement

With the training and education activities listed below the PhD candidate has complied with the requirements set by the C.T. de Wit Graduate School for Production Ecology and Resource Conservation (PE&RC) which comprises of a minimum total of 32 ECTS (= 22 weeks of activities)



### **Review of literature (5 ECTS)**

- Systematics and evolutionary history of the African genus *Campylosperrum* Tiegh. (Ochnaceae) (2008)

### **Writing of project proposal (4.5 ECTS)**

- Systematics and evolutionary history of the African genus *Campylosperrum* Tiegh. (Ochnaceae) (2008)

### **Post-graduate courses (3 ECTS)**

- Advanced biosystematics course; Biosystematics group (2009)
- Seed morphology and anatomy; Leiden (2011)
- Introduction to R for statistical analysis; PE&RC (2013)

### **Laboratory training and working visits (4.5 ECTS)**

- Herbarium visits; London (2009)
- Herbarium visits; Paris (2011)
- Herbarium visits; Meise (2012)

### **Invited review of (unpublished) journal manuscript (1 ECTS)**

- Plant Ecology and Evolution: the genus *Idertia* (2013)

### **Deficiency, refresh, brush-up courses (3 ECTS)**

- Phylogenetic reconstruction (2009)
- Taxonomic descriptions and nomenclature (2009)

### **Competence strengthening / skills courses (3.3 ECTS)**

- Editorial skills for Flore du Gabon; Naturalis, Leiden (2009)
- Information literacy PhD including EndNote; WUR Library (2012)
- Scientific writing course; WUR language service (2013)

**PE&RC Annual meetings, seminars and the PE&RC weekend (2.9 ECTS)**

- PhD Day biodiversity (2009)
- PhD Day biodiversity (2011)
- PE&RC Last year PhD weekend (2013)

**Discussion groups / local seminars / other scientific meetings (4.5 ECTS)**

- Biosystematics group colloquia (2011)
- NHN-Leiden colloquia (2011)
- Biosystematics journal club (2012)

**International symposia, workshops and conferences (8.1 ECTS)**

- AETFAT; Madagascar (2010)
- Biodiversity and Conservation Genetics Research in Central Africa; Gabon (2011)
- Pro-iBiosphere workshop; Leiden (2013)
- AETFAT; South Africa (2014)

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