

LINDLEYANA

Rare and Threatened Orchids of Central Africa

Part 1

By Murielle Simo-Droissart, Tariq Stévant, Bonaventure Sonké and Vincent Droissart



ORCHIDS REPRESENT AN emblematic plant family for biodiversity conservation worldwide. The greatest threat to their huge diversity is the human-induced habitat loss that reaches dramatic levels in the tropics. In western Central Africa, rapid population growth and need for natural products is leading to concurrent destruction of forest and woodland for plantations of cash crops, subsistence agriculture, wood for fuel, development of livestock and cities. Also, logging and mining by local or multinational companies represent a large part of the current and future threats to the natural habitats. These threats affect the orchid diversity since two-thirds of Central Africa's orchids are epiphytic plants.

Reducing habitat loss for orchids can be mainly accomplished by (a) the inventory, report and risk of extinction assessment of the most threatened species; (b) the identification of critical habitats and areas that host extraordinarily high diversity and endemism; and (c) the simultaneous development of integrated in situ and ex situ conservation approaches to ensure maintaining of the threatened species. In a series of two papers, we would like to present how we are gradually implementing these important conservation approaches in Central Africa, thanks to support from the American Orchid Society. In this first part, we will briefly explain how to assess the extinction risk for plant species, and more specifically for orchids. In a second paper, we will present how we can better identify or target priority areas for conservation and how to deal with in and ex situ conservation of the most threatened orchid species in Central Africa.

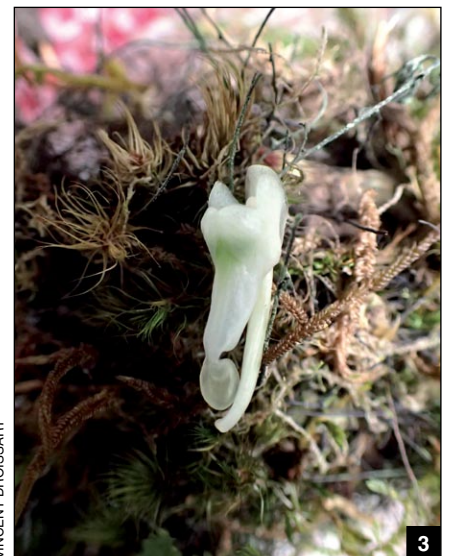
We firstly identified 177 orchid taxa (belonging to 38 genera) that are endemic to Atlantic Central Africa (ACA). This region roughly covers the southern part of Nigeria, Cameroon, Gabon, Equatorial Guinea, Republic of the Congo, and four small islands of the Gulf of Guinea. Then, thanks to funding from the AOS granted in 2016, Murielle Simo-Droissart assessed, in the frame of postdoctoral research, the conservation status of these 177 taxa by applying the methodology recommended by the authoritative International Union for Conservation of Nature (IUCN, <http://www.iucnredlist.org>).

The IUCN Red List categories define the extinction risk of species' wild populations inside their natural range, and the following nine categories are defined: Not Evaluated (NE), Data Deficient (DD), Least Concern (LC), Near Threatened



(NT), Vulnerable (VU), Endangered (EN), Critically Endangered (CR), Extinct in the Wild (EW) and Extinct (EX). There are five quantitative criteria (from A to E) of which only one criterion has to be met to assign the threatened category. Due to the orchids' life forms (around 70 percent of the species are epiphytes and therefore difficult to study) and their mode of dispersal (they have tiny wind-dispersed seeds), it is not obvious to quantify the population evolution (criteria A, C and D) or to perform a quantitative analysis showing the probability of extinction in the wild (criterion E). Criterion B, which principally uses georeferenced distribution data, is the most widely used to assess conservation status of orchid taxa.

HOW DO WE ASSESS THE IUCN CONSERVATION STATUS OF ORCHID SPECIES? First, we used a computer-based methodology (i.e., the *ConR* package, see Dauby et al. 2017, <https://cran.r-project.org/web/packages/ConR/>) to perform, in a batch process, calculations of the two main parameters used to assess criterion B: (1) the extent of occurrence (EOO; i.e., the surface of largest polygon encompassing all the known records of a given species) and (2) the area of occupancy (AOO; i.e., the surface among the EOO that is actually being occupied by the species). By using a geographic information system (GIS) and data from the World Database on Protected Areas (<https://www.protectedplanet.net/>), we generated a map to identify the occurrences within protected areas and the number of occupied protected areas for each of those 177 endemics. Then, and with the collaboration and



- [1] *Ancistrorhynchus crystalensis* general habitat and closeup of an inflorescence in full flower.
- [2] *Ancistrorhynchus crystalensis* flowering habit.
- [3] Flower close-up. Note the unusual globose nectary.

exchange of information between Central Africa's orchid specialists (especially during workshops and meetings), we used projection and inference based on information on habitat to provide high-quality assessment rationale for each species. We should stress that an IUCN category assigned to a species is not static, as species can be moved from one category to another depending on the current main threat affecting their population and habitat.

A "full" IUCN assessment provides detailed information about range,

population size, habitat and ecology, use and trade, threats, and conservation actions that will help inform necessary conservation decisions. These assessments are made publicly and freely available via the IUCN Red List portal (for example see <https://www.iucnredlist.org/species/87582588/87582628>). Globally, results obtained with the assessment of the 177 species endemic to ACA are truly breathtaking and quite alarming: two species, both endemic to São Tomé Island, might be in the Extinct category (*Angraecopsis dolabriformis* and *Angraecum astroarche*), 131 (74 percent) are threatened with extinction (with 25 classified as being Critically Endangered, 76 Endangered and 30 Vulnerable), 13 are Near Threatened and only 26 are classified as Least Concern. We also lack information for five species that have consequently been assessed as Data Deficient. Statistics about these full conservation assessments allow us to identify the most important threats affecting orchid diversity in Central Africa; namely, shifting agriculture (for 95 percent of the species assessed as Critically Endangered, Endangered, Vulnerable or Near Threatened according to the IUCN categories), followed by selective logging (91 percent) and urbanization (27 percent).

Among the 131 species threatened with extinction, we will present below and in a forthcoming paper the characteristics and main threats for 15 highly threatened species that we have recently collected and pictured in Central Africa. Six of the following species have been assessed as EN, and the last one as CR.

A N C I S T R O R H Y N C H U S
CRYSTALENSIS *Ancistrorhynchus crystalensis* was first discovered in the Crystal Mountains, in the northwestern part of Gabon, during an expedition led by the University of Wageningen (the Netherlands). Based on two specimens that flowered in cultivation at Wageningen greenhouses in August 1984 and August 1988, Philip J. Cribb and Frank M. van der Laan described this remarkable species in 1989 (see Cribb et al. 1989) and considered it as endemic to that area. Thanks to several field trips we carried out, the species was reported from Rio Muni (the Continental Region of Equatorial Guinea) in 1999 and from Príncipe Island in 2004, although it was collected in the latter place six years before (see Stévant and de Oliveira 2000). During inventories carried out in the vicinity of the Campo Ma'an National Park, southern part of Cameroon, in 2004, we harvested a living



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- [4] *Angraecopsis lisowskii* general habitat.
- [5] Plants of *Angraecopsis lisowskii* resemble small *Phalaenopsis* species.
- [6] Inflorescence of *Angraecopsis lisowskii* in full bloom.
- [7] *Angraecum angustum* in situ and close-up of the flower.
- [8] *Bulbophyllum lizae* plant and flower close-up.
- [9] A pure green form of the species.

plant that we assigned to that species. We have brought into cultivation that living plant in our ex situ collection at Yaoundé, Cameroon, and, despite our tremendous efforts to keep it alive, the plant died before flowering, which prevented us at that time from confirming its occurrence in Cameroon. Fortunately, we collected flowering specimens of the species within the same protected area in 2015.

Of the 17 tropical African species recognized in the genus, *Ancistrorhynchus crystalensis* possesses the most beautiful and largest flowers. It is an epiphytic herb usually found in very humid vegetation, such as submontane forest or deep valley with rushing streams. It has also been found growing as a lithophyte (i.e., on rocks) near waterfalls in the northwestern part of Gabon. The species occurs at an elevation of 328–3,051 feet (100–930 m). *Ancistrorhynchus crystalensis* is currently known from five distinct collecting sites in Central Africa of which four occur within protected areas. Outside the protected area network, its habitat is fairly accessible to people living in the vicinity. Human pressure to meet domestic needs (in particular from shifting agriculture and selective logging for firewood) is possible but should be quite limited. However, the future construction of a hydroelectric dam will probably lead to the loss of this subpopulation in the northwestern part of Gabon, a situation that, combined with its small distribution range, justifies the IUCN conservation status of EN (Simo et al. 2018a, <http://dx.doi.org/10.2305/IUCN.UK.2018-1.RLTS.T87583266A87739837.en>). Nevertheless, *Ancistrorhynchus crystalensis* is easily being grown in the most humid shadehouses of our network (Bom Successo in São Tomé, and Jardi-Gab and the Sibang Arboretum in Libreville, Gabon).

ANGRAECOPSIS LISOWSKII *Angraecopsis lisowskii* was described in 2001 by Dariusz L. Szlachetko and Tomasz S. Olszewski in the third volume of the *Flore du Cameroun* (see Szlachetko and Olszewski 2001), from a specimen collected in 1975 in the Northwest Region of Cameroon. This highly distinctive species has coriaceous leaves up to 2 inches (5 cm) wide (the largest in the genus) that are very similar to those of *Phalaenopsis* or *Aeranthes*, and possesses a spur up to 1.2 inches (3 cm) long (one of the longest in the genus). Ten years after the description of the species, we collected it twice on the lower slope and inhabited part of Mount Oku, also situated in the Northwest Region of Cameroon.



Angraecopsis lisowskii is an epiphyte growing in submontane humid forest, in plantations and on isolated trees in villages near roadsides, where it occurs at an elevation of 3,772–5,905 feet (1,150–1,800 m). The species is currently known only from two distinct collecting sites and its habitat there is easily accessible by local residents. The main threats to the species are small-scale activities such as shifting agriculture and collecting of fuel wood, which gradually led to the species decline. According to the IUCN Red List categories and criteria, we assessed this rare species as Endangered (Simo et al. 2018b, <http://dx.doi.org/10.2305/IUCN.UK.2018-1.RLTS.T87583579A87739852.en>).

ANGRAECUM ANGUSTUM *Angraec-*





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cum angustum was initially described in 1898 by an English botanist, Robert Allen Rolfe (1855–1921), the first curator of the orchid herbarium at the Royal Botanic Gardens, Kew (see Rolfe 1898). The flowers of this rare and tiny *Angraecum* species appear solitarily or in small inflorescences, and have largely golden or pale orange floral segments. For more than a century, the species was known only from the type specimen collected in 1897 from Old Calabar, southern part of Nigeria, which flowered in cultivation in the Royal Botanic Gardens, Kew. The first rediscovery of the species was made in Cameroon in 2006, during orchid surveys that we carried out. After that, many additional specimens were collected in the South and the Southwest regions of Cameroon, and the species is currently known from five distinct collecting sites. *Angraecum angustum* is an epiphyte growing on small mossy branches in submontane forest, at an elevation of 1,476–3,444 feet (450–1,050 m). In Nigeria and for some collecting sites in Cameroon,

the species occurs in unprotected areas that are easily accessible to local residents. In addition to logging activities and shifting agriculture at a small scale, some sites are under mining threats (such as the Ngovayang massif area), a situation that leads to the gradual decline in quality of the species habitat. According to the IUCN Red List categories and criteria, we assessed *Angraecum angustum* as Endangered (Simo et al. 2018c, <http://dx.doi.org/10.2305/IUCN.UK.2018-1.RLTS.T87583688A87739862.en>).

BULBOPHYLLUM LIZAE *Bulbophyllum lizae* was first collected on São Tomé Island in 1980. Described by Jaap J. Vermeulen from a plant that flowered in cultivation at Wageningen in 1984 (see Vermeulen 1984), it was also recorded in 1988 from Bioko Island (Equatorial Guinea). With its shiny light green leaves and pale yellow flowers, this beautiful species has the largest flowers among West and Central African *Bulbophyllum*. It occurs in dense primary and secondary lowland, submontane and montane forests at an elevation of 2,624–5,282 feet (800–1,610 m). *Bulbophyllum lizae* is currently recorded from four distinct collecting sites among them the Obò National Park (São Tomé) and the Pico Basile National Park in Bioko (Equatorial Guinea). Within these two well-managed protected areas, the species habitat is not under threat. The two other collecting sites outside the Obò Park, in wasteland and tree fallow, are easily accessible by local residents and consequently, the species habitat is threatened. Small-scale logging activities and shifting agriculture for subsistence represent the main threats for this spectacular *Bulbophyllum* species. The ongoing loss of the species habitat will lead to a continuous decline of its mature individuals, a reason for which we assigned to *Bulbophyllum lizae* an IUCN conservation status of Endangered (Simo et al., 2018d, <http://dx.doi.org/10.2305/IUCN.UK.2018-1.RLTS.T44392996A87584907.en>).

CALYPTROCHILUM AURANTIACUM Better known as *Ossiculum aurantiacum*, we recently transferred this species to the genus *Calyptrochilum* (Simo-Droissart et al. 2018a, 2018b). It was first collected in the Mungo River Forest Reserve, western part of Cameroon, in 1980 by the Dutch botanist Henk J. Beentje. A young seedling was then cultivated at the University of Wageningen and produced in November 1983 a flowered specimen, which was used by Cribb and van der



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Laan to describe the species in 1986 (van der Laan and Cribb 1986). Despite thousands of botanical collections made in the original locality, the species was not spotted again for nearly a quarter century. In 2004, we discovered a new locality in an officially protected area, the Banyang-Mbo Wildlife Sanctuary, Cameroon, casting away the fears that *C. aurantiacum* might already be extinct. This discovery has fostered new specific surveys and a dedicated conservation program (<https://www.speciesconservation.org/case-studies-projects/beentje-orchid/5698>). Intensive fieldwork in Cameroon between 2011 and 2017 allowed us to discover three additional collecting sites of *C. aurantiacum*. In 2018, while examining dried material deposited in the herbarium of the Université Libre de Bruxelles

[10] *Calyptrochilum aurantiacum* habitat and close-up.

[11] *Diaphananthe garayana* plant growing in the Yaoundé shadehouse and flower close-up.

[12] *Distylodon sonkeanus* flowering in cultivation in the Yaoundé shadehouse.

(Brussels), we discovered that the species had also been collected more than 20 years ago, in 1996, in the Odzala National Park, a protected area in the Republic of the Congo, but had been misclassified among the *Cyrtorchis* collections. The species is currently known from five distinct collecting sites. *Calyptrochilum aurantiacum* is an epiphyte found at an elevation of 787–1,968 feet (240–600 m). It grows naturally in lowland evergreen

rainforests that are currently experiencing a great deal of human pressure from forest clearance for timber exploitation, cocoa and oil palm plantations, and shifting agriculture. Somewhat surprisingly, our recent study also revealed that the species could adapt to this new human-transformed habitat. As a matter of fact, we found one living specimen in the canopy of a cocoa tree, in secondary lowland forest. This finding provides a glimmer of hope for the future and, with this in mind, transplantation experiments are now underway in those cocoa plantations. In spite of this new finding, the ongoing loss of the species habitat leads us to predict a continuous decline in mature individuals of *C. aurantiacum* and to assign to the species an IUCN conservation status of Endangered (Simo et al. 2018e, <http://dx.doi.org/10.2305/IUCN.UK.2018-1.RLTS.T46364A87750844.en>).

DIAPHANANTHE GARAYANA This species was first collected in southern part of Cameroon in 1918. It was described in 2001 by Szlachetko and Olszewski in the *Flore du Cameroun* based on that unique collection (see Szlachetko and Olszewski 2001). The species is dedicated to the famous American botanist Leslie Andrew Garay (1924–2016), who was director and curator of the Oakes Ames Orchid Herbarium at Harvard University for a half century. Garay also reviewed many orchid genera, and described at least 13 new genera and 75 new species. The intensive botanical surveys we have carried out since 2004 in the southern part of Cameroon have enabled us to collect this rare species. *Diaphanante garayana* is an epiphyte in lowland forest and occurs at an elevation of 164–820 feet (50–250 m). Its habitat in the two known collecting sites in Cameroon is currently impacted by human activities and settlements. The main threats to the species are shifting agriculture, small-holder farming and plantations, and selective logging for domestic uses. These activities will continue in the future and we project that they will lead to a continuous decline of the species. For these reasons, we assigned an IUCN conservation status of Endangered to *D. garayana*.

DISTYLODON SONKEANUS *Distylodon* is a mysterious angraecoid genus collected only twice, with a large disjunction of distribution. *Distylodon sonkeanus* is only known from the type specimen we collected in 2007 in the South Region of Cameroon (Droissart et al. 2014). Indeed, we brought into

cultivation in our shadehouse in Yaoundé a living plant collected on a fallen branch from the canopy. Once it flowered few months later, we erroneously thought that it was an *Angraecopsis* due to the presence of a trilobed lip on the flower. After detailed examination and comparison with literature and closely related material preserved in several herbaria, we were amazed to find that the flowering specimen was a new species of *Distylodon*, a heretofore monotypic genus established more than 50 years ago by Victor S. Summerhayes and known only from the first species, *Distylodon comptum*, collected in Uganda. *Distylodon sonkeanus* is an epiphyte found in the lowland evergreen forest at an elevation of 328 feet (100 m). The species is currently known from a unique collection site in southern Cameroon. This site is accessible to local residents who are gradually transforming the area into secondary forest through their practices of shifting agriculture and selective logging, a situation that will lead to a continuous decline of the habitat of *D. sonkeanus*. We thus assigned to the species an IUCN conservation status of Critically Endangered.

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— Dr. Murielle Simo-Droissart is a research associate in the plant systematics and ecology laboratory, Higher Teachers' Training College, University of Yaoundé I, Cameroon. Her PhD activities dealt with taxonomy, molecular phylogeny and conservation of African orchids. She is now focusing her research on assessing threatened species and identifying priority areas for conservation (email: murielle.simo@gmail.com).

— Dr. Tariq Stévant is Scientist at the Africa and Madagascar Department of the Missouri Botanical Garden (USA). He is a plant taxonomist focusing his research on the orchid family since 1997 and has initiated scientific and conservation projects devoted to study orchids of tropical Africa. (email: tariq.stevart@mobot.org).

— Prof. Bonaventure Sonké is currently head of the Department of Biology at the Higher Teachers' Training College of the University of Yaoundé I. He specializes in the systematics of Rubiaceae (the coffee family) and is also interested in studying forest dynamics for a sustainable management of African forests (email: bonaventuresonke@ens.com).

— Dr. Vincent Droissart is a researcher at the Institut de Recherche pour le Développement (IRD, France) and specializes in the taxonomy, phytogeography and conservation of African orchids. He also devotes a part of his research in assessing plant diversity patterns at local and regional scales in Africa. (email: vincent.droissart@ird.fr).

Pictures and scientific activities related to African orchids are disseminated through the web-based portal www.orchid-africa.net.