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## Journal of Plant Taxonomy and Geography

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**Journal of Plant Taxonomy and Geography (*Webbia*)** is a peer-reviewed journal on Plant Taxonomy, Nomenclature, Phylogeny, Phytogeography and Palaeobotany of the Vascular Plants.

The journal aims to allow research in botanical topics such as taxonomy, systematics, nomenclature, molecular phylogeny, conservation, biogeography, and history of botany, and botanical collections.

It was founded in **1905** in Florence by **Ugolino Martelli** (1860-1934), a botanist well known for his studies of and contributions to the systematics of the tropical genus *Pandanus* and on the Flora of Sardinia.

In the 19th century Florence represented one of the most important European centres in Plant Taxonomy and Phytogeography with several notable Italian botanists worth mentioning such as Filippo Parlatore, Teodoro Caruel, Eugenio Baroni, Stefano Sommier, Odoardo Beccari and Ugolino Martelli himself. In 1842 **Filippo Parlatore** (1817-1877) founded in Florence the *Herbarium Centrale Italicum (FI)*, which soon became one of the most important herbaria in the world. Most of the specimens described and/or cited in *Webbia* are still kept in it.

In 1905, and as a consequence of this multitude of activities in Plant Systematics and Phytogeography, Ugolino Martelli established the journal *Webbia-Raccolta di Scritti Botanici*, firstly published annually in a single issue, and later twice a year. Webbia also began to be a place of publication of contributions from Tropical Botany, especially after the Royal Colonial Herbarium founded in 1904 in Rome was moved to Florence in 1914, currently named Tropical Herbarium Study Center (Centro Studi Erbario Tropicale - Herbarium FT) belonging to the Department of Biology of the University of Florence.

*Webbia* had been created in honor of **Philip Barker Webb** (1793-1845), a close friend of Filippo Parlatore, who before passing away entrusted his personal herbarium and a library rich of old botanical books and publications to the then Botanical Museum in Florence.

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# *Eplingiella sanoi* sp. nov. (Hyptidinae-Lamiaceae): supports the urgent need for *campos rupestres* conservation in the Serra do Espinhaço Septentrional, Minas Gerais state, Brazil

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**Abstract.** A new species of Lamiaceae, *Eplingiella sanoi*, from the *campo rupestre* of an ecotone zone between the Cerrado and the Caatinga domains is described and illustrated. The new species expands the distribution of the genus to Southeast Brazil, previously restricted to Northeast Brazil. *Eplingiella sanoi* is compared to the three other species of the genus, especially *E. cuniloides*, the morphologically closest related species. We present an identification key for all the species of the genus, an occurrence map for *Eplingiella sanoi*, *E. cuniloides* and *E. brightoniae* and a formal conservation assessment for the new species. *Eplingiella sanoi* is endemic to the region between Pico da Formosa and Pico do Sucuruiú (Minas Gerais state, Serra do Espinhaço), an area under threat due to a planned wind farm installation. Recognizing this species emphasizes the imperative for more taxonomic studies and conservation of Serra do Espinhaço.

**Keywords:** Espinhaço Range, Labiatae, *Hyptis*, Ocimeae, protected areas.

## INTRODUCTION

*Eplingiella* Harley & J.F.B.Pastore (Lamiaceae, tribe Ocimeae, subtribe Hyptidinae) is a genus from Tropical America named in honour of

Carl Epling (1894–1968), one of the major specialists in tropical American Lamiaceae, especially Hyptidinae (Harley and Pastore 2012). The genus is characterized as shrubs with fasciculate or much branched stems, bearing reduced leaves adapted to xeromorphic climates, which are borne on brachyblasts, short pedunculate and subumbellate cymes subtended by foliaceous bracts and containing 2 to 18 flowers, blue or violet-blue corollas spreading lobes with lips unmarked, and gynoecium without a stylopodium (Harley 2014; Harley et al. 2017). Additionally, *Eplingiella* is unique within the subtribe in displaying resupinate dimorphy and the style opposing the stamens and not lying alongside them (Harley 2014; Harley et al. 2017).

The genus is mainly distributed in the semi-arid region of Northeast Brazil (Harley 2014; Antar et al. 2024) and is represented by three species: *Eplingiella brightoniae* Harley, from the further North portion of Chapada Diamantina region, in the municipalities of Umburanas and Sento Sé, Northern Bahia state; *E. cuniloides* (Epling) Harley & J.F.B.Pastore, known from a small locality in Morro do Chapéu municipality, also in Bahia state; and *E. fruticosa* (Salzm. ex Benth.) Harley & J.F.B.Pastore, with a much wider distribution, occurring in both semi-arid and the coastal *restinga* areas of Northeastern Brazil, from Bahia to Rio Grande Norte states (Harley 2014; Soares et al. 2019). The latter species, which is the type species of the genus, was firstly described by Bentham (1833) as *Hyptis fruticosa* Salzm. ex Benth. a member of *Hyptis* sect. *Mesosphaeria* Benth., one of the 19 sections that this author divided *Hyptis* into. With further morphological studies (e.g. Epling 1949; Harley 1988), the species was withdrawn from *H.* sect. *Mesosphaeria* and its taxonomic position remained uncertain, until molecular data revealed the paraphyletic nature of *Hyptis* s.lat. (Pastore et al. 2011, 2021). Finally, the phylogenetic study of Pastore et al. (2011) led to a new generic classification of Hyptidinae (Harley and Pastore 2012), in which the genus *Eplingiella* was delimited for *E. fruticosa* and allied species (Harley 2014).

The Espinhaço Range is an important centre of plant diversity in eastern Brazil (Giulietti et al. 1997), with a high number of endemic, rare and endangered species (Rapini et al. 2021). Beyond its biological importance, the Espinhaço Range stands out in the geological and geographical context as an extensive watershed, stretching longitudinally for over 1,000 km, from the Jacobina region (Bahia state, northern limit) to the Quadrilátero Ferrífero (Minas Gerais state, southern limit; Derby 1906; Saadi 1995). Based on geology, it can be divided into Chapada Diamantina, Espinhaço Meridional and Espinhaço Septentrional (Saadi 1995; Knauer 2007). Historically, a significant number of studies on the flora in eastern Brazil has been focussed on the Chapada Diamantina (e.g., Harley & Simmons, 1986; Stannard, 1995; Zappi et al. 2003) and, particularly, on the Serra do Espinhaço Meridional (e.g., Giulietti et al. 1987 [including the Flora da Serra do Cipó Collection]; Zappi et al. 2014). Apart from floristic studies in the Grão Mogol region (Pirani et al. 2003, including the Flora de Grão Mogol Collection), the flora of the Serra do Espinhaço Septentrional is still poorly known (Almeida et al. 2023).

The northernmost mountains of Minas Gerais state, situated near the border with the state of Bahia, including the complex formed by Serra Montevidéu, Pico da Formosa, and Pico do Sucuruiú, are part of the Serra do Espinhaço Septentrional. This region is characterized by an ecotone zone between the Cerrado and the Caatinga domains, including extensive areas of *campos rupestres* (herbaceous and shrubby vegetation inhabiting quartzite and ironstone soils and outcrops in elevations above 900 m asl). It remains floristically underexplored, partly due to its challenging accessibility, despite being designated as a conservation priority area (MMA, 2018). Recent efforts have been made to catalogue the plant diversity in this portion of the Serra do Espinhaço Septentrional, with notable contributions from researchers at the Rio de Janeiro Botanical Garden Research Institute and the Brazilian Agricultural Research Corporation, which made first floristic surveys. Following these initial efforts, the region has caught the attention of other botanical researchers who are now getting involved in cataloguing the local flora. In the past years, a significant number of new species to science have been described (e.g., Cardoso et al. 2022; Almeda & Pacifico, 2023; Pacifico et al. 2023; Silva et al. 2023; Zavatin et al. 2023), and at least six new species are currently under study by taxonomists (Verdi, pers. comm.). To document the local flora and support the creation of a Protected Area, over 50 taxonomists are collaborating on a checklist led by researchers from the Rio de Janeiro Botanical Garden Research Institute. These studies are expanding floristic knowledge and highlighting an elevated diversity of plants in the *campos rupestres* of this mountain complex in the Serra do Espinhaço Septentrional.

Here, we propose a new species of *Eplingiella* from the *campos rupestres* of Minas Gerais, an ecotone zone between the Cerrado and Caatinga domains, expanding the genus distribution and assessing the species' conservation status. Our results contribute to the understanding of biodiversity within a botanically poorly explored yet highly threatened region of *campos rupestres* in Serra do Espinhaço Septentrional. Therefore, this study provides further support for decision-making regarding the adoption of effective conservation strategies in the region.

## MATERIAL AND METHODS

The taxonomic treatment was made from field observations and studying specimens housed on the following herbaria: ALCB, BHCB, BM, CEN, CEPEC, CTBS, HST, HUEFS, IBGE, IPA, JPB, K, MOSS, P, RN, SAMES, SPF, UB, UFRN and W (acronyms according to Thiers, continuously updated), as well as the examination of digital images of samples available at JABOT (http://rb.jbrj.gov.br/v2/consulta.php), REFLORA (http://reflora.jbrj.gov.br/) and speciesLink (http://specieslink.net) databases. The terminology of morphological description follows Hickey (1973) for leaf shape, Harris and Harris (2001) for general morphology and Harley and Pastore (2012) and Harley (2014) for specific nomenclature.

We assessed the conservation status of the *Eplingiella* species according to version 3.1 of the IUCN Red List Categories and Criteria for Threatened Species (IUCN 2001, IUCN Standards & Petitions Committee 2022). Available data and information on distribution, occurrence, population, habitat and ecology, uses and trade, and threats were included in the National System for the Conservation of Flora (ProFlora) of the Brazilian National Center for Plant Conservation (CNCFlora), Rio de Janeiro Botanical Garden Research Institute (JBRJ), which serves as the IUCN SSC Brazil Plant Red List Authority (IUCN SSC BP-RLA), to document the assessment. The assessment will undergo technical review by the IUCN Red List Unit and may subsequently be added to the Species Information System (SIS) of the IUCN for publication on its portal. Therefore, the complete assessment of the conservation status of the *Eplingiella* species herein described will be accessible through both the official global and national Red Lists.

Our estimates of Area of Occupancy (AOO) and Extent of Occurrence (EOO) followed the default definitions (Bachman et al. 2011). These estimates were provided by the ProFlora system, based on the inclusion of occurrence records validated by the botanical specialists in Lamiaceae (GMA, JFBP, RMH and ASS). We generated the species distribution maps using the open-source software QGIS version 3.24.3 (QGIS Development Team 2018). The data for historical land use data from the period 1985–2020 was provided by MapBiomas (MapBiomas 2021). The data for *Eplingiella cuniloides* and *E. brightoniae* distribution was obtained by gatherings available at JABOT, REFLORA and speciesLink databases that have been checked by the authors.

## TAXONOMIC TREATMENT

***Eplingiella sanoi*** Antar, A.Soares & Harley, **sp. nov.** (Figures 1, 2)

Type: Brazil, Minas Gerais, Mun. Santo Antônio do Retiro: sítio 10, ponto 6, 15°22’49”S 42°45’34”W, 17 Mar 2017, *A. C. Sevilha et al. 6525* (holotype, CEN [barcode CEN00103452]; isotype, SAMES [barcode SAMES14610]).

### *Diagnosis*

The new species differs from *Eplingiella cuniloides,* its morphologically closest related species, by the leaves narrowly elliptic or linear (vs. obovate in *E. cuniloides*), 0.5–1 mm wide (vs. 1–3.8 mm wide in *E. cuniloides*), with sessile glandular trichomes on the adaxial surface and sometimes pubescent with hairs mostly in the nerves (vs. silvery-grey-green tomentose in *E. cuniloides*), and calyx slightly curved in fruit (calyx straight in fruit in *E. cuniloides*).

### *Description*

Subshrub, ca. 30 cm tall, citric aromatic, often forming thickets, with several stems arising from a woody subterranean structure. Stems 1–3 mm diam., slender, straight and sub-erect, younger stems quadrangular, slightly canaliculate, glabrous except by scattered glandular sessile trichomes, sometimes pubescent with scattered small white tector hairs mostly in the nodes, older stems ± terete, glabrous, peeling in small plates. Leaves, slightly coriaceous, mostly in fascicles from very short and poorly developed brachyblasts along the stem; lamina 6–14 × 0.5–1 mm, linear of very narrow elliptic, longer than internodes in secondary branches and mostly shorter than the internodes in principal stems, apex rounded, base attenuate and imperceptibly merging into the petiole, margin thickened, entire, revolute, sometimes deeply so and with replicate margins obscuring the abaxial surface, adaxial surface with sessile glandular trichomes and sometimes pubescent with small tector hairs mostly in the nerves, primary vein impressed, secondary venation inconspicuous, abaxial surface with similar indumentum, venation prominent, conspicuous; petiole absent to 2 mm long, jointed, with the basal part persistent after leaf-fall, indumentum as on lamina. Inflorescence cymose, sub-umbellate, along the upper portion of the stem, with similar indumentum as on stems and leaves, but more dense, cymes 3–6-flowered, borne on peduncle 1.4–4.1(–5.3) cm long. Flowers with inconspicuous, linear bracteoles 1–1.9 × 0.1–0.2 mm, on pedicels 0.5–1 mm long; calyx at anthesis 2.1–3.1 mm long, tube 1.3–1.8 mm long, infundibuliform, with glan-

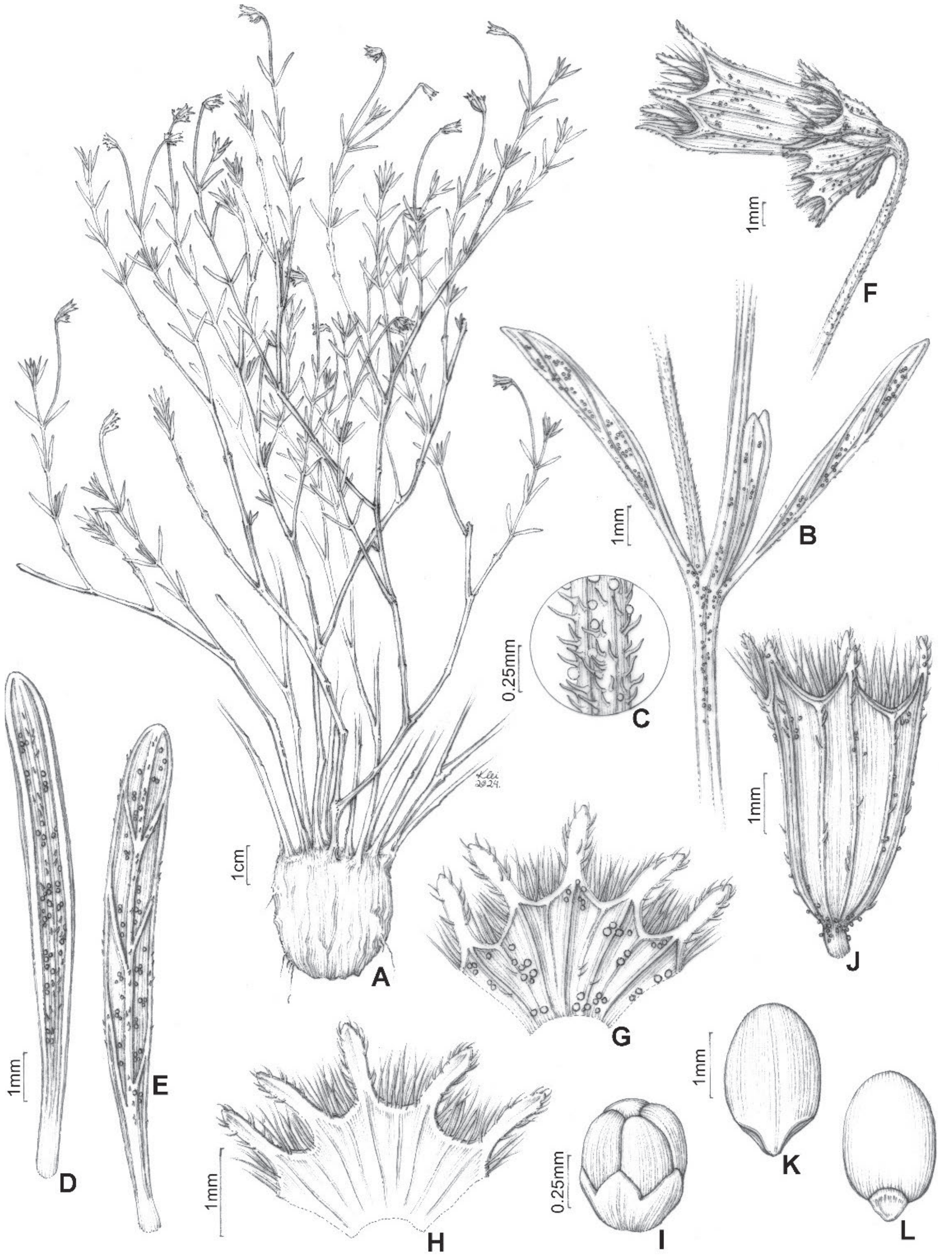

**Figure 1.** *Eplingiella sanoi* Antar, A.Soares & Harley: A. Habit. B. Branch detail, evidencing the leaves in fascicles on short lateral brachyblasts. C. Branch in detail evidencing the indumentum. D. Leaf, adaxial surface. E. Leaf, abaxial surface. F. Cyme. G. Opened calyx, outer surface. H. Opened calyx, inner surface. I. Ovary. J. Fruiting calyx. K. Nutlet, ventral view. L. Nutlet, dorsal view. Illustration by Klei Souza based on *A.C. Sevilha et al.* 6525 (SAMES).

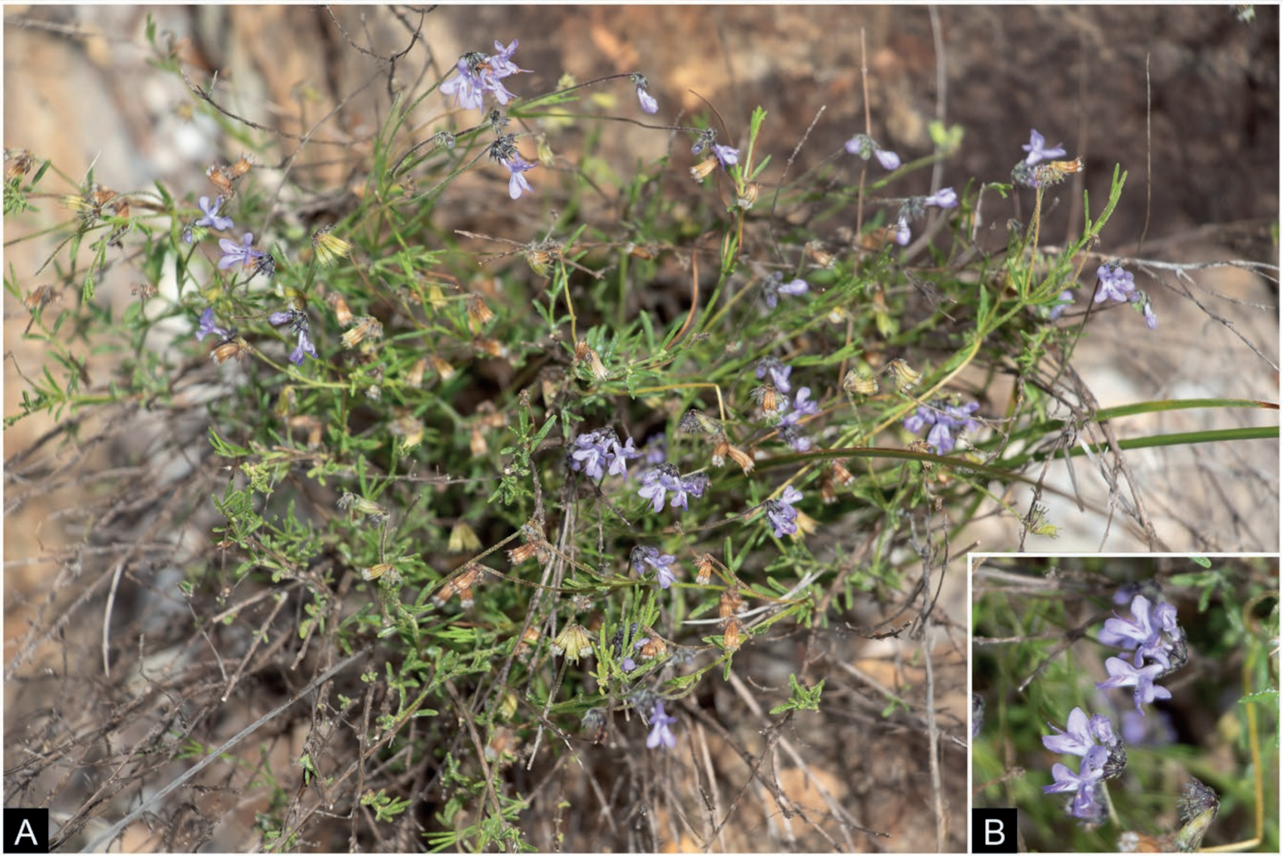

**Figure 2.** *Eplingiella sanoi* Antar, A.Soares & Harley: A. Habit. B. Inflorescence detail. Photos by Anderson C. Sevilha.

dular sessile trichomes and small tector hairs on outer surface, glabrous internally, with oblique mouth, lobes 5, slightly unequal, 1–1.6 mm long, subulate, with broadly truncate sinus between them, and a ring of erect, conspicuous white hairs at throat; calyx in fruit 5–5.9 mm long, tube 3.9–4.6 mm long, ± cylindrical, slightly curved, thin between the thickened, prominent nerves, lobes 1.1–1.3 mm long, weakly spreading to erect, the ring of white hairs in throat conspicuous; corolla purple, 3.5–5.1 mm long, tube pale, c. 4 mm long, infundibuliform, pubescent externally, especially on distal portion, glabrous internally, lobes spreading, the posterior lip 2-lobed, anterior lip concave, boat-shaped; stamens glabrous; style without a stylopodium, elongate and exserted parallel with the posterior lip at early anthesis, with a very short bluntly bi-lobed stigma. Nutlets c. 1.9–2.1 × 1.0–1.2 mm, ellipsoid, glabrous, minutely tuberculate, strongly mucilaginous when wet (Fig. 1).

### Etymology

The epithet honors Dr. Paulo Takeo Sano, Brazilian professor and researcher at the *Universidade de São Paulo*. Paulo made significant contributions to the systematics of Neotropical angiosperms, in particular in Eriocaulaceae and Myrtaceae, as well as to the flora of the *campos rupestres* in the mountains of the Espinhaço Range, actively participating in several floristic studies, especially the Flora de Grão-Mogol and Flora da Serra do Cipó projects. He has also supervised numerous students engaged in the study of *campo rupestre* flora and worked with traditional knowledge from local communities and the teaching of botany and biology in schools.

### Distribution, habitat & phenology

*Eplingiella sanoi* is a terrestrial heliophilic subshrub, approximately 30 cm in height, occurring in *campos rupestres* above 950 m asl within an ecotone zone between the Cerrado and Caatinga domains. The new species has been recorded from a single gathering in Santo Antônio do Retiro municipality, Minas Gerais state, south of the border with Bahia state (Fig. 3). The new species has been collected flowering and fruiting in March, which agrees with the most common flowering \\

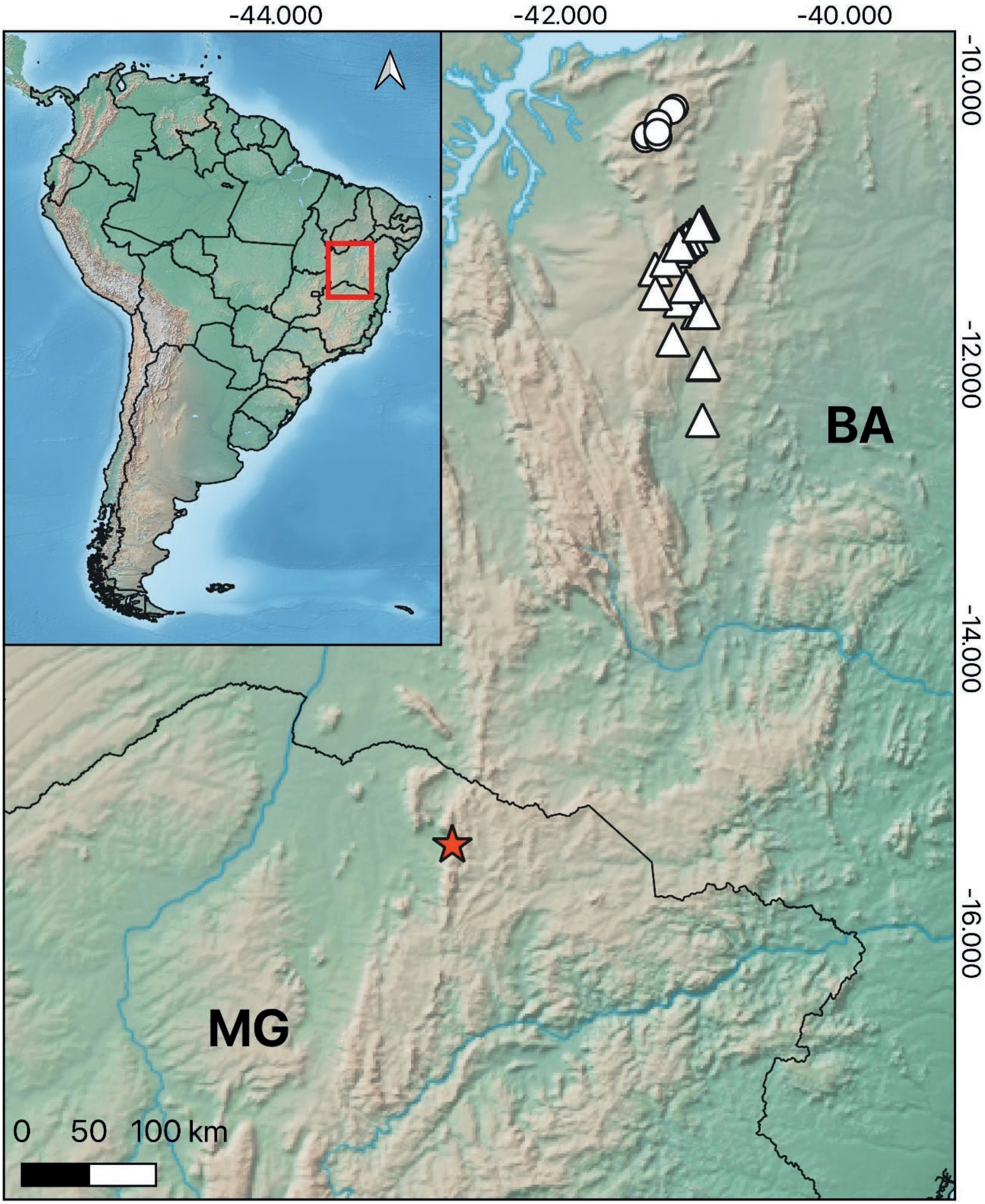

**Figure 3.** Map showing the distribution of *Eplingiella sanoi* Antar, A.Soares & Harley (red star) and the related species *E. cuniloides* (Epling) Harley & J.F.B.Pastore (white triangles) and *E. brightoniae* Harley (white circles). Abbreviation for Brazilian states: BA: Bahia; MG: Minas Gerais.

pattern observed in Hyptidinae, which concentrates its flowering and fruiting in March, April and May.

### *Assessment of conservation status*

Data Deficient - DD. The species is known only from the type specimen collected in the municipality of Santo Antônio do Retiro, located in the northern region of the Minas Gerais state, Brazil (Fig. 4). The estimated area of occupancy for the species is AOO = 4 km$^2$, while it was not possible to estimate the extent of occurrence (EOO) due to a single-point limitation. There is no available information regarding population size and trends, as well as its occurrence within Protected Areas. Nevertheless, the region where *Eplingiella sanoi* occurs has been exposed to human-induced threats, including fire, quartzite mining, and road construction for the installation of wind turbine generators. If these threats continue to advance within its potential range, it could negatively impact the species in the near future, leading to habitat degradation and decline. Considering the species' restricted distribution, potential threats, and AOO, the *Eplingiella sanoi* could be assessed as Critically Endangered under the criterion B2ab. Given the general lack of data and insufficient floristic inventories in the region where the species was recorded, this taxon is assessed as Data Deficient (DD). Research efforts aiming to find the species at its known location and in nearby areas are crucial to enhance our understanding of its distribution and population dynamics, ultimately enabling a robust assessment of its conservation status.

### *Key to species of Eplingiella (adapted from Harley 2014)*

1. Leaves not in fascicles, brachyblasts absent, at least some leaves with lamina >15 mm long and >5 mm broad, with distinct petiole. Calyx tube strongly curved in fruit, with throat not conspicuously hairy ........................... ***E. fruticosa***

1′. Leaves in fascicles on short lateral brachyblasts, lamina 4 – 14 × 0.5 – 3.8 mm, with petiole indistinct. Calyx tube straight or slightly curved in fruit, with conspicuous white hairs in throat ......................................................................... 2

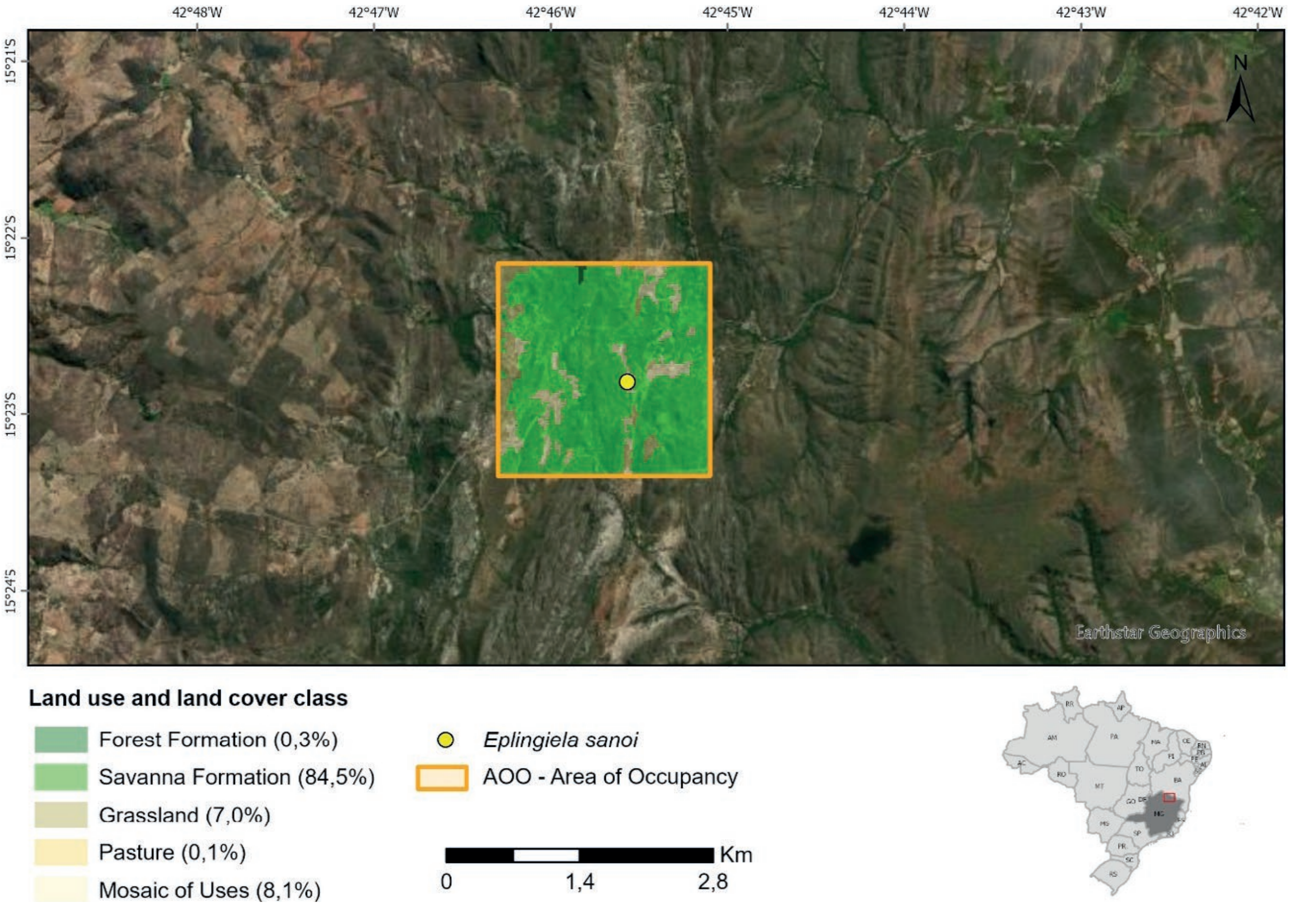

**Figure 4.** Distribution map of *Eplingiella sanoi* Antar, A.Soares & Harley indicating its Area of Occupancy, land use and land cover class.

2. Leaf margin entire .................................................................. 3

2´. Leaf margin with small teeth in upper half. . ***E. brightoniae***

3. Leaves obovate, silvery-grey-green tomentose ...................... .............................................................................. ***E. cuniloides***

3´. Leaves narrowly elliptic or linear, with glandular sessile trichomes and sometimes pubescent with hairs mostly in the nerves ........................................................................... ***E. sanoi***

*Comments and affinities*

With leaves arranged in fascicles (brachyblasts), *Eplingiella sanoi* joins *E. brightoniae* and *E. cuniloides* that have this feature. It differs from *Eplingiella brightoniae* by the entire leaf margin (vs. distinctly toothed in the upper half of the leaf in *E. brightoniae*), lamina linear of very narrow elliptic, 0.5–1 mm wide (vs. lamina narrowly obovate to spathulate, 2.5–3.8 mm wide in *E. brightoniae*) and calyx lobes at anthesis 1 – 1.6 mm long (vs. 1.7–2 mm long in E. *brightoniae*). From *Eplingiella fruticosa*, the new species immediately differs by the leaves in fascicles (vs. leaves not in fascicles in *E. fruticosa*), which are narrowly elliptic or linear 6–14 × 0.5–1 mm (vs. leaves ovate to elliptic 4–29 × 2–30 mm) and calyx slightly curved with conspicuous white hairs in throat (vs. curved calyx with throat not conspicuously hairy).

*Eplingiella sanoi* is surprisingly known from just a single and very recent gathering. This supports the outstanding pattern that Brazil (and, likely true for other world's tropical areas) still harbours areas of biological richness, which have only rarely, or have never been, botanically explored (BFG 2015). The genus has now had its distribution extended due to this new gathering, as seen in other neotropical genera such as *Dinizia* Ducke (Leguminosae - Lewis *et al.* 2017), *Freziera* Willd. (Penthaphyllacaceae – Zorzanelli et al. 2015), *Markea* Rich. (Solanaceae – Stehmann and Giacomin 2012) and *Bahiana* J.F.Carrión (Euphorbiaceae – Wurdack 2023). These findings can change significantly our understanding of the distribution and evolution of many neotropical lineages. Despite the lack of recognition and funding (Engel et al. 2021), basic taxonomy is still much needed for flora description in most of the neotropics, especially in the threatened Serra do Espinhaço Septentrional.

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# Additions to and revisions of the endemic and near-endemic Acanthaceae of Ethiopia

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**Abstract.** Taxonomic studies in the Acanthaceae of Ethiopia and neighbouring countries reveal the presence of several previously overlooked endemic and near-endemic taxa. The *Isoglossa somalensis* Lindau complex is revised, resulting in the description of a new species, *Isoglossa recurva* Hanny & I.Darbysh. from the forests of southwest Ethiopia, and a new variety of *I. somalensis*, var. *glandulosa* Hanny, G.Hoban & I.Darbysh. from montane southeast Ethiopia. *Barleria induta* C.B.Clarke from Ethiopia and Eritrea, treated as *B. prionitis* L. subsp. *induta* (C.B.Clarke) Brummitt & J.R.I.Wood in the *Flora of Ethiopia and Eritrea* (FEE), is reevaluated and found to represent two species, with *B. praetermissa* I.Darbysh. described from the Tigray region of northwest Ethiopia. Finally, *Hypoestes microphylla* Nees is resurrected as a good species, separate from the widespread *H. triflora* (Forssk.) Roem. & Schult. under which it was treated as a synonym in FEE. Descriptions, tables of comparison and notes on the habitat, ecology and extinction risk for these taxa are provided. The first record of *I. gregorii* (S.Moore) Lindau for Ethiopia is also noted and a revised key to *Isoglossa* in Ethiopia is presented. The endemic Acanthaceae of Ethiopia now stands at 21 species (23 taxa), whilst an additional 23 species (24 taxa) are considered to be range-restricted near-endemics.

**Keywords:** diversity, endemism, IUCN Red List assessment, new species, taxonomy.

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## INTRODUCTION

The Acanthaceae are among the most species-rich and morphologically and ecologically variable lineages of flowering plants (Manzitto-Tripp et al. 2022). The family is particularly noteworthy for its high rates of local endemism, with many species having highly restricted ranges. Species of Acanthaceae can also be locally abundant and comprise an important component of the local ground flora, hence they are often of high ecological significance.

Given this combination of high diversity, restricted ranges and ecological importance, the Acanthaceae can be considered a high priority for plant conservation focus in many parts of the world (Manzitto-Tripp et al. 2022).

Ethiopia is very rich in endemic plant species (Ensermu and Sebsebe 2014; Sebsebe et al. 2021) and, indeed, Sosef et al. (2017) estimated Ethiopia to be the tropical African country with the second highest rate of plant endemism, with a rate of 19.9% of the total flora, bettered only by neighbouring Somalia (32%). In the account of the Acanthaceae for the *Flora of Ethiopia and Eritrea* (FEE), Ensermu (2006) documented 215 taxa in 41 genera, this being the sixth most species rich family within the Flora region (Ensermu and Sebsebe 2014). Of these, 17 species and three subspecies were recorded as endemic to Ethiopia, with a further 11 undescribed potential endemics also documented (Ensermu 2006). Many other taxa of Acanthaceae were recorded from Ethiopia and only one other country. Since the FEE account, one new species in each of the genera *Acanthopale* C.B.Clarke (*A. aethiogermanica* Ensermu), *Blepharis* Juss. (*B. gypsophila* Vollesen & Thulin), *Lepidagathis* Willd. (*L. pseudoaristata* Ensermu) and *Rhinacanthus* Nees (*R. mucronatus* Ensermu), and four new species in *Barleria* L. (*B. baluganii* Ensermu, *B. ferox* Ensermu & I.Darbysh., *B. gidoleensis* Ensermu & I.Darbysh. and *B. negelleensis* Ensermu & I.Darbysh.) have been described (Ensermu 2009; Vollesen and Thulin 2015; Ensermu and Darbyshire 2018), although all but *B. gypsophila* were based on species included as unnamed taxa in FEE. All these new taxa were thought to be endemic to Ethiopia at the time of publication, but *L. pseudoaristata* has since been recorded from northern Kenya (Darbyshire et al. 2010) and so can be considered near-endemic.

This publication is part of an ongoing study by Addis Ababa University, the Royal Botanic Gardens, Kew and the Ethiopian Biodiversity Institute on the diversity and extinction risk of the endemic flora of Ethiopia. In this current work we investigate several taxa of Ethiopian Acanthaceae for which further taxonomic work was required to fully delimit the taxa. The first concerns the *Isoglossa somalensis* Lindau complex in the forests of central and southern Ethiopia; the second concerns the *Barleria induta* C.B.Clarke (or *B. prionitis* L.) complex and the third concerns the status of *Hypoestes microphylla* Hochst. ex Nees, these latter two from the drylands of northern Ethiopia and western Eritrea.

With the findings of the current work, the endemic Acanthaceae of Ethiopia currently stand at 21 species and two further infraspecific taxa, whilst an additional 23 species and one infraspecific taxon are considered to be range-restricted near-endemics for which Ethiopia holds a majority or globally important portion of the population (Appendix 1).

## MATERIALS & METHODS

Herbarium specimens of the relevant species were analysed at the herbaria of BM, K, ETH, FT and P (herbarium abbreviations follow Thiers, updated continuously) using standard herbarium practices. Other relevant type material was viewed online via JSTOR Global Plants (https://plants.jstor.org/). Prior to dissection, flowers were soaked in Aerosol OT 5% solution; all other characters were measured on dry material. All duplicates seen are indicated with an exclamation mark "!"; those only seen electronically are marked with an asterisk "*".

The extinction risk (conservation) assessments for each taxon follow the Categories and Criteria of the IUCN Red List (IUCN 2012) and the guidelines for their use (IUCN Standards and Petitions Subcommittee 2022). Extent of Occurrence (EOO) and Area of Occupancy (AOO) were calculated using the GeoCAT tool (https://geocat.iucnredlist.org/; Bachman et al. (2011).

The distribution maps were produced in QGIS version 3.2. Country boundaries were obtained from GADM (https://gadm.org/). Within Ethiopia and Eritrea, we have applied (in grey lines) a shapefile of the floristic region boundaries of *Flora of Ethiopia and Eritrea*. However, in the "Distribution" section for each taxon, we also list the current administrative regions in which they are found. Note that the boundaries of the regional states in Ethiopia have been updated recently, with the Southern Nations Nationalities and People's Regional State being subdivided into the South West Ethiopia Peoples' Regional State, South Ethiopia Regional State, Central Ethiopia, and Sidama. However, this change has not yet been reflected in the GADM layers for Ethiopia and we have not been able to locate any suitably up-to-date GIS shapefiles for these new administrative boundaries, hence why these are not shown on the maps.

## TAXONOMIC ACCOUNTS

### *1.* ***Isoglossa***

*Isoglossa* Oerst. (Acanthoideae: Justicieae: Isoglossinae; Kiel et al. 2006; Manzitto-Tripp et al. 2022) is a genus of ca. 70 species. It has a palaeotropical and subtropical distribution, with a centre of diversity in east Africa, where it is noted for its high number of highly range-restricted montane species (Darbyshire 2009; Darbyshire and Hemp 2023). In the *Flora of Ethiopia* *and Eritrea*, five species were documented (Ensermu 2006): *I. congesta* Hedrén, *I. ovata* E.A.Bruce (= *I. bruceae* I.Darbysh.; Darbyshire 2009), *I. parvifolia* Rendle, *I. punctata* (Vahl) Brummitt & J.R.I.Wood and *I. somalensis* Lindau. The lattermost of these species was treated in a broad sense and is morphologically variable across the Ethiopian highlands. Following a taxonomic revision of the *I. somalensis* complex based on detailed morphological analyses, one new species, *Isoglossa recurva* Hanny & I.Darbysh., and a new variety of *I. somalensis*, var. *glandulosa* Hanny, G.Hoban & I.Darbysh., are here described. In addition, the first record of *I. gregorii* (S.Moore) Lindau for Ethiopia is noted. In view of these taxonomic changes and additions, we provide a revised key to the genus in Ethiopia.

### ***Isoglossa recurva*** Hanny & I.Darbysh., **sp. nov.**

Type: Ethiopia, Illubabor Region, 66 km north of Tepi along the road to Mocha and Gore, 25 Jan. 2000 (fl., fr.), *I. Friis*, *S. Bidgood*, *Ermias Getachew & Mulugeta Gichile 9814* (holotype ETH!; isotypes C, K! [K005326606]). (Figure 1).

(=) *Isoglossa somalensis sensu* Ensermu (2006: 494), pro parte, non Lindau.

*Diagnosis*

This species is most likely to be confused with *Isoglossa somalensis*, and in particular var. *glandulosa* Hanny, G.Hoban & I.Darbysh. (described below) which both share a glandular inflorescence indumentum. However, *I. recurva* differs most markedly in (1) the upper lip of the corolla being strongly recurved, with clearly protruding lower lip (versus upper lip not or barely recurved, lower lip not clearly protruding); (2) the inflorescence being narrowly and laxly paniculate and the glandular hairs having minute, inconspicuous gland tips (versus spiciform or more rarely narrowly paniculate, not so lax, glandular hairs when present [var. *glandulosa*] with conspicuous, thick gland tips); (3) the staminal filaments being much shorter, ± 2.8 mm long, and the anthers thecae being smaller, 1.1–1.5 mm (versus filaments 5–8 mm long, thecae 1.4–2.8 mm long, ≥ 2.3 mm in var. *glandulosa*); and (4) having a shorter style, ± 3.9 mm long (versus 7.7–11.5 mm long). It is easily separated from the sympatric *Isoglossa somalensis* var. *somalensis* by having a dense glandular indumentum on the inflorescence (versus glandular hairs absent or at most very sparse), and for this reason it is only compared to var. *glandulosa* in Table 1.

*Isoglossa recurva* is also similar to *I. ventricosa* I.Darbysh. from southern Tanzania but can be separated from that species by (1) the anther thecae overlapping by more than half their length and oblique (versus anther thecae fully superposed and separated, subparallel); (2) the seeds having short blunt tubercles lacking minute hooks (versus tubercles elongate towards the seed rim and minutely hooked); (3) having longer calyx lobes, 4.7–6.8 mm long in flower, 7.5–9.5 mm in fruit (versus 3–5 mm long in flower, 5–6 mm in fruit); and (4) having a more deeply lobed upper lip, lobes 2.3–3 mm long (versus 1.5–2 mm long).

*Description*

Perennial herb with basal stems prostrate and leafy stems ascending, 40–50 cm tall; stems with internodes 2.5–11.5 cm long; young stems grey to greyish-green, with two opposite lines of spreading or curled hairs when young but soon glabrous except at and immediately below the nodes where few hairs persist. Leaves elliptic or ovate-elliptic, becoming more ovate distally, largest leaves 3.9–11.6 × 1.8–5 cm, base attenuate, margin shallowly repand, apex attenuate, upper surface sparsely pubescent, lower surface with hairs largely restricted along main veins and margin; cystoliths dense, linear; lateral veins 7–9 pairs; petiole 3.4–25 mm long, spreading- to antrorse-pubescent on upper side. Inflorescence a narrowly paniculate thyrse, 10.5–21.5 × 3–5.5 cm, ± densely glandular-pilose, hairs ± 1 mm long with a minute gland-tip, and eglandular-puberulous with hairs 0.2–0.3 mm long, or sometimes (*Friis et al.* 7167) more densely eglandular-pubescent with hairs to 0.6 mm long; main axis bracts green, linear-lanceolate, 2.2–5.8 mm long or sometimes proximal-most pairs more leaf-like, up to 10.3 mm long, with eglandular hairs on upper surface and along margin; bracteoles similar to bracts but 2–4.2 mm long; pedicels 0.8–2.7 mm long. Calyx lobes linear-lanceolate, 4.7–6.8 mm long in flower, extending to 7.5–9.5 mm in fruit, glandular-pilose with minute brown gland-tip, and also with shorter finer eglandular hairs especially towards calyx base and margins of lobes. Corolla 15–18 mm long, white with pink to translucent spotting on lower lip, with short eglandular hairs dorsally on tube and extending onto upper lip, with or without longer hairs on tube ventrally, tube pubescent internally below attachment point of stamens; tube 6.7–9.2 mm long, including cylindrical basal portion 2–3 × 1.4–2 mm, throat markedly expanded ventrally, mouth 2.8–4.5 mm in diameter; upper lip hooded, recurved, 5–9 mm long, with 2 rounded lobes 2.3–3 mm long; lower lip protruding, 8–10.6 mm long with 3 rounded lobes 2.8–5 mm long, palate raised upward with central furrow and

**Table 1.** A comparison of the diagnostic characters separating *Isoglossa recurva* from *Isoglossa somalensis* var. *glandulosa*.

| Character | *Isoglossa recurva* | *Isoglossa somalensis* var. *glandulosa* |
|---|---|---|
| Inflorescence form | Narrowly paniculate thyrse | Spiciform or narrowly paniculate thyrse |
| Inflorescence indumentum: glandular hairs | ± densely glandular-pilose, hairs with inconspicuous, minute gland tips | Densely glandular-pilose, hairs with conspicuous, thick gland tips |
| Calyx length: flower / fruit | 4.7–6.8 mm / 7.5–9.5 mm | 6–12 mm / 9–13.2 mm |
| Corolla length | 15–18 mm | (13–) 15.5–27 mm |
| Corolla tube shape and length | Throat markedly expanded ventrally, not expanded dorsally<br>6.7–9.2 mm | Throat expanded both dorsally and ventrally and somewhat saccate<br>8–10.5 mm |
| Cylindrical portion of tube, width | 1.4–2 mm | 2.4–4.2 mm |
| Corolla lips | Upper lip strongly recurved, lower lip clearly protruding | Upper lip not recurved, lower lip not clearly protruding |
| Upper lip length | 5–9 mm | 9.8–11.8 mm |
| Upper lip lobe length | 2.3–3 mm | 0.6–1.6 mm |
| Staminal filament length | ± 2.8 mm | 5–7 mm |
| Anther theca length | 1.1–1.5 mm | 2.3–2.8 mm |
| Ovary length | ± 1.5 mm | 2.6–3 mm |
| Style length | ± 3.9 mm | 10–10.7 mm |

with raised "herring-bone" venation, glabrous. Stamens inserted ± 5 mm from base of corolla tube; filaments ± 2.8 mm long, glabrous; anther thecae overlapping by more than half their length and oblique; upper theca 1.3–1.4 mm long, lower theca 1.1–1.5 mm long, glabrous. Pistil glabrous; ovary ± 1.5 mm long; style ± 3.9 mm long; stigma ± 0.3 mm long, minutely bilobed. Capsule 11.8–16.6 mm long, glabrous; seeds ca. 2.1 × 1.5 mm, tuberculate with short blunt tubercles.

### *Distribution*

Recorded from Gambela and South West Ethiopia Peoples' regional states in Illubabor and Keffa floristic regions of Southwest Ethiopia (Fig. 2).

### *Habitat & Ecology*

Recorded from dense montane forest with "*Schefflera*" (probably = *Astropanax abyssinicus* (Hochst. ex A.Rich.) Seem.), *Ficus* L., *Aningeria adolfi-friederici* (Engl.) Robyns & Gilbert and *Cyathea* Sm., and in *Oldeania alpina* (K.Schum.) Stapleton bamboo thicket; 2100–2550 m asl.

### *Conservation status*

This species is restricted to five locations in the Kefa and Illubabor floristic regions of Ethiopia, with an estimated AOO of 20 km$^2$ and EOO of 4,588 km$^2$. While this AOO value is likely underestimated due to incomplete botanical coverage in this part of Ethiopia, it is considered likely that the true value falls within thresholds for a threatened category under criterion B2. Two of the five locations lie within protected areas, namely the Sele Anderacha National Forest Priority Area and the Mizan-Teferi Controlled Hunting Area, the latter also falling partly within the Kefa UNESCO-MAB Biosphere Reserve. However, protection of the forest for biodiversity within these reserves is considered to be highly limited and the expansion of agriculture, grazing and human settlement into the forest, and tree felling for charcoal production, are inferred to threaten this species through most of its range, particularly in the vicinity of the main transport routes and towns such as Mizan Teferi and Gecha. In addition, several of these forests are managed for coffee production which may impact this species negatively by clearance of the ground flora.

It is therefore inferred to be undergoing a continuing decline in the area, extent, and quality of habitat and is preliminarily assessed as **Endangered B1ab(iii)+2ab(iii)**.

This species is currently known from one Important Plant Area (IPA) in Ethiopia: the Mount Karkarha IPA, which qualifies under criterion A(i) due to the presence of two other globally threatened Ethiopian endemic species, *Dorstenia soerensenii* Friis (EN B1ab(iii)+2ab(iii)) and *Scadoxus nutans* (Friis & I.Bjørnstad) Friis & Nordal (VU B1ab(iii,v)) for which this IPA is considered to be an important site (House *et al.* 2023). The presence of *Isoglossa recurva* at this site provides further evidence of its importance for plant diversity. This species is also likely to occur within the Shako-Bench Forest IPA and the Bonga Forests IPA but has not yet been recorded from

**Figure 1.** *Isoglossa recurva.* A. Habit. B. Mature leaf, adaxial surface. C**.** Node of stem showing indumentum. D. Detail of stem hairs. E. Flower, side view. F. Stamen, showing attachment to corolla tube and associated indumentum. G. Mature capsule within calyx. H. Outer face of capsule valve. J. Indumentum of calyx lobe in fruit. K**.** Seed. A, C–E and J from *Gilbert et al. 4203*; B, F–H and K from *Friis et al. 9814*. Drawn by Andrew Brown.

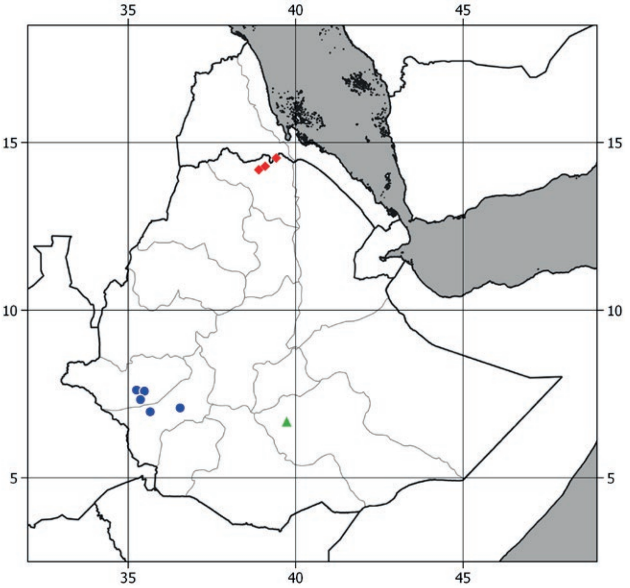

**Figure 2.** Distribution of *Isoglossa recurva* (blue circles), *I. gregorii* (green triangle) and *Hypoestes microphylla* (red diamonds) in Ethiopia and Eritrea.

there. The remnant forested areas north of Tepi in which this species occurs may also qualify as an IPA but this area has not yet been assessed for its IPA status.

*Taxonomic notes*

The cited specimens display some differences in leaf size and inflorescence length. Two populations with small leaves and small, slender inflorescences (*Friis et al. 7167*, *Puff & Ensermu 861109-1/4*) look superficially rather different to the other specimens but they share with them the distinctive corolla form and inflorescence indumentum, and the flowers are also closely comparable in size. We have no doubt that they are conspecific. It is likely that these slender variants are a result of sub-optimal environmental conditions. However, it should be noted that several species of *Isoglossa* are long-lived but monocarpic and often mass-flowering on a cycle of several years (plietesial; see Darbyshire 2009). In such cases, occasional individuals can flower more early in the growth cycle than most of the population and in those cases, the plants can appear smaller in stature than fully mature individuals. However, we do not yet have evidence as to whether or not *I. recurva* is a plietesial species.

Given their geographic proximity, *Isoglossa recurva* is most likely to be confused with *I. somalensis*, and in particular with var. *glandulosa* which shares the long-glandular indumentum of the new species (see below). The two are readily separated by the characters listed in the Recognition and Table 1; the corolla morphology is particularly diagnostic. See also the key to Ethiopian species below. However, it should be noted that only the eglandular var. *somalensis* is sympatric with *I. recurva*; indeed, the two have been recorded together at the same site near Felege Salem village in Keffa floristic region by C. Puff & Ensermu K. (their numbers *861111-1/4* and *861111-1/6*).

The corolla morphology – the markedly expanded ventral side of the tube, reflexed upper lip and protruding lower lip – and the inflorescence form and indumentum of *Isoglossa recurva* are most similar to that of *I. ventricosa* I.Darbysh. from the Mufindi Highlands of southern Tanzania (Darbyshire 2009), hence these species are compared in the Diagnosis.

*Additional specimens examined (paratypes)*

**ETHIOPIA: Illubabor Region:** Mocha Awraja, 21 km from Tepi (on the track to Gecha), 9 Nov. 1986 (fl.), *Puff & Ensermu 861109-1/4* (ETH!); 65 km north of Tepi, along the new road to Gore, between Gecha and Macha, 16 Nov. 1995 (fl., fr.), *Friis et al. 7167* (C, ETH!, K!); **Keffa Region:** Kaka [Karkarha] Mountain, near Mizan Teferi, 13 Jan. 1976 (fl.), *Gilbert & Rankin 4203a* (K!); Kefa Awraja, 52 km from (S of) Bonga towards the border of Kefa Kulo Konta Awraja (= c. 5 km beyond Felege Salem Village), 11 Nov. 1986 (fl., fr.), *Puff & Ensermu 861111-1/4* (ETH!).

***Isoglossa somalensis*** Lindau, Annuario del Reale Ist. Bot. di Roma. 6: 82. 1895.

See Friis & Vollesen (2005: 445); Ensermu (2006: 494), pro parte; Darbyshire et al. (2015a: 349).

Type: Ethiopia, "inter Alghe et Oi", 16 Sept. 1893 (fr.), *D. Riva 1293* (holotype FT! [FT003267]; isotype B, photo at K!) – see note.

(=) *Isoglossa ovata sensu* Andrews (1956: 177), non E.A.Bruce.

*Description*

Perennial herb or slender subshrub with basal stems prostrate, leafy stems ascending to erect or sometimes straggling in bushes or undergrowth, 30–490 cm tall; stems with internodes 2–16 (– 19) cm long; young stems greyish-green or light/dark green to violet-tinged, with two opposite lines of spreading or curled hairs, sometimes restricted to immediately below the nodes when mature, sometimes scattered hairs persist or glabrous. Leaves elliptic, ovate-elliptic or lanceolate, becoming more ovate distally, largest leaves 3–12.7 × 1.4–6.6 cm, apex attenuate to acute, or attenuate-acuminate, base attenuate, cuneate or oblique or distalmost leaves obtuse to rounded, margin entire to shallowly repand or crenate; with ± dense inconspicuous antrorse hairs along the main vein, lateral veins and margins on both surfaces; cystoliths dense, linear; lateral veins 4–12 pairs; petiole 0.4–8.2 cm long, spreading- to antrorse-pubescent mainly on upper surface and margin. Inflorescence terminal, a spiciform or narrowly to broadly paniculate thyrse, 5–35 × 2–21 cm, axes with numerous short eglandular hairs only or sometimes also densely glandular-pilose, these with conspicuous dark-brown gland tips; branching along main axis opposite, main axis bracts green, those in proximal portion of inflorescence ovate or elliptic, 12–47 × 3.5–26 mm, those in distal portion gradually reducing in size or more rarely quickly becoming linear-lanceolate, 2.2–15 × 1.7–9.4 mm long, with eglandular hairs on upper surface and along margin; bracteoles similar to bracts but linear-lanceolate, 2–4.3 mm long; pedicels 1–2 mm long. Calyx lobes linear-lanceolate, 4–12 mm long in flower, extending to 5–30 mm in fruit, with short eglandular hairs and sometimes also densely glandular-pilose with thickened dark-brown gland-tips. Corolla (13–) 16–27 mm long, white to pale lilac-pink, with red-pink, purplish or purple-brown spots and stripes on lower lip and into throat, densely pubescent on dorsal part of the corolla externally, sometimes tube pubescent internally below attachment point of stamens; tube (6.7–) 8–14 mm long, including short cylindrical basal portion 0.8–3.1 × 2.3–4.8 mm, throat expanded both dorsally and ventrally and somewhat saccate, mouth 4.5–14 mm in diameter; upper lip hooded, (6.5–) 8–11.8 mm long, with 2 rounded lobes 0.6–3 mm long; lower lip 7.3–15.5 mm long, with 3 rounded lobes 1.5–6 mm long, palate raised upwards with a central furrow and with somewhat prominent "herringbone" venation, glabrous. Stamens inserted 5–9.5 mm from base of corolla tube; filaments 5–8 mm long, glabrous; anther thecae overlapping by half their length or slightly more than half their length and oblique or sometimes patent to each other; upper theca 1.5–2.8 mm long, lower theca 1.4–2.7 mm long, glabrous. Pistil with ovary 1.7–3 mm long, glabrous or shortly pubescent at apex; style 7.7–11.5 mm long; stigma 0.2–0.3 mm long, minutely bilobed. Capsule (11–) 15–23 mm long, glabrous or sometimes with glandular hairs with dark- brown gland tips towards apex; seeds ca. 1.8–2.7 × 1.8–2.7 mm, tuberculate with short blunt tubercles.

### *Conservation status*

*Isoglossa somalensis* is widespread in Ethiopia and extends to South Sudan. Its large EOO of 362,810 km$^2$ greatly exceeds thresholds for a threatened category under criterion B1. It occurs at many more than 10 locations and is not thought to be severely fragmented or subject to extreme fluctuations. Some of the subpopulations are likely to be under significant threat from expansion of agriculture, human settlement and grazing, even in cases where they occur within protected areas, hence the global population is likely to be in decline and some subpopulations will probably have been lost. However, it is not thought that past or future rates of population reduction are high enough for this species to qualify as threatened under criterion A. Therefore, this species is preliminarily assessed as **Least Concern**.

## ***Isoglossa somalensis*** **Lindau var. *somalensis***

### *Description*

Mature leaves 4.5–12.7 × 1.7–6.6 cm. Inflorescence a ± broadly paniculate thyrse with short eglandular hairs only, rarely with few scattered glandular hairs.

### *Distribution*

*Isoglossa somalensis* var. *somalensis* is recorded from Imatong State in South Sudan and from Gambela, Oromia, South Ethiopia and South West Ethiopia Peoples' regional states and Addis Ababa city, in Arsi, Bale, Gamo Gofa, Harer, Illubabor, Keffa, Shewa and Sidamo floristic regions of Ethiopia (Fig. 3). It may also occur in northern Uganda but has not yet been collected from there. Despite its name, this species does not occur in Somalia.

### *Habitat & Ecology*

Understorey of moist montane forest, occurring in a range of forest types with dominant tree species including *Afrocarpus gracilior* Pilg. and/or *Juniperus procera* Hochst. ex Endl., to more mixed assemblages with e.g., *Acacia abyssinica* Hochst. ex Benth. (*Vachellia abyssinica* (Hochst. ex Benth.) Kyal. & Boatwr.), *Albizia gummifera* (J.F.Gmel.) C.A.Sm., *Aningeria adolfi-friederici* (Engl.) Robyns & Gilbert, *Astropanax abyssinica*, *Bersama abyssinica* Fresen., *Brucea antidysenterica* J.F.Mill, *Croton macrostachyus* Hochst. ex Delile, *Galiniera saxifraga* (Hochst.) Bridson, *Hagenia abyssinica* (Bruce) J.F.Gmel, *Erythrina brucei* Schweinf., *Macaranga kilimandscharica* Pax, *Maytenus* Molina, *Myrsine melanophloeos* (L.) R.Br. ex Sweet, *Ocotea kenyensis* (Chiov.) Robyns & R.Wilczek,

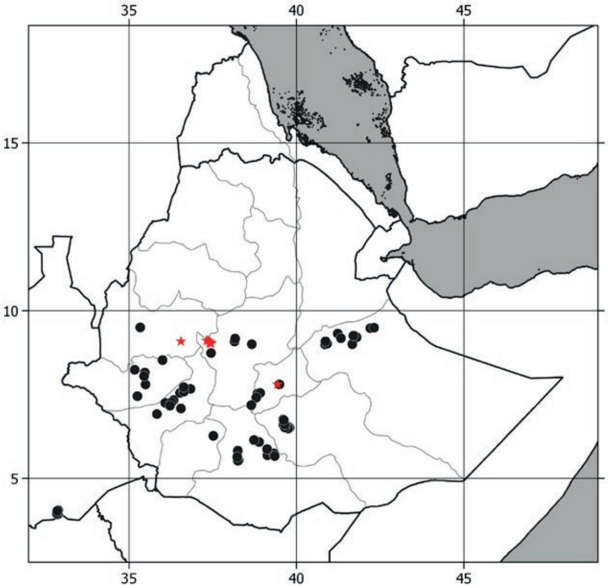

**Figure 3.** Distribution of *Isoglossa somalensis* var. *somalensis* (black circles) and specimens intermediate between var. *somalensis* and var. *glandulosa* (red stars) in Ethiopia and South Sudan.

*Olea welwitschii* (Knobl.) Gilg & G.Schellenb. and/or *Syzygium afromontanum* (F.White) Byng. It also occurs along paths, margins and clearings in forest and sometimes in secondary scrub. Recorded over a wide elevation range, from 1600–3050 m asl.

*Conservation status*

This variety occupies the full EOO (362,810 km$^2$) of *Isoglossa somalensis* s.l. and the other information provided in the preliminary assessment of the species as a whole (see above) is equally applicable here; this variety is therefore preliminarily assessed as **Least Concern**.

*Taxonomic notes*

Leaf shape and leaf base are variable in this variety. Most of the specimens have elliptic leaves with a cuneate/attenuate base. However, *Gillett 5198* (Harar region) and *de Wilde 8705* (Shoa region) have ovate leaves with rounded bases whereas *Friis et al. 3577* (Bale region), *de Wilde 9205* (Arsi region) and *Chaffey 1112* (Arsi region) have more lanceolate leaves with attenuate bases. This variety nearly always lacks glandular hairs throughout, but there are rare specimens with very few scattered glandular hairs on the inflorescence.

The type specimen at FT is attribute to Dr. Riva but the printed label states "Legit Coll. Ruspoli. Dr. Riva".

*Additional specimens examined*

**ETHIOPIA: Arsi Region:** Chellemo forest, 45 miles W of Addis Ababa, 8 Dec. 1953 (fl., fr.), *Mooney 5094* (ETH!, FT!, K!); E slope of Mt. Boruluccu along road to Ticcio, about 25 km SE of Asella, 6 Dec. 1965 (fl.), *de Wilde & de Wilde-Duyfjes 9205* (ETH!, K!); Munessa forest, Nov. 1976 (fl.), *Chaffey 1112* (K!); Chilalo Awraja, ± 9 km W of Kersa, 5 Dec. 1982 (fl.), *Ensermu et al. 561* (ETH!); **Bale Region:** ca. 20 km N of Delo Menna (Masslo), on road to Goba, 28 Oct. 1984 (fl., fr.), *Friis et al. 3577* (K!); Dello Awraja, Harenna forest, Shawe swamp, 15 Dec. 1986 (fl., fr.), *Mesfin 5712* (ETH!); Dello Awraja, Harenna forest, 21 km from turnoff near Shisha River, 16 Dec. 1986 (fl., fr.), *Mesfin 5767* (ETH!); Dello Awraja, c. 23–25.5 km on Dello Menna-Goba road, 28 Dec. 1990 (fl., fr.), *Mesfin et al. 8245* (ETH!); Dollo Awraja, c. 20.5 km on Dello Menna-Goba road, 28 Dec. 1990 (fr.), *Mesfin et al. 8253* (ETH!); Dalo Awraja, Tate, 16 km from Dalo Menna on the road Goba, (Tate), Harenna forest, 9 Oct. 1993 (fl.), *Ensermu & Melaku 2577* (ETH!); Dello Mena Werede, 25 km from Delo Menna towards Goba, 31 Jan. 1995 (fr.), *Sebsebe et al. 4369* (ETH!); 42–43 km from Delo Menna towards Goba to the western side of the main road, 5 Feb. 1995 (fl., fr.), *Sebsebe et al. 4387* (ETH!); 42 km from Delo Menna towards Goba 11 Feb. 1995 (fl.), *Sebsebe et al. 4407* (ETH!); **Gamo Gofa Region:** Gughe highlands, 9 km from Chencha on road to Dorse, 10 Oct. 1989 (fl., fr.), *Gilbert* & *Phillips 9249* (ETH!, K!); **Harar Region:** between Harer and Addis Ababa, Oct. 1898 (fl.), *Wellby s.n.* (K!); Garra pass, 24 Feb. 1933 (fl.), *Gillett 5198* (K!); Gara muleta, 20 Oct. 1960 (fl.), *IECAMA J-4* (K!); S face of Gara Muleta Mountain, c. 50 km due W of Harar, 24 Sept. 1961 (fl.), *Burger 1044* (ETH!, K!); near Firta, Jan. 1961 (fl., fr.), *IECAMA RS-240* (K!); Gara Ades, 21 Oct. 1962 (fl., fr.), *Burger 2255* (K!); S face of Gara Mullata Mountain, c. 50 km due W of Harar, 2 Aug. 1962 (fl.), *Burger 2007* (ETH!, FT!, K!); 1 km from Harawacha along road to Deder, track to the left leading to the top of the mountain, 28 July 1967 (fl.), *Westphal & Westphal-Stevels 914* (K!); 80 km from Asebe Teferi, road to Kobbo, 18 Aug. 1967 (fl.), *Westphal & Westphal-Stevels 1347* (K!); road Bedeno-Longhe, 16 km from Bedeno, 26 Oct. 1967 (fl.), *Westphal & Westphal-Stevels 2434* (K!); NW face of Gara Mullata, about 36 km on the road from Kulubi via Whater to Mennonite Mission at Badenno, 9 Jan. 1969 (fl.), *de Wilde 4395* (K!); ± 29 km from Harar on road to Jarso (Ejersa Goro), 25 Sept. 1980 (fl.), *Ensermu & Tamrat 374* (ETH!); Chercher and Adal and Gara Gracha Awraja, Asebe Teferi-Gelemso road, 21 Sept. 1982 (fl., fr.), *Puff et al. 820921-3/2* (ETH!, K!); Gara Mulleta Awraja, 75 km SW Dire Dawa closer to Girawa town, 20 Apr. 1983 (fl.), *Sebsebe & Ensermu 1393* (ETH!); Harer Zuriya Awraja, 48 km from Harer (13 km from Jarso) on the road to Gursum, 22 Jan. 1987 (fl., fr.), *Ensermu & Petros 1935* (ETH!, K!); 7 km on Gelemso road from Asebe Teferi road, 18 Oct. 2006 (fl., fr.), *Friis et al. 12511* (K!); **Illubabor Region:** about 20 km S of Gore, along the Gore-Mocha-track, 16 Dec. 1972 (fl., fr.), *Friis et al. 1801* (ETH!, K!); around Gumaro tea plantation, 9 Jan. 1978 (fl., fr.), *Mesfin & Sebsebe 186* (ETH!); Gore Awraja, 40 km from Gore on the way to Gambella, 9 Oct. 1980 (fl.), *Mesfin & Sebsebe 1366* (ETH!); Gore Awraja, 37–41 km from Gore on the road to Masha, 1 Feb. 1984 (fl., fr.), *Ensermu et al. 836* (ETH!); Gore Awraja, c. 15 km S of Gore (on new Mocha and Tepi road), 4 Nov. 1986 (fl., fr.), *Puff & Ensermu 861104-3/2* (ETH!); 55 km N of Tepi, along the new road to Gore, between Gecha and Macha, 16 Nov. 1995 (fl.), *Friis et al. 7165* (ETH!, K!); **Keffa Region:** Santama, 18 m NW of Jimma, 11 Oct. 1954 (fl., fr.), *Mooney 5987* (ETH!, K!); Jimma, 12 Aug. 1961 (fl., fr.), *Brehme s.n.* (ETH!); Bonga, about 5 km S of R.C. Mission, 21 Dec. 1965 (fl., fr.), *de Wilde* and *de Wilde-Duyfjes 9365* (ETH!, K!); Belleta forest, some 40 km SW of Jimma on Bonga road, 10 Nov. 1970 (fl., fr.), *Friis et al. 252* (ETH!, FT!, K!); Belleta forest, 10 km N of Bonga, or 88 km SW of Jimma, 1 Jan. 1972 (fl., fr.), *Ash 1459* (ETH!, K!); Bonga beyond the Catholic Mission, near the water fall (450 km W of Addis Ababa), 7 Oct. 1980 (fl.), *Mesfin & Sebsebe 1297* (ETH!); Woshi, 28 May 1985 (fl.), *Admasu & Reinhard 625* (ETH!); Kea Awraja, c. 37–32 km S of turnoff from Mizan Teferi-Bonga road (= new road S to Bachuma and Maji, c. 10-5 km from Shewa Gimira), 10 Nov. 1985 (fl., fr.), *Puff & Ensermu 861110-2/4* (ETH!); Kefa Awraja, 52 km from (S of ) Bonga towards the border of Kefa and Kulo Konta Awraja), c. 5 km beyond Felege Salem village, 11 Nov. 1986 (fl.), *Puff & Ensermu 861111-1/6* (ETH!); Jimma Awraja, Belete forest, 35–44 km from Jimma on the road to Bonga, 28 Dec. 1998 (fl., fr.), *Ensermu & Aschalew Getahun 4147* (ETH!); Belete [Belleta] forest, SW of Jimma on road to Bonga, 16 Sept. 2003 (fl.), *Brummitt 20926* (K!); **Shewa Region:** Foresta di Bagieo (Gaggi), 22 April 1937 (fl.), *Giordano 500* (FT!); Bosco di Gaggi, 13 May 1937 (fl., fr.), *Senni 752* (FT!); Woliso, 7 Nov. 1958 (fl.), *Mooney 7612* (ETH!, FT!, K!); Hayikoch & Butajira Awraja Lepiz Gambo state forest 22 km E of (Arsi) Negele (=E escarpment of Rift Valley), 24 Sept. 1982 (fl.), *Puff et al. 820924-1/7* (K!); Hayikoch and Butajira Awraja, c. 10 km E of Shashamene on Goba road, 25 Sept. 1982 (fl., fr.), *Puff et al. 820925-1/2* (ETH!); Hossaina, 15 Mar. 1985 (fr.), *Fichtl 542* (ETH!); Jibat and Mecha Awraja, Chilimo forest, 7–12 km from Ginchi on the road to Jeldu, 30 Dec. 1986 (fl.), *Ensermu & Zemede 1803* (ETH!); Jibat and Mecha Awraja, 2–3 km W of Shenen, 8 Dec. 1987 (fl.), *Ensermu & Petros 1989* (ETH!); **Sidamo Region:** Socorà, 5 Nov. 1937 (fl.), *Vàtova 426* (FT!); idem, 10 Nov. 1937 (fl., fr.), *Vàtova 498* (FT!); idem, 10 Nov. 1937 (fr.), *Vàtova 863* (FT!); idem, 10 Nov. 1937 (fl.), *Vàtova 885* (FT!); Afrera–Irba Moda, 17 Nov. 1937 (fl., fr.), *Vàtova 761* (FT!); Agere Mariam (Alghe), 1 Dec. 1952 (fl., fr.), *Gillett 14560* (FT!, K!); Mogade forest, 6 Jan. 1954 (fr.), *Mooney 5468* (ETH!, FT!, K!); Wadere, 26 Jan. 1954 (fr.), *Mooney 5635* (ETH!, FT!, K!); Zembaba, ± 25 km SE of Adola, near wood factory on road side, 19 Oct. 1980 (fl., fr.), *Ensermu 442* (ETH!); Jemjem Awraja, 84–88 km from Negele on road to Kibre Mengist (=SE of Kontema), 29 Dec. 1982 (fl., fr.), *Puff & Ensermu 821229-5/3* (ETH!); Jemjem Awraja, 31 km N of Kibre Mengist on road to Wendo, 30 Dec. 1982 (fl., fr.), *Puff & Ensermu 821230-1/2* (ETH!); Arero Awraja, Gedebada, ca. 20 km N of Agere Mariam (c. 444 km S of Addis Ababa on Addis-Moyale road), 8 Oct. 1985 (fl., fr.), *Mesfin et al. 3136* (ETH!); Arero Awraja, c. 2–17 km N of Agere Mariam, 14 Oct. 1985 (fl.), *Mesfin et al 3604* (K!, ETH!); Mogade forest, S of Agere Mariam, 6 Nov. 1990 (fl., fr.), *Friis et al. 6231* (K!); Jemjem Awraja, Harru, 17 km from Wadere on the road to Adola, 14 Oct. 1993 (fl.), *Ensermu & Melaku 2624* (ETH!); 86 km N of Yabello on the road to Agere Mariam and Addis Ababa, Mogade forest, 20 Oct. 1993 (fl.), *Ensermu & Melaku 2657* (ETH!); Arero Awraja, Mogade forest about 2 km S of Agre Mariam on the road to Yabello, 24 Dec. 1998 (fl.), *Ensermu & Aschalew 4082* (ETH!).

**SOUTH SUDAN: Imatong State:** Itibol to Ibahin, 18 Dec. 1935 (fl., fr.), *Thomas 1658* (K!); Imatong Mountains, 12 Feb. 1936 (fr.), *Johnston 1480* (K!); Gilo, Imatongs, 10 May 1954 (fl.), *Jackson 3132* (K!); Imatong Mountains, 13 Feb. 1976 (fl., fr.), *Howard IM 44* (K!); near Gilo village, 8 Nov. 1980 (fl., fr.), *Friis & Vollesen 5* (K!); between Gilo and Mt Konoro, 23 Nov. 1980 (fl.), *Friis & Vollesen 406* (C, K!).

### ***Isoglossa somalensis*** Lindau var. ***glandulosa*** Hanny, G.Hoban & I.Darbysh., **var. nov.**

Type: Ethiopia, Sidamo Region, 23 km from Bore towards Kibre Mengist, 13 Dec. 1990 (fl., fr.), *Sebsebe & Ensermu 2603* (holotype ETH!; isotypes C, K! [K005326598]).

#### *Diagnosis*

Var. *glandulosa* differs from var. *somalensis* in having a dense glandular indumentum on the inflorescence (versus eglandular only or rarely with very few scattered

**Table 2.** The main morphological differences between *Isoglossa somalensis* var. *somalensis* and *Isoglossa somalensis* var. *glandulosa*.

| Character | *Isoglossa somalensis* var. *somalensis* | *Isoglossa somalensis* var. *glandulosa* |
|---|---|---|
| Leaf size | 4.5–12.7 × 1.7–6.6 cm | 2–8.6 × 1.4–5 cm |
| Inflorescence form | Broadly paniculate thyrse | Spiciform or narrowly paniculate thyrse |
| Inflorescence indumentum | Dense short eglandular hairs, rarely also with few scattered glandular hairs | Densely glandular-pilose and also with dense eglandular hairs |

glandular hairs), and in the inflorescence typically being spiciform or narrowly paniculate (versus ± broadly paniculate); Table 2.

### *Description*

Mature leaves 2–8.6 × 1.4–5 cm. Inflorescence spiciform or a narrowly paniculate thyrse, densely glandular-pilose with conspicuous, thick dark-brown gland tips in addition to the shorter eglandular hairs.

### *Distribution*

*Isoglossa somalensis* var. *glandulosa* is recorded from Oromia, Sidama and South Ethiopia regional states in the Bale and Sidamo floristic regions of Ethiopia (Fig. 4).

### *Habitat & Ecology*

Recorded from montane forest with, e.g., *Hagenia abyssinica*, "*Schefflera*" (probably *Astropanax abyssinicus*), *Ilex mitis* (L.) Radlk., *Allophylus abyssinicus* (Hochst.) Radlk. and *Croton macrostachyus* including in clearings; also occurs in bamboo (*Oldeania alpina*) thicket and *Erica*-*Hypericum*-"*Schefflera*" forest near the treeline; 2300–3400 m asl.

### *Conservation status*

This variety is restricted to high montane areas in the Bale and Sidamo floristic regions of Ethiopia. The estimated AOO and EOO are 80 km$^2$ and 12,558 km$^2$ respectively. This AOO value may be underestimated due to incomplete botanical coverage in this part of Ethiopia, but it is considered likely that the true value falls within thresholds for a threatened category under criterion B2. This variety is known from 11 locations some of which are under threat from expansion of agriculture and human settlement. These threats are inferred to be contributing to a continuing decline in the area, extent, and quality of suitable habitat for this taxon. While most of this taxon's known distribution is within protected areas, they are not strictly managed and are still impacted by agricultural encroachment and grazing. As it meets the Vulnerable threshold under criteria B1 and B2 and is undergoing a continuing decline, but narrowly exceeds the threshold for number of locations, this variety is preliminarily assessed as **Near Threatened B1ab(iii)+2ab(iii)**.

### *Taxonomic notes*

Some specimens from Bale region have a narrowly paniculate thyrse, with well-developed, though short, secondary peduncles and the bracts typically reducing from ovate to linear-lanceolate moving up the inflorescence rachis. Plants from the Sidamo region usually have a spiciform inflorescence with secondary peduncles very short or absent and there is little or no reduction in bract size up the rachis, the bracts being ovate throughout. However, there is variation in this trend, for example *Gilbert & Ermias 8478* from Bale has a spiciform inflorescence, whilst *Mooney 8200* and *de Wilde & de Wilde-Duyfjes 8381* from Sidamo have narrowly paniculate thyrses. In all cases, the inflorescences are markedly narrower than in var. *somalensis*.

The large majority of specimens of *Isoglossa somalensis* are easily separated into the two taxa defined here,

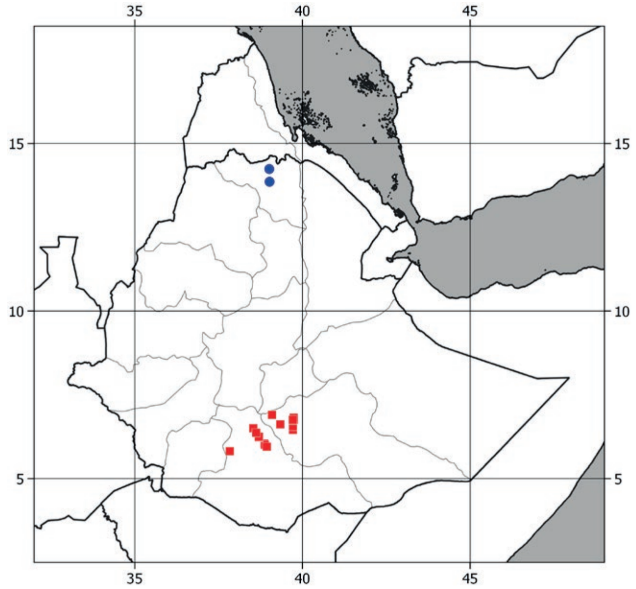

**Figure 4.** Distribution of *Isoglossa somalensis* var. *glandulosa* (red squares) and *Barleria praetermissa* (blue circles) in Ethiopia.

which look very distinct from one another and are worthy of recognition. However, there are a few intermediate specimens and the two are not wholly allopatric. Unusually, most of the intermediate specimens are from Shewa Region, thus not within the current known range of var. *glandulosa*. These intermediate specimens of *I. somalensis* (see citations below) have a glandular inflorescence indumentum similar to var. *glandulosa*, though typically less dense, however they have a more lax inflorescence an often larger leaves, tending towards var. *somalensis*. Furthermore, on *Friis et al. 3722* (and *3722A*) from Bale Region, the collectors note that "glandular and glabrous forms intermix"; however, the two specimens seen both have glandular hairs, one more dense than the other, indicating that true var. *somalensis* is not present at that site. Whether these intermediate forms are the product of ancient hybridisation when the range of var. *glandulosa* was wider than today, or whether they should be treated as a third infraspecific taxon is uncertain. However, they are not given formal taxonomic status at present and, given their presence, variety appears to be the most appropriate rank at which to separate the two formally recognised taxa here. Future molecular studies may help to elucidate the status of these few intermediate populations.

*Additional specimens examined (paratypes)*

**ETHIOPIA: Bale Region:** 46 km from Goba along the road to Delo Menna (Masslo), 2 Nov. 1984 (fl.), *Friis, Gilbert* & *Vollesen 3722* (K) - see note; 45 km N of Dolo Menna on the road to Goba, 12 Nov. 1986 (fl.), *Gilbert & Ermias 8478* (ETH!, K!); Dello Awraja in Harenna forest, c. 16 km on Dello Menna-Goba road, 14 Dec. 1986 (fl., fr.), *Mesfin 5674* (ETH!); Dello Awraja in Harenna forest, c. 8 km S of Kocha, 15 Dec. 1986 (fl.), *Mesfin 5698* (ETH!); Harenna forest, 24 Dec. 1989 (fl.), *Mesfin 7602* (ETH!); near road to Dolo Menna, Harenna forest below Rira, 23 Dec. 1989 (fl.), *Miehe 103* (K!); above Rira, 9 Feb. 1990 (fl.), *Miehe 2148* (K!); Mendeyu Awraja, Rira Town, along Rira stream, 28 Dec. 1990 (fl., fr.), *Mesfin et al. 8144* (ETH!); Bale forest, 27 Nov. 1993 (fl., fr.), *Fichtl 921* (ETH!); 6 km [from] Rira village on the road to Delo Menna, 8 Dec. 1993 (fl.), *Ensermu & Melaku 2570* (ETH!); 47 km from Delo Menna towards Goba, 6 Feb. 1995 (fl., fr.), *Sebsebe et al. 4398* (ETH!); 48 km from Delo Mena towards Goba, 8 Feb. 1995 (fl.), *Sebsebe et al. 4402* (ETH!); Region 4, Bale zone, Adaba woreda, Tarura area, 10 km S of Dodola Peasant Association, edge of Witte forest, 11 Oct. 1995 (fl., fr.), *Sebsebe & Ensermu 4781* (ETH!); **Sidamo Region:** E slopes [of] Mt. Delo, 28 Jan. 1953 (fl., fr.), *Gillett 14979* (FT!, K!); Gajaso, 16 Mar. 1958 (fl.), *Smeds 1301* (K!); Shosho, 16 Mar. 1958 (fl.), *Smeds 1310* (K!); near Irba Meda, 10 Oct. 1959 (fl.), *Mooney 8200* (ETH!, K!); Aghere Selam, 13 Dec. 1962 (fl.), *Mooney 9697* (ETH!); between Wondo & Hagere Selam, 21 Oct. 1965 (fl., fr.), *de Wilde & de Wilde-Duyfjes 8381* (ETH!, K!); road Hagere Selam to Kebre Mengist, 39 km from Agere Selam, 15 km from Bore, 18 Nov. 1967 (fl., fr.), *Westphal* & *Westphal-Stevels 2696* (K!); 43 km S of Agere Selam on the road to Kebre Mengist, 1 Nov. 1972 (fl.), *Friis et al. 765* (ETH!, K!); ca. 23 km from Adola on the road to Bore and Awassa, 5 Apr. 1993 (fl., fr.), *Ensermu et al. 2516* (ETH!); Jemjem Awraja, 17 km from NW of Adola on the road to Bore and Addis Abeba, 15 Oct. 1993 (fl.), *Ensermu & Melaku 2640* (ETH!); 63 km from Bore towards Kebre Mengist forest, 24 Oct. 1996 (fl., fr.), *Melaku & Kaleab* 172 (ETH!).

*Specimens examined that are intermediate between var.* somalensis *and var.* glandulosa (Fig. 3).

**ETHIOPIA: Arsi Region:** on track to Ticcio, 28 Nov. 1966 (fl., fr.), *Gilbert 139* (ETH!, K!); **Bale Region:** 46 km from Goba along the road to Delo Menna (Masslo), 2 Nov. 1984 (fl.), *Friis et al. 3722A* (K!); **Shewa Region:** Scioa, Kachiny, 21 Oct. 1935 (fl., fr.), *Taschdjian 143* (FT!); 40 km W of Ambo, along road to Lekemti, 9 Nov. 1965 (fl.), *de Wilde & de Wilde-Duyfjes 8705* (ETH!, K!); 8 km W of Ghedo, 20 Sept. 1975 (fl.), *Gilbert & Thulin 920* (K); c. 5 miles W of Ghedo, on Addis Ababa to Lekemti road, May 1978 (fl., fr.), *Ash 3301* (K!); Finchoa Magoria (Gedo), 5 Feb. 1979 (fl.), *A. B. & G. Tadesse 156* (ETH!); 26 km N of Gedo on the road to Fincha, 27 Oct. 1982 (fl.), *Hedrén 521* (ETH!); Jibat and Mecha Awraja, Gbedo Wereda, 183 km from Addis Ababa on the way to Nekemt, 25 Oct. 1985 (fl.), *Sebsebe & Ensermu 1516* (ETH!); Jibat and Mecha Awraja, c. 18 km from Gedo on the road to Fincha, 30 Nov. 1986 (fl., fr.), *Ensermu & Zemede 1799* (ETH!).

***Isoglossa gregorii*** (S.Moore) Lindau in H.G.A.Engler (ed.), Pflanzenw. Ost-Afrikas, C: 372. 1895.

See Darbyshire et al. (2010: 621; 2015b: 147).

(≡) *Homilacanthus gregorii* S.Moore, J. Bot. 32: 129. 1894.

Type: Kenya, Mt Kenya, 24 June 1893 (fl., fr.), *J. W. Gregory s.n.* (holotype BM! [BM000931245]).

*Distribution*

Widespread in the mountains of East Africa, recorded from southern Ethiopia (newly recorded here), Uganda, Kenya, Tanzania, eastern D. R. Congo, Malawi and eastern Zimbabwe. In Ethiopia it is known only from Oromia regional state, in the Bale floristic region (Fig. 2).

*Habitat & Ecology*

A species of moist montane and submontane forest and forest margins, in Ethiopia recorded from Mixed Afromontane *Aningeria-Olea-Croton-Prunus* forest at ca. 2,000 m asl.

*Conservation status*

This is a widespread and locally common species and has been assessed as **Least Concern** (Darbyshire et al. 2010, 2015b).

*Taxonomic notes*

The Ethiopian specimen cited below was uncovered by the last author (I.D.) during a visit to the ETH herbarium in 2010, but this new country record has not been published until now; this species is incorporated into the revised key to Ethiopian *Isoglossa* below.

*Additional specimens examined*

**ETHIOPIA: Bale Region:** Dello Awraja, Harenna Forest, ca. 4 km S of Kecha, 15 Dec. 1986 (fl., fr.), *Mesfin 5702* (ETH!).

*Revised key to species of Isoglossa in Ethiopia*

1. Inflorescences axillary with bracts leaf-like, peduncles widely divergent from stems, patent or deflexed; leaf blades (1.7 –) 2–3 × 1–1.5 (– 1.8) cm ................................**2**

   Inflorescences predominately terminal, bracts usually rapidly modified from leaves in size and shape up the inflorescence axis, cyme peduncles not so widely divergent from axis; leaf blades (2 –) 4–18 (– 20) × (1 –) 3.5–8.5 cm ....................................................................................................**3**

2. Inflorescences congested; peduncles deflexed; calyx lobes 6–10 mm long, pilose with long-stalked glandular hairs with small gland tips and with short non-glandular hairs; style pubescent at base .........................................*I. congesta*

   Inflorescences lax; peduncle ± patent or at most slightly deflexed; calyx lobes 3–4 mm long, with short stalked glandular hairs with large gland tips and short non-glandular hairs; style glabrous ..................................*I. parvifolia*

3. Inflorescence spiciform or if branched then branches spiciform; corolla 7–17 mm long; seeds with elongate hooked tubercles ................................................................................**4**

   Inflorescence paniculate, or if spiciform then with corolla (13–) 15–25 (–27) mm long; seeds with tubercles broader, not elongate and lacking hooks, but sometimes with fine hair-like processes ..................................................................**5**

4. Cymule bracts 1.5–4.5 (–6) mm long, triangular-ovate; inflorescences with opposite cymules, sometimes branched, axes straight with well-spaced cymules, bracts not imbricate; calyx lacking pilose hairs and only rarely with glandular hairs; corolla white or rarely pale pink. ....... ..................................................................................*I. punctata*

   Cymule bracts 4.5–14 mm long, ovate, elliptic or somewhat obovate; inflorescence wholly or partially unilateral (i.e. 1 cyme per node), spiciform or few-branched, axes often curved, cymules usually shortly spaced and with imbricate bracts distally; calyx often with long pilose hairs and/or glandular hairs; corolla pink, mauve or rarely (not in Ethiopia) white ..................................................*I. gregorii*

5. Inflorescence with short eglandular hairs only, glandular hairs absent or rarely very sparsely present ......................... ...................................................*I. somalensis* var. *somalensis*

   Inflorescence with indumentum including numerous long glandular hairs ......................................................................**6**

6. Young stems long white-retrorse to patent-pubescent in two opposite lines, hairs fine and without conspicuous cell walls; anther thecae offset and separated by 0.7–1.3 mm, upper or both thecae held almost patent to filament; seeds rugose-tuberculate, tubercles with minute hair-like processes........................................................................ *I. bruceae*

   Young stems shortly pubescent in two opposite lines or below the nodes, hairs appearing deflated in dry state and with conspicuous cell walls; anther thecae offset but overlapping, oblique but neither theca patent to filament; seeds tuberculate with short blunt tubercles lacking hair-like processes ................................................................................7

7. Inflorescence spiciform or narrowly paniculate, densely glandular-pilose with conspicuous, thick gland tips; calyx lobes 6–12 mm long in flower, 9–13.2 mm in fruit; corolla throat expanded both dorsally and ventrally and somewhat saccate, upper lip not recurved, 9.8–11.8 mm long with lobes 0.6–1.6 mm long, lower lip not clearly protruding; staminal filaments 5–7 mm long; anther theca 2.3–2.8 mm long; style 10–10.7 mm long ...*I. somalensis* var. *glandulosa*

   Inflorescence narrowly paniculate, ± densely glandular-pilose with inconspicuous, minute gland tips; calyx lobes 4.7–6.8 mm long in flower, 7.5–9.5 mm in fruit; corolla throat abruptly expanded ventrally but not expanded dorsally, upper lip strongly recurved, 5–9 mm long with lobes 2.3–3 mm long, lower lip clearly protruding; staminal filaments ± 2.8 mm long; anther theca 1.1–1.5 mm long; style ± 3.9 mm long ........................................................*I. recurva*

## *2. Barleria*

*Barleria* L. (Acanthoideae: Barlerieae; Manzitto-Tripp et al. 2022) is the fourth largest genus in the Acanthaceae family with ± 300 species, the majority of which are from tropical and southern Africa (Darbyshire et al. 2019; Comito et al. 2022). Many of the species are highly range-restricted. In the *Flora of Ethiopia and Eritrea* account of Acanthaceae, Ensermu (2006) recorded 39 species of *Barleria*, including 11 that were considered to be potentially new species to science but were not formally named and published. Four of those 11 taxa have since been described as new species, endemic to Ethiopia (Ensermu and Darbyshire 2018).

*Barleria induta* C.B.Clarke, a striking species with large yellow flowers and harsh spines, was described from northern Ethiopia and Eritrea (Clarke 1899), where it is now known to occupy a small range in the dry rocky terrain of Gonder and Tigray floristic regions and neighbouring western Eritrea. Ensermu (2006) tentatively followed Wood et al. (1983) in treating *B. induta* as a subspecies of the Asian species *B. prionitis* L. However, Ensermu noted that subsp. *induta* (C.B.Clarke) Brummitt & J.R.I.Wood could potentially be re-elevated to species rank or combined with Arabian subsp. *appressa* (Forssk.) Brummitt & J.R.I.Wood and Indian subsp. *pubiflora* (Benth. ex Hohen.) Brummitt & J.R.I.Wood. under a resurrected *B. appressa* Forssk. It has since been argued that the various taxa from across Africa, Arabia and the Indian Subcontinent treated as subspecies of *B. prionitis* by Wood et al. (1983) are so distinct morphologically that they should be (re-)elevated to separate species (see, e.g., Darbyshire et al. 2010). A RADseq phylogeny of *Barleria* (Comito et al. 2022) has subsequently demonstrated that *B. induta* is not closely related to *B. prionitis* (including subsp. *pubiflora*) and instead is resolved in a clade together with *B. appressa* and another species from northeast Africa and Arabia, *B. trispinosa* (Forssk.) Vahl. This makes much more sense both morphologically and phytogeographically. As part of an ongoing revision of sect. *Prionitis* (I. Darbyshire, unpubl. data), the *B. induta-appressa-trispinosa* clade has been re-evaluated, and there are clear morphological characters to treat these taxa as distinct species. Furthermore, specimens previously treated as *B. induta* or *B. prionitis* subsp. *induta* have been found to represent two distinct taxa. *Schimper 682* from Tigray region of Ethiopia was included within subsp. *induta* by Brummitt & Wood (in Wood et al. 1983), but they remarked on one of the two sheets at K "but sepals almost glabrous"; they did not comment on the much smaller corollas and anthers. *Friis et al. 12246* from the same region is a close match for the early Schimper specimen and confirms this taxon to be distinct from *B. induta*, with a number of notable morphological differences. Here, we present a revised description of *B. induta* excluding the aforementioned two specimens which we describe as a new species, *B. praetermissa* I.Darbysh. For completeness, the two species are compared with *B. appressa* in Table 3.

With the addition of this new species, *Barleria* is the genus of Acanthaceae with the highest number of endemics in Ethiopia; six species are strict endemics (*B. baluganii*, *B. ferox*, *B. gidoleensis*, *B. longissima* Lindau, *B. negelleensis* and *B. praetermissa*) whilst a further four are range-restricted near-endemics (*B. boranensis* Fiori, *B. grandis* Nees, *B. induta* and *B. punctata* Milne-Redh.). Furthermore, several other potential Ethiopian endemic *Barleria* taxa noted by Ensermu (2006) only remain undescribed due to insufficient material and are clearly distinct, endemic species.

### ***Barleria praetermissa*** I.Darbysh., **sp. nov.**

Type: Ethiopia, Tigray Region, 45 km S of Adwa (Adi Abun) on the new road to Abi Adi (fl.)13 Oct. 2005, *I. Friis, S. Bidgood, Wege Abebe & Ermias Getachew 12246* (holotype K! [K001295149]; isotypes C, ETH). (Figure 5).

(=) *Barleria diacantha* sensu Clarke (1899: 145), pro parte quoad *Schimper* 682, non Nees.

(=) *Barleria prionitis* L. subsp. *induta* (C. B. Clarke) Brummitt & J.R.I. Wood in Wood et al., Kew Bull. 38: 438. 1983, pro parte quoad *Schimper* 682 & *sensu* Ensermu (2006: 414), pro parte.

*Diagnosis*

Differs from *Barleria induta* in the anterior and posterior calyx lobes being glabrous to very sparsely glandular-pubescent externally (versus ± densely glandular-pubescent and with interspersed finer eglandular hairs); having smaller corollas, less than 40 cm long (versus ≥ 50 cm long), with a short tube 7.5–10 mm long (versus 14.5 –22.5 mm) and with the abaxial lobe 16–17.5 mm long, ± equal in length to the other four lobes (versus 26.5−34 mm long, markedly larger than the other lobes); having smaller anthers, 4.2–4.7 mm long (versus 5–6.3 mm long); and in the antherodes of the reduced lateral stamens being shortly exserted from the corolla tube (versus included within the tube); see Table 3.

*Description*

Spiny shrub, ± 100 cm tall, much branched; leafy stems brown, somewhat angular, largely glabrous or some internodes sparsely puberulous on two opposite sides. Axillary spines few to numerous, pale sandy-coloured or whitish, 2- or 4-rayed, stalk 0.5–2 mm long, longest ray 8–20 mm long, straight. Leaves held

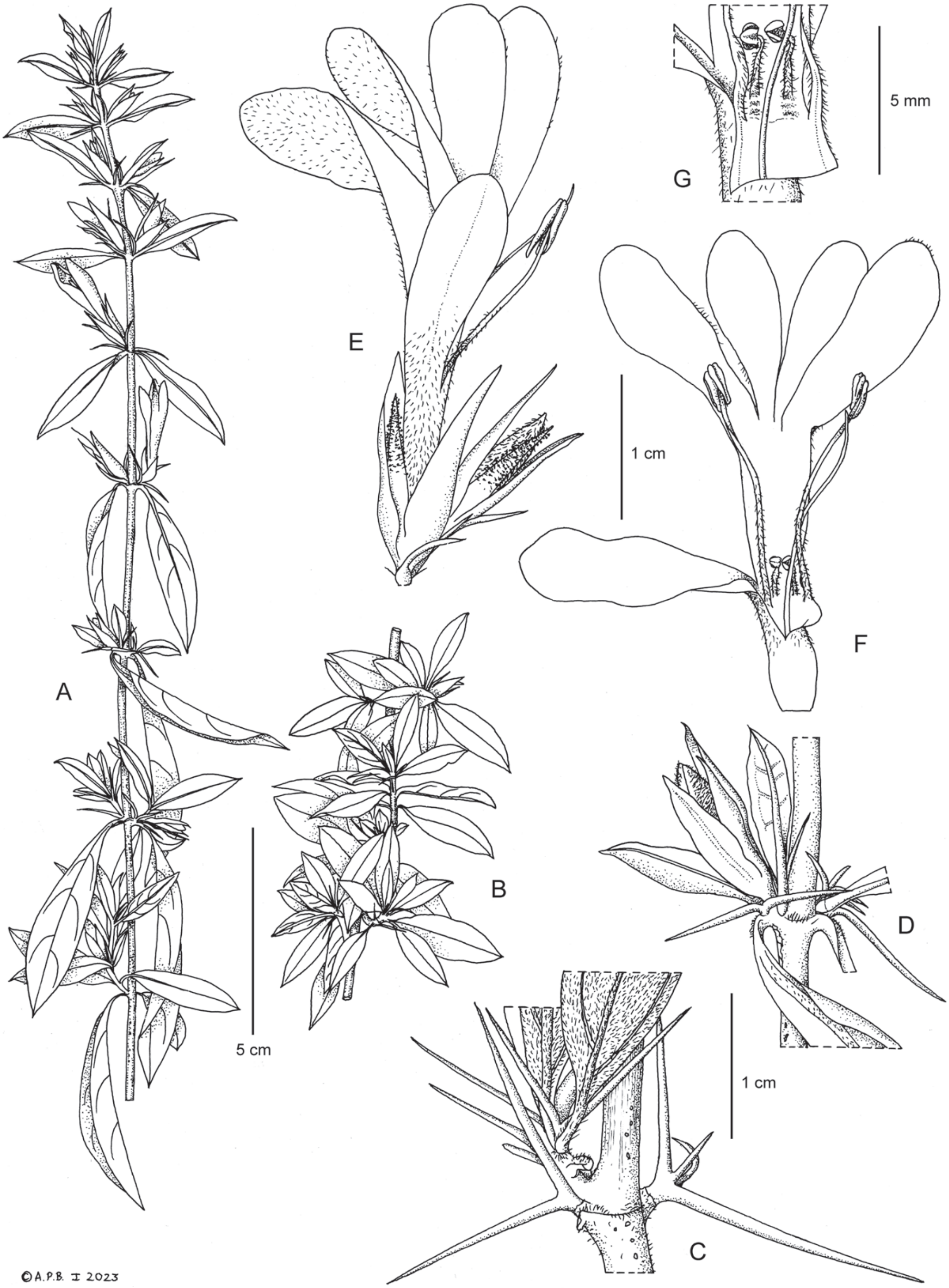

**Figure 5.** *Barleria praetermissa*. A. Habit, fertile distal portion of stem. B. Habit, proximal stems with shorter nodes and short lateral branches. C**.** Proximal node with axillary rayed spines. D**.** Node with flower bud, showing calyx and bracteoles. E**.** Paired flowers. F**.** Dissected corolla with androecium. G. Detail of short lateral stamens (note the exserted antherodes) and base of long, abaxial stamens. A, B and D–G from *Friis et al. 12246*, C from *Schimper 682*.

**Table 3.** The main morphological differences between and distribution of *Barleria appressa*, *B. praetermissa* and *B. induta*.

| Character | *Barleria appressa* | *Barleria praetermissa* | *Barleria induta* |
|---|---|---|---|
| Leaf apex | Acute or attenuate, apiculate or mucronulate for up to 1 mm | Acute or somewhat attenuate, shortly mucronate for up to 1.7 mm | Acute or attenuate, conspicuously and stiffly mucronate for up to 2.2 mm |
| Calyx indumentum: external surface of anterior and posterior lobes | Eglandular-puberulous and with few to numerous short glandular hairs, these often mainly towards margin and apex, with interspersed pale strigulose hairs; rarely whole calyx glabrous (*Wood* 2508; BM, K) | Glabrous or with very few glandular hairs towards margin | ± densely glandular-pubescent and with interspersed finer eglandular hairs, these sometimes more numerous towards base |
| Calyx shape: anterior and posterior lobes | Lanceolate, attenuate to acuminate into apical spine(s) | Lanceolate, acute or only slightly attenuate into apical spine(s) | Ovate-lanceolate to lanceolate, attenuate or acuminate into apical spine(s) |
| Corolla length | 43 - 60 mm | 37 - 39.5 mm | (50 –) 56 - 75 mm |
| Corolla tube length (fully fused portion below split of abaxial lobe) | 15–19.5 mm | 7.5–10 mm | 14.5–26 mm |
| Abaxial corolla lobe dimensions and relation to other lobes | (13.5 –) 17.5–27 × (4.5 –) 10–12.5 mm; subequal to longer than the other lobes | 16–17.5 × 5.8–7.5 mm; subequal in length to other lobes | 26.5–38 × 10.5–15.5 mm; markedly longer than other lobes |
| Filament length on fully developed (abaxial) stamens | 23 - 31 mm | ± 18 mm | 28 - 37 mm |
| Anther length on fully developed (abaxial) stamens | 2.8–4 mm | 4.2–4.7 mm | 5–6.3 mm |
| Position of reduced lateral stamens (sometimes referred to as staminodes) | Included within corolla tube | Antherodes exserted slightly beyond abaxial corolla lobe (corolla mouth) | Included within corolla tube |
| Distribution | Yemen | Northwest Ethiopia | Northwest Ethiopia and West Eritrea |

on main and short lateral branches, the latter can appear clustered, petiole 2–8 mm long, puberulent above when young; blade elliptic or narrowly elliptic-lanceolate, 3.6–9.8 × 0.9–3 cm (l/w ratio 3.3–3.9: 1), base cuneate or attenuate, margin entire, apex acute or somewhat attenuate, with a short mucro to 1.7 mm long, young leaves pale-strigulose along margin and main veins beneath, sometimes also with short fine spreading white hairs on both surfaces but these soon-caducous, mature leaves often glabrescent; lateral veins 3–4 pairs, somewhat prominent beneath. Inflorescences opposite-axillary, together forming loosely defined contracted to lax terminal spikes; flowers solitary at each axil, subsessile; bracts foliaceous but reducing in size upwards, those towards stem apex typically oblanceolate, 2.3–2.4 × 0.3–0.6 cm, indumentum as young leaves, broad sessile glands few or largely absent; bracteoles pale sandy-coloured, pale green or white, linear-spinose or narrowly oblanceolate-spinose, 6.5–11 × 0.7–1.2 mm, largely glabrous. Calyx drying green-brown (or dark brown when young), anterior lobe lanceolate, 10–12.5 × 4.3–4.5 mm, apex acute or only slightly attenuate, with a short simple or minutely notched spine, base somewhat rounded, margins revolute, external surface glabrous or with very few glandular hairs towards margin, venation parallel, obscure or faintly visible, not prominent; posterior lobe as anterior lobe but 12.5–15.7 mm long, apex with a longer spine; lateral lobes narrowly lanceolate, 8.5–10.7 mm long, glandular-puberulous. Corolla yellow, 37 - 39.5 mm long, shortly eglandular-pubescent externally; tube 7.5–10 mm long; limb in strong “4+1” configuration; abaxial lobe offset by 8.7–12.2 mm, oblanceolate or narrowly oblong-elliptic, 16–17.5 × 5.8–7.5 mm, apex rounded; lateral lobes as abaxial lobe but 6.3–8.3 mm wide; adaxial lobes narrower, 4.5–6.5 mm wide. Stamens inserted ± 7.5 mm from base of corolla tube; filaments of long abaxial stamens ± 18 mm long, shortly pubescent in proximal half; anthers 4.2–4.7 mm long; short lateral stamens inserted higher than abaxial stamens, ± 1.7 mm long, pilose, antherodes exserted slightly beyond corolla mouth, ± 0.7 mm long. Pistil glabrous; stigma linear, 1.3–1.5 mm long. Capsule not seen.

*Distribution*

Occurs in Tigray regional state and floristic region of northern Ethiopia (Fig. 4).

*Habitat & Ecology*

Recorded from degraded *Terminalia* woodland [presumably dominated by *Terminalia brownii* Fresen.] on brown and grey schist (*Friis et al. 12246*); 1400–1525 m asl.

*Conservation status*

This species is known only from the two cited localities (representing two locations), ca. 40 km apart in Tigray floristic region of northwest Ethiopia. It is highly likely to be under-recorded as botanical survey in this region has been limited, in part due to the challenging mountainous terrain making access away from major transport routes difficult. However, we are confident that this species is highly range-restricted and is probably naturally rare given the paucity of collections despite its large and showy flowers. There has been widespread and significant loss and degradation of natural habitat throughout the range of this species, through a long history of human occupation and associated arable and pastoral agriculture and settlement. Satellite imagery available via Google Earth Pro reveals intensive agriculture including terraced hillslopes in the vicinity of the two known locations for the species. The only available habitat information suggests that it may be able to persist in degraded habitats and its spiny nature may also protect it to some extent from high grazing pressure. However, given its apparent scarcity, an estimated AOO well below the 500 km$^2$ threshold for Endangered under criterion B2, and the high levels of habitat transformation within its range, this species is preliminarily assessed here as **Endangered B2ab(iii)**.

*Taxonomic notes*

*Barleria praetermissa* and *B. induta* are sympatric and are morphologically similar, for example in having leaves clustered on short lateral branches, but *B. praetermissa* is a less robust plant and they are otherwise separated by the characters listed in the Recognition section and in Table 3. The flowers and inflorescences of *B. praetermissa* resemble more *B. appressa* from Yemen and it could be confused with a rare variant of that species that has glabrous anterior and posterior calyx lobes (*Wood 2508* [BM!, K!] from Shahārah, the northernmost collection of that species seen). However, *B. appressa* also has larger corollas but with smaller anthers, the calyx lobes are more attenuate or acuminate in that species, particularly the posterior lobe, and its leaves are only apiculate or at most shortly mucronulate, whereas those of *B. praetermissa* are more conspicuously mucronate. *Barleria praetermissa* is also notable for having shortly exserted antherodes on the short lateral stamens - in all other species of sect. *Prionitis* including *B. appressa* and *B. induta*, these are included within the corolla tube. The three species are compared in Table 3.

*Additional specimen examined (paratype)*

**ETHIOPIA. Tigray Region:** Addi Ana, 4 Nov. 1862 (fl.), *Schimper 682* (B* [photo at K], BM!, K!).

***Barleria induta*** C.B.Clarke, Fl. Trop. Afr. 5: 146. 1899, pro parte excl. *Salt s.n.* ex Ethiopia.

(≡) *Barleria prionitis* L. subsp. *induta* (C.B.Clarke) Brummitt & J.R.I.Wood in Wood et al., Kew Bull. 38: 1983, pro parte excl. *Schimper 682*; Ensermu (2006: 414), pro parte.

Type: Ethiopia, prope Adoam [near Adwa], 7 Mar. 1837 (fl., fr.), *Schimper 208* (lectotype K! [K000394475], designated by Brummitt and Wood, l.c.; isolectotypes B* [2 sheets, photos at K], BM!, BR* [BR0000006268718, BR0000008356307], K! [K000394474; K000394476], L* [L.2840328, L.2840329], LISU!, M* [M0109634, M0109635], MO*, MPU* [MPU007105], P! [P02895021, P02895023, P02895024, P02895025], S* [S09-3627, S09-3629], TUB* [TUB004329, TUB004330], WAG* [WAG0000007]).

*Additional syntypes, not selected as lectotype*

**ERITREA**: Bogos, Aug. 1872 (fl.), *J. M. Hildebrandt 450* (B!, photo at K!); Ethiopia, Sabra [locality and date on P sheets only], 7 Oct. 1852 (fl.), *Schimper 782* (B, photo at K!; MPU* [MPU015407], P! [P0295017, P02895018, P02895019]); Ethiopia, without precise locality, *Herb. Linnaeus* (n.v.).

(=) *Barleria horrida* Buscal. & Muschl., Bot Jahrb. Syst. 49: 495. 1913.

Type: cited in the protologue as Mozambique, "am ufer des Mbusi", 14 Dec. 1909 (fl.), *E. d'Aosta 121* (holotype B, photo at K!), but actually pertaining to Eritrea, *G. Schweinfurth 652*, *fide* Lindau (1915: 373).

(=) *Barleria hystrix* L. var. b *oblongifolia* Nees in A.P.D.C., Prodr. 11: 483. 1847, pro parte quoad *Schimper 208*.

(=) *Barleria bispinosa* sensu Anderson (1863: 27) quoad *Schimper 208*, non (Forssk.) Vahl.

### Description

Harshly spiny shrub or shrublet, 100–250 cm tall, sometimes forming rounded bushes; leafy stems dark reddish- or greenish-brown, somewhat angular, puberulous, sometimes most densely so on two opposite sides, mature stems glabrescent, becoming stout and woody towards the base with brown bark, up to 1 cm (or probably more) in diameter. Axillary spines pale sandy-coloured or whitish, 2 or 4-rayed, if the latter then two longer and two shorter, stalk 2–5 mm long, longest ray 16–31 mm long, straight. *Leaves* clustered on short lateral branches as well as along the main branches, petiole 2.5–10 mm long, puberulent; blade elliptic or ovate-elliptic to narrowly oblong-elliptic, 2.2–13 × 0.9–5.3 cm (l/w ratio 1.8–3.3 (–4): 1), base cuneate or attenuate, margin entire, apex acute or attenuate, with a stiff mucro 0.8–2.5 mm long, young leaves with short fine spreading white hairs on both surfaces and whitish-strigulose along margin and main veins beneath, the spreading hairs soon-caducous and the mature leaves can be largely glabrescent, broad sessile glands sparsely scattered on the lower surface and often more numerous towards base; lateral veins 3–6 pairs, prominent and usually pale beneath. Inflorescences axillary but sometimes clustered towards stem apices on both main stems and short lateral branches; flowers solitary at each axil, subsessile; bracts foliaceous but reducing in size upwards, those towards stem apex typically 1.5–3.7 × 0.3–1.2 cm, can be obovate-elliptic, indumentum as young leaves; bracteoles pale sandy-coloured or whitish, spinose, (6.5 –) 11.5–24 × 0.8–1.3 mm, sparsely puberulous and/or strigulose, sometimes with few short glandular hairs towards base, often with scattered broad sessile glands; rarely some bracteoles at proximal fertile nodes with a more developed blade, then oblanceolate-spinose, up to 3.5 mm wide. Calyx green, anterior lobe ovate-lanceolate to lanceolate, 10.5–20.5 × 4.5–7 (– 9) mm, apex attenuate or acuminate into a simple or rarely shortly notched spine, base somewhat rounded, margins revolute, external surface ± densely glandular-pubescent and with interspersed finer eglandular hairs, these sometimes more numerous towards base, venation obscure or only midrib prominent; posterior lobe as anterior lobe but 12.5–25 mm long, apex long-attenuate or -acuminate into spine; lateral lobes lanceolate-attenuate, 10–13.7 mm long. Corolla yellow to yellow-orange, (50–)55–75 mm long, densely eglandular-pubescent externally; tube 14.5–26 mm long; limb in strong "4+1" configuration; abaxial lobe offset by 16.5–21 mm, oblong-elliptic or slightly oblanceolate, 26.5–38 × 10.5–15.5 mm, apex rounded; lateral lobes oblong-elliptic, 20.5–32 × 10–14.5 mm, apices rounded or with very short attenuate tips; adaxial lobes as lateral lobes but 9–13.5 mm wide. Stamens inserted 9.5–15.5 mm from base of corolla tube; filaments 28–37 mm long, shortly pubescent in proximal half or two-thirds; anthers 5–6.3 mm long; lateral staminodes (0.8–)2–5 mm long, pilose towards base, antherodes 1–1.2 mm long or rarely undeveloped. Pistil glabrous; stigma linear, 1.4–1.7 mm long. Capsule 18.5–23 mm long, glabrous; seeds 10–10.5 × 6.7–7 mm.

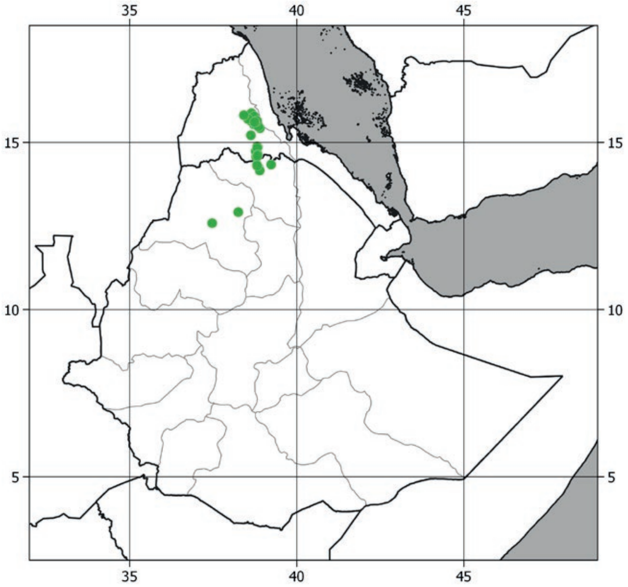

**Figure 6.** Distribution of *Barleria induta* (green circles) in Ethiopia and Eritrea. Note that the southern two localities may not be accurately placed.

### Distribution

Restricted to Anseba and Debub regions in the Eritrea-West floristic region of Eritrea, and Amhara and Tigray regional states in the Tigray and Gondar floristic regions of northern Ethiopia (Fig. 6).

### Habitat & Ecology

Occurs on arid rocky hillslopes with thin soils, growing in open *Acacia* Mill. woodland, in low bushland with frequent succulents, or in areas of evergreen bushland dominated by *Euclea* L.; it can be locally dominant in these habitats; 1400–2400 m asl.

### Conservation status

This species has a restricted range, with an EOO of 29,859 km$^2$ and an AOO of 60 km$^2$ based on known occurrence data. However, the two historical outlier records from Amhara state may not be accurately located; if excluded, the EOO is only 5,823 km$^2$. It can be locally abundant in suitable habitat, but expanding human settlements and increased agricultural activity in the majority of areas where this species has been collected are inferred to have resulted in a decline in area of occupancy and quality and extent of suitable habitat. The fact that this species tends to grow on stony hillsides, which tend to be less impacted than flatter areas, may reduce the level of threat to this species. The impact of overgrazing on this species is unclear, although its harsh spines should provide some protection. It is currently assessed as **Near Threatened B2ab(ii,iii)** (Darbyshire et al. 2023).

*Taxonomic notes*

This is a very striking species due to its large, highly zygomorphic flowers with a large and strongly offset abaxial lobe, and with densely glandular-pubescent calyces. It is quite unlike the Indian *Barleria prionitis* in a whole range of facies such that it is difficult to understand why they were united by Wood et al. (1983).

On the specimen *Tekle Hagos 112*, this species is described as a tree 3–5 m tall, but this is at odds with other descriptions of this species and it is likely to be the result of a mix-up in the collection notes.

The specimen "*Rousseau s.n.*" cited below from the herbarium of the Naturalis Biodiversity Center (L) is of uncertain origin; no such collector is mentioned by Friis (2009) in the review of botanical collectors in Ethiopia and Eritrea, and he/she has not been traced.

*Additional specimens examined*

**ERITREA: Eritrea-West Region**: Habab, Bogos, Aug. 1872 (fl.), *Hildebrandt 449* (B!, photo at K!); Aztaclesan–Abrascico, 6 May 1892 (fr.), *Terracciano & Pappi 334* (FT!); Mensa, Aba Maitan–Dada, 8 Jan. 1893 (fl.), *Terracciano & Pappi 2154* (FT!); (Mensa) Mt Agaro, 18 Jan. 1893 (fl.), *Terracciano & Pappi 493* (FT!); Bogos, Lalamba, 3 Feb. 1893 (fl., fr.), *Terracciano & Pappi 2590* (FT!); (Mensa) Belta, 4 Feb. 1893 (fl.), *Terracciano & Pappi 975* (FT!); (Mensa), Sella Mogasaz - Mt Ira, 5 Feb. 1893 (fl.), *Terracciano & Pappi 819* (FT!); Bogos, Abi Mandel–Alibaret, 5 Feb. 1893 (fl., fr.), *Terracciano & Pappi 2509* (FT!); Mensa, Adinalai–Maldi, 10 Feb. 1893 (fl.), *Terracciano & Pappi 1487* (FT!); (Amasen), Sciumma-Negus, 11 Feb. 1893 (fl.), *Terracciano & Pappi 383* (FT!); tra Halibaret [Elabered] ed Asmara, 8–15 May 1902 (fl., fr.), *Tellini 701* (FT!); Az-taclesan–Keren, 11–13 Oct. 1902 (fl.), *Tellini 1167* (FT!); Saraé, Adi Quala, 23 Oct. 1902 (fl.), *Pappi 542* (FT!, MO, P!); da Halibaret ad Amba Derho, 8–11 Dec. 1902 (fl., fr.), *Tellini 899* (FT!); Grat Gabru, 1 Nov. 1905 (fl.), *Beccari 219* (FT!); without precise locality, 1908 (fl., fr.), *Mangano 15* (FT!); Hamasen Region, Anseba ad Abrascico, 16 Feb. 1909 (fl., fr.), *A. Fiori 424* (FT!); Hamasen Region, tra Elaberet ed Azteclesan [Adi Tekelezan], 1 Mar. 1909 (fr.), *Fiori 726* (FT!); Serae, Adi Ugri, [Mendefira], 20 Mar. 1909 (fl.), *Fiori 424 bis* (FT!); Serae, a SE di Adi Ugri, 30 Oct. 1910 (fl.), *Bellini 342* (FT!); Addi Ugri [Mendefira], 17 Feb. 1913 (fl., fr.), *Baldrati 1003* (FT!); Serae Region, Addi Ugri [Mendefira], 21 May 1914 (fl.), *Baldrati 1000* (FT!); Addi Uogiri [Mendefira], 21 May 1914 (in bud), *Baldrati 1091* (FT!); Addi Ugri, Feb. 1915 (fl., fr.), *Baldrati 10* (FT!); Serae, Addi Ugri, 17 Feb. 1915 (fl., fr.), *Baldrati 1085* (FT!); Maragus, 26 Jan. 1917 (fl., fr.), *Baldrati 1077* (FT!); Asmara–Keren road, 19 Nov. 1956 (fl., fr.), *Hemming 1118* (BM!, EA!, ETH!, K!); a few miles from Teclezan village on the way to the village Elaberet, 12 Jan. 1963 (fl., fr.), *Tekle Hagos 112* (ETH!, K!); Mareb R. Valley, 8 km S of Adi Quallo or 102 km from Asmara on the Axum road, 29 Dec. 1972 (fl.), *Ash 1827* (EA!, ETH!, K!, MO!); Seraje Awraja, c. 61 km S of Asmara, 6 Mar. 1986 (fl.), *Mesfin & Sebsebe 3703* (ETH!); Gundet, ca. 5 km S of Adi Kwala along the road to the Tigray border, 17 Nov. 1988 (fl.), *Ryding et al. 1551* (ETH!, K!); on the pass between Elabored and Adi Teklezan, 13 Dec. 1997 (fl., fr.), *Wood 12949* (K!).

**ETHIOPIA: Tigray Region:** Massoua a Adowa, without date (fl.), *Quartin-Dillon s.n.* (P!); without locality 1856–1857 (fl.), *Schimper A.81* (B, photo at K!); "prope Adoam", Sept. 1909, "*Rousseau s.n.*" (L*) - see note above; Tigré, Mai Cio, tra Adua e il Mareb [R.], 15 Feb. 1936 (fl., fr.), *Guidotti 764* (FT!); Mareb, N of Adua, 4 Nov. 1952 (fl.), *Scott 214* (BM!, K!); 13 km Adua–Mereb on the road to Asmara, 26 Oct. 1991 (fl.), *Ensermu 2395* (ETH!); 5 km W of the turn off towards Debra Damo on the main road from Adigrat to Adwa and Axum, 8 Oct. 2005 (fl.), *Friis et al. 12197* (C, ETH, K!, WAG*); in the Mereb Valley 15 km S of Rama on the road that connected Adwa (Adi Abun) with Asmara, 12 Oct. 2005 (fl.), *Friis et al. 12238* (C, ETH, K!, WAG*); **Gondar Region:** Gondar and vicinity, without date (fl.), *Massey 54* (K!);

## *3. **Hypoestes***

The genus *Hypoestes* R.Br. (Acanthoideae: Justicieae: Justiciinae; Manzitto-Tripp et al. 2022) is restricted to the palaeotropics and subtropics, comprising over 150 accepted species, with by far the most diversity in Madagascar (POWO 2023). In tropical Africa, 10–12 species of *Hypoestes* are currently accepted, depending on the circumscription of some of the widespread species, with the most recent additions being *H. canescens* Hedrén & Thulin (syn.: *H. cinerea* Hedrén) from coastal central Somalia and *H. ecbolioides* I.Darbysh. described from western Angola (Hedrén 2006; Hedrén & Thulin 2015; Darbyshire 2015). In the *Flora of Ethiopia and Eritrea* account, Ensermu (2006) recorded only three species, the widespread and variable *H. aristata* (Vahl) Roem. & Schult., *H. forskaolii* (Vahl) R.Br. and *B. triflora* (Forssk.) Roem. & Schult. However, Ensermu's circumscription of *H. triflora* included some very distinctive woody populations from northwest Ethiopia that were previously separated as *H. microphylla* Hochst. ex Nees, and maintained as an accepted species by the African Plants Database (2023). Here, we investigate *H. microphylla* further and compare it to forms of *H. triflora* from across tropical Africa.

*Hypoestes microphylla* is known from three historic specimens from the Tigray floristic region (although one is without precise locality), all collected by Wilhelm Schimper (Clarke 1900). An additional collection has recently been uncovered in the Florence (FT) herbarium from West Eritrea (*Pappi 623*). It is a highly distinctive plant with much-branched woody stems with flaking and peeling bark, small leaves and with the cymules solitary, paired or held in lax spikes. These characters readily separate these collections from typical *H. triflora*, hence *H. microphylla* is considered to be distinct and is resurrected here. The two species are compared in Table 4.

Also of interest in this discussion is *Hypoestes busii* Pic.Serm., a further name synonymised by Ensermu (2006) for which the type collection is *Pichi Sermolli 2097* (holotype FT! [FT003247]; isotype K! [K000379091]) from "presso Ifàg", 10 March 1937 (Pichi Sermolli 1951: 142). It is superficially very similar to *H. triflora*, for example in having the umbellate cymules with obovate bracts (these are broader than in any other Ethiopian material, but similarly broad bracts are recorded elsewhere within the range of *H. triflora*). However, it does differ notably from most other material of *H. triflora* in having pubescent staminal filaments and in the stems being softly lignified and sandy brown. The filaments of typical *H. triflora* are usually glabrous, although a few specimens from Ethiopia do have sparse hairs along the dorsal side, for example *Gillett* 14537 from Agheremariam [Hagere Mariam] (K!). Of interest, the staminal filaments of *H. microphylla* on the one well preserved flowering specimen (*Schimper 573*) are also conspicuously hairy along a line on the dorsal side. However, those on the A. Pappi specimen from Eritrea do not appear to have such hairy filaments. Given the close similarity of *H. busii* to *H. triflora* it is tentatively retained within that species for now, but further collections from around the type locality would be useful to investigate that population further.

***Hypoestes microphylla*** Hochst. ex Nees in A.P.DC., Prodr.11: 504. 1847.

See Clarke (1900: 248).

Type: Ethiopia. "regionis inferioris in parte australi montis Scholoda", 13 Dec. 1837 (in bud), *W. Schimper 400* (lectotype GZU* [GZU000250794], selected here; isolectotypes BR* [BR0000008356697], HAL* [HAL0113877], HBG* [HBG502226], HOH* [HOH009282], K! [K000379102, K000379103], L* [L.2841364, L.2841365], M* [M0109722], S* [S09-5830], TUB* [TUB004397, TUB004398, TUB004399, TUB004400], WAG* [WAG0000012]).

(-) *Hypoestes uniflora* Hochst., Flora 24(1, Intelligenzbl.): 24. 184 & Anderson, J. Proc. Linn. Soc. Bot. 7: 48. 1863, *nom. nud.*

(=) *Hypoestes triflora* sensu Ensermu (2006: 450), pro parte, non (Forssk.) Roem. & Schult.

### *Description*

Shrublet (to 60 cm tall *fide* Nees 1847, but apparently taller on *Pappi* 623), many-branched, stems soon becoming softly woody with pale sandy-coloured flaking or peeling bark, 6-angular, mature stems pubescent with spreading or slightly retrorse hairs 0.5–0.9 mm long or some internodes rather densely pale-pilose with hairs to 1.6 mm long, young stems puberulous. Leaves subsessile or on petioles to 3 mm long; blade ovate or lanceolate, 6–25 × 2–9.5 mm (length: width ratio 1.95–3.6: 1), base rounded to cuneate, margin bluntly but conspicuously serrate with 2–9 teeth, apex acute or attenuate, surfaces pubescent particularly along veins and margins; cystoliths conspicuous, linear, often arcuate; lateral veins 3–5 per side. Inflorescences of solitary or paired cymules at apex of branches or sometimes with 3 or more cymules in a lax, secund spike; cymule peduncles 1.5–12 mm long, can be curved, geniculate or twisted, eglandular-puberulent and glandular-puberulent to -pubescent, the latter hairs to 0.5 mm long, can be sparse; primary (main axis) bracts held erect, somewhat fleshy, narrowly oblong-elliptic or -lanceolate, 2–6.5 × 0.6–1.5 mm, base cuneate, margin entire, apex rounded or obtuse, surfaces puberulent; cymule bracts free but clasping, pairs only slightly unequal, lanceolate, 6–15 × 1.7–2.5 mm, green but can be paler towards base except for darker midrib, external surfaces ± densely glandular-pubescent to -puberulent and eglandular-puberulent; bracteoles 1 or 2 pairs per cymule, lanceolate, 6–11 × 1–1.2 mm, green or pale brown with darker apex and midrib, glandular- and

**Table 4.** The main morphological differences between *Hypoestes triflora* and the newly resurrected species *H. microphylla*.

| Character | *Hypoestes triflora* | *Hypoestes microphylla* |
|---|---|---|
| Growth habit | Creeping, ascending or straggling annual or perennial herb, stems not or only very tardily woody, leafy stems herbaceous, usually green or purple-tinged | Many-branched shrublet, even leafy stems soon woody, sandy-brown with flaking and peeling bark |
| Leaf shape, size and margin | Ovate to narrowly elliptic, 15–130 × 8–65 mm, subentire to crenate-serrate | Small, ovate to lanceolate, 6–25 × 2–9.5 mm, conspicuously bluntly serrate with 2–9 teeth per side |
| Inflorescence form | Umbellate, typically with 3–4 (– 6) cymules per umbel, sometimes becoming compounded then appearing verticillate, rarely cymules solitary | Solitary or paired cymules at apex of branches or sometimes with 3 or more cymules in a lax, secund spike |
| Primary (main axis) bracts | Leaf-like, ovate to oblanceolate, up to 20 mm long | Somewhat fleshy, narrowly oblong-elliptic or -lanceolate, 2–6.5 mm long |
| Cymule bracts | Obovate to narrowly elliptic, larger of each pair 8–17 × 2–7 mm | Lanceolate, larger of each pair 6–15 × 1.7–2.5 mm |
| Staminal filament indumentum | Glabrous or rarely sparsely pubescent above | Shortly pubescent above for most of length (*Schimper* 573) |
| Capsule indumentum | Glabrous or sparsely eglandular-puberulous towards apex, sometimes with few interspersed glandular hairs | Eglandular-puberulous with occasional glandular hairs towards apex |

eglandular-puberulent. Calyx pale-hyaline, deeply divided into 5 lanceolate lobes, each 2.4–3 mm long, puberulent. Corolla ± 11.5 mm long, colour unknown, tube twisted through 180°, 6.8 mm long, 1.3 mm wide above the twist; lip held in lower position ± 4.6 mm long; lip held in upper position ± 5 × 3.5 mm, apex 3-lobed, lobes rounded, ± 0.7 mm long. Stamens with filaments ± 7.5 mm long, shortly pubescent on upper side for ¾ of length with distal portion becoming glabrous; thecae 0.6–0.8 mm long. Ovary ± 1 mm long, glabrous; style ± 9.5 mm long, shortly pubescent towards apex, elsewhere glabrous; stigma minutely 2-lobed. Capsule 7–7.5 mm long, eglandular-puberulous with occasional glandular hairs towards apex; seeds lenticular, ± 2 mm in diameter, tuberculate.

### *Distribution*

Restricted to the Tigray regional state and floristic region of northern Ethiopia, and Debub region in the Eritrea-West floristic region of Eritrea (Fig. 6).

### *Habitat & Ecology*

Habitat information is limited but it has been recorded from rocky ground; in Eritrea it was recorded from ca. 2,200 m asl.

### *Conservation status*

This species was last collected in the early 1900s and information on its distribution, habitat requirements, and threats is very limited. It is likely to be scarce, given that it has not been recorded during botanical exploration within its range in the intervening period, and there has been significant habitat transformation such that this species is highly likely to be globally threatened. However, given how little information we have available at present, it is currently assessed as **Data Deficient**.

### *Taxonomic notes*

The description of the flowers of this species is based on a single flower from *Schimper 573*. There is an open flower on *Pappi 623* which is broadly comparable in size to the Schimper specimen, but it is insufficiently well preserved for further measurement. Clarke (1900) cites a third W. Schimper specimen without precise locality, *Schimper 1623*, but we have not seen that collection.

### *Additional specimens examined*

**ERITREA: Eritrea-West Region**: Scimenzana, Guna Guna, 21 Sept. 1902 (fl.), *Pappi 623* (FT!).

**ETHIOPIA: Tigray Region**: Amba Sea, 21 Feb. 1856 (fl., fr.), *Schimper 573* (K!).

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**Appendix 1.** The endemic and near-endemic Acanthaceae of Ethiopia, their distribution and extinction risk status. The distribution in Ethiopia follows the floristic regions of *Flora of Ethiopia & Eritrea*: AR Arsi; BA Bale; GD Gonder; GG  Gamo Gofa; GJ Gojjam; HA Harerge; SD Sidamo; TU Tigray; WG Wellega; WO Wello. For the IUCN Red List assessment, those in bold are published on https://www.iucnredlist.org/, those in normal font have been assessed but not yet published; those with an asterisk have been reviewed and passed and so are in press.

| Taxon | Distribution in Ethiopia; floristic regions | Endemic / near-endemic | Other countries | IUCN Red List Assessment | Notes |
|---|---|---|---|---|---|
| *Acanthopale aethiogermanica* Ensermu | AR BA GD KF SD SU | E | | VU B2ab(iii)* | Widespread but scarce in west and south Ethiopian upland forests |
| *Acanthus sennii* Chiov. | AR BA GD GG GJ HA KF SD SU WG WU | E | | **LC** | Widespread and fairly common in a range of habitats in the Ethiopian Highlands |
| *Asystasia ammophila* Ensermu | SD | E | | **VU B2ab(iii)** | Highly localised in woodlands and dry forest margins of south Ethiopia |
| *Barleria baluganii* Ensermu | IL KF WG | E | | **NT B2ab(iii)** | Fairly frequent in the forests of southwest Ethiopia |
| *Barleria boranensis* Fiori | BA SD | NE | Kenya | **LC** | Localised but unthreatened in the dry woodlands of the Ethiopia-Kenya border region |
| *Barleria ferox* Ensermu & I.Darbysh. | HA | E | | **EN B1ab(iii)** | Scarce and highly localised in dry woodland of east Ethiopia |
| *Barleria praetermissa* I.Darbysh. | TU | E | | EN B2ab(iii), provisional | Scarce and highly localised in dry woodland of northwest Ethiopia |
| *Barleria gidoleensis* Ensermu & I.Darbysh. | GG SD | E | | **EN B1ab(iii)** | Scarce and highly localised in dry woodland of south Ethiopia |
| *Barleria grandis* Hochst. ex Nees | GD KF SU TU WG | NE | Eritrea | - | Fairly widespread in the woodlands of northwest Ethiopia and extending into Eritrea |
| *Barleria induta* C.B.Clarke | TU | NE | Eritrea | **NT B2b(ii,iii,v)** | Localised in the dry bushlands and rocky terrain of northwest Ethiopia and west Eritrea |
| *Barleria longissima* Lindau | GG SD | E | | **EN B2ab(iii)** | Scarce and highly localised in dry woodland of south Ethiopia |
| *Barleria negeleensis* Ensermu & I.Darbysh. | BA SD | E | | **EN B1ab(iii)+2ab(iii)** | Scarce and highly localised in dry grassland and open woodland of south Ethiopia |
| *Barleria punctata* Milne-Redh. | HA | NE | Somalia | **VU B1ab(iii)+2ab(iii)** | Scarce and localised in dry bushland of east Ethiopia and northwest Somalia |
| *Blepharis cuspidata* Lindau | SD | E | | **DD** | Known only from the type locality from dry bushland in southeast Ethiopia |
| *Blepharis gypsophila* Thulin & Vollesen | HA | E | | **VU D2** | Known only from the type locality from dry bushland in east Ethiopia |
| *Brillantaisia grottanellii* Pic.Serm. | GD GG GJ IL KF SD WG | E | | **LC** | Widespread in upland forests of west and south Ethiopia |
| *Crossandra infundibuliformis* (L.) Nees subsp. *boranensis* Vollesen | SD | NE | Kenya | - | Highly localised in dry bushland and woodland of southeast Ethiopia and just extending into northeast Kenya |
| *Dicliptera minutifolia* Ensermu | SD | NE | Kenya | - | Scarce in dry woodland of southeast Ethiopia with one record from north Kenya, but perhaps overlooked |

(Continued)

**Appendix 1.** (Continued).

| Taxon | Distribution in Ethiopia; floristic regions | Endemic / near-endemic | Other countries | IUCN Red List Assessment | Notes |
|---|---|---|---|---|---|
| *Ecbolium albiflorum* Vollesen | SD | NE | Kenya | - | Locally common but highly restricted in southeast Ethiopia and northeast Kenya |
| *Ecbolium boranense* Vollesen | BA SD | NE | Kenya | - | Local in woodlands and dry forest of south Ethiopia and north Kenya |
| *Hypoestes microphylla* Hochst. ex Nees | TU | NE | Eritrea | DD, provisional | Scarce in northwest Ethiopia and southwest Eritrea; habitat incompletely known |
| *Ichthyostoma thulinii* Hedrén & Vollesen | SD | NE | Somalia | NT B2ab(iii)* | Highly localised in dry woodlands of southeast Ethiopia and central and south Somalia |
| *Isoglossa congesta* Hedrén | SD | NE | Somalia | EN B1ab(iii)+2ab(iii)* | Known only from two localities, in dry bushland of southeast Ethiopia and south Somalia |
| *Isoglossa parvifolia* Rendle | BA HA SD | E |  | **NT B2ab(iii)** | Widespread but scarce in woodland and bushland of eastern Ethiopia, including in seasonally inundated areas |
| *Isoglossa somalensis* Lindau var. *somalensis* | AR BA GG IL KF SD SU | NE | South Sudan | LC, provisional | Widespread in upland forest in Ethiopia and extending to the Imatong Mts of South Sudan |
| *Isoglossa somalensis* Lindau var. *glandulosa* Hanny, G.Hoban & I.Darbysh. | BA SD | E |  | NT B1ab(iii)+2ab(iii), provisional | Local in montane forest in southeast Ethiopia |
| *Isoglossa recurva* Hanny & I.Darbysh. | IL KF | E |  | EN B1ab(iii)+B2ab(iii) provisional | Scarce and highly localised in montane forest in southwest Ethiopia |
| *Justicia aridicola* Rendle | BA HA SD | NE | Somalia | - | Widespread in dry woodland in east and southeast Ethiopia, extending into Somalia |
| *Justicia bizuneshiae* Ensermu | WG IL KF GG SD BA | NE | Kenya, Tanzania | - | Widespread in upland forest margins, woodland and scrub in south Ethiopia; only 4 collections known from south Kenya and north Tanzania |
| *Justicia dallarii* Fiori | GG IL SD WG | E |  | LC | Widespread but scarce in a range of habitats in southwest and south Ethiopia |
| *Justicia grisea* C.B.Clarke | BA[?] HA SD | NE | Somalia | - | Local in dry bushland on limestone in east Ethiopia and neighbouring Somalia |
| *Justicia heterocarpa* T.Anderson subsp. *vallicola* Hedrén | GG SD SU | E |  | - | Local in a range of wooded habitats in central and south Ethiopia |
| *Justicia kuchari* Hedrén | HA | NE | Somalia | - | Scarce and highly localised in dry bushland in east Ethiopia and into central Somalia |
| *Justicia potamophila* Lindau | SD | NE | Somalia | - | Highly localised in dry woodland in southeast Ethiopia and into central and south Somalia |
| *Justicia rendlei* C.B.Clarke | BA HA SD | NE | Somalia | - | Fairly widespread in dry woodland and bushland on limestone in east and southeast Ethiopia, extending into Kenya, possibly also in Somalia |
| *Justicia schoensis* Lindau | AR BA SU | E |  | VU B1ab(iii)+2ab(iii)* | Local in montane grassland and woodland in central Ethiopia |

(Continued)

**Table S1.** (Continued).

| Taxon | Distribution in Ethiopia; floristic regions | Endemic / near-endemic | Other countries | IUCN Red List Assessment | Notes |
|---|---|---|---|---|---|
| *Justicia vixspicata* Lindau | SD | NE | Somalia | - | Highly localised in dry woodland and bushland of southeast Ethiopia and just extending into south Somalia |
| *Lepidagathis pseudoaristata* Ensermu | BA SD | NE | Kenya | **EN B2ab(iii)** | Highly localised in dry bushland of southeast Ethiopia and northeast Kenya |
| *Lepidagathis speciosa* (Rendle) Hedrén | BA HA SD | NE | Somalia | - | Widespread but scarce in dry open woodland in east and southeast Ethiopia, extending into south Somalia |
| *Neuracanthus lindaui* C.B.Clarke | HA | NE | Somalia | - | Localised in the dry bushland of southeast Ethiopia and west-central Somalia |
| *Rhinacanthus mucronatus* Ensermu | SD | E |  | **EN B1ab(iii,v)+2ab(iii,v)** | Scarce and highly localised in dry bushland in southeast Ethiopia |
| *Ruellia boranica* Ensermu | SD | E |  | **VU B1ab(iii)+2ab(iii)** | Scarce and highly localised in dry bushland in southeast Ethiopia |
| *Ruellia fiorii* Chiov. | BA HA SD | NE | Eritrea | - | Widespread in dry woodland in east and south Ethiopia; also in west Eritrea but possibly two taxa involved |
| *Ruttya speciosa* (Hochst.) Engl. | GD GJ TU | NE | Eritrea | **LC** | Note: recorded as endemic in FEE but a historic record from Eritrea has since been uncovered |
| *Thunbergia hirsuta* T.Anderson | GD GJ | E |  | **EN B2ab(ii,iii)** | Scarce and localised in grassland and open shrubland in northwest Ethiopia |
| *Thunbergia mauginii* Fiori | BA SD | E |  | **VU B1ab(iii)+2ab(iii)** | Scarce and localised in woodland and bushland in southeast Ethiopia |
| *Thunbergia ruspolii* Lindau | GG IL KF SD SU WG | E |  | **LC** | Widespread in a range of habitats in central and south Ethiopia |

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# Possible horizontal gene transfer: *Virectaria stellata* (Sabiceeae-Rubiaceae), a new sandstone cliff species from the Republic of Guinea with stellate hairs recorded for the first time in the Rubiaceae

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**Abstract.** *Virectaria* (Sabiceeae-Cinchonoideae-Rubiaceae), is a morphologically isolated genus of tropical African herbs or subshrubs, occurring from Senegal to Tanzania. *Virectaria stellata,* a new species from Guinea, is published. It is a perennial herb, with stems becoming creeping and rooting, to 60 cm long. *Virectaria stellata* has stellate hairs, recorded here for the first time in the family Rubiaceae. We hypothesize that the stellate hairs of this species result not from mutation but from horizontal gene transfer (HGT) from an Acanthaceae, most likely *Barleria*, due to their common and perhaps uniquely shared microstructure. We briefly review literature on the control of the transition from simple to stellate hairs and on HGT in plants. *Virectaria stellata* is found in Forécariah and Kindia Prefectures in the Republic of Guinea. A *Virectaria* specimen without stellate hairs but otherwise similar to *V. stellata* was collected in Guinea, about 90 km to the North of the northernmost *V. stellata* collection. This specimen may represent a possible progenitor of *V. stellata*. The identification of this specimen requires further study. *Virectaria stellata* occurs in fissures in vertical sandstone rock at altitudes of 450 to 910 m, in sun or half-shade. An overview of sandstone endemic plant species in the vicinity of the new *Virectaria* is provided. No threats have been observed, therefore, *Virectaria stellata* is provisionally assessed here as Least Concern (LC).

**Keywords:** Acanthaceae, *Barleria*, horizontal gene transfer, lateral gene transfer, sandstone, stellate hairs.

## INTRODUCTION

Among the specimens collected during botanical surveys aimed at establishing Important Plant Areas in the Republic of Guinea (henceforth Guinea;

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Couch et al. 2019; Darbyshire et al. 2017) was a new species of *Virectaria* Bremek. (Rubiaceae: Sabiceeae) found on the Benna Plateau and Mont Kouroula in the prefectures Forécariah and Kindia respectively. The new material from Guinea was placed in *Virectaria* due to the presence of several traits that characterise this morphologically isolated genus: the stigma is unlobed and capitate and only slightly wider than the style; both style and stamens are exserted about as long as the corolla lobes; aestivation simply valvate; one of the two fruit valves is deciduous, the other persistent; and the floral disc is cone-like, accrescent, and dehiscing into two halves in fruit.

*Virectaria* Bremek. (Bremekamp 1952) was erected to contain most of the African species previously referred to the genus *Virecta* L.f. (Linnaeus 1782). The International Plant Names Index (IPNI 2024) lists 28 names under *Virecta*. The neotropical *Virecta* names, together with the type of *Virecta, V. biflora* L.f., are referrable to *Sipanea* Aubl., a genus of about 19 species in northern S. America and C. America. The Asian names of *Virecta* refer to *Ophiorrhiza* L., a genus of about 320 species occurring from India to N.E. Australia and Japan. Some African *Virecta* names are referred to *Pentas* Benth. (e.g. *Virecta lanceolata* Forssk.), *Parapentas* Bremek. (*Virecta setigera* Hiern); or *Sabicea* Aubl. (*Virecta lutea* G. Don). Verdcourt (1953) revised *Virectaria*, recognising five species from the 12 *Virecta* names attributable to the genus *Virectaria*.

*Virectaria* was placed in Ophiorhizeae by Bremekamp or was often formerly place in a loosely circumscribed Hedyotideae (both Rubioideae) e.g. Hepper (1963), together with *Oldenlandia* L., *Pentas, Parapentas* and *Hekistocarpa* Hook.f. However, Verdcourt (1953) did not concur and erected the mono-generic tribe Virectarieae (Verdcourt 1975) to accommodate the genus. He also recognised that it did not belong to Rubioideae but to Cinchonoideae/Henriquezieae. Currently eight species are recognised, *V. angustifolia* (Hiern) Bremek., *V. belingana* N. Hallé, *V. herbacoursii* N. Hallé, *V. major* (K.Schum.)Verdc., *V. multiflora* (Sm.) Bremek., *V. salicoides* (C.H.Wright) Bremek. and *V. tenella* J.B.Hall. Seven infraspecific taxa are also accepted (Dessein et al. 2001b).

Publication and molecular placement of the monotypic Socotran *Tamridaea* Thulin & B. Bremer showed a close relationship with *Virectaria* and the placement of these two genera in an expanded Sabiceeae (Bremer & Thulin 1998). Placement of *Virectaria* within the Sabiceeae was contested by Dessein et al. (2001a) on morphological grounds, and *Virectaria* was instead placed with *Hekistocarpa* and *Tamridaea* in an expanded Virectarieae near to Sabiceeae (Dessein et al. 2001b). However, more detailed subsequent molecular studies reconfirmed placement in Sabiceeae (Khan et al. 2008a; 2008b). The monotypic Cameroonian *Hekistocarpa* is sister to the three other genera of Sabiceeae, Socotran *Tamridaea* is sister to *Virectaria*, and these two genera are in turn sister to the most species-diverse genus *Sabicea* which, with c. 167 species, extends from the Neotropics, through Africa and Madagascar, to Sri Lanka.

In this paper we describe *Virectaria stellata sp. nov.*, increasing the numbers of species in the genus in Guinea from two to three (Gosline et al. 2023a; 2023b). The new species is exceptional in the Rubiaceae in having stellate hairs, and further remarkable in that they include an unusual type of stellate hair otherwise known from some Acanthaceae.

New, nationally endemic plant species continue to be steadily published from Guinea e.g. recently *Casearia septandra* Breteler & A.Baldé (Breteler & Baldé 2024, Salicaceae), *Keita deniseae* Cheek (Cheek et al. 2024, Olacaceae), *Erianthemum nimbaense* Jongkind and *Phragmanthera cegeniana* Jongkind (Jongkind 2023, Loranthaceae) and *Gymnosiphon fonensis* Cheek (Cheek et al. 2024, Burmanniaceae).

## MATERIALS & METHODS

All specimens cited have been seen. Herbarium material was examined with a binocular microscope fitted with an eyepiece graticule. Measurements of flower structures and fruits were made from rehydrated material. The drawings were made using the same equipment equipped with a camera lucida. Herbarium codes follow Index Herbariorum (Thiers, updated continuously). Names of species and authors follow IPNI (2024). Nomenclature follows Turland et al. (2018). The extent of occurrence and the area of occupancy were calculated using GeoCAT (Bachman et al. 2011) and the conservation assessment was made following the categories and criteria of IUCN (2012). The morphological terminology follows Beentje (2016).

## TAXONOMIC TREATMENT

*Key to the species of the genus* Virectaria *in Guinea*

1. Hairs stellate........................................................... ***V. stellata***

Hairs simple ........................................................................... 2

2 Leaves elliptic to lanceolate; hairs on stems erect, to 2 mm long ..................................................................... ***V. multiflora***

Leaves ovate-oblong, elliptic or sub-spathulate; hairs on stems appressed, to 0.2 mm long ................. ***V. procumbens***

***Virectaria stellata*** Cheek, I.Darbysh. & Simbiano **sp. nov.**

Type: Republic of Guinea, Forécariah Prefecture, Benna Plateau, 4 km West of Gombokori, 9° 44' 19.2" N, 12° 49' 32.9" W, 780 m, fl., fr., 1 Nov. 2019, *Burgt & P.M. Haba* 2332 (holotype HNG; isotypes B, BR, EA, FI, K001381504, K001381505, LISC, MO, NY, P, PRE, SERG, SING, SL, US, WAG).

*Diagnosis*

*Virectaria stellata* differs from the other species of *Virectaria* Bremek., and from all other Rubiaceae species, in the presence of stellate hairs, which are abundant on the stems, both surfaces of the leaf, inflorescences, and on the outer surfaces of the calyx-hypanthium and the corolla. Morphologically, *Virectaria stellata* resembles *V. tenella* J.B.Hall, a species from Ghana (Hall 1972), that is also found in vertical rock habitat. The leaf blade of *V. stellata* is 10–30 (–50) mm long (vs (5–) 7–12 mm long) and the corolla of *V. stellata* is densely stellate hairy outside (vs glabrous).

*Description*

Perennial herb, prostrate, stoloniferous. Stellate hairs dense on stems, stipules, leaves (both surfaces), pedicel, calyx and corolla outer surfaces, and fruits; hairs white to colourless, 0.3–0.8 mm in diam., 10–25-armed, individual arms unequal in length, overlapping with adjacent hairs; in some stellate hairs, the central arm is a little longer to much longer than all other arms, extending from the centre of the stellate hair, 0.6–5 mm long, spiralled, erect, or appressed and directed to the leaf apex (Fig. 1B). Stems dull red, drying pale reddish, initially erect, then creeping, pendant, terete, each 10–60 cm long; young stems herbaceous, older stems woody, 0.7–1.5 mm in diam., to 4 (–10) mm in diam. at base, internodes 0.5–4 (–8) cm long, sometimes rooting at the nodes. Roots to 3 mm thick, to at least 50 cm long, with numerous wiry root branches, themselves highly branched. Stipules simple, triangular, to 1 mm × 1.5 mm, or bifurcate to the base into two triangular (rarely narrowly triangular-oblong) parts, apices acute to rounded; colleters inconspicuous. Leaves opposite, in equal pairs, decussate; petiole canaliculate, 2–10 × 0.5–0.7 mm, articulated at junction with stem. Leaf blades papery, drying pale green, leaf blade ovate, 10–30 (–50) × 6–17 (–28) mm, apex acute to attenuate, base obtuse to rounded; lateral nerves 4–7 on each side of the midrib, starting at 60–70° near the petiole, starting at c. 45° towards the apex, straight, then arching upwards and becoming parallel with the margin, not uniting; nerves channelled above, raised below, domatia absent, secondary and tertiary nerves moderately conspicuous above, not branching, not reticulate, quaternary nerves not visible. Inflorescence a densely branched cyme, axillary or terminal, 1–15(–30)-flowered, bracts elliptic, 2–3 mm long. Flowers 13–15 × 7–9 mm. Pedicel terete, shortly cylindrical, 1–1.5 mm long. Calyx-hypanthium shortly cylindrical to ellipsoid, 1.2–1.5 × 0.9–1 mm, lacking surface sculpture; calyx tube very short or absent, calyx lobes 5, green, narrowly triangular to linear, accrescent, very slightly unequal in length, 1–2 × 0.5 mm, colleters inconspicuous, glabrous inside. Corolla white, 7–8(–10) mm long, 8–9 mm diam. at anthesis, tube 3–5 mm long, 0.5–0.6 mm wide at base, widening gradually to 1 mm wide near lobes; lobes 5, lanceolate-oblong, 3.5–4 × 0.8–1.2 mm, apex acute, corolla outside with dense stellate indumentum, inside glabrous. Stamens 5, exserted, inserted in corolla mouth, 5–6 mm long, filaments white, terete, glabrous, anthers medifixed, dark brown to black, lanceolate-elliptic, 0.9–1.1 mm long. Disc (nectary) conical, purple, 0.25 × 0.1 mm, glabrous. Style white, filamentous, 9–11 mm long, exserted for half its length, glabrous. Stigma white, capitate, 0.3 mm diam.; ovary 2-locular, each locule with numerous ovules. Fruit straw-coloured, overall c. 4 x 1.5–2.5 mm in diam., fruit body ellipsoid, surmounted by the accrescent calyx, lobes linear-ligulate, 0.5–1.8 × 0.2 mm, glabrous inside; fruit dehiscing longitudinally into two valves, with one valve falling, the other remaining attached to the pedicel (Fig. 1 H). Disc (nectary) dividing into two halves that reflex away from each other and which either persist or fall in the ripening fruit. Placentas 2, c. 0.7 × 0.5 mm, protruding into the locule, each bearing 20–30 seeds. Seeds bright brown, truncated-obconic, (3–) 4–6-sided, widest distally, tapering to the hilum, c. 0.5 mm × 0.2–0.25 mm, surface tuberculate, distal surface with 20–30 rounded tubercles (Fig. 1I), hilum slightly raised, orbicular, 0.025 mm diam.

*Etymology*

The species epithet *stellata* is named after the stellate hairs that are so characteristic of this species (Figs. 1, 3).

*Distribution*

Endemic to Republic of Guinea, Kindia and Forécariah Prefectures (Map 1).

*Habitat & ecology*

*Virectaria stellata* occurs in fissures on vertical sandstone rock at altitudes of 450 to 910 m, in sun or

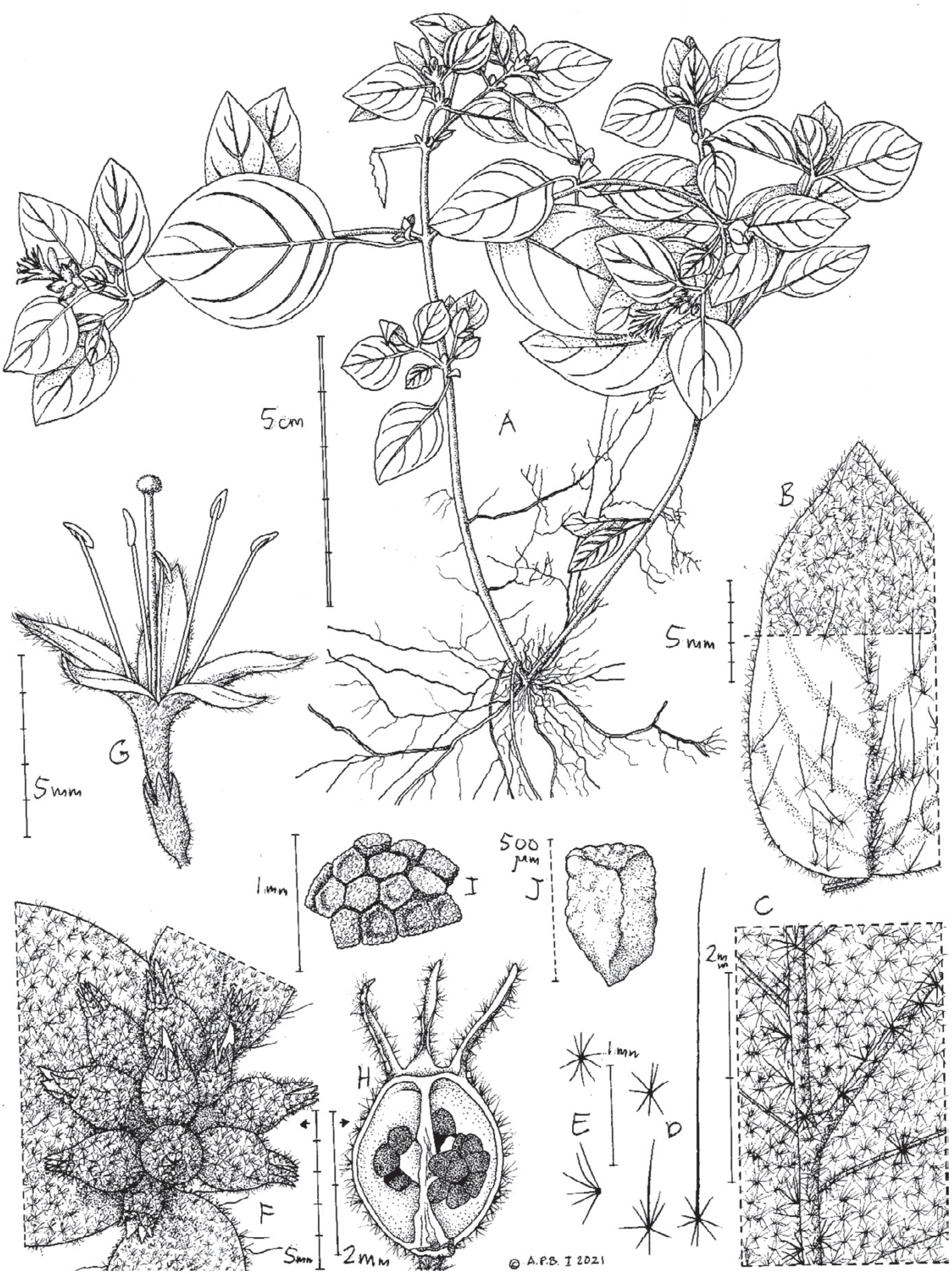


**Figure 1.** *Virectaria stellata.* A. habit, flowering plant; B. leaf upper surface (full cover of stellate hairs drawn only on distal part); C. leaf lower surface, showing midrib and secondary nerves; D. stellate hairs from upper leaf surface; E. stellate hair seen from above and side; F. infructescence, immature; G. open flower; H. fruit, after dehiscence (valve fallen); I. mature seeds *in situ* on placenta; J. mature seed, side view. A–J drawn from *Burgt & P.M. Haba* 2332 by Andrew Brown.

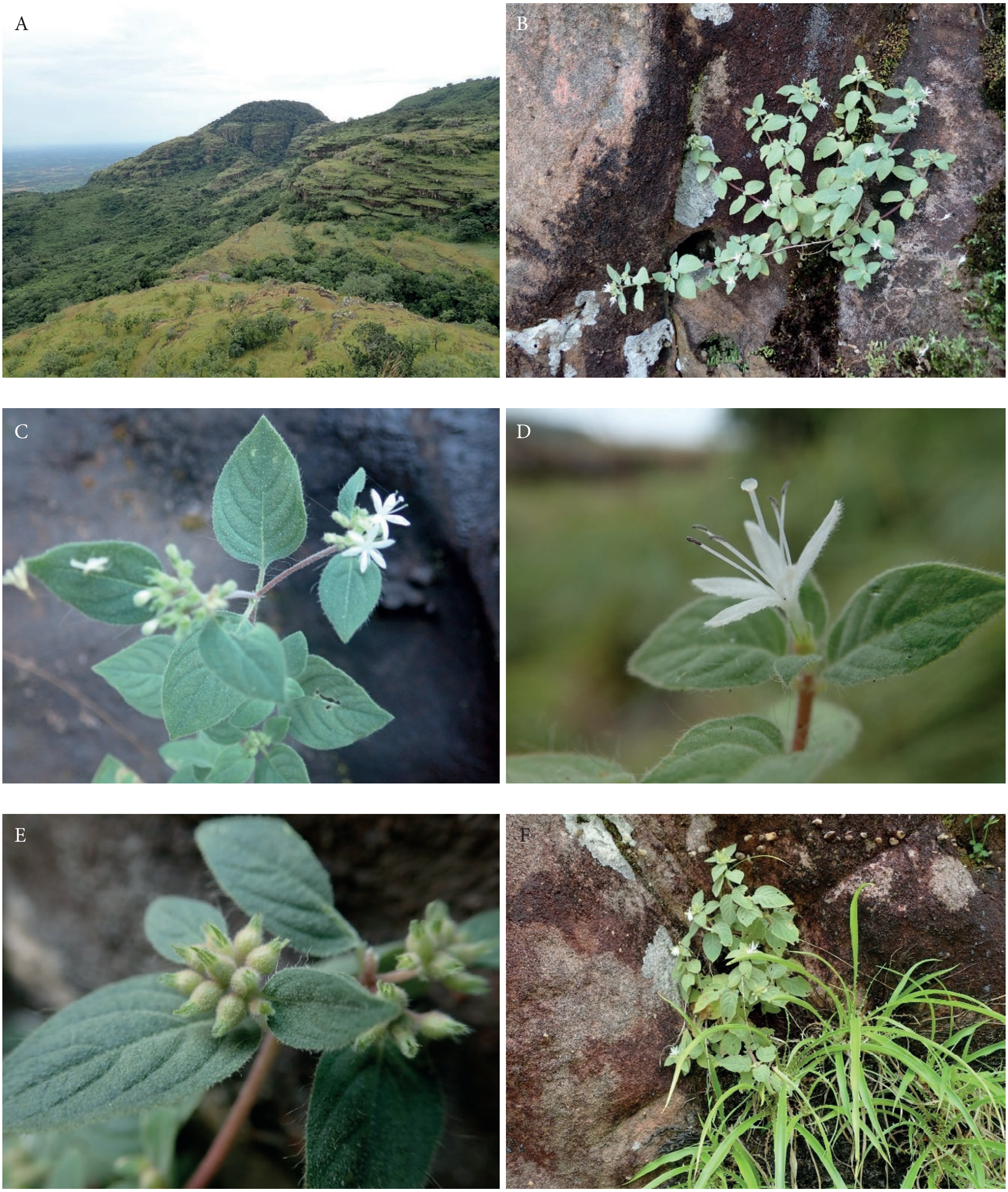


**Figure 2.** *Virectaria stellata*. A. vertical rock habitat on the Benna Plateau. The type specimen was collected on the rocks at the centre of the photo; B. flowering plant; C. inflorescence; D. flower; E. young fruits; F. flowering plant growing with *Pitcairnia feliciana*. B, D, E, F from: *Burgt* 2332; C from *Simbiano* 683. Photos: A, B, D–F by Xander van der Burgt; C by Faya Julien Simbiano.

half-shade (Fig. 2A). The species has been found growing with other Guinea endemic species, *Cailliella praerupticola* Jacq.-Fél. (Melastomataceae) (*Burgt* 2332), *Fleurydora felicis* A.Chev. (Ochnaceae) (*Burgt* 2332), *Kindia gangan* Cheek (Rubiaceae) (*Burgt* 2345) and *Pitcairnia feliciana* (A.Chev.) Harms & Mildbr. (Bromeliaceae) (*Burgt* 2332; Fig. 2F).

*Phenology*

*Virectaria stellata* was collected in flower in November, and in fruit in February, March and November. The dry season is from November to March and the rainy season is from April to October.

*Conservation status*

*Virectaria stellata* is known from eight collections in three localities which correspond to three locations. Three collections are from the centre of the Benna Plateau, South of Kindia, where thousands of plants were seen. Three other collections are from the 250 m high vertical rock escarpment at the Northern end of the Benna Plateau, South of Kindia; where hundreds of plants were seen. Many more plants are probably present here, higher up on the vertical rocks, where they cannot be seen from the base of the vertical rock. Two collections are from Mont Kouroula, North of Kindia, about 50 km North of the Benna Plateau; thousands of plants were seen here. The extent of occurrence (EOO) is 121 km$^2$, and area of occupancy (AOO) is 20 km$^2$. Although suitable areas of sandstone cliff habitat exist where the species is not found, it is likely that the EOO and AOO underestimate the true distribution of the species, as it is likely that other populations exist but have not yet been found. The extent of occurrence of the species is supposed to probably be less than 5,000 km$^2$ and the area of occurrence less than 500 km$^2$. Fires started by herders during the dry season have been observed to damage plants at the base of the cliffs on which this species grows. Fires are also set up cliffs to drive off bees from their nests, to collect honey (Cheek pers. obs., Kindia region). Although underground perennating structures are not recorded in this species, burned plants were observed by the specimen collectors to resprout from the base. Some plants have buds at the stem base showing signs of regeneration after the passage of fire (see for example *Burgt* 2332, HNG, K, SERG). Juvenile plants and young flowering plants were recorded near the base of the cliffs, in areas presumably affected by dry-season fires. It seems that, when mature plants are destroyed by fire, a new generation will grow back in the same place. Therefore, no decline was observed in area, extent and/or quality of habitat, as well as in number of mature individuals. *Virectaria stellata* is therefore provisionally assessed here as Least Concern (LC).

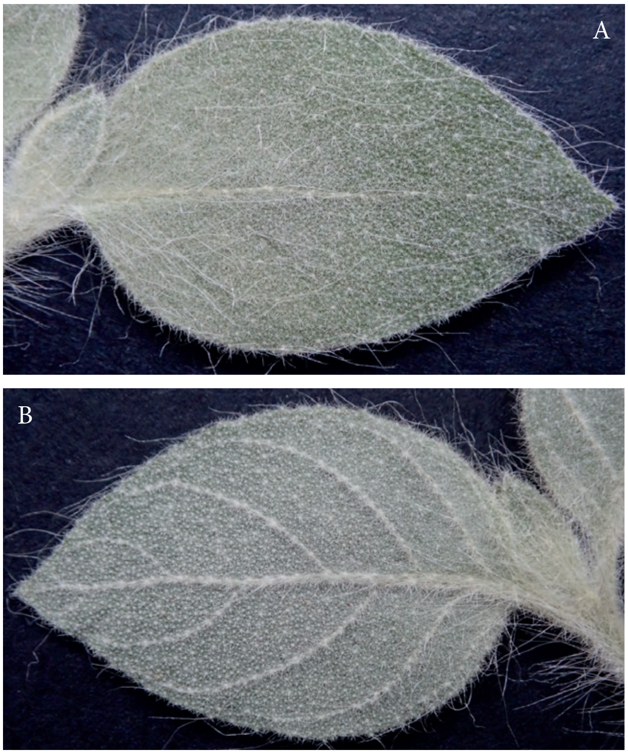
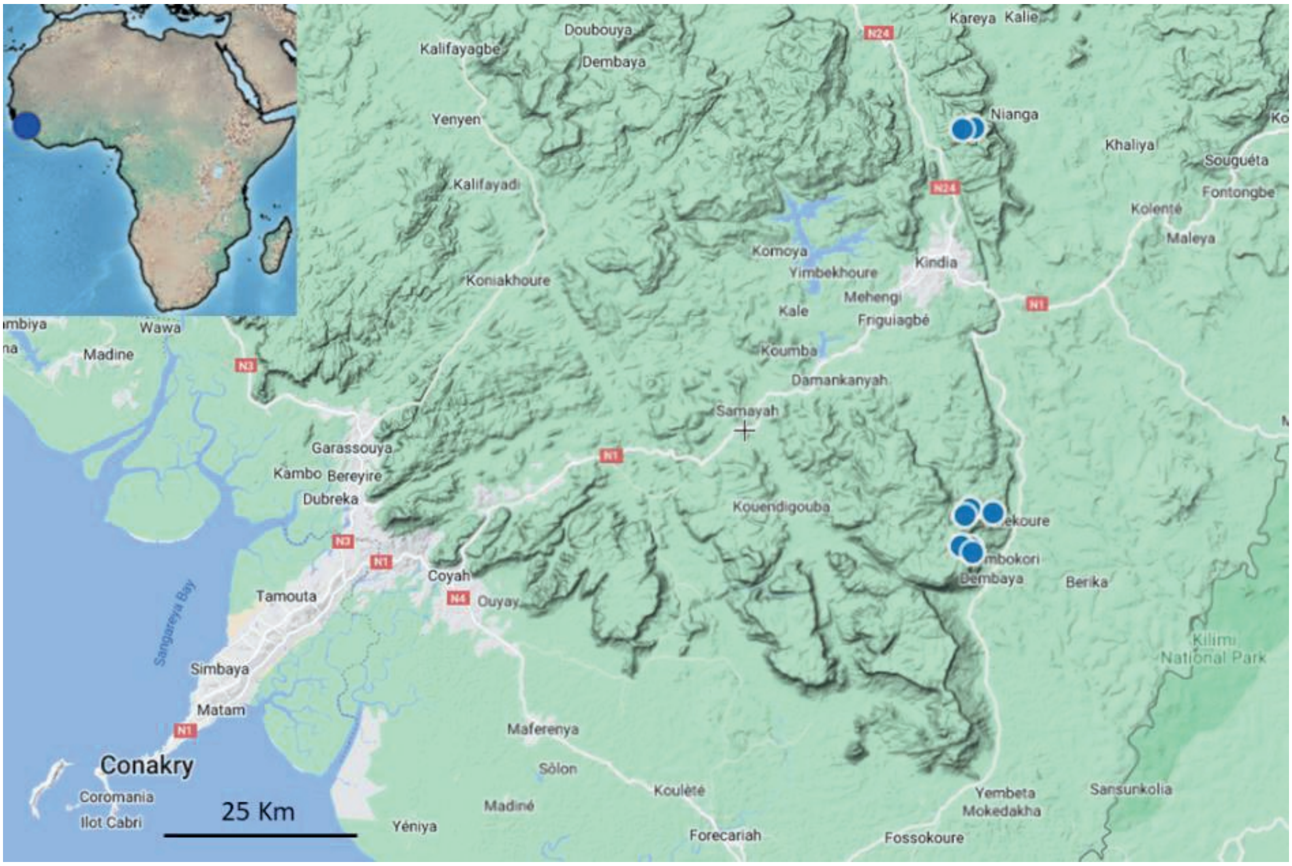


**Figure 3.** *Virectaria stellata*. A. Adaxial side of the leaf with stellate hairs, including many with one arm to 5 mm long; B. Abaxial side of the leaf with stellate hairs, including a few with one arm to 5 mm long. Length of leaf blade 19 mm. From *P.M. Haba* 1375. Photos: Xander van der Burgt.

*Additional specimens examined*

**GUINEA. Forécariah Prefecture**, Benna Plateau, 5 km W of Gombokori, 9° 44’ 22.9” N, 12° 50’ 11.4” W, 910 m, fl. & fr., 4 Nov. 2019, *P.M. Haba & Burgt* 1363 (B, BR, G, HNG, K, MO, P, SERG, US, WAG). **Kindia Prefecture**. Mont Kouroula, 6 km E of Koumbaya, 10° 10’ 57” N, 12° 49’ 21.4” W, 450 m, fl. & fr., 7 Nov. 2019, *Burgt, P.M. Haba & Holt* 2345 (HNG, K, P, WAG); Mont Kouroula, 6 km E of Koumbaya, 10° 10’ 52.5” N, 12° 50’ 06.5” W, 460 m, fr., 10 Nov. 2019, *P.M. Haba, Burgt & Holt* 1375 (HNG, K); near Mambia village, mount Yon-Ya, 9° 46’ 31.1” N, 12° 48’ 8.9” W, 720 m, fr., 30 March 2023, *Konomou, Burgt, Conté & Thiam* 1128 (B, BR, G, HNG, K, MO, P, PRE, SERG, WAG); near Molota, path to Balaqui, 9° 46’ 23.6” N, 12° 49’ 57.6” W, 660 m, sterile, 31 March 2023, *Thiam, Konomou, Conté & Burgt* 23 (HNG, K); between villages Dokokouré and Tinekouré, 9° 46’ 43.6” N, 12° 49’ 34” W, 640 m, fl., 16 Nov. 2023, *Simbiano, Thiam, Touré & Bangoura* 683 (HNG, K).



**Map 1.** Distribution of *Virectaria stellata* (blue dots). Map data © Google 2024.

## DISCUSSION

### *Possible horizontal gene transfer: Stellate hairs: a newly discovered trait for Rubiaceae*

The presence of stellate hairs in *Virectaria stellata* (Fig. 1 and 3) is remarkable because not only is it here recorded for the first time in the genus *Virectaria*, but also for the first time in the entire family Rubiaceae, from which, until now, only simple hairs have been recorded apart from T-shaped hairs in the genus *Coptosapelta* Korth. (Robbrecht 1988), unrelated to *Virectaria*. In fact stellate hairs are thought to be absent from the Gentianales as a whole (Bridson pers. comm. in review 2024). In many of the stellate hairs in *Virectaria stellata*, the central arm greatly exceeds the others, by a factor of ten or more. On the leaf upper surface, these stellate hairs are appressed and directed towards the leaf apex. This unusual stellate hair type is absent in plant families from which stellate hairs are almost universal, e.g. the Malvales (Cheek in Heywood et al. 2007; Cheek and Dorr 2007). In fact this stellate hair type is otherwise known to us only from the tribe Barlerieae in Acanthaceae, in the genera *Barleria* L. and *Lepidagathis* Willd. (Darbyshire et al. 2010)._In *Barleria*, this trait has evolved independently in several lineages (Balkwill & Balkwill 1997; Darbyshire et al. 2019; Comito et al. 2022). Two species of *Barleria* in Guinea have stellate hairs, *B. asterotricha* Benoist and *B. maclaudii* Benoist, and those of *B. asterotricha* in particular are similar to the hairs seen in *Virectaria stellata*. Both *Barleria* species are recorded in the same highland area (Fouta Djalon) as *Virectaria stellata* but have not yet been recorded as sympatric with it. We conjecture that horizontal gene transfer from a *Barleria* to the progenitor of *V. stellata* may be the explanation for this phenomenon, in the absence of any other plausible explanation. Horizontal gene transfer can be defined as the transfer of genetic material from one species to another without sexual reproduction (which is vertical gene transfer).

Horizontal gene transfer is a more likely explanation than gene mutation for these structures because to change from the simple hairs (trichomes) seen in all other *Virectaria* species (and indeed Rubiaceae/

Gentianales) to the stellate hair trait would require a change of not one (credible by mutation), but multiple genes simultaneously (unlikely in a single mutation event). The regulation of the changes between simple and stellate hairs has been studied in detail in *Arabidopsis thaliana* (L.) Heynh. (Brassicaceae/Cruciferae) in many tens of papers beginning with Folkers et al. (1997). Study of changes in the leaf hairs of this species have become the model for understanding the biological and molecular basis underlying the development of cell shape in plants (Mathur 2006; Syzmanski et al. 2000; Luo and Oppenheimer 1999; Pattanaik et al. 2014). Over 30 different genes are known to control the developmental processes of trichomes in the species. These processes include changes in endoreduplication, cell enlargement and in the microtubule and actin cytoskeletons (Schellmann and Hulskamp 2005; Pattanaik et al. 2014). More than 15 genes have been shown to function as activators or suppressors of trichome branch initiation alone. Among these, some genes influence branching directly, while others control branch number in an endoreplication-dependent manner (Camoirano et al. 2020).

Horizontal gene transfer (HGT) is a universal phenomenon and most frequently documented in prokaryotes, while also known in animals, fungi and plants (Quispe-Huamanquispe et al. 2017; Richardson and Palmer 2007; Gao et al. 2014). Existing literature on HGT in plants is extensive, and growing fast with the increasing availability of next generation gene sequencing allowing the detection of HGT events (Quispe-Huamanquispe et al. 2017). Studies to date have mainly relied on the phylogenetic signal of the donated DNA being discordant from that of the host (Richardson & Palmer 2007). However, the gold standard to determine gene function resulting from HGT is the existence of a phenotype that is correlated with the presence of those genes (Quispe-Huamanquispe et al. 2017). Ten possible pathways to HGT in plants are reviewed in Gao et al. (2014). Parasitic plants commonly acquire genetic material by HGT from their hosts. For example, transcriptome analyses of three parasitic members of Orobanchaceae show the occurrence of 52 high-confidence HGT events (Yang et al. 2016). HGT events mediated by the bacterium *Agrobacterium* have been detected in *Nicotiana* L. (Solanaceae), *Linaria* Mill. (Plantaginaceae) and *Ipomoea* L. (Convolvulaceae). The transferred material persists in the germline and appears to have a role in evolution. The ability of *Agrobacterium* to transform plants has been exploited for decades as a means to introduce foreign genes of interest into crop plants (Quispe-Huamanquispe et al. 2017).

The case of *Amborella trichopoda* Baill. (Amborellaceae) is spectacular because at least several dozen (and possibly hundreds) of HGT events are thought to have occurred in this species, to the extent that most of the mitochondrial genetic material is thought to be foreign, from multiple different donors including mosses and flowering plants, possibly resulting from plant-to-plant contact from epiphytes (Richardson and Palmer 2007).

Since this paper was submitted, a *Virectaria* specimen that entirely lacks stellate hairs but is otherwise morphologically very similar to *V. stellata*, was collected in Guinea, about 90 km to the North of the northernmost *V. stellata* collection. This specimen: *de Nevers* 14581 (HNG, K), was collected from a prostrate, densely hairy, flowering herb, on 25 Sept. 2019, on vertical rock surface near Télimélé, 10° 55’ N, 13° 10’ W. The longest hairs on this specimen are several mm long, transparent, and spiralled; these hairs look exactly like the long arms of the stellate hairs of *V. stellata*. This specimen may represent a possible progenitor of *V. stellata*. Since *de Nevers* 14581 differs in several other characters from *V. stellata* the collection may represent a new taxon, for example a new variety or a new species of *V. stellata*. Further study by both morphological and molecular phylogenetic analysis is needed, of this specimen and additional specimens to be collected, to test the hypothesis that this entity shares a recent common ancestor with *V. stellata*. Genomic analysis is needed to test the hypothesis that HGT from *Barleria asterotricha* has occurred.

### *Endemics of the sandstone table mountains of the Fouta Djalon*

Of the 22 Important Plant Areas (IPAs) in Guinea (Couch et al. 2019), five are in the sandstone table mountains area. Although *Virectaria stellata* does not occur in any of these five IPA’s, one of the three localities where the species is found, is on Mont Kouroula, located in the buffer zone of the Mont Gangan IPA area (Couch et al., 2019). The Benna Plateau contains two of the three localities where *Virectaria stellata* occurs, is rich in rare plant species, and should be considered for designation as an IPA. For further information on the sandstone habitats of the Fouta Djalon see Couch et al. (2019: 20–29).

*Virectaria stellata* is the latest in a steady flow of new species to science published from the sandstone habitats of the southwestern outliers of the Fouta Djalon highlands in Guinea. The table mountains are perhaps best known to botanists for being the home of *Pitcairnia feliciana* (Bromeliaceae), the only Old World species of that family (Larridon 2018). *Fleurydora felicis*

(Ochnaceae) a monotypic tree genus arising from a South American clade, has a similar geographic range and is also restricted to sandstone cliffs (Canteiro & Cheek 2019). Many other endemic plant species occur on the table mountains. These include the monotypic genus *Benna alternifolia* Burgt (Melastomataceae), *Cailliella praerupticola* (Melastomataceae), *Ctenium bennae* Xanthos (Poaceae, Xanthos et al. 2021), *Gladiolus mariae* Burgt (Iridaceae), *Impatiens bennae* Jacq.-Fél. (Balsaminaceae), *Inversodicrea tassing* Cheek (Podostemaceae, Cheek et al. 2019), *Kindia gangan* (Rubiaceae, Cheek et al. 2018), *Mesanthemum bennae* Jacq.-Fél. (Eriocaulaceae), *Rhytachne perfecta* Jacq.-Fél. (Poaceae), *Tephrosia kindiana* Haba, B.J.Holt & Burgt, *Ternstroemia guineensis* Cheek (Pentaphylacacae, Cheek et al. 2020), and *Trichanthecium tenerium* Xanthos (Poaceae, Xanthos et al. 2020). There is no doubt that more discoveries of new taxa, and range extensions, will be made if botanical survey work continues.

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# *Xylopia nilotica* (Annonaceae) in Ethiopia, Sudan, South Sudan, and Uganda, with a review of the genus in North Eastern Tropical Africa

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**Abstract.** Based on written records and specimens of the new species, *Xylopia nilotica* D. M. Johnson & N. A. Murray (2018), described from Uganda and west of the Nile in Sudan and South Sudan, we have mapped the species. We find that it also occurs east of the Nile in South Sudan and in western Ethiopia. Its habitats range from open rain forest to open woodland. Modelling the potential distribution of *X. nilotica* suggests that it occurs in the periphery of the upper Nile basin, but it is probably under-collected. The potential distributions of *X. longipetala* (a Guineo-Congolian species) and *X. holtzii* Engl. (an East African coastal species), distinct but previously considered conspecific with *X. nilotica*, only marginally overlap with that of *X. nilotica*, which is endemic to the countries Uganda, South Sudan, Sudan, and Ethiopia, apparently a unique pattern of endemism. The new information does not change the assessment of *X. nilotica* as Vulnerable (VU). Other species of *Xylopia* in North Eastern Tropical Africa are *X. rubescens* Oliver and *X. thomsonii* Oliver in the Equatoria region of South Sudan, and *X. rubescens*, *X. staudtii* Engl. & Diels, and *X. aethiopica* (Dunal) A. Rich. in Uganda. A record of *X. aethiopica* in Ethiopia is based on false label information on the only known specimen.

**Keywords:** Annonaceae, conservation, modelled distribution, Nile Basin, North Eastern Tropical Africa, *Xylopia*.

## INTRODUCTION

### *Updating the Flora of Ethiopia and Eritrea*

The only species of *Xylopia* documented in the *Flora of Ethiopia and Eritrea* was *X. parviflora* (A.Rich.) Benth. from the western lowlands of Ethiopia. The present work updates the nomenclature and records of *Xylopia* (Annonaceae) in North Eastern Tropical Africa, which here includes Ethiopia, Sudan, South Sudan, and Uganda. These countries include the north-easternmost areas of Africa where the genus *Xylopia* occurs. Our work provides habitat notes on *X. nilotica*, the only species of *Xylopia* endemic to the region, supported by field experience of the plants and their habitats. The paper also provides a model of potential distribution of two species previously considered conspecific with *X. nilotica*. The account follows other papers presenting specific improved information that has become available after the *Flora of Ethiopia and Eritrea* was completed in 2009 (Friis et al. 2024). First, Friis et al. (2011) published a list of newly discovered species, later, articles on the genus *Plumbago* (Plumbaginaceae in Friis et al. 2013), and on *Euphorbia venefica* (Weber et al. 2020).

Verdcourt (2000: 7), in *Flora of Ethiopia and Eritrea*, recognized only one species of *Xylopia* from Ethiopia, *X. parviflora*, but this Ethiopian plant is *X. nilotica* D.M. Johnson & N.A.Murray (2018: 126), which is not closely related to *X. parviflora*, the name of which has also been changed to *X. longipetala* De Wild. & T.Durand. The drawings of twigs, leaves and flowers of what is called *X. parviflora* in *Flora of Ethiopia and Eritrea* (Fig. 1.3.6–8) were made from material from the Kenya coast (*Gillett & Kibuwa* 19846), now identified by Johnson and Murray (2018: 121) as *X. holtzii*. The drawings of fruits and seeds (Fig. 1.3.9–10) were made from material from Liberia (*Baldwin* 6970), which Johnson and Murray (2018: 151) identify as *X. acutiflora*.

## *Patterns of collecting activity in North Eastern Tropical Africa, and records of* Xylopia *in the floristic and ecological literature*

Data documenting the distribution and ecology of *Xylopia* in previous literature on North Eastern Tropical Africa is scattered. Although both Uganda, the former Sudan (including the present South Sudan), and Ethiopia have a long history botanical collecting beginning before 1850, the number of herbarium specimens of vascular plants from western Ethiopia, Sudan and South Sudan is low and the collected areas limited (Beentje and Smith 2001; Friis 2009a: 5–25, 2009b: 97–123; Darbyshire et al. 2015: 11).

According to the above sources, botanical collecting in Ethiopia was centred on the highlands until ca. 1950. In the former Sudan most collecting went on along the Red Sea coast, in the area around Khartoum, along the Blue Nile, around Jebel Marra and in a narrow zone along the White Nile. A map based on the RAINBIO mega-database (Sosef et al. 2017: Fig. 5) confirms that collecting activity in Sudan by botanists other than 19th century explorers like Georg Schweinfurth began in the 1920s and 1930s, mainly in a belt across the country at the level with Khartoum and southwards towards the present border with South Sudan. After Sudanese independence, collecting activity in the country has been low due to long periods of civil unrest and war. A similar situation existed in South Sudan: after protracted fighting against the Sudanese government, South Sudan became independent in 2005, but the fight for autonomy was followed by internal unrest, and the only reasonably well collected area is the extreme south along the White Nile (south of Bor and Juba), a narrow zone to the west of the Nile along the border with Uganda and the Democratic Republic of the Congo, and the Imatong, Dongotona and Didinga Mountains to the east of the Nile.

With a grid of one degree cells, Küper et al. (2006: Fig. 2) estimated the deficiency of data documenting plant distributions in Africa south of the Sahara, analysing the differences between observed and modelled number of species per cell. The study showed a high degree of data deficiency in the southern part of Sudan, in the central part of South Sudan, and in northern and central Uganda. A similar pattern was shown for Uganda by Beentje and Smith (2001: Fig. 1–2), based on an estimated degree of floristic exploration; only a zone along the shores of Lake Victoria and one in Western Uganda along the lakes in in Albertine Rift were indicated as well-collected. Using a grid of half-degree cells, Sosef et al. (2017: Fig. 1) showed a pattern similar to that of Küper et al. All studies therefore show deficient data for Sudan and South Sudan, more representative data from Ethiopia (even in the western lowlands) and from Uganda, particularly near Lake Victoria and in Western Uganda.

Due to the scarce herbarium material and the limitation of other information, we have here cited and evaluated ecological information from floristic and ecological literature. Some ethnobotanical observations of importance for conservation are also cited. The nomenclature of the original publications in relation to the synonymy of by Johnson and Murray (2018) is incorporated in the section *Species*. Brief references to the recent names are also made here in sharp brackets.

Jackson (1956: 356) observed on a habitat in which *Xylopia vallotii* [*X. nilotica*] occurred: “Near the Imatong [Mountains], gallery forest may be regarded as a reduced type of rain forest confined to the vicinity of stream beds [Note by Friis and Weber: In the classification of White (1983: 79), Jackson’s Sudanian “rain forest” would not be considered a typical rain forest, but rather “Drier peripheral semi-evergreen Guineo-Congolian rain forest …”]. As a riverine habitat, it is generally found in deep U-shaped valleys and in addition to the extra supplies of ground water produced by the streams, the protection from fire afforded by the steep slopes of the valleys is an important factor in preserving the forest. The characteristic dominants are *Khaya grandifoliola*, *Cola cordifolia*, *Syzygium guineense* and *Erythrophleum guineense*, while other species occurring include *Chlorophora excelsa*, *Aphania senegalensis*, *Xylopia vallotii*, *Trichilia prieureana*, *Rauvolfia oxyphylla*, *Erythrina excelsa* and *Cassia petersiana*." Jackson did not cite specimens but we have traced *Jackson* 763 (FHO, KHF) from Imelia forest in the Kinyeti Valley near the Imatong Mountains.

Harrison and Jackson (1958) did not mention *Xylopia* in their description of the vegetation of Sudan. Specimens from hills around the Nuba Mountains in Kordofan were mentioned in floras as *X. vallotii* [*X. nilotica*] and *X. parviflora* [*X. nilotica*]. These specimens were collected in vegetation which Harrison and Jackson classify as "Hill Catena", a complex vegetation on mountain slopes with various types of forest and woodlands and with its main extension on the western slope of the Ethiopian Highlands.

El Amin (1990: 13–14) cited four species of *Xylopia* from Sudan with indication of their ecology: (1) *X. acutiflora* [*X. thomsonii*] in high rainfall savannah and gallery forests in Southern Bahr El Ghazal, South Western Equatoria and Southern Kordofan; (2) *X. aethiopica* [see below] in high rainfall savannah and swampy forest; (3) *X. parviflora* [*X. nilotica*] in riverine and swamp forest in the tall grass savannah in Nuba Mountains (Jebel Eliri) and in the Equatoria region; and (4) *X. rubescens* Oliv. in riverine forests in high rainfall savannah in the Equatoria region. Because El Amin did not cite voucher specimens, it is not possible to relate these four names directly to those of Johnson and Murray (2018) but based on geography, ecology and the morphological descriptions in his work, the taxonomic position of El Amin's species has been suggested here in the section *Species*. The identity of El Amin's *X. aethiopica* is not clear, Darbyshire et al. (2015: 72) state that "It [*X. aethiopica*] is likely to occur in Equatoria, but this needs confirmation."

Verdcourt (1971: 79), Friis (1992: 94), and Verdcourt (2000: 7) indicated that the distribution of the only Ethiopian species, called *X. parviflora* [*X. nilotica*], extended in lowland forest vegetation across Africa from the Atlantic to the Indian Ocean and included *X. holtzii* Engl. on the east coast of Africa. Friis (1992) mentioned from own observations in the western Ethiopian lowlands that *X. parviflora* could be a tree up to c. 10 m high, occurring in woodland with *Acacia sieberiana*, *Annona senegalensis*, *Lannea barteri*, *Ficus dicranostylis*, *Bridelia scleroneura*, and *Grewia mollis*. These associated species are typical of the western woodlands of the Gambela Region (Friis et al. 2022: 201), rather than of the Transitional rainforest of Friis et al. (2010: 106–113), from where the species of *Xylopia* was also recorded. This is the same vegetation in Ethiopia as the type referred to in Friis (1992: 28) with White's name "Dry peripheral semi-deciduous Guineo-Congolian rain forest."

Woube (1995: 73, 76) recorded the Anuak name *Orway* for trees he named *X. parviflora* [*X. nilotica*] and stated that it occurred "along waterways in the study region", which must mean in riverine forest. The wood was useful for dug-out canoes, mortars, pestles and tool-handles and was much in demand, for which reason the tree was rare and often utilised when only 10–15 years old. On a specimen (cited below), Woube recorded a DBH of ca. 50 cm.

Senbeta et al. (2007: 34) recorded *X. parviflora* [*X. nilotica*] in their analysis of the Sheko forest in SW Ethiopia. This forest is located near Mezan Teferi and Tepi at 7° 00'–10' N, 35° 20'–40' E, with altitudes ranging from 900 to 1810 m. *Xylopia* did not appear in the phytosociological statistics of the paper, only recorded from Sheko without further information in a in a general species list from the forests in "Appendix 1". The Sheko Forest is partly a lowland forest and partly an Afromontane forest; the lowland forest occurs in the valleys to the west of the road between Mezan Teferi and Tepi, at altitudes below 1250 m. No specimen at ETH documents the identification by Senbeta et al.

Darbyshire et al. (2015: 72–73) listed information about these species of *Xylopia* in Sudan and South Sudan: (1) *X. acutiflora* [*X. thomsonii*] was indicated as a shrub or small tree is forests; (2) *X. aethiopica* was only cited with a reference to El Amin (1990: 13) and indicated as a shrub or tree in swamp forest or moist woodland, but according to Johnson and Murray (2018: 76), a plant called shrub at the stage of flowering is almost certainly not *X. aethiopica*; (3) *X. longipetala* [synonym *X. parviflora*; *X. nilotica*] was indicated as a tree in forest and dense woodland; and (4) *X. rubescens* was indicated as a tall tree in riverine and swamp forest.

Johnson et al. (2017: 8) described new species of *Xylopia* from Eastern Africa, and analysed *X. parviflora* sensu Verdcourt (1971). The name *X. parviflora* was rejected as illegitimate (Maas et al. 1986: 277) after Verdcourt's 1971-account, and replaced with *X. longipetala* De Wild. & T. Durand. Johnson et al. pointed out that material identified as this taxon from western and central Africa, including the type of *X. longipetala*, differed in many vegetative, floral and fruiting characters from East African material. The East African material shared more similarities with *X. odoratissima* Welw. ex Oliv. than with *X. longipetala*.

Johnson and Murray (2018), in their monograph of the African species of *Xylopia*, recorded the species from North Eastern Tropical Africa that are listed here in the part called *Species*. In their work from 2018, Johnson and Murray analysed further the “East African material” from their 2017-work. They described and named a new species, *X. nilotica,* restricted to the Nile Basin and distinguished from the East African coastal species, *X. holtzii*, by mainly vegetative characters, as well as by fruiting characters. This pair of species was morphologically nearest to, but distrinct from *X. odoratissima*, which is distributed in southern Africa from Angola to Zambia, Zimbabwe, Namibia and Botswana.

Masresha et al. (2024), in an analysis of forests in the western lowlands of Ethiopia, observed *X. parviflora* [*X. nilotica*] with a density of 93.4 (trees per ha), a DBH (in m) of 5.6, and a basal area of 0.08 (indicated as in $m^2$/ha – this indication must be an error by Masresha et al.). The density listed is one of the two highest for trees in their study area; the common lowland tree *Celtis zenkeri* had a density of 90.3 trees per ha. According to the field observations of the present first author, this is a highly unusual density of *Xylopia* in the western Ethiopian lowlands. It may be due to a misidentification during recording in the field, and it would only be possible in stands of many young trees. However, the latter assumption does not agree with Masresha et al.’s indication of an exceptionally high average DBH of 5.6 m. Although no specimen at ETH documents the identification, there is no reason to doubt that the species does occur in the Gambela forests.

### Xylopia aethiopica *and other species in “the Ethiopian collections of Dr. Rousseau”*

The record of *Xylopia aethiopica* from Ethiopia cited by Johnson and Murray (2018: 82), “ETHIOPIA. Rég. de Bonga, Jul 1909 (yg fr), *Rousseau* s. n. (L)” is almost certainly wrong, because – most likely – it is based on faulty label information on the specimen, which is registered in the Naturalis database (https://bioportal.naturalis.nl/en/specimen/L.4370474, accessed April 2024) and is correctly identified as *X. aethiopica*. The text on the label is: “HERBIER de Ch. D’Alleizette / Plantes provenant d’échanges. / Xylopia aethiopica L. / Abyssinie: Rég. de Bonga, partes boisées / Juillet 1909 / Dr. Rousseau”. In the Naturalis database the specimen is annotated: ”Actual locality unknown, material stolen in P herbarium.” Dr. J. Wieringa at Naturalis (pers. com.) has concluded that Charles d’Alleizette, after having sold duplicates of his own collections from Madagascar to Leiden, apparently started taking duplicates from the collections of others in the Paris herbarium, making up new labels and selling the specimens to the Leiden Herbarium as if they were obtained by exchange. In Naturalis, there are more than 360 specimens labelled ”Herb. Ch. D’Alleizette”, said to have been collected by ”Dr. Rousseau” from localities all over Ethiopia and dated “Julliet 1909”, “Aout 1909” and “Julliet 1910”, mostly from well-known collecting sites, for example from G.W. Schimper’s localities in Tigray and Gondar. In the *Index Herbariorum - Collectors* (Vegter 1983: 791) there is no collector named “Rousseau” having collected in Ethiopia in 1909–1910. In *Encyclopaedia Aethiopica*, a critical and scholarly work with more than 6000 pages (Uhlig et al. 2003–2014), there are detailed accounts of travels by European scholars in Ethiopia up to mid-1900, but no record of a ”Dr. Rousseau”. It is unlikely that it was possible with the transportation facilities in 1909-1910 to travel so widely in Ethiopia in one or two months. Moreover, specimens labelled “HERBIER de Ch. D’Alleizette / Plantes provenant d’échanges” and said to have been collected by ”Dr. Rousseau” are only known from L.

*Xylopia aethiopica* seems to be the only species among the “Ethiopian collections of Dr. Rousseau” that is not known from other Ethiopian material. We have found no other case in the Naturalis Database, but similar cases where not only the collector, but also the country of origin, locality and date were fabrications are known from other African “d’Alleizette collections” (several cases according to Wieringa pers. com.), as well as a single record of *X. aethiopica* from Chad, cited by Johnson and Murray (2018: 82) as collected at “N’Djamena [“Fort Lamy”], Nov 1919 (fl).”

## MATERIALS AND METHODS

The present study is based on specimens at C (Fig. 1), ETH, and K as listed in the Appendix, on the literature reviews, and on field observations by the first author in Ethiopia during 1995–2005. Due to the scarcity of specimens, particularly of flowering and fruiting material, sterile North Eastern Tropical African material has also been identified, using the vegetative characters of Johnson and Murray (2018: 38–39, 126). Records from forest surveys without preserved specimens (Getinet et al. 2024 – central part of study area: 7.6500 N, 34.2375 E; Feyera et al. 2007 – central part of western lowland part of the Sheko forest: 7.1256 N, 35.3958 E) are also accepted as documentation and mapped.

As far as possible, georeferencing of specimens and records from the literature have been made and tested with Google Earth Pro vs. 7.3.6.9796 (64-bit) (https://www.google.com/earth/about/versions/2024, accessed April 2024). Ugandan specimens were georeferenced with the index of Polhill (1988). The 1930s collections from the Jebels around the Nuba Mountains and from

**Figure 1.** A specimen, *I. Friis, Zerihun Woldu & K. Vollesen* 2485 (C), of *Xylopia nilotica*, collected between the villages Pugnido and Gog south of Gambela in the western lowlands of Ethiopia. The scale belongs with the specimen to the left; to the right a detail of leaves magnified ca. x 3, showing the reticulate secondary and tertiary venation of the adaxial side of lamina.

Bar el Ghazal were georeferenced from the historical maps of Sudan in 1:250,000 (no. 55-M, 66-E, and 78-E, as digitized by the US Library of Congress, https://www.loc.gov/item/87692353/, accessed April 2014. Specimens from South Sudan west of the Nile were georeferenced from Reid (1952: map on p. 37). Mapping for Fig. 2 and 3 in this work was done with DIVA-GIS 7.5 (https://diva-gis.org/download, accessed March 2024). Modelling of potential distributions was made with MaxEnt 3.4.4. (Phillips et al. 2006; Phillips et al. 2024; software downloaded from https://biodiversityinformatics.amnh.org/open_source/maxent/, accessed March 2024). Coordinates for the localities for *Xylopia longipetala* and *X. holtzii* used in our modelling were acquired from the KML-files of Johnson and Murray (2018; Supplementary material I). The environmental data used for the modelling was the climatic data from BioClim 1–19, covering the years 1970–2000 and with a resolution of 30”, almost equivalent to a pixel size of 1 km$^2$ (https://www.worldclim.org/data/bioclim21.html, accessed March 2024).

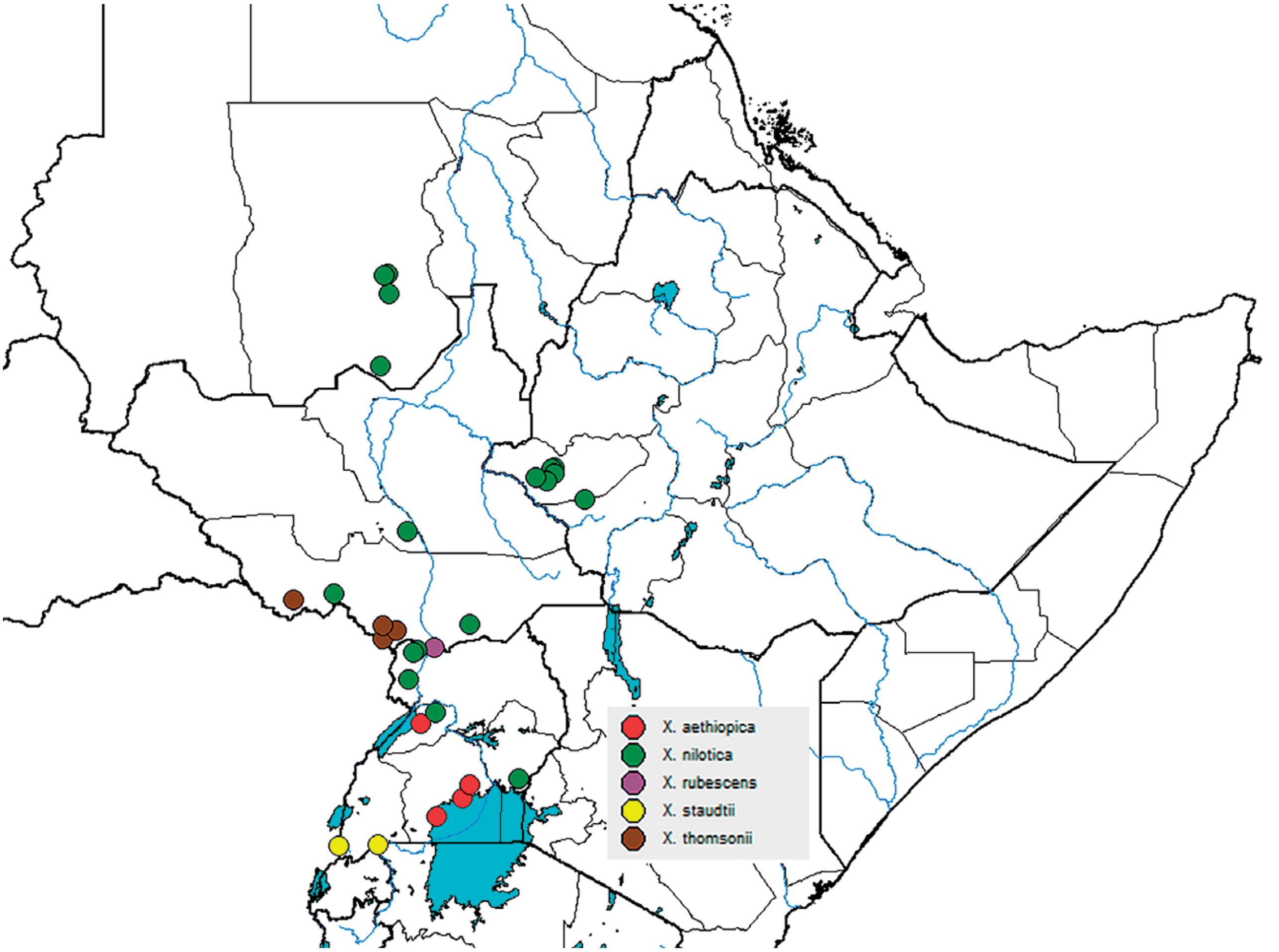

**Figure 2.** The distribution of species of *Xylopia* recorded from North Eastern Tropical Africa (Uganda, South Sudan, Sudan, and Ethiopia), only showing the distribution of the species within that area: *X. aethiopica* (red) occurs westwards to Senegal. *X. nilotica* (green) is endemic within the area shown on the map. *X. rubescens* (violet) occurs westwards to Guinea, on the map, only the record from Uganda is shown, two records from South Sudan are covered by a group of three records of *X. thomsonii*. *X. staudtii* (yellow) occurs westwards to Sierra Leone. *X. thomsonii* (brown) occurs westwards to Nigeria. The thick black lines indicate country boundaries. The thin blue lines are rivers; the thin black lines indicate the floristic boundaries of Verdcourt (1971, 2000) and Darbyshire et al. (2015). The southernmost region of South Sudan is the Equatoria region, divided in a western and an eastern part by the Nile.

The map in Fig. 3 was produced by superimposing our records of *X. nilotica* with DIVA-GIS on a simplified version of Frank White's vegetation map of Africa (White 1983), using a shapefile produced by ICRAF / World Agroforestry Centre at http://www.landscapesportal.org/layers/geonode%3Aafrica_white. (Accessed April 2024). In the conservation assessment, the preliminary evaluation of the EOO and AOO was made with GeoCAT (https://geocat.iucnredlist.org/, accessed April 2024). The evaluation of threats to the populations followed https://www.iucnredlist.org/resources/redlistguidelines (accessed April 2024). The information about protected areas is from https://www.protectedplanet.net/en (accessed April 2024).

## RESULTS AND DISCUSSIONS: SPECIES, MAPPING AND MODELLING, HABITATS, AND CONSERVATION

### *Species*

The following is a summary of the species of *Xylopia* in North Eastern Tropical Africa with the data mentioned in *Materials*. Classification, sequence of species, key and synonymy follow Johnson and Murray (2018), with addition of new information from the sterile material studied from South Sudan and Ethiopia. The cited altitudinal ranges cover only the ranges in North Eastern Tropical Africa; if altitude was not indicated on specimens, then the ranges were estimated from altitudes of the localities on Google Earth.

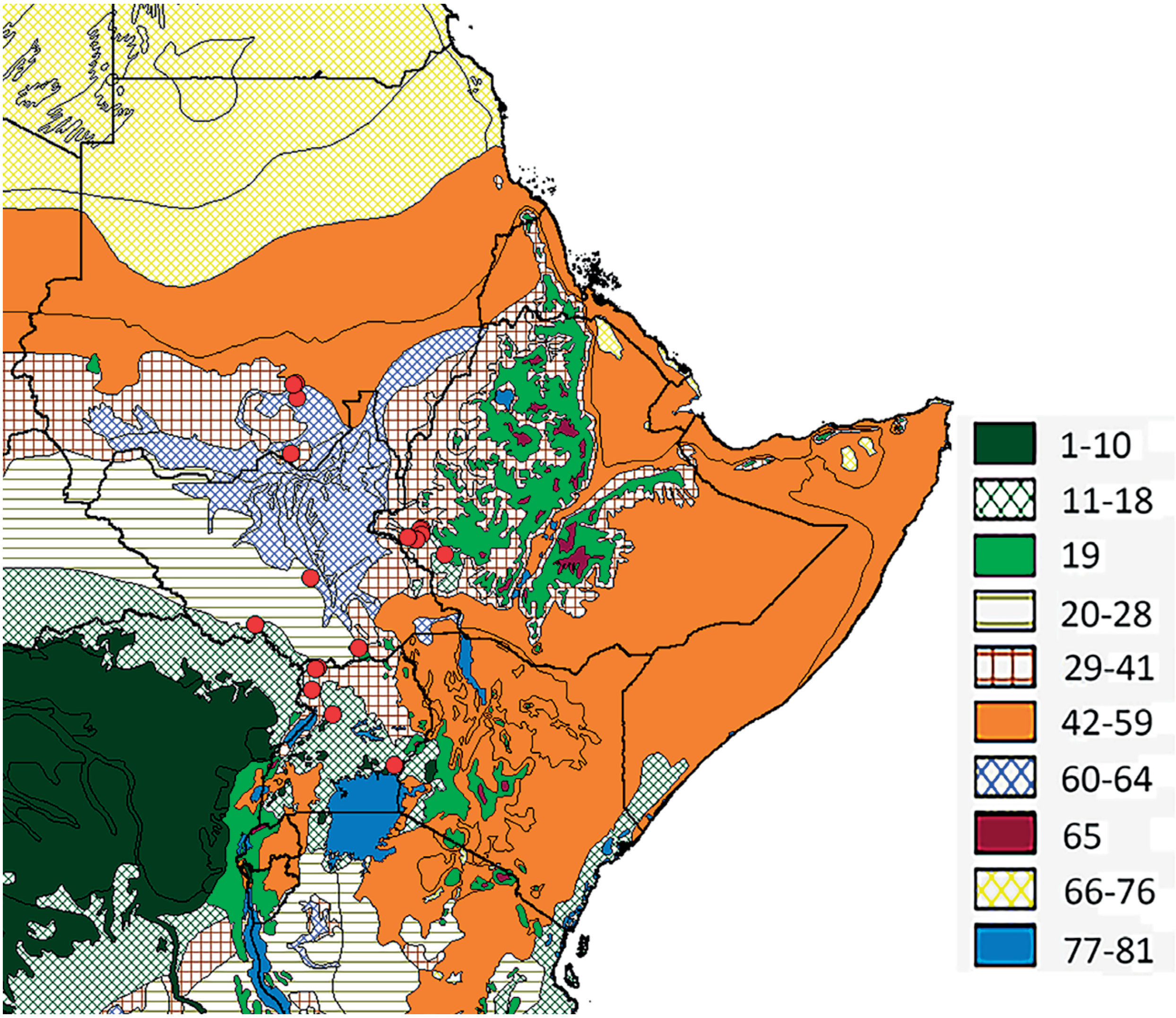

**Figure 3.** The distribution of *Xylopia nilotica* (circular red dots) superimposed on the northeastern part of White's vegetation map (map and legends simplified from White 1983). The thick black lines indicate country boundaries; the thin black lines indicate the borders between the full set of White's 81 vegetation types here assembled in ten groups marked with colouring and hatching as in the legend. For vegetation types of Frank White from which *X. nilotica* has been recorded and not been recorded, see the text in the section *Habitats*, where the numbers of the legend are also explained.

Identification with the following key (data from Johnson and Murray 2018) will mostly require flowering or fruiting material, but some vegetative characters may be used. The East African coastal species *Xylopia holtzii*, from outside North Eastern Tropical Africa but related to *X. nilotica*, is included here.

1. Seeds arillate, sarcotesta absent; nodes with either one or two axillary branches; staminal cone [the cone- or ring-shaped structure surrounding the carpels] rudimentary or absent, if well-developed then rim of cone even and carpels and monocarps more than 22 (sect. *Xylopia* and sect. *Neoxylopia*)........................................2

–. Seeds not arillate, but a fleshy sarcotesta present on the seed (waxy layer that scratches off); some nodes with two axillary branches; staminal cone well developed but usually with an irregular laciniate rim, carpels and monocarps never more than 22, often many fewer (sect. *Stenoxylopia)*........................4

2. Aril not bilobed, carpels and monocarps up to 15 per fruit; staminal cone absent or rudimentary in the form of a ring only covering the bases of the carpels; leaves short-acuminate (up to 6 mm long) or, if longer, then sharply cuspidate, not gradually acuminate (section *Neoxylopia*); tall trees.......3

–. Aril bilobed, carpels and monocarps up to 36 per fruit; staminal cone well developed, completely enclosing the ovaries; leaf gradually long-acuminate, the acumen 6–20 mm long (sect. *Xylopia*); tall trees; in study area only in Uganda............................................................ 3. ***X. aethiopica***

3. Outer petals much longer than inner petals; mature monocarps strongly torulose [with alternate swellings and contractions], often moniliform [resembling a string of beads]; tall trees; in study area in South Sudan and Uganda……………….. ...........................................1. ***X. rubescens***

–. Outer and inner petals subequal in length; mature monocarps torulose or not, but not moniliform; in study area only in Uganda .................................................. 2. ***X. staudtii***

4. Most pedicels with 3–6 bracts, these often imbricate and more or less persistent, even in fruit; pedicels 1 or rarely 2 per axil (sect. *Stenoxylopia*, *Xylopia acutiflora* group); shrub or small tree, sometimes lianesque; in study area only in South Sudan....................................... 5. ***X. thomsonii***

–. Most pedicels with 2 bracts, these often separated and with the upper persistent in flower and the lower caducous, not usually present in fruit; pedicels 1–12 per axil (some inflorescences with >1 pedicel); smaller or larger trees ............. 5

5. Higher-order veins equal in prominence to the secondary veins, forming a conspicuous raised reticulum on the adaxial surface; larger leaf blades 6.5–9.2 cm long; monocarps conspicuously verrucose but not much wrinkled, stipe 3.5–5 mm thick at the midpoint; endemic in the study area, in Ethiopia, Sudan, South Sudan, and Uganda ......4. ***X. nilotica***

[–. Higher-order veins less prominently raised than the secondary veins, forming only a faint reticulum on the adaxial surface; larger leaf blades 7.4–11.4 cm long; monocarps obliquely wrinkled and minutely verrucose (visible with hand lens), stipe 3-3.5 mm thick at the midpoint; East African endemic, only in coastal Kenya and Tanzania .........................***X. holtzii***]

### ***Xylopia*** sect. ***Neoxylopia*** Engler & Diels (1901).

**1. *Xylopia rubescens*** Oliv., Fl. Trop. Afr. 1: 30. 1868.

Eggeling and Dale (1951: 23); Verdcourt (1971: 76); El Amin (1990: 14); Johnson and Murray (2018: 48).

Tall tree to ca. 25 m tall. DBH up to 70 cm (Johnson and Murray 2018: 49). Mainly in riverine forest or swampy places in mixed woodland and forest (Verdcourt 1971: 76), up to ca. 800 m a.s.l. Map of distribution in North Eastern Tropical Africa in Fig. 2.

*Distribution*

Guinea, Liberia, Ivory Coast, Ghana, Nigeria, Cameroon, Central African Republic, South Sudan, Equatorial Guinea, Gabon, Republic of the Congo, Democratic Republic of the Congo, Uganda, Tanzania, Angola, Zambia, Mozambique.

**2. *Xylopia staudtii*** Engler & Diels, Notizbl. Königl. Bot. Gart. Berlin 2: 298. 1899.

Verdcourt (1971: 75); Hamilton (1981: 148); Johnson and Murray (2018: 56).

Very tall tree up to 35 (–50) m, DBH up to 80 cm (Johnson and Murray 2018: 56). In tall lowland forest up to 1350 m. Map of distribution in North Eastern Tropical Africa in Fig. 2.

*Distribution*

Sierra Leone, Liberia, Ivory Coast, Ghana, Nigeria, Cameroon, Equatorial Guinea, Gabon, Republic of the Congo, Democratic Republic of the Congo, Uganda, Angola.

### ***Xylopia*** sect. ***Xylopia***

**3. *Xylopia aethiopica*** (Dunal) A.Rich. in R.de la Sagra, Hist. Phys. Cuba, Pl. Vasc.: 53. 1841.

Verdcourt (1971: 76); Hamilton (1981: 148); El Amin (1990: 13); Darbyshire et al. (2015: 72–73); Johnson and Murray (2018: 76). *X. eminii* Engler (1895): Eggeling and Dale (1951: 22).

Tall tree, commonly 15-30 m. DBH up to ca. 60 cm (Johnson and Murray 2018: 76). In moist lowland forest, often secondary, but rarely cultivated (Johnson and Murray (2018: 76), up to ca. 1200 m a.s.l. Map of distribution in North Eastern Tropical Africa in Fig. 2.

*Distribution*

Gambia, Guinea Bissau, Guinea, Sierra Leone, Liberia, Ivory Coast, Ghana, Togo, Benin, Nigeria, Cameroon, Central African Republic, São Tomé & Principe, Equatorial Guinea, Gabon, Republic of the Congo, Democratic Republic of the Congo, Uganda, Kenya, Tanzania, Angola, Zambia, Malawi, Mozambique, Zimbabwe. Johnson and Murray (2018) also indicate record from Chad, but that is based a d'Alleizette specimen and should be deleted according to the information about these collections (a d'Alleizette specimen and should be deleted (Johnson and Murray pers. com).

***Xylopia*** sect. ***Stenoxylopia*** Engler & Diels (1901).

**4. *Xylopia nilotica*** D.M.Johnson & N.A.Murray, PhytoKeys 97: 126. 2018.

*X. parviflora* auct., non *X. parviflora* Spruce (1860: 6), nec *X. parviflora* (A.Rich.) Benth. (1862: 479), *nom. illeg.*: Eggeling and Dale (1951: 23); Verdcourt (1971: 79); Hamilton (1981: 148); El Amin (1990: 14); Friis (1992: 94); Woube (1995: 73, 76); Friis and Vollesen (1998: 66); Verdcourt (2000: 7); Senbeta et al. (2007: 34); Friis et al. (2010: 107–108, 178); Masresha et al. (2024: 6, 10, 12).

[*X. parviflora* auct., non Vallot (1882: 219), *nom. illeg.*]

*X. vallotii* auct., non *X. vallotii* Chipp ex Exell (1926: 8), *nom. nud.*, non Hutch. and Dalziel (1927a, b): Broun and Massey (1929: 50); Andrews (1950: 7).

*X. longipetala* auct., non De Wild. & T.Durand (1899: 4): Darbyshire et al. (2015: 72–73); Friis et al. (2022: 201).

Shrub or tree up to 25 m; DBH 50 cm (or more). In a range of vegetation types from open lowland forests, sometimes in Ethiopia with *Baphia abyssinica*, sometimes in South Sudan in forest patches in U-shaped valleys with *Khaya grandifoliola* and *Cola grandifolia*, in riverine forest, and in dense and open high rainfall woodlands with *Terminalia* spp. and *Anogeissus leiocarpa;* associates of *X. nilotica* listed in Johnson and Murray (2018) were *Holoptelea grandis*, *Milicia excelsa*, as well as species of *Khaya*; 420-1020 m a.s.l. Wood much used by Anuak population (Woube 1995). Map of distribution in North Eastern Tropical Africa in Fig. 2; distribution imposed on part of the vegetation map of Africa by White (1983) in Fig 3; modelled potential distribution in Fig. 4B.

*Distribution*

Uganda, South Sudan, Sudan. The records from South Sudan east of the Nile and Ethiopia represent sterile material identified on the diagnostic characters from Johnson and Murray (2018: 126).

**5. *Xylopia thomsonii*** Oliver, Fl. Trop. Afr. 1: 31. 1868.

Johnson and Murray (2018: 207).

*X.* sp. aff. *X. oxypetala* (DC ex Dunal) Engl. & Diels (1901): Broun and Massey (1929: 50).

*X. acutiflora* auct., non (Dunal). A.Rich.: Andrews (1950: 7); El Amin (1990: 13); Darbyshire et al. (2015: 72–73).

Shrub or small tree to ca 10 m, sometimes lianesque; DBH up to ca. 17.5 cm (Johnson and Murray 2018: 207). Possibly in high rainfall woodlands and certainly in damp places in lowland forests at altitudes below 1000 m a.s.l. Map of distribution in North Eastern Tropical Africa in Fig. 2.

*Distribution*

Nigeria, Cameroon, Central African Republic, South Sudan, Gabon, Republic of the Congo, Democratic Republic of the Congo, Angola.

### *Mapping and diversity of* Xylopia *species*

The mapped distributions in Fig. 2 of all species of *Xylopia* in North Eastern Tropical Africa show that the species, apart from *X. nilotica*, are restricted to Uganda and the Equatoria province of South Sudan to the west of the Nile. Species richness per quarter or one degree square has been analysed, and is found to be low. We found generally no or one species in each square, except for two species per square the areas in Equatoria province just west of the Nile. As appears from Fig. 2, most of the *Xylopia* species in North Eastern Tropical Africa occur in Uganda and along the Congo-South Sudan border west of the Nile. The fact that there are few quarter or one degree squares with more than one species can most likely be explained with the fact that North Eastern Tropical Africa is marginal in relation to the distribution of *Xylopia* in Africa, and the few quarter or one degree squares with one record, mostly *X. nilotica*, must be due to these areas having been poorly collected, as explained in the section *Xylopia in floristic and ecological literature on North Eastern Tropical Africa*.

### *Habitats*

Johnson and Murray (2018: 26, 27, Fig. 5) point out that the majority of African *Xylopia* species occupy lowland tropical wet forest below 1000 m, which is a typical habitat for Annonaceae worldwide, and that the greatest concentration of species is found in the high rainfall countries of Cameroon and Gabon. *Xylopia longipetala* and *X. rubescens* are riparian species, but the former does not occur in North Eastern Tropical Africa; *X. rubescens* appears to be a widespread and generally opportunistic wetland species, which in North Eastern

Tropical Africa is only known from the southernmost South Sudan and nearby Uganda. The distribution of *X. aethiopica*, a secondary forest species used as a spice and a medicinal plant, has likely been augmented by human activity, but is mostly collected from secondary habitats, and is known to be locally cultivated; in North Eastern Tropical Africa, it is only known from Uganda.

In Fig. 3, the distribution of *X. nilotica* is shown on a simplified presentation of the vegetation types of White (1983). All records occur in a peripheral position to the large, swampy area (the Sudd) along the Nile (the core area of the Nile Basin with White's vegetations no. 61, *Edaphic grassland in the upper Nile basin*, no. 62, *Edaphic grassland mosaic with Acacia wooded grassland*, and no. 64, *Edaphic grassland mosaic with semi-aquatic vegetation*). The habitats of *X. nilotica* are also outside the dense lowland forests of the Congo Basin. The literature and specimen records from South Sudan and Western Ethiopia are from habitats where lowland forests form a mosaic with wooded and secondary grassland, open riparian vegetation, open forest, forest-woodland mosaic, and from open woodland with *Anogseissus leiocarpa*, a dominant species in Sudanian woodland across Africa from the Atlantic Coast to Ethiopia and Eritrea (Friis et al. 2022: 216).

The vegetation types, in which *X. nilotica* has been found, are: *Mosaics of lowland forests and woodlands and secondary grasslands* (11–18; *X. nilotica* is recorded from 11a, *Mosaic of lowland rain forest and secondary grassland – Guineo-Congolian). Dense types of woodlands, including Sudanian Isoberlinia woodlands* (20–28; *X. nilotica* is recorded from 27, *Sudanian woodland with abundant Isoberlinia). Open types of woodlands, including open Sudanian and Ethiopian woodlands* (29–41; *X. nilotica* is recorded from 29a, *Undifferentiated woodland – Sudanian*, 29b, *Undifferentiated woodland – Ethiopian*, and 35b, *Transition from undifferentiated woodland to Acacia deciduous bushland and wooded grassland – Ethiopian*). *Xylopia nilotica* seems to be absent from the dense *Guineo-Congolian lowland forests* (1–10), all types of *Afromontane vegetation* (19) and *Altimontane (Afroalpine) vegetation* (65), and the lowland vegetation south and east of the Ethiopian highlands, the *Somalia-Masai Acacia-Commiphora deciduous bushlands and Sahel Acacia wooded grassland and deciduous bushland* (42–59). *Xylopia nilotica* only marginally intrudes into the *Moist edaphic grasslands of the Nile Valley* (60–64), and it completely avoids the swampy Sudd vegetation along the Nile itself. *Xylopia nilotica* is also completely absent from *Desert and halophytic vegetation* (66–76), and *Mangroves and inland lakes* (77–81).

### *Modelling of* Xylopia longipetala*,* X. nilotica*, and* X. holtzii

Because the species of *Xylopia* distinguished by Johnson and Murray (2018) as *X. longipetala*, *X. nilotica*, and *X. holtzii* were previously considered conspecific and named *X. parviflora* (e.g. by Verdcourt 1971: 79; 2000: 7), we have modelled their distribution and the potential suitability of their habitats across Africa with MaxEnt (Fig. 4A, B, & C). The scale indicating variation in suitability ranges from Dark Green (lowest suitability 0.0) to Dark Red (highest suitability 1.0).

Fig. 4A shows that the most suitable areas for *X. longipetala* is West Tropical Africa from Cameroon and the Republic of Congo and westwards. However, areas with actual records and areas with suitability up to 0.6–0.8 occur in the Central African Republic and in the northern part of the Democratic Republic of Congo.

Fig. 4B shows that the most suitable areas for *X. nilotica* is western Ethiopia, the Equatoria province of South Sudan, large parts of Uganda, and the western parts of Kenya near Lake Victoria (the species has not yet been recorded from Kenya). The records from around the Nuba Mountains in Sudan occur in small areas with a suitability above 0.8 or between 0.6 and 0.8. A possible explanation for the records in this area with relatively low suitability could be that the trees on the *jebels* around the Nuba Mountains grow under more favourable local conditions than detected by the modelling. Such ecological variation over short distances is part of the definition of the vegetation type 'hill catena', which Harrison and Jackson (1958) mapped around the Nuba Mountains and on the western slopes of the Ethiopian Highlands. That there may be more favourable ecological conditions for forest in valleys was also described by Jackson (1956: 356) from the Imatong Mountains.

Another observation possible to make on the models is that although both sides of the watershed between the Nile and the Congo River seem to have conditions highly suitable for *X. nilotica*, the actual distribution of the species seems to be restricted to north of this watershed and only to the west of the Nile-Omo watershed. We cannot suggest why watersheds seem to be distributional barriers for *X. nilotica,* unless we assume that the species is restricted to dispersal along streams, but that would not agree with the dispersal of seeds of *Xylopia* by vertebrates, which in the studied species are attracted by the brightly coloured arils or sarcotesta exposed in open fruits (Johnson and Murray 2018: 21–22). However, there is no information about which animals may disperse *X. nilotica*, which has no aril but a red to orange sarcotesta in vivo. In Fig. 2, it can be seen that – unlike for *X. nilotica* – a number of West African species of *Xylopia*

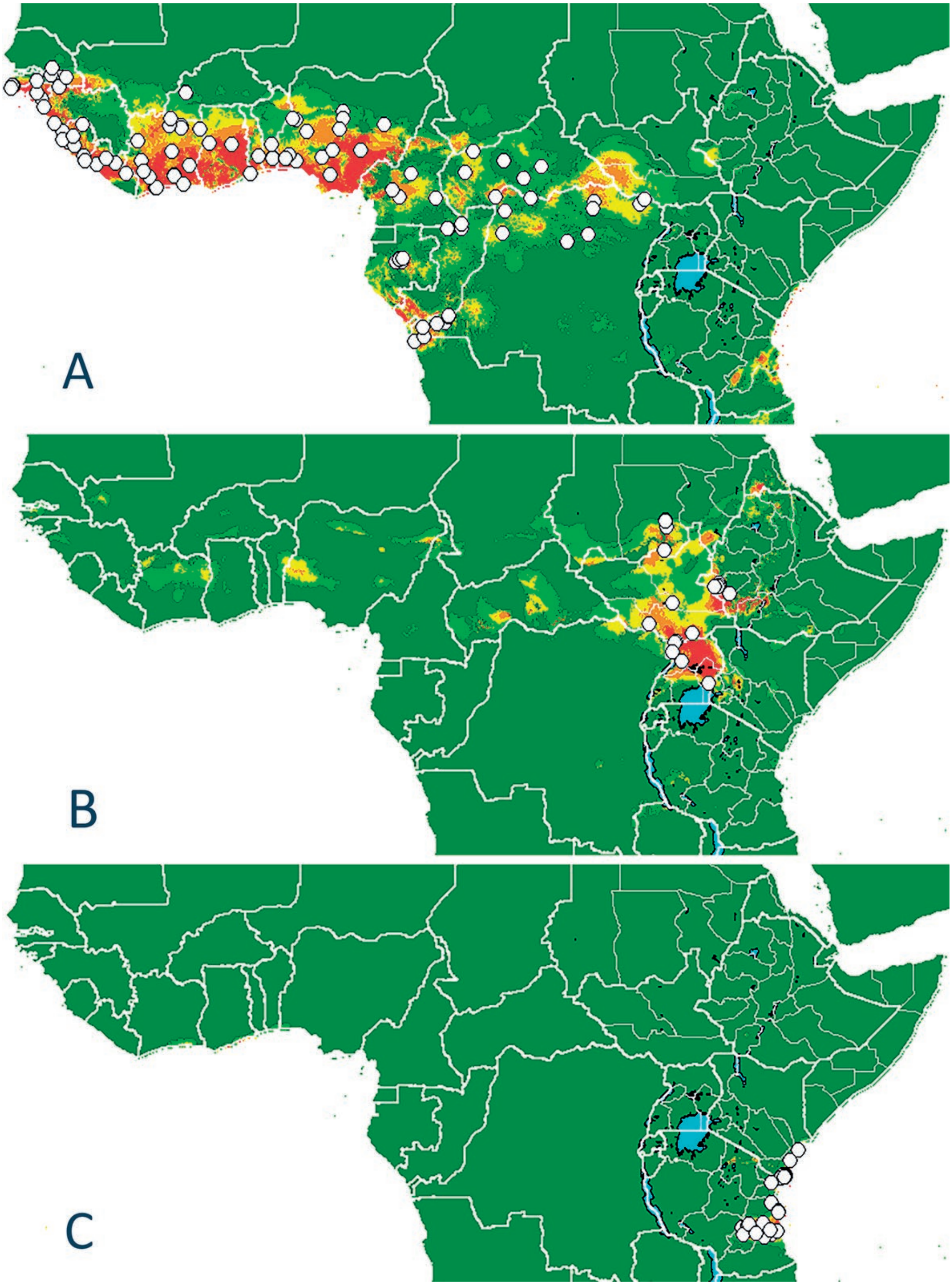

**Figure 4.** Maps of the actual (white dots) and potential distribution (shown by a gradient from dark green to dark red) of three species of *Xylopia,* previously regarded as conspecific and named *X. parviflora* (A.Rich.) Benth. (A) *X. longipetala*. (B) *X. nilotica.* (C) *X. holtzii*. The thick white lines are borders between countries, the thin white lines indicate the flora regions used in Darbyshire et al. (2015) and Verdcourt (1971; 2000). The colours in all three models indicate: Dark green: suitability 0.0–0.2. Pale green: suitability 0.2–0.4. Yellow: suitability 0.4–0.6. Orange: suitability 0.6–0.8. Dark red: suitability 0.8–1.0

cross the watershed from the Congo to the Nile Basin and penetrate a short distance into the western Equatoria region.

Fig. 4C shows that the known distribution of *X. holtzii,* the closest relative of *X. nilotica*, covers the entire area of the potential distribution of this species.

Fig. 4A, B, & C show that nowhere the known or potential distributions of *X. nilotica* and *X. holtzii* overlap, but along the Congo-Nile watershed to the west of the Nile there is a small area where the known distributions of *X. longipetala* and *X. nilotica* are very close and the potential distributions slightly overlap.

### Xylopia nilotica *and patterns of endemism in North Eastern Tropical Africa*

An interesting result of this study is the observation that *Xylopia nilotica* is a species endemic to the combined countries Ethiopia, Sudan, South Sudan, and Uganda, all with parts of the White Nile and its tributaries, and that the distribution of this endemic species overlaps the borders between three of Frank White's phytogeographical regions: III. Sudanian regional centre of endemism, XI. Guinea-Congolia/Sudania regional transition zone, and XII. Lake Victoria regional mosaic (White 1983: Fig. 4). However, *Xylopia nilotica* has its widest distribution in the Sudanian region. Without modifications of the software, the international databases (Global Biodiversity Information Facility (https://www.gbif.org/), Enumération des plantes à fleurs d'Afrique tropicale (https://africanplantdatabase.ch/, or RAINBIO https://gdauby.github.io/rainbio/download_page.html) do not allow search for species present in Ethiopia, Sudan, South Sudan, and Uganda combined, and absent in all other countries, and therefore we have not with certainty been able to identify other species with a parallel distribution and span of phytogeographical regions.

Before the recognition of *Xylopia nilotica*, Darbyshire et al. (2015: 28, Table 3.2) studied endemism in Sudan and South Sudan, listing 86 taxa believed to be endemic to Sudan and South Sudan and also species with distribution restricted to Sudan, South Sudan, and one or a few neighbouring countries. Only one taxon was listed as occurring in South Sudan and Ethiopia, and none was restricted to Sudan, South Sudan and Uganda or to Sudan, South Sudan, Uganda and Ethiopia. If this list is complete, there is no endemic with a distribution similar to that of *Xylopia nilotica*.

Generally, local endemism is low in the distribution area of *Xylopia nilotica*. Linder (2001) mapped endemism in 2½ degree grid-cells in the whole of mainland Africa and calculated weighted endemism on a scale from 1 to 10 for each cell. In North Eastern Tropical Africa, only grid cells in the highlands of Ethiopia, along the border between Ethiopia and Somalia, and next to the Albertine Rift scored a weighted endemism of 2 or more, the remaining cells scored only 1, while zero weighted endemism was scored for most of the Sudan and the northern and central part of South Sudan. Demissew et al. (2021), studying endemism in Ethiopia based on the floristic units used in the Flora of Ethiopia and Eritrea, found the highest endemism in the Ethiopian highlands and in the eastern lowland near Somalia; there was very low endemism in the western lowlands near Sudan and South Sudan.

*Xylopia nilotica* as endemic to the combined countries Ethiopia, Sudan, South Sudan, and Uganda is therefore, as far as we can see, unique, in being a relatively widespread endemic in an area where local endemics are few and near-endemics spanning two or more countries are rare.

### *Conservation status of* Xylopia nilotica

Johnson and Murray (2018: 30) point out that while some African species of *Xylopia* are widespread, over half of the species on the continent have limited distributions and are vulnerable or potentially threatened. However, their analyses for the 24 least widely distributed species do not include X. *nilotica*. A later assessment of that species is presented by Cosiaux et al. (2019), based on the records from Uganda, South Sudan, and Sudan west of the Nile, and assuming an altitudinal range of 760–1220 m a.s.l. They published an extent of occurrence (EOO) of 246,813 km², an area of occupancy (AOO) of only 32 km², and an assessment of threat as Vulnerable B2ab(iii,iv). Category B2 was estimated due to the limited Area of Occupancy, (a) due to the area being *Severely fragmented*, and (b) due to (iii) *Continuing decline observed, estimated, inferred, or projected … in area, extent and/or quality of habitat,* and (iv) *number of locations or subpopulations low*. They state that in Uganda, the species is threatened by habitat loss due to forest clearance for farming (Nakakaawa et al. 2011).

Woube (1995) provided the most detailed statements about threats to the populations of *X. nilotica* in Ethiopia. The wood is much used by the Anuak for making dug-out canoes, mortars and other tools; the tree must be 10–15 years before it can be used, but, as stated by Woube, the demand is high, so there are few mature trees left in either the resettlement areas or in the mechanized farm sites. The resettlements expanded quickly during 1975–1984, when 80,000 drought-stricken farmers from the highlands were moved to the lowlands. Many new resettlements were planned in 1984–1986, after which the numbers declined. However, after the resettlements, the threat to the natural vegetation increased when big, mechanized farming-schemes were initiated. In the 1980s, the large-scale farming started with state farms mechanized for mass production of oil seeds, cotton, sugar cane and other tropical agricultural products, and, after the failure of the Ethiopian state farms in the late 1980s, foreign investment in big agricultural schemes has continued. Due to civil unrest in South Sudan, the lowlands south of Gambela received large numbers of refugees settled in vast refugee camps. For a review of threats to the western lowland vegetation of Ethiopia, see Friis et al. (2022: 53).

*Xylopia nilotica* is recorded from some protected areas. Cosiaux et al. (2019) mention two in Uganda: the Murchison Falls National Park and the Ajai Wildlife Reserve. In South Sudan, the species is reported from the Kinyeti Valley just outside the Imatong Forest Reserve. In Ethiopia, *X. nilotica* is reported from the Gambela National Park, but the park has been severely encroached by settlements and big-scale farming. In the Sheko National Forest Priority Area, where the species is infrequent, nothing is known about threats, except from expansion of coffee-growing areas.

Our analysis of all the now known records of *X. nilotica* with Google Earth resulted in an extended altitudinal range of 420–1250 m a.s.l. Analysis of our distributional data with GeoCAT (https://geocat.iucnredlist.org/) resulted in a larger extent of occurrence (EOO) than that of Cosiaux et al. (2019), now ca. 490,000 km$^2$. According to GeoCAT, this suggested a category of threat of Least Concern (LC). In spite of the distribution being extended to Ethiopia and South Sudan East of the Nile, the estimated area of occupancy (AOO) was only slightly larger than that indicated by Cosiaux et al. (2019), ca. 52 km$^2$ with a cell-size of 2x2 km. According to GeoCAT, this suggests a category of threat of Endangered (EN). However, the threats to *X. nilotica* under category B remain the same as for the estimate of Cosiaux et al. (2019), and it is not possible to state that *X. nilotica* meets any of the criteria A and C to E for the category Endangered (EN). Therefore, although the Imatong and Ethiopian locations were previously not considered, we think it reasonable to retain the category Vulnerable (VU). In making this assessment, we also consider that we in this work consider *X. nilotica* to be undercollected, and that it should be noted that, apart from Ethiopia, there are no recent or relatively recent collections, and that many colections (all Ethiopian) are sterile.

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## APPENDIX

### *Specimens observed from North Eastern Tropical Africa*

***Xylopia rubescens*** Oliv., Fl. Trop. Afr. 1: 30. 1868.

**UGANDA.** Amua River, West Madi, May 1948 (fl), *Eggeling* E.5775 (K - 3.6167° N, 31.8167° E). **SOUTH SUDAN.** Equatoria, Yei, Libogo, Khor Ini, 19 Nov 1940 (st), *Myers* 13586 (K – 3.8267° N, 30.6027° E); Libogo, Yei, 27 Nov 1940 (fr), *Myers* 13598 (K – 3.8267° N, 30.6027° E).

***Xylopia staudtii*** Engler & Diels, Notizbl. Königl. Bot. Gart. Berlin 2: 298. 1899.

**UGANDA.** Impenetrable Forest, Kigezi, Apr 1946 (fl), *Butt* 45 (ENT, not seen, photo at K - 1.0833° S, 29.5833° E); [U2], Rukungiri District, Kayonza, Bwindi forest, Ishasha Gorge, 0°53'–1°08'S, 30°25'–30°35'E, 1350 m, Apr 1998 (fl), *Hafashimana* 0504 (K – 1.0333° S, 30.5000° E).

***Xylopia aethiopica*** (Dunal) A.Rich. in R.de la Sagra, Hist. Phys. Cuba, Pl. Vasc.: 53. 1841.

**UGANDA**. Entebbe District, 3900 ft., 1904, *Dawe* 118 (K); Bujeje District, 3600 ft, 1905 (fl, fr), *Dawe* 229 (K); Masaka District, NW side of Lake Nabugabo, 1140 m, 9 Oct 1953 (fl, fr), *Drummond & Hemsley* 4714 (B, EA, FI-T, K—2 sheets); Namanve, Mengo, 3700 ft., Jan 1935 (fr), *Eggeling* 1524 (BR, K—indicates *Eggeling* 1583 to be a wood collection of this number, but duplicates at EA and NY bear only the number 1583); without definite locality, 1922 (fr), *Maitland* s.n. (K).

***Xylopia nilotica*** D.M.Johnson & N.A.Murray, PhytoKeys 97: 126. 2018.

**UGANDA**. Northern Region, Leya and Aiyu river junction, W. Madi, 25 Mar 1945 (fl, fr), *Greenway & Eggeling* 7251 (holotype: EA; isotypes: K, PRE - 3.563575° N, 31.419057° E); West Nile, Koich River, Rumogi, Mar 1935 (fl), *Eggeling* 1650 (K - 3.502779° N, 31.346995° E); Madi, 830 m, Feb 1961 (fl), *Philip* 931 (EA, K - 2.861307° N, 31.220318° E); Murchison Falls National Park, Rabongo Forest, 02°06' N, 31°52' E, 1020 m, 1 May 1993 (fl, fr), *Sheil* 1443 (K - 2.1000° N,31.8667° E); Busoga District, Igwe mutalla, 10 mi S of Bugiri, 1260 m, 20 May 1951 (fl), *Wood* 610 (EA, K—2 sheets - 0.5126°N, 33.8177°E). **SOUTH SUDAN**. [Bahr el Ghazal, on label:] Equatoria [in fact Bar el Ghazal], Tior, Aliab country, small tree frequent in *Anogeissus* woodland, vernacular name "Bo" (Aliab Dinka), 13 Nov 1938 (st), *Myers* 10102 (K – 6.3775° N, 31.1782° E); West Equatoria, "Large tree of Azza Forest," 28 Apr 1933 (fr), *Smith* 39 (K - 4.8918° N, 29.4609° E); East Equatoria, Torit Dist., Imeila Forest, 4° 10' N, 32° 40' E, 750 m, forest with *Khaya grandifoliola* and *Cola grandifolia*, tree to 80 ft and 24 inch DBH with straight bole and small, round buttresses to 7 ft, 27 May 1949 (st), *Jackson* 763 (FHO, KHF - 4.16667° N, 32.66667° E). **SUDAN**. South Kordofan, Jebel Eliri, 13 Jan 1908 (st), *Broun & Broun* 1373 (K - 10.2834° N, 30.5667° E); Gebel Amira, Nuba Mts., 16 Apr 1930 (buds), *Simpson* 7778 (K—2 sheets - 12.2500°

N, 30.73334° E); Jebel El Dair, vernacular name Dooru (?, many languages around Jebel Dair), Mar 1936 (st), *Longe* 40 (K - 12.4667° N, 30.7167° E); Eastern Kordofan Province, Jebel Dair, 4000 ft, 17 Jul 1937 (fl), *Turner* 241 (K - 12.4667 N, 30.7167 E). **ETHIOPIA**. Tree 5 cm DBH, Height 4 m, Abobo to Gog, 34° 25' E, 7° 40' N, 1600 ft., vernacular name *Orwyee* (Anuak), Feb 1976 (st), *Chaffey & Thomerson* 658 (K - 7.5794° N, 34.5018° E); Illubabor, c. 7 km S of Abobo, 650 m., woodland, tree to 10 m (st), 21 Apr 1982 (st), *Friis & al.* 2485 (C [Fig. 1], ETH, K - 7.8672° N, 34.6022° E); Gambela, Ukuna kijan, evergreen thicket and forest, swampy area along stream, 420 m, tree, DBH ca. 50 cm, 27 Dec 1990 (st), *Woube* 15 (ETH - 7.8975° N, 34.6590° E); Abobo-Gog Forest, Dumbong, 82 km S of Gambela towards Gog, 7° 44.261' N, 34° 39.420' E, 580 m, common in lowland semi-deciduous forest dominated with *Baphia abyssinica*, vernacular name *Orway* (Anuak), tree to 6 m, DBH 3 cm, 14 Oct 2000 (st), *Simon, Getachew & Hagere* 1002 (ETH - 7.7378° N, 34.6569° E). Records from forest surveys without preserved specimens (Getinet et al. 2024 – central part of study area: 7.6500 N, 34.2375 E; Feyera et al. 2007 – central part of western lowland part of the Sheko forest: 7.1256 N, 35.3958 E) have been mapped.

***Xylopia thomsonii*** Oliver, Fl. Trop. Afr. 1: 31. 1868.

**SOUTH SUDAN.** SW Equatorial Province, Aloma Plateau, ca. 1 mile SSW of Iwatoka, 23 Mar 1939 (fl), *Hoyle 823* (BM, K – 3.8356° N, 30.6120° E); Korobe Forest, Yei District, Equatoria, 2 Jul 1958 (st), *Jackson* 3894 (K – 4.0298° N, 30.9228° E); Nabambisso, 19 Feb 1870 (bud, fr), *Schweinfurth* 3032 (K – 4.7500° N, 28.4833° E); Lado, Yei River, Asugi, 23 Oct 1919, *Sillitoe* 353 (K – 4.1617° N, 30.6120° E); Lado, Yei River, 10 Nov 1919 (fl), *Sillitoe* 479 (K – 4.1617° N, 30.6120° E).

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# Schismatoglottideae (Araceae) of Borneo LXXVII — Circumscribing *Schismatoglottis sensu stricto*, and seven new genera

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**Abstract.** Based on published molecular analyses combined with morphological data, the genus *Schismatoglottis* is restricted to species with hapaxanthic shoots and a caducous spathe limb shed almost always in a single piece. Thus defined, *Schismatoglottis* comprises sixty-nine accepted species, twenty-four provisionally accepted names, and three species of doubtful affinity [*Schismatoglottis conoidea*, *S. convolvula*, and *S. priapica*] that are retained provisionally in *Schismatoglottis* pending further study. Eighty-five species hitherto assigned to *Schismatoglottis* with pleionanthic shoots and spathe limbs variously senescing are transferred into seven new genera: *Aia* (monotypic), *Ayuantha* (four species), *Bau* (26 species), *Borneoa* (22 species), *Ibania* (12 species), *Sarawakia* (five species), and *Tweeddalea* (15 species). All genera are illustrated, together with representative species of *Schismatoglottis* s.s., and a species-finder list provided as an Appendix. The changes presented here take the vascular plant Bornean flora to 1601 native genera.

**Keywords:** Araceae, Schismatoglottideae, monophyly, new genera.

## INTRODUCTION

The taxonomy of *Schismatoglottis* Zoll. & Moritzi has been the focus of much additional work since the publication of what was in all but name a monograph (Hay and Yuzammi 2000). Outputs include the recognition of an additional seventy-seven new species, the majority Bornean, and, beginning with Boyce and Wong (2008) and Wong et al. (2010), with supporting evidence in Low et al. (2014), and Low et al. (2018), compelling evidence that *Schismatoglottis sensu* Hay & Yuzammi is polyphyletic. Combined molecular and morphological evidence supported the first splits from *Schismatoglottis* including the new genus *Schottarum* P.C.Boyce & S.Y.Wong (Boyce and Wong 2008), resurrection of the neotropical genus *Philonotion* Schott (Wong et al. 2010), resurrection of *Apoballis* Schott (Boyce and Wong 2010), and establishment of *Hestia* S.Y.Wong & P.C.Boyce [later for nomenclatural reasons renamed *Vesta* S.Y.Wong & P.C.Boyce (Low et al. 2018)] for *Schismatoglottis longifolia* Ridl. (Boyce and Wong 2010). Subsequent molecular analyses of the Schismatoglottideae (Low et al. 2018) recovered a clade of *Schismatoglottis* with hapaxanthic stems (Hay 1996) centred on the generic type, *Schismatoglottis calyptrata* (Roxb.) Zoll & Moritzi, that we subsequently referred to as 'Core *Schismatoglottis*'. Although we were confident at that time to erect new genera from the mass of species assigned to *Aridarum* Ridl. and *Piptospatha* N.E.Br., we were, with the exception of describing the massive pachycaul *Schismatoglottis corneri* A.Hay as a monotypic new genus, *Nabalu* S.Y.Wong & P.C.Boyce, and resurrecting Schott's *Colobogynium,* owing to the grade-nature of some of the retrieved clusters, reluctant of making further splits, even though intuitively further division of *Schismatoglottis* was indicated. Subsequently, a much larger gene sampling albeit of a limited taxon sampling (Haigh et al. 2022) provided broad support for the Low et al. (2018) topology of Schismatoglottideae giving us confidence to complete the dismemberment of *Schismatoglottis* that we began in 2018.

## *SCHISMATOGLOTTIS SENSU STRICTO*

The genus *Schismatoglottis* is here defined by hypogeal (mostly), hapaxanthic (all), shoots, a colonial habit (most), and a caducous spathe limb falling while fresh as a single piece (Figs. 1, 2). Further typical, but neither unique nor universal, characteristics of this newly defined *Schismatoglottis* are an hourglass-shaped spadix, a clavate spadix appendix composed of well-defined staminodes (a notable exception is *S. wallichii* (Fig. 3)), infructescences pendulous post-antheses, and cordato-sagittate leaf blades. Seventy-two species are assigned to *Schismatoglottis*, with a further twenty-four names (all allied to *S. calyptrata s.s.*, and almost all Papuasian) provisionally accepted pending further field studies.

*Schismatoglottis* is widespread, occurring from SW Myanmar throughout continental tropical and subtropical Asia into SW China, including Hainan and southern Taiwan (Lanyu Do), and the Malay Peninsula, including Singapore, throughout the entire Indonesian Archipelago, with centres of diversity on, e.g., Sumatera, Borneo, the Philippines, and thence throughout New Guinea and the Bismarck Archipelago and extending to the Solomon Islands. Despite the proximity of New Guinea to northern Australia *Schismatoglottis* has yet to be found in Australia [c.f. *Alocasia*, (Hay and Wise 1991)].

The main purpose of this paper is establishment of new nomenclature, ahead of preparation for a forthcoming generic monograph of the Araceae (Hay, in prep.) wherein a key to the genera including these new ones will appear.

## THE NEW GENERA

With *Schismatoglottis* thus demarcated, eight-five species with pleionanthic shoots hitherto assigned to *Schismatoglottis* but falling into separate clades/grades in Low et al. (2018) are transferred to seven new genera: *Aia* (monotypic), *Ayuantha* (four species), *Bau* (27 species, corresponding to part of the informal Asperata Group of Hay and Yuzammi (2000)), *Borneoa* (20 species, corresponding to the core species the informal Asperata Group of Hay and Yuzammi (2000)), *Ibania* (12 species), *Sarawakia* (five species), and *Tweeddalea* (16 species, corresponding to the informal Multiflora Group of Hay and Yuzammi (2000)) based on molecular analyses (Low et al. 2018: Figs. 1, 2) and well-defined morphological characteristics.

We are fully aware that the dismantling of *Schismatoglottis* and erecting of yet more genera proposed here will likely be met with scepticism from certain quarters. Our approach to the taxonomy of the tribe was explained in Low et al. (2018: 10) and readers are directed there.

The geology of Borneo is specified based on Hutchison (1989, 2005) and Tate (2001).

The changes presented here take the *Flora of Borneo: The vascular plant genera* (Wong 2023), to 1601 native genera.

### *AIA*

***Aia*** S.Y.Wong & P.C.Boyce, **gen. nov.**

Type species: *Aia tseui* (S.Y.Wong & P.C.Boyce) S.Y.Wong & P.C.Boyce, **comb. nov.**

Bas.: *Schismatoglottis tseui* S.Y.Wong & P.C.Boyce, Aroideana 37E(2): 22, fig. 2 (2014)]. Figure 4.

*Diagnosis*

*Aia* is unique in the tribe Schismatoglottideae by the branched interstice staminodes. The persistent ligular portion of the petiolar sheath and leaf blades with pellucid interprimary veins are reminiscent of some species of

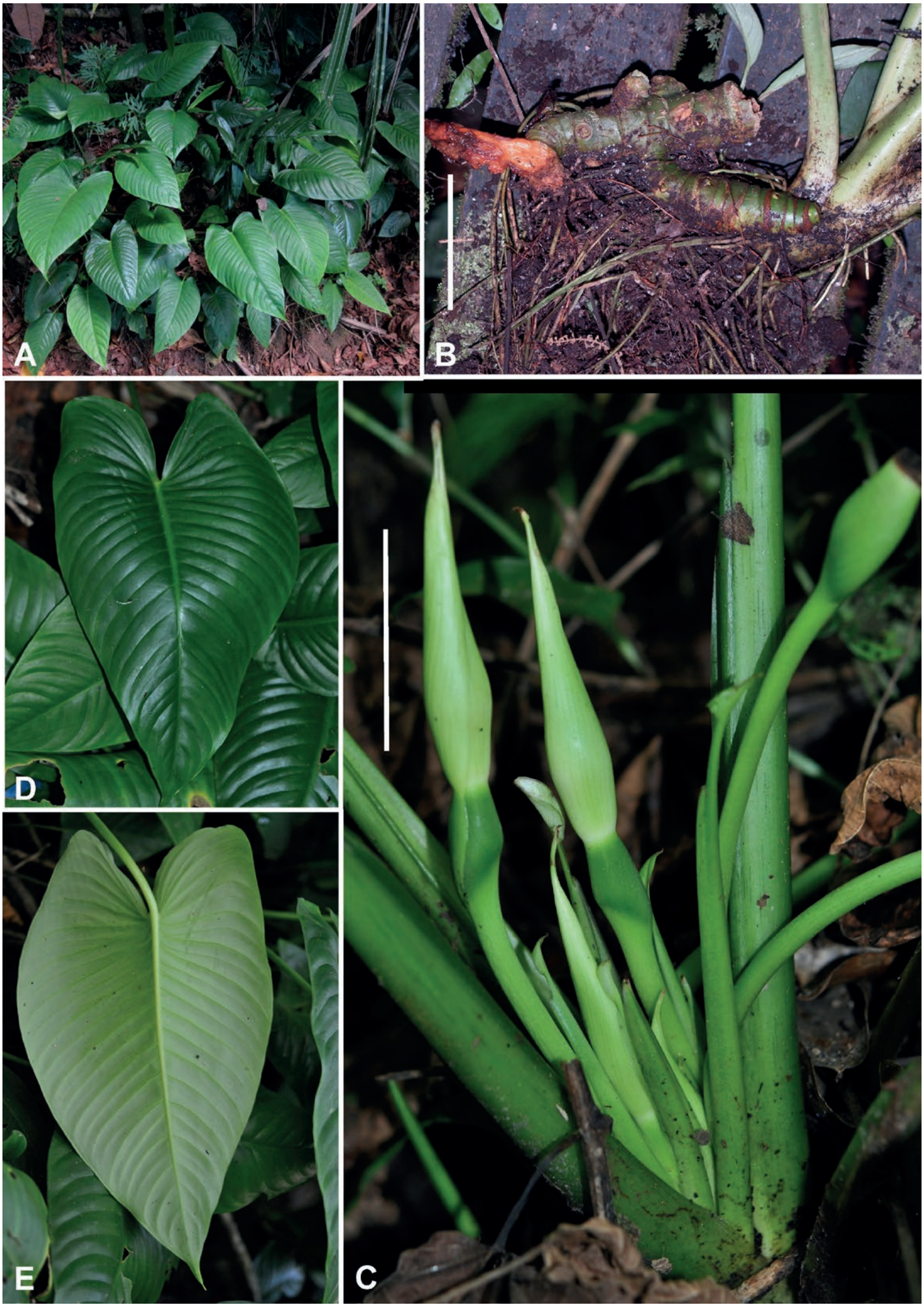

**Figure 1.** *Schismatoglottis calyptrata*. A. Plants in habitat, Ambon. B. Excavated stems showing hapaxanthic modules. C. Detail of flowering plant with two blooms close to anthesis and a developing infructescence. D. Leaf blade adaxial surface. E. Leaf blade abaxial surface. Scale bars: B = 10 cm; C = 5 cm. Photos: Hoe Yin Chen.

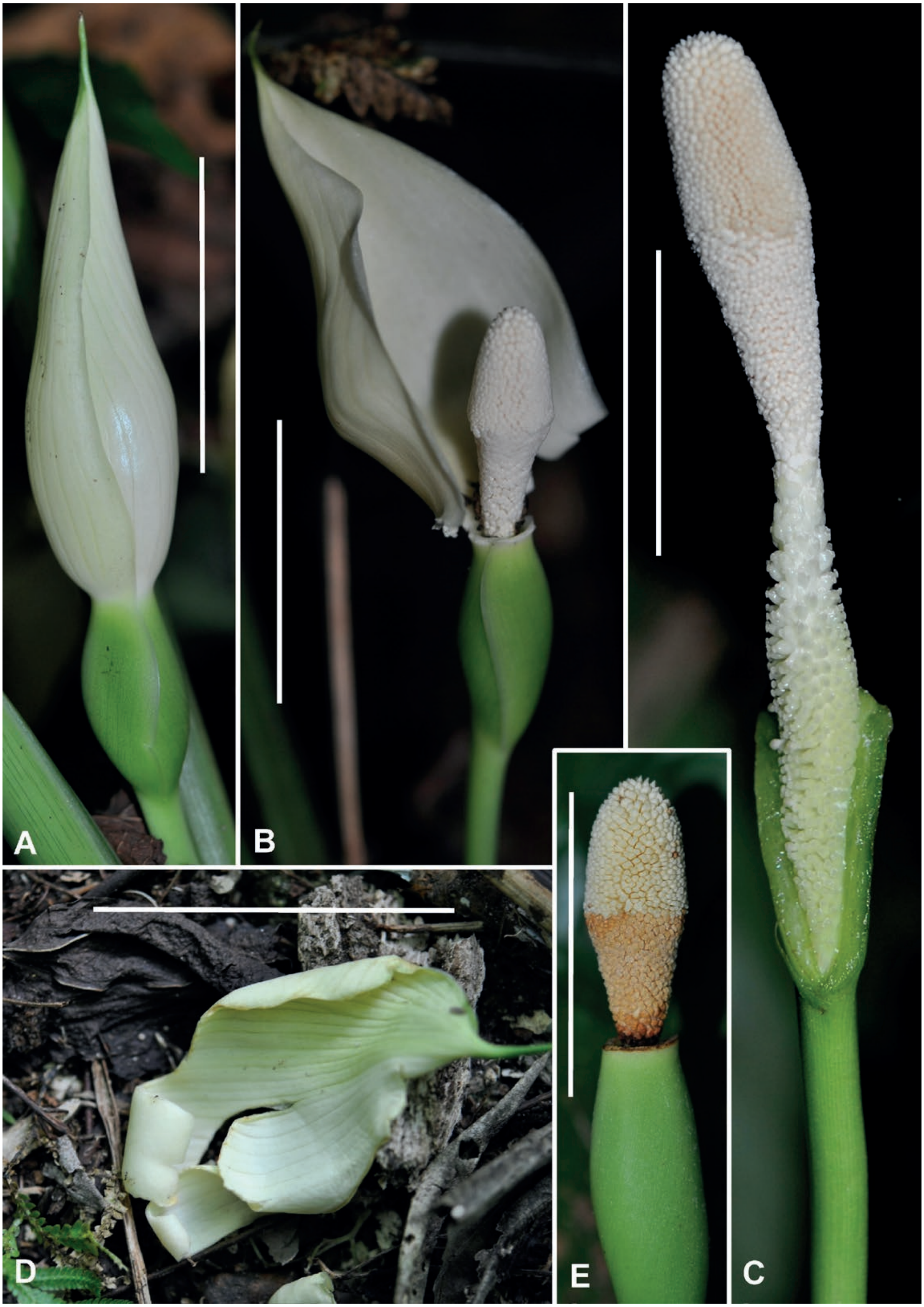

**Figure 2.** *Schismatoglottis calyptrata*. A. Bloom at onset of pistillate anthesis. B. Bloom at end of pistillate anthesis, spathe limb almost shed. C. Spadix at pistillate anthesis, spathe artificially removed. D. Fallen spathe limb. E. Bloom post-anthesis. Note that spathe limb is lost, leaving a dark scar, and that the post-anthesis staminate florets (in light brown) are now well-differentiated from the spadix appendix (cream). Scale bars: A–C = 5 cm; C = 10 cm. Photos: Hoe Yin Chen.

**Figure 3.** *Schismatoglottis wallichii*. A. Plant in habitat. B. Bloom at pistillate anthesis. C. Bloom at onset of staminate anthesis, spathe limb beginning to shed. D. Bloom at late staminate anthesis, spathe limb splitting into numerous circumferential pieces. E. Spadix at pistillate anthesis, spathe artificially removed. F. Pistillate zone. G & H. Staminate flower fertile to tip or (G) with a few terminal staminodes. Scale bars: A = 5 cm; C & D = 3 cm; E = 2 cm; F–G = 2 cm. Photos: P.C.Boyce.

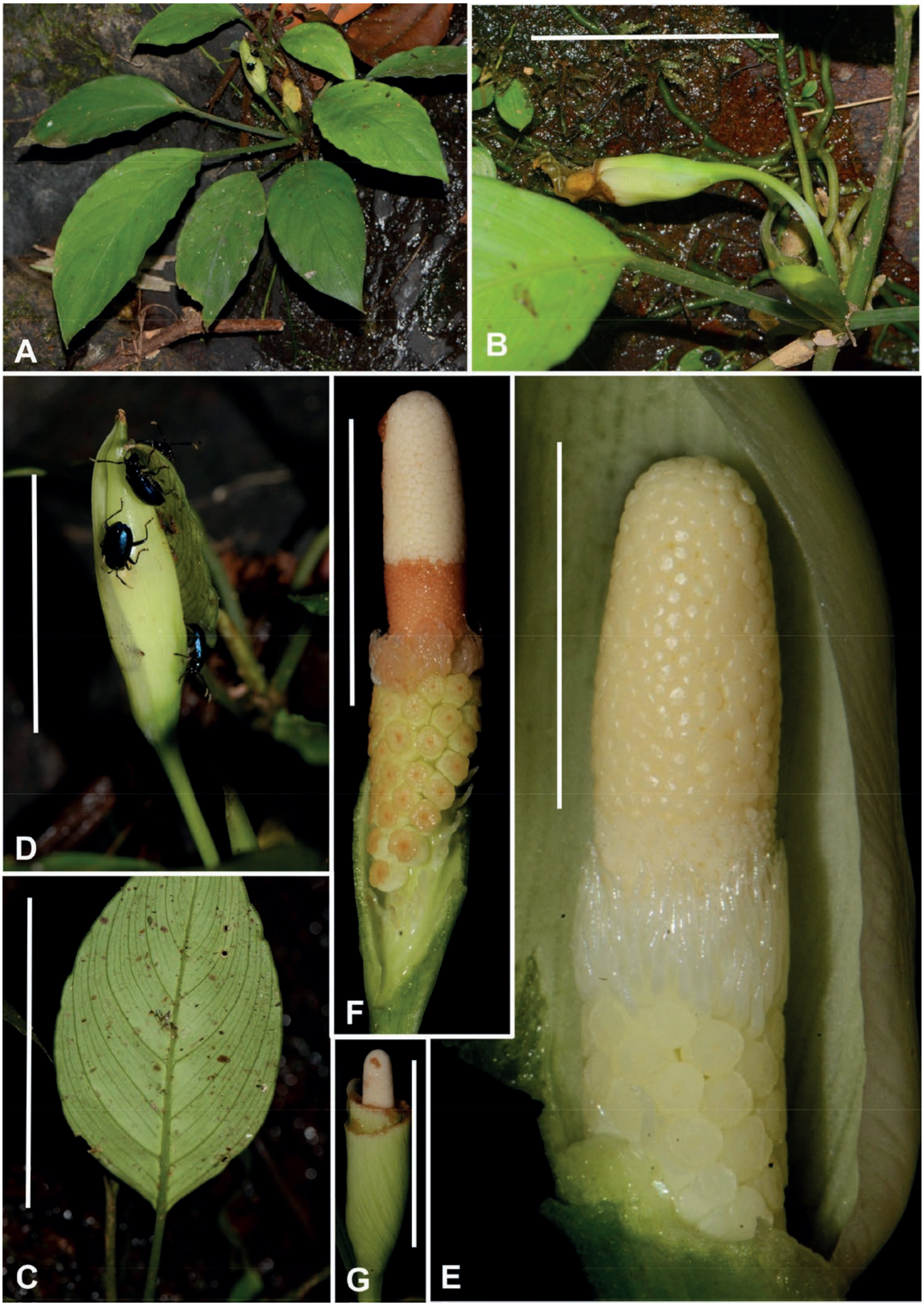

**Figure 4.** *Aia tseui*. A. Flowering plant in habitat, Type locality. B. Developing infructescence. Note the declinate peduncle. **C.** Leaf blade, abaxial view. D. Bloom at pistillate anthesis, with chrysomelid beetles and *Colocasiomyia* (Diptera) in attendance. E. Bloom at pistillate anthesis, spathe limb artificially opened. F. Bloom at end of staminate anthesis, spathe artificially removed. G. Developing infructescence. Scale bar = 1.5 cm. Photos: P.C.Boyce.

*Borneoa*, from which *Aia* differs by the branched interstice staminodes, and pendent (vs erect) infructescences.

### *Description*

Tufted small rheophytic herbs. Stem pleionanthic, creeping with the active shoot erect, internodes congested, rooting along their length in mud. Leaves several together; petiole approximately equalling to slightly shorter than blade, long, sub-terete, dorsally very slightly flattened with angles very weakly alate, sheathing only at extreme base, wings extended into a triangular ligular persistent portion; blade broadly elliptic to broadly lanceolate, thinly coriaceous, adaxially semi-glossy medium green, abaxially paler matte olive-green, base broadly cuneate to rounded, apex bluntly acute and apiculate; midrib adaxially very slightly raised, abaxially slightly prominent; primary lateral veins ca. 6 on each side, conspicuously darker than surrounding tissue; interprimary veins much finer than primaries although still conspicuous, pellucid; secondary venation adaxially more or less obscure, abaxially very fine and comprised of somewhat dense pellucid veins; tertiary venation abaxially forming an obscure sub-tessellate reticulum. Blooms ca. 3 in a simple synflorescence subtended by one or two lanceolate fleshy cataphylls resembling the ligules, producing a weak esteric odour at pistillate anthesis; peduncle cylindric. Spathe erect at pistillate anthesis, lower spathe almost imperceptibly narrower than the spathe limb, without an obvious constriction at the junction of the spathe limb with the lower spathe; lower spathe narrowly asymmetric funnel-form, glossy white-yellowish green, persistent; spathe limb pale yellow-green with darker veining at pistillate anthesis, becoming glossy-white with faint darker longitudinal veins during staminate anthesis, broadly lanceolate, briefly rostrate, inflating at pistillate anthesis and opening via a narrow slit, hardly opening further during staminate anthesis and the degrading and semi-deliquescent. Spadix shorter than spathe, subcylindric; pistillate zone inserted obliquely on spathe, cylindric; pistillate florets comparatively large, rather lax, stoutly flask-shaped with a slight constriction below the stigma; stigma sessile, discoid, wider than the top of the pistil, papillose; placentation basal; ovules several on a long funicle; interpistillar staminodes forming a sparse row at the junction with the peduncle, ascending-aristate, shorter the pistils, translucent very pale green; sterile interstice well-defined, with a single row of branched staminodes; interstice staminodes individually branched, comprising a thick base each with 2–5 aristate-vermiform ‘arms’; staminate zone cylindric; individual florets tiny and difficult to individuate, consisting of two anthers each with two thecae, thecae sub-globose each with a single comparatively large terminal pore; appendix weakly conic-cylindric, blunt, proximally very slightly wider than the top of the staminate zone, tapering distally and narrowly obtuse, creamy white; appendix staminodes sub-columnar-globose, much resembling stamens in shape but larger. Fruiting spathe pendulous by deflexing of the peduncle post-anthesis, narrowly cylindrical, with a conspicuous scar at the orifice. Fruits & seeds not seen.

### *Etymology*

Named for the Batang Ai drainages to which the only described species is confined.

### *Distribution*

Endemic to Sarawak (but see Notes) along the Batang Ai drainages, Lubok Antu, Sri Aman Division.

### *Ecology*

Rheophytic on shaded thinly mud-covered permanently wet shale waterfalls and rocks of forest streams in lowland moist forest.

### *Notes*

One species, with images of a second species purportedly from Kalimantan Barat circulating on social media.

1. ***Aia tseui*** (S.Y.Wong & P.C.Boyce) S.Y.Wong & P.C.Boyce Bas.: *Schismatoglottis tseui* S.Y.Wong & P.C.Boyce, Aroideana 37E(2): 22, fig. 2 (2014).

## ***AYUANTHA***

***Ayuantha*** S.Y.Wong & P.C.Boyce, **gen. nov.**

Type species: *Ayuantha petri* (A.Hay) S.Y.Wong & P.C.Boyce, **comb. nov.**

Bas.: *Schismatoglottis petri* A.Hay, Telopea 9: 162, fig. 19 (2000). Figure 5.

### *Diagnosis*

*Ayuantha* is defined by the petiole sheathing only at extreme base, with the sheath reduced to conspicuous thickened collar, and shoot modules comprised of a few foliage leaves alternating with stout but soon-marcescent prophylls. Superficially similar in overall appearance to *Colobogynium*, *Ayuantha* is differentiated by oligophyllous (vs monophyllous) modules, and the persistent spathe splitting basipetally (vs circumscissile at the junc-

**Figure 5.** *Ayuantha petri*. A. Plants in habitat. B. Leaf blade adaxial view, C. Bloom prior to anthesis. D. Bloom at pistillate anthesis, nearside spathe artificially removed. E. Spathe limb deliquescent post anthesis. Scale bar = 3 cm. Photos: P.C.Boyce.

tion with the peduncle and thence splitting acropetally) at fruit maturity.

*Description*

Epilithic herbs. Stems pleionanthic, internodes often elongated, ascending for some distance, leafy portions rooting through and among the leaf bases on the substrate, rooted stems long-persistent even when leafless and occasionally reiterating from lower dormant buds. Leaves few together, alternating with tapering lanceolate dark brown cataphylls; petiole sheathing only at extreme base with the sheath reduced to a conspicuous thickened collar; blade somewhat coriaceous, elliptic, often somewhat falcate, base narrowly to broadly rounded, tip rather abruptly acuminate, midrib adaxially impressed, abaxially prominent; primary lateral veins adaxially rather obscure, distinct abaxially, not prominent; secondary venation adaxially obscure, abaxially very faint, arising from the midrib. Blooms 2 together, subtended by lanceolate cataphylls; peduncle short, mostly obscured by cataphylls. Lower spathe squat subcylindric, oblique-based, differentiated from the limb by a slight constriction; limb marcescent, somewhat cucullate, apically mucronate. Spadix sessile, pistillate zone obliquely inserted but not adnate to the spathe; pistils ovoid, crowded; stigma sessile, discoid and centrally raised, narrower than the ovary; interpistillar staminodes absent; sterile interstice with a few whorls of sterile stamens expanding laterally during staminate anthesis; staminate zone partly within the lower spathe chamber, somewhat attenuate; stamens crowded; anther sessile, with the narrowly pyramidal connective extended above the thecae, apically flat-topped, polygonal; appendix clavate-cylindric, about twice as thick as the male zone, composed of columnar flat-topped, irregularly polygonal, occasionally united, staminodes. Infructescence with the spathe limb crumbling or marcescent, and the distal parts of the spadix persistent. Fruits oblong polygonal laterally compressed by lateral congestion, truncate-topped; seeds few per berry, stoutly ellipsoid with a short terminal waxy caruncle.

*Etymology*

From the Indonesian adjective *ayu*, meaning beautiful or pretty, in allusion to some forms of the four species being highly ornamental, most notably the three-colour variegated plants of *Ayuantha pudenda*, and Greek *anthos*, a flower.

*Distribution*

North Borneo, with two centres of distribution, *A. evelyniae* and *A. pudenda* in the SW and *A. petri* and *A. platystigma* in the C & NE.

*Ecology*

Lowland to hill-forest forested vertical wet shady rocky or mud banks; *Ayuantha evelyniae* is restricted to wet Karst. Field observations of *A. pudenda* indicate fruit/seed dispersal by ants, with the ants feeding on the waxy caruncle.

*Notes*

Four species, with images circulating on social media of an undescribed fifth species unique by peltate leaf blades,

1. ***Ayuantha evelyniae*** (P.C.Boyce & S.Y.Wong) S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis evelyniae* P.C.Boyce & S.Y.Wong, Aroideana 36E(1): 6, figs 1–16 (2013).
2. ***Ayuantha petri*** (A.Hay) S.Y.Wong & P.C.Boyce
   *Schismatoglottis petri* A.Hay, Telopea 9: 162, fig. 19 (2000).
3. ***Ayuantha platystigma*** (M.Hotta) S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis platystigma* M.Hotta, Mem. Coll. Sci. Kyoto Imp. Univ., Ser. B, Biol. 32(3): 229, fig. 3A–H (1966).
4. ***Ayuantha pudenda*** (A.Hay), S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis pudenda* A.Hay, Telopea 9: 98 (2000).
   (=) *Schismatoglottis jepomii* P.C.Boyce & S.Y.Wong, Gard. Bull. Singapore 58: 11 (2006).

## *BAU*

*Bau* S.Y.Wong & P.C.Boyce, **gen. nov.**

Type species: *Bau nervosa* (Ridl.) S.Y.Wong & P.C.Boyce, **comb. nov.**

Bas.: *Schismatoglottis nervosa* Ridl., J. Straits Branch Roy. Asiat. Soc. 49: 50 (1908). Figure 6.

*Diagnosis*

*Bau* comprises small to medium-sized compact to sprawling mesophytes with aromatic (resin, probably terpenoids), vegetative tissues, polyphyllous modules, leaf blades with conspicuously tessellate secondary venation (often visible fresh, always visible in dry specimens), petioles commonly longitudinally ribbed and/or scabrid, and erect blooms in which the lower persistent part has pronouncedly thickened walls, and with the spathe limb either wide-spreading, and darkening and deliquesc-

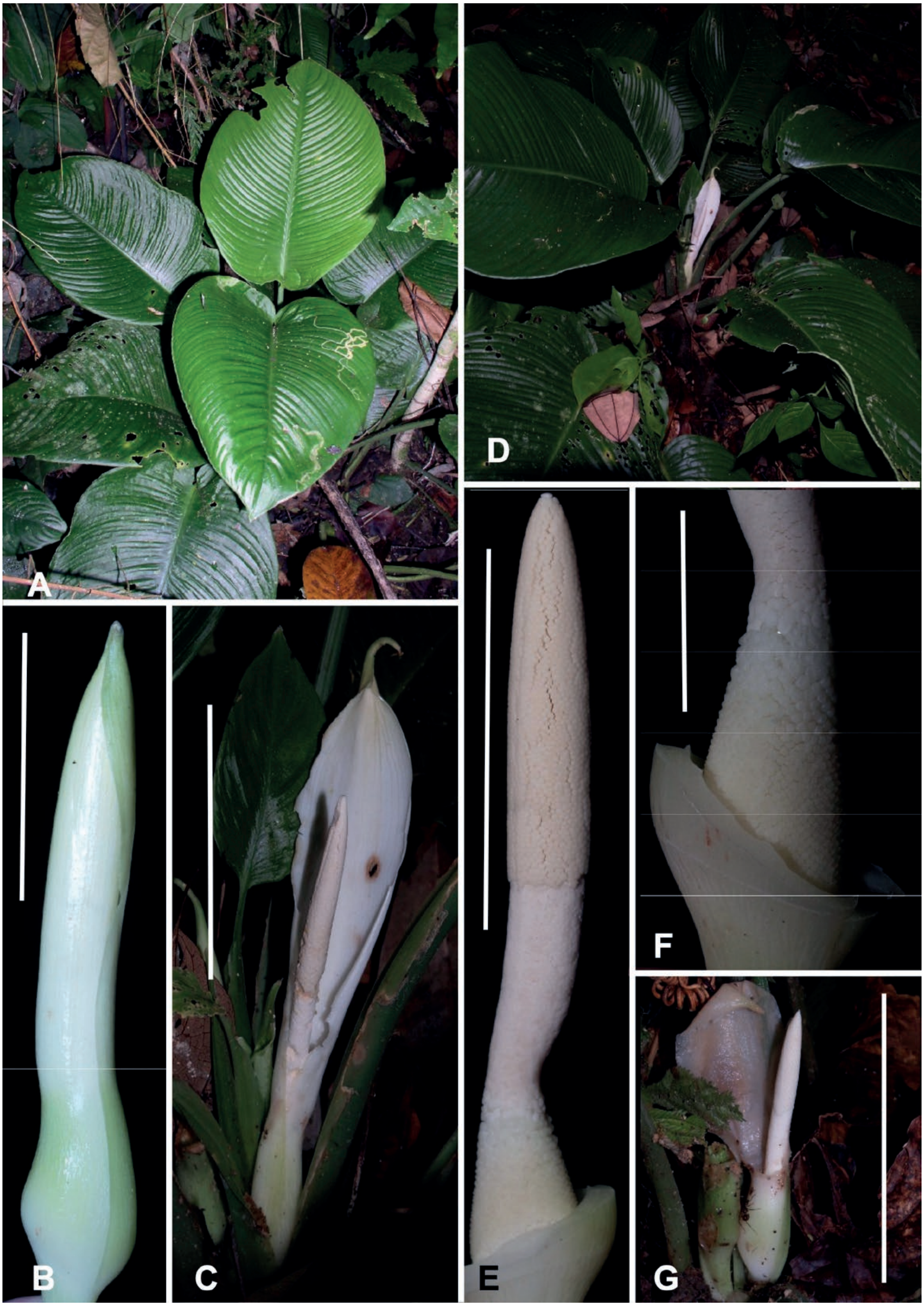

**Figure 6.** *Bau nervosa.* A. Flowering plant in habitat. B. Bloom prior to anthesis. C. Bloom at staminate anthesis. D. Whole plant with bloom at staminate anthesis. E. Spadix with the spathe artificially removed. F. Pistillate zone. G. Spathe limb deliquescent post anthesis. Scale bars: B–E = 3 cm; F = 1.5 cm; G = 10 cm. Photos: P.C.Boyce.

ing at the onset of staminate anthesis, or more or less hardly opening, and persisting until post anthesis before partially rotting. Some species propagate spontaneously from whole or fragmentary leaves, and several species produce viviparous plantlets from various parts of still-active leaves. Superficially like the genus *Borneoa* but immediately distinguished by the aromatic tissues, tessellate venation, and by the absence of a petiolar sheath ligule.

*Description*

Solitary to clumping medium-sized mesophytic herbs, all tissues strongly resin-aromatic. Stems pleionanthic, erect or sprawling, rooting along their length, occasionally climbing on suitable surfaces.; Leaves several together; petiole erect, slightly scabrid to conspicuously longitudinally ribbed; petiolar sheath wings long persistent, slightly unequal with tips auriculate but not ligular, oldest petioles with sheath margins marcescent; leaf blade spreading, cordato-elliptic to oblong-cordate, rather stiffly chartaceous, margins occasionally minutely erose, apex acuminate, mucronate, often producing viviparous plantlets from various locations specific to the species in question (e.g., from the leaf blade tip in *Bau hayi*); midrib abaxially rounded raised, adaxially ± impressed into surface of blade; primary lateral veins abaxially and adaxially slightly raised; interprimary veins almost indiscernible from primaries; secondary venation forming a conspicuous tessellate reticulum. Blooms solitary to a few together, each subtended by a narrowly triangular 2-keeled stiff prophyll, erect at anthesis; peduncle almost completely obscured by subtending prophyll. Spathe thick, with a strong constriction, or with faint constrictions coinciding with sterile interstice and staminate flower zone; lower spathe ellipsoid, often strongly obliquely inserted on peduncle, and with a conspicuous umbonate septum intruding from ventral wall coinciding with sterile interstice, spathe limb either wide-spreading, often darkening and always deliquescing at the onset of staminate anthesis, or more or less hardly opening, and persisting until post anthesis before partially rotting. Spadix clavate to hourglass-shaped, less often tapering cylindrical, with well-demarcated sterile interstice; pistillate zone narrowly conic, obliquely inserted, pistils small, crowded, mostly cylindric; stigma sessile, discoid, narrower than top of pistil; interpistillar staminodes absent; interpistillar pistillodes forming an incomplete row at junction with peduncle, often squat with a large overhanging discoid surface; sterile interstice well defined, with well-defined squat pistillodes or large clavate, round-topped staminodes; staminate zone cylindric to obconic; stamens irregularly crowded, individual florets difficult to distinguish, rectangular-butterfly-shaped from above, truncate with thick connective very slightly elevated above thecae, dull cream; thecae opening by a single pore; appendix fusiform to clavate or tapering-slender conic, pointed, proximally slightly wider than top of staminate zone; appendix staminodes rectangular-butterfly-shaped from above, much resembling stamens in shape and size but more regularly arranged. Fruiting spadix erect. Fruits & seeds not seen.

*Etymology*

From the Malay *bau*, a smell, often implied as unpleasant, and coined to highlight the strong terpenoid smell of the crushed tissues of all species.

*Distribution*

Widespread on Borneo, with most described species occurring in the northern half of the island, but elsewhere sampling sporadic. One species (*Bau brevicuspis*) widespread in the Malay Peninsula, extending to the far south of the Thai Isthmus of Kra, and Sumatera (North Sumatera and Aceh provinces), and one species (*Bau inculta)* on Sulawesi.

*Ecology*

Wet forest, often riverine gallery forest, with most species highly localized on specific geologies, notably Karst and shales.

*Notes*

Twenty-six species with observation of yet unflowered plants suggesting numerous certainly undescribed localised species. The genus probably numbers in the region of 50 species.

1. ***Bau adoceta*** (S.Y.Wong) S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis adoceta* S.Y.Wong, Gard. Bull. Singapore 62: 181, pl. 1 (2010).
2. ***Bau amosyui*** (S.Y.Wong, S.L.Low & P.C.Boyce) S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis amosyui* S.Y.Wong, S.L.Low & P.C.Boyce, Willdenowia 46: 294, fig. 3 (2016).
3. ***Bau antu*** (S.Y.Wong & P.C.Boyce) S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis antu* S.Y.Wong & P.C.Boyce, Aroideana 38E(2): 32, fig. 2 & 3A (2015).
4. ***Bau brevicuspis*** (Hook.f.) S.Y.Wong & P.C.Boyce, **comb. nov.**

Bas.: *Schismatoglottis brevicuspis* Hook.f., Fl. Brit. India 6: 537 (1893).

5. ***Bau camera-lucida*** (P.C.Boyce & S.Y.Wong) S.Y.Wong & P.C.Boyce, **comb. nov.**
Bas.: *Schismatoglottis camera-lucida* P.C.Boyce & S.Y.Wong, Aroideana 37E(1): 19, fig. 2 (2014).
6. ***Bau elegans*** (A.Hay) S.Y.Wong, A.Hay & P.C.Boyce, **comb. nov.**
Bas.: *Schismatoglottis elegans* A.Hay, Telopea 9: 67 (2000).
7. ***Bau gui*** (P.C.Boyce & S.Y.Wong) S.Y.Wong & P.C.Boyce, **comb. nov.**
Bas.: *Schismatoglottis gui* P.C.Boyce & S.Y.Wong, Aroideana 37E(1): 24, fig. 4 (2014).
8. ***Bau hayi*** (S.Y.Wong & P.C.Boyce) S.Y.Wong & P.C.Boyce, **comb. nov.**
Bas.: *Schismatoglottis hayi* S.Y.Wong & P.C.Boyce, Acta Phytotax. Geobot. 61: 135, fig. 2 (2011).
9. ***Bau hendrikii*** (S.Y.Wong & P.C.Boyce) S.Y.Wong & P.C.Boyce, **comb. nov.**
Bas.: *Schismatoglottis hendrikii* S.Y.Wong & P.C.Boyce, Aroideana 40(3): 28, fig. 1 & 2C (2017).
10. ***Bau inculta*** (Kurniawan & P.C.Boyce) S.Y.Wong & P.C.Boyce, **comb. nov.**
Basionym: *Schismatoglottis inculta* Kurniawan & P.C.Boyce, Acta Phytotax. Geobot. 62: 41, fig. 1 (2011).
11. ***Bau latevaginata*** (Engl.) S.Y.Wong & P.C.Boyce, **comb. nov.**
Bas.: *Schismatoglottis latevaginata* Engl., Pflanzenr., IV, 23Da: 106 (1912).
12. ***Bau liniae*** (S.Y.Wong) S.Y.Wong & P.C.Boyce, **comb. nov.**
Basionym: *Schismatoglottis liniae* S.Y.Wong, Gard. Bull. Singapore 62: 187, pl. 3 (2010) '*linae*'.
13. ***Bau matangensis*** (S.Y.Wong) S.Y.Wong & P.C.Boyce, **comb. nov.**
Bas.: *Schismatoglottis matangensis* S.Y.Wong, Gard. Bull. Singapore 62: 190, pl. 4 (2010).
14. ***Bau meriraiensis*** (P.C.Boyce & S.Y.Wong) S.Y.Wong & P.C.Boyce, **comb. nov.**
Bas.: *Schismatoglottis meriraiensis* P.C.Boyce & S.Y.Wong, Telopea 18: 445, fig. 1 (2015).
15. ***Bau metallica*** (S.Y.Wong, Koens & P.C.Boyce) S.Y.Wong & P.C.Boyce, **comb. nov.**
Bas.: *Schismatoglottis metallica* S.Y.Wong, Koens & P.C.Boyce, Webbia 77(1): 160, fig. 1–3A (2022).
16. ***Bau multinervia*** (M.Hotta) S.Y.Wong & P.C.Boyce, **comb. nov.**
Bas.: *Schismatoglottis multinervia* M.Hotta, Mem. Coll. Sci. Kyoto Imp. Univ., Ser. B, Biol. 32(3): 237, fig. 6G–N (1966).
17. ***Bau nervosa*** (Ridl.) S.Y.Wong & P.C.Boyce
*Schismatoglottis nervosa* Ridl., J. Straits Branch Roy. Asiat. Soc. 49: 50 (1908).
18. ***Bau pellucida*** (S.Y.Wong, P.C.Boyce & S.K.Chai) S.Y.Wong P.C.Boyce, **comb. nov.**
Bas.: *Schismatoglottis pellucida* S.Y.Wong, P.C.Boyce & S.K.Chai, Nordic J. Bot. 37(11)-e02566: 4, fig. 2, 3 (2019).
19. ***Bau pocong*** (S.Y.Wong, S.L.Low & P.C.Boyce) S.Y.Wong & P.C.Boyce, **comb. nov.**
Bas.: *Schismatoglottis pocong* S.Y.Wong, S.L.Low & P.C.Boyce, Willdenowia 46: 296, fig. 4 (2016).
20. ***Bau porpax*** (S.Y.Wong, Kartini & P.C.Boyce) S.Y.Wong & P.C.Boyce, **comb. nov.**
Bas.: *Schismatoglottis porpax* S.Y.Wong, Kartini & P.C.Boyce, Ann. Bot. Fenn. 56: 296, fig. 1 & 2 (2019).
21. ***Bau puberulipes*** (Alderw.) S.Y.Wong & P.C.Boyce, **comb. nov.**
Bas.: *Schismatoglottis puberulipes* Alderw., Bull. Jard. Bot. Buitenzorg, sér. 3, 4: 200 (1922).
(=) *Schismatoglottis gamoandra* M.Hotta, Mem. Coll. Sci. Kyoto Imp. Univ., Ser. B, Biol. 32(3): 237, fig. 7 A–G (1966).
22. ***Bau reticosa*** (S.Y.Wong & P.C.Boyce) S.Y.Wong & P.C.Boyce, **comb. nov.**
Bas.: *Schismatoglottis reticosa* S.Y.Wong & P.C.Boyce, Webbia 77(1): 163, fig. 4, 5 (2022).
23. ***Bau simonii*** (S.Y.Wong) S.Y.Wong & P.C.Boyce, **comb. nov.**
Bas.: *Schismatoglottis simonii* S.Y.Wong, Gard. Bull. Singapore 62: 196, pl. 6 (2010).
24. ***Bau tessellata*** (S.Y.Wong) S.Y.Wong & P.C.Boyce, **comb. nov.**
Bas.: *Schismatoglottis tessellata* S.Y.Wong, Gard. Bull. Singapore 62: 200, pl. 7 (2010).
25. ***Bau turbata*** (S.Y.Wong) S.Y.Wong & P.C.Boyce, **comb. nov.**
Bas.: *Schismatoglottis turbata* S.Y.Wong, Gard. Bull. Singapore 62: 203, pl. 8 (2010).
26. ***Bau ulusarikeiensis*** (S.Y.Wong) S.Y.Wong & P.C.Boyce, **comb. nov.**
Bas.: *Schismatoglottis ulusarikeiensis* S.Y.Wong, Gard. Bull. Singapore 62: 205, fig. 9 (2010).

### *BORNEOA*

***Borneoa*** S.Y.Wong & P.C.Boyce, **gen. nov.**

Type species: *Borneoa asperata* (Engl.) S.Y.Wong & P.C.Boyce, **comb. nov.**

Bas.: *Schismatoglottis asperata* Engl., Bull. Soc. Tosc. Ortic. 4: 297 (1879)]. Figure 7.

### *Diagnosis*

Small to medium-sized compact herbs with polyphyllous modules, petioles often scabrid- or hispid-ornamented with conspicuous leathery persistent, later marcescent, often unequal, ligules, and erect blooms in which the lower persistent part has pronouncedly thickened walls, and with the spathe limb mostly white, and crumbling-liquefying at staminate anthesis. A few species (*Borneo barbata*, *B. ciliata*, *B. crinitissma*, *B. ferruginea*, and *B. pyrrhias*) have conspicuously 'hairy' leaf blades and petioles and one species (*B. mira*) has leaf blades abaxially viviparous with the plantlets reaching a one or two cm across before either detaching or by virtue of the leaf senescing and falling thereby able to establish on the substrate. *Borneoa* species are superficially like species of *Bau* but differ consistently by the presence of a ligule on the petiolar sheath, odourless tissues, and the absence of tessellate venation.

### *Description*

Mesophytic or facultative (obligate?) rheophytic herbs, solitary or forming small clumps. Stems pleionanthic, condensed, in older plants epigeal, or elongated and rooting into with accumulations of leaflitter and then plants often associated with stinging ants; internodes obscured by overlapping leaf bases, not conspicuous. Leaves several together; petioles asperulate, or with crystalline structures, or variously hairy; petiolar sheath adnate to petiole for about half its length, then conspicuously persistent-ligular, sheath rather narrow, margins inrolled; blades narrowly obovate to oblong-cordate, often sub-succulent, occasionally with a roughened surface or hairy, either plain or variously variegated marbled/feathered with paler and/or brighter markings, base slightly obliquely rounded truncate to cordate, tip attenuate and apiculate; midrib somewhat impressed adaxially, raised abaxially; primary lateral veins slightly impressed adaxially, weakly raised abaxially; secondary veins either barely discernible, or distinct and then often pellucid. Blooms mostly paired, erect, subtended by one narrow prophyll and one broad cataphyll; peduncle short, not, or only barely exserted from leaf bases during anthesis. Spathe often pinkish, sometimes dusky pink; lower spathe ovoid, differentiated from limb by a barely perceptible constriction corresponding with upper part of staminate floret zone; limb narrowly ovate-lanceolate, acuminate distally, gaping at onset of pistillate anthesis then opening almost flat with margins recurving during staminate anthesis, crumbling-deliquescent at late staminate anthesis. Spadix sessile, usually somewhat obliquely inserted on the spathe/peduncle, shorter than spathe; pistillate floret zone obliquely very shortly adnate (to spathe), cylindrical; pistils crowded, oblong-barrel- shaped, often brightly coloured; stigma sessile, discoid, centrally depressed, papillate, fractionally wider than ovary; interpistillar staminodes scattered, claviform, rather few among pistils, about twice height of pistils; sterile interstice slightly wider with top of pistillate and equalling base of staminate zone, with a few whorls of staminodes; interstice staminodes mostly irregularly polygonal,; staminate floret zone cylindrical to slightly conical; staminate florets crowded, often brightly coloured, truncate with thick connective slightly elevated above thecae, irregularly bi- or triandrous, rather irregular in shape, although roughly rectangular from above; pollen extruded in short often pale orange strands; appendix mostly fusiform and gradually tapering to a rather narrow sharp tip; appendix staminodes more or less flat-topped, irregularly polygonal, densely crowded. Fruiting spathe erect, obliquely urceolate with rim margins recurved somewhat, exterior very pale olive-green, flushed pink. Fruits oblong-cylindric, usually truncate-topped; seeds ellipsoid with a sticky enclosing aril and large caruncle.

### *Etymology*

For the island of Borneo, to which all but one species (*Borneoa scortechinii*) is restricted.

### *Distribution*

North Borneo, with the most diversity in the central north. One species, *Borneoa scortechinii*, restricted to and widespread in Peninsular Malaysia

### *Ecology*

Largely restricted to humid shady forest at low to mid-elevation, often on steep slopes above the flood zone of riverine gallery forest. A few species are rheophytic or at least able to withstand spate flooding (e.g., *Borneoa crypta, B. jelandii, B. tegorae*), and most species appear to be geologically obligated, often to shales, with *B. tegorae*, remarkably, restricted to cinnabar-bearing rocks. To date the genus is not known to occur on limestone. *Borneoa ciliata* is restricted to damp kerangas where it habitually forms a terrestrial litter-trapping plant with the accumulated humus associated with aggressive stinging ants.

### *Notes*

Twenty-two described species which, based upon masses of largely indeterminable herbarium material, personal observations, and images circulating on

**Figure 7.** *Borneoa asperata***.** A–C. Plants in habitat showing variation in leaf blade markings in a single population. D. Detail of petiole ornamentation. E. Bloom at pistillate anthesis. F. Spadix (spathe artificially removed) at pistillate anthesis. G. Bloom at staminate anthesis. Scale bars: E & F = 3 cm; G = 5 cm. Photos: P.C.Boyce.

social media represents probably less than one quarter of the total number. Several species observed in the field attract ants during fruiting, with the ants removing the fruits and eating the sticky seed aril and caruncle.

1. ***Borneoa asperata*** (Engl.) S.Y.Wong & P.C.Boyce
   *Schismatoglottis asperata* Engl., Bull. Soc. Tosc. Ortic. 4: 297 (1879).
   (=) *Schismatoglottis asperata* var. *albomaculata* Engl., Bull. Soc. Tosc. Ortic. 4: 11 (1879).
   (=) *Schismatoglottis crispata* Hook.f., Curtis's Bot. Mag. descr. ad t. 6576).
   (=) *Schismatoglottis rispate purpurea* Anon., Gard. Chron., n.s., 24: 183 (1885).
2. ***Borneoa barbata*** (Engl.) S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis barbata* Engl., Bull. Soc. Tosc. Ortic. 4: 298 (1879) & in Becc., Malesia 1: 286, pl. 22, figs. 11–20 (1883).
   (=) *Schismatoglottis rubiginosa* M. Hotta, Mem. Coll. Sci. Univ. Kyoto, ser. B, 32: 231, fig. 4, J–Q (1966).
3. ***Borneoa ciliata*** (A.Hay) S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis ciliata* A.Hay, Telopea 9: 60, fig. 6 (2000).
4. ***Borneoa crinitissima*** (A.Hay) S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis crinitissima* A.Hay, Telopea 9: 64, fig. 6 (2000).
5. ***Borneoa crypta*** (P.C.Boyce & S.Y.Wong) S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis crypta* P.C.Boyce & S.Y.Wong, Webbia 69(2): 225, fig. 1, 9A (2014).
6. ***Borneoa dilecta*** (S.Y.Wong, P.C.Boyce & S.L.Low) S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis dilecta* S.Y.Wong, P.C.Boyce & S.L.Low, Gard. Bull. Singapore 64(1): 61, fig. 2 (2012).
7. ***Borneoa ferruginea*** (Merr.) S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis ferruginea* Merr., J. Straits Branch Roy. Asiat. Soc. 85: 159 (1922).
8. ***Borneoa gampsospadix*** (P.C.Boyce & S.Y.Wong) S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis gampsospadix* P.C.Boyce & S.Y.Wong, Aroideana 37E(1): 23 (2014).
9. ***Borneoa gillianiae*** (P.C.Boyce) S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis gillianiae* P.C.Boyce, Kew Bull. 49(4): 793, fig. 1 (1994).
10. ***Borneoa hottae*** (Bogner & Nicolson) S.Y.Wong & P.C.Boyce, **comb. nov.**
    Bas.: *Schismatoglottis hottae* Bogner & Nicolson, Aroideana 2: 120 (1979). [*Schismatoglottis cordifolia* M. Hotta, Mem. Coll. Sci. Univ. Kyoto, ser. B, 32: 229, fig.4A–I (1966) *nom. illeg., non S. cordifolia* Ridl., J. Straits Branch Roy. Asiat. Soc. 57: 112 (1911)].
11. ***Borneoa jelandii*** (P.C.Boyce & S.Y.Wong) S.Y.Wong & P.C.Boyce, **comb. nov.**
    Bas.: *Schismatoglottis jelandii* P.C.Boyce & S.Y.Wong, Gard. Bull. Singapore 58: 7, pl. 1 (2006).
12. ***Borneoa mira*** (S.Y.Wong, P.C.Boyce & S.L.Low) S.Y.Wong & P.C.Boyce, **comb. nov.**
    Bas.: *Schismatoglottis mira* S.Y.Wong, P.C.Boyce & S.L.Low, Gard. Bull. Singapore 64: 263, fig.3 (2012).
13. ***Borneoa mons*** (Kartini) S.Y.Wong & P.C.Boyce, **comb. nov.**
    Bas.: *Schismatoglottis mons* Kartini, Webbia 77(2): 268 (2022).
14. ***Borneoa persistens*** (S.Y.Wong & P.C.Boyce) S.Y.Wong & P.C.Boyce, **comb. nov.**
    Bas.: *Schismatoglottis persistens* S.Y.Wong & P.C.Boyce, Willdenowia 44: 247, fig. 1 (2014).
    *Notes*
    Wong and Boyce (2014) mistakenly assigned *Schismatoglottis persistens* to the Multiflora Group (Hay and Yuzammi 2000) [= *Tweeddalea* in the sense of this paper].
15. ***Borneoa pyrrhias*** (A.Hay) S.Y.Wong & P.C.Boyce, **comb. nov.**
    Bas.: *Schismatoglottis pyrrhias* A.Hay, Telopea 9: 78 (2000).
16. ***Borneoa scortechinii*** (Hook.f.) S.Y.Wong & P.C.Boyce, **comb. nov.**
    Bas.: *Schismatoglottis scortechinii* Hook. f., Fl. Brit. Ind. 6: 537 (1893).
    (=) *Schismatoglottis kingii* Engl., Engl. & K. Krause, Pflanzenr. 55 (IV.23Da): 97, fig. 62J (1912).
    (=) *Schismatoglottis marginata* Ridl., J. Bot. 40: 36 (1902) *nom. illeg., non Schismatoglottis marginata* Engl., Bull. Soc. Tosc. Ortic. 4: 298 (1879) [i.e., *Rhynchopyle marginata* (Engl.) Engl., Bot. Jahrb. Syst. 1: 184 (1880). (Borneo)].
17. ***Borneoa sejuncta*** (A.Hay) S.Y.Wong & P.C.Boyce, **comb. nov.**
    Bas.: *Schismatoglottis sejuncta* A.Hay, Telopea 9: 83 (2000).
18. ***Borneoa shaleicola*** (P.C.Boyce & S.Y.Wong) S.Y.Wong & P.C.Boyce, **comb. nov.**
    Bas.: *Schismatoglottis shaleicola* P.C.Boyce & S.Y.Wong, Webbia 69: 228, fig. 2, 10D (2014).
19. ***Borneoa tahubangensis*** (A.Hay & Hersc.) S.Y.Wong & P.C.Boyce, **comb. nov.**

Bas.: *Schismatoglottis tahubangensis* A.Hay & Hersc., Gard. Bull. Singapore 55: 27, fig. 1 (2003).

20. ***Borneoa tegorae*** (P.C.Boyce & S.Y.Wong) S.Y.Wong & P.C.Boyce, **comb. nov.**
    Bas.: *Schismatoglottis tegorae* P.C.Boyce & S.Y.Wong, Webbia 69: 230, fig. 3, 9E (2014).
21. ***Borneoa thelephora*** (S.Y.Wong, P.C.Boyce & S.L.Low) S.Y.Wong & P.C.Boyce, **comb. nov.**
    Bas.: *Schismatoglottis thelephora* S.Y.Wong, P.C.Boyce & S.L.Low, Gard. Bull. Singapore 64: 266, fig. 4 (2012).
22. ***Borneoa zainuddinii*** (Kartini, P.C.Boyce & S.Y.Wong) S.Y.Wong & P.C.Boyce, **comb. nov.**
    Bas.: *Schismatoglottis zainuddinii* Kartini, P.C.Boyce & S.Y.Wong, Nordic J. Bot. 35: 721 (2017).

## *IBANIA*

***Ibania*** S.Y.Wong & P.C.Boyce, **gen. nov.**

Type species: *Ibania smaragdina* (S.Y.Wong, Aisahtul & P.C.Boyce) S.Y.Wong & P.C.Boyce, **comb. nov.**

Bas.: *Schismatoglottis smaragdina* S.Y.Wong, Aisahtul & P.C.Boyce, Aroideana 40: 23, fig. 10 & 11E (2017)]. Figure 8.

### *Diagnosis*

*Ibania* is defined by lanceolate to (oblong-)elliptic to narrowly obovate leaf blades in which the base is broadly acute to cuneate to slightly decurrent, with the primary lateral veins numerous and closely spaced, alternating with lesser interprimaries (these and primary veins sometimes rather difficult to differentiate) and all diverging at (80–)90(–100)°, usually running more or less straight for much of the width of the blade then rather abruptly deflected towards the tip before joining the margin or upcurved rather gradually, with tertiary venation abaxially forming a more or less obscure tessellate reticulum. Bloom solitary; peduncle short, concealed by leaf bases and subtending cataphyll(s) at flowering (slightly exserted later).

### *Description*

Small, usually colony-forming mesophytic herbs. Stems pleionanthic, epigeal, erect to sprawling, rather to markedly elongate, decumbent portions tending to root along their length. Leaves several together along distal parts of stem and more clustered at apex; petioles semi-erect; petiolar sheath wings fully attached to petiole, tapering, membranous, wide-spreading, long-persistent; leaf blades oblong-elliptic to broadly lanceolate or elliptic, base obtuse to shallowly cordate, apex acute and slightly acuminate, upper surface often with a metallic sheen; midrib abaxially prominent, adaxially slightly impressed with blade; primary lateral veins and barely lesser interprimaries, diverging from midrib at 90° or thereabouts, abaxially rather prominent; secondary venation mostly arising from midrib, occasionally from base of primary veins; tertiary venation forming a faint tessellate reticulum. Bloom solitary; peduncle to only slightly exserted from leaf bases, more often peduncle and part of lower spathe obscured by leaf bases and subtending cataphylls. Spathe erect, lower spathe oblong to ovoid, differentiated from limb by an abrupt constriction, spathe inflating markedly at pistillate anthesis; spathe limb broadly to rather narrowly ovate, mucronate, degrading/darkening then shedding post anthesis. Spadix sessile or briefly stout-stipitate; pistillate floret zone mostly stoutly conoid; pistils slightly lax, subglobose; stigma sessile, button-like, c. 1/2 diameter of ovary; interpistillar staminodes confined to a ring at base of staminate flower zone, oblong-clavate on a slender stipe; sterile interstice obscured by staminodes or almost naked; interstice staminodes rhomboidal-topped to clavate on a stout stipe; staminate flower zone rather stoutly obconoid; stamens very crowded, not obviously arranged into discrete florets, dumbbell-shaped, more or less truncate with connective flat between thecae; pores each with a heavily thickened rim; appendix isodiametric with staminate floret zone, oblong-conica to curving conic, blunt to pointed; appendix staminodes composed of irregularly polygonal, more or less flat-topped staminodes. Fruiting spathe short-peduncled, erect, urceolate with a broad opening. Fruits & seeds not seen.

### *Etymology*

From the Iban, the largest of the about two hundred groups of indigenous peoples of Borneo.

### *Distribution*

North Borneo above the central mountain block of the Müller and Schwaner mountains.

### *Ecology*

Terrestrial mesophytes in lowland to lower montane forest, usually on moderate banks in deep leaf litter with the older stems decumbent and rooting along their length with the active tips ascending.

### *Notes*

Twelve species described and about the same number represented by material too inadequate to permit formal description.

**Figure 8.** *Ibania smaragdina***.** A. Plants in habitat, note the rather lax habit. B. Flowering shoot, bloom at late staminate anthesis, spathe limb already degraded. C. Bloom at pistillate anthesis; note that the spathe limb hardly opens. D. Spadix at pistillate anthesis, spathe artificially removed. E. Bloom at late staminate anthesis; note shed powdery pollen. Scale bar = 2 cm. Photos: P.C.Boyce.

1. ***Ibania belonis*** (S.Y.Wong, Aisahtul & P.C.Boyce) S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis belonis* S.Y.Wong, Aisahtul & P.C.Boyce, Aroideana 40(1): 7, figs. 1, 11A (2017).
2. ***Ibania fossae*** (S.Y.Wong, P.C.Boyce & Aisahtul) S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis fossae* S.Y.Wong, P.C.Boyce & Aisahtul, Nordic J. Bot. 37(11)-e02566: 2, fig. 1 (2019).
3. ***Ibania gaesa*** (S.Y.Wong, Aisahtul & P.C.Boyce) S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis gaesa* S.Y.Wong, Aisahtul & P.C.Boyce, Aroideana 40(1): 10, figs. 2, 11B (2017).
4. ***Ibania gangsai*** (S.Y.Wong, Aisahtul & P.C.Boyce) S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis gangsai* S.Y.Wong, Aisahtul & P.C.Boyce, Aroideana 41(1): 141, figs. 1, 5D (2018).
5. ***Ibania gephyra*** (P.C.Boyce) S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis gephyra* P.C.Boyce, Borneo J. Resource Sci. Technol. 7(2): 85, figs. 1, 4F (2017).
6. ***Ibania imbakensis*** (Kartini, S.Y.Wong & P.C.Boyce), S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis imbakensis* Kartini, S.Y.Wong & P.C.Boyce, Webbia 75(1): 116, figs. 1, 3A (2020).
7. ***Ibania patentinervia*** (Engl.) S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis patentinervia* Engl., Pflanzenr., IV, 23Da: 90 (1912).
8. ***Ibania pectinervia*** (A.Hay) S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis pectinervia* A.Hay, Telopea 9: 138 (2000).
9. ***Ibania pichinensis*** (P.C.Boyce) S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis pichinensis* P.C.Boyce, Borneo J. Resource Sci. Technol. 7(2): 87, figs. 2, 4C (2017).
10. ***Ibania puncakborneensis*** (P.C.Boyce) S.Y.Wong & P.C.Boyce, **comb. nov.**
    Bas.: *Schismatoglottis puncakborneensis* P.C.Boyce, Borneo J. Resource Sci. Technol. 7(2): 89, figs. 3, 4A (2017).
11. ***Ibania retinervia*** (Furtado) S.Y.Wong & P.C.Boyce, **comb. nov.**
    Bas.: *Schismatoglottis retinervia* Furtado, Gard. Bull. Straits Settlem. 8: 157 (1935).
12. ***Ibania smaragdina*** (S.Y.Wong, Aisahtul & P.C.Boyce) S.Y.Wong & P.C.Boyce
    *Schismatoglottis smaragdina* S.Y.Wong, Aisahtul & P.C.Boyce, Aroideana 40: 23, fig. 10, 11E (2017).

## ***SARAWAKIA***

*Sarawakia* S.Y.Wong & P.C.Boyce, **gen. nov.**

Type species: *Sarawakia clausula* (S.Y.Wong) S.Y.Wong & P.C.Boyce, **comb. nov.**

Bas.: *Schismatoglottis clausula* S.Y.Wong, Gard. Bull. Singapore 61: 530, fig. 1 (2010)]. Figure 9.

### *Diagnosis*

*Sarawakia* is defined by condensed pleionanthic shoots composed of numerous single leaved modules, each module subtended by a conspicuous marcescent then soon-degrading prophyll, scabrid petioles with the petiolar sheath reduced to a basal ridge, and with the protective role of the sheath homeotically taken up by the subtending prophyll, leaf blades abaxially with conspicuous tessellate secondary venation, and a synflorescence of pendent blooms, with the spathe limb senescing by disarticulating into numerous circumferential rings along the length. In overall appearance *Sarawakia* most closely resembles *Tweeddalea*, differing by the monophyllous (vs polyphyllous) shoot modules, scabrid (vs smooth) petioles, the absence of a ligular petiolar sheath, tessellate secondary venation (vs all veins striate), pendulous (vs erect to arching) blooms, and by the spathe limb degrading by splitting into pieces (vs falling in a single piece).

### *Description*

Pendent rheophytic herbs. Stem condensed, with congested internodes. Leaves several together each alternating with soon-marcescent, somewhat brittle tapering lanceolate scabrid cataphylls; petiole shorter than blade, arching to almost pendent, sub-terete, minutely scabrid, sheathing only at very base, with the petiolar sheath reduced to an obscure thick collar; blades broadly lanceolate, leathery to almost sub succulent, rather brittle, matte and strongly discolorous, paler beneath; midrib adaxially more or less flush with blade, abaxially prominent; primary lateral veins ca. 12 on each side, diverging at 45–60°, abaxially slightly raised, adaxially impressed; secondary venation adaxially invisible, abaxially forming a conspicuous darker tessellate reticulum. Bloom pendulous, solitary several together maturing sequentially, subtended by lanceolate chartaceous cataphylls, with a weak esteric odour at pistillate anthesis; peduncle compressed-cylindric, subtended by a conspicuous prophyll or cataphyll, minutely scabrid. Spathe with a moderate constriction between the lower part and the limb, limb inflating and gaping at pistillate anthesis, opening further at staminate anthesis; lower spathe compressed

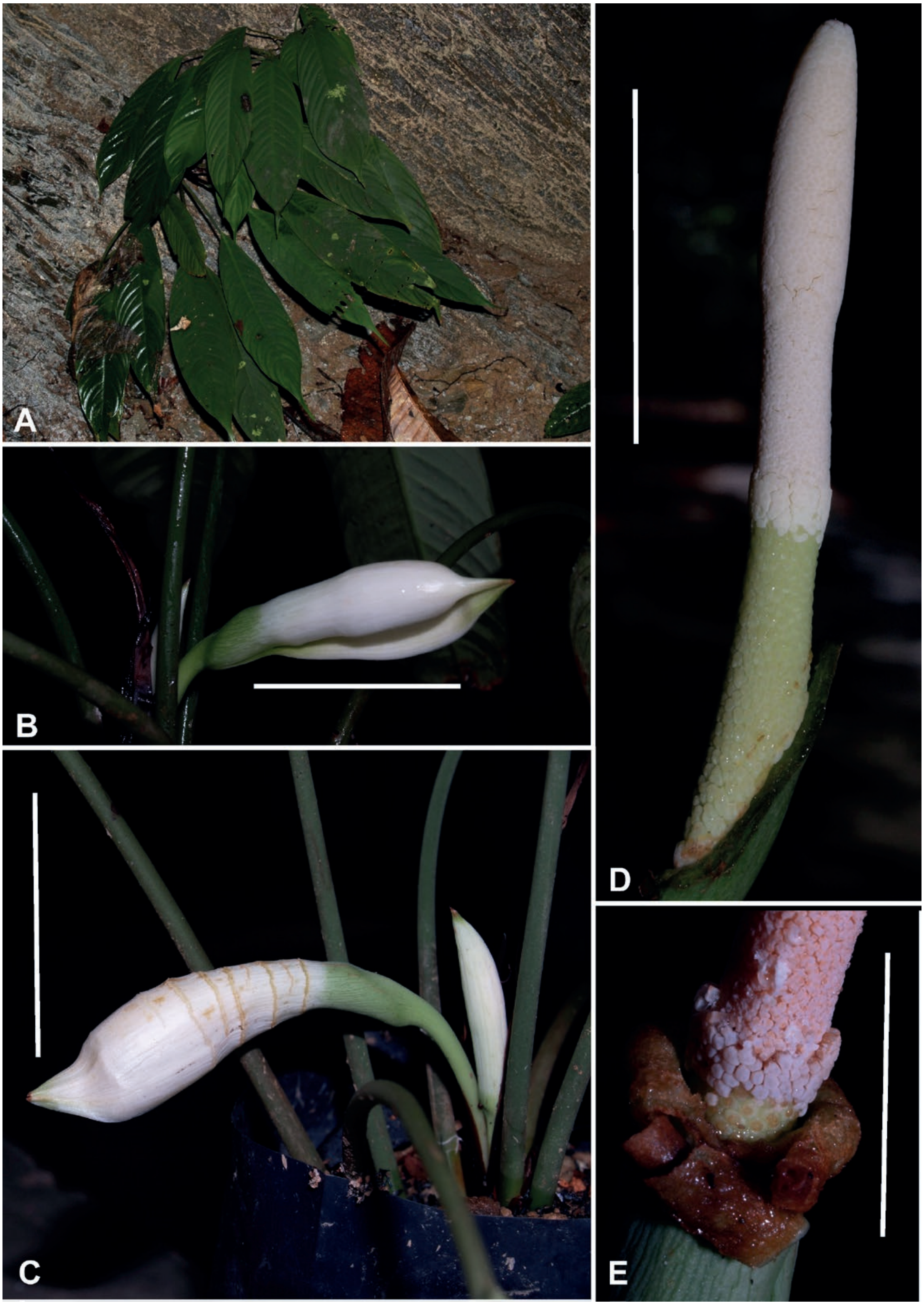

**Figure 9.** *Sarawakia clausula*. A. Plants in habitat on exposed shales. B. Bloom at pistillate anthesis. C. Spathe limb senescence by disarticulating into numerous circumferential rings along the length. D. Spadix at pistillate anthesis, spathe artificially removed. E. Upper part of persistent lower spathe at staminate anthesis, showing expanded interstice staminodes and deliquesced remnants of spathe limb. Scale bars: B & C = 4 cm; D & E = 2 cm. Photos: P.C.Boyce.

ovoid and strongly asymmetric, dorsally flattened-convex corresponding to the adnation of the pistillate floret zone, upper half opening at pistillate anthesis initially via a narrow terminal slit, then wide-gaping and weakly fornicate, limb margins reflexing during staminate anthesis, then whole limb degrading-caducous with the rim remaining above the lower spathe insertion reflexing somewhat. Spadix ca. 5.5 cm long, pistillate zone entirely adnate to spathe, compressed conic; pistils crowded narrowly barrel-shaped; stigma sessile, discoid, wider than top of pistil; interpistillar pistillodes forming a row at junction with peduncle, resembling slender, compressed pistils; sterile interstice with about 3 rows of staminodes; interstice staminodes compressed-cylindrical, initially equalling the height of pistils, later (late pistillate anthesis) staminodes lengthening to form a ring ca 1/3 wider than fertile zones; staminate zone cylindric; stamens irregularly densely crowded, individual florets difficult to distinguish, rectangular-dumbbell shaped from above, truncate with thick connective slightly elevated above thecae, thecae opening by a single pore; appendix stoutly cylindrical, blunt, proximally as wide as staminate zone, distally slightly tapering and narrowly obtuse; appendix staminodes very dense, irregularly rectangular shaped from above, often centrally with a narrow, deep depression. Fruiting spadix, fruits & seeds not seen.

*Etymology*

From Sarawak, one of the two states, the other being Sabah that, together with the Federal State of Labuan, form East Malaysia. To date all but one species of *Sarawakia* is endemic to Sarawak.

*Distribution*

Central north Borneo, east of the Lupar river, with the highest diversity of the Rejang and Kanowit basins, extending as far east and north as eastern Brunei.

*Ecology*

Facultative rheophytes (*S. clausula*, *S. cyria*, *S. larynx*, *S. rejangica*), or probably obligate (*S. petradoxa*) on shaded shales in wet lowland forest.

*Notes*

The known five species are highly localized, and certainly a considerable number of taxonomic novelties awaits discovery in the multitude of riverine streams that occur in the known area of generic distribution.

1. ***Sarawakia clausula*** (S.Y.Wong) S.Y.Wong & P.C.Boyce
   *Schismatoglottis clausula* S.Y.Wong, Gard. Bull. Singapore 61: 530, fig. 1 (2010).
2. ***Sarawakia cyria*** (P.C.Boyce), S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis cyria* P.C.Boyce, Kew Bull. 49: 796, fig. 2 (1994).
3. ***Sarawakia larynx*** (S.Y.Wong & P.C.Boyce), S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis larynx* S.Y.Wong & P.C.Boyce, Aroideana 39: 18, fig. 1 (2016).
4. ***Sarawakia petradoxa*** (S.Y.Wong & P.C.Boyce), S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis petradoxa* S.Y.Wong & P.C.Boyce, Aroideana 37E(2): 19, fig. 1 (2014).
5. ***Sarawakia rejangica*** (S.Y.Wong & P.C.Boyce), S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis rejangica* S.Y.Wong & P.C.Boyce, Aroideana 39: 22, fig. 2 (2016).

## *TWEEDDALEA*

***Tweeddalea*** S.Y.Wong & P.C.Boyce, **gen. nov**

Type species: *Tweeddalea multiflora* (Ridl.) S.Y.Wong & P.C.Boyce, **comb. nov.**

Bas.: *Schismatoglottis multiflora* Ridl., J. Straits Branch Roy. Asiat. Soc. 44: 181 (1905)]. Figure 10.

*Diagnosis*

*Tweeddalea* is defined by the combination of condensed pleionanthic shoots comprised of polyphyllous modules, a ligular petiolar sheath with the leaf blades with all venation striate, and a synflorescence of arching to erect blooms, with the spathe limb senescing by disarticulating into numerous circumferential rings along the length. In overall appearance *Sarawakia* most closely resembles *Tweeddalea*, differing by the monophyllous (vs polyphyllous) shoot modules, the pendulous (vs erect to arching) blooms, and by the spathe limb degrading by splitting into pieces (vs falling in a single piece).

*Description*

Lithophytic, mesophytic (seldom), or obligate rheophytic herbs. Stem pleionanthic, condensed to rarely elongated, and in which case then buried in leaf litter. Leaves several together; petiole erect to spreading, slender, smooth, sheathing only at extreme base, sheath extended tapering marcescent to persistent ligular portion; leaf blade pendulous, erect or spreading, narrowly elliptic to rather broadly oblong-ovate; midrib abaxially

**Figure 10.** *Tweeddalea multiflora***.** A, B. Plants in habitat on sandstone rocks. C. Bloom at pistillate anthesis; note spathe limb not opening wide. D. Bloom at onset of staminate anthesis; note spathe limb beginning to degrade. E. Spadix at pistillate anthesis, spathe artificially removed. F. Detail of lower portion of spadix showing pistillate zone, interstice, and lowermost part of staminate zone. G. Terminal portion of spadix at staminate anthesis; note pollen strings. Scale bars: C–E = 4 cm; F, G = 1.5 cm. Photos: P.C.Boyce.

prominent very occasionally with scattered bulbils on the sides; primary lateral veins hardly prominent abaxially, alternating with lesser interprimary veins; secondary venation arising from midrib, very fine and dense, pellucid and darker than surrounding tissue, or not. Bloom solitary, comparatively large; in lithophytic and rheophytic species ⅓ – ½ length of subtending petiole, with the apex bent, obliquely deflecting spathe and spadix, in terrestrial species obscured by subtending cataphylls and erect. lower spathe spindle-shaped to oblong, differentiated from limb by a distinct constriction; limb mostly broadly lanceolate, gaping ventrally at pistillate anthesis, caducous, very seldom marcescent but not long-remaining, at staminate anthesis (with lower spathe apical edges then flaring). Spadix sessile; interpistillar staminodes clavate mostly restricted to (sometimes incomplete) basal row to pistillate zone on each side along adnation of spathe and spadix, less often with a few scattered among the pistillate florets, exceeding pistils in height; pistillate flower zone obliquely inserted onto spathe, and often adnate to spathe for up to half the length; pistils very numerous and crowded, narrowly ovoid to bottle-shaped; stigma sessile, button-like, narrower than to equalling the pistil width, papillate; sterile interstice short, with 2 or 3 irregular whorls of staminodes that expand laterally during staminate anthesis; staminate flower zone subcylindric; stamens closely packed, irregularly rectangular, truncate, with wide connective and often a shallow suture between thecae; thecae at short ends, each with 2 minute pores; appendix sometimes absent (*T. bulbifera* and *T. multiflora*), otherwise subcylindric to weakly clavate, blunt-tipped,, composed of densely packed sterile staminodes somewhat resembling larger forms of the staminate florets. Infructescence pendulous. Fruits oblong; seeds ellipsoid with a thin but very sticky aril.

### *Etymology*

Named for aroid specialist Alistair Hay, who as heir presumptive to the Marquisate of Tweeddale in the Peerage of Scotland, holds the dignity of Master of Tweeddale. Tweeddale is an area in south-eastern Scotland, the traditional name for the dale drained by the upper reaches of the River Tweed, with boundaries corresponding to historical Peeblesshire, until 1975 a county of SE Scotland, now part of Scottish Borders. Arthur Hay F.R.S (1824–1878), the 9th Marquis and his great great uncle, was a leading expert of his day on tropical Asian birds, describing over 40 species under the authority name [Viscount] Walden (Wardlaw Ramsay 1881).

### *Distribution*

Largely restricted to NW Borneo, with a second minor centre of diversity in northern central Borneo, and a solitary species in northeast Sarawak. Based on extensive fieldwork it does appear that these three separate areas of distribution are not a sampling artefact. It would be interesting to undertake further work to establish if further splits are needed, although *Tweeddalea roseospatha* from the Rejang Basin morphologically fits well enough into the western most and most diverse group, as also, slightly less convincingly, does the geographically isolated *T. monoplacenta*.

### *Ecology*

Obligate rheophytes (*Tweeddalea bulbifera*, *T. hayana*, *T. iliata*, *T. multiflora*, *T. roseospatha*) or facultative (*T. dulosa*, *T. maelii*, *T. mayoana*, *T. nicolsonii*), occasionally epilithic, and then Karst-obligated (*T. bauensis*, *T. confinis, T. monoplacenta*), less often forest-floor mesophytes on shaded banks under damp forest *(T. erecta.*, *T. jitiniae*, *T. schottii*), all at low altitudes.

### *Notes*

Fifteen described species with five more known from incomplete material. *Tweeddalea* equals the Multiflora Group of Hay & Yuzammi (2000).

1. ***Tweeddalea bauensis*** (A.Hay & C.Lee) S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis bauensis* A.Hay & C.Lee, Telopea 9: 84, fig. 10 (2000).
2. ***Tweeddalea bulbifera*** (H.Okada, H.Tsukaya & Y.Mori) S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis bulbifera* H.Okada, H.Tsukaya & Y.Mori, Syst. Bot. 24: 62, fig. 1–5 (1999).
3. ***Tweeddalea confinis*** (S.Y.Wong & P.C.Boyce) S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis confinis* S.Y.Wong & P.C.Boyce, Gard. Bull. Singapore 60: 159, pl. 2 (2008).
4. ***Tweeddalea dulosa*** (S.Y.Wong) S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis dulosa* S.Y.Wong, Gard. Bull. Singapore 61: 532, fig. 2 (2010).
5. ***Tweeddalea erecta*** (M.Hotta) S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis erecta* M.Hotta, Mem. Coll. Sci. Kyoto Imp. Univ., Ser. B, Biol. 32(3): 233, fig. 5 (1966).
6. ***Tweeddalea hayana*** (Bogner & P.C.Boyce) S.Y.Wong & P.C.Boyce, **comb. nov.**

Bas.: *Schismatoglottis hayana* Bogner & P.C.Boyce, Gard. Bull. Singapore 60: 175, pl. 1–3 (2009).

7. ***Tweeddalea iliata*** (S.Y.Wong & P.C.Boyce) S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis iliata* S.Y.Wong & P.C.Boyce, Willdenowia 44: 6, fig. 1 (2014).
8. ***Tweeddalea jitinae*** (S.Y.Wong) S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis jitinae* S.Y.Wong, Gard. Bull. Singapore 61: 535, fig. 3 (2010).
9. ***Tweeddalea maelii*** (P.C.Boyce & S.Y.Wong) S.Y.Wong & P.C.Boyce, **comb. nov.**
   Bas.: *Schismatoglottis maelii* P.C.Boyce & S.Y.Wong, Gard. Bull. Singapore 58: 14, pl. 3 (2006).
10. ***Tweeddalea mayoana*** (Bogner & M.Hotta) S.Y.Wong & P.C.Boyce, **comb. nov.**
    Bas.: *Schismatoglottis mayoana* Bogner & M.Hotta, Acta Phytotax. Geobot. 34: 48, fig. 1 & 2 (1983).
    (=) *Schismatoglottis beccariana* var. *cuspidata* Engl., Bull. Soc. Tosc. Ortic. 4: 297
    (1879).
    (=) *Schismatoglottis multiflora* var. *latifolia* Ridl., J. Straits Branch Roy. Asiat. Soc. 49: 50 (1908).
11. ***Tweeddalea monoplacenta*** (M.Hotta) S.Y.Wong & P.C.Boyce, **comb. nov.**
    Bas.: *Schismatoglottis monoplacenta* M.Hotta, Mem. Coll. Sci. Kyoto Imp. Univ., Ser. B, Biol. 32(3): 227. Fig. 2 (1966).
12. ***Tweeddalea multiflora*** (Ridl.) S.Y.Wong & P.C.Boyce
    *Schismatoglottis multiflora* Ridl., J. Straits Branch Roy. Asiat. Soc. 44: 181 (1905).
13. ***Tweeddalea nicolsonii*** (A.Hay) S.Y.Wong & P.C.Boyce, **comb. nov.**
    Bas.: *Schismatoglottis nicolsonii* A.Hay, Telopea 9: 95, fig. 13 (2000).
14. ***Tweeddalea roseospatha*** (Bogner) S.Y.Wong & P.C.Boyce, **comb. nov.**
    Bas.: *Schismatoglottis roseospatha* Bogner, Aqua Pl. 1988: 96, three unnumbered figs. (1988).
15. ***Tweeddalea schottii*** (Bogner & Nicolson) S.Y.Wong & P.C.Boyce, **comb. nov.**
    Bas.: *Schismatoglottis schottii* Bogner & Nicolson, Aroideana 2: 120 (1979).

### *Provisional placement*

Three species with pleionanthic elongated stems are provisionally retained in *Schismatoglottis* (where they almost certainly do not belong). None are assignable to any of the new genera herein proposed, nor to any previously recognized genus (Low et al. 2018), and none seem obviously related to one another. Removal from *Schismatoglottis* would therefore require the recognition of further three new genera which, until molecular examination is undertaken, is premature.

***Schismatoglottis conoidea*** Engl., Bull. Soc. Tosc. Ortic. 4: 298 (1879).

(=) *Schismatoglottis caulescens* Ridl., J. Straits Branch Roy. Asiat. Soc. 44: 182 (1905).

***Schismatoglottis convolvula*** P.C.Boyce in Mayo & al., Gen. Araceae: 346 (1997).

***Schismatoglottis priapica*** S.Y.Wong, P.C.Boyce & Kartini, Webbia 74: 255 (2019).

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APPENDIX 1.

*Schismatoglottis acuminatissima* Schott, Ann. Mus. Bot. Lugduno-Batavi 1: 281 (1864) = **Apoballis acuminatissima** (Schott) S.Y.Wong & P.C.Boyce.

*Schismatoglottis acuminatissima* var. *concinna* (Schott) Engl. Monogr. Phan. 2: 353 (1879) = **Apoballis acuminatissima** (Schott) S.Y.Wong & P.C.Boyce.

***Schismatoglottis acutangula*** Engl., Pflanzenr., IV, 23Da: 110 (1912) — provisionally accepted.

*Schismatoglottis acutangula* f. *staminodiifera* Alderw., Bull. Jard. Bot. Buitenzorg, sér. 3, 4: 220 (1922) = **Schismatoglottis acutangula** Engl.

*Schismatoglottis acutifolia* (Engl.) M.Hotta, Mem. Coll. Sci. Kyoto Imp. Univ., Ser. B, Biol. 32(3): 233 (1966), *nom. illeg.*, non Engl. (1912) = **Tweeddalea schottii** (Bogner & Nicolson) S.Y.Wong & P.C.Boyce.

***Schismatoglottis acutifolia*** Engl., Pflanzenr., IV, 23Da: 88 (1912) — provisionally accepted**.**

**Schismatoglottis adducta** S.Y.Wong & P.C.Boyce, Webbia 76(2): 82 (2021).

*Schismatoglottis adoceta* S.Y.Wong, Gard. Bull. Singapore 62: 181 (2010) = **Bau adoceta** (S.Y.Wong) S.Y.Wong & P.C.Boyce.

**Schismatoglottis ahmadii** A.Hay, Telopea 9: 102 (2000).

*Schismatoglottis americana* A.M.E.Jonker & Jonker, Acta Bot. Neerl. 2: 360 (1953) = **Philonotion americanum** (A.M.E.Jonker & Jonker) S.Y.Wong & P.C.Boyce.

*Schismatoglottis amosyui* S.Y.Wong, S.L.Low & P.C.Boyce, Willdenowia 46: 294 (2016) = **Bau amosyui** (S.Y.Wong, S.L.Low & P.C.Boyce) S.Y.Wong & P.C.Boyce.

***Schismatoglottis angustifolia*** Alderw., Bull. Jard. Bot. Buitenzorg, sér. 3, 4: 344 (1922) — provisionally accepted.

*Schismatoglottis antu* S.Y.Wong & P.C.Boyce, Aroideana 38E(2): 32 (2015) = **Bau antu** (S.Y.Wong & P.C.Boyce) S.Y.Wong & P.C.Boyce.

**Schismatoglottis ardenii** A.Hay, Aroideana 25: 67 (2002 publ. 2003).

*Schismatoglottis asperata* Engl., Bull. Soc. Tosc. Ortic. 4: 297 (1879) = **Borneoa asperata** (Engl.) S.Y.Wong & P.C.Boyce.

*Schismatoglottis asperata* var. *albomaculata* Engl., Bull. Soc. Tosc. Ortic. 4: 11 (1879) = **Borneoa asperata** (Engl.) S.Y.Wong & P.C.Boyce.

**Schismatoglottis auyongii** S.Y.Wong & P.C.Boyce, Webbia 77(1): 153 (2022).

**Schismatoglottis baangongensis** S.Y.Wong, Y.C.Hoe & P.C.Boyce, Aroideana 39: 80 (2016).

*Schismatoglottis barbata* Engl., Bull. Soc. Tosc. Ortic. 4: 298 (1879) = **Borneoa barbata** (Engl.) S.Y.Wong & P.C.Boyce.

*Schismatoglottis batoeensis* Engl., Pflanzenr., IV, 23Da: 111 (1912) = **Apoballis mutata** (Scort. ex Hook.f.) S.Y.Wong & P.C.Boyce.

*Schismatoglottis bauensis* A.Hay & C.Lee, Telopea 9: 84 (2000) = **Tweeddalea bauensis** (A.Hay & C.Lee) S.Y.Wong & P.C.Boyce.

*Schismatoglottis beccariana* var. *albolineata* Engl., Bull. Soc. Tosc. Ortic. 4: 297 (1879) = **Colobogynium variegatum** (Hook. ex Veitch) S.Y.Wong, A.Hay & P.C.Boyce.

*Schismatoglottis beccariana* var. *angustifolia* Engl., Bull. Soc. Tosc. Ortic. 4: 297 (1879) = **Colobogynium variegatum** (Hook. ex Veitch) S.Y.Wong, A.Hay & P.C.Boyce.

*Schismatoglottis beccariana* var. *cuspidata* Engl., Bull. Soc. Tosc. Ortic. 4: 297 (1879) = **Tweeddalea mayoana** (Bogner & M.Hotta) S.Y.Wong & P.C.Boyce.

*Schismatoglottis beccariana* var. *oblonga* Engl., Bull. Soc. Tosc. Ortic. 4: 297 (1879) = **Colobogynium variegatum** (Hook. ex Veitch) S.Y.Wong, A.Hay & P.C.Boyce.

*Schismatoglottis beccariana* Engl., Bull. Soc. Tosc. Ortic. 4: 297 (1879) = **Colobogynium variegatum** (Hook. ex Veitch) S.Y.Wong, A.Hay & P.C.Boyce.

*Schismatoglottis belonis* S.Y.Wong, Aisahtul & P.C.Boyce, Aroideana 40(1): 7 (2017) = **Ibania belonis** (S.Y.Wong, Aisahtul & P.C.Boyce) S.Y.Wong & P.C.Boyce.

**Schismatoglottis bifasciata** Engl., Pflanzenr., IV, 23Da: 107 (1912).

**Schismatoglottis bitaeniata** Engl., Bot. Jahrb. Syst. 37: 124 (1905).

**Schismatoglottis bogneri** A.Hay, Telopea 9: 105 (2000).

*Schismatoglottis bolivarana* G.S. Bunting & Steyerm, Brittonia 21(2): 187 (1969) = **Philonotion bolivaranum** (G.S. Bunting & Steyerm.) S.Y.Wong & P.C.Boyce.

*Schismatoglottis brevicuspis* Hook.f., Fl. Brit. India 6: 537 (1893) = **Bau brevicuspis** (Hook.f.) S.Y.Wong & P.C.Boyce.

*Schismatoglottis brevipes* Hook.f., Fl. Brit. India 6: 358 (1892) = **Apoballis brevipes** (Hook.f.) S.Y.Wong & P.C.Boyce.

*Schismatoglottis brooksii* Alderw., Bull. Jard. Bot. Buitenzorg, sér. 3, 4: 341 (1922) = **Apoballis mutata** (Scort. ex Hook.f.) S.Y.Wong & P.C.Boyce.

*Schismatoglottis bulbifera* H.Okada, H.Tsukaya & Y.Mori, Syst. Bot. 24: 62 (1999) = **Tweeddalea bulbifera** (H.Okada, H.Tsukaya & Y.Mori) S.Y.Wong & P.C.Boyce.

**Schismatoglottis cadierei** Buchet & Gagnep. ex S.Y.Wong & P.C.Boyce, Aroideana 41(2-3): 54 (2018).

*Schismatoglottis cadierei* Buchet & Gagnepain, Fl. Indo-Chine 6: 1118 (1942) as '*cadieri*', *nom. inval. nom. nud.* without latin descr. (Art. 39.1 – Turland et al. 2018) = **Schismatoglottis cadierei** Buchet & Gagnep. ex S.Y.Wong & P.C.Boyce.

**Schismatoglottis caesia** S.Y.Wong, P.C.Boyce & Y.C.Hoe, Webbia 76(2): 109 (2021).

**Schismatoglottis calyptrata** (Roxb.) Zoll. & Moritzi in A.Moritzi, Syst. Verz. Java: 83 (1846).

*Schismatoglottis calyptrata* f. *dahlii* (Engl.) Engl., Pflanzenr., IV, 23Da: 116 (1912) = **Schismatoglottis calyptrata** (Roxb.) Zoll. & Moritzi.

*Schismatoglottis calyptrata* f. *glaucescens* (Hallier f.) (Engl.) Engl., Pflanzenr., IV, 23Da: 116 (1912) = **Schismatoglottis calyptrata** (Roxb.) Zoll. & Moritzi.

*Schismatoglottis calyptrata* f. *grandifolia* (Engl.) Engl., Pflanzenr., IV, 23Da: 116 (1912) = **Schismatoglottis calyptrata** (Roxb.) Zoll. & Moritzi.

*Schismatoglottis calyptrata* f. *grandifolia* Engl., Bot. Jahrb. Syst. 25: 18 (1898) = **Schismatoglottis calyptrata** (Roxb.) Zoll. & Moritzi.

*Schismatoglottis calyptrata* f. *minor* Engl., Pflanzenr., IV, 23Da: 116 (1912) = **Schismatoglottis calyptrata** (Roxb.) Zoll. & Moritzi.

*Schismatoglottis calyptrata* f. *multimarginata* Alderw., Bull. Jard. Bot. Buitenzorg, sér. 3, 4: 212 (1922) = **Schismatoglottis calyptrata** (Roxb.) Zoll. & Moritzi.

*Schismatoglottis calyptrata* f. *resupinata* Alderw., Bull. Jard. Bot. Buitenzorg, sér. 3, 4: 343 (1922) = **Schismatoglottis wallichii** Hook.f.

*Schismatoglottis calyptrata* var. *albidomaculata* (Hallier f.) Ridl., Fl. Malay Penins. 3: 31 (1907) **=** **Schismatoglottis calyptrata** (Roxb.) Zoll. & Moritzi.

*Schismatoglottis calyptrata* var. *albidomaculata* Hallier f. ex Ridl., Materials Fl. Mal. Pen. 3: 31 (1907), *nom. superfl.* pro *Schismatoglottis calyptrata* var. *maculata* Hallier f. = **Schismatoglottis calyptrata** (Roxb.) Zoll. & Moritzi.

*Schismatoglottis calyptrata* var. *albidomaculata* Hallier f., Ann. Bot. Gard. Buitenzorg 14: 260 (1897), *nom. nud.* = **Schismatoglottis calyptrata** (Roxb.) Zoll. & Moritzi.

*Schismatoglottis calyptrata* var. celebica Koord., Meded. Lands Plantentuin 19: 303 (1898) = **Schismatoglottis calyptrata** (Roxb.) Zoll. & Moritzi.

*Schismatoglottis calyptrata* var. *concolor* Hallier f., Bull. Herb. Boissier 6: 620 (1898) = **Schismatoglottis calyptrata** (Roxb.) Zoll. & Moritzi.

*Schismatoglottis calyptrata* var. *concolor* f. *glaucescens* Hallier f., Bull. Herb. Boissier 6: 620 (1898) = **Schismatoglottis calyptrata** (Roxb.) Zoll. & Moritzi.

*Schismatoglottis calyptrata* var. *concolor* f. *olivacea* Hallier f., Bull. Herb. Boissier 6: 620 (1898) = **Schismatoglottis calyptrata** (Roxb.) Zoll. & Moritzi.

*Schismatoglottis calyptrata* var. *dahlii* Engl., Bot. Jahrb. Syst. 25: 19 (1898) = **Schismatoglottis calyptrata** (Roxb.) Zoll. & Moritzi.

*Schismatoglottis calyptrata* var. *flavidomaculata* Hallier f., Ann. Jard. Bot. Buitenzorg 14: 260 (1897) = **Schismatoglottis neoguineensis** (Linden ex André) N.E.Br.

*Schismatoglottis calyptrata* var. *maculata* Hallier f., Bull. Herb. Boissier 6: 621 (1898) = **Schismatoglottis calyptrata** (Roxb.) Zoll. & Moritzi.

*Schismatoglottis calyptrata* var. *maculata* f. *albidomaculata* Hallier f., Bull. Herb. Boissier 6: 621 (1898) = **Schismatoglottis calyptrata** (Roxb.) Zoll. & Moritzi.

*Schismatoglottis calyptrata* var. *maculata* f. *flavidomaculata* (Hallier f.) Hallier f., Bull. Herb. Boissier 6: 621 (1898) = **Schismatoglottis neoguineensis** (Linden ex André) N.E.Br.

*Schismatoglottis calyptrata* var. *ornata* Ridl. ex Engl., Pflanzenr., IV, 23Da: 116 (1912) = **Schismatoglottis calyptrata** (Roxb.) Zoll. & Moritzi.

*Schismatoglottis calyptrata* var. *picta* (Schott) Hallier f., Ann. Jard. Bot. Buitenzorg 14: 260 (1897) = **Schismatoglottis picta** Schott.

*Schismatoglottis calyptrata* var. *trivittata* (Hallier) Hallier f., Ann. Jard. Bot. Buitenzorg 14: 260 (1897) = **Schismatoglottis trivittata** Hallier.

***Schismatoglottis calyptratoides*** Alderw., Bull. Jard. Bot. Buitenzorg, sér. 3, 4: 213 (1922) — provisionally accepted.

*Schismatoglottis camera-lucida* P.C.Boyce & S.Y.Wong, Aroideana 37E(1): 19 (2014) = **Bau camera-lucida** (P.C.Boyce & S.Y.Wong) S.Y.Wong & P.C.Boyce.

**Schismatoglottis canaliculata** Engl., Pflanzenr., IV, 23Da: 112 (1912).

*Schismatoglottis cardiophylla* Quisumb. & Merr., Philipp. J. Sci. 37: 136 (1928) = **Schismatoglottis plurivenia** Alderw.

*Schismatoglottis caulescens* Ridl., J. Straits Branch Roy. Asiat. Soc. 44: 182 (1905) = **Schismatoglottis conoidea** Engl.

*Schismatoglottis celebica* Engl., Bot. Jahrb. Syst. 25: 19 (1898), nom. illeg. = **Schismatoglottis subundulata** (Zoll. ex Schott) Nicolson.

*Schismatoglottis ciliata* A.Hay, Telopea 9: 60 (2000) = **Borneoa ciliata** (A.Hay) S.Y.Wong & P.C.Boyce.

**Schismatoglottis clarae** A.Hay, Telopea 9: 119 (2000).

*Schismatoglottis clausula* S.Y.Wong, Gard. Bull. Singapore 61: 530 (2010) = **Sarawakia clausula** (S.Y.Wong) S.Y.Wong & P.C.Boyce.

**Schismatoglottis clemensiorum** A.Hay, Telopea 9: 61 (2000).

**Schismatoglottis clivemarshii** S.Y.Wong, P.C.Boyce & Kartini, Webbia 74: 251 (2019).

**Schismatoglottis colocasioidea** M.Hotta, Mem. Coll. Sci. Kyoto Imp. Univ., Ser. B, Biol. 32(3): 238 (1966).

*Schismatoglottis concinna* Schott, Ann. Mus. Bot. Lugduno-Batavi 1: 281 (1864) = **Apoballis acuminatissima** (Schott) S.Y.Wong & P.C.Boyce.

*Schismatoglottis concinna* var. *immaculata* N.E.Br., Gard. Chron., n.s., 18: 298 (1882) = **Apoballis acuminatissima** (Schott) S.Y.Wong & P.C.Boyce.

*Schismatoglottis concinna* var. *purpurea* N.E.Br., Gard. Chron., n.s., 18: 298 (1882) = **Apoballis acuminatissima** (Schott) S.Y.Wong & P.C.Boyce.

*Schismatoglottis confinis* S.Y.Wong & P.C.Boyce, Gard. Bull. Singapore 60: 159 (2008) = **Tweeddalea confinis** (S.Y.Wong & P.C.Boyce) S.Y.Wong & P.C.Boyce.

**Schismatoglottis conoidea** Engl., Bull. Soc. Tosc. Ortic. 4: 298 (1879) — provisionally retained in *Schismatoglottis* pending further study.

*Schismatoglottis conversa* Alderw., Bull. Jard. Bot. Buitenzorg, sér. 3, 4: 344 (1922) = **Schismatoglottis wallichii** Hook.f.

**Schismatoglottis convolvula** P.C.Boyce in Mayo & al., Gen. Araceae: 346 (1997) — provisionallu retained in *Schismatoglottis* pending further study.

*Schismatoglottis cordifolia* M.Hotta, Mem. Coll. Sci. Kyoto Imp. Univ., Ser. B, Biol. 32(3): 229 (1966), nom. illeg., non Ridl. (1911) = **Borneoa hottae** (Bogner & Nicolson) S.Y.Wong & P.C.Boyce.

**Schismatoglottis cordifolia** Ridl., J. Straits Branch Roy. Asiat. Soc. 57: 112 (1911).

*Schismatoglottis corneri* A.Hay, Telopea 9: 29 (2000) = **Nabalu corneri** (A.Hay) S.Y.Wong & P.C.Boyce.

*Schismatoglottis costata* hort. ex Gentil., Pl. Cult. Serres Jard. Bot. Brux. 174 (1907), *nomen nudum* (Art. 38, Turland et al. 2018) = ?

*Schismatoglottis costata* var. *splendens* hort. ex Gentil, Pl. Cult. Serres Jard. Bot. Brux. 174 (1907), *nomen nudum* (Art. 38, Turland et al. 2018) = ?

*Schismatoglottis crassifolia* Engl., Pflanzenr., IV, 23Da: 86 (1912) = **Colobogynium variegatum** (Hook. ex Veitch) S.Y.Wong, A.Hay & P.C.Boyce.

*Schismatoglottis crinitissima* A.Hay, Telopea 9: 64 (2000) = **Borneoa crinitissima** (A.Hay) S.Y.Wong & P.C.Boyce.

*Schismatoglottis crispa* Pitcher & Manda, Nursery Cat. (United States Nurseries) 1892: 95 (1892) = **Aglaonema robeleynii** (Van Geert) Pitcher & Manda.

*Schismatoglottis crispata* Hook.f., Curtis's Bot. Mag. 107: t. 6576 (1881) = **Borneoa asperata** (Engl.) S.Y.Wong & P.C.Boyce.

*Schismatoglottis crispata purpurea* Anon., Gard. Chron., n.s., 24: 183 (1885) = **Borneoa asperata** (Engl.) S.Y.Wong & P.C.Boyce.

*Schismatoglottis crispata* Van Geert, Nursery Cat. (Auguste Van Geert) 81: 96 (1881) = **Borneoa asperata** (Engl.) S.Y.Wong & P.C.Boyce.

*Schismatoglottis crypta* P.C.Boyce & S.Y.Wong, Webbia 69: 225 (2014) = **Borneoa crypta** (P.C.Boyce & S.Y.Wong) S.Y.Wong & P.C.Boyce.

*Schismatoglottis cyria* P.C.Boyce, Kew Bull. 49: 796 (1994) = **Sarawakia cyria** (P.C.Boyce) S.Y.Wong & P.C.Boyce.

**Schismatoglottis decipiens** A.Hay, Telopea 9: 120 (2000).

*Schismatoglottis decora* W.Bull, Nursery Cat. (William Bull) 1884: 16 (1884) = **Schismatoglottis pulchra** N.E.Br.

*Schismatoglottis decora wittiana* Anon., Gard. Chron., n.s., 24: 183 (1885) = **Schismatoglottis pulchra** N.E.Br.

*Schismatoglottis dilecta* S.Y.Wong, P.C.Boyce & S.L.Low, Gard. Bull. Singapore 64: 261 (2012) = **Borneoa dilecta** (S.Y.Wong, P.C.Boyce & S.L.Low) S.Y.Wong & P.C.Boyce.

***Schismatoglottis diversicolor*** Alderw., Bull. Jard. Bot. Buitenzorg, sér. 3, 4: 205 (1922) — provisionally accepted.

***Schismatoglottis djamuensis*** Engl., Bot. Jahrb. Syst. 49: 99 (1912) — provisionally accepted.

*Schismatoglottis dorensis* Gibbs, Fl. Arfak Mts.: 201 (1917) = **Schismatoglottis calyptrata** (Roxb.) Zoll. & Moritzi.

*Schismatoglottis dulosa* S.Y.Wong, Gard. Bull. Singapore 61: 532 (2010) = **Tweeddalea dulosa** (S.Y.Wong) S.Y.Wong & P.C.Boyce.

**Schismatoglottis ecaudata** A.Hay, Telopea 9: 121 (2000).

**Schismatoglottis edanoi** A.Hay, Telopea 9: 121 (2000).

*Schismatoglottis elegans* A.Hay, Telopea 9: 67 (2000) = **Bau elegans** (A.Hay) S.Y.Wong, A.Hay & P.C.Boyce.

*Schismatoglottis elongata* Engl., Bull. Soc. Tosc. Ortic. 4: 298 (1879) = **Rhynchopyle elongata** (Engl.) Engl.

***Schismatoglottis emarginata*** Engl., Pflanzenr., IV, 23Da: 93 (1912) — provisionally accepted.

**Schismatoglottis engleriana** Alderw., Bull. Jard. Bot. Buitenzorg, sér. 3, 4: 217 (1922).

*Schismatoglottis erecta* M.Hotta, Mem. Coll. Sci. Kyoto Imp. Univ., Ser. B, Biol. 32(3): 233 (1966) = **Tweeddalea erecta** (M.Hotta) S.Y.Wong & P.C.Boyce.

*Schismatoglottis evelyniae* P.C.Boyce & S.Y.Wong, Aroideana 36E(1): 6 (2013) = **Ayuantha evelyniae** (P.C.Boyce & S.Y.Wong) S.Y.Wong & P.C.Boyce.

***Schismatoglottis eximia*** Engl., Pflanzenr., IV, 23Da: 101 (1912) — provisionally accepted.

**Schismatoglottis eymae** A.Hay, Telopea 9: 122 (2000).

*Schismatoglottis fasciata* (Ridl.) Engl., Pflanzenr., IV, 23Da: 87 (1912) = **Colobogynium variegatum** (Hook. ex Veitch) S.Y.Wong, A.Hay & P.C.Boyce.

*Schismatoglottis ferruginea* Merr., J. Straits Branch Roy. Asiat. Soc. 85: 159 (1922) = **Borneoa ferruginea** (Merr.) S.Y.Wong & P.C.Boyce.

*Schismatoglottis forbesii* Engl., Pflanzenr., IV, 23Da: 103 (1912) = **Apoballis longicaulis** (Ridl.) S.Y.Wong & P.C.Boyce.

*Schismatoglottis fossae* S.Y.Wong, P.C.Boyce & Aisahtul, Nordic J. Bot. 37(11)-e02566: 2 (2019) = **Ibania fossae** (S.Y.Wong, P.C.Boyce & Aisahtul) S.Y.Wong & P.C.Boyce.

*Schismatoglottis gaesa* S.Y.Wong, Aisahtul & P.C.Boyce, Aroideana 40(1): 10 (2017) = **Ibania gaesa** (S.Y.Wong, Aisahtul & P.C.Boyce) S.Y.Wong & P.C.Boyce.

*Schismatoglottis gamoandra* M.Hotta, Mem. Coll. Sci. Kyoto Imp. Univ., Ser. B, Biol. 32(3): 237 (1966) = **Bau puberulipes** (Alderw.) S.Y.Wong & P.C.Boyce.

*Schismatoglottis gampsospadix* P.C.Boyce & S.Y.Wong, Aroideana 37E(1): 23 (2014) **= Borneoa gampsospadix** (P.C.Boyce & S.Y.Wong) S.Y.Wong & P.C.Boyce.

*Schismatoglottis gangsai* S.Y.Wong, Aisahtul & P.C.Boyce, Aroideana 41(1): 141 (2018) = **Ibania gangsai** (S.Y.Wong, Aisahtul & P.C.Boyce) S.Y.Wong & P.C.Boyce.

*Schismatoglottis gephyra* P.C.Boyce, Borneo J. Resource Sci. Technol. 7(2): 85 (2017) = **Ibania gephyra** (P.C.Boyce) S.Y.Wong & P.C.Boyce.

**Schismatoglottis giamensis** S.Y.Wong, Y.C.Hoe & P.C.Boyce, Webbia 76(2): 88 (2021).

*Schismatoglottis gillianiae* P.C.Boyce, Kew Bull. 49: 793 (1994) = **Borneoa gillianiae** (P.C.Boyce) S.Y.Wong & P.C.Boyce.

***Schismatoglottis glauca*** Engl., Pflanzenr., IV, 23Da: 106 (1912) — provisionally accepted.

**Schismatoglottis grabowskii** Engl., Pflanzenr., IV, 23Da: 121 (1912).

*Schismatoglottis grandiflora* Alderw., Bull. Jard. Bot. Buitenzorg, sér. 3, 4: 201 (1922) = **Apoballis grandiflora** (Alderw.) S.Y.Wong & P.C.Boyce.

**Schismatoglottis guabatuensis** S.Y.Wong & P.C.Boyce, Nord. J. Bot. 2020: e02808: 1 (2020).

*Schismatoglottis gui* P.C.Boyce & S.Y.Wong, Aroideana 37E(1): 24 (2014) = **Bau gui** (P.C.Boyce & S.Y.Wong) S.Y.Wong & P.C.Boyce.

***Schismatoglottis hainanensis*** H.Li, Acta Phytotax. Sin. 15(2): 103 (1977) — provisionally accepted.

**Schismatoglottis harmandii** Engl., Pflanzenr., IV, 23Da: 104 (1912).

*Schismatoglottis hastata* Elmer, Leafl. Philipp. Bot. 10: 3701 (1939), no latin descr. = **Schismatoglottis pusilla** Engl.

*Schismatoglottis hastifolia* Hallier f. ex Engl., Pflanzenr., IV, 23Da: 116 (1912) = **Apoballis hastifolia** (Hallier f. ex Engl.) S.Y.Wong & P.C.Boyce.

*Schismatoglottis havilandii* (Engl.) M.Hotta, Mem. Coll. Sci. Kyoto Imp. Univ., Ser. B, Biol. 32(3): 233 (1966) = **Ooia havilandii** (Engl.) S.Y.Wong & P.C.Boyce.

*Schismatoglottis hayana* Bogner & P.C.Boyce, Gard. Bull. Singapore 60: 175 (2009) = **Tweeddalea hayana** (Bogner & P.C.Boyce) S.Y.Wong & P.C.Boyce.

*Schismatoglottis hayi* S.Y.Wong & P.C.Boyce, Acta Phytotax. Geobot. 61: 135 (2011) = **Bau hay**i (S.Y.Wong & P.C.Boyce) S.Y.Wong & P.C.Boyce.

***Schismatoglottis hellwigiana*** Engl., Nova Guinea 8: 806 (1912) — provisionally accepted.

*Schismatoglottis hellwigiana* var. *subcordata* Engl., Pflanzenr., IV, 23Da: 102 (1912) = **Schismatoglottis hellwigiana** Engl.

*Schismatoglottis hendrikii* S.Y.Wong & P.C.Boyce, Aroideana 40(3): 28 (2017) = **Bau hendrikii** (S.Y.Wong & P.C.Boyce) S.Y.Wong & P.C.Boyce.

**Schismatoglottis heterodoxa** S.Y.Wong, Willdenowia 42: 255 (2012).

*Schismatoglottis homalomenoidea* M.Hotta, Mem. Coll. Sci. Kyoto Imp. Univ., Ser. B, Biol. 32(3): 225 (1966) = **Colobogynium variegatum** (Hook. ex Veitch) S.Y.Wong, A.Hay & P.C.Boyce.

*Schismatoglottis hottae* Bogner & Nicolson, Aroideana 2: 120 (1979) = **Borneoa hottae** (Bogner & Nicolson) S.Y.Wong & P.C.Boyce.

**Schismatoglottis ifugaoensis** S.Y.Wong, Bogner & P.C.Boyce, Willdenowia 41: 101 (2011).

*Schismatoglottis iliata* S.Y.Wong & P.C.Boyce, Willdenowia 44: 6 (2014) = **Tweeddalea iliata** (S.Y.Wong & P.C.Boyce) S.Y.Wong & P.C.Boyce

*Schismatoglottis imbakensis* Kartini, S.Y.Wong & P.C.Boyce, Webbia 75(1): 116 (2020) = **Ibania imbakensis** (Kartini, S.Y.Wong & P.C.Boyce), S.Y.Wong & P.C.Boyce.

*Schismatoglottis inculta* Kurniawan & P.C.Boyce, Acta Phytotax. Geobot. 62: 41 (2011) = **Bau inculta** (Kurniawan & P.C.Boyce) S.Y.Wong & P.C.Boyce.

*Schismatoglottis irosinensis* Elmer, Leafl. Philipp. Bot. 10: 3632 (1938), no latin descr. = **Schismatoglottis pusilla** Engl.

**Schismatoglottis irrorata** Engl., Nova Guinea 8: 806 (1912).

*Schismatoglottis javanica* Engl., Nova Guinea 8: 806 (1912) = **Apoballis javanica** (Engl.) S.Y.Wong & P.C.Boyce.

*Schismatoglottis jelandii* P.C.Boyce & S.Y.Wong, Gard. Bull. Singapore 58: 7 (2006) = **Borneoa jelandii** (P.C.Boyce & S.Y.Wong) S.Y.Wong & P.C.Boyce.

*Schismatoglottis jepomii* P.C.Boyce & S.Y.Wong, Gard. Bull. Singapore 58: 11 (2006) = **Ayuantha pudenda** (A.Hay) S.Y.Wong & P.C.Boyce.

*Schismatoglottis jitinae* S.Y.Wong, Gard. Bull. Singapore 61: 535 (2010) = **Tweeddalea jitinae** (S.Y.Wong) S.Y.Wong & P.C.Boyce.

*Schismatoglottis josefii* A.Hay, Telopea 9: 89 (2000) = **Schottarum josefii** (A.Hay) P.C.Boyce.

*Schismatoglottis kingii* Engl., Nova Guinea 8: 806 (1912) = **Borneoa scortechinii** (Hook.f.) S.Y.Wong & P.C.Boyce.

***Schismatoglottis klossii*** Ridl., Trans. Linn. Soc. London, Bot. 9: 239 (1916) — provisionally accepted.

***Schismatoglottis kotoensis*** (Hayata) T.C.Huang, J.L.Hsiao & H.Y.Yeh, Taiwania 45: 305 (2000) — provisionally accepted.

*Schismatoglottis kurimana* Alderw., Bull. Jard. Bot. Buitenzorg, sér. 3, 4: 207 (1922) = **Apoballis acuminatissima** (Schott) S.Y.Wong & P.C.Boyce.

*Schismatoglottis kurzii* Hook.f., Fl. Brit. India 6: 539 (1893) = **Apoballis mutata** (Scort. ex Hook.f.) S.Y.Wong & P.C.Boyce.

*Schismatoglottis lancifolia* Hallier f. & Engl., Pflanzenr., IV, 23Da: 88 (1912) = **Apoballis acuminatissima** (Schott) S.Y.Wong & P.C.Boyce.

*Schismatoglottis lansbergiana* Linden, Cat. Gén. 109: 5 (1883) = **Apoballis acuminatissima** (Schott) S.Y.Wong & P.C.Boyce.

*Schismatoglottis larynx* S.Y.Wong & P.C.Boyce, Aroideana 39: 18 (2016) = **Sarawakia larynx** (S.Y.Wong & P.C.Boyce), S.Y.Wong & P.C.Boyce.

*Schismatoglottis latevaginata* Engl., Pflanzenr., IV, 23Da: 106 (1912) = **Bau latevaginata** (Engl.) S.Y.Wong & P.C.Boyce.

*Schismatoglottis latifolia* Miq., Fl. Ned. Ind. 3: 214 (1856) = **Apoballis rupestris** (Zoll. & Moritzi) S.Y.Wong & P.C.Boyce.

*Schismatoglottis latifolia* var. *rubescens* Engl., Pflanzenr., IV, 23Da: 118 (1912) = **Apoballis rupestris** (Zoll. & Moritzi) S.Y.Wong & P.C.Boyce.

*Schismatoglottis latifolia* var. *viridis* Engl., Pflanzenr., IV, 23Da: 118 (1912), *nom. superfl.* pro var. typ. = **Apoballis rupestris** (Zoll. & Moritzi) S.Y.Wong & P.C.Boyce.

*Schismatoglottis lavallei* Linden, Ill. Hort. 28: 71, t.418 (1881) = **Apoballis acuminatissima** (Schott) S.Y.Wong & P.C.Boyce.

*Schismatoglottis lavalleei* (Van Geert) Linden ex N.E.Br., Ill. Hort. 28: 71 (1881) = **Apoballis acuminatissima** (Schott) S.Y.Wong & P.C.Boyce.

*Schismatoglottis lavallei* var. *immaculata* N.E.Br., Gard. Chron., n.s. 18: 298 (1882) = **Apoballis acuminatissima** (Schott) S.Y.Wong & P.C.Boyce.

*Schismatoglottis lavallei* var. *lansbergiana* Linden, Ill. Hort. 29: 173, t.468 (1882) = **Apoballis acuminatissima** (Schott) S.Y.Wong & P.C.Boyce.

*Schismatoglottis lavallei* var. *purpurea* N.E.Br., Gard. Chron., n.s. 18: 298 (1882) = **Apoballis acuminatissima** (Schott) S.Y.Wong & P.C.Boyce.

**Schismatoglottis laxipistillata** S.Y. Wong, P.C.Boyce & Y.C.Hoe, Webbia 76(2): 112 (2021).

*Schismatoglottis leptophylla* Alderw., Bull. Jard. Bot. Buitenzorg, sér. 3, 4: 210 (1922) = **Apoballis mutata** (Scort. ex Hook.f.) S.Y.Wong & P.C.Boyce.

**Schismatoglottis lingua** A.Hay, Telopea 9: 124 (2000).

*Schismatoglottis linguiformis* Engl., Pflanzenr., IV, 23Da: 93 (1912) = **Apoballis linguiformis** (Engl.) S.Y.Wong & P.C.Boyce.

*Schismatoglottis liniae* S.Y.Wong, Gard. Bull. Singapore 62: 187 (2010) = **Bau liniae** (S.Y.Wong) S.Y.Wong & P.C.Boyce.

*Schismatoglottis longicaulis* Ridl., J. Bot. 40: 37 (1902) = **Apoballis longicaulis** (Ridl.) S.Y.Wong & P.C.Boyce.

*Schismatoglottis longicuspis* Engl., Pflanzenr., IV, 23Da: 100 (1912) = **Schismatoglottis wallichii** Hook.f.

*Schismatoglottis longifolia* Ridl., J. Bot. 40: 37 (1902) = **Vesta longifolia** (Ridl.) S.Y.Wong.

***Schismatoglottis longipes*** Miq., Fl. Ned. Ind. 3: 214 (1856) — provisionally accepted.

**Schismatoglottis longispatha** W.Bull, Nursery Cat. (William Bull) 1881: 20 (1881).

**Schismatoglottis lowiae** S.Y.Wong & P.C.Boyce, Aroideana 40: 31 (2017).

*Schismatoglottis luzonensis* Engl., Pflanzenr., IV, 23Da: 121 (1912), nom. illeg. = **Schismatoglottis plurivenia** Alderw.

**Schismatoglottis luzonensis** Engl., Pflanzenr., IV, 23Da: 88 (1912).

*Schismatoglottis maculata* Alderw., Bull. Jard. Bot. Buitenzorg, sér. 3, 4: 218 (1922) = **Schismatoglottis nieuwenhuisii** Engl.

*Schismatoglottis maelii* P.C.Boyce & S.Y.Wong, Gard. Bull. Singapore 58: 14 (2006) = **Tweeddalea maelii** (P.C.Boyce & S.Y.Wong) S.Y.Wong & P.C.Boyce.

*Schismatoglottis marginata* Ridl., J. Bot. 40: 36 (1902), nom. illeg. non. Engler (1879) = **Borneoa scortechinii** (Hook.f.) S.Y.Wong & P.C.Boyce.

*Schismatoglottis matangensis* S.Y.Wong, Gard. Bull. Singapore 62: 190 (2010) = **Bau matangensis** (S.Y.Wong) S.Y.Wong & P.C.Boyce.

*Schismatoglottis mayoana* Bogner & M.Hotta, Acta Phytotax. Geobot. 34: 48 (1983) = **Tweeddalea mayoana** (Bogner & M.Hotta) S.Y.Wong & P.C.Boyce.

*Schismatoglottis megaphylla* Furtado, mss = **Nabalu corneri** (A.Hay) S.Y.Wong & P.C.Boyce.

*Schismatoglottis meriraiensis* P.C.Boyce & S.Y.Wong, Telopea 18: 445 (2015) = **Bau meriraiensis** (P.C.Boyce & S.Y.Wong) S.Y.Wong & P.C.Boyce.

**Schismatoglottis merrillii** Engl., Pflanzenr., IV, 23Da: 89 (1912).

*Schismatoglottis metallica* S.Y.Wong, Koens & P.C.Boyce, Webbia 77(1): 160 (2022) = **Bau metallica** (S.Y.Wong, Koens & P.C.Boyce) S.Y.Wong & P.C.Boyce.

**Schismatoglottis mindanaoana** Engl., Pflanzenr., IV, 23Da: 103 (1912).

*Schismatoglottis minor* Hook.f., Fl. Brit. India 6: 538 (1893) = **Apoballis brevipes** (Hook.f.) S.Y.Wong & P.C.Boyce.

*Schismatoglottis mira* S.Y.Wong, P.C.Boyce & S.L.Low, Gard. Bull. Singapore 64: 263 (2012) = **Borneoa mira** (S.Y.Wong, P.C.Boyce & S.L.Low) S.Y.Wong & P.C.Boyce.

**Schismatoglottis modesta** Schott, Ann. Mus. Bot. Lugduno-Batavi 1: 125 (1863).

*Schismatoglottis monoplacenta* M.Hotta, Mem. Coll. Sci. Kyoto Imp. Univ., Ser. B, Biol. 32(3): 227 (1966) = **Tweeddalea monoplacenta** (M.Hotta) S.Y.Wong & P.C.Boyce.

*Schismatoglottis mons* Kartini, Webbia 77(2): 268 (2022) = **Borneoa mons** (Kartini) S.Y.Wong & P.C.Boyce.

*Schismatoglottis monticola* Alderw., Bull. Jard. Bot. Buitenzorg, sér. 3, 4: 202 (1922) = **Apoballis mutata** (Scort. ex Hook.f.) S.Y.Wong & P.C.Boyce.

**Schismatoglottis moodii** A.Hay, Telopea 9: 131 (2000).

**Schismatoglottis motleyana** (Schott) Engl., Pflanzenr., IV, 23Da: 102 (1912).

*Schismatoglottis multiflora* Ridl., J. Straits Branch Roy. Asiat. Soc. 44: 181 (1905) = **Tweeddalea multiflora** (Ridl.) S.Y.Wong & P.C.Boyce.

*Schismatoglottis multiflora* var. *latifolia* Ridl., J. Straits Branch Roy. Asiat. Soc. 49: 50 (1908) = **Tweeddalea mayoana** (Bogner & M.Hotta) S.Y.Wong & P.C.Boyce.

*Schismatoglottis multinervia* M.Hotta, Mem. Coll. Sci. Kyoto Imp. Univ., Ser. B, Biol. 32(3): 237 (1966) = **Bau multinervia** (M.Hotta) S.Y.Wong & P.C.Boyce.

**Schismatoglottis muluensis** M.Hotta, Mem. Coll. Sci. Kyoto Imp. Univ., Ser. B, Biol. 32(3): 235 (1966).

*Schismatoglottis mutata* Scort. ex Hook.f., Fl. Brit. India 6: 538 (1893) = **Apoballis mutata** (Scort. ex Hook.f.) S.Y.Wong & P.C.Boyce.

**Schismatoglottis neoguineensis** (Linden ex André) N.E.Br., Gard. Chron., n.s., 24: 776 (1885).

*Schismatoglottis nervosa* Ridl., J. Straits Branch Roy. Asiat. Soc. 49: 50 (1908) = **Bau nervosa** (Ridl.) S.Y.Wong & P.C.Boyce.

**Schismatoglottis niahensis** A.Hay, Telopea 9: 137 (2000).

*Schismatoglottis nicolsonii* A.Hay, Telopea 9: 95 (2000) = **Tweeddalea nicolsonii** (A.Hay) S.Y.Wong, A.Hay & P.C.Boyce.

**Schismatoglottis nieuwenhuisii** Engl., Bot. Jahrb. Syst. 48: 95 (1912).

*Schismatoglottis okadae* M.Hotta, Contrib. Biol. Lab. Kyoto Univ. 27: 151 (1987) = **Apoballis okadae** (M.Hotta) S.Y.Wong & P.C.Boyce.

*Schismatoglottis opaca* Engl., Pflanzenr., IV, 23Da: 86 (1912) = **Colobogynium variegatum** (Hook. ex Veitch) S.Y.Wong, A.Hay & P.C.Boyce.

*Schismatoglottis ornata* Alderw., Bull. Jard. Bot. Buitenzorg, sér. 3, 4: 220 (1922) = **Colobogynium variegatum** (Hook. ex Veitch) S.Y.Wong, A.Hay & P.C.Boyce.

*Schismatoglottis ovata* Schott, Ann. Mus. Bot. Lugduno-Batavi 1: 125 (1863) = **Apoballis ovata (**Schott) S.Y.Wong & P.C.Boyce.

**Schismatoglottis pantiensis** S.Y.Wong, P.C.Boyce & Y.C.Hoe, Webbia 76(2): 115 (2021).

***Schismatoglottis parviflora*** M.Hotta, Mem. Coll. Sci. Kyoto Imp. Univ., Ser. B, Biol. 32(3): 225 (1966) = **Colobogynium variegatum** (Hook. ex Veitch) S.Y.Wong, A.Hay & P.C.Boyce.

*Schismatoglottis parvifolia* Alderw., Bull. Jard. Bot. Buitenzorg, sér. 3, 4: 342 (1922) — provisionally accepted.

*Schismatoglottis patentinervia* Engl., Pflanzenr., IV, 23Da: 90 (1912) = **Ibania patentinervia** (Engl.) S.Y.Wong & P.C.Boyce.

*Schismatoglottis pectinervia* A.Hay, Telopea 9: 138 (2000) = **Ibania pectinervia** (A.Hay) S.Y.Wong & P.C.Boyce.
*Schismatoglottis pellucida* S.Y.Wong, P.C.Boyce & S.K.Chai, Nordic J. Bot. 37(11)-e02566: 4 (2019) = **Bau pellucida** (S.Y.Wong, P.C.Boyce & S.K.Chai) S.Y.Wong & P.C.Boyce.

***Schismatoglottis penangensis*** Engl., Pflanzenr., IV, 23Da: 88 (1912) — provisionally accepted.

*Schismatoglottis persistens* S.Y.Wong & P.C.Boyce, Willdenowia 44: 247 (2014) = **Borneoa persistens** (S.Y.Wong & P.C.Boyce) S.Y.Wong & P.C.Boyce.

*Schismatoglottis petradoxa* S.Y.Wong & P.C.Boyce, Aroideana 37E(2): 19 (2014) = **Sarawakia petradoxa**

(S.Y.Wong & P.C.Boyce), S.Y.Wong & P.C.Boyce.

*Schismatoglottis petri* A.Hay, Telopea 9: 162 (2000) = **Ayuantha petri** (A.Hay) S.Y.Wong, A.Hay & P.C.Boyce.

*Schismatoglottis pichinensis* P.C.Boyce, Borneo J. Resource Sci. Technol. 7(2): 87 (2017) = **Ibania pichinensis** (P.C.Boyce) S.Y.Wong & P.C.Boyce.

**Schismatoglottis picta** Schott, Oesterr. Bot. Z. 13: 317 (1863).

*Schismatoglottis picta* f. *bivittata* Engl., Pflanzenr., IV, 23Da: 114 (1912) = **Schismatoglottis picta** Schott.

*Schismatoglottis picta* f. *robusta* Engl., Pflanzenr., IV, 23Da: 114 (1912) = **Schismatoglottis picta** Schott.

*Schismatoglottis pimula* hort. ex Gentil, Pl. Cult. Serres Jard. Bot. Brux. 174 (1907) = ?

*Schismatoglottis platystigma* M.Hotta, Mem. Coll. Sci. Kyoto Imp. Univ., Ser. B, Biol. 32(3): 229 (1966) = **Ayuantha platystigm**a (M.Hotta), S.Y.Wong & P.C.Boyce.

**Schismatoglottis plurivenia** Alderw., Bull. Jard. Bot. Buitenzorg, sér. 3, 4: 209 (1922).

*Schismatoglottis pocong* S.Y.Wong, S.L.Low & P.C.Boyce, Willdenowia 46: 296 (2016) = **Bau pocong** (S.Y.Wong, S.L.Low & P.C.Boyce) S.Y.Wong & P.C.Boyce.

*Schismatoglottis porpax* S.Y.Wong, Kartini & P.C.Boyce, Ann. Bot. Fenn. 56: 296 (2019) = **Bau porpax** (S.Y.Wong, S.L.Low & P.C.Boyce) S.Y.Wong & P.C.Boyce.

***Schismatoglottis potamophila*** Alderw., Bull. Jard. Bot. Buitenzorg, sér. 3, 4: 343 (1922) — provisionally accepted.

**Schismatoglottis priapica** S.Y.Wong, P.C.Boyce & Kartini, Webbia 74: 255 (2019) — provisionally retained in *Schismatoglottis* pending further study.

**Schismatoglottis prietoi** P.C.Boyce, Medecilo & S.Y.Wong, Willdenowia 45: 407 (2015).

***Schismatoglottis pseudocalyptrata*** Alderw., Bull. Jard. Bot. Buitenzorg, sér. 3, 4: 212 (1922) — provisionally accepted.

*Schismatoglottis puberulipes* Alderw., Bull. Jard. Bot. Buitenzorg, sér. 3, 4: 200 (1922) = **Bau puberulipes** (Alderw.) S.Y.Wong & P.C.Boyce.

*Schismatoglottis pudenda* A.Hay, Telopea 9: 98 (2000) = **Ayuantha pudenda** (A.Hay) S.Y.Wong & P.C.Boyce.

**Schismatoglottis pulchra** N.E.Br., Ill. Hort. 31: t. 520 (1884).

**Schismatoglottis pumila** Hallier f. ex Engl., Pflanzenr., IV, 23Da: 111 (1912).

*Schismatoglottis puncakborneensis* P.C.Boyce, Borneo J. Resource Sci. Technol. 7(2): 89 (2017) = **Ibania puncakborneensis** (P.C.Boyce) S.Y.Wong & P.C.Boyce.

*Schismatoglottis purpurea* hort. ex Gentil, Pl. Cult. Serres Jard. Bot. Brux. 174 (1907) = ?

*Schismatoglottis pyrrhias* A.Hay, Telopea 9: 78 (2000) = **Borneoa pyrrhias** (A.Hay) S.Y.Wong & P.C.Boyce.

**Schismatoglottis ranchanensis** S.Y.Wong, Willdenowia 42: 257 (2012).

*Schismatoglottis rejangica* S.Y.Wong & P.C.Boyce, Aroideana 39: 22 (2016) = **Sarawakia rejangica** (S.Y.Wong & P.C.Boyce), S.Y.Wong & P.C.Boyce.

*Schismatoglottis reticosa* S.Y.Wong & P.C.Boyce, Webbia 77(1): 163 (2022) = **Bau reticosa** (S.Y.Wong & P.C.Boyce) S.Y.Wong & P.C.Boyce.

*Schismatoglottis retinervia* Furtado, Gard. Bull. Straits Settlem. 8: 157 (1935) = **Ibania retinervia** (Furtado) S.Y.Wong & P.C.Boyce.

*Schismatoglottis ridleyana* Engl., Pflanzenr., IV, 23Da: 116 (1912) = **Apoballis ridleyana** (Engl.) S.Y.Wong & P.C.Boyce.

***Schismatoglottis riparia*** Schott, Ann. Mus. Bot. Lugduno-Batavi 1: 281 (1864) — provisionally accepted.

*Schismatoglottis rizalensis* Engl., Pflanzenr., IV, 23Da: 100 (1912) = **Schismatoglottis merrillii** Engl.

*Schismatoglottis roebelinii* Pitcher & Manda, Gen. Ill. Guide Pl.: 141 (1895), orth. var. = **Aglaonema robeleynii** (Van Geert) Pitcher & Manda.

**Schismatoglottis roh** S.Y.Wong, Y.C.Hoe & P.C.Boyce, Webbia 76(2): 97 (2021).

**Schismatoglottis roseopedes** S.Y.Wong, P.C.Boyce & S.K.Chai, Nordic J. Bot. 37(11)-e02566: 6 (2019).

*Schismatoglottis roseospatha* Bogner, Aqua Pl. 1988: 96 (1988) = **Tweeddalea roseospatha** (Bogner) S.Y.Wong & P.C.Boyce

*Schismatoglottis rotundifolia* Engl., Pflanzenr., IV, 23Da: 122 (1912) = **Apoballis mutata** (Scort. ex Hook.f.) S.Y.Wong & P.C.Boyce.

*Schismatoglottis rubiginosa* M.Hotta, Mem. Coll. Sci. Kyoto Imp. Univ., Ser. B, Biol. 32(3): 231 (1966) = **Borneoa barbata** (Engl.) S.Y.Wong & P.C.Boyce.

*Schismatoglottis rubrocincta* Engl., Pflanzenr., IV, 23Da: 106 (1912) = **Apoballis acuminatissima** (Schott) S.Y.Wong & P.C.Boyce.

*Schismatoglottis rupestris* Zoll. & Moritzi in H.Zollinger, Syst. Verz. Ind. Archip. 1: 77 (1854) = **Apoballis rupestris** (Zoll. & Moritzi) S.Y.Wong & P.C.Boyce.

***Schismatoglottis ruttenii*** Alderw., Bull. Jard. Bot. Buitenzorg, sér. 3, 4: 211 (1922) — provisionally accepted.

**Schismatoglottis saafiei** Kartini, P.C.Boyce & S.Y.Wong, Nordic J. Bot. 35: 719 (2017).

*Schismatoglottis sagittifolia* Alderw., Bull. Jard. Bot. Buitenzorg, sér. 3, 4: 204 (1922) = **Apoballis sagittifolia** (Alderw.) S.Y.Wong & P.C.Boyce.

**Schismatoglottis samarensis** A.Hay, Telopea 9: 143 (2000).

*Schismatoglottis sarikeensis* (Bogner & M.Hotta) A.Hay & Bogner, Telopea 9: 100 (2000) = **Schottarum sarikeense** (Bogner & M.Hotta) P.C.Boyce & S.Y.Wong.

*Schismatoglottis schottii* Bogner & Nicolson, Aroideana 2: 120 (1979) = **Tweeddalea schottii** (Bogner & Nicolson) S.Y.Wong & P.C.Boyce.

**Schismatoglottis scintillans** Scherber. & P.C.Boyce, Willdenowia 43: 88 (2013).

*Schismatoglottis scortechinii* Hook.f., Fl. Brit. India 6: 537 (1893) = **Borneoa scortechinii** (Hook.f.) S.Y.Wong & P.C.Boyce.

*Schismatoglottis sejuncta* A.Hay, Telopea 9: 83 (2000) = **Borneoa sejuncta** (A.Hay) S.Y.Wong & P.C.Boyce.

**Schismatoglottis serratodentata** S.Y.Wong, P.C.Boyce & S.K.Chai, Nordic J. Bot. 37(11)-e02566: 8 (2019).

*Schismatoglottis shaleicola* P.C.Boyce & S.Y.Wong, Webbia 69: 228 (2014) = **Borneoa shaleicola** (P.C.Boyce & S.Y.Wong) S.Y.Wong & P.C.Boyce.

*Schismatoglottis siamensis* W.Bull, Nursery Cat. (William Bull) 1885: 15 (1885) = **Aglaonema brevispathum** (Engl.) Engl.

**Schismatoglottis silamensis** A.Hay, Telopea 9: 144 (2000).

*Schismatoglottis simonii* S.Y.Wong, Gard. Bull. Singapore 62: 196 (2010) = **Bau simonii** (S.Y.Wong) S.Y.Wong & P.C.Boyce.

*Schismatoglottis smaragdina* S.Y.Wong, Aisahtul & P.C.Boyce, Aroideana 40: 23 (2017) = **Ibania smaragdina** (S.Y.Wong, Aisahtul & P.C.Boyce) S.Y.Wong & P.C.Boyce.

*Schismatoglottis spruceana* (Schott) G.S.Bunting, Ann. Missouri Bot. Gard. 47: 70 (1960) = **Philonotion spruceanum** Schott.

*Schismatoglottis spruceana* var. *williamsii* (Steyerm.) G.S.Bunting, Ann. Missouri Bot. Gard. 47: 71 (1960) = **Philonotion spruceanum** Schott.

***Schismatoglottis sublaxiflora*** Alderw., Bull. Jard. Bot. Buitenzorg, sér. 3, 4: 222 (1922) — provisionally accepted.

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*Schismatoglottis wallichii* var. *oblongata* Hook.f., Fl. Brit. India 6: 537 (1893) = **Schismatoglottis lowiae** S.Y.Wong & P.C.Boyce.

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# *Cyrtosperma prasinispathum*: a new fascinating Aroid species from Papua, Indonesia

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**Abstract.** *Cyrtosperma prasinispathum* A.S.D.Irsyam & M.R.Hariri is a newly described species of Lasioid discovered in Sorong, Southwest Papua Province, Indonesia. This new species is exclusively described from living specimens that are kept at the Bogor Botanic Gardens. Morphologically, it has a glossy leek-green spathe that is deflected, with a yellowish-green or yellow spadix. Its striking-colored spathe made this species an important candidate for horticultural plants.

**Keywords:** Araceae, Lasieae, Lasioideae, Malesia, New Guinea.

## INTRODUCTION

*Cyrtosperma* Griffith (1851: 149) is the only oligotypic aroid genus exhibiting higher diversity to the east than to the west of Wallace's Line, comprising 14 species spread of which 13 occur east of Wallace's Line (Hay 1988; Dearden and Hay 2001; Hay and Imran 2020; Raynalta et al. 2024).

In 2024, we conducted an examination of the living collection of *Cyrtosperma* collected from the Southwest Papua Province, which is currently kept in the Bogor Botanic Gardens (BBG). It has come to our attention that certain specimens previously labelled as *C. hambalii* A.Dearden & A.Hay exhibit notable morphological traits that do not align with the assigned name. After further examination we have considered that the specimens are new to science. The new species can be distinguished from *C. hambalii* based on its vegetative and generative morphological characteristics. In this study, we provide a comprehensive description and accompanying photograph of a newly described species of *Cyrtosperma* found in the Indonesian region of Papua.

## MATERIALS & METHODS

The plant material was examined from the living collection of Bogor Botanic Gardens. In addition, we inspected the herbarium specimens at Herbarium Bogoriense (BO) and Herbarium Bandungense (FIPIA) to find further specimens that corresponded to the recently identified species. The plant material was examined for its morphological characteristics and selected portions were captured using the Dinolite digital microscope.

## TAXONOMIC TREATMENT

***Cyrtosperma prasinispathum*** A.S.D.Irsyam & M.R.Hariri, **sp. nov.** (Figure 1).

Type: Prepared from a living plant at Bogor Botanic Gardens-BRIN. Indonesia: Southwest Papua Province, Sorong Regency, 14 March 2024, *MRH 777* (holotype FIPIA, isotype BO).

### *Diagnosis*

*Cyrtosperma prasinispathum* is geographically associated with *C. macrotum* Becc. ex Engl. (1988: 451), but exhibits distinct characteristics. *Cyrtosperma prasinispathum* differs by having unarmed abaxial leaf (vs armed abaxial leaf), oblanceolate posterior lobes (vs ovate to broadly lanceolate posterior lobes), elliptic anterior lobe (vs ovate to deltoid anterior lobe), a deflected spathe (vs deflected or shortly decurrent spathe on the peduncle), entire spathe margin (vs undulate spathe margin), leek-green (vs white-yellowish green/brown to purple), a yellowish-green to yellow spadix (vs pale yellow to green), and tetramerous tepal (vs hexamerous to tetramerous, or mixed tepal).

### *Description*

Small herbs, 21–30 cm high. Leaves ca. 5–9 per crown, clustered; sheath 2–4 cm long, brown; petiole slender, 5–25 cm long, brown with black patches, armed; spines straight, downward, and mostly upward, 1–4 mm long, yellowish brown; lamina sagittate-hastate, anterior lobe elliptic, shorter than posterior lobes, 3.5–12 × 2–6.2 cm, downward, flat in juvenile leaves; posterior lobes oblanceolate, 4.2–17 × 2–5.5 cm, downward, sinus 60–80 degrees; adaxial leaf surface dark green, abaxial leaf surface glaucous. Peduncle 50–73 cm long, brown and black patches, armed; spines straight, downward, and mostly upward, minute, 1–2 mm long, yellowish brown. Spathe broadly opened, lanceolate, deflected, 10.9–11.5 × 2.5–2.9 cm, leek-green. Spadix 35–45 × 6–7 mm, yellowish green, turning yellow when mature; stipe 3–6 mm long, leek-green. Flowers bisexual, perigoniate; tepals 4, free, green, turning yellow when mature; stamens 4, free; filaments free, flat, and broad; anthers ca. 0.5 mm long, white, not exserted from the tepals when anthesis; pollen white; ovary 1-locular, brown; stigma discoid, sessile, brown.

### *Etymology*

The specific epithet is derived from the Latin ‘*prasinus*’ – and ‘*spathum*’, which signifies the leek-green coloured spathe.

### *Proposed conservation assessment*

The species status is yet to be determined according to the criteria specified by the IUCN Red List. Based on the limited available information, we recommend categorizing it under the Data Deficient (DD). This conclusion is drawn solely from the observations made on the living collection at BBG.

### *Notes*

The living collections of *C. prasinispathum* were originally collected from Taman Wisata Alam (TWA) Sorong, located in Southwest Papua, in 2007. The collection took place at an altitude of 27 meters above sea level, as part of Prof. Dr. Widyatmoko’s exploratory endeavours from June 11th to July 9th, 2007. The seeds, under collection number *DW1091*, were subsequently germinated and cultivated in the Bogor Botanic Gardens greenhouse. The species previously recognised as *C. hambalii* has been designated as a distinct species based on our observations in 2024.

*Cyrtosperma prasinispathum* belongs to the ‘Macrotum group’ and consists of tetramerous flowers. The ‘Macrotum group’ is distinguished by a non-convolute spathe at the lower part, and it consists of species with tetramerous, pentamerous or hexamerous flowers (Hay, 1988). This study introduced a novel species to the ‘Macrotum group’, resulting in a total of four species, consisted of *C. beccarianum* A.Hay (1988: 455), *C. macrotum* A.Hay, *C. hayii* Raynalta, M.R.Hariri & A.S.D. Irsyam (2024: 235), and *C. prasinispathum*.

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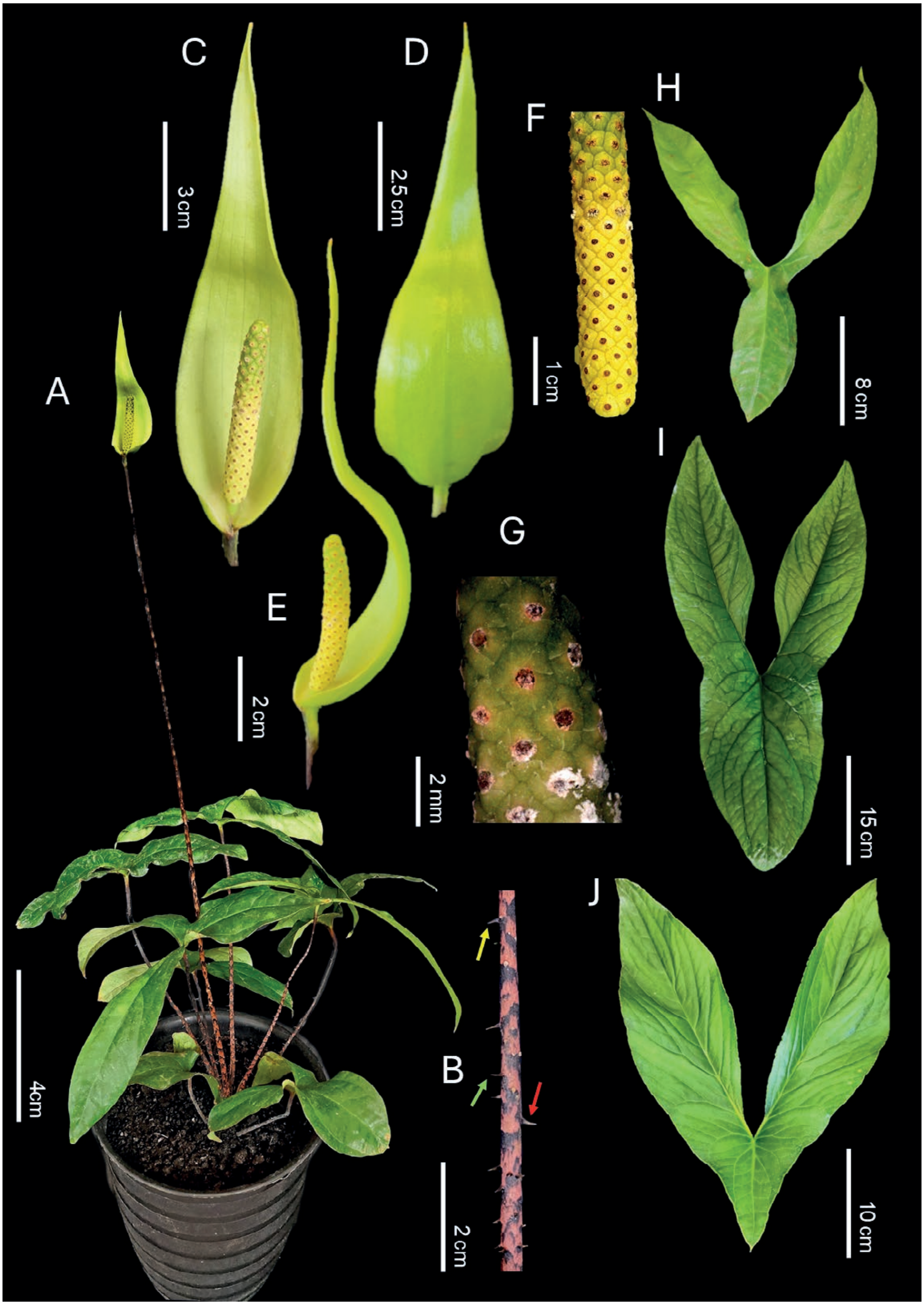

**Figure 1.** *Cyrtosperma prasinispathum* (A-H), *C. macrotum* (I), and *C. hambalii* (J). A. Habit; B. Petiole with spine tip pointing upward (red arrow), downward (yellow arrow), and straight (green arrow); C-E. Three different views of spathe; F. Spadix; G. Part of upper-half spadix showing immature flowers; H. *C. prasinispathum* leaf; I. *C. macrotum* Becc. ex Engl. Leaf; and J. *C. hambalii* A.Dearden & A.Hay leaf. The three leaves show distinguishable characteristics among different species.

Seed Bank Partnership, under the guidance of Dr. Dian Latifah, M.App.Sc, which allowed for the macromorphological observation of *C. prasinispathum*. The authors express gratitude to the editor and reviewers for their essential and insightful suggestions.

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# *Amorphophallus samarensis* (Araceae), a new species endemic to Samar Island, Eastern Visayas, Philippines

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**Abstract.** *Amorphophallus samarensis* is described as a new species from Paranas, Samar Island Natural Park, Samar Eastern Visayas, Philippines. *A. samarensis* resembles *A. calcicola* by having a solitary leaf, long peduncled solitary flower, cylindric female zone, ovary depressed, disk shape, slightly distant ovaries, and absence of staminode. It differs from *A. calcicola* by having the rachis winged at the distal part of the leaf, pale to dark maroon slightly depressed globose capitate stigma, style color, length of spadix, and truncate anther. The new species is considered Critically Endangered (CR) based on IUCN guidelines due to persistent anthropogenic activities. There are 30 individual plants encountered in the locality with less than 100 sq. km area of occupancy with an observed threat.

**Keywords:** *Amorphophallus calcicola*, biodiversity, conservation, critically endangered, taxonomy.

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## INTRODUCTION

One of the biggest families of flora is Araceae. This family is also called "Arum" (Moodley et al. 2016). *Amorphophallus* is one of the biggest genera of the family Araceae (Claudel and Lev-Yadun 2021; Islam et al. 2023). This genus is considered to have an extremely small population (Tang et al. 2020) and is the third-largest genus of the family Araceae with paleotropical dispersion (Claudel and Lev-Yadun 2021). Based on the record of the World Checklist of Vascular Plants (WCVP 2022), there are 241 accepted *Amorphophallus* species worldwide (Bulawin et al. 2022; Bulawin et al. 2023). In the Philippines, a total of 20 accepted *Amorphophallus* species (Pelser et al. 2011 onwards; Bulawin et al. 2023) are currently recorded, and one of these could

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also be found in Samar. The discovery of *A. samarensis* is another addition to Philippine *Amorphophallus*.

Due to its unique topography, climate condition, and physical structure, the Philippines has a rich biodiversity consisting of endemic and diverse species, nevertheless, it is on the list of conservation preferences (Batuyong et al. 2020). In the Philippines, Samar is considered the third largest island, with a total land area of 13,458 sq km (PCARRD 2006). Samar Island consists of a huge area of karst, and some of these areas are part of Samar Island Natural Park (SINP) (Villanueva et al. 2021) and located in Northern and Eastern Samar. The park has highlands with distinct peaks surrounded by limestone rock (Patindol 2016). Under Presidential Proclamation 442, SINP was established as Protected Area on April 13, 2003 (Meniano 2022) by the National Integrated Protected Areas System (NIPAS) Act of 1992. The forest of Samar Island Natural Park covers 330,300 hectares and 124,500 hectares buffer zone and was nominated as UNESCO World Natural Heritage Site (Villanueva et al. 2021).

The SINP is one of the significant spots in Samar because of its rich biodiversity (Patindol 2016). It is also a dwelling area for the Philippine Eagle, Philippine Hawk Eagle, and the Philippine Cockatoo and some endangered species like Giant Golden-Crowned Flying Fox, Philippine Nectar Bat, Philippine Pygmy Roundleaf Bat, Philippine Warty Pig, Philippine Brown Deer, large forest rat, hairy tailed rat, and squirrel (Senate Bill No. 2392). Additionally, new species of palms and orchids are included in the present record of SINP's biodiversity.

The first author conducted fieldwork last 2019 and found this interesting *Amorphophallus* species. Another fieldwork was done at SINP in 2022 to validate the new species and additional specimens were collected for further examination.

## MATERIALS & METHODS

Gratuitous Permit no. 312 with GP holder (Norilyn Fontarum-Bulawin) was obtained from the Department of Environment and Natural Resources Biodiversity Management Bureau (DENR-BMB). Fieldworks at Paranas, Samar Island Natural Park, Samar Eastern Visayas, Philippines was conducted from June 23-25, 2022.

Specimens were collected over the steep shaded karst in SINP, Paranas, Samar, Eastern Visayas (Fig 1). Field data were recorded, and photo documentation was done to get accurate information of the plant in situ. Specimens were collected for herbarium studies and the vouchers were deposited in PNH and USTH. *A. samarensis* was comprehensively compared to the protologues and digital type specimens of closely related species, namely *A. calcicola* Tamayo et al., *A. longispathaceus* Engl. & Gehrm, and *A. rostratus* Hett. An updated taxonomic key of five (5) Philippine *Amorphophallus* is here presented with reference using Hetterscheid (1994), Pelser et al. (2011) onwards, Magtoto et al. (2013), Bustamante et al. (2020), and Tamayo et al. (2021).

## TAXONOMIC TREATMENT

***Amorphophallus samarensis*** Fontarum-Bulawin, Medecilo-Guiang & Alejandro., **sp. nov.** (Figures 2, 3, & 4).

Type: Philippines, Eastern Visayas, Samar Island, Municipality of Paranas, Samar Island Natural Park (SINP), 137–329 masl elevation, on the shady areas, karst forest, 23 June 2022, *Norilyn Fontarum-Bulawin 031* (holotype PNH! [258714]; isotypes PNH! [258715] & USTH! [016887]).

### *Diagnosis*

*Amorphophallus samarensis* has widely triangular, undulating, pale green, cream to maroon spathe, with maroon spots, an undulate to entire spathe margin; cylindric female zone; spadix longer than spathe; slightly distant depressed globose ovaries; pale to dark maroon slightly depressed globose capitate stigma; elongate cylindrical male zone; truncate anther; absent of staminode; and smooth narrowly elongate cylindric appendix. *A. samarensis* is like *A. calcicola, A. longispathaceus,* and *A. rostratus* for having solitary leaf, spadix longer than spathe, long peduncled solitary flower, congested male flowers, and slightly distant female flowers. However, it differed from *A. calcicola* by its subglobose tuber, smooth petiole, distal part of winged rachis not branched, narrowly elliptic leaflets, undulate to entire leaf margin, undulated in the upper part and entire in the lower part spathe margin, pale to dark maroon slightly depressed globose capitate stigma, and elongate to widely triangular-ovate spathe. Also different from *A. longispathaceus* by its tuber, rachis, leaflets shape, spathe margin, shape of stigma, and spathe shape. Different from *A. rostratus* in leaflets, rachis, absence of staminode, ovary shape, and shape of stigma.

### *Description*

Tuber subglobose, 6–7 cm in diameter, 3.5–4.5 cm high, pale to dark brown. Leaf solitary; petiole 55–58 cm long, 3.3–3.5 cm in diameter, surface smooth narrow-

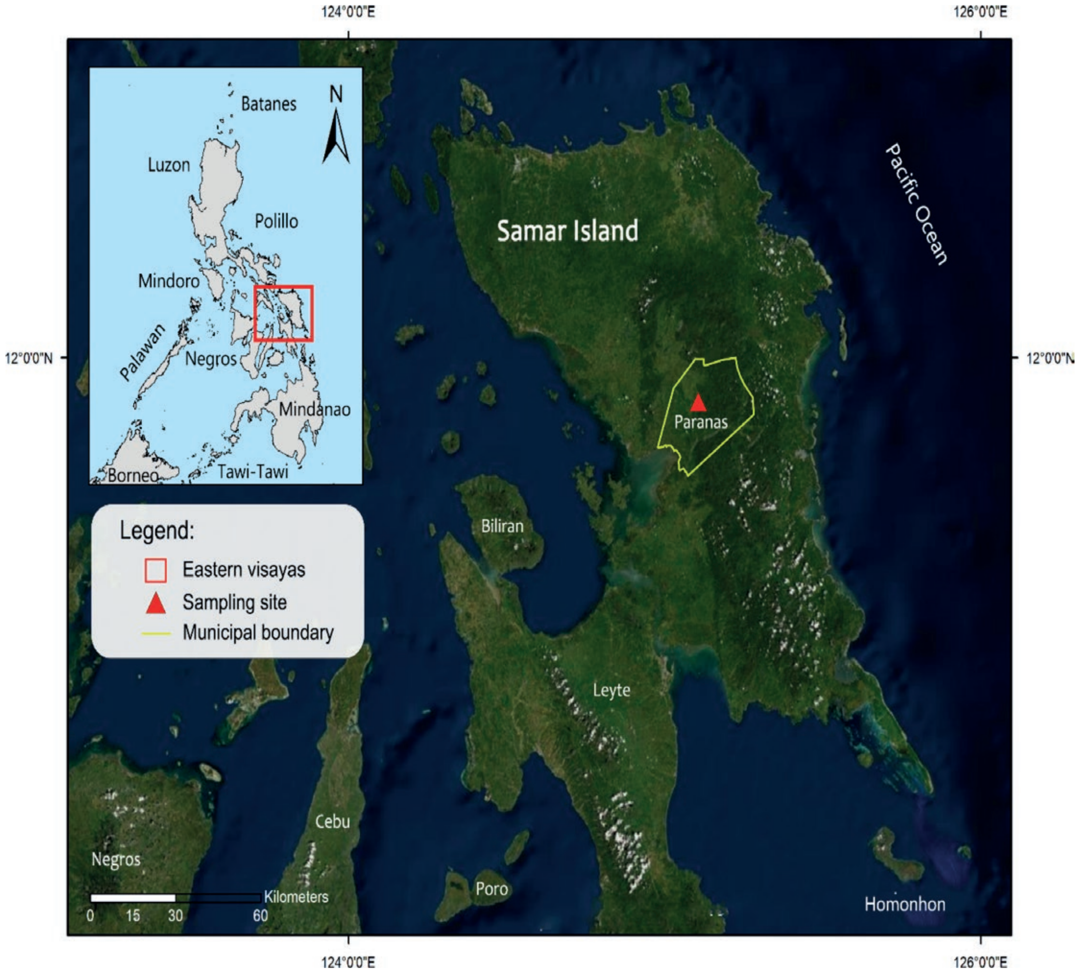

**Figure 1.** Map of the type locality. Eastern Visayas, Samar Island (province), Municipality of Paranas (in red triangle), Samar Island Natural Park.

ing to the upper part, pale to dark brown or pale to dark green with irregular to narrowly elliptic, green whitish, purple or dark brown spots from the base to the upper part; lamina 36–40 cm in diameter; rachis winged at the distal part not branched, divided into three leaflets, green or light brown, smooth with white and green spots, 12.7–15 cm long, 1.5–2 cm in diameter; leaflets narrowly elliptic, 13.5–16 cm long, 2–3.5 cm wide with acumen 1–1.5 cm long, acuminate tip and cuneate to narrowly cuneate base, their adaxial surface green to dark green, abaxial surface pale green to green, with depressed midrib and impressed lateral veins in 7–11 nerve pairs, brochidodromous secondary veins forming prominent upward loops near the margin; lamina margin undulate to entire with decurrent leaf attachment. Inflorescence solitary erect; peduncle 34–36 cm long, 3.2–3.5 cm in diameter, pale green to cream or white, smooth with green and maroon spots upward, white and maroon spots downward. Spathe elongate, widely triangular-ovate when spread, 15–16 cm long, 13–14 cm wide erect, without constriction, at the base outside distinctly convolute, pale green to cream or white with vertical veins and irregular purple or maroon spots, inside pale green to cream or white, reddish to maroon downward with slightly grooved and verrucae; limb outside widely triangular undulating, pale green, reddish to maroon with purple or maroon spots, inside pale green to reddish to maroon with purple or maroon spots, undulate margin upward, entire margin downward. Spadix sessile, much longer than spathe, 17–19 cm × 0.53–3 cm; female zone cylindric, 4–5 cm long, 3–4 cm in diameter; female flowers slightly distant, pale to dark maroon; ovaries depressed globose, 1.7–3.4 mm diam, 1.33–2.85 mm high, pale to dark maroon, unilocular; style straight upward, 5–6.4 mm long, 0.58–0.62 mm in diameter, pale to dark maroon; stigma slightly depressed globose capitate, pale to dark maroon, 0.63–2.1 mm in diameter, 0.89–1.29 mm high; male zone elongate, 4–5 cm long, 3–4 cm in diameter; male flowers with one

**Figure 2.** *Amorphophallus samarensis* Fontarum-Bulawin, Medecilo-Guiang & Alejandro. A. Rear view of inflorescence, B. Habit in situ, C. Front view of inflorescence, D. Posterior view of peduncle, E. Petiole in situ, F. Anterior view of the peduncle. Photos taken by Norilyn Fontarum-Bulawin.

**Figure 3.** *Amorphophallus samarensis* Fontarum-Bulawin, Medecilo-Guiang & Alejandro sp. nov. A. Leaves, B. Top and side view of the tuber, C. Anterior view of young inflorescence, D. Female flowers, E. Pollens released from male flowers, F. Male flowers. Photos taken by Norilyn Fontarum-Bulawin.

stamen, irregular nearly ovate shaped, congested, slightly distant at the base , cream to pale yellow; stamens 1.79–2.3 mm long, cream to pale yellow; anthers .5–1 mm long, truncate, with .3–.5 mm subfusiform apical pores ; filaments 1.5–2 mm long, slightly clavate; appendix smooth narrowly elongate cylindric, 7–11.5 cm long,

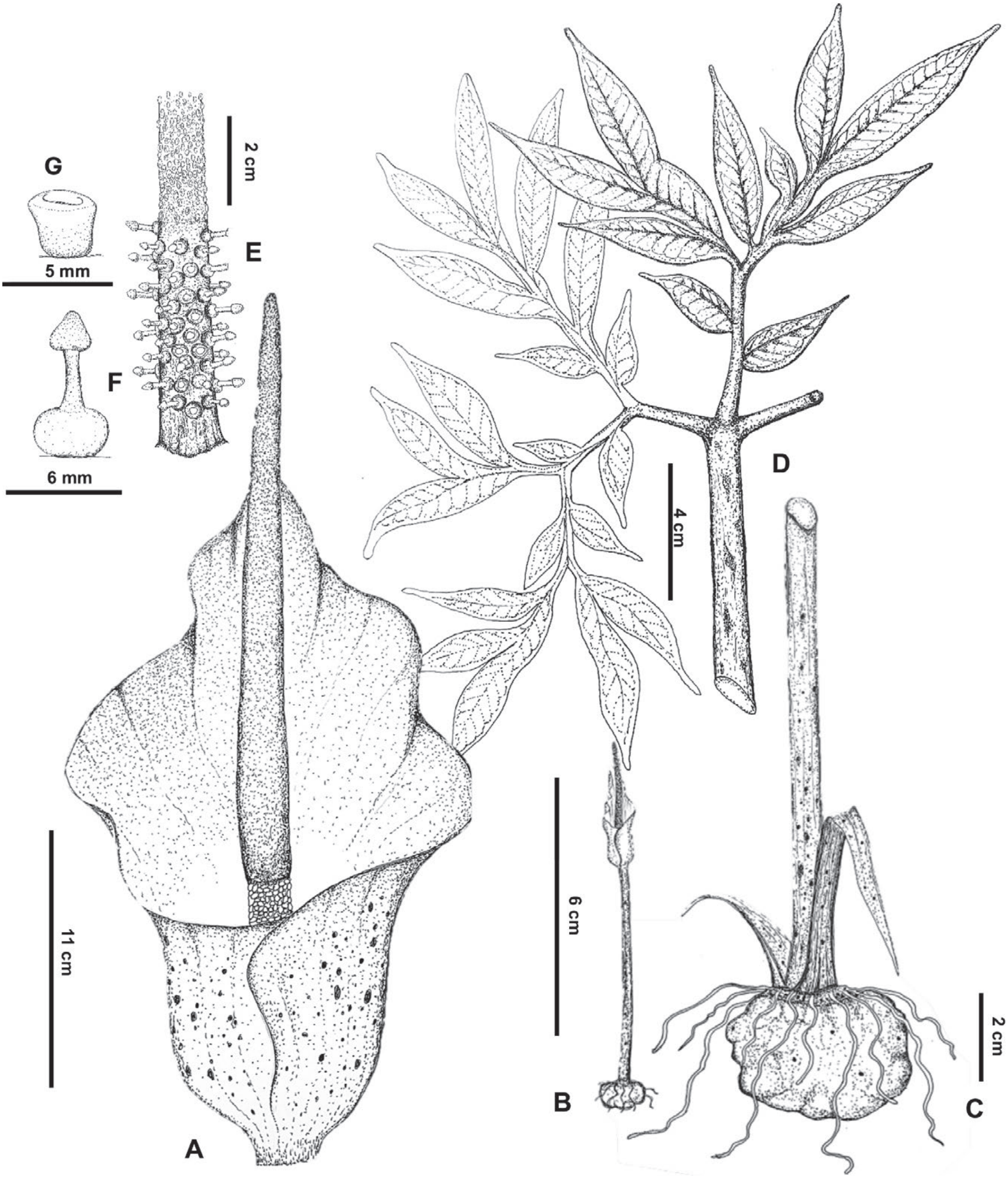

**Figure 4.** *Amorphophallus samarensis* Fontarum-Bulawin, Medecilo-Guiang & Alejandro sp.nov. A. Inflorescence during maturity, B. Habit, C. Tuber, D. Leaves, E. Spadix, F. Female flower, G. Male flower. Illustration by: Michael A. Calaramo.

5.88–9.29 mm in diameter above the base; base dilated cylindrically, slightly smooth, maroon to dark maroon, at apex narrowly long cylindric tapered maroon to dark maroon. Fruits not observed.

### *Etymology*

The species epithet was attributed to its type locality, Samar Island.

### *Phenology*

Flowering from June to July; fruiting not observed.

### *Distribution and ecology*

*Amorphophallus samarensis* is endemic in Eastern Visayas Samar, Samar Island Natural Park (SINP) Philippines. This species is found in Paranas, within 556.12 sq km land area in the shady areas, karst forest at 137–329 m elevation.

### *Conservation status*

Since the extent of occurrence of *A. samarensis* is less than 100 km$^2$ and there are less than 250 mature plants in the forest, it is considered critically endangered [CR] (IUCN, 2022). There are 30 individual plants, and three inflorescences were encountered in the locality. Being a small population and having limited distribution, endemic species are more vulnerable to the impact of anthropogenic and natural calamities (Yudaputra et al. 2022; Calaramo et al. 2022).

### *Notes*

*Amorphophallus samarensis* is comparable to *A. calcicola* by solitary leaf, long peduncled solitary flower, cylindric female zone, ovary depressed, disk shape, slightly distant ovaries, and absence of staminode. However, it differed to *A. calcicola* by its subglobose tuber, smooth petiole, distal part of winged rachis not branched, narrowly elliptic leaflets, undulate to entire leaf margin, undulated in the upper part and entire in the lower part spathe margin, slightly depressed globose capitate stigma, and elongate to widely triangular-ovate spathe. It resembles *A. longispathaceus* by its smooth petiole, solitary leaf, long peduncled solitary flower, cylindric female zone, ovary shape, and truncate anther. But different by its tuber, rachis, leaflets shape, spathe margin, shape of stigma, and spathe shape. Besides, it is similar to *A. rostratus* by having spadix longer than spathe, slightly distant female flowers, congested male flowers, solitary leaf, and long peduncled solitary flower, except in leaflets, rachis, absence of staminode, ovary shape, and stigma. A comparison of *A. samarensis, A. calcicola, A. longispathaceus,* and *A. rostratus* is presented in Table 1.

**Table 1.** Comparative morphology of *A. samarensis*, *A. calcicola*, *A. longispathaceus*, and *A. rostratus*.

| Characters | *A. samarensis* | *A. calcicola* | *A. longispathaceus* | *A. rostratus* |
|---|---|---|---|---|
| Petiole diam | 3.3–3.5 cm | 1.0–2.5 cm | 2–6 cm | 1-2 cm |
| Leaflets apex | acuminate | long acuminate | long acuminate | long acuminate |
| Acumen | 1–1.5 cm long | 3.0–3.5 cm long | 3 cm long | 3-4 cm long |
| Spathe base inside | pale green to cream or white upward, reddish to maroon downward with slightly grooved and verrucae | dirty white and densely clothed with ovoid or irregularly shaped warts | dark purple densely clothed with short and long simple or branched, fleshy or flacky purple to reddish or brown finger-like warts | uniformly green with numerous large irregular warts aligned into vertical ridges |
| Spathe length | 15–16 cm | 9–17 cm | 30–38 cm | 20-45 cm |
| Spadix length | 17–19 cm | 16–30 cm | 42–60 cm | 35-90 cm |
| Female zone length | 4–5 cm | 2.0–3.0 cm | 4–8.5 cm | 4-5 cm |
| Stigma | slightly depressed globose capitate | lobed | lobed | lobed/rostrate |
| Stigma lobes | capitate | 2–3 lobed | 2–3 lobed | 1 to many |
| Male zone length | 4–5 cm | 1.7–2.5 cm | 4.5–6.5 cm | 4-5 cm |
| Stamen | 1.79–2.3 mm | 1.5–1.8 mm | 1–1.5 mm | 1.5 mm |
| Filament | thick, fused at the base, 1.5–2 mm long | connate, 1.0–1.2 mm long | 0.1–0.5 mm long, connate | 0.5 mm long |

## Identification key of morphologically similar species of Philippine *Amorphophallus*

1. Limb outside brown with white spots; stamen reddish, 1–1.5 mm long........................................................................2

– Limb outside pale green reddish to maroon with purple or maroon spots; stamen cream to pale yellow, 1.79-2.3 mm long ..........................................................................................3

2. Peduncle greyish green with whitish or green spots; 60–130 cm × 1–3.5 cm ............................***A. longispathaceus***

– Peduncle green to purplish brown with whitish green to whitish purple spots; 158 cm × 3.5 cm ..............................4

3. Ovary depressed disk-shaped; stigma yellowish, 2–3 lobed; spadix 16–30 cm × 0.8-1.5 cm.............................***A. calcicola***

– Ovary depressed globose; stigma pale to dark maroon with 1 lobed; spadix 17–19 × 0.53–3 cm .............. ***A. samarensis***

4. Leaflets lanceolate, 3-7 cm long; male flowers congested .... ................................................................................ ***A. rostratus***

– Leaflets oval to elongate elliptic, 9.5-24 cm long; male flowers distant..................................................***A. adamsensis***

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# *Monstera cedenoi* (Araceae: Monsteroideae), a new glaucous species with pinkish spathes endemic to Costa Rica (Central America)

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**Abstract.** *Monstera cedenoi,* endemic to eastern Costa Rica, is described and illustrated. Based on its pinkish spathes, the taxonomic novelty belongs to the *Monstera oreophila* complex, which also includes *M. gentryi*, *M. mittermeieri*, and *M. oreophila*. Detailed comparisons between the new proposed taxon and its morphological relatives are included.

**Keywords:** Araceae, Central America, endemism, taxonomy.

## INTRODUCTION

*Monstera* Adanson is a Neotropical genus of Araceae comprising about 80 published species, which are generally found in humid tropical forested regions at low to mid elevations, particularly in Central America with more than 50 species (Croat et al. 2024). This genus was revised in its entirety by Madison (1977), but recently Cedeño-Fonseca et al. (2022) and Croat et al. (2024) published comprehensive taxonomic revisions for Costa Rica and Central America, respectively. Despite being a relatively well-known genus in the latter region, new species have been discovered in recent years (Zuluaga and Cameron 2018; Cedeño-Fonseca et al. 2018, 2020a, 2020b, 2020c, 2021a, 2021b), mainly from poorly explored areas of Costa Rica and Panama.

Recently, during a scientific expedition carried out in the Pérez Zeledón Cantón, a plant was encountered which presented a particular combination of morphological characters (especially the glaucous petioles and pinkish spathes), which seemingly allied it to seven species mainly restricted to Costa Rica and/or Panama (except *M. glaucescens* Croat & Grayum, which occurs from Nicaragua to Colombia): *M. bocatorensis* Croat & M.Cedeño, *M.*

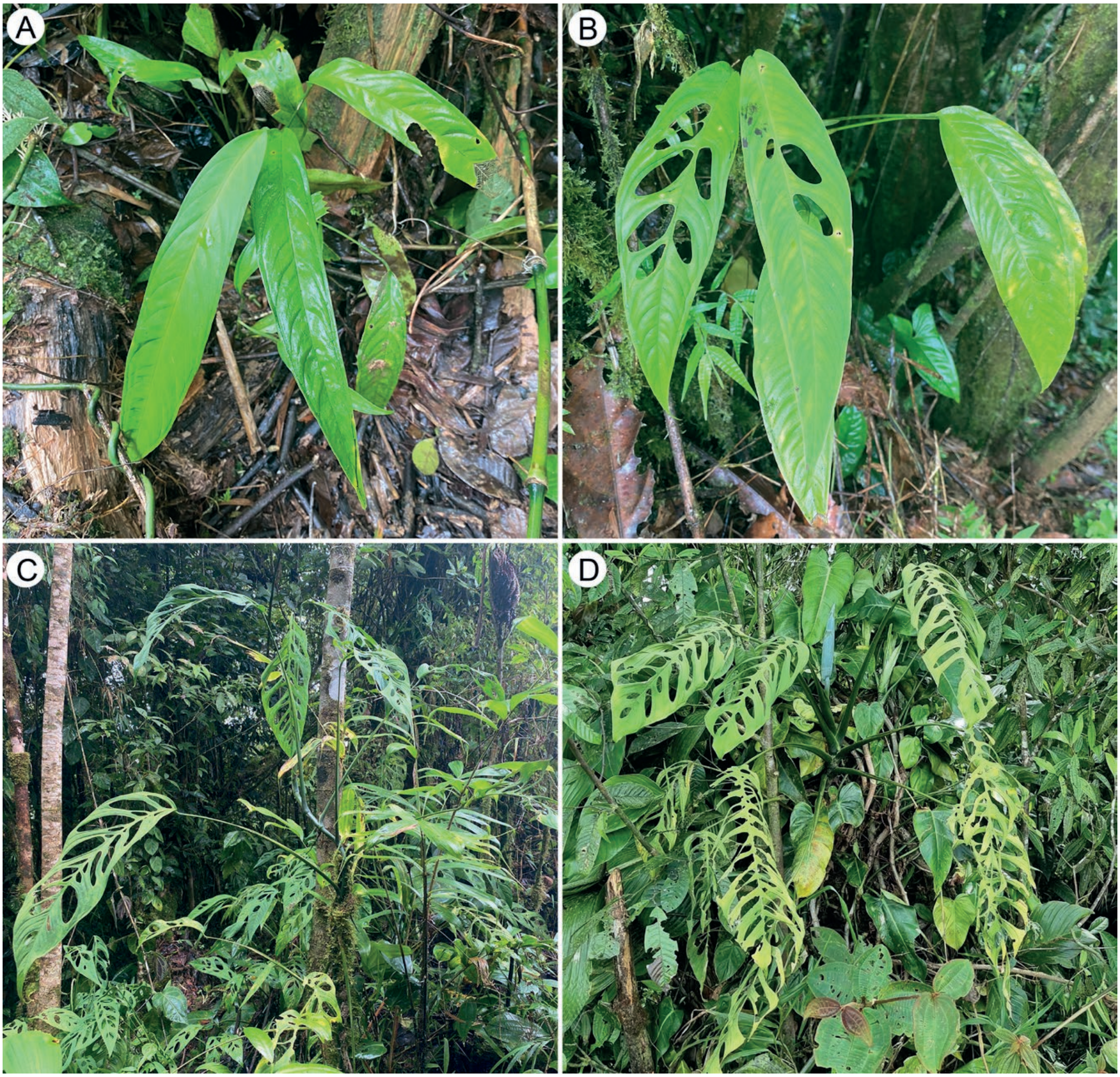

**Figure 1.** *Monstera cedenoi in situ*. A. Juvenile plant with entire blades. B. Juvenile plant with fenestrated blades. C. Pre-adult plant. D. Adult plant with an inflorescence. Photos by Orlando O. Ortiz.

*croatii* M.Cedeño & A.Hay, *M. epipremnoides* Engl., *M. gentryi* Croat, M.Cedeño & O.Ortiz*, M. glaucescens, M. mittermeieri* M. Cedeño, and *M. oreophila* Madison. In this article, *M. cedenoi* is described and proposed as a species new to science, which so far is restricted to eastern Costa Rica. Detailed comparisons between the taxonomic novelty and its morphological relatives, and field photographs, are included.

## TAXONOMY

***Monstera cedenoi*** O. Ortiz, Croat & J. Hughes **sp. nov.**

Type: Costa Rica. San José: Cantón Pérez Zeledón, 1000 m, 7 de Oct. 2022, *M. Cedeño, O. Ortiz, J. M. Hughes 2515* (holotype USJ [2 sheets]; isotypes B, MO, PMA).

### *Diagnosis*

*Monstera cedenoi* differs from *M. bocatorensis, M. croatii, M. epipremnoides, M. gentryi, M. glaucescens, M. mittermeieri* and *M. oreophila* by the combination of the following morphological characters: leaves with glaucous-pruinose, terete, petioles with persistent petiolar sheaths that reach up to 1/2 of its length, entire (but sometimes torn), extensive fenestrated blades, inflorescences with pinkish (externally) and orange-yellow (internally) spathes, pale-orange spadices, and flowers with a rectangular ovary and a linear stigma.

### *Description*

Nomadic vine, terrestrial or appressed-climbing habit. Seedlings bearing foliage leaves. Juvenile plants: root climbers; terrestrial; stems dark or light green, smooth, cylindrical, 0.2–0.5 cm diam.; internodes 1–2 cm long; cataphylls unknown; petiole distinct, dark or light green, smooth, 13–30 cm long, sheathed half or 4–10 cm below base of the geniculum; petiole sheath persistent; unsheathed portion terete or slightly ribbed; geniculum almost terete, 0.3–0.5 cm long; blades lanceolate, attenuate at base, acuminate, thinly coriaceous, 12–25 × 2–7.5 cm, not appressed to the phorophyte; fenestrations present or absent, completely fenestrated or generally one fenestrated side. Adult plants: root climbers; stems green or dark green, cylindrical, internodes 0.5–7 cm long, 1.5–2 cm diam.; anchor and feeder root black or light brown, glaucous; petioles light green or dark green in the base, smooth and glaucous, 40–75 cm long; petiole sheath persistent and involute, up to 1/2 of the petiole length; unsheathed portion terete and slightly ribbed near geniculum; geniculum almost terete, sulcate adaxially, 1–2.5 cm long; blades narrowly ovate, asymmetrically rounded at base, sometimes obtuse in one side and rounded in the other, acuminate at apex, subcoriaceous, drying yellowish-brown, 40–53 × 11.5–21 cm, not decurrent onto the geniculum; ribbed adaxially, convex abaxially; primary lateral veins 8–15 per side, departing midrib at 75–85°, strongly sunken adaxially, prominent abaxially, irregularly sinuous to the margin; secondary veins parallel; collective veins visible on the margins of each lobe; fenestrations present, those located along each side of the midrib larger oblong elliptical, those located near the midrib usually comprising small sub-circular holes 0.3–2 cm diam., with filamentous strands connecting between the perforations, the larger perforations often tearing through to the margins, the spaces between perforations 0.3–2.5 cm wide, often with a primary lateral vein; margins entire or pinnatilobed due to tearing of the fenestrations that extend to the margin, the sinuses reaching halfway or all the way to the midrib. Inflorescences on ascending stems, solitary; peduncle smooth, 24 cm long; spathe naviculiform, acuminate to long-acuminate, glaucous-green externally during development, glaucous-green and pinkish externally and light orange-yellow internally at anthesis, becoming torn at base as it fully opens, deciduous soon after anthesis, 12–17 × 10–14 cm, up to 6 cm longer than the spadix; spadix during development unknown, pale-orange at anthesis, 8–11 cm long, 2–2.5 cm diam., sterile zone basal, 2.5 cm long; sterile flowers 3–5 mm long, with a transparent secretion; fertile flowers 5–6 mm long; ovary rectangular in longitudinal section; style hexagonal; stigma linear; stamens with laminar filaments, 1.5–6 mm long; anthers 1.5–3 mm long; berries unknown; seeds unknown.

### *Eponymy*

*Monstera cedenoi* is dedicated to Marco Vinicio Cedeño Fonseca, specialist in Neotropical Araceae and especially in the genus *Monstera*.

### *Phenology*

Flowering in October.

### *Distribution and habitat*

*Monstera cedenoi* is endemic to Costa Rica, only known from the south on the Pacific side in the region of Pérez Zeledón at ca. 1000 m. It occurs in the *Tropical moist forest* life zone, in primary and secondary forest, and open areas.

## DISCUSSION

The species is a member of sect. *Monstera* (*sensu* Madison 1977) and is characterized by its long, glaucous-pruinose petioles, extensively fenestrated, narrowly ovate, asymmetrically rounded blades and acuminate apex, primary lateral veins strongly sunken adaxially, and inflorescences with spathes glaucous-green externally during development, glaucous-green and pinkish externally and pale orange yellow internally at anthesis, as well as by its pale orange spadices at anthesis.

Taking into account the pink spathes (internally), *Monstera cedenoi* belongs to the *Monstera oreophila* complex (Cedeño-Fonseca et al. 2021), which includes *M. gentryi*, *M. mittermeieri*, and *M. oreophila*. However, *M. cedenoi* differs from the aforementioned taxa in having pruinose-glaucous petioles with the petiolar sheaths reaching up to half their length (vs. up to the geniculum or very close to it) and the free portion completely terete (vs. sulcate, flat or absent). Additionally, *M. gentryi* has orange spathes externally and *M. mittermeieri* greenish, whereas *M. cedenoi* is consistently pinkish.

**Figure 2.** Some diagnostic characters of *Monstera cedenoi*. A. Adult plant with a glaucous-green spathe externally. B. Inflorescence at pre-anthesis. C. Inflorescence at male anthesis with the orange-yellow spathe (internally) and the pale-orange spadix. D. Inflorescence at male anthesis with a glaucous-green and pinkish (externally) spathe. Photos by Jason M. Hughes, all from *M. cedeño et al. 2515* (USJ)

**Table 1.** Morphological comparison of *M. cedenoi* and its relatives.

| | *M. cedenoi* | *M. bocatorensis* | *M. croatii* | *M. epipremnoides* | *M. gentryi* | *M. glaucescens* | *M. mittermeieri* | *M. oreophila* |
|---|---|---|---|---|---|---|---|---|
| Petiole pruinose | Present | Present | Present | No | No | Present | No | No |
| Petiolar sheath length | 1/2 of the petiole | 1/2 of the petiole | 1/2 of the petiole | 5 cm of the geniculum | 5 cm of the geniculum | 1/2 of the petiole | up to the geniculum | up to the geniculum |
| Petiolar sheath | Persistent | Persistent | Persistent | Persistent | Persistent | Persistent | Persistent | Deciduous |
| Free portion of the petiole (adaxially) | Terete | Terete | Terete | Sulcate or flat | Sulcate or flat | Sulcate or flat | Absent | Absent |
| Leaf blade shape | Entire (but sometimes torn) | Entire or pinnatilobed or pinnatifid | Pinnatilobed or pinnatifid | Pinnatilobed or pinnatifid | Entire | Pinnatilobed or pinnatifid | Pinnatilobed or pinnatifid | Entire or pinnatilobed or pinnatifid |
| Fenestrations | Present | Absent | Absent | Present | Present | Present | Present | Present |
| Spathe colour (externally) | Pinkish | Creamy-white | Creamy-white | Greenish | Orange | Creamy-white | Greenish | Pinkish |
| Spathe colour (internally) | Orange-yellow | Creamy-white | Creamy-white | Creamy-white | Pinkish-salmon | Creamy-white | Pinkish-salmon | Pinkish-salmon |
| Ovary shape | Rectangular | Square | Square | Rectangular | Rectangular | Square | Rectangular | Rectangular |
| Stigma shape | Linear | Linear | Linear | Circular | Linear | Linear | Linear | Linear |

Considering the glaucous petioles and the persistent petiolar sheaths, *M. cedenoi* is similar to *M. bocatorensis*, *M. croatii* and *M. glaucescens*, but these taxa differ in having leaf blades without fenestrations, as well as creamy-white spathes (vs. pinkish or pinkish-salmon), and square-shape ovaries (vs. rectangular).

According to the leaf blade shape and the presence of extensive fenestrations, *M. cedenoi* resembles *M. epipremnoides*, but the latter differs by its petioles never pruinose and  sulcate or flat (vs. terete) in the free portion (at apex) and its sheaths that reach almost to the geniculum (vs. up to 1/2 of the petiole length), as well as by its greenish or creamy-white spathes (vs. pinkish), and circular stigmas (vs. linear).

All differences among *M. cedenoi* and its relatives are summarized in Table 1.

### *Additional specimens examined (paratypes)*

**COSTA RICA**. **San José**: Cantón Pérez Zeledón, 1000 m, 7 Oct. 2022, *M. Cedeño & al. 2516* (USJ); Cantón Pérez Zeledón, 1000 m, 7 Oct. 2022, *M. Cedeño & al. 2517* (USJ).

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# The pendent species of *Anthurium* sect. *Porphyrochitonium* from Costa Rica and Panama: synopsis, nomenclatural notes, new species, and conservation status

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**Abstract.** A review of the Costa Rican and Panamanian taxa of *Anthurium* sect. *Porphyrochitonium* with a pendent growth form is presented here. Two new species (*A. cascantei* and *A. embera*) are described and illustrated, and five new synonyms are proposed. We recognize 16 taxa of *Anthurium* sect. *Porphyrochitonium* with pendent growth form distributed in the region: eight exclusively from Costa Rica, one exclusively from Panama, and three species endemic to both countries. *Anthurium gregneversii* is reported as a new record for Costa Rica and the distribution of *A. edtysonii* is extended from Costa Rica to Ecuador. Nomenclatural notes and typifications for *A. friedrichsthalii* Schott and *A. linearifolium* Engl. are included. Information about geographic distribution and habitat, conservation assessments, phenology, and taxonomic comments are provided, along with a dichotomous key to identify the species.

**Keywords:** Araceae, Conservation, Darién, Fila Anguciana, Fila Costeña, nomenclature, taxonomy, Tinamaste, Turrialba.

## INTRODUCTION

*Anthurium* Schott is a genus of Araceae that stands out for exhibiting a wide spectrum of habits, ranging from terrestrial plants, lithophytes, rheophytes, nomadic vines, hemiepiphytes or epiphytes (Croat 1988; Zotz 2013; Croat and Ortiz 2020). The epiphytes themselves present a wide variety of growth forms (e.g., climbers, rosette like birds' nests or pendent) that can occupy various types of tropical ecosystems (Croat 1986, 1988; Croat and Ortiz 2020). In the pendent growth condition, plants are characterized by having the leaves (both blades and petioles) completely held downwards. *Anthurium* species with pendent growth form can be found in various sections, as in sect. *Pachyneurium* (Schott) Engl. (*A. brenesii* Croat & R.A.Baker, *A. prolatum* Croat & R.A.Baker, *A. protensum* Schott, *A. spectabile* Schott, *A. pseudospectabile* Croat), sect. *Leptanthurium* (Schott) Engl. (*A. fornicifolium* Croat, *A. lutheri* Croat, *A. pallidiflorum* Engl., *A. vittariifolium* Engl.), and sect. *Porphyrochitonium* (Schott) Engl. (the subject of this paper).

*Anthurium* section *Porphyrochitonium* was initially proposed as one of the 28 rankless "greges" by Schott (1860: 439) and later elevated to sectional status by Engler (1878: 55) (for more taxonomic history information about this group, consult Croat et al. 2022). This group represents one of the most diverse and large sections within *Anthurium*, and ranges principally from Costa Rica to Peru with the greatest diversity of species in northwestern Colombia (Croat and Sheffer 1983; Croat et al. 2022). In Central America, its diversity is found mainly in Costa Rica and Panama, which represent approximately ca. 30% (29 spp.) and 37% (111 spp.) of total recorded species, respectively (Croat 1983, 1986; Croat et al. 2022). Species of this section are characterized by its short internodes, with marcescent and usually fibrous prophylls and cataphylls generally elongate, non-cordate leaf blades which are glandular-punctate on at least one surface, and ovaries with more than one ovule per locule (usually 2–4 per locule) (Croat and Sheffer 1983; Croat et al. 2022). They include mainly epiphytic species that occur from lowland humid forests such as mangroves, gallery forests, to mid-elevation humid forests, premontane, montane, and elfin cloud forests; a few are common in seasonal forests (Croat 1986, 1988).

Recent molecular studies in *Anthurium* showed that sect. *Porphyrochitonium* represents a non-monophyletic group, placing its representatives intermixed with species of sect. *Digitinervium* Sodiro (Carlsen and Croat 2013, 2019). Members of the latter section, like *Porphyrochitonium* present black-glandular punctations on the leaves but are differentiated by having steeply ascending basal veins together with numerous more or less scalariform lateral secondary veins arranged in parallel (melastome-like pattern of venation) (Croat 1983, 1986; Croat and Sheffer 1983). Phylogenetic analyses by Carlsen and Croat (2019) placed the studied species of *Porphyrochitonium* and *Digitinervium* in two distinct clades, clade No. 7 (consisting of five *Porphyrochitonium* and three *Digitinervium* taxa) which is sister to clade 6 (involving two species of *Porphyrochitonium* and one taxon of *Digitinervium*) + clade No. 5 (represented by members of sect. *Tetraspermium* Schott (Engl.)). Both sections, *Porphyrochitonium* and *Digitinervium*, comprise great vegetative morphological diversity (especially *Porphyrochitonium*) which can make interpretation of their taxonomic and evolutionary history complicated. This makes it crucial to explore other reproductive morphological characteristics, such as the color of the fruits (Carlsen and Croat 2019), that range from red, yellow or orange to violet-purple to lavender-blue or white (Croat et al. 2022). For example, Carlsen and Croat (2019) included taxa in clade 7 characterized by having berries of distinct colors (red, reddish orange, white, and purple), while those in clade 6 have yellow or pale yellow-orange berries. Perhaps the yellowish berries character could be a diagnostic character within clade 6; however, to confirm this notion, the current backbone of the molecular phylogeny must be increased by including similar congeners, like *Anthurium alticola* Croat, *A. durandii* Engl., *A. collinsii* Croat, *A. cuasicanum* Croat, *A. oxystachyum* Croat, *A. pendens* Croat, *A. supraglandulum* Croat, *A. vanninii* Croat, among others.

In this paper, we review species of *Anthurium* sect. *Porphyrochitonium* with a pendent growth form from Costa Rica and Panama, through extensive field documentation and herbarium work. We describe two new species, one from Costa Rica which is threatened by the expansion of livestock and coffee plantations, and another from Panama. Considering the species described in this work, 16 taxa of the section *Porphyrochitonium* with hanging habit occur in Panama and Costa Rica, eight exclusively from Costa Rica, one exclusively from Panama, and three endemics to both countries. Some of these species are relatively well-documented while others are very poorly documented in the field.

## MATERIAL AND METHODS

In order to study and document the morphological characteristics of the taxa in the field, multiple trips were made in and to Costa Rica and Panama from 2017 to 2024. The newly proposed species were documented with photographs, drawings, and herbarium specimens. The plates were made using the Lankester Composite Dissection Plate (LCDP) methodology (Karremans et al. 2020) and the Adobe Photoshop 2021–2023 software.

Species descriptions are formulated based on guidelines established by Croat and Bunting (1979). The habits and growth forms terminology follow Croat (1988), Schimper (1903), Zotz (2013), and Sperotto et al. (2020). The colors of the reproductive structures included in the descriptions were determined using the ArtyClick (2022) online application, which based on a dictionary of more than 1700 entries, allows determining the colors of structures by analyzing an image or photograph accompanied by a match percentage and a unique code for each color. The color matches score, that ranges between 0% and 100%, represents the similarity between the selected color from the photograph and the most similar color from the dictionary. In this work, the evaluated colors are accompanied by their respective code, which were based on match values above 95%. Spadix, spathe, and flower colors were determined using photographs of the structures at anthesis, and fruits only when ripe were considered.

Types and herbarium specimens of *Anthurium* from Costa Rica and Panama housed at B, CR, HLDG, LSCR, MA, MO, PMA, SCZ, UCH, and USJ, were studied. Additionally, type material from A, BM, C, COLU, E, F, G, GH, K, L, M, MO, NY, P, PMA, SCZ, US, were examined digitally using the following online databases: Bioportal (2022), GBIF (2022), HUH (2022), JACQ consortium (2004 onwards), JSTOR (2022), The Field Museum (2022), MNHN (2022), Natural History Museum (2014), NYBG (2022), Reflora (2022), Royal Botanic Garden Edinburgh (2022), Royal Botanic Gardens Kew (2022), Smithsonian Institution (2022), and Universität Zürich (2019). The acronyms of all herbaria follow Thiers (2022). Original protologues of all the names included in this work were reviewed using the online catalogues of the Biodiversity Heritage Library (2022). Typifications follow the International Code of Nomenclature (ICN) rules and recommendations (Turland et al. 2018).

The geographical distribution of taxa was obtained from Croat and Stiebel (2001), Grayum (2003), Correa et al. (2004), Funk et al. (2007), Idárraga-Piedrahita et al. (2011), Dorr and Stergios (2014), GBIF (2022), and TROPICOS (2022). The conservation assessments of all species follow the IUCN Standards and Petitions Committee (2019) guidelines, considering the number of locations, criterion B1 (extent of occurrence: EOO), and criterion B2 (area of occupancy: AOO). The IUCN B criteria values were calculated using the GeoCAT tool (Bachman et al. 2011), and the Rapid Least Concern web application (Bachman et al. 2020). Due to the high demand of the hanging species of *Anthurium* as ornamentals, the coordinates in type localities and cited specimens were omitted to reduce the possibility that the populations will be looted.

## TAXONOMY

### ***Anthurium cascantei*** O.Ortiz & M.Cedeño, **sp. nov.**

Type: Costa Rica. San José, Cantón Pérez Zeledón, distrito San Isidro del General, Fila Tinamaste, 1000 m, 7 Oct. 2022, *M. Cedeño, O. Ortiz & J. Hughes 2511* (holotype USJ; isotypes B, MO). Figure 1.

#### *Diagnosis*

*Anthurium cascantei* differs from *A. orosiense* Croat in having erect inflorescences with the spadices pointing downwards at anthesis (vs. inflorescence pendent), yellowish orange peduncles (vs. reddish), dark purple spadices with 7–8 flowers in the principal spiral (vs. yellowish to brown with 4–5 flowers in the principal spiral), pinkish stigmas (vs. white), and yellow seeds (vs. orange).

#### *Description*

Epiphyte, with pendent growth form; stems 6–20 cm long; internodes short, 1.0–2.1 cm long, 0.9–1.8 cm diam.; cataphylls thin, up to 3 cm long, brownish, soon weathering to coarse brown fibers, persisting at base. Leaves pendent; petiole terete, 8.5–22.5 cm long, 2.5–3.5 mm diam., green with white dots, and sparse inconspicuous black glandular punctations; geniculum thick, 1.5–2.4 cm long, weakly sulcate adaxially; blades oblong-elliptic, 23–35 × 5.5–10.4 cm, moderately coriaceous, gradually acuminate at apex, obtuse to rounded at base, broadest at about the middle, the margins straight; upper surface matte, obscurely light-green, glandular-punctate, weakly papillate; lower surface conspicuously black glandular-punctate; midrib acutely raised above becoming flat toward apex; primary lateral veins 14–21 per side, departing midrib at ca. 45°, marked above, scarcely visible below; lesser veins inconspicuous; collective veins arising from the base, slightly loop-connected, 4–6 mm from margin. Inflorescence erect sometimes between 45°–60° (erect peduncles with the spadices pointing downwards) at anthesis; peduncle terete, light-green with white dots, 30–38 cm long; spathe oblong-lanceolate, thin, green at pre-anthesis, light-green, orange-yellow (code #A88F59) with pinkish stains at female anthesis, 10–11.1 × 1.8–2.0 cm, acuminate at apex, revolute basally, curved medially and apically, withering promptly after anthesis; spadix sessile, 17–19.5 cm long, 0.4–0.6 cm diam., brownish to red-orange (code #3E1C14) at anthesis, dark purple at post-anthesis, cylindric to slightly tapered towards apex; flowers 4-lobed, 2.5–3 mm, the sides more or less straight parallel to spirals, sigmoid perpendicular to spirals, 4–6 flowers in the principal spiral, 7–9 flowers visible in the

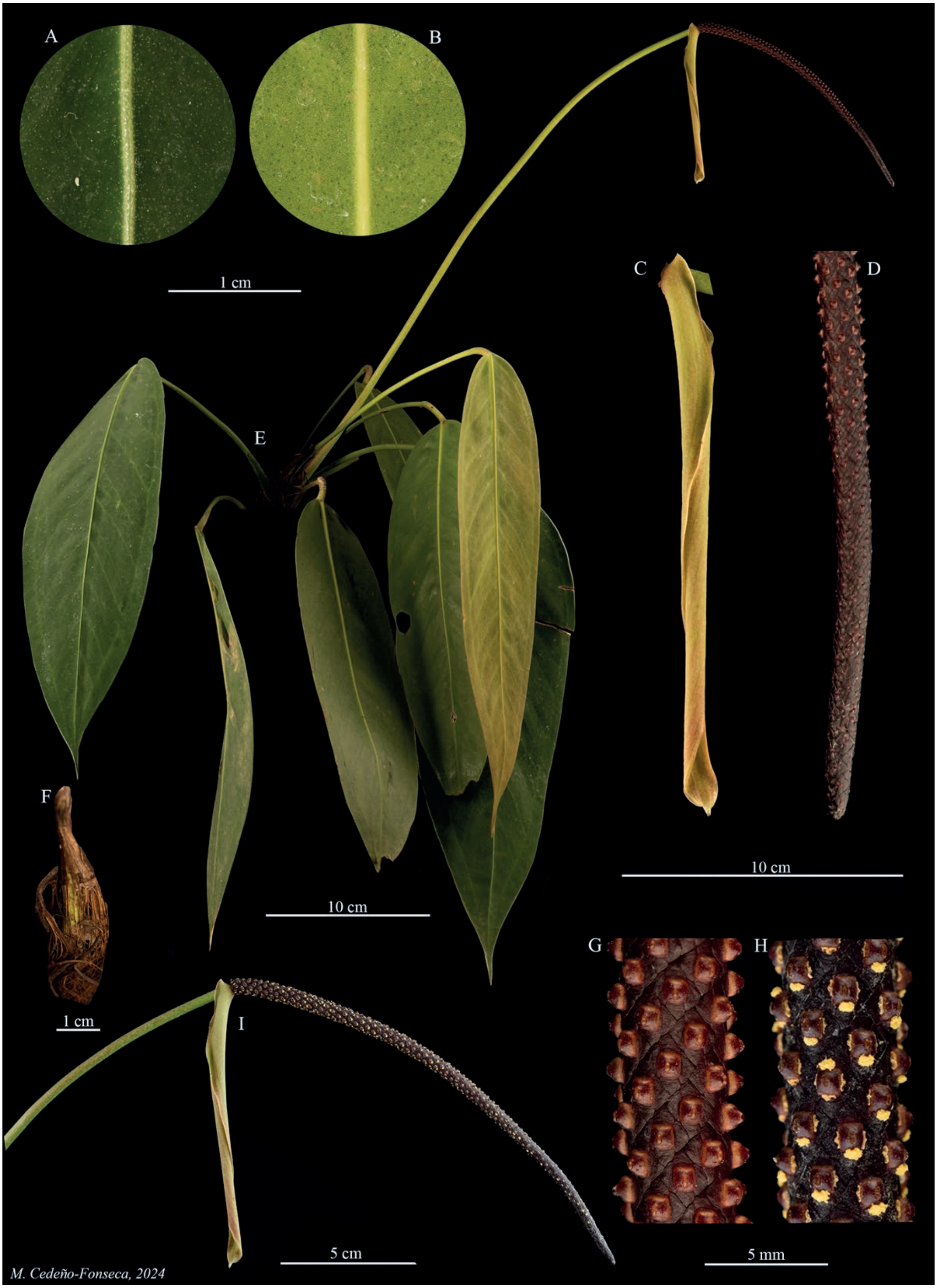

**Figure 1.** *Anthurium cascantei*. A: detail of the leaf blade on the upper surface; B: detail of the leaf blade on the lower surface; C: spathe; D: spadix; E: habit; F: cataphylls; G: flowers at female anthesis; H: flowers at male anthesis; I: inflorescence. Photographs by A. Serna-Sánchez and Plate by M. Cedeño-Fonseca. All photos from *M. Cedeño et al. 3038* (USJ, Cultivated at Lankester Botanical Garden).

alternate spiral; tepals smooth, glossy, lateral tepals 1.5–1.8 mm wide, brown; pistils slightly raised, orange-red (code #541012); stigma reddish-orange (code #864D1E), ca. 2 mm long; anthers white, held at sides of pistil just above tepals. Infructescence, berries; seeds not seen.

### *Eponymy*

The species is named after the ecologist and botanist Dr. Alfredo Cascante Marín, who has contributed to the study of Neotropical plants, especially the epiphyte flora.

### *Distribution and habitat*

Endemic to Costa Rica, only known from Fila Tinamaste, Pérez Zeledón, San José. It occurs in the *premontane wet forest* of the Pacific watershed in Fila Costeña, in primary and/or secondary forests, at 1000 m elevation.

### *Conservation status*

*Anthurium cascantei* is a rare species known from two herbarium specimens, both collected from a single location in an unprotected area which is highly pressured by destructive human activities, specifically extensive cattle ranching. Considering the reduced geographic distribution (AOO: ca. 8 km$^2$) and the threats to its natural habitats, we consider that this species qualifies as Critically Endangered [CR B2ab(iii)].

### *Remarks*

*Anthurium cascantei* is recognized by its long peduncles, oblong-lanceolate spathes, brownish to red-orange spadices at anthesis, large spathes (10–11.1 cm), orange-yellow to slightly pinkish towards margins, spadices with 4–6 flowers visible in the principal spiral and 7–9 flowers in the alternate spiral, orange-red pistils, and reddish-orange stigmas.

*Anthurium cascantei* is similar to *A. orosiense* sharing coarse brown fibrous cataphylls, black glandular-punctate (on both surfaces), oblong leaf blades, and long peduncles. However, *A. cascantei* has multiple differences in the inflorescence, especially in the arrangement, colors of both the spadix and the flowers (see the characters listed in the diagnosis). Additionally, there is a marked allopatry between the two species, *A. cascantei* grows in the Southern Pacific of Costa Rica in Fila Costeña, whereas *A. orosiense* is distributed in the Caribbean slope of Talamanca Mountain Range.

### *Additional specimens examined (paratypes)*

**COSTA RICA**: **San José**: Cantón Pérez Zeledón, distrito San Isidro del General, 1000 m, 7 octubre, 2022, *M. Cedeño & al. 3038* (USJ, Cultivated at Lankester Botanical Garden).

## ***Anthurium chiriquense*** Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 22(2): 67. 1940.

Type: Panama. Chiriquí, Bajo Chorro, Boquete Dist., 1800 m, *M. Davidson 283* (holotype F-V0044842F; isotype MO-1154936). Figure 2.

### *Distribution and habitat*

*Anthurium chiriquense* is endemic to Costa Rica and Panama, and occurs from Coto Brus Cantón, Costa Rica, to Chiriquí Province, Panama, at 1900 to 2400 m in *Premontane wet forest, Premontane rain forest*, and *Lower montane rain forest* life zones.

### *Phenology*

Flowering in February and March.

### *Conservation Status*

This species is known from 11 specimens representing three locations: Fortuna Forest Reserve (eastern Chiriquí in Panama), Boquete (type locality: western Chiriquí in Panama), and Jurutungo (Costa Rica–Panama border). Currently, some parts of Boquete and Jurutungo are under serious disturbance due to livestock or farming-related activities. During recent fieldwork, we observed that the devastation of the natural areas in these sites persists, putting the populations in evident peril. We have calculated this species has an AOO of 44 km$^2$ and an EOO of 303.5 km$^2$. Based on the considerations mentioned above, *Anthurium chiriquense* must be considered as Endangered [EN B1ab(iii)+2ab(iii)].

### *Remarks*

The species is distinguished by having pale persistent fibrous cataphylls, long petioles (almost equaling the leaf blade), both leaf surfaces black-glandular-punctate, large oblong-elliptic blades with the collective vein 5–10 mm from the margin, long pedunculate inflorescences, red orange (code #9E5B40) spathes, and long-stipitate, usually coiled, pink (code #FD9FA2) spadices with 3–4 flowers visible per spiral, and globose-ovoid, red orange (code #E55B3C) berries which are beaked at apex. Croat (1986) stated, based on few collections available at the time, that this species is generally epiphytic and does not have coiled spadices. However, during recent fieldwork carried out at the type locality, we documented that this species usually presents a rupicolous or terrestrial habit

**Figure 2.** *Anthurium chiriquense*. A: adult individual growing terrestrially with pendent leaves; B: inflorescence with the spadix in the female anthesis; C: inflorescence with the spadix in the male anthesis; D: mature infructescence with ripe berries. A–B, D from *O. Ortiz et al. 4222* (PMA); C from *O. Ortiz et al. 2782* (PMA). All photographs by M. Cedeño-Fonseca.

(rarely epiphytic) on steep rocky walls, and coiled spadices pinkish at anthesis, which post-anthesis become straight and change colour to purple-reddish brown.

*Anthurium chiriquense* is morphologically similar to *A. longistipitatum* due to the similarity in their leaf blades and especially by having slender and long-stipitate spadices. *Anthurium longistipitatum* differs from *A. chiriquense* in having orange red, straight spadices, and flowers with stamens retracted after anthesis (vs. exserted at post-anthesis).

### *Specimens examined*

**COSTA RICA**. **Puntarenas**: Cantón de Coto Brus, Z. P. Las Tablas, cuenca Terralba-Sierpe, Jurutungo, 2400 m, 6 Mar. 1997, *E. Navarro & A. Picado 673* (INB) [now at CR!]. **PANAMA**. **Chiriquí**: Along trail between N fork of Río Palo Alto and Cerro Pate Macho, ca. 6 km NE of Boquete, 1600 - 1700 m, 6 Feb. 1986, *M.H. Grayum, & al. 6360* (MO!); Boquete, Tree Trek Mountain Resort, 1958 m, 19 Mar. 2017, *O. Ortiz, R. Flores, M. Cedeño & E. Jiménez 2782* (MO, PMA); Vicinity of Bajo Chorro, 1900 m, 20 Jul 1940–22 Jul. 1940, *R.E. Woodson, Jr. & R.W. Schery 678* (MO); Along Quebrada de Arena, N of Carretera del Oleoducto, IRHE Fortuna Hyroelectric Project., 1100 m, 12 Mar. 1982, *S. Knapp & al. 4084* (MO); Cerro Pate [Pata] de Macho ca. 5 mi NE of Boquete, along trail to Continental Divide which leads on to Finca Serrano (Francisco Serrano), pacific slope, 1800–2200 m, 23 Nov. 1979, *T.B. Croat 48558* (MO); Cerro Pate [Pata] de Macho, in forest and pasture below, 1800 - 2330 m, 15 Mar. 1982, *W.J. Kress & al. 82-1377* (MO); Boquete, Bajo Chorro. Rain forest, 15 Feb. 1938, *M.E. Davidson 283* (F, MO); Gualaca, Reserva Forestal Fortuna, Division Continental, 961 m, 6 Mar. 2014, *O. Ortiz & G. Villareal 2127* (MO, PMA); Tree Trek Mountain Resort, 1958 m, 15 Mar. 2021, *O. Ortiz & al. 4222* (PMA).

## ***Anthurium edtysonii*** Croat, Aroideana 45(2): 127, f. 35, 2022.

Type: Panama. Colón: Portobello, vic. of bridge over Río Viejo, 9 m, 4 km NE of Puerto Pilón, 9 m, 27 Mar. 1974, *M. Nee & E. Tyson 10897* (holotype MO-2251621). Figure 3.

(=) *Anthurium sknappiae* Croat, Aroideana 45(2): 221, f. 83, 2022, **syn. nov**.

Type: Panama. Coclé: Ridge NW of village of Río Blanco de Norte, between Caño Sucio and Río Blanco de Norte, property of Dideymo [Dídimo] Olivera; 350 m, 20 Feb. 1982, *S. Knapp 3679* (holotype MO-3043619).

### *Distribution and habitat*

*Anthurium edtysonii* occurs from Costa Rica to northern Ecuador, in humid lowland forests below 600 m elevation. It is relatively common on the Pacific slope of Costa Rica. In Panama, it is common to observe it on the entire Caribbean side, less frequent on the Pacific slope.

### *Phenology*

Flowering in March, April. Fruiting in May, August, September.

### *Conservation Status*

This species has a relatively wide geographical distribution (EOO: ca.135,000 km$^2$), occurs in multiple protected areas and its populations are not facing a potential threat; therefore, we suggest this species to be considered as Least Concern [LC].

### *Remarks*

According to Croat et al. (2022), *Anthurium edtysonii* is characterized by its short-petiolate leaves, sulcate petioles, relative narrowly oblong-oblanceolate leaf blades with the upper surface with an acutely raised midrib, short pale-lineate and epunctate, lower surface elineate and densely glandular-punctate as well as by the long-pedunculate inflorescence with a green spathe and orange yellow (code #C8B560) spadices with 4–5 flowers visible in the principal spiral and 3–4 in the alternate spiral.

Croat et al. (2022) suggested that this taxon seems morphologically closer to *A. iguanitense* Croat, distinguished it by having proportionately shorter, more deeply sulcate petioles, broader oblanceolate-elliptic blades which are 10 times longer than petioles. However, based on the collections of *A. friedrichsthalii* studied, we considered that *A. edtysonii* is morphologically more closely related to *A. friedrichsthalii* than to *A. iguanitense*. The most notable differences found between the neotype of *A. friedrichsthalii* (designated below) and the holotype of *A. edtysonii* is that the latter taxon represents a much more robust plant, with thicker stems, wider leaf blades (4.2–5.4 cm vs. up to 2 cm wide in *A. friedrichsthalii*) that present conspicuously interprimary veins above (vs. obscure or absent), and collective veins more than 1 mm from margin (vs. less or ca. 1 mm). Based on the morphological notion mentioned above, we separated some representative specimens from other localities, which allowed us to expand the geographical range of this spe-

**Figure 3.** *Anthurium edtysonii*. A: adult individual from Panama (Colón: Portobelo); B: adult individual from Costa Rica (Puntarenas: Dominical). Not collected. All photos by M. Cedeño-Fonseca.

cies and confirm its occurrence in Costa Rica, Colombia, and Ecuador.

Croat et al. (2022), additionally described *A. sknappiae,* a new species that we consider conspecific with *A. edtysonii*, because both share oblong-oblanceolate, usually falcate, blades which have glandular black punctations only on the upper surface, as well as by the long-pedunculate inflorescences with green spathes, and spadices with few flowers per spiral (3–5 flowers). Considering that both taxa share important reproductive and vegetative characters, we propose here the synonymy of *A. sknappiae* under *A. edtysonii*. These two names have equal priority, because both were published in the same article, however, we chose *A. edtysonii* for practical reasons taking into account the alphabetical order.

*Selected specimens examined*

**COSTA RICA**. **Puntarenas**: P.N. Corcovado, Península de Osa, Estación El Tigre, Cabecera Río Agujas, Finca Azofeifa, 200–300 m, 8 May 1994, *R. Aguilar & al. 3251* (CR, MO). Cantón Golfito, distrito Puerto Jiménez, Playa Matapalo, (Planta cultivada en el Jardín de Jason Mark Hughes), 20 M, 13 Jun. 2020, *M. Cedeño 1906* (USJ); Reserva Forestal Golfo Dulce, Osa Península, Rancho Quemado, in forest and forest edges at S end of valley, 160 m, 3 May 1988, *B.E. Hammel & al. 16824* (MO); Parque Nacional Corcovado, Camaronal from behind the lab. building to the water tanks, 0 m, 8 Apr. 1988, *C. Kernan 392* (MO); **San Jose**: Cantón Turrubares, distrito San Luis, Sobre el camino al pueblo La Potenciana, 720 m, 18 Jun. 2020, *M. Cedeño & al. 1898* (USJ); Turrubares, Reserva Biológica Carara, Valle del Tárcoles, Puesto Carara, Montañas Jamaica, lado este, bosque primario entre Carara y Sur, 200–500 m, 3 Apr. 1993, *B.E. Hammel & al. 18910* (CR); Z.P. Cerro de Turrubares, Cuenca del Tárcoles, San Pablo de Turrubares, 100–200 m, 8 Dec. 2004, *D. Santamaría 303* (CR, MO). **PANAMA**: **Colón**: Near Salamanca Hydrographic Station on the gorge of the R. Pequení, 70 - 80 m, 15 Dec. 1934, *C.W. Dodge & al. 16523A* (MO); Along Río Viejo, between the Portobelo road and Quebrada Ruíz, 4 km NE of Puerto Pilón, 29 Sept. 1973, *M. Nee 7172* (MO); Santa Rita lumber road, about 5 miles from Highway, 8 Apr. 1971, *T.B. Croat 14187* (MO); **Panamá Province**: Parque Nacional Chagres, Sección Boquerón, Río San Juan de Pequeni, 31 Aug. 1999, *Florpan, A. Espinosa & al. 4486* (MO!, PMA); **Darién**: S of El Real, headwaters of Rio Pirre at fork known as Dos Bocas, 100 m, 25 Sep.

1969, *H. Kennedy & R.B. Foster 2823* (MO); Área de Manejo Especial de Bahía Piñas, bosque secundario circundante al hotel Tropic Star Lodge, 0 m, 30 Jun. 2018, *O. Ortiz & al. 3031* (PMA). **COLOMBIA**: **Chocó**: zona de Urabá, Cerros del Cuchillo, camino de Macondo al Cuchillo, bosque primario perturbado, bmh-T, 20–540 m, 17 Apr. 1988, *D. Cárdenas 1712* (MO). **ECUADOR**: **Esmeraldas**: Along road from San Lorenzo to Ricaurte, 2 km from main Lita to San Lorenzo Road, 64 m, 11 Oct. 2012, *T.B. Croat & al. 104162* (MO).

### ***Anthurium embera*** O.Ortiz & M.Cedeño, **sp. nov**.

Type: Panama. Darién, Distrito de Chepigana, corregimiento Puerto Piña, Bahía Piña, cima de Cerro Venado, 1235 m, 29 Nov. 2022, *M. Cedeño, & O. Ortiz, N. Köster & R. da Pena 2842* (holotype PMA; isotype: B). Figure 4.

#### *Diagnosis*

*Anthurium embera* differs from *A. cascantei* in having pendent inflorescences with shorter peduncles of 12.5–13.8 cm long (vs. erect inflorescences with longer peduncles of 30–38 cm long), short and thick, pinkish-red spathes of 2.3–2.6 cm long (vs. thin and longer orange-yellow pinkish spathes of 10–11.1 cm long), and shorter spadices of 7.0–7.4 cm long, with 2–3 flowers in the principal spiral (vs. longer spadices of 17–19.5 cm, with 4–6 flowers in the principal spiral).

#### *Description*

Epiphyte, with pendent growth form; stems 6–15 cm long; *internodes* short, 1.0–2.0 cm long, 1.5–2.8 cm diam.; *cataphylls* thin, up to 4.3 cm long, brownish, fibrous. Leaves pendent; *petiole* terete, 9.5–32.5 cm long, 2.0–3.5 mm diam., green with sparse inconspicuous black glandular punctations; geniculum distinct, 1.2–2.0 cm long, weakly sulcate adaxially; *blades* oblong-elliptic to ovate, 14.5–16 × 3.5–4.2 cm, moderately coriaceous, gradually acuminate at apex, obtuse to rounded at base, broadest at about the middle, the margins straight; *upper surface* green, very glossy, lacking black glandular-punctations, weakly papillate; *lower surface* mate, conspicuously black glandular-punctate; *midrib* acutely raised above becoming flat toward apex; *primary lateral veins* 8–10 per side, departing midrib at ca. 45° angle, sunken above, plane and scarcely visible below; lesser veins inconspicuous; *collective veins* arising from the base, slightly loop-connected, 3–5 mm from margin. *Inflorescence* pendent at anthesis; *peduncle* terete, reddish-orange (code #C47451), 12.5–13.8 cm long; *spathe* oblong-lanceolate, thick, pinkish-red (code #F08080) at anthesis, 2.3–2.6 × 0.4–0.5 cm, truncate at apex, revolute in all its extension, perpendicular forming an angle between 90–110° to the spadix; *spadix* sessile, 7.0–7.4 cm long, 0.4–0.6 cm diam., reddish orange (code #A2653E) at anthesis, cylindric; *flowers* 4-lobed, 1.0–1.3 mm, the sides more or less straight parallel to spirals, sigmoid perpendicular to spirals, 2–3 flowers in the principal spiral, 5–6 flowers visible in the alternate spiral; tepals smooth, glossy, lateral tepals 1.5–1.8 mm wide, pinkish; pistils slightly raised, orange red (code #9E5B40); stigma red-orange (code #AF593E), ca. 1 mm long; anthers white, held at sides of pistil just above tepals. *Infructescence*, *berries* and *seeds* not seen.

#### *Etymology*

The species is named honoring the indigenous Comarca Emberá.

#### *Distribution and habitat*

Endemic to Panama, only known from the top of Cerro Venado in Puerto Piña, Darién. It occurs in the *premontane wet forest* of the Pacific watershed, on primary forests, from 1200–1300 m elevation.

#### *Conservation status*

*Anthurium embera* is a rare species known only from the type specimen, collected in the protected area of Darién National Park. It grows in quite remote areas, in a special montane habitat (elfin forests, see Myers 1969), which is characterized by comprising forests with an extremely humid understory and a relatively low canopy (usually less than 15 m high) (Gradstein and Salazar 1992). Furthermore, elfin forests of Darién comprise a unique flora where many endemic species occur (Ortiz et al. 2019). These forests, due are located on mountain ridges that are almost inaccessible, are generally not threatened by destructive anthropogenic activities. However, the surrounding ecosystems, such as evergreen, semi-deciduous, deciduous forests and wetlands, are highly threatened, mainly by deforestation due to indiscriminate logging and forest fires. Probably the greatest threat facing *Anthurium embera* and its natural habitats is climate change (perhaps enhanced by the alteration of adjacent ecosystems), possibly related to alterations in biogeochemical cycles (Foster 2001), such as hydrological cycles, the formation of orographic rains and horizontal precipitations, typical conditions of elfin cloud forests (Myers 1969; Stadtmüller 1986; Whiteman 2000). Due to the potential threats mentioned above, we recommend tentatively considering this species as Critically Endangered [CR B2ab(iii)]

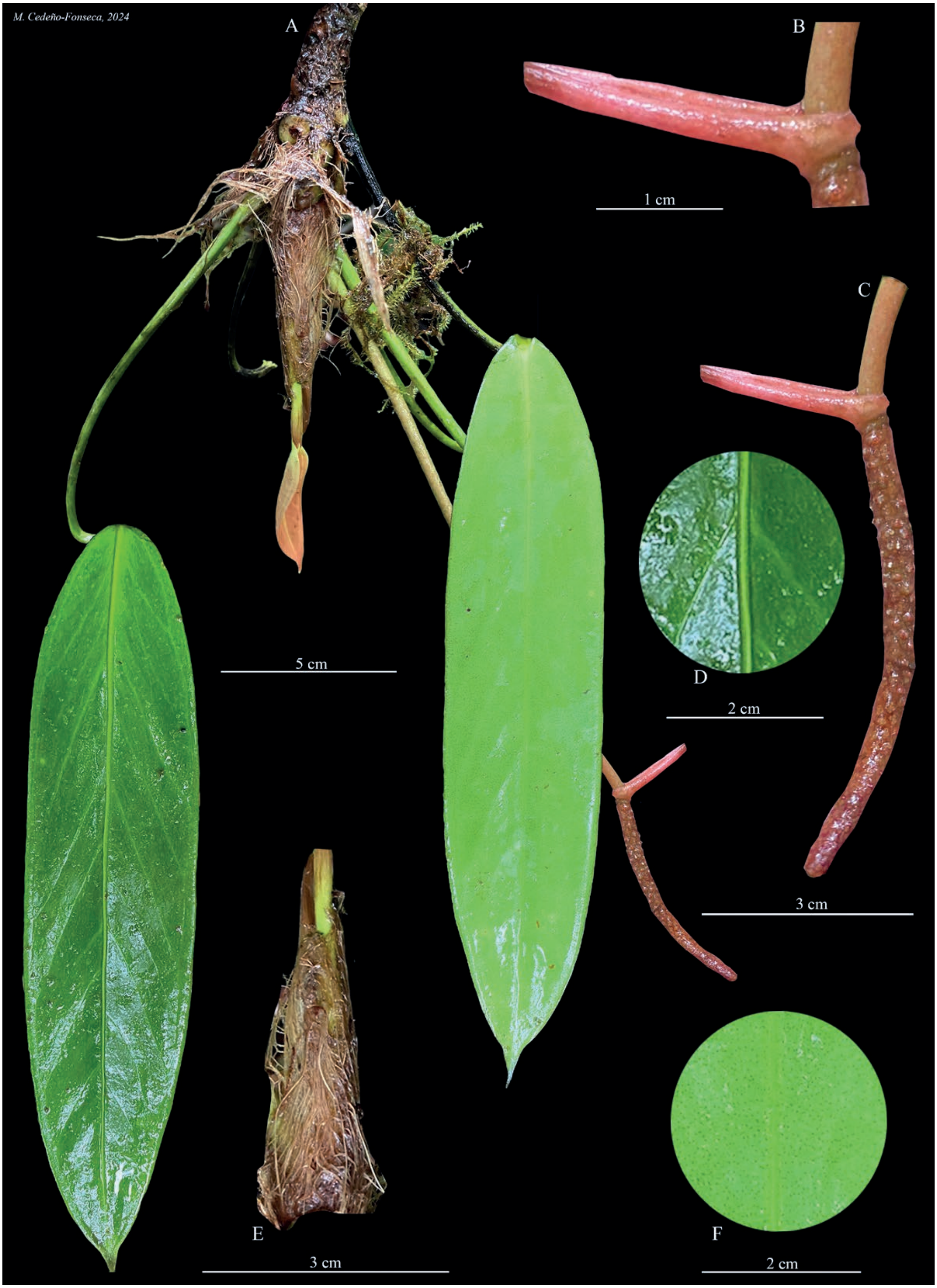

**Figure 4.** *Anthurium embera*. A: habit; B: spathe; C: inflorescence at female anthesis; D: detail of the leaf blade on the upper surface; E: cataphylls; F: detail of the leaf blade on the lower surface. all from *M. Cedeño et al. 2842* (PMA; type collection). Plate and photos by M. Cedeño-Fonseca.

### *Remarks*

*Anthurium embera* is recognized by its oblong-elliptic to ovate leaf blades, and pendent inflorescences with relatively short pinkish-red spathe and reddish orange spadix compared with most of the species with pendent leaves. *Anthurium embera* is morphologically similar to *Anthurium cascantei* because share coarse brown fibrous cataphylls and oblong leaf blades. Both can be distinguished based on the morphological characteristics listed in the diagnosis, and also there is a conspicuous allopatry between the two species. *Anthurium embera* grows in eastern Panama in Darién province, whereas *A. cascantoi* is distributed in the Fila Costeña of the Pacific of Costa Rica.

This new taxon could also be confused with *A. edtysonii*, because both species have relatively wide leaf blades, lack black glandular punctations on the upper surfaces, as well as their pendent inflorescences. However, *A. embera* differs in having very glossy leaf blades on the upper surfaces (vs. mate), 8–10 pairs of lateral primary veins (vs. 14–20 pairs of primary lateral veins), and reddish orange spadices with 5–6 flowers visible in the alternate spiral (vs. orange yellow spadices with 3–4 flowers visible in the alternate spiral).

***Anthurium friedrichsthalii*** Schott, Oesterr. Bot. Wochenbl. 5(9): 65. 1855.

(°) *Anthurium gracile* (Rudge) Lindl. var. *friedrichsthalii* (Schott) Engl., Bot. Jahrb. Syst. 25: 370. 1898.

Type: "Habit in Guatemalae [Nicaragua or Costa Rica] Insula Cativo," *Friedrichsthal s.n.* (holotype: W, destroyed). **Neotype (designated here)**: [illustration] H. W. Schott's *Icones Aroideae et Reliquiae No. 332* (Schott 1984) [Figure 5], deposited in the Natural History Museum of Vienna, also available in the microfiche edition (Nicolson 1984). Figures 5, 6.

(=) *Anthurium linearifolium* Engl., Bot. Jahrb. Syst. 25: 370. 1898.

Type: "Columbia [Panama]: ad arbores in silvis densis ad flumen Rio Chaques [Chagres], in isthmo panamensi," Apr. 1888, *F.C. Lehmann 4538* (B-100247071, **lectotype designated here**, negative at F barcode F0BN011966; isolectotypes F, F-0044933F, K, K-000434205).

(=) *Anthurium perangustum* Croat, Aroideana 45(2): 207–208, f. 76, 2022, **syn. nov**.

Type: Panama. Panamá Province: El Llano-Cartí Road, 9.6 from Interamerican Hwy, ca. 350 m, 26 May 1975, *S. Mori & J. Kallunki 6392* (holotype MO-2274535).

### *Distribution and habitat*

The species is distributed from Nicaragua to Colombia and now in Ecuador, at elevations from sea level to usually 800 m. In Costa Rica and Panama, it is common in *tropical moist forest*, but also occurs in *premontane wet forest* and *tropical wet forest* life zones. The occurrence of *Anthurium friedrichsthalii* for Ecuador is confirmed here, representing a new country record. The representative collection, *C. Aulestia 216* (MO), was collected in the north of the country, in the Awá Ethnic Reserve, Centro Guadualito.

### *Phenology*

Flowering and fruiting throughout the year.

### *Conservation Status*

*Anthurium friedrichsthalii* has a wide-ranging distribution (EOO: 1,039,724 km$^2$; AOO: 15,700 km$^2$), and it is not facing any important threats, therefore it must be considered as Least Concern [LC].

### *Nomenclature*

Schott (1855) stated in the protologue of *Anthurium friedrichsthalii*, that the plant inhabits in "Guatemalae Insula Cativo," but also cited the naturalist and explorer Emanuel von Friedrichsthal (as "Friedrichsthal") as collector. It is known that Friedrichsthal carried out fieldwork during 1837–1841, visiting the Antilles, United States, Mexico, and Central America (Wurzbach 1858; Stevens and Montiel 2001; Grayum et al. 2004; Taracena-Arriola and Sellen 2006; Jiménez-Madrigal 2022). According to the biographical information available (Wurzbach 1858), Friedrichsthal, in 1837, undertook a long journey to Central American lands. In 1838, starting from the Caribbean coast, he explored the Río San Juan between Nicaragua and Costa Rica, then made expeditions upwards to Cocibolca lake (known also as Nicaraguan Lake), passing through Acoyapa, and arriving to the port of San Juan del Sur on the Pacific coast of Nicaragua. In 1839 and 1840, Friedrichsthal carried out other field trips to El Salvador, Guatemala, Belize, United States, and Mexico (Yucatán) (Taracena-Arriola and Sellen 2006). Later, in 1841, he returned to Europe (specifically Vienna). With the information gathered during that time, Friedrichsthal prepared maps, plant specimens, and notes on the natural history, archeology, and cultural aspects of the places visited (Wurzbach 1858; Taracena-Arriola and Sellen 2006).

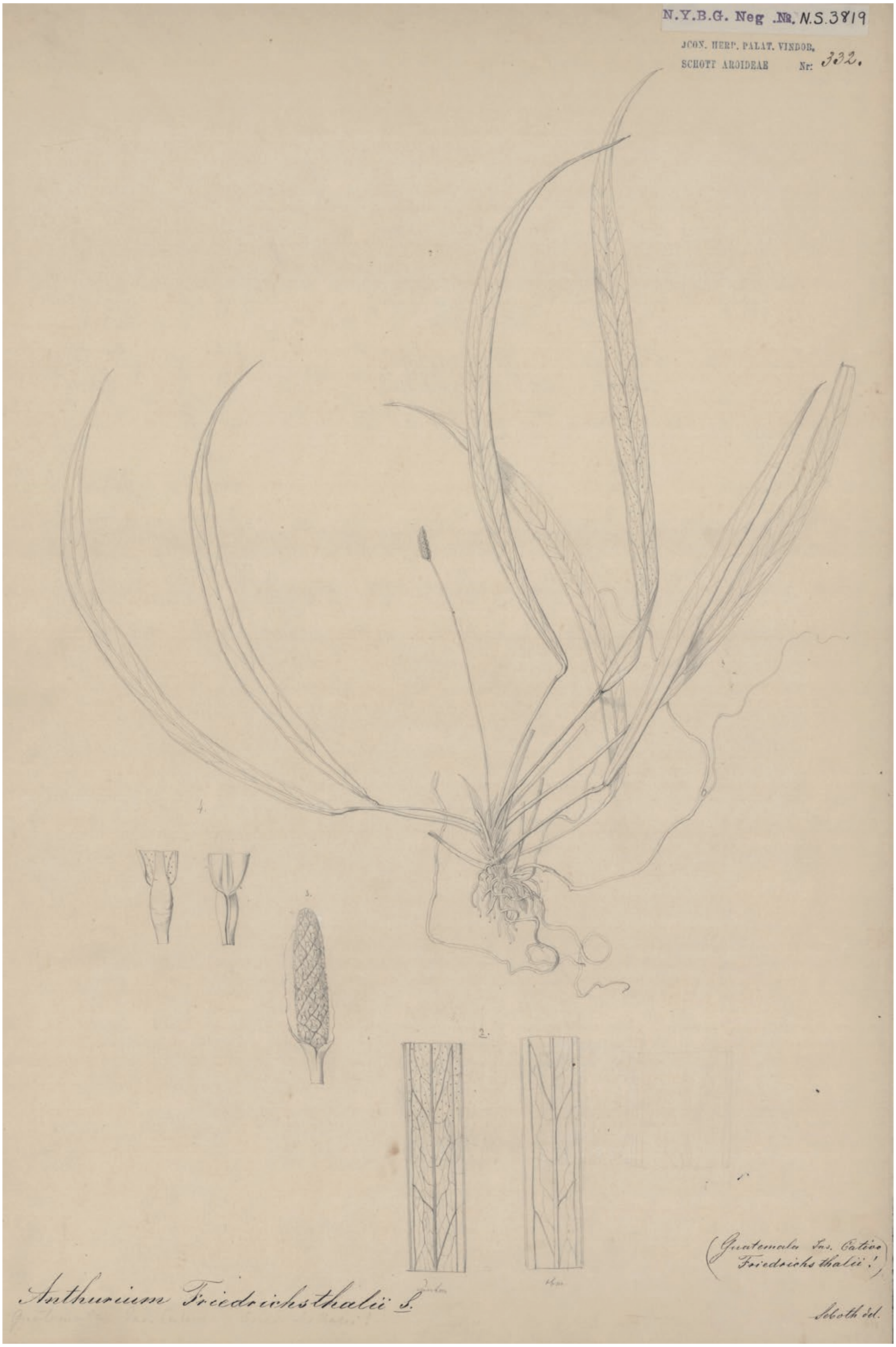

**Figure 5.** Neotype of *A. friedrichsthalii*. Scan image courtesy of the Naturhistorisches Museum Wien (used with authorization).

**Figure 6.** *Anthurium friedrichsthalii*. A: habit; B: inflorescence at female anthesis; C: ripe berries. All from *M. Cedeño et al. 2019* (USJ). Photos by M. Cedeño-Fonseca.

Almost all the Central American herbarium material collected by Friedrichsthal contains labels indicating that the specimens were collected in "Guatemala". However, historical evidence (Taracena-Arriola and Sellen 2006) and location notes included on the labels suggest that Friedrichsthal collected in several Central American countries, not only in Guatemala. This confusion seems to be related to the geopolitical situation presented in Central America at that time (1837–1840). In that period, most Central American territory was occupied by the former "Federal Republic of Central America" (1824–1838, although the fiction of union was preserved until Guatemala officially separated in 1847), made by Guatemala, El Salvador, Honduras, Nicaragua, and Costa Rica, with Guatemala City as the capital for a long time (Smith 1963). The historical facts mentioned match well with Friedrichsthal's explorations in Central America, therefore is likely that Friedrichsthal, when citing "Guatemala" on his labels, was referring to the Federal Republic of Central America (see Gerrit Davidse's comments for this taxon in TROPICOS 2022). Thus, the original material used for the description of *A. friedrichsthalii* probably came from Nicaragua or Costa Rica where it is distributed. The locality "Cativo Island" mentioned in the original protologue is unknown and we were unable to locate it. Currently, *A. friedrichsthalii* is only known from SE Nicaragua to Ecuador, and there are no subsequent records from Honduras, El Salvador, Guatemala, Belize, and Mexico (Croat 1986; Croat and Stiebel 2001; Grayum 2003; TROPICOS 2022).

Almost all the original material of *Anthurium* species housed at W, studied by Schott, were destroyed during World War II (Riedl and Riedl-Dorn 1988), including the presumed holotype of *A. friedrichsthalii* (Christian Bräuchler pers. comm., 2022), which was cited by Engler (1905: 89) as deposited in the "K. K. Hofmuseum Wien." Although much of the material collected by Friedrichsthal is now in W and GOET (Wagenitz 1982), unfortunately, as yet, it has been impossible to locate any original material of *A. friedrichsthalii* in those herbaria or the rest of the herbaria consulted.

In the absence of original material, we propose the illustration Icones Aroideae et Reliquiae No. 332, prepared for Schott by Joseph Seboth, as the neotype of *Anthurium friedrichsthalii* (Fig. 5). This illustration includes some elements cited in the protologue of the species and adequately matches with the morphological features incorporated in the original diagnosis. Also, it should also be noted that it bears a presumably contemporary note indicating that it is a drawing of the Friedrichsthal specimen, nevertheless does not include a specific date; consequently, the illustration No. 332 should be treated as a neotype rather than lectotype (see Coelho and Mayo 2007).

Regarding the heterotypic synonym *Anthurium linearifolium*, when Engler (1898) published this name, he cited only the collection "*F. C. Lehmann 4538*," without indicating the herbarium where the specimen was deposited, which was not a requirement at the time. We traced three specimens at B, F, and K, which all seem to match the original diagnosis, and bear the stated collector and number. In agreement with Art. 9.12 of ICN (Turland et al. 2018), the specimen at B (barcode 100247071) is here designated as lectotype since it bears Engler's handwriting and agrees with the protologue and the type locality. Furthermore, the B specimen was cited by Engler (1905), supporting the notion that Engler himself probably used it to prepare the original description.

### *Remarks*

*Anthurium friedrichsthalii* is recognized by having a pendent habit, strap-shaped leaves, leaf blades black-glandular-punctate only on the lower surfaces, collective veins less or ca. 1 mm from the margin, long-pedunculate, hanging inflorescences, lanceolate, green spathes, sessile, long-tapered, yellowish orange (code #E3A857) spadices at anthesis, with 4–6 flowers visible in the principal spiral and 4–5 flowers visible in the alternate spiral, and oblate-obcordate (truncate at apex with a central depression), pale yellowish orange (code #FF9F00) berries.

This species could be confused with juvenile plants of *Anthurium utleyorum* Croat & R.A. Baker and *A. pendens* Croat, due to the elongated leaf blades; but both species differ by having markedly black glandular-punctate blades on both surfaces. Additionally, *A. pendens* has darker leaf blades (when dry) and *A. utleyorum* has ovoid red berries.

Recently, Croat et al. (2022) described *Anthurium perangustum* based on a single collection from eastern Panama, which is very similar to the neotype of *A. friedrichsthalii* designated here. Croat et al. (2022) suggested that *A. perangustum* differs by having short peduncles (5.3 cm long), a green spathe (white in the original label), a green tinged, purplish spadix (noted as red in the original label), as well by the leaf blades with upper midrib narrowly raised above, the surface moderately smooth on drying, that is finely and acutely ridged. We argue here that *A. perangustum* is conspecific with *A. friedrichsthalii* because almost all diagnostic characters cited are present in the examined specimens of *A. friedrichsthalii*, including blade shape, lack of interprimary veins and black glandular punctations on the upper surface, shape of the spadix and the number of flowers per spiral. The only unusual character in the holotype of *A. perangustum* is the presence of a noticeably short peduncle. Nevertheless, this can be an aberrant specimen of *A. friedrichsthalii* (since there are many collections in the same locality), or this character could be considered a morphological variation of the species. We have visited the type locality of *A. perangustum* multiple times (it is a widely botanized site), and we have only documented specimens that match *A. friedrichsthalii*.

### *Selected specimens examined*

**COSTA RICA**: **Alajuela**: Cantón San Carlos, distrito Cutris, Camino a Chorreras. Borde de bosque sobre los potreros, 258 m, *M. Cedeño & al. 2019* (USJ); 3 miles north of San Miguel, 380 m, 26 May 1976, *T.B. Croat 35650* (MO). **Cartago**: Paraíso, Atlantic rainforest, collected Feb. 1989 by Clarence Kl. Horich, in cultivation at MO, headwater range of Río Naranjo (confluent of Río Reventazón), north of Quelitaleo de Cachí, on one old tree along trail with very rare *Anthurium tenerum* on same tree, 1350 m, 30 Nov. 1990, *T.B. Croat 71839* (MO); Turrialba, Río Tuis, near La Suiza, 600 m, 4 May 1956, *L.O. Williams & A. Molina 19573* (MO). **Guanacaste**: 3.5 km N of Santa Elena on road to San Gerardo, 0.5 km N of junction road and Río Negro, 1540 m, 20 Aug. 1988, *W.A. Haber & W. Zuchowski 8626* (CR). **Heredia**: Finca La Selva, the OTS field station on the Río Puerto Viejo just E of its junction with the Río Sarapiquí, 100 m, 14 Jun. 1981, *B. E. Hammel & J. Trainer 10881* (MO); La Selva Biological Station, 100 m, 1 Feb. 1987, *R. Antibus & P. Lesica 4158* (MO); **Limón**: Camino entre Fila Dimat y Río Uren, finca de Hermógenes Pereira, 22 Oct. 1985, *L. D. Gómez & al. 23764* (MO); Hacienda Tapezco-Hacienda La Suerte, 29 air km W of Tortuguero, area of low hills and mounds, a few small streams, 40 m, 21 Mar. 1978, *C. Davidson & al. 7102* (MO). **PANAMA**: In Bäumen, dichten Wäldern am Rio Chagres, Isthmus von Panama, s.d., *F. C. Lehmann 4538* (MO); **Bocas del Toro**: North coast of Escudo de Veraguas Island, 5 m, 8 Aug. 1987, *G. McPherson 11425* (MO); Vicinity of Fortuna Dam, along pipeline road leaving road to Chiriquí Grande at continental divide, 2.8 road-miles from divide, 850–

950 m, 25 Jun. 1986, *G. McPherson 9670* (MO); **Chiriquí**: Punta Burica, El Chorogo. Desde la Finca de Fernando Chavarria, hacia el Río San Bartolo cabecera y afluentes, 16 May 2007, *J.E. Aranda & al. 3940* (MO, PMA, SCZ); Burica Peninsula. Primary forest, San Bartolo Limite, 12 mi. (20 km) west of Puerto Armuelles, 400–500 m, 24 Feb. 1973, *R.L. Liesner 191* (MO!). **Coclé**: Continental Divide on road to Coclesito, in patch of forest near road, 1500 ft, 20 Jun. 1978, *B. E. Hammel 3507* (MO); Road from La Pintada to Coclesito, 600 m, 07 Feb. 1983, *C.W. Hamilton & G. Davidse 2877* (MO); **Colón**: Santa Rita Ridge, ca. 12 km from Transistmian Highway, 28 Jun. 1978, *B.E. Hammel 3650* (MO); Parque Nacional Chagres, Sección Boquerón, Río Juan de Pequeni, 24 Mar. 1999, *Florpan & al. 3818* (MO); **Darién**: Punta Cocalito, on large rock on beach, 24 Feb. 1982, *C. Whitefoord & A. Eddy 296* (MO); Parque Nacional del Darién, ridge between Río Topalisa and Río Pucuro, ca. 17 km E of Pucuro, Mi Casita to La Laguna, 600–850 m, 15 Oct. 1987, *G. de Nevers & al. 8347* (MO); **Panamá Province**: Parque Nacional Altos de Campana, Buena Vista, Bejuco, Chame, 24 Feb 1999, *Florpan & al. 3294* (MO); El Llano-Carti road, about 4.6 miles north de junction with Pan-American Highway, trail to east, 300 m, 14 May 1988, *G. McPherson 12523* (MO); **Guna Yala Comarca (San Blas)**: El Llano-Cartí Road, Km 19.1, 350 m, 19 Mar. 1985, *G. de Nevers 5186* (MO); El Llano-Cartí Rd. Km 19.1, 350 m, 14 Jun. 1985, *G. de Nevers & H. Herrera 5849* (MO); El Llano-Cartí Road, Km 26.5, 200 m, 9 Apr. 1985, *G. de Nevers & al. 5272* (MO). **Veraguas**: Ridge of Cordillera de Tute, trail to Cerro Tute, above Escuela Agrícola Alto de Piedra, just W of Santa Fé, 800–1350 m, 5 Jun. 1982, *S. Knapp & R.L. Dressler 5423* (MO); Vicinity of Santa Fe along ridge which extends to summit, trail begins from edge of a plantation along the road less than 1 km from the Escuela Circlo Alto de Piedra, on road to north going to Rio San Luis, 800–950 m, 29 Jun. 1987, *T.B. Croat 67000* (MO).

***Anthurium gregneversii*** Croat, Aroideana 45(2): 142–143, fig. 42, 2022.

Type: Panama. Bocas del Toro: Oleoducto Road, near Continental Divide, Fortuna Dam area, 1000 m, 5 Feb 1984, *H.W. Churchill, G. de Nevers & H. Stockwell 4619* (holotype MO-3210675). Figure 7.

### *Distribution and habitat*

*Anthurium gregneversii* is endemic to Panama and Costa Rica (new record).

### *Conservation Status*

This species is known from four collections made in two locations: Costa Rica (Moravia, Chirripó) and Panama (Bosque Protector Palo Seco, Bocas del Toro). Currently, the Panama occurrence, despite being within the limits of a protected area (Palo Seco), lacks effective protection, because the habitats of this site are continually altered by extensive livestock and indiscriminate logging activities. Due to the mentioned threats and based on the calculated parameters (EOO: 2488.6 km$^2$, AOO: 16 km$^2$), we consider this species under the Endangered category [EN B1ab(iii)+B2ab(iii)].

### *Phenology*

Flowering in February.

### *Remarks*

*Anthurium gregneversii* is characterized by its oblong blades, short peduncles, pinkish spathes spadices at anthesis, with up to five flowers per spiral. According to Croat et al. (2022), this taxon is closest to *A. crassiradix* subsp. *purpureospadix* Croat, differing mainly by many floral and vegetative characters. However, we think that this taxon is more closely related morphologically to *A. utleyorum* Croat & R.A. Baker, mainly due to the shape of the leaf blades and inflorescences. *Anthurium gregneversii* differs from *A. utleyorum* by having pink spadices at anthesis (vs. red orange), which have fewer flowers in the alternate spiral (4–5 vs. 5–9). This taxon was known only from the type specimen collected in the continental division between the provinces of Chiriquí and Bocas del Toro in Panama, now recorded in Costa Rica by three more specimens.

### *Specimens examined*

**COSTA RICA**: **Cartago**: Upper Río Naranjo headwaters, above Quelitales de Cachi, ca. 1350 m, 2 Aug. 1989, *T.B. Croat & C. Horich 69774* (MO); Turrialba, Chirripó, Moravia de Chirripó, bosque nuboso, 1602 m, 13 May 2021, *M. Cedeño & J.M. Hughes 2482* (USJ); **Limón**: Almirante, Divide between the headwaters of the upper Río Xichiari and the headwaters of the upper Río Boyei, 1300 m, 12 Aug. 1995, *G. Herrera 8441* (INB, MO). **PANAMA**: **Bocas del Toro**: Bosque Protector Palo Seco, Sendero El Verrugoso, 802 m, 6 Feb. 2013, *O.O. Ortiz & al. 1245* (MO, PMA).

**Figure 7.** *Anthurium gregneversii*. A: adult individual with pendent leaves (from Panama); B: inflorescence with the spadix in the female anthesis (from Panama); C: adult individual with pendent leaves (from Costa Rica); D: inflorescence with the spadix in the female anthesis (from Costa Rica). A–B from *O. Ortiz & al. 1245* (PMA); B–C from *M. Cedeño & J.M. Hughes 2482* (USJ) A–B photos by O. Ortiz. B–C photos by M. Cedeño-Fonseca.

***Anthurium jicoteense*** Croat, Aroideana 45(2): 162–163, 165, f. 53, 2022.

Type: Costa Rica. Cartago: Cantón Turrialba, Distrito Tayutic, Jicotea, Finca La Pradera, subiendo la Fila hacia San Antonio, 14 Jun 1995, 1400 m, *G. Herrera 7886* (holotype MO-05036250; isotype CR).

*Distribution and habitat*

*Anthurium jicoteense* is known only from the type locality in Costa Rica, in Turrialba Province, found at 1400 m in a *Premontane rain forest* life zone.

*Conservation Status*

This taxon is only known from a single collection, which was collected in an area that currently has deforestation caused by unsustainable agricultural activities. During the field work carried out recently, it was impossible to locate additional specimens, so it could represent a rare species. Due to documented threats to the natural habitats where this species occurs, we recommend considering this species as Critically Endangered [CR B2ab(iii)].

*Phenology*

Flowering in June.

*Remarks*

*Anthurium jicoteense* is characterized by its moderately long-petiolate leaves with the petioles only about half as long as the blades, narrowly oblong-elliptic, grayish drying, dark green, matte and glandular-punctate, paler and glandular-punctate below, with the primary lateral veins less conspicuous than the collective veins, long-pedunculate inflorescence with a reddish-brown spathe and a long tapered green spadix. Due to the leaf blade shape and the absence of black glandular punctations on the upper surface, this species is more similar to *A. tayuticense*, which differs by having fewer primary lateral veins (15–27 vs. 12–14 pairs), and reddish-brown spadices with flowers 5 visible per spiral (vs. red orange spadices with more than 7 flowers visible per spiral).

***Anthurium longistipitatum*** Croat, Monogr. Syst. Bot. Mo. Bot. Gard. 14: 129, figs 107 & 108. 1986.

Type: Panama. Chiriquí: along road between Gualaca and the Fortuna Dam site on the Río Chiriquí, 22.7 mi. beyond the bridge over the Río Estí, 11.8 mi. N of Los Planes de Hornito, 10.7 mi. N of jct. to tunnel, *T.B. Croat 48670* (holotype MO-2738911; isotypes K-K000434286, PMA-161). Figure 8.

(=) *Anthurium monroi* Croat, Aroideana 45(2): 186, f. 66–68, 2022. **syn. nov.**

Type: Panama. Bocas del Toro: Ridge N of Campamiento Lucho, 2000 m, 18 Mar 2004, *A.K. Monro & E. Alfaro 4475* (holotype MO-5881318; isotypes BM, INB, MEXU, PMA).

*Distribution and habitat*

*Anthurium longistipitatum* occurs from Costa Rica to western Panama in Chiriquí Province and Ngöbe-Buglé Comarca, at 1100–2000 m in *premontane* and *lower montane rain forest* life zones.

*Conservation Status*

This species is known from at least five occurrences of which four are currently in protected areas (Fortuna Forest Reserve in Panama, La Amistad International Park between Costa Rica and Panama, and Monteverde Biological Reserve in Costa Rica). Considering its natural distribution, this species comprises an EOO of approximately 6508 km$^2$ and an AOO of 136 km$^2$. Currently, its populations are not pressured by destructive anthropic activities such as livestock or unsustainable agriculture. In the lack of data on population size, and contingent upon successful protection of the protected areas, *A. longistipitatum* can be provisionally assessed as Least Concern [LC].

*Phenology*

Flowering and fruiting throughout the year.

*Remarks*

*Anthurium longistipitatum* is recognized by its epiphytic habit, pendent growth form, long petioles, coriaceous leaf blades which are black-glandular punctate on both surfaces, orange yellow (code #FFFBDC) spathes, long-stipitate, orange red (code #DE7E5D) spadices with 3–4 flowers visible in the principal spiral, 6–8 flowers visible in the alternate spiral, and globose or subglobose, red orange (code #AA2704) berries (when ripe) which are truncate at apex (with a central depression). *Anthurium longistipitatum* is morphologically similar to *A. chiriquense*, due to the same size and shape of the leaf blade, as well as its long-stipitate spadices. But the latter differs from *A. longistipitatum* in having red orange spathes, pink, usually coiled spadices at anthesis, spadices with 3–4 flowers visible in the alternate spiral, and flowers with exserted stamens at post-anthesis.

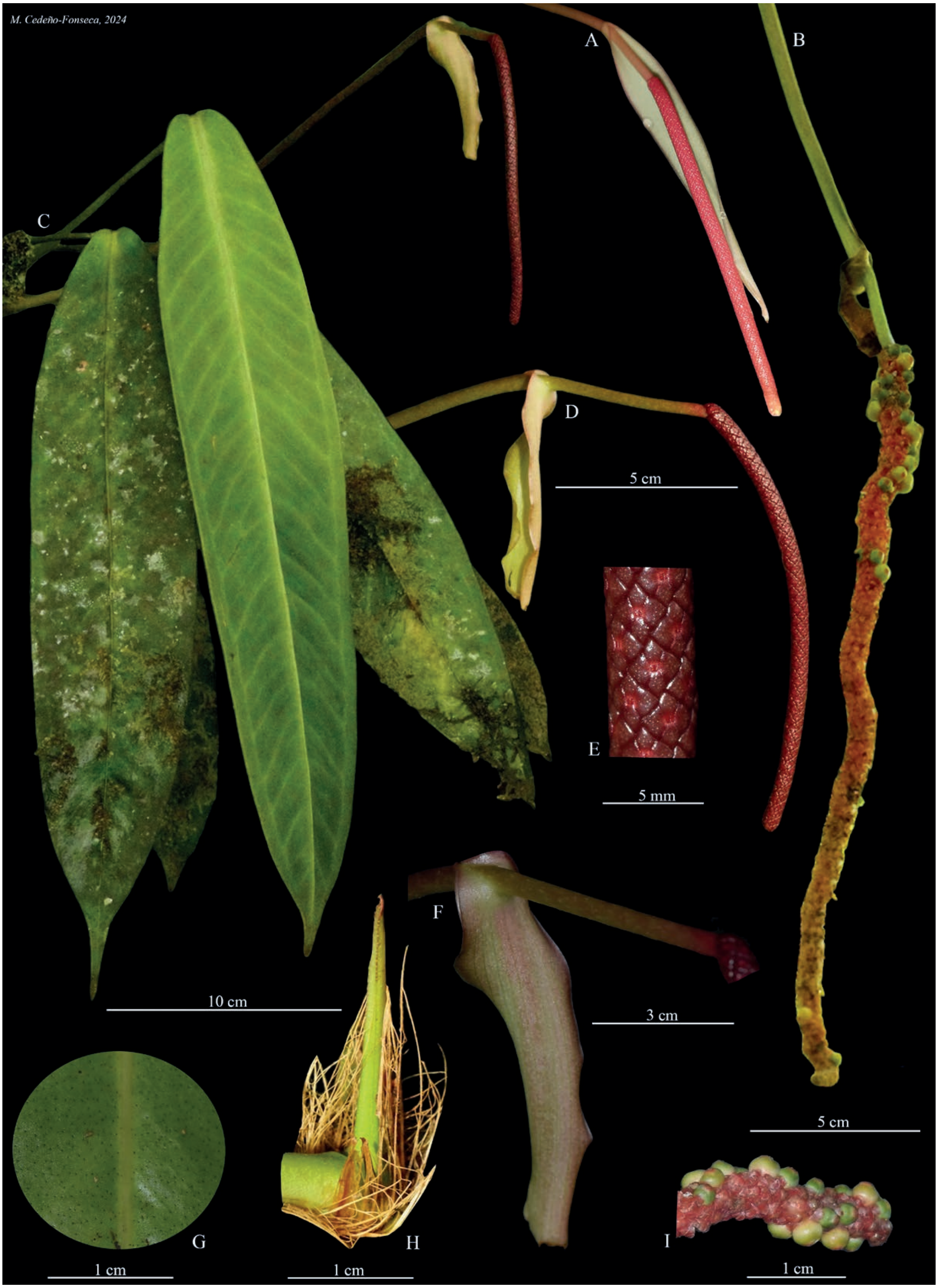

**Figure 8.** *Anthurium longistipitatum*. A: inflorescence at pre-anthesis; B: infructescence; C: habit; D: inflorescence at female anthesis; E: flowers at female anthesis; F: spathe at female anthesis; G: detail of the leaf blade on the lower surface; H: cataphylls; I: berries. All from *O. Ortiz et al. 4235* (PMA). Plate and photos by M. Cedeño-Fonseca.

Croat et al. (2022) recently described *Anthurium monroi*, a species which appears to us morphologically identical to *A. longistipitatum* to which no comparison was made in the protologue of *A. monroi*. Based on the documentation carried out in the type locality of *A. longistipitatum*, we propose here to place *A. monroi* as a synonym of *A. longistipitatum*. Both taxa share significant morphological characters, such as the shape and texture of the leaf blade, the color of the spathe (orange yellow), the presence of a noticeable stipe, orange-red spadices, and globose or subglobose berries which are truncated at apex [cf. figure 8 vs. Croat et al. (2022): figs 66–68)]. Croat et al. (2022) described *A. monroi* with green to cream spadices, however, a photograph of the holotype in the field, which was included in the original protologue (Croat et al. 2022: 189), clearly shows that the spadix is orange red.

*Specimens examined*

**COSTA RICA**: **Alajuela**: San Ramón. Reserva Biológica Monteverde, Cordillera de Tilarán, Valle del Río Peñas Blancas, Quebrada el Valle, 1600 m, 17 Aug. 1993, *E. Bello & E. Cruz 5232* (CR, MO). **Limón**: Talamanca, Cordillera de Talamanca, Río Lori, Cerro junto al paso del Sendero de Ujarrás a San José Cabécar, 1900 m, 22 Mar. 1993, *Á. Fernández 782* (CR); Cordillera de Talamanca, siguiendo fila frente unión Queb. Kuisa/ Río Lori. de Ujarrás a San José Cabécar, 1850 m, 21 Mar. 1993, *G. Herrera 5963* (CR, MO); P.N. Cordillera de Talamanca; Cordillera de Talamanca. Margen izquierdo unión Queb. Kuisa a Río Lori, entre Ujarrás y San José Cabécar, 1850 m, 22 Mar. 1993, *G. Herrera & W. Gamboa 5988* (CR, MO). **PANAMA**. Fortuna or Cerro Colorado, 20 May 1991, *S.W. Ingram & D. Atwood 980* (MO). **Bocas del Toro**: ca 5 km ENE of Cerro Pate Macho near Finca Serrano, NE of Boquete, in forest near trail along ridge N of Finca Serrano, 12 Feb. 1979, *B. E. Hammel 6171* (MO); Along trail on divide separating Chiriquí and Bocas del Toro, 1150 m, 22 Oct. 1985, *G. McPherson 7231* (MO); Changuinola, bosque secundario, cerca de la quebrada, zona pantanosa con pocos árboles de más de 20m, de altura, 19 Apr. 2008, *A. de Sedas & D. Solano 701* (MO, PMA); PILA, Point 8, ca 3km from estación de Alto Uri, valley bottom, relatively flat, tree height ca 25m, dbh range 40–50cm., 1500 m, 16 Apr. 2008, *D. Santamaría & al. 7361* (MO, PMA); **Ngobe Buglé Comarca**: Cerro Colorado, border of Chiriquí and Bocas del Toro provinces, along intersection of Bocas Road with main ridge road, 11.8 km from Chami [Chame] along path headed into Bocas del Toro, 1400–1700 m, 24 Oct. 1977, *J.P. Folsom 6135* (MO); Cerro Colorado, 9.2 miles W of Chamé, along trail E of road which leads down to stream, 1450–1480 m, 6 Jul. 1988, *T.B. Croat 69072* (MO); Cerro Colorado, along road between Río San Felix and mining exploration camp, 7 mi W of Chamé, along trail through Guaymí village, 1500 m, 8 Jul. 1988, *T.B. Croat 69175* (CR, MO, PMA); 12 km above Chami Copper Mine near Cerro Colorado, along path down to river., 3000–4000 f, 21 Jun. 1986, *W.J. Kress & al. 86-1956* (MO!); Bocas & Chiriquí, Cerro Colorado mine area, in elfin woods on divide road, along trail into Bocas and in woods on Pacific slope, from Chami station to ca. 9 miles along road, 1100–1750 m, 27–31 Mar. 1986, *B.E. Hammel & J. Trainer 14917* (MO); N of San Félix at Chiriquí-Bocas del Toro border, on Cerro Colorado copper mine road along continental divide. Lower Montane rain forest (cloud forest, trees to 5 m tall), 5000–5500 ft, 4 May 1975, *S.A. Mori & J. A. Kallunki 5853* (MO); **Chiriquí**: 15 km N of Hornito on road to La Fortuna, 4000 ft, 17 Feb. 1979, *B.E. Hammel 6248* (MO); Fortuna hydroelectric project, along trail uphill behind camp, 1200–1400 m, 21 Mar. 1978, *B.E. Hammel 2125* (MO); Fortuna, Fortuna Field Station, Cordillera de Talamanca, 7 Dec. 1997, *D.W. Roubik & L. Quiroz 1275* (MO); Vicinity of Fortuna Dam, 1250 m, 28 Apr. 1986, *G. McPherson 9102* (MO); Near Fortuna Dam, along trail near forestry station towards river, 1150 m, 23 Oct. 1985, *G. McPherson 7265* (MO); Fortuna Dam area, N of reservoir, Quebrada Bonito to E of road, 1100 m, 23 May 1984, *H.W. Churchill 5261* (MO); Fortuna Dam area, along Quebrada Bonito to E of road, 1100 m, 8 Feb. 1984, *H.W. Churchill & al. 4816* (MO); Fortuna Dam area, along Quebrada Bonito to E of road, 1100 m, 08 Feb 1984, *H.W. Churchill & al. 4817* (MO); Fortuna Dam area, at the Continental Divide, bog at edge of Oleoducto road, 1200 m, 6 Feb. 1984, *H.W. Churchill & al 4659* (MO); Fortuna Dam Site, top of mountain above camp to south., 1700 m, 13 Sep. 1977, *J.P. Folsom & al. 5400* (MO); Fortuna Dam Project Area, slope NW of confluence of Rio Hornito and Rio Chiriqui, 1050–1100 m, 10 Nov. 1980, *K.J. Sytsma & W.D. Stevens 2205* (MO); Windswept ridge 8 km N of Los Planes de Hornito, IRHE Fortuna Hydroelectric Project, 1250–1300 m, 9 May 1982, *S. Knapp 4999* (MO); Along road and into forests 10 km N of Los Planes de Hornito, IRHE Fortuna Hydroelectric Project, 1100–1200 m, 10 May 1982, *S. Knapp 5027* (MO); Along road and into forests 10 km N of Los Planes de Hornito, IRHE Fortuna Hydroelectric Project, 1100–1200 m, 10 May 1982, *S. Knapp 5033* (MO!); Trail to the Río Hornito, 11 km N of Los Planes de Hornito, IRHE Fortuna Hydroelectric Project, 1100–1200 m, 12 May 1982, *S. Knapp 5109* (MO); Border of Bocas del Toro/Chiriqui provinces, Continental Divide above Quebrada Arena, Carretera del Oleoducto, IRHE

Fortuna Hydroelectric Project, 1150–1200 m, 19 Jun. 1982, *S. Knapp & M.R. Vodicka 5665* (MO); Chiriqui-Bocas del Toro, ca 5 km N of Fortuna Dam, trail along Continental Divide, 1200–1300 m, 25 Apr. 1988, *S.A. Thompson 4955* (MO); Along continental divide on Cerro Colorado, on upper mining road 20–28 miles from San Félix., 1200–1500 m, 14 Mar. 1976, *T.B. Croat 33402* (MO); Cerro Colorado, along mining road 24 mi above bridge over Río San Félix, north of village of San Félix, primary forest along road, 1430–1500 m, 22 Nov. 1979, *T.B. Croat 48496* (MO); Along road to Fortuna dam site on Río Chiriquí, N of Gualaca, 7.7 mi beyond Francisco Linare's lane, 19.2 mi beyond bridge over the Río Estí, 9.1 mi beyond Los Planes de Hornito, 8 mi beyond jct. in road to tunnel, 1300 m, 27 Nov. 1979, *T.B. Croat 48753* (MO); Along road to Fortuna dam, site N of Gualaca on Río Chiriqui, 17.8 miles beyond the bridge over Río Estí, 7.7 miles beyond Los Planes de Hornito, 6.6 miles beyond junction of road to the tunnel, 1400 m, 28 Nov. 1979, *T.B. Croat 48762* (MO); Along road between Gualaca and the Fortuna dam site 10.1 mi NW of Los Planes de Hornito, 1300 m, 8 Apr. 1980, *T.B. Croat 49818* (MO); Along road between Gualaca and Fortuna dam site, 7.9 mi beyond (NW) of Los Planes de Hornito, 1300 m, 9 Apr. 1980, *T.B. Croat 49933* (MO); Along road between Gualaca and Fortuna dam site, 10.1 mi NW of Los Planes de Hornito, 1250 m, 10 Apr. 1980, *T.B. Croat 50029* (MO); Along road between Fortuna Lake and Chiriquí Grande, 4.5-5 km N of dam over Fortuna Lake, 1100–1135 m, 8 Mar. 1985, *T.B. Croat 60081* (MO); Along the road to the Fortuna Dam site, N of Gualaca, 22.7 mi beyond the bridge over the Río Estí, 11.8 mi N of Los Planes de Hornito, 10.7 mi N of jct. to tunnel, 1400 m, 26 Nov. 1979, *T.B. Croat 48670* (MO); Along road from Gualaca to Fortuna dam site, 5.9 mi NW of Los Planes de Hornito, 1370 m, 9 Apr. 1980, *T.B. Croat 49888* (MO); Vicinity of Fortuna Dam in valley of Río Chiriqui, along aquaduct to water source for IRHE facilities near dam, 1200–1300 m, 22 Jun. 1987, *T.B. Croat 66621* (MO); Fortuna Dam Area, trail to Meteorological Station of Río Hornito, beginning 0.5 km S of Centro de Cientificos, 23 Jun 1994, *T.B. Croat & G. Hua Zhu 76301* (CR, MO); Along the road between Gualaca and the Fortuna Dam site, at 10.1 mi NW of Los Planos de Hornito, 1300 m, 8 Apr. 1980, *T.M. Antonio 4082* (MO); Gualaca, Reserva Forestal Fortuna, Sendero de la Quebrada Alemán, 1390 m, 11 Dec. 2013, *O. Ortiz & al. 1881B* (MO, PMA); Reserva Forestal Fortuna. Sendero Samudio., 1205 m, 6 Nov. 2013, *O. Ortiz & al. 1784* (MO); Chiriquí, Reserva Forestal Fortuna, s.d., *O. Ortiz & al. 4235* (PMA).

***Anthurium loratum*** Croat, Aroideana 45(2): 176-177, f. 58–59, 2022.

Type: Costa Rica. Cartago: 1.5 miles E of Cachi, 10.2 miles NE of junction at Paraiso, 1300–1350 m, 5 Feb. 1979, *T.B. Croat 47085* (holotype MO-2769783; isotypes MO-2815924, INB).

### *Distribution and habitat*

*Anthurium loratum* is endemic to Costa Rica, known only from Cartago Province a *Premontane wet forest* life zone.

### *Phenology*

Flowering in February.

### *Conservation Status*

This species is known from one locality, along disturbed forests from Cartago. During the field work carried out recently, we were able to observe that the habitats near the registered location are highly threatened by activities related to the extensive coffee crops. Because of this, we consider this species Critically Endangered [CR B2ab(iii)].

### *Remarks*

*Anthurium loratum* is characterized by its terete glandular-punctate heavily sheathed petioles, strap-shaped narrowly and weaky attenuated blades glandular-punctate on both surfaces, more than 25 primary lateral veins per side, two pairs of basal veins, a long-pedunculate inflorescence (32–35 cm long), lanceolate spathes, and cylindroid spadices of 10–12 cm long, with 4–5 flowers visible in the principal spiral and 5–6 flowers in the alternate spiral. According to Croat et al. (2022), this taxon is similar to *A. pendens* Croat, which differs by having the blade narrowly oblanceolate with the peduncle shorter than the petioles. Furthermore, because this species presents strap-shaped narrow leaf blades, it could also be confused with *A. friedrichsthalii* and *A. gregneversii*. Among the most notable differences between *A. loratum* and *A. friedrichsthalii* is that the latter taxon comprises smaller plants that lack a prominent petiole sheath and black glandular punctations on the upper surface. In the case of *A. gregneversii*, it differs from *A. loratum* also by lacking a prominent petiole sheath and having fewer lateral primary veins (up to 25 pairs), as well as shorter peduncles (up to 14 cm long). The specimens *Croat & Horich 69774* and *Herrera 8441* from Limón Province, were included in the original protologue of *A. loratum* as paratypes (Croat et al. 2020). Nevertheless, they correspond to *A. gregneversii*, because both lack a long petiole sheath and have noticeably shorter peduncles.

***Anthurium orosiense*** Croat, Aroideana 45(2): 202, fig. 74, 2022.

Type: Costa Rica. Cartago: Tapantí Hydroelectric Reserve along Río Orosi, 4.5 km beyond small bridge which crosses river inside the reserve, along road to the diversion dam, 1500–1700 m, 23 Jun. 1976, *T.B. Croat 36123* (holotype MO-2390064; isotype INB). Figure 9.

*Distribution and habitat*

*Anthurium orosiense* is known only from Tapantí Hydroelectric Reserve in Cartago Province (Río Grande de Orosi) at ca. 1500 m in a *Premontane rain forest* life zone.

*Phenology*

Flowering in June.

*Conservation Status*

This species is only known from two collections, made in the same location (Moravia, Chirripó). Currently, the habitats surrounding this location are threatened by extensive coffee planting, which represents a short and long-term danger for the species. Considering the restricted distribution of this taxon (AOO = 8 km$^2$), we recommend considering this species as Critically Endangered [CR B2ab(iii)].

*Remarks*

*Anthurium orosiense* is characterized by having terete petioles, more or less equalling the blades, narrowly oblong-elliptic blades with obscure primary lateral veins, black glandular punctations on both surfaces, pendent inflorescences with pinkish red (code #D5869D) peduncles, green, linear-lanceolate spathes, and narrowly tapered, reddish orange (code #EDB381) spadices at anthesis, red (code #990012) infructescences, bright orange red (code #9F2305) berries, and reddish orange (code #A2653E) seeds. *Anthurium orosiense* is similar to *A. utleyorum* Croat & R.A.Baker which differs by having usually smaller and narrower, more coriaceous blades with the collective veins closer to the margin and by having a shorter, more prominently tapered purplish spadix with protruding pistils.

*Specimens examined*

**COSTA RICA**: **Cartago**: Cantón Turrialba, distrito Chirripó, Moravia de Chirripó, Bosque nuboso, 1602 m, 13 enero 2021, *M. Cedeño & al. 2404* (USJ).

***Anthurium pendens*** Croat, Monogr. Syst. Bot. Mo. Bot. Gard. 14: 153–156. 1986.

Type: Panama. Colón: Santa Rita Ridge Road, along trail at end of road that goes to Río Indio, beginning 10.6 km from Transisthmian Hwy., 3 km beyond hydrographic station, ca. 380 m, *T.B. Croat 34296A* (holotype MO-2815427; isotypes K-K000434254, PMA-190). Figure 10.

*Distribution and habitat*

The species occurs from eastern Panama to Colombia, at sea level to 1000 m in *tropical wet* and *lower montane rain forest* life zones.

*Conservation Status*

This species has a relatively wide distribution (EOO: 23,868 km$^2$; AOO: 72 km$^2$), and its populations are not confronting significant threats, consequently *A. pendens* could be considered as Least Concern [LC].

*Phenology*

Flowering and fruiting throughout the year.

*Remarks*

*Anthurium pendens* is characterized by its epiphytic habit, pendent growth form, very elongate, oblanceolate, leaf blades glandular-punctate on both surfaces, with up to 12 pairs of primary lateral veins, green flat spathes, brownish gray (code #86775F), straight spadices with 5–6 flowers visible in the principal spiral, 7–8 flowers visible in the alternate spiral, gray (code #929591) stigmas, and pale yellowish orange (code #FF9F00), oblate berries.

The species is morphologically related to *A. wendlingeri*, which has similar, elongate, coriaceous, and black-glandular punctate leaf blades, but that species differs from *A. pendens* by having usually numerous primary lateral veins (up to 24 pairs), generally coiled spathes and spadices, whitish stigmas, and oblong-globose red berries.

*Specimens examined.*

**PANAMA**: **Colón**: Río Guanche, 1-4 km upstream from Portobelo Road, 0–100 m, 10 Dec. 1973, *A.H. Gentry 8815* (MO); Below Cerro Bruja, beyond Mino, Selby 85-119, 100–200 m, 19 Feb. 1986, *E.A. Christenson 1212* (MO); Santa Rita Ridge Road, along the trail at end of road which goes to Río Indio, beginning 10.6 km from Transisthmian Hwy, 3 km beyond hydrographic station, 380 m, 13 Apr. 1976, *T.B. Croat 34296A* (MO); Río Guanché above bridge on Portobelo Road; ca. 3 to

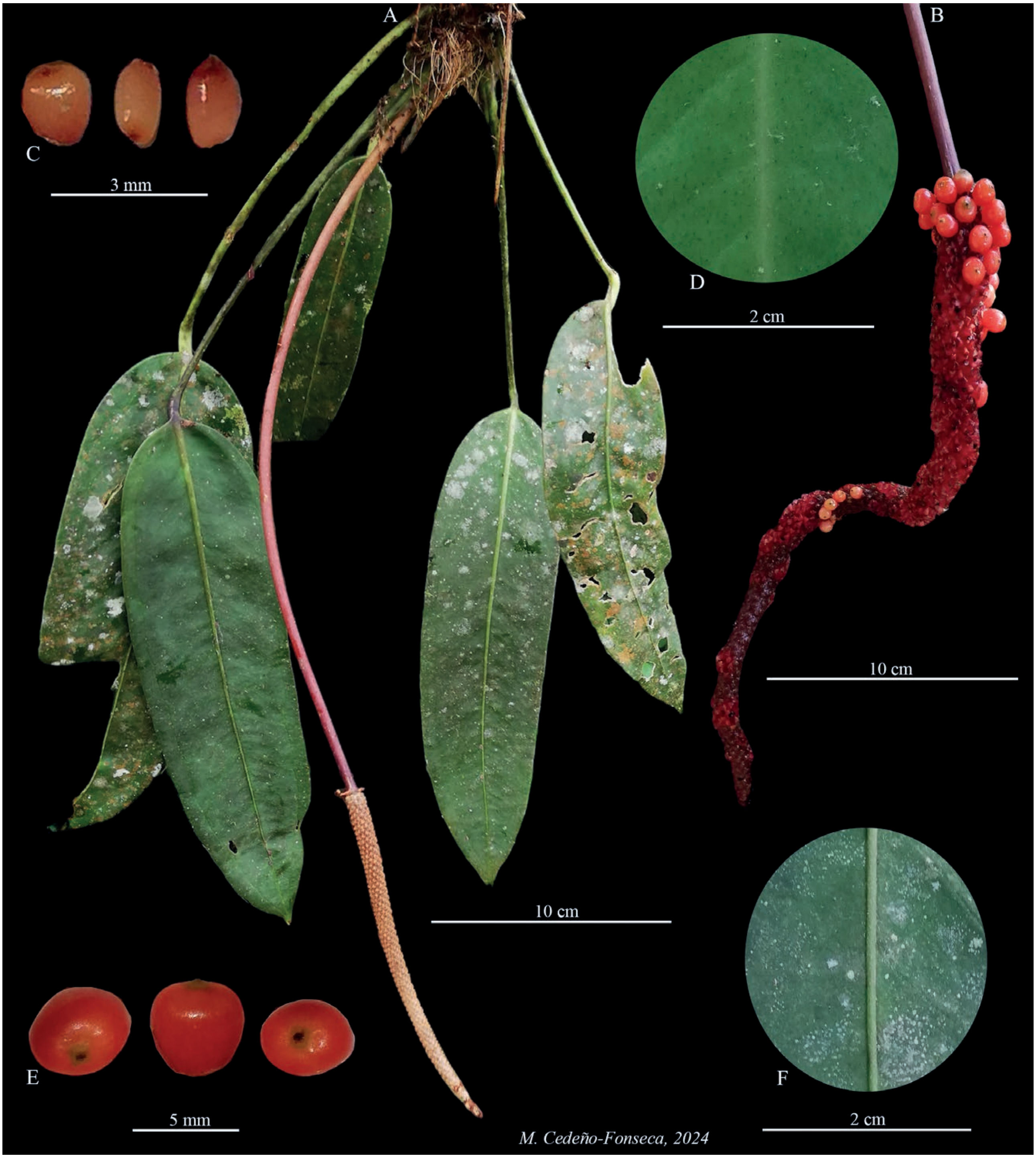

**Figure 9.** *Anthurium orosiense*. A: habit; B: infructescence; C: seeds; D: detail of the leaf blade on the lower surface; E: ripe berries; F: detail of the leaf blade on the upper surface. All from *M. Cedeño et al. 2404* (USJ). Plate and photos by M. Cedeño-Fonseca.

5 km above bridge, 50–200 m, 8 Jul 1976, *T.B. Croat 37006* (MO); Below Cerro Bruja along Río Escandaloso beyond Mino #2, 100–200 m, 18 Mar. 1982, *W.J. Kress & S. Knapp 82-1393* (MO). **Darién**: Cerro Sapo, 2500 ft, 01 Feb. 1978, *B.E. Hammel 1199* (MO); Cerro Sapo, ca. 5 km south of Garachiné, along ridge at north approach

**Figure 10.** *Anthurium pendens* from Panama (Colón). A: adult individual with pendent habit; B: infructescence in development. Photos by M. Cedeño-Fonseca.

to cerro, 600–800 m, 23 Mar. 1986, *B.E. Hammel & al. 14831* (MO); South of Garachine on western slope of Serranía Sapo, above place called Casa Vieja, along boundary trail of Darién National Park, 550–830 m, 25 May 1991, *G. McPherson & al. 15384* (MO); W side of SW ridge leading to Alturas de Nique, headwaters of Río Coasí, 350 m, 27 Dec. 1980, *R.L. Hartman 12296* (MO); Middle slopes on W side of Cerro Pirre, 550–760 m, 28 Jun 1988, *T.B. Croat 68887* (MO). **Panamá Province**: Chepo. Along new El Llano-Cartí road, 8–12 km N of El Llano, 400–450 m, 12 Dec. 1973, *M.H. Nee & al. 8758* (MO!); road from Panamerican Highway to Cerro Jefe, summit, 21.7 km from Panamerican Highway, forest after pastured area, 700–1000 m, 22 Jun. 1977, *J.P. Folsom 3849* (MO). **Guna Yala Comarca (San Blas):** Nusagandi, El Llano-Cartí Road, 19.1 km from Interamerican Hwy, 350 m, 6 Nov. 1984, *G. de Nevers 4205* (MO); El Llano-Cartí Road, Km 19.1, 350 m, 8 Mar. 1986, *G. de Nevers & H. Herrera 7280* (MO).

***Anthurium tarrazuense*** Croat, Aroideana 45(2): 231, fig. 88. 2022.

Type: Costa Rica. San José: Tarrazú, Nápoles, Ladera Oeste de Cerro Pito, 1500 m, 1 Dec. 1995, *G. Herrera, A. Cascante & J. Sánchez 8799* (holotype CR-196066). Figure 11.

### *Distribution and habitat*

Endemic to Costa Rica, known only from Tarrazú, Nápoles on the slopes of Cerro Pito at 1500 m in a *Premontane wet forest* life zone.

### *Phenology*

Flowering in December.

### *Conservation Status*

This species is only known from one location in an area highly threatened by extensive and unsustainable

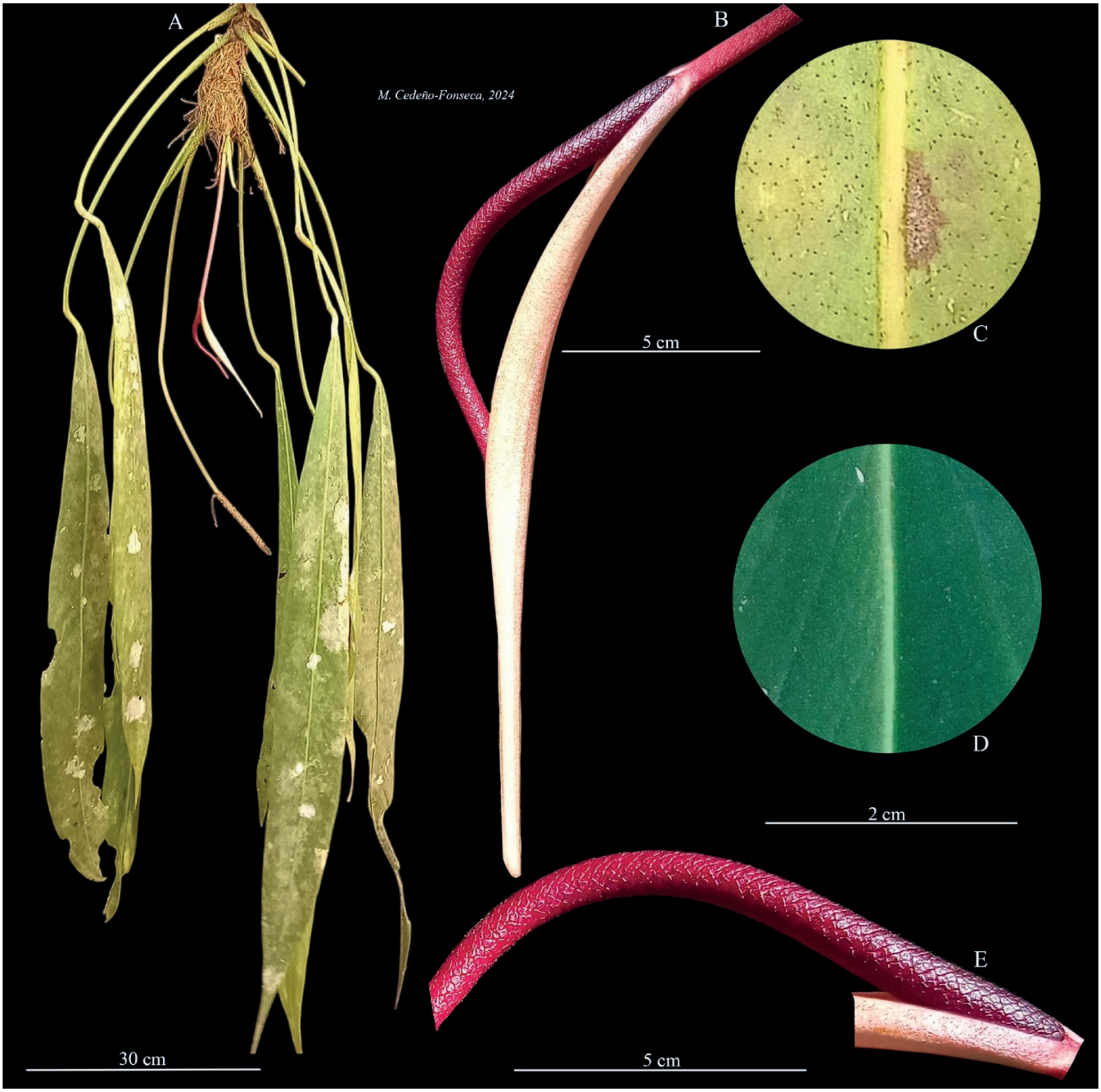

**Figure 11.** *Anthurium tarrazuense.* A: habit; B: inflorescence at female anthesis; C: detail of the leaf blade on the lower surface; D: detail of the leaf blade on the upper surface; E: flowers at female anthesis. Photos by Florian Wollinger. Plate by M. Cedeño-Fonseca.

planting of coffee crops. Fieldwork carried out in the type locality and surroundings suggest that *Anthurium tarrazuense* is not a common species, because just one individual was found. Unfortunately, we did not voucher the individual. Considering the threats to its natural habitats and its restricted distribution (AOO = 4 km$^2$), we recommend listing this species as Critically Endangered [CR B2ab(iii)].

### *Remarks*

*Anthurium tarrazuense* is recognized by having narrow, long-petiolate leaves, glandular-punctate only on the lower surface, long-pedunculate pendent inflorescences, pinkish red (code #E75480) peduncles, yellowish orange (code #FAECCC) slender spathes, and long, bright pinkish red (code #A9203E) spadices at anthesis.

Due to the long petioles and long peduncles, *Anthurium tarrazuense* could be confused with *A. orosiense*, but the latter differs owing to its leaf blades with glandular black punctations on both surfaces (vs. only on the lower surface in *A. tarrazuense*) and several primary lateral veins (16–18 vs. 6–10 pairs).

***Anthurium tayuticense*** Croat, Aroideana 45(2): 234, fig. 89. 2022.

Type: Costa Rica. Cartago: Cantón Turriaba. Distrito Tayutic. Vereda Grana de Oro, 2 km E., trail to Llanos del Quetzal, 1200 m, 28 July 1995, *G. Herrera & A. Cascante 8157* (holotype MO-5036242; isotype CR). Figures 12, 13.

(=) *Anthurium nutans* Croat, Aroideana 45(2): 199, fig. 73, 2022, **syn. nov.**

Type: Costa Rica. Heredia: Atlantic slope of Volcán Barva, between Río Peje and Río Sardinalito, 700–800 m, 3 Apr 1986, *M.H. Grayum 6714* (holotype MO-3489956; isotype INB).

### *Distribution and habitat*

*Anthurium tayuticense* is endemic to Costa Rica, known only from Alajuela, Heredia and Cartago Province of Costa Rica from 700–1200 m elevation in a *Premontane wet forest* life zone.

### *Phenology*

Flowering in January. Fruits have been collected in May and July.

### *Conservation Status*

*Anthurium tayuticense* is a rare species known from three herbarium specimens, all collected from a single location in an unprotected area which is highly pressured by destructive human activities, specifically extensive cattle ranching. Considering the reduced geographic distribution (AOO = ca. 4 km$^2$) and the threats to its natural habitats, we consider that this species qualifies as Critically Endangered [CR B1a(iii)+2ab(iii)].

### *Remarks*

This species is distinguished by its epiphytic habit with a pendent growth form, persistent and fibrous reddish-brown cataphylls, pendent leaves, terete petioles, glandular-punctate (only below), usually oblong to elliptic or narrowly ovate to elliptic leaf blades which are glossy on the lower surfaces, 30–45 pairs of primary lateral veins, pendent, short-pedunculate and sessile inflorescences, straight spathes, red orange (code #8C472F), straight spadices (brown at post-anthesis) at anthesis, with more than 7 flowers visible per spiral, and globose-elliptic, reddish orange (code #F8481C) berries.

*Anthurium tayuticense* could be confused with *A. pendens* and especially *A. wendlingeri*, because all share similar habit, growth form and long petioles and leaf blades. *Anthurium pendens* differs from *A. tayuticense* in having narrowly linear-oblanceolate leaf blades, fewer primary lateral veins (up to 12 vs. 15–27 pairs) departing midrib at 10–20° angle (vs. 35–40°), and pinkish spadices at anthesis (vs. red orange). *Anthurium wendlingeri* (both var.*wendlingeri* and var. *horichii*) differs from *A. tayuticense* in having markedly oblong leaf blades (vs. oblong-elliptic), fewer primary lateral veins (up to 24 vs. up to 45 pairs), coiled spadices with 4–6 flowers visible in the principal spiral (vs. straight spadices with more than 7 flowers visible in the principal spiral), and oblong-globose berries (vs. globose-elliptic).

According to Croat et al. (2022), *Anthurium tayuticense* is most closely related to *A. jicoteense* Croat which differs in having obtusely and broadly sulcate petioles, narrower leaf blades (less than 7 cm wide), and green spadices with only 5 flowers visible per spiral (vs. red orange with more than 7 flowers per spiral). *Anthurium nutans*, also described by Croat et al. (2022) from Heredia (Costa Rica), is very similar to *A. tayuticense*, since both have oblong leaves lacking black glandular punctations above, several primary lateral veins and peduncles shorter or equal than the spadix. Recent explorations in the type locality of *A. nutans* confirmed that this taxon is conspecific to *A. tayuticense* (see the specimen *Cedeño et al. 2655*, USJ). Consequently, we consider *A. nutans* a synonym of *A. tayuticense*.

### *Specimens examined*

**COSTA RICA**: **Alajuela**: Cantón Grecia, distrito Río Cuarto, Laguna Hule, 900 m, 31 Oct. 2022, *M. Cedeño & al. 2655* (USJ!); **Cartago**: Turrialba, Tres Equis, 800 m, 13 Mar. 2021, *M. Cedeño et al. 2403* (USJ!, PMA!); Turrialba, Tayutic, área no protegida, Vereh, Grano de Oro, 2 km al este, camino a Llanos del Quetzal, 1200 m, 28 julio 1995, *G. Herrera & A. Cascante 8157* (CR!); Cantón Turrialba, distrito Tres Equis, 800 m, 13 May 2021, *M. Cedeño & al. 2393* (B!, USJ!).

**Figure 12.** *Anthurium tayuticense*. A: adult individual with blade bullate and developing infructescence and peduncle 6 cm long; B: adult individual with leaves pendent and tilted at an angle of 65° to 90°; C: adult individual with mature infructescence and reddish orange ripe berries; D: adult individual growing up to 15 m about the ground with long inflorescence. – A from *M. Cedeño et al. 2403* (USJ); B from *M. Cedeño & al. 2393* (USJ). All photos by M. Cedeño-Fonseca.

***Anthurium utleyorum*** Croat & R.A.Baker ('*utleyi*'), Brenesia 16 (Supl. 1): 100. 1979.

Type: Costa Rica, Alajuela: 2 km N of Angeles Norte de San Ramon, ca. 1200 m, *J. Luteyn 3695* (holotype DUKE-233270). Figure 14.

*Distribution and habitat*

*Anthurium utleyorum* is endemic to Costa Rica at 800 to 1700 m in *premontane* and *lower montane rain forest* life zones.

**Figure 13.** *Anthurium tayuticense*. A: habit; B: black glandular punctuations on blade abaxial surface; C: stem with short internodes and fibrous cataphylls and roots; D: inflorescence, spadix (right) and spathe (left); E: detail of the flowers on the spadix; F: ripe fruits on the spadix; G: fruit; H: seed. Drawn by Maíra Cordero Pagoaga from *M. Cedeño & al. 2393* (USJ).

**Figure 14.** *Anthurium utleyorum*. A: adult individual with pendent habit; B: inflorescence with the spadix in female stage; C: mature infructescence with red orange berries; D: spadix with ovoid berries beaked at the apex. A–D from *J.E. Jiménez & al. 5492* (USJ). Photos by J.E. Jiménez.

### *Phenology*

Flowering and fruiting throughout the year.

### *Conservation Status*

This species is known from three locations which are found in two protected areas (and their buffer zones), such as Alberto Manuel Brenes Biological Reserve and Monteverde Cloud Forest Biological Reserve. Its geographical distribution includes approximately an EOO of 2552.6 km$^2$ and an AOO of 108 km$^2$. At present, the populations located in the buffer zones (outside protected areas) are experiencing extensive cattle ranching, destructive agricultural activities, and livestock-related activities, which poses an obvious threat to the conservation of the species. Based on the information mentioned above, *A. utleyorum* qualifies as Endangered [EN B1a(iii)+2ab(iii)].

### *Remarks*

*Anthurium utleyorum* is characterized by its epiphytic habit, pendent growth form, oblong to oblong-elliptic, glandular-punctate leaf blades (on both surfaces), with 14 to 20 pairs of primary lateral veins, orange red (along margins) (code #905D5D) to orange yellow (along middle parts) (code #8A8360) spathes and red orange (code 81422C) spadices at anthesis, with 4–5 flowers in the principal spiral and 5–9 flowers visible in the alternate spiral, and red orange (code #F8481C), markedly ovoid berries which are beaked at the apex.

Because of the similar habit and leaves, *Anthurium utleyorum* could be confused with *A. cascantei, A. friedrichsthalii,* and *A. gregneversii* (for more details, see the discussion under *A. gregneversii*). *Anthurium cascantei* differs from *A. utleyorum* primarily in having dark purple spadices with 7–8 flowers in the principal spiral and 4–5 flowers visible in the alternate spiral (vs. red orange spadices with 4–5 flowers in the principal spiral and 5–9 flowers visible in the alternate spiral), and oblate-obcordate berries (vs. ovoid). *Anthurium friedrichsthalii* differs in having yellowish orange spadices with 3–4 flowers visible in the principal spiral, and pale yellowish orange, oblate-obcordate berries.

We consider that the specimens of from the Cordillera de Guanacaste (Santa María Volcano) previously identified as *Anthurium utleyorum*, do not correspond to this entity. In fact, Grayum (2003) stated that these collections, characterized by remarkably small plants with eglandular blades on the upper surface, could represent a different entity. We agree with Grayum's proposal, nevertheless we considered that these specimens rather seem to be more morphologically related to the *Anthurium lancifolium* complex, such as *A. albifructum* (Croat) O.Ortiz & Croat, *A. dichrophyllum* Croat, *A. gracililaminum* Croat, and *A. lancifolium* Schott. Members of *A. lancifolium* complex are characterized by their small size, eglandular (on the upper surface), lanceolate leaf blades, and relatively tiny spadices with few flowers per spiral. In order to be more conclusive with the identity of these specimens, it is necessary to document their reproductive characters in the field.

### *Specimens examined*

**COSTA RICA**: **Alajuela**: Reserva Forestal San Ramón, Los Ángeles, Colonia Palmareña, cuenca media de Río San Lorenzo, camino a la mina de yeso, 1100 m, 22 Feb. 1991, *G. Herrera 4947* (CR); Reserva Forestal San Ramón, Los Ángeles, Colonia Palmareña, cuenca media de Río San Lorenzo, camino a la mina de yeso, 1100 m, 22 Feb. 1991, *G. Herrera 4954* (CR, MO); Reserva Forestal de San Ramón, 800–1000 m, 3 Nov. 1986, *G. Herrera & V. Mora 182* (MO); Reserva Forestal de San Ramón, 800–1000 m, 26 Jan. 1987, *G. Herrera & al. 412* (MO); Along road between San Ramón and Balsa, at Angeles Norte, primary cloud forest on slopes, 1250 m, 2 Feb. 1979, *T.B. Croat 46846* (MO); Sendero pantanoso hacia el Río Peñas Blancas, 1540–1575 m, 18 Jun. 1985, *W.A. Haber & E. Bello 1673* (MO); San Ramón. Bajo La Balsa, 1100 m, 4 Mar. 1983, *A. Carvajal 464* (MO); 15 km northwest of San Ramón by air, Cerro Azahar, headwaters of Río San Pedro, by road, 9 km northwest of San Ramón to Piedades Norte, then 3 more km northwest to La Paz, then left on jeep road 1.7 km to cluster of houses, then left again on jeep road 4–5 km to top of ridge, 1400–1500 m, 14 May 1983, *R.L. Liesner& al. 15497* (MO). **Cartago**: Turrialba, Chirripó, Moravia de Chirripó, Bosque nuboso, 1602 m, 13 May 2021, *M. Cedeño 2484* (USJ). **Guanacaste**: Monteverde 2 km N Santa Elena on road to San Gerardo. Hills above Río Negro. Atlantic slope near continental divide, 1550 m, 31 Jan. 1989, *W.A. Haber 9042* (MO); Monteverde 5 km N Santa Elena on road to Las Nubes, Finca San Bosco road, Río Negro, atlantic slope, 1400 m, 10 Nov. 1988, *W.A. Haber & W. Zuchowski 8745* (CR, MO). **San José**: Vásquez de Coronado, Cascajal, Fincas Privadas del Clodomiro Picado, 1487 m, 16 Feb. 2021, *J.E. Jiménez & F. Oviedo-Brenes 5492* (USJ).

## ***Anthurium wendlingeri*** G.M.Barroso var. ***wendlingeri***, Bol. Soc. Venez. Ci. Nat. 26(109): 151. 1965.

Type: Costa Rica, Cartago, Turones [Pavones], Turrialba, 700 m, *Wendlinger s.n.* (holotype RB-18049). Figure 15.

**Figure 15.** *Anthurium wendlingeri* var. *wendlingeri*. A: adult individual with pendent habit and purple spathe and spadix in the Caribbean of Costa Rica; B: inflorescence with purple spathe and cream spadix in female stage in the Caribbean of Costa Rica; C: adult individual with pendent habit and coiled spadix in the Caribbean, Chagres of Panama; D: coiled spadix in the Caribbean Fortuna of Panama. A. Not collected; B from *M. Cedeño al. 2394* (USJ); D: from *O. Ortiz & F. Miranda 1250* (PMA). Photos A–C by M. Cedeño-Fonseca; D. by O. Ortiz.

### *Distribution and habitat*

The species ranges from Nicaragua to Colombia at 250 to 1700 m elevation.

### *Phenology*

Flowering and fruiting throughout the year.

### *Conservation Status*

*Anthurium wendlingeri* var. *wendlingeri* has a broad geographical distribution (EOO = 118,954 km$^2$; AOO: 244 km$^2$), and it is not confronting any critical threats, hence this species must be considered as Least Concern [LC].

### *Remarks*

*Anthurium wendlingeri* var. *wendlingeri* is distinguished by its epiphytic habit, pendent growth form, coriaceous, oblong, elongate, usually bullate, glandular-punctate leaf blades (on both surfaces), 10–24 pairs of primary lateral veins, usually coiled, solid burgundy (code #9E1E29) spathes, and generally coiled spadices with 4–6 flowers visible in the principal spiral and 8–10 flowers visible in the alternate spiral, and oblong-globose red berries (code #C11B17). *Anthurium wendlingeri* var. *wendlingeri* could be confused with *A. tayuticense* (in Costa Rica) and *A. pendens* (in Panama), due to their pendent growth forms and elongated leaves. But both species differ from *A. wendlingeri* in having generally flat spathes and straight spadices throughout most of their length.

Historically, the color of the spadix of *Anthurium wendlingeri* var. *wendlingeri* has been ambiguous, as it has been described as pale green to white or grayish white (Croat 1983, 1986), pale green before anthesis and dark purple-violet at anthesis (Croat and Stiebel 2001), white to tan or grayish (Grayum 2003), white (Croat 2022), or white to gray-white (Croat et al. 2022). Due to this discrepancy, some authors (Croat and Stiebel 2001; Croat 2022) argued that there is a possibility that Barroso (1965), who defined the spadices in the original protologue as "atropurpureus", may have described the species using plants of different species. Recently, Croat (2022) indicated the possibility that Barroso (1965) may have prepared the description using plants of *A. wendlingeri* (var. *wendlingeri*) and the recently described *A. kubickii* (= *Anthurium wendlingeri* var. *horichii*) from a locality very close to the *locus classicus* of *A. wendlingeri* (var. *wendlingeri*). The problem with this notion is that it is based on the possibility that Barroso (1965) performed the description using more than two specimens, however, in the original protologue of *A. wendlingeri* only a single specimen (holotype) was cited. On the other hand, we consider that the discrepancy regarding the coloration of the spadix is linked to inadequate field work and poor understanding of the species throughout the development of the inflorescence. Extensive documentation of this species in the field allowed us to determine the color of the spadices during different phases of the development: at anthesis spadices can be dark rose (code #B34559) and creamy white (code #F6F0BC) at type locality, or grayish-white (code #F6F4F5; Costa Rica and Panama), at post anthesis spadices are reddish-orange (code #9E6842), during fruit development are brownish (code #825E29), and when fruits are ripe the spadices become rose brown (code #B28580). Our observations at the type locality of *A. wendlingeri* suggested that the color of the spadix between dark rose and white is a natural variation of the species, even within the same population (see Figs. 15 A–B).

### *Specimens examined*

**COSTA RICA**: **Alajuela**: Reserva Biológica de San Ramón, road from Las Lagunas to Colonia Palmareña, 850–1100 m, 30 May 1986, *G. C. de Nevers & al. 7787* (MO); Alajuela, Along Río Sarapiquí just upstream from crossing of road from San Miguel to Colonia Carvajal, 375 m, 18 Aug. 1990, *M. H. Grayum & N. Murakami 9945* (MO); San Ramón, Estación Biológica Alberto Manuel Brenes, 850 m, 3 Jul. 2003, *R.C. Moran & M. Mora 6882* (MO); **Cartago**: Turrialba, Tres Equis, 800 m, 13 May 2021, *M. Cedeño & al. 2394* (USJ); Turrialba, Parque Nacional Barbilla, Cuenca del Matina, sendero principal junto al río, 300–400 m, 20 Sep. 2000, *E. Mora & E. Rojas 1502* (MO). **Heredia**: 3 miles south of Cariblanco, 760 m, 28 May 1976, *T.B. Croat 35830* (MO); **Limón**: Reserva Indígena Talamanca Camino entre Sukut y Amubri por la fila Tsiurábeta, 700–900 m, 9 Jul. 1989, *B.E. Hammel & al. 17614* (MO); Llanuras de Santa Clara, river-shore junction and jungle below Hacienda El Zorro, north of road to Guapiles, along Rio Danta, 250 m, 1983, *C.K. Horich s.n.* (MO); Talamanca, Bratsi, Reserva Indigena Bri Bri, 1.7 km southwest of Kivut, 6.1 km southwest of Alto Lari, 0–1450 m, 12 Mar. 1992, *H.H. Schmidt & R. Aguilar 651* (MO); Cordillera de Talamanca between headwaters of Río Madre de Dios and Quebrada Barreal, 400 - 440 m, 5 Sep. 1988, *M.H. Grayum & al. 8807* (CR, MO); Limón, Cerro Muchilla, Fila Matama, Valle de la Estrella, 850 m, 5 Apr. 1989, *G. Herrera & al. 2510* (CR, MO); Pococí, Río Costa Rica, 250 m, 15 Feb. 1989, *C. K. Horich s.n.* (MO!); Talamanca, Cordillera de Talamanca. Río Coén, 800 m aguas arriba unión Queb. Kirigú, de Ujarrás a San José Cabécar, 1700 m, 28 Mar. 1993, *Á. Fernández 860* (CR); Croriña, Cerro Cruibeta, afluentes de Quebrada Lumbeta, 550 m, 20 Jul. 1989, *G. Herrera 3320* (MO); Camino de Fila Dimat (casa de Hermógenes Pereira) hasta Soki [Tsaki], pasando por la quebrada Sha [Sheaub?], 26 Oct. 1985, *L.D. Gómez & al. 23850* (MO); **Puntarenas**: San Vito de Java, Las Cruces, from R.G. Wilson, Greenhouse #17. Acc. No. 681267, 11 Mar. 1982, *F.P. Darke D-795* (MO); San Vito, as Selby 77-1989, 31 May 1986, *E.A. Christenson 1525* (MO); **San José**: Tarrazú, San Marcos de Tarrazú between Cerro Toro and Cerro Hormiguero along the road between Basuero de Tarrazú and Esquipulas, vicinity of Cerro Hormiquero, 1100–1200 m, 5 Sep. 1996, *T.B. Croat 78902* (MO). **PANAMA**: **Bocas del Toro**: Gualaca-Chiriquí Grande, 1.6 mi N of Continental Divide, 850 m, 29 Mar. 1993, *T.B. Croat 74925* (MO); Along road between Gualaca and Chiriquí Grande, 9.4 mi N of the Continental Divide (border of Bocas del Toro and Chiriquí Provinces) 14 mi N of bridge over Fortuna Lake, along river banks, 175 m, 25 Jun. 1987, *T.B. Croat 66821* (MO). **Coclé**: Caribbean side of divide at El Copé, 200–400 m, 3 Feb 1983, *C.W. Hamilton & G. Davidse 2659* (MO); El Valle, end of road leading to Turístico Hotel, walking up into crevasse between the central and the eastern hill of the three rim masses soaring above El Valle, 11 May 1977, *J.P. Folsom 3108* (MO); La Mesa, 4 km N of El Valle, 875 m, 3 Jan. 1974, *M.H. Nee & J.D. Dwyer 9168* (MO); Along road past Furlong's Finca, due N of Cerro Pilón, 880 m, 22 Jul. 1976, *T.B. Croat 37517* (MO); Received from R.M. Cirino, originally collected in Panama, Coclé Province: Cerro Tute, 22 Jun. 2005, *T.B. Croat 95418* (MO); Vicinity of La Mesa, N of El Valle de Antón, along steep slopes above water reservoirs, ca. 1 km W of road between Finca Mandarinas and Finca Furlong, 800–900 m, 12 Jul. 1987, *T.B. Croat 67181* (MO); La Mesa, above El Valle de Antón, ca. 2 km W of Cerro Pilón on slopes of steep hill, 860–900 m, 21 Jul. 1976, *T.B. Croat 37329* (MO); Along road between Llano Grande and Coclesito (north of Pintada), 4 mi N of Llano Grande, 600 m, 28 Jan. 1980, *T.M. Antonio 3595* (MO); La Pintada, along road between Llano Grande and Coclecito (N of La Pintada), 4.0 mi N of stream at Llano Grande, 550 m, 7 Dec. 1979, *T.B. Croat 49221* (MO). **Colón**: Santa Rita Ridge, east of transisthmian highway, 300–500 m, 16 Dec. 1972, *A.H. Gentry 6604* (MO); Along road into Santa Rita, east of Agua Clara rain gauge, 4 Mar. 1973, *H. Kennedy 2749* (MO); Santa Rita Ridge lumber road near Agua Clara weather station, 24 Sep. 1968, *M.D. Correa & R.L. Dressler 1053* (MO); Santa Rita Ridge Road, along trail at end of road which goes to Río Indio, beginning 10.6 km from Transisthmica Hwy, 3 km beyond hydrographic station, 380 m, 13 Apr. 1976, *T.B. Croat 34295* (MO); Donoso, San Juan del General, Conseción del Proyecto Mina de Cobre Panama, Botija, sendero dorado, 199 m, 12 Jan 2015, *J. De Gracia 843* (MO). **Darién**: Parque Nacional del Darién, slopes of Cerro Mali, headwaters of S branch of Río Pucuro, ca. 22 km E of Pucuro, 1300–1400 m, 21 Oct. 1987, *H. Cuadros & al. 3950* (MO). **Panamá**: Parque Nacional Altos de Campana, Buena Vista, Chame, 1 Apr. 2000, *Florpan & al. 4707* (MO); Cerro Jefe region, c. 1.5 miles along Río Pacora road from junction with Cerro Jefe road, 750 m, 23 Jan. 1986, *G. McPherson & M. Merello 8130* (MO); Road past Altos de Pacora, 3–3.5 mi NE of Altos de Pacora, 7.8–8.2 mi above Pan Am Highway, 11.1–11.6 mi beyond Lago Cerro Azul, 700–750 m, 19 Jun. 1988, *T.B. Croat 68678* (MO, SCZ); Chepo, along new El Llano-Cartí road, 8–12 km N of El Llano, 400–450 m, 12 Dec. 1973, *M.H. Nee & al. 8735* (MO); El Llano-Cartí Road, 10–12 km from junction with Inter-American Highway, 410 m, 30 Oct. 1974, *S.A. Mori & J.A. Kallunki 2854* (MO); El Llano-Cartí Road in vicinity of Gorgas Lab Mosquito Control Project site at km 12, 250 m, 1 Aug. 1974, *T.B. Croat 26033* (MO); Panamá, vicinity of Cerro Jefe, 4.6 km beyond peak on road to Altos de Pacora, 26.3 km from the Inter-American Highway, 600 m, 12 Jun. 1976, *T.B. Croat 35917* (MO). **Guna Yala Comarca (San Blas)**: Boundary trail on Llano-Cartí road, 350 m, 27 Jan. 1986, *G. McPherson & M. Merello 8173* (MO); El Llano-Cartí Road, 19.1 km from Interamerican Hwy. Continental divide trail E of camp, 325 m, 28 Aug. 1984, *G. de Nevers 3781* (MO); Trail to Cerro Camucañala from Río Titamibe, 60–100 m, 28 Jan. 1985, *G. de Nevers & al. 4705* (MO). **Veraguas**: Santa Fe, Vicinity of Escuela Agricola Alto Piedra near Santa Fe, 0.3 mi beyond the fork in the road near the agricultural school toward Atlantic coast, along trail to top of Cerro Tute, 1050–1150 m, 29 Nov. 1979, *T.B. Croat 48914* (MO); Along western fork of road beyond Escuela Agrícola Alto Piedra, NW of Santa Fé, Pacific slope, 0.6 mi beyond fork in the road1300–1350 m, 1 Dec. 1979, *T.B. Croat 49046* (MO); Valley of Río Dos Bocas along road between Escuela Agricola Alto Piedra and Calovebora, 15.6 km northwest of Santa Fé, along trail to Santa Fé, steep forested hill east of river, 450–550 m, 31 Aug. 1974, *T.B. Croat 27659* (MO).

***Anthurium wendlingeri*** G.M.Barroso var. ***horichii*** Croat, Aroideana 45(2): 256, figs 102 & 103. 2022. Figure 16.

Type: Cultivated Missouri Botanical Garden ex COSTA RICA. Limón: Llanuras de Santa Clara, Atlantic rain forest, rare, pendulous epiphyte on tall old trees of shore-jungle along lower Río Costa Rica near Hacienda “El Zorro Cruel”, 250 m, originally collected by Clarence

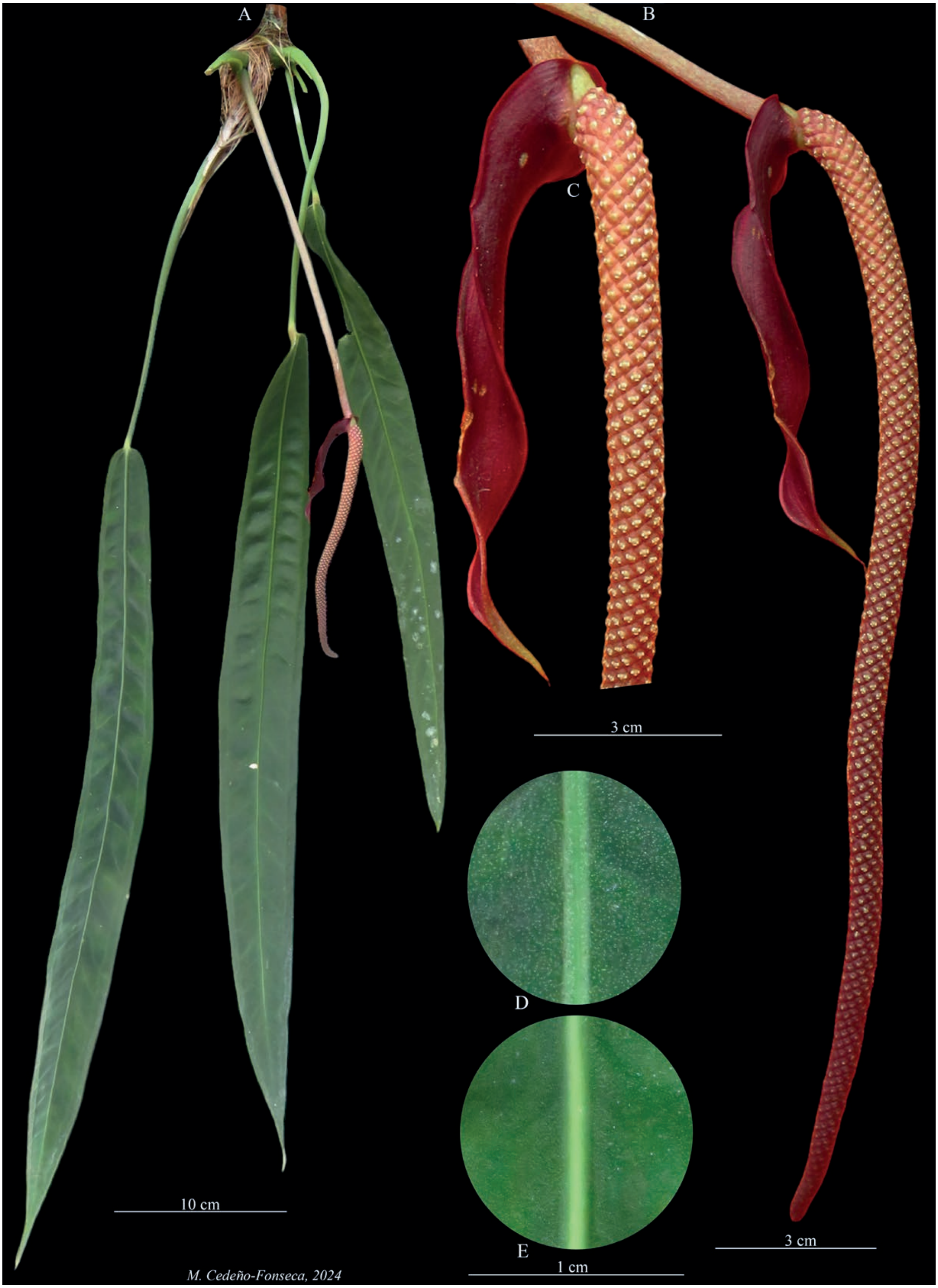

**Figure 16.** *Anthurium wendlingeri* var. *horichii*. A: habit; B: Inflorescence at male anthesis; C: Spathe and flowers at male anthesis; D: detail of the leaf blade on the upper surface; E: detail of the leaf blade on the lower surface. Photos by Oscar Cubero. Plate by M. Cedeño-Fonseca.

Horich; vouchered Mar. 1990, *T.B. Croat 71837* (holotype MO-5451888; isotypes CR, K, US).

(=) *Anthurium kubickii* Croat, Aroideana 45(3): 34, figs. 3 & 5–10. 2022, **syn. nov.**

Type: Costa Rica. Limón: Guayacán Rainforest Reserve, along CR Hwy #10, in foothills above Siquirres, 450 to 610 m, primary forest, *T.B. Croat & B. Kubicki 108730* (holotype MO-6813000; isotypes CR, K, US).

### *Distribution and habitat*

*Anthurium wendlingeri* var. *horichii* is endemic to Costa Rica, known only from the Caribbean slope of the Talamanca Mountain range, at 250–610 m in a *Tropical wet forest* to *Premontane wet forest* life zone.

### *Phenology*

Flowering in March and July.

### *Conservation Status*

This taxon is only known from one location (between Llanuras de Santa Clara and Siquirres), which includes a protected area (Guayacan Rainforest Reserve). However, the forests surrounding this reserve are highly threatened (cf. Croat 2022: fig. 1), by extensive monocultures of banana, pineapple, and oil palm crops. Considering the threats present around the existing locality and the possible effects of monocultures, such as the fragmentation of the possible natural habitats that this species could be occupying in the region, we suggest including this taxon as Critically Endangered [CR B2ab (iii)].

### *Remarks*

This taxon is characterized by having sulcate petioles, narrowly oblong to oblong-oblanceolate, more than 10 times longer than wide, dark green and velvety blades, pendent, long-pedunculate inflorescence with red (code #E30022) spathes, pinkish red (code #893843), sessile spadices at anthesis (purplish violet at post anthesis) with 5–6(7) flowers visible per spiral, and orange red (code #FF3F00), subglobose berries. Croat et al. (2022) proposed *A. wendlingeri* var. *horichii* arguing that this variety differs from the typical *A. wendlingeri* concept, by having pink spadices at anthesis (purplish after anthesis) that do not develop a tight spiral before anthesis.

Croat et al. (2022) recently described *Anthurium kubickii* from a zone very close to the type locality of *A. wendlingeri* var. *horichii*. These two taxa were defined using the same combination of diagnostic characters (straight, pinkish red spadices) (cf. Croat et al. 2022: 256 vs. Croat 2022: 34), however, they were not directly compared in their respective protologues. After examining type material of both names, we concluded that they are the same taxon, because in addition to sharing the previously mentioned characters, both have bullate leaves (when fresh), and spadices with stamens exserted after anthesis. Furthermore, it should be noted that the holotype of *A. wendlingeri* var. *horichii*, cited in the original protologue by Croat et al. (2022), comes from a material originally collected by Clarence Horich (from Limón: Llanuras de Santa Clara in 1995), which was grown at Munich Botanical Garden. In the case of the *A. kubickii* (Croat 2022), a paratype was included that was collected by Horich (with the provenance only cited as 'Costa Rica') also cultivated at Munich Botanical Garden. This indicates that both protologues involved materials based on collections that were probably from the same locality or origin, which were previously documented by Horich.

According to the ICN (Turland et al. 2018), neither of the names in question (*A. kubickii* and *A. wendlingeri* var. *horichii*) has nomenclatural priority over the other because priority only operates within the same rank (Art. 11.2). In this case, we adopt the variety name *A. wendlingeri* var. *horichii* instead of the species level *A. kubickii*, based on the concept of morphological variety (Duistermaat 1987, Hamilton and Reichard 1992, Grayum 1996), in which the rank of variety is considered appropriate when there is a minor morphological difference without any geographical or ecological distinction. This taxonomic proposal is based on the fact that both A. *wendlingeri* var. *wendlingeri* and *A. wendlingeri* var. *horichii* occur sympatrically (documented at Heredia, Horquetas), and do not have significant differentiation based on a combination of substantial morphological characters, both taxa only differ in the presence of a spiral spadix which can be white or pink in *A. wendlingeri* var *wendlingeri*, whereas *A. wendlingeri* var. *horichii* has straight pink spadices becoming purplish violet after anthesis.

Both the reviewed herbarium material of *A. wendlingeri* var *wendlingeri* and the field work suggested the existence of specimens with other small morphological differentiations (such as the case of the populations from western Panama with white and extensively spiraled spadices; fig. 15D), but to have a better taxonomic conclusion, it is necessary to make a revision of all material throughout its entire distributional range (Nicaragua to Colombia), accompanied by molecular phylogenetic studies.

### *Specimens examined*

**COSTA RICA**: Cultivated at Munich Botanical Garden ex Costa Rica, originally collected by Clarence

Horich, *J. Bogner 2684* (M); Cultivated at Munich Botanical Garden ex Costa Rica: Llanuras de Santa Clara, Hacienda El Zorro Cruel, 1995, *Botanische Garten München 92/3437* (MO); **Heredia**: Horquetas, 11 Jul 2024, *O. Cubero 022* (USJ).

## CONSERVATION STATUS AND ITS POTENTIAL THREATS

According to the results obtained through the conservation assessments, eight species are listed as Critically Endangered (CR), three are Endangered (EN), and five are Least Concern (LC) (Table 1). *Anthurium edtysonii, A. friedrichsthalii, A. pendens,* and *A. wendlingeri* var. *wendlingeri* do not require urgent attention, due to its wide distribution (including protected localities) and do not present significant threats. *Anthurium longistipitatum*, despite its restricted distribution (EOO = 6508 km$^2$), we consider it to be LC since its populations occur in a preserved area with effective protection, which does not pose any risk of threat to its conservation.

The taxa with the highest risk of threat, based on their geographic distribution and potential threats, are *Anthurium cascantei*, *A. embera*, *A. jicotense, A. wendlingeri* var. *horichii, A. loratum*, *A. orosiense*, *A. tarrazuense*, and *A. tayuticense* (all assessed as CR), followed by *A. chiriquense*, *A. gregneversii,* and *A. utleyorum* (all assessed as EN) (Table 1). Almost all these species occur in Costa Rica (except *A. embera*; Table 1) and face common threats, including habitat loss due to destructive non-sustainable activities such as extensive ranching and large-scale agricultural practices (Fig. 17). These localities are not supported by legislative instruments that regulate land use change, resulting in a drastic reduction of the forest area where these species grow. Additionally, coffee crops are being established on steep slopes, up to 70°, spreading towards the uppermost part of the mountains and further fragmenting the remnants and disrupting the connectivity of natural biological corridors (Cedeño-Fonseca et al. 2020).

Another potential threat to the conservation of the species is the continuous unsustainable extraction of wild plants for illegal sale on the black market. Many individuals of *Anthurium*, are often boosted by online sales through social media or internet stores, which usually do not have any regulation or restriction (Olmos-Lau and Mandujano 2016; Lavorgna 2014; Lavorgna et al. 2018; Frantz 2021, Lavorgna and Sajeva 2021). One of the triggers of this problem is the sale of plants considered "rare" or "exclusive" (many of them endemic), since it causes a certain demand in the market which is supplied by a few providers, which triggers the monopoly and inflation, so much so that plant prices can reach exorbitant sums (Frantz 2021). This leads people to acquire them through any means (either for trade or for private collections), which encourages unsustainable extraction of adult plants *in situ*. Currently, many pendent *Anthurium* are highly valued as ornamentals, but this growing demand has the consequence that several

**Table 1.** Conservation status and distribution of *Anthurium* sect. *Porphyrochitonium* species with a pendent growth form from Costa Rica and Panama.

| Taxon | UICN category | Distribution |
|---|---|---|
| *Anthurium cascantei* | Critically Endangered [CR] | Costa Rica |
| *Anthurium chiriquense* | Endangered [EN] | Costa Rica and Panama |
| *Anthurium edtysonii* | Least Concern [LC] | Costa Rica to Ecuador |
| *Anthurium embera* | Critically Endangered [CR] | Panama |
| *Anthurium friedrichsthalii* | Least Concern [LC] | Nicaragua to Ecuador |
| *Anthurium gregneversii* | Endangered [EN] | Costa Rica and Panama |
| *Anthurium jicoteense* | Critically Endangered [CR] | Costa Rica |
| *Anthurium longistipitatum* | Least Concern [LC] | Costa Rica and Panama |
| *Anthurium loratum* | Critically Endangered [CR] | Costa Rica |
| *Anthurium orosiense* | Critically Endangered [CR] | Costa Rica |
| *Anthurium pendens* | Least Concern [LC] | Panama and Colombia |
| *Anthurium tarrazuense* | Critically Endangered [CR] | Costa Rica |
| *Anthurium tayuticense* | Critically Endangered [CR] | Costa Rica |
| *Anthurium utleyorum* | Endangered [EN] | Costa Rica |
| *Anthurium wendlingeri var. horichii* | Critically Endangered [CR] | Costa Rica |
| *Anthurium wendlingeri var. wendlingeri* | Least Concern [LC] | Nicaragua to Colombia |

**Figure 17.** A: Fila Anguciana threatened by illegal logging for the establishment of local crops; B: Cerro Anguciana threatened by the establishment of livestock at 1400 m elevation; C–D Naranjo de Dota threatened by illegal logging for the establishment of coffee plantations. Photos by M. Cedeño-Fonseca.

species (many endemic) are being "hunted" in the field (often without collection permits) and sold on the black market deprived of any regulation, which could seriously compromise the conservation of these species *in situ* (Kaminski et al. 2012; Phelps and Webb 2015), due to the deterioration of their habitats added to the continuous extraction of wild individuals (Lande 1998; Peres 2001; Rosser and Mainka 2002; Campos et al. 2019). Unfortunately, this could drive to the extinction of these species in the wild, just as it has happened with species of other aroid genera, such as *Aglaonema*, *Alocasia*, *Caladium*, *Cryptocoryne*, and *Scindapsus* (Oldfield 1983; Brown 1984; Burnett 1985; Boyce 1995).

## Key to the pendent *Anthurium* sect. *Porphyrochitonium* from Costa Rica and Panama

1. Leaf blades mostly more than 10 times longer than wide **2**

– Leaf blades generally less than 10 times longer than wide ........................................................................................... **6**

2. Leaf blades usually bullate (when fresh); spadices tapered (narrow towards the apex); berries red, oblong-globose, beaked at apex....................................................**3**

– Leaf blade flat; spadices cylindroid; berries pale yellowish orange, oblate-obcordate, truncate at apex ........................ **4**

3. Inflorescences at anthesis with straight (never coiled), pinkish red spadices................ ***A. wendlingeri var. horichii***

– Inflorescences at anthesis with coiled, dark rose, creamy white or grayish-white spadices. ............................................ ............................................ ***A. wendlingeri var. wendlingeri***

4. Leaf blades oblanceolate, usually less than 13 times longer than wide; peduncle shorter, 0.5–0.7 times as long as the petiole; spadices brownish ................................. ***A. pendens***

– Leaf blades linear, typically more than 13 times longer than wide; peduncle more than 1.2 times longer than the petiole; spadices yellowish orange or reddish...................... **5**

5. Leaf blades with black-glandular punctations on both surfaces, drying grayish yellow-brown; spadices with 6–7 flowers visible per spiral....................................... ***A. loratum***

– Leaf blades with black-glandular punctations on the lower surface only, drying yellowish or yellow-brown; spadices up to 4 flowers visible per spiral ........... ***A. friedrichsthalii***

6. Leaf blades eglandular on the upper surfaces (black-glandular punctations on the lower surface only)...................... **7**

– Leaf blades with black-glandular punctations on both surfaces....................................................................................... **11**

7 Leaf blades generally more than 8 times longer than wide, usually falcate (easily observable when fresh).. ***A. edtysonii***

– Leaf blades less than 8 times longer than wide, never falcate ............................................................................................ **8**

8 Leaf blades with 15 pairs or more primary lateral veins....... ........................................................................... ***A. tayuticense***

– Leaf blades generally with less than 15 pairs of primary lateral veins ............................................................................. **9**

9 Leaf blades narrowly oblong-elliptic, more than 5 times longer than wide; primary lateral veins obscure when fresh; spadices bright red at anthesis........... ***A. tarrazuense***

– Leaf blades oblong-elliptic or ovate-oblong, less than 5 times longer than wide; primary lateral veins distinct when fresh; spadices brown, purple or orange at anthesis .. ................................................................................................ **10**

10 Leaf blades very glossy on the upper surface (when fresh), not velvety; inflorescences pendent with orange spadices at anthesis; Panama (Darién) ..................................... ***A. embera***

– Leaf blades matte on the upper surface, velvety; inflorescences erect with brownish to purple spadices at anthesis; Costa Rica (Tinamaste) ....................................... ***A. cascantei***

11 Spadices markedly stipitate, stipe 1 cm long or more .... **12**

– Spadices sessile or subsessile, stipe up to 0.6 cm long ... **13**

12. Leaf blades oblong-elliptic to elliptic, 3.2–4.0 times longer than wide; spadices pinkish and usually coiled at anthesis; berries globose-ovoid, beaked at apex ........ ***A. chiriquense***

– Leaf blades oblong-lanceolate to strap-shaped, 4.3–6.6 times longer than wide; spadices orange red and non-coiled (straight); berries globose or subglobose, truncate at apex (with a central depression) ........... ***A. longistipitatum***

13 Leaf blades narrow, mostly less than 4.5 cm wide ............ **14**

– Leaf blades generally more than 5 cm wide....................... **15**

14 Leaf blades with 20–25 pairs of primary lateral veins; spadices pinkish at anthesis; berries truncate at apex; Costa Rica and Panama ............................................ ***A. gregneversii***

– Leaf blades usually with less than 20 pairs of primary lateral veins; spadices red orange at anthesis; berries beaked at apex; Costa Rica ............................................ ***A. utleyorum***

15 Leaf blades gray to olive-green when dry; spadices green at anthesis ................................................................ ***A. jicoteense***

– Leaf blades yellow-brown when dry; spadices yellowish to brown at anthesis. ............................................... ***A. orosiense***

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# Index of New Taxa

Edited by Riccardo M. Baldini (Editor in Chief)

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