

WITH GREAT BIODIVERSITY COMES GREAT RESPONSIBILITY: THE UNDERESTIMATED DIVERSITY OF *EPIDENDRUM* (ORCHIDACEAE)

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Abstract. *Epidendrum* (Orchidaceae) has been suggested to be a promising model system for evolutionary and ecological studies in the Neotropical region. Given its species diversity, the broad biogeographical and ecological range, and the variation in morphology, chromosome numbers and ecological interactions, the genus presents a rich source for intriguing and yet unanswered questions. *Epidendrum* is also a prime candidate to study speciation and this makes establishing precise species boundaries and diversity estimates in the genus extremely important. Through the recognition and discovery of hundreds of undescribed taxa, the number of formally described *Epidendrum* species has grown from 1000 to 1800 in the last two decades, while projections suggest the genus may have up to ca. 2400 species. This notorious underestimation of species diversity has serious consequences in many macroecological studies, including speciation, biogeographical patterns, diversification processes, and conservation priorities. Such a large number of unrecognized species in the genus has multiple unforeseen negative consequences and closing the gap between the described and projected diversity needs to become a priority. The isthmus of Costa Rica and Panama, one of the most biodiverse regions in the world, is also a center of diversity of *Epidendrum*. One out of every six species in the genus is present in the region and half of them are endemic. In the current paper, 20 new species are described from the isthmus and new records and exclusions are presented for both countries. Many of the newly recognized species had previously been included within broader circumscriptions of other taxa or had simply been misidentified. They represent a good example of how taxonomy can cause a sudden shift from a scenario where a few broadly distributed and unthreatened species become multiple potentially threatened species for which the population size, distribution and conservation status need to be urgently established. *Epidendrum* is the most speciose orchid genus in Costa Rica and Panama, as well as most other Latin American countries, but species are poorly represented in herbaria and literature, and indetermination or incorrect determination of specimens is widespread. This results in a severe underestimation of *Epidendrum* species both in terms of species richness and their conservation priority levels.

Keywords: conservation, Costa Rica, Neotropics, new species, Panama, taxonomy, speciation

Epidendrum L. (Orchidaceae: Laeliinae) is a highly diverse and ubiquitous orchid genus endemic to the Neotropics. Species of *Epidendrum* may be found growing from North Carolina in the United States to Argentina, through Central America and the Antilles, and from sea level to about 4000 m elevation, covering virtually every type of habitat in the tropical and subtropical new world. They are recognized by the usually thick stems, with distichous leaves, apical inflorescences and flowers with the lip frequently fused to the column (Hágsater et al., 2003). The highest diversity is found in the mid to high elevation mountains of the Andes, especially Colombia, Ecuador, and Peru, but also in neighboring countries (Hágsater and Soto-Arenas, 2005; Hágsater et al., 2016). The isthmus of Costa Rica and Panama in Central America is a relatively small geographical area which nonetheless contains more than 10% of all known orchid species (Bogarín et al., 2013), giving it one

of the highest species densities worldwide (Karremans and Bogarín, 2013). The isthmus has been shown to have a crucial role as biotic source for Neotropical Orchidaceae biodiversity (Pérez-Escobar et al., 2017), and with hundreds of species and tenths of dozens of endemics (Bogarín et al., 2016), it is another *Epidendrum* hotspot.

The painstaking effort to illustrate and describe the diversity of *Epidendrum* has been the focus of the AMO herbarium in Mexico for the last three decades or so, monographing hundreds of species, old and new, within the series *Icones Orchidacearum*: The genus *Epidendrum* (Hágsater and Salazar, 1993; Hágsater et al., 1999; Hágsater and Sánchez-Saldaña, 2001, 2004, 2006, 2007, 2008, 2009, 2010, 2013, 2015, 2016; Hágsater and Santiago, 2018a, 2018b, 2019, 2020a, 2020b, 2021). In 1993, upon publishing the first fascicle of *Icones Orchidacearum*: The genus *Epidendrum*, Hágsater noted that “little is known

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about the ecology of most *Epidendrum* species,” and shortly after, the author estimated the diversity of *Epidendrum* at around 2000 species (Hágsater et al., 1999), which meant a whopping increase of 100% on the ca. 1000 species of *Epidendrum* described at that time. After carefully inspecting hundreds of herbarium specimens from diverse countries he cautioned “what seemed to be variable species have turned out to be groups of well-defined species.” Not surprisingly, since then more or less 800 species and nothospecies of *Epidendrum* have been formally published, bringing the total number of accepted taxa in the genus to 1800, significantly closing the gap between formally recognized and estimated diversity. However, the authors have since also increased their projection to 2400 species (Hágsater et al., 2016), which would make *Epidendrum* the largest genus in Orchidaceae and one of the top three among vascular plants. It also means we are still far from grasping the full diversity of this genus (Table 1).

Why has the diversity of *Epidendrum* been so underestimated until recently? One critical issue pointed out by Hágsater and colleagues is “how poorly the diversity of species is represented in herbaria,” coupled to the fact that “it is not until a number of species in a group have been cultivated together, illustrated and studied, that the specific differences become apparent,” and they concluded “what seemed to be variable species have turned out to be groups of well-defined species.” The key reasons *Epidendrum* diversity has been traditionally misjudged can be summarized in collection neglect or lack of representative specimens in herbaria and collections, and an overestimation of the natural variation of taxa. Contrary to what was believed before, there is a significant amount of local species radiation and endemism. The consequences of heavily underestimating the diversity of a genus like *Epidendrum* may be severe when it comes to conservation. Given the high degree of endemism in the genus it is quite likely that the populations of certain

TABLE 1. *Epidendrum* species, endemics and IUCN assessed.

REGION	SPECIES (ENDEMICS)/SPECIES PROJECTED	SPECIES IUCN ASSESSED (PERCENT)
Costa Rica (2002)	162* (29.6%*)	–
Costa Rica (2021)	247 (36.2%**)	5 (2%)
Panama	207 (23.1%**)	4 (1.9%)
Isthmus	310 (ca. 50%**)	6 (2%)
New World (1999)	1000 / 2000***	–
New World (2021)	1800 / 2400***	24 (1.3%)

* According to Pupulin (2002).
 ** Based on Bogarín et al. (2016).
 *** Estimated by Hágsater et al. (1999) and Hágsater et al. (2016) respectively.

unrecognized taxa with very narrow distributions are highly threatened, and that such conservation priorities are being overlooked or overshadowed as a result of the misconception that *Epidendrum* species are common and widespread. Even though the outcome of a few recent studies has been the reduction of species diversity in the genus (Pessoa et al., 2020), the vast majority of works result in a continuous increase in the numbers of *Epidendrum* species recognized (e.g., Zambrano Romero et al., 2021).

In Costa Rica and Panama, species of *Epidendrum* are mainly distributed in the wet, montane and cloud forest, between 1000 and 2500 m elevation (Hágsater et al., 2003). Nevertheless, *Epidendrum* species can be found virtually anywhere in both countries and the genus is by far the most species rich of both their orchid floras (Bogarín et al., 2016). Dozens of species have been added in recent years as new species and new country records are discovered in little explored areas and within species complexes (Hágsater and Sánchez-Saldaña, 2004, 2006, 2008, 2009, 2013; Bogarín et al., 2008; Karremans and Hágsater, 2010; Pupulin and

Karremans, 2010; Karremans et al., 2012; Fernández et al., 2014; Díaz-Morales and Karremans, 2016). The unpublished updated catalogue of Costa Rican Orchidaceae (Pupulin, Bogarín and Karremans, in prep.) lists 223 *Epidendrum*. Here, 20 new species are described from the country, five species are newly recorded, and one is excluded. Therefore, Costa Rica currently holds 247 species of *Epidendrum*, a 52 % increase from the 162 species registered by Pupulin (2002) in the previous catalogue, twenty years ago. This substantial increase of 85 species—which roughly corresponds to the whole orchid diversity of countries such as the UK and The Netherlands—is a clear indication that the country is a center of diversity for *Epidendrum*, and Orchidaceae in general. The catalogue of orchids of Panama is much more recent (Bogarín et al., 2014), and just one *Epidendrum* novelty from the country has been described since (Hágsater and Sánchez-Saldaña, 2016). Two new species and a new record are added here, but two previously registered taxa are also excluded from the country, with a total of 207 species recognized (Table 1).

By carefully studying the species of the *Epidendrum anoglossoides* Ames & C.Schweinf., *E. rugosum* Ames and *E. sanchoi* Ames complexes in Costa Rica and Panama it has become apparent not only that there is much more diversity in this group than previously thought, but also that despite being locally abundant, each species clearly has a relatively narrow distribution, with many taxa growing only on a particular mountain range at a specific elevation. As soon as this habitat changes so does the species of *Epidendrum*. Both *E. rugosum* (Hágsater and Sánchez-Saldaña, 2007) and *E. sanchoi* (Hágsater and Sánchez-Saldaña, 2008) were circumscribed much more broadly than in the current paper, here several additional species are recognized in these complexes. It is certain that additional novelties will indeed be found in the future and it is best at this time not to speculate on the identity of all the specimens included in the records under those names without reinspecting them. The fact is, I have only seen plants of both species growing near the city of Cartago where they were originally discovered by Charles Lankester and can only speculate about what their true distribution may be.

The full list of taxonomic changes proposed herein is the following: *Epidendrum anoglossoides*, *E. bilobatum* Ames,

E. microcardium Schltr., *E. rugosum* and *E. sanchoi* are recircumscribed. The former Panamanian endemics *Epidendrum bugabense* Hágsater, *E. cymbiglossum* Hágsater, *E. gymnochlamys* Hágsater & E.Santiago and *E. longibracteatum* Hágsater, as well as *E. vexillum* Hágsater, previously known to occur in Panama and Colombia, are recorded from Costa Rica for the first time. The former Costa Rican endemic *E. jorge-warneri* Karremans & Hágsater is reported for Panama. The reinterpretation of specimens of *Epidendrum unicallosum* Hágsater & E.Santiago from Costa Rica result in its reinstatement as a Panamanian endemic. *Epidendrum anoglossoides* and *E. rugosum* are excluded from Panama. The following novelties from Costa Rica and Panama are proposed: *Epidendrum aeolicum* Karremans, *E. bicentenarium* Karremans & Gil-Amaya, *E. capitalinum* Karremans, *E. chespiritorium* Karremans, *E. colibri* Karremans, *E. conservatorum* Karremans, *E. globuliferum* Karremans, *E. iricolor* Karremans, *E. mantabirostris* Karremans, *E. miriamae* Karremans, *E. nativitatis* Karremans, *E. rossanae* Karremans, *E. rudolfii* Karremans, *E. saltatrix* Karremans, *E. santaelenae* Karremans, *E. sidereum* Karremans, *E. sinac* Karremans, *E. spiculiferum* Karremans & Bogarín, *E. usurpator* Karremans, and *E. utyumii* Karremans.

MATERIALS AND METHODS

The examination of living plants, both in the field and cultivation, is a strong component in this study, allowing for a more refined assessment of morphological and geographical variation. This is especially needed in the *E. anoglossoides*, *E. rugosum* and *E. sanchoi* species complexes where many distinct entities have been included under broadly circumscribed species concepts because of their overall similarity. Species in these groups may be locally abundant, which helps when assessing their natural variation, but they are typically restricted in distribution with different species found on different mountain chains and at different altitudinal ranges.

The plant collection and documentation mostly followed the methods described by Pupulin et al. (2021). Living plants intended for this study were collected between 2005 and 2021 and cultivated at Lankester Botanical Garden (JBL, its acronym in Spanish), University of Costa Rica. Whenever possible, type localities and other critical localities were visited for plant collecting and subsequent study. At JBL plants were individually labelled and cultivated, field data was recorded and stored in the general databases. Photographs were mostly taken with Nikon cameras (D5200, D7100, D810) mounted on Manfrotto tripods, fitted with macro lenses (Micro Nikkor 105mm AF f/2.8, Sigma DG Macro HSM 105mm f/2.8). Images were optimized through post-processing with Adobe® Photoshop CS5 and CS6, and

comparative plates of flowers and/or relevant floral details were also prepared using the same software. One or more vouchers for each specimen were conserved in the liquid collection of JBL.

Standard conditions of each organ, such as green leaves, glabrous perianth parts or regular and straight margins, are not mentioned expressly in any description. Descriptions are based on the type specimen unless specified otherwise. The dissected perianth is always shown in a resupinate position in the LCDP even when the flowers are naturally non-resupinate, their natural orientation is always shown in the flower detail. The measurement of the lip always includes the basal section fused to the column.

The possibility of physical inspection of herbarium specimens for the current study has been reduced due to the travel and visitation restrictions imposed worldwide during 2020 and 2021, as a consequence of the pandemic caused by COVID19. Specimens cited here have been assessed physically or through digital photographs by the author. Specimens listed by other authors under the taxa here discussed have been expressly excluded when direct inspection and/or determination was not possible. This is necessary because herbarium materials of closely related taxa are difficult to distinguish and erroneous determinations are the rule rather than the exception.

TAXONOMIC TREATMENT

The lack of a formal subgeneric classification of the mammoth genus *Epidendrum* makes it challenging to treat the many species alliances which are found in the genus. Hágsater and colleagues have proposed groups and subgroups of species which are extremely useful in treating discrete taxa. Unfortunately, being informal they

lack a clear phylogenetic placement, circumscription, and hierarchy. The proposal of a formal subgeneric classification of *Epidendrum* is a pressing necessity but is beyond the scope of the current paper. For the time being, reluctantly, the informal groupings are used to be able to place and treat the species according to their closest relatives.

NEOWILLIAMSI GROUP

Hágsater and Sánchez-Saldaña (2007) informally characterize species belonging to the “Neowilliamsia Group” by the ancipitose stems and rachis, the rachis with conduplicate, acute bracts, distichous, usually non-resupinate flowers, the lip often digitate and the 2–4 pollinia with 2 hard, laminar, caudicles.

Epidendrum cymbiglossum Hágsater, Icon. Orchid. 2: pl. 126. 1993. TYPE: PANAMA. Chiriquí: Distr. Bugaba, Santa Clara, 8°50'N, 82°44'W, to Cerro Pando, *H. van der Werff* 7186 and *J. Herrera* (Holotype, SEL [not seen]; Isotypes, MO, SEL [not seen]).

Epiphytic, erect *herb*, somewhat scandent, up to 10 cm tall, excluding the inflorescence. Roots 1 mm in diameter, fleshy. *Stems* erect to arched, laterally compressed, born from an internode above the base of previous stem, covered by a papyraceous bract. *Leaves* up to 2–3, distributed only on the apex of the stem; leaf sheath 1–2 cm long, flattened, carinate; blade 4.5–7.0 × 1.7–2.0 cm, coriaceous, elliptic, unequally bilobed. *Inflorescence* up to 15 cm long, elongate, slightly sinuous, apical on mature stem, rachis flexuous, ancipitose. *Floral bracts* 1.0–1.5 cm long, ancipitose, carinate, shortly apiculate. *Flowers* up to 10, opening in succession, greenish-

yellow throughout. *Ovary* 15–17 mm long, cylindrical, inflated towards the apex. *Sepals* free, spreading, recurved; dorsal sepal 13 × 5 mm, narrowly ovate-triangular, obtuse; lateral sepals 17.8–18.2 × 7.0–7.5 mm deflexed, narrowly ovate-triangular, falcate, acute. *Petals* 13.0–13.3 × 4.0 mm, free, spreading, recurved, lanceolate, acute. *Lip* 18 × 9 mm, fused to the column only at the very base, entire, concave, trapezoid-elliptic, obtuse, unornamented. *Column* 13 mm long, broad laterally, ventrally narrowed, straight, apically rounded. *Anther* obovoid, 4-celled. *Pollinia* 4, obovoid, laterally compressed, caudicles hard. *Capsule* not seen. *Description based only on *Karremans* 7575.

Etymology: From Greek *kymbes*, boat-shaped vessel, and *glossa*, tongue, in reference to the concave, boat-shaped lip of this species.

Habitat and distribution: Only known from ca. 2100 m on the Pacific watershed of the southern Talamanca mountain range in Costa Rica and neighboring western Panama (Fig. 1).

Phenology: Collected in bloom in January and April.

Additional specimens examined: COSTA RICA. Puntarenas: Buenos Aires, Buenos Aires, camino a Cerros Utyum, 9°18'04.93"N, 83°12'51.59"W, 2157 m, bosque pluvial montano bajo, epífitas en bosque secundario,



FIGURE 1. View of the Talamanca mountain range in southern Costa Rica and western Panama, as seen from a collection site of *E. cymbiglossum* Hágsater, on the route to Cerros Utyum. By A.P. Karremans.

16 January 2017, A.P. Karremans, D. Bogarín, M. Cedeño, I. Chinchilla, M. Díaz, E. Kaes, P. Lehmann and O. Zúñiga 7575 (JBL-J0652; Fig. 2). Buenos Aires, Buenos Aires, cerca de la división continental, cerro arbolado, entre cerro Durika y cerro Utyum, 9°19'15"N, 83°14'49"W, 2070 m, epífitas en bosque secundario. Transtalamanca, ruta de los conquistadores día 1, 24 April 2017, A.P. Karremans, M. Cedeño, I. Chinchilla, E. Kaes, G.A. Rojas-Alvarado, O. Zúñiga 7726 (JBL-E1288).

Epidendrum cymbiglossum is closely related to the common *E. anoglossum* Schltr. but easily distinguished by the compact plants, with few apical leaves, a successive inflorescence bearing much larger flowers and a broad, elliptic-trapezoid lip. Previously known only from the type collected in Chiriquí, it is here recorded from Costa Rica based on material from high elevations on the Pacific watershed of the southern Talamanca mountain range.

Epidendrum wercklei Schltr., Repert. Spec. Nov. Regni Veg. Beih. 3: 48. 1906.

TYPE: COSTA RICA. [San José:] Bei [Alto de] La Palma, ca. 1500 m, October 1902, C. Wercklé 16419 [Holotype, B, destroyed; drawings, based on Schlechter's analysis of type, published by Mansfeld (1931: pl. 59, fig. 234)]. Neotype, selected by Pupulin (2010), Costa Rica. [San José]: San Isidro de Coronado, 'Las Nubes', 10 November 1932, A.M. Brenes s.n. [153 Serie de varios colectores] (CR).

Epiphytic, scandent herb, up to 1 m tall. Roots 1 mm in diameter, originating from the basal internodes of each stem, scarce, thin. Stems simple, produced from the lower internodes of the previous stems, cane-like, terete towards the base, laterally compressed above, thin, erect, straight, covered by rugose sheaths. Leaves up to 7, distributed on the apical half of the stem, the lower ones deciduous; leaf sheath up to 5 cm long, tubular, laterally compressed, ancipitose, minutely striated, transitioning from green to papery to brown with age; blades 6.5–7.8 × 1.3–1.6 cm, elliptic-lanceolate, acute, minutely apiculate. Inflorescence up to 20 cm long, apical, suberect to pendent, paniculate, many-flowered, flowering only once; peduncle laterally compressed, ancipitose, straight; rachis fractiflex, ancipitose. Floral bracts 2 mm long, notoriously shorter than the ovary. Flowers +65, opening almost simultaneously, creamish-white with dark-purple stripes and spots on the lip and occasionally on the sepals and petals, lip calli and column apex with bright yellow markings. Ovary 6.5–7.0 mm long, terete, thin. Sepals free, spreading widely, thick, obovate, obtuse, with a minute apiculum, margins microscopically glandular-irregular; dorsal sepal 3.9 × 2.2 mm; lateral sepals 4.5–4.7 × 2.5 mm. Petals 3.9–4.0 × 2.1–2.2 mm, free, partly spreading, somewhat concave above the middle, spatulate, broadly rounded, with a very small apiculate, apical margins minutely irregular. Lip 5.0 × 4.5 mm, fused to the column, free blade 3 mm long, conspicuously fringed-flabellate, fleshy, somewhat concave, the blade in shape broadly ovate to triangular, obtuse, ecallose, with 3 fleshy, thin keels, the lateral keels running from the blade base to the base of the midlobe, the central one longer, provided with 4–5 digitiform lobes on each side of the lanceolate midlobe. Column 3 mm,

short, terete, straight with respect to the ovary, with a dentate clinandrium hood, and forming a narrow, conical, glandular, basal cuniculus with the lip. Anther sub-spherical, 2-celled, with a pair of long tails. Pollinia 2, obovoid, laterally compressed, caudicles laminar, notoriously larger than the pollen masses. Fragrance an intense sweet, coconut smell. *Description based only on *Karremans 8860*.

Etymology: The name honors Karl (Carlos) Wercklé (18 July 1860–24 November 1924), who extensively botanized in central Costa Rica from 1897 onwards.

Habitat and distribution: This species is a relatively common epiphyte at high elevations between 1500–1800 m north-east of San José in the Central Valley. Most specimens have been collected in the same general area around Zurquí and La Palma in the Braulio Carrillo National Park.

Phenology: It was recorded blooming between August and November.

Additional specimens examined: COSTA RICA. San José: Moravia, San Jerónimo, antes de llegar a túnel del Zurquí, sobre la Carretera que atraviesa el Parque Nacional Braulio Carrillo, 10°3'3"N, 84°0'20"W, 1610 m, 29 June 2021, prepared 21 October 2021, A.P. Karremans and I. Chinchilla 8860 (JBL-spirit, Fig. 3). Moravia, San Jerónimo, 4–6 km norte del pueblo sobre camino conocido como "calle la torre," área de potreros para ganadería, árboles remanentes y pequeños fragmentos de bosque riparios, 10°17.9"N, 83°58'45.2"W, 1539 m, 4 November 2008, A. Cascaete and E. Volio 2040 (CR-257611). Vásquez de Coronado: Braulio Carrillo National Park, Zurquí Station, around Alto La Palma, 10°3'00"N, 83°59'20"W, 1600 m, S. Ingram and K. Ferrell 542 (CR; GH). La Palma de San José, 26 August 1940, J. León 56 (CR-26639). Zurquí, September 1935, J. Valerio 1183 (CR-25343). Zurquí, 1800 m, 28 October 1969, L.D. Gómez 2422 (CR-57674). Cordillera Central en ciénega asbesta en medio de selva de neblina entre La Palma y Cascajal, ca. 1500–1550 m, 7 October 1982, E. Hågsater 6927 (CR; AMO; pl. 1000 in Hågsater and Sánchez-Saldaña 2007).

Epidendrum bicentarium Karremans & Gil-Amaya, *sp. nov.*

TYPE: COSTA RICA. Heredia: Heredia, Vara Blanca, Calle la Legua, epífitas en bosque a orilla del camino, bosque pluvial montano bajo, 10°11'37.00"N, 84°7'41.12"W, 1745 m, 13 October 2021, G. Rojas-Alvarado, I. Chinchilla and A.P. Karremans 577 (Holotype, JBL-spirit; Fig. 4).

Similar to *E. wercklei* but distinguished by the much larger flowers (more than double in area), the sepals 6.5–7.0 × 3.6–3.9 mm (vs. 3.9–4.7 × 2.2–2.5 mm), the petals 6.5–6.6 × 3.6–3.7 mm (vs. 3.9–4.0 × 2.1–2.2 mm) and lip 7.5–7.7 × 6.2–6.3 mm (vs. 5.0 × 4.5 mm), the greenish-white petals and sepals with dark-purple spots (vs. whitish-cream, sometimes with few purple spots), the lip with 7–8 digitiform lobes on each side of the midlobe (vs. 4–5 digitiform lobes on each side of the midlobe), the clinandrium erose and erect (vs. dentate and descending), the pollinarium with caudicles sub-equal to the pollinia (vs. caudicles notoriously larger) and the subtle disagreeable fragrance (vs. sweet, intense, coconut smell).

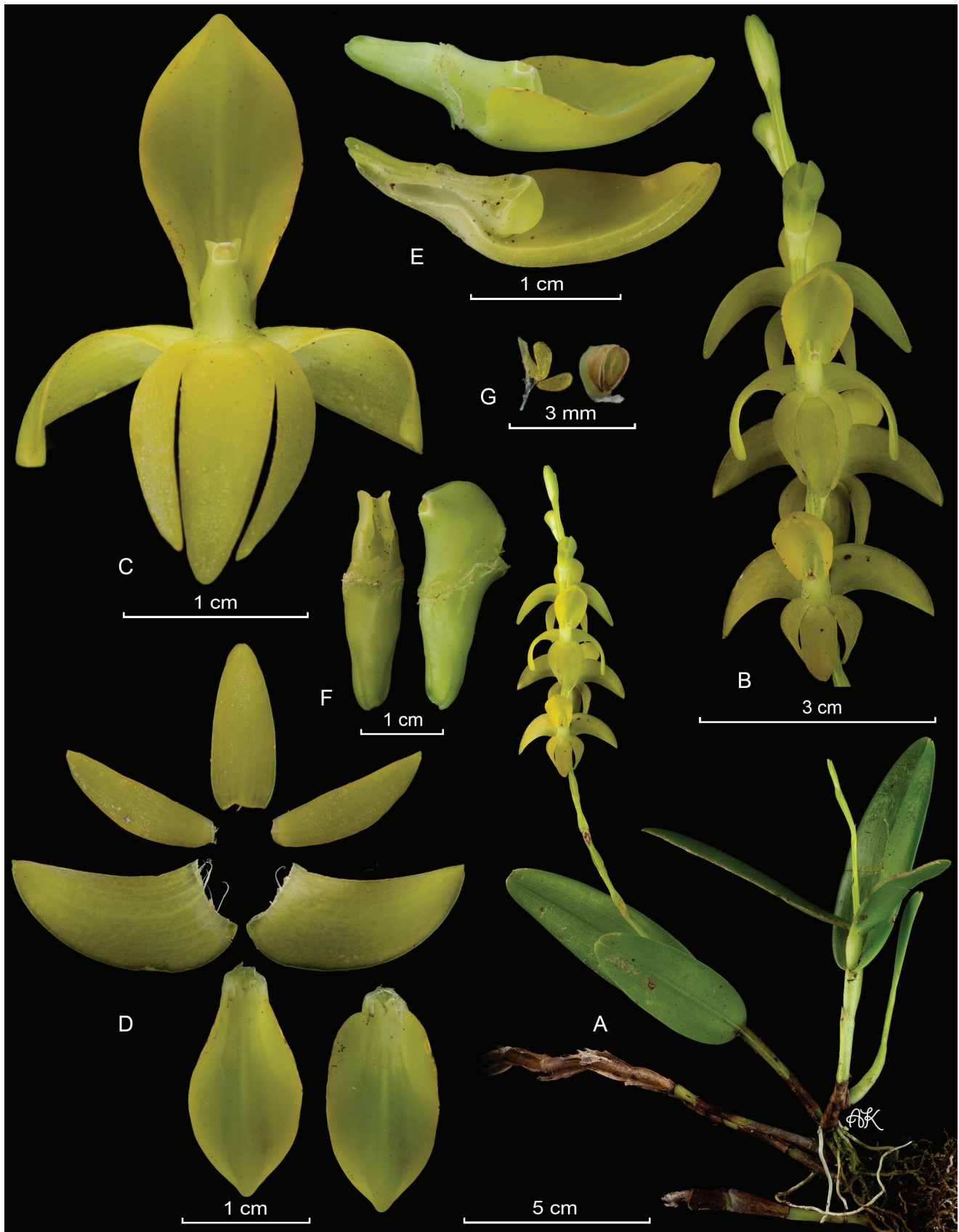


FIGURE 2. LDCP of *Epidendrum cymbiglossum* Hágsater. **A**, Habit; **B**, Inflorescence; **C**, Flower; **D**, Dissected perianth; **E**, Lip and column lateral view, and transversal section; **F**, Column, ventral and lateral views; **G**, Anther cap and pollinarium. By APK based on *Karremans 7575* (JBL-spirit).

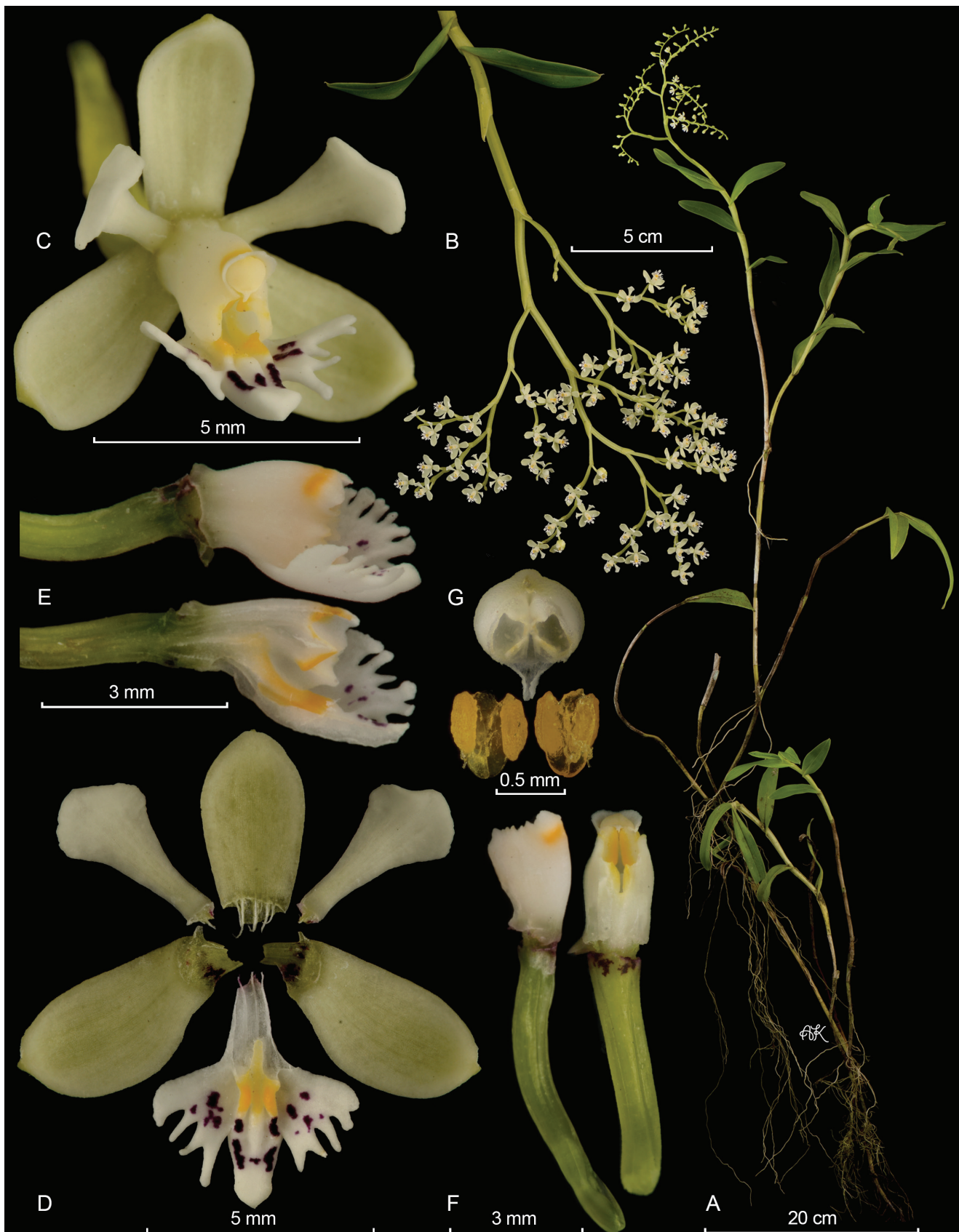


FIGURE 3. LDCP of *Epidendrum wercklei* Schltr. A, Habit; B, Inflorescence; C, Flower; D, Dissected perianth; E, Lip and column lateral view and transversal section; F, Column, ventral and lateral views; G, Anther cap and pollinarium. By APK and K. Gil Amaya based on Karremans 8860 (JBL-spirit).

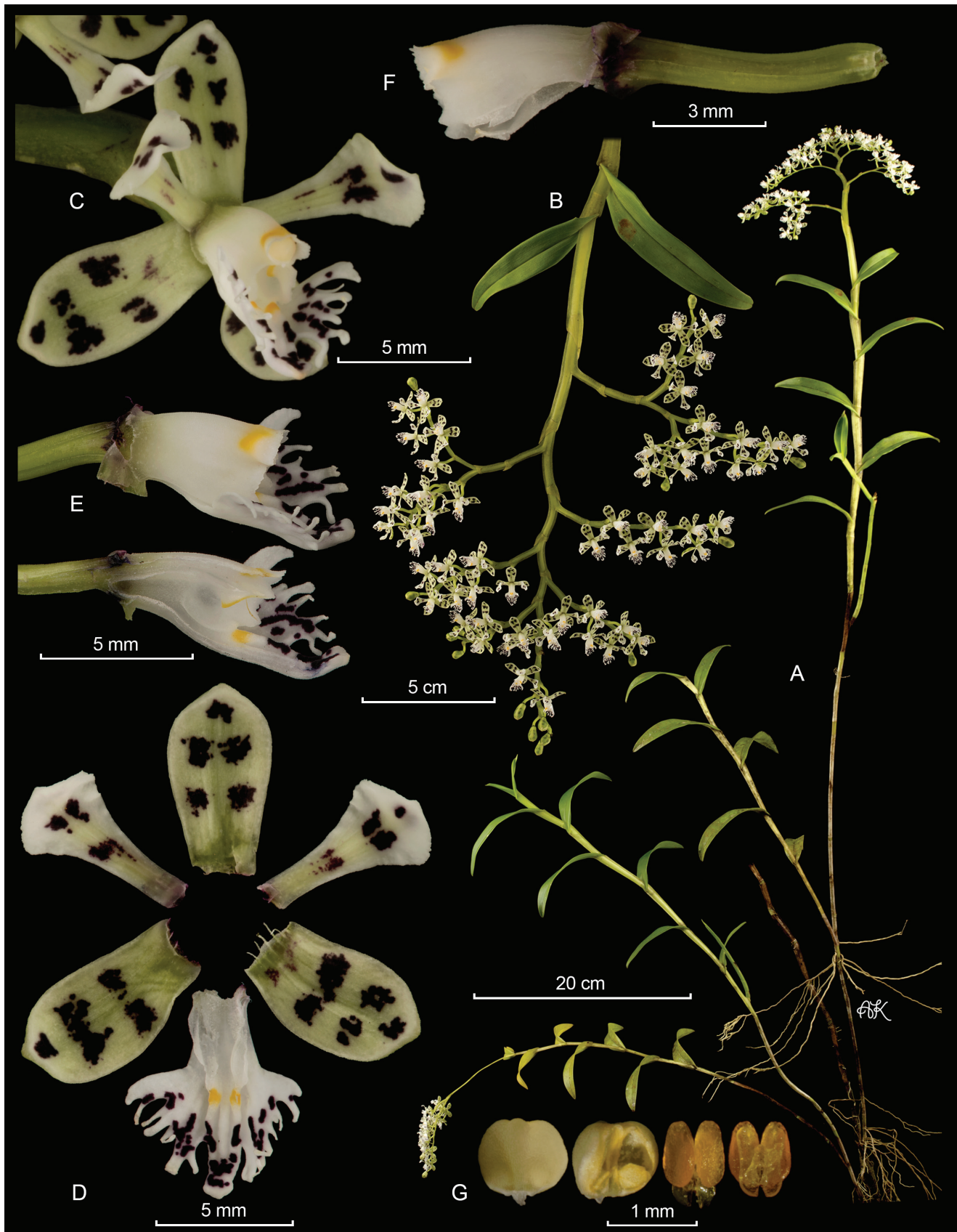


FIGURE 4. LDCP of *Epidendrum bicentenarium* Karremans & Gil-Amaya. A, Habit; B, Inflorescence; C, Flower; D, Dissected perianth; E, Lip and column lateral view and transversal section; F, Column lateral views; G, Anther cap and pollinarium views. By APK and K. Gil Amaya based on *Rojas-Alvarado 577* (JBL-spirit).

Epiphytic, scandent *herb*, up to 1 m tall. Roots 1 mm in diameter, originating from the basal internodes of each stem, scarce, thin. *Stems* simple, produced from the lower internodes of the previous stems, cane-like, terete towards the base, laterally compressed above, thin, erect, straight, covered by rugose sheaths. *Leaves* up to 9, distributed on the apical half of the stem, the lower ones deciduous; leaf sheath up to 6.5 cm long, tubular, laterally compressed, ancipitose, minutely striated, transitioning from green to papery to brown with age; blades 4.5–8.2 × 1.2–1.6 cm, elliptic-lanceolate, acute, minutely apiculate. *Inflorescence* up to 20 cm long, apical, suberect to pendent, paniculate, many-flowered, flowering only once; peduncle laterally compressed, ancipitose, straight; rachis fractiflex, ancipitose. *Floral bracts* 1.9–2.2 mm long, notoriously shorter than the ovary. *Flowers* +70, opening almost simultaneously, greenish-white with large, dark-purple spots on the sepals, petals, lip calli and column apex with bright yellow markings. *Ovary* 7.2 mm long, terete, thin. *Sepals* free, spreading widely, thick, obovate, obtuse, with a minute apiculum, margins microscopically glandular-irregular; dorsal sepal 6.8–7.0 × 3.6–3.8 mm; lateral sepals 6.5–6.7 × 3.8–3.9 mm. *Petals* 6.5–6.6 × 3.6–3.7 mm, free, partly spreading, somewhat concave above the middle, spatulate, broadly rounded, with a very small apiculate, apical margins minutely erose. *Lip* 7.5–7.7 × 6.2–6.3 mm, fused to the column, free blade 4.8 mm long, conspicuously fringed-flabellate, fleshy, somewhat concave, the blade in shape broadly ovate to triangular, obtuse, ecallose, with 3 fleshy, thin keels, the lateral keels running from the blade base to the base of the midlobe, the central one shorter, provided with 7–8 digitiform lobes on each side of the ligulate midlobe. *Column* 5.0–5.2 mm, short, terete, straight with respect to the ovary, with an erose clinandrium hood, and forming a conical, notoriously glandular, basal cuniculus with the lip. *Anther* sub-spherical, 2-celled. *Pollinia* 2, obovoid, laterally compressed, caudicles laminar. Fragrance a subtle disagreeable odor during the day.

Etymology: This striking new species honors the 200 anniversary of Costa Rican independence, officially celebrated on the 15th of September 2021.

Habitat and distribution: Currently known only from the Caribbean watershed of the Central and Tilarán mountain ranges in Costa Rica, where it grows as an epiphyte at high elevations between 1550 and 1745 m in elevation.

Phenology: It was recorded blooming from October to January.

Additional specimens examined: COSTA RICA. Puntarenas: Reserva Biológica Monteverde Road to divide, disturbed weedy forest edge and second growth, roadside, 10°18'N, 84°47'W, 1550 m, 5 January 1990, *W. Haber and W. Zuchowski* 9738 (CR-164552).

Epidendrum bicentenarium is a large and attractive species closely related to and previously confused with *E. wercklei*, which is common in the Central Valley north-east of San José. However, the flowers of the new species are more than double in size, heavily spotted with purple, have a more prominent, erose and erect clinandrium, a larger cuniculus, the lip being more prominently fringed-flabellate, the caudicles sub-equal to the pollinia, and lack the characteristic coconut smell.

OERSTEDDELLA GROUP-*ABERRANS* SUBGROUP.

The “Oerstedella Group” incorporates the members of the former genus *Oerstedella*, which can be recognized by the sympodial habit, verrucose stems, and the rostellum that is transverse to the column instead of parallel. Species informally placed in the “Aberrans subgroup” are recognized by the small, membranaceous flowers, with a prominent clinandrium-hood, and translucent, flattened, unequal pollinia, with the inner pair much smaller than the outer pair (Hágsater and Sánchez-Saldaña, 2006). To those features I would add that the inflorescence is typically sub-second, the ovary crested-alate, the sepals thickened, with a prominent external elevated crest especially near the apex, and the anther is sub-rectangular and papery thin.

Epidendrum iricolor Karremans, *sp. nov.*

TYPE: COSTA RICA. Limón: Talamanca, Bratsi, Parque Internacional La Amistad, Valle del Silencio, alrededores de refugio, bosque pluvial montano, 2,462 m, 9°06'41.81"N, 82°57'42.44"W, 18 September 2014, *A.P. Karremans, M. Díaz, M. Fernández, C. Godínez, J. Godínez, L. Oses, J. Ramírez and D. Villalobos* 6335 (Holotype, JBL [E1119]; Isotype, JBL [D6453]; Fig. 5).

Similar to *Epidendrum unicallosum* Hágsater & E.Santiago, but distinguished by the plants with shorter stems (10.3–11.7 vs. 22–42 cm tall), with fewer leaves (3–4 vs. +12), concentrated on the apical third of the stem (distributed along at least half of the stem), the sepals broader (3.5 mm vs. 2.8 mm), the shorter and broader (8.2 × 2.3 mm vs. 8.7 × 1.9 mm), obtuse (vs. acute) petals, and the significantly narrower lip (4.0–4.5 mm vs. 7.1 mm), that is almost completely covered by the clinandrium, the triangular (vs. elliptic) lateral lobes, and a sinuous column (vs. straight).

Epiphytic, sympodial, climbing *herb*, up to 20 cm tall including the inflorescence. *Roots* 2–3 mm in diameter, thin, fleshy. *Stems* 10.3–11.7 × 0.3–0.4 cm, erect, cane-like, terete, one or more produced from a middle internode of the previous stem, forming chains of multiple growths. *Leaves* 3–4, restricted to apical half of stem; leaf sheath 0.9–2.1 cm long, tubular, verrucose; blade 1.7–2.5 × 0.6–0.9 cm, articulate, lanceolate, acute, with margins entire. *Inflorescence* 2.0–2.5 cm long, apical, from mature growth, racemose, erect, lax. *Floral bracts* 2.0–2.5 mm long, up to 7 times shorter than the ovary, acute, incurved, green. *Flowers* 5–9, successive, 4–5 open at once, resupinate, sepals and petals whitish-pink to greenish-salmon, column pink, with a white apex. *Ovary* 1.5–1.7 cm long, cylindrical, thin, elongate, inflated ventrally behind the perianth, crested. *Sepals* free, spreading, 5-veined, apically thickened into a dorsal crest; dorsal sepal 8.1 × 3.5 mm, elliptic to narrowly oblanceolate, obtuse; lateral sepals 10.2 × 3.5 mm, elliptic, acute. *Petals* 8.2 × 2.3 mm, free, spreading, 3-veined, glabrous, margin entire, oblanceolate, obtuse. *Lip* 6.0–6.5 × 4.0–4.5 mm, fused to the column, trilobed, margin entire, white, callus single; lateral lobes triangular-narrowly ovate, acute, oblique, divaricate; midlobe ligulate, acute, with a pair of incipient apical triangular lobes. *Column* 6.5–7.0 mm long including the clinandrium-hood, straight, white to purple on the base; clinandrium-hood almost half the length of the column, margin crenate, white with purple

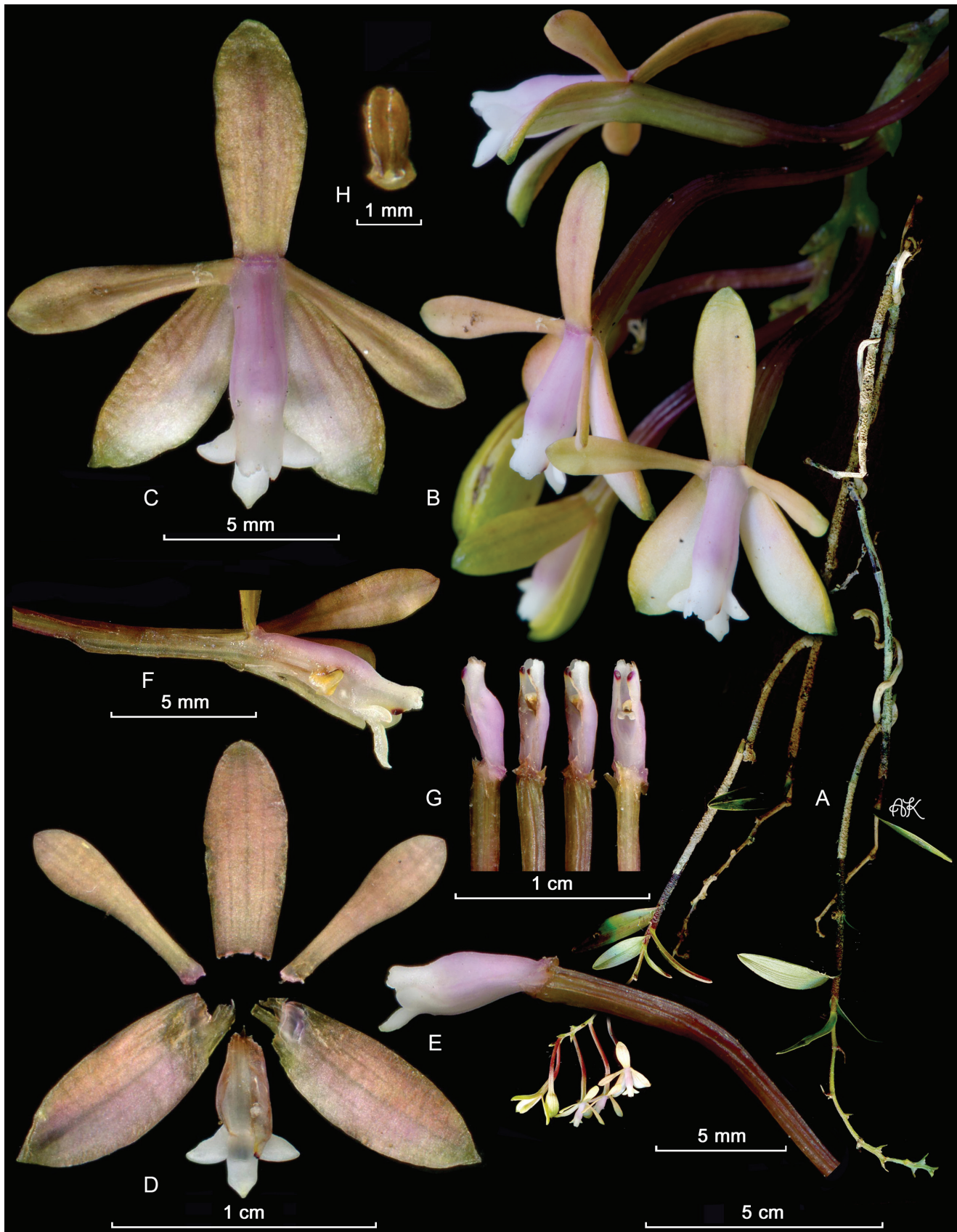


FIGURE 5. LDCP of *Epidendrum iricolor* Karremans. A, Habit; B, Inflorescence; C, Flower; D, Dissected perianth; E, Lip and column lateral view; F, Lip and column in transversal section; G, Column, ventral and lateral views. H, Pollinarium. By M. Díaz-Morales and APK based on *Karremans 6335* (JBL-spirit).

to red dots on outer crenations; rostellum perpendicular to the axis of the column. *Anther* ovoid, 4-celled. *Pollinia* 4, ovoid, laterally compressed, inner pair half the size of the outer pair. *Capsule* not seen.

Etymology: From the Latin *iris*, rainbow, in reference to the many colors of the flowers of this species which includes white, green, salmon, and pink, and changes notoriously with the age.

Habitat and distribution: Known from Valle del Silencio protected area in La Amistad National Park. It grows as an epiphyte in montane rainforest at above 2400 m elevation.

Phenology: Collected in bloom in September and November.

Additional specimens examined: COSTARICA. Limón: Talamanca, Parque Internacional La Amistad (PILA), sector Altamira, Valle del Silencio, sendero a El Jardín, epífitas en bosque primario, bosque pluvial montano, 2550 m, 18 September 2014, *Fernández et al.* 925 (JBL-spirit). Limón: Talamanca, Bratsi, Parque Internacional La Amistad, Valle del Silencio, orillas del Río Terbi cerca del andarivel, bosque pluvial montano, recolectada por D. Jiménez, 2462 m, 9°06'41.81"N, 82°57'42.44"W, 6 May 2013, *Bogarín 10133* (JBL-spirit). Limón: Talamanca, Parque Nacional La Amistad, Tararia, Valle del Silencio, 2 km antes del albergue, 2400–2500 m, 9°06'10"N, 82°58'25"W, 18 November 2004, *Soto and González 291* (CR-INB).

Díaz-Morales and Karremans (2016) mistakenly placed the specimens of *Epidendrum iricolor* under the name *E. unicallosum*, a species originally described from Panama. At the time the authors believed there was a single species with a three-lobed lip with a prominent clinandrium-hood that is longer than the body of the column and a thickened midlobe of the lip bearing triangular appendages near the apex, but in fact there are a few different species with these features. Two of them are described here on the basis of Costa Rican material, returning *E. unicallosum* to its status as a Panamanian endemic for now.

Epidendrum miriamae Karremans, *sp. nov.*

TYPE: COSTA RICA. Cartago: El Guarco, San Isidro, Madreselva, Tres de Junio, Carretera Interamericana Sur, 9°40'31"N, 83°53'33"W, 2530 m, bosque pluvial montano, en bosque secundario de Robles a orillas de la carretera, 19 June 2021, *A.P. Karremans and M. Contreras Fernández 8770* (Holotype: JBL-spirit; Fig. 6).

Similar to *Epidendrum unicallosum* Hágsater & E.Santiago, but distinguished by the longer plants with shorter stems (16–22 vs. 22–42 cm tall), with fewer leaves (3–7 vs. +12), the inflorescence with more flowers (up to 18 vs. 6), white with a basal orange blotch (vs. pink), the shorter petals (7.1–7.2 vs. 8.7 mm), the longer and narrower lip (6.3–6.4 × 5.3 mm vs. 5.1 × 7.1 mm), the bilobed callus (vs. unlobed), the lateral lobes oblanceolate and truncate (vs. elliptic and subacute), and a column bent (vs. straight).

Epiphytic, sympodial, pendent *herb*, up to 1 m long. Roots 2 mm in diameter, fleshy. *Stems* 16–22 × 0.2–0.3 cm, more or less horizontal, becoming pendent, cane-like, terete, one or more produced from a subapical internode of the previous stem, forming elongate chains of multiple

growths. *Leaves* 3–7, restricted to the apical half of the stem or new stems; leaf sheath 0.9–2.1 cm long, tubular, verrucose, reddish when young, becoming papery with age; blade 1.3–3.0 × 0.3–0.6 cm, articulate, elliptic, acute. *Inflorescence* 5.5–6.0 cm long, apical, from mature new growths, racemose, arching, congested, sub-secund. *Floral bracts* 2.5–4.0 mm long, many times shorter than the ovary, acute, green marked with purple, dropping downwards from the ovary. *Flowers* up to 18 opening in succession, most eventually open simultaneously, resupinate, white, turning cream with age, bearing an orange blotch at the base of the lip and column sides. *Ovary* 1.8–1.9 cm long, cylindrical, thin, elongate, alate-crested. *Sepals* free, spreading, recurved, 5-veined, very thick, dorsally with elevated veins and a conspicuous green apical crest; dorsal sepal 8.0 × 2.2 mm, elliptic, acute; lateral sepals 8.9–9.1 × 3.0–3.2 mm, elliptic, acute. *Petals* 7.1–7.2 × 2.1–2.2 mm, free, spreading, 3-veined, oblanceolate, obtuse. *Lip* 6.3–6.4 × 5.3 mm, fused to the column, trilobed, white, with an orange blotch at the base, callus single, bilobed; lateral lobes obliquely oblanceolate to oblong, truncate, divaricate, 2.1–2.3 × 1.1–1.3; midlobe thickened, trilobate, with a ligulate base and three more or less triangular, opposing apical lobes. *Column* 5.0–6.0 mm long including the clinandrium-hood, with a 45 degree bend with respect to the ovary, white with an orange blotch near the base of the lip; clinandrium-hood more than half the length of the column, the margin crenate, sigmoid. *Anther* sub-rectangular, very thin, 4-celled, margins irregular. *Pollinia* 4, ovoid, laterally compressed, inner pair significantly smaller than the outer pair, so-called bird-wing type. *Capsule* not seen.

Etymology: The name honors my wife Miriam Contreras Fernández with whom I first found this beautiful white-flowered *Epidendrum*.

Habitat and distribution: Known only from the oak forests around Tres de Junio where it was found growing at 2530 m in elevation.

Phenology: Found blooming in June.

POLYCHLAMYS GROUP-POLYCHLAMYS SUBGROUP.

Hágsater and Sánchez-Saldaña (2006) informally recognize species of the “Polychlamys subgroup” by the successive lateral growths produced from the middle of the previous growth, few leaves aggregate towards the apex of the stems, the distichous, apical inflorescence with prominent, conduplicate, acute, glumaceous floral bracts.

Epidendrum bugabense Hágsater, *Icon. Orchid.* 2: t. 115. 1993. **TYPE:** PANAMA. Chiriquí: Distrito Bugaba, Cerro Punta, 8°52'N, 82°33'W, 2200 m, along ridge watershed to Bocas del Toro, 25 January 1985, *H. van der Werff and J. Herrera 6427* (Holotype, AMO; Isotype, MO [not seen]).

Etymology: The epithet refers to the Bugaba district in Chiriquí, Panama where the type specimen was collected.

Habitat and distribution: Known only from a few collections found between 2200–2560 m in elevation close to the continental divide on the Talamanca mountain range in southern Costa Rica and eastern Panama.

Phenology: Collected in bloom in January and September.

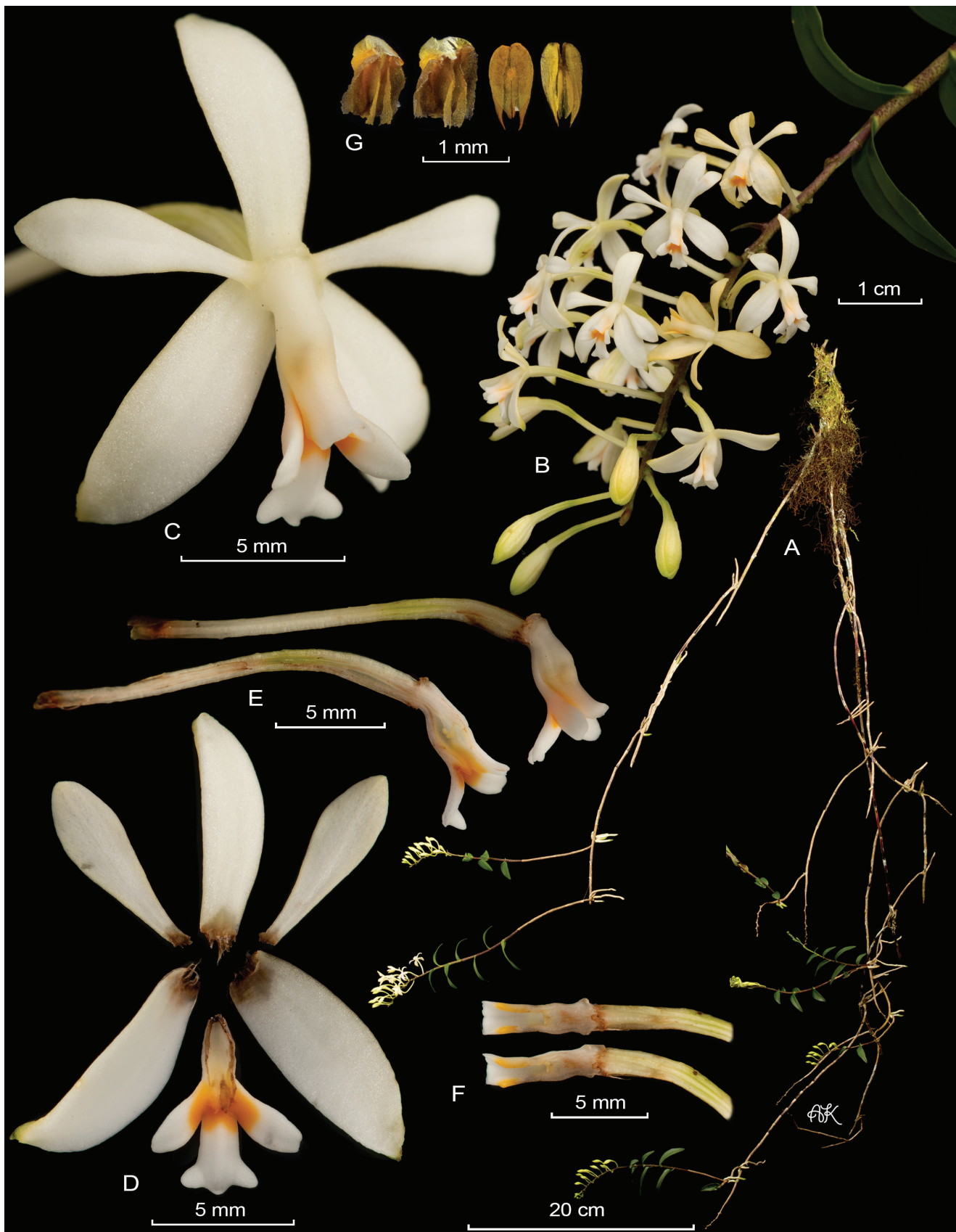


FIGURE 6. LDCP of *Epidendrum miriamae* Karremans. A, Habit; B, Inflorescence; C, Flower; D, Dissected perianth; E, Lip and column lateral view and transversal section; F, Column, ventral and lateral views; G, Anther cap and pollinarium. By APK based on *Karremans 8770* (JBL-spirit).

Additional specimens examined: COSTA RICA. Limón: Talamanca, Bratsi, Parque Internacional La Amistad, Valle del Silencio, sendero desde el Jardín (turbera) hacia los Cerros Tararias, sobre la parte alta del cerro mediano conocido como “Ventanas,” 9°08'53.03"N, 82°57'25.91"W, 2560 m, bosque pluvial montano, 19 September 2014, A.P. Karremans, M. Díaz, M. Fernández, C. Godínez, J. Godínez, L. Oses, J. Ramírez and D. Villalobos 6370 (JBL-6436). PANAMA. Reserva de la Biosfera La Amistad trail from Las Nubes Ranger Station, G. Yong Gee s.n. (AMO-digital voucher; Fig. 7).

This former Panamanian endemic is here recorded for Costa Rica on the basis of a specimen at JBL. Unfortunately, the specimen is in bad shape and there are no photographs of living material available. It is nonetheless the rare *E. bugabense*, for which an illustration and description can be found in Hágsater and Salazar (1993).

Epidendrum gymnochlamys Hágsater & E.Santiago, Icon. Orchid. 8: t. 839. 2006. TYPE: PANAMA. Chiriquí: above Boquete, on trail to Pate Macho on continental divide, 1850–2100 m, 13 March 1988, G. McPherson 12323 (Holotype, MO).

Epiphytic, sympodial, erect herb, with successive lateral growth, where each new stem originates from an intermediate internode of the previous stem. Roots 1.0–1.5 mm thick scarce, distributed along the basal internodes of

the stems, thin white. Stems 6–14 cm tall, simple, cane-like, terete at base, thin, short, erect, base arcuate; basal half covered by tubular sheaths, slightly inflated towards the apex, scarios, ancipitose, fibrous with time. Leaves 4–10, green to dark green, distichous, gladiate, alternate, articulate, basal leaf somewhat smaller; sheaths tubular; blade 12–40 × 3–14 mm, narrowly elliptic, acute, coriaceous, margin entire. Inflorescence 30 × 1 mm, apical, arching, flowering only once, distichous, lax-flowered; peduncle 20 × 3 mm, slightly compressed, very short, lacking bracts; rachis straight, hidden by floral bracts. Floral bracts 9.0–16.0 × 2.5 mm, much longer than the ovary covering nearly half the flower, progressively shorter, ovate, acute, conduplicate. Flowers successive, resupinate, pale green. Ovary 3 mm long, short, terete, thin, straight, not inflated, smooth. Sepals 8.0–8.5 × 2.5–2.8 mm, free, partly spreading, glabrous, narrowly triangular, 3-veined. Petals 7.5–8.0 × 2.8 mm, free partly spreading, elliptic, oblique, acute, 1-veined, the vein branching near the middle, margin spreading, entire. Lip 8.0 × 4.5 mm, united to the column, sides involute and embracing the apex of column covering it entirely in natural position, entire, ovate-oblong, base cordate, margin entire; bicallose the calli thin, laminar, low; disc with one smooth, keel that vanishes before the apex of the lip. Column 1.8 mm long, arcuate, short, thick. Clinandrium-hood short, margin entire. Nectary without penetrating the ovary, not inflated, smooth. *Description based only on Karremans 7610.



FIGURE 7. Photograph of *Epidendrum bugabense* Hágsater in situ at the Reserva de la Biosfera in Panama. By Gary Yong.

Etymology: From the Greek *gymnós*, naked, unclad, stripped, and *kládos*, military cloak, mantle, in reference to the lack of bracts on the peduncle of the inflorescence which are generally characteristic of the *Polychlamys* Group of species, and facilitate its recognition.

Habitat and distribution: Known only from a few collections made close to the continental divide at elevations between 1850–2748 m on the Talamanca mountain range in southern Costa Rica and eastern Panama (Fig. 8).

Phenology: Collected in bloom in January and March.

Additional specimens examined: COSTA RICA. Puntarenas: Buenos Aires, Buenos Aires, camino a Cerros Utyum, 9°19'22.54"N, 83°11'30.71"W, 2748 m, bosque pluvial montano, epífita en bosque secundario, 19 January 2017, A.P. Karremans, D. Bogarín, M. Cedeño, I. Chinchilla, M. Díaz, E. Kaes, P. Lehmann and O. Zúñiga 7610 (JBL-J0323; JBL-A0035; Fig. 9).

PSEUDEPIDENDRUM GROUP-PANICULATUM SUBGROUP.

The “Pseudepidendrum group” features species with caespitose plants, cane-like stems, acute to acuminate leaves, the inflorescence is usually apical, the petals filiform and the lip usually 3-lobed, bearing 3 parallel fleshy keels, the apical

lobe often bifurcate, and the pollinarium is of the “bird-wing” type. Those belonging to the “Paniculatum subgroup” have green flowers, the lip white, the disc sometimes marked with purple (Hágsater and Sánchez-Saldaña, 2008). I would add that many species have minutely verrucose inflorescences and sepal exteriors, and the bracts of the inflorescence are notoriously variable in length. Interestingly, the so-called bird-wing type pollinaria are similar to those of the unrelated “Aberrans subgroup.” However, they differ in that the pollinia are apically rounded in the “Paniculatum subgroup” rather than apically acuminate.

Epidendrum longibracteatum Hágsater, Icon. Orchid. 3: t. 347. 1999. TYPE: PANAMA: Chiriquí: Cerro Horqueta, detrás de Boquete, al Edel Volcán Barú, ca. 2000 m, col. 15 March 1981, pressed 7 June 1981, Hágsater et al. 6526 (Holotype, AMO [not seen]; Isotypes, PMA [not seen], SEL [not seen]; Clonotypes: 22 February 1983 F [not seen], QCNE [not seen], S, WIS [not seen], 11 April 1989 AMES, COL [not seen], CR [not seen], ENCB [not seen], G [not seen], INB [not seen], K, MEXU [not seen], MO [not seen], NY [not seen], P, SCZ [not seen], US [not seen], USM [not seen]).



FIGURE 8. The continental divide, where *E. gymnochlamys* Hágsater & E.Santiago was found growing, separates the Caribbean and Pacific watersheds of the Talamanca mountain range. By APK.

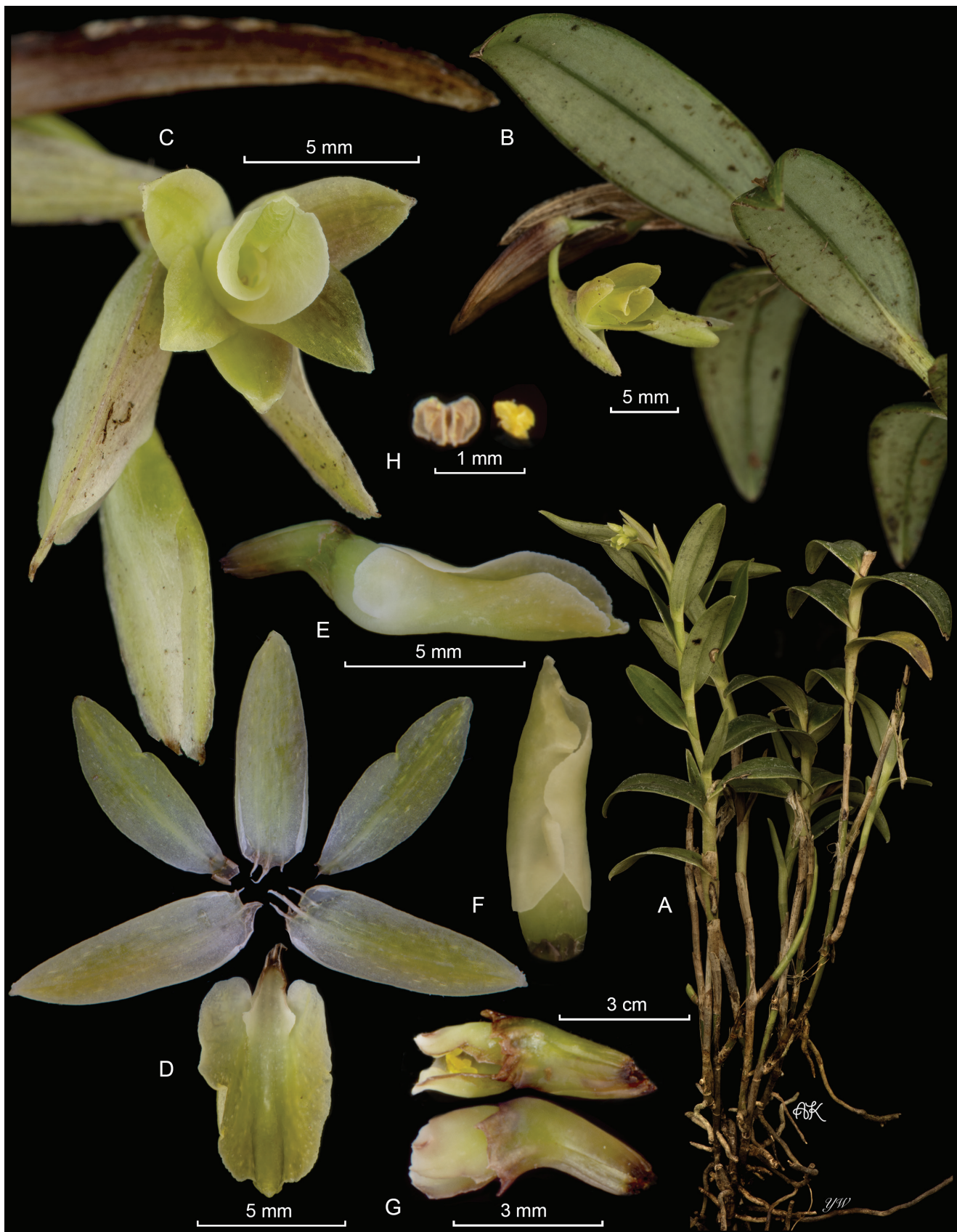


FIGURE 9. LDCP of *Epidendrum gymnochlamys* Hágsater & E.Santiago. **A**, Habit; **B**, Detail of the stem and inflorescence; **C**, Flower; **D**, Dissected perianth; **E**, Lip and column lateral view; **F**, Lip and column seen from above; **G**, Column, ventral and lateral views; **H**, Anther cap and pollinarium. By Youri Witmer and APK based on *Karremans 7610* (JBL-spirit).

Epiphytic, caespitose *herb*, up to 50 cm tall. *Roots* basal, fleshy. *Stems* simple, cane-like, terete, straight. Leaves 8–18 × 1.5–3.5 cm, distributed on the apical half of the plant; sheath tubular, 2–4 cm long; blade lanceolate, acuminate, main nerves clearly visible. *Inflorescence* 20 cm long, apical, paniculate, arched, from the mature stem, flowering once. Floral bracts 1–10 mm long, variable, long at the base of the inflorescence and progressively becoming shorter towards the apex. *Flowers* +100, opening in succession, many open at the same time, resupinate, sepals and petals green, lip immaculate white, column apical half white, basal half green. *Ovary* 1 cm long, not inflated, cylindrical, tomentose, bent. *Sepals* 7.2–7.9 × 2.0–2.5 mm, free, spreading, reflexed, oblanceolate, acute, thick, papillose-tomentose abaxially, lateral sepals oblique. *Petals* 6.1–6.3 × 0.4 mm, spreading, reflexed, filiform, apically broadening, rounded, membranaceous. *Lip* three lobed, 8.6 × 7.8 mm; unicallose, disc with three central carinae; lateral lobes 2.5–2.8 × 2.5–2.8 mm, subquadrate, oblique; midlobe 3.8 × 0.9 mm, bilobed, divaricate, lobes linear-ligulate, rounded. *Column* 5.7–5.8 mm long, straight, thin, broadening apically. *Anther* ovoid, 4-celled. *Pollinia* 4, “bird-wing” type, laterally compressed. *Capsule* not seen. *Description based only on *Pupulin* 5844.

Etymology: In reference to the very long floral bracts sometimes observed in this species.

Habitat and distribution: *Epidendrum longibracteatum* seems to be endemic to the mountains between Coto Brus in southern-eastern Costa Rica and Chiriquí in western Panama, where it grows at elevations between 1500 and 2000 m.

Phenology: Flowering from May to August.

Additional specimens examined: COSTA RICA. Puntarenas: Coto Brus, Las Alturas de Cotón, Zona Protectora Las Tablas, Las Alturas Biological Station, southern slopes of Cerro Chai, 8°56'59"N, 82°50'01"W, 1500 m, lower montane wet forest, primary vegetation, 26 October 2005, prepared May 2008, *Pupulin* 5844, D. Bogarín, R.L. Dressler, R. Gómez, A.P. Karremans, A. Rambelli and S. Rambelli (JBL-D1768, JBL-D6129, Fig. 10). Primary forest above coffee fincas along Río Coto Brus, near Coton, 23 km north of La Unión (on Panama border), 9 August 1974, T.B. Croat 26633 (MO).

Epidendrum longibracteatum was originally described from Cerro Horqueta, east of Volcán Barú in Chiriquí, Panama. The type locality is not far from the border with Costa Rica, and the species has since been collected in the neighboring Coto Brus, Puntarenas.

The species features large plants with prolific inflorescences bearing +100, tiny, immaculate green and white flowers. The Costa Rican plant illustrated and described has relatively short floral bracts and the flowers are larger and somewhat different in shape than those of the type, but at this time I believe they are conspecific. Hágsater et al. (1999) noted the extremely long floral bracts and used them as a diagnostic feature. However, the floral bracts are extremely variable in length in several species belonging to this group, and even within a single specimen they can vary from much shorter to much longer than the ovary (see duplicates of the type).

***Epidendrum rossanae* Karremans, sp. nov.**

TYPE: COSTA RICA. Cartago: Turrialba, Santa Teresita, Guayabo, Monumento Nacional Guayabo, alrededores de los senderos principales, 9°58'23.31"N, 83°41'28.73"W, 1128 m, bosque muy húmedo, epífitas, 20 June 2015, A.P. Karremans, M. Cedeño, I. Chinchilla, M. Díaz, L. Oses, G. Salguero, D. Sánchez y Curso de Orquideología UCR 6662 (Holotype, JBL-spirit [J0158]; Fig. 11).

Similar to *Epidendrum piliferum* Rchb.f. but the plants shorter (up to 90 vs. 200 cm tall), the inflorescence with more, elongated branches (vs. suborbicular), the sepals smaller (8.0–12.5 × 2.0–3.8 vs. 12.5–17.0 × 3.5–5.0 mm), much more conspicuously papillose-tomentose externally, reflexed about 45 degrees (vs. reflexed 90 degrees), the petals shorter (7.0–12.0 vs. 12.5–15.0 mm), the lip narrower (7.0–7.8 vs. 12 mm), with the basal and apical lobes overlapping when extended (vs. apical lobes well separated from basal lobes), and the purple dots on the lip forming three lines (vs. five lines).

Epiphytic, caespitose *herb*, up to 60–90 cm tall. *Roots* basal, fleshy. *Stems* simple, cane-like, terete, straight. Leaves 8.0–13.5 × 2.0–3.5 cm, distributed on the two apical third of the stems; sheath tubular, 2.5–3.5 cm long, when young green, marked with purple and becoming papery white; blade lanceolate, shortly acuminate, main nerves clearly visible. *Inflorescence* up to 30 cm long, apical, paniculate, with up to 8 branches, dense, arched, from the mature stem, flowering once, rachis furfuraceous. *Floral bracts* 3–22 mm, variable, very long at the base of the inflorescence and progressively becoming shorter towards the apex. *Flowers* +200, simultaneous, resupinate, sepals and petals green, lip white with a row of purple spots on each carina of the disc, and with purple spots in a ring around the disc, column apical half white, basal half green. *Ovary* 1.6 cm long, not inflated, cylindrical, tomentose, bent. *Sepals* 8.0–12.5 × 2.0–3.8 mm, free, spreading, reflexed about 45 degrees, oblanceolate, acute, fleshy, apical margins thickened, forming a robust apiculum, papillose-tomentose abaxially. *Petals* 7.0–12.0 × 1.0 mm, spreading, reflexed, typically coiling basally, making a full circle behind the lateral sepals and emerging frontally towards the lip, filiform, apically broadening, rounded, membranaceous. *Lip* 8–10 × 7.0–7.8 mm, three lobed, basal and apical lobes overlapping when extended; unicallose, disc with three central carinae; lateral lobes 2.5–3.0 × 3.0 mm, subquadrate, oblique, margins erose; midlobe bilobed, lobes 4.0 × 1.0 mm, divaricate, linear-ligulate, acute. *Column* 6.5–7.0 mm long, straight, thin, broadening apically. *Anther* white, ovoid, 4-celled. *Pollinia* 4, “bird-wing” type, laterally compressed, inner pair smaller. *Capsule* not seen.

Etymology: The name honors my mother Rossana Lok, on who's property, on the slopes of the Turrialba volcano (Fig. 12), I first became acquainted with this species.

Habitat and distribution: A common species in the Central Valley of Costa Rica, especially the mountains around Cartago where it grows at elevations between 1100 and 2000 m.

Phenology: Flowering has been registered from February to June.

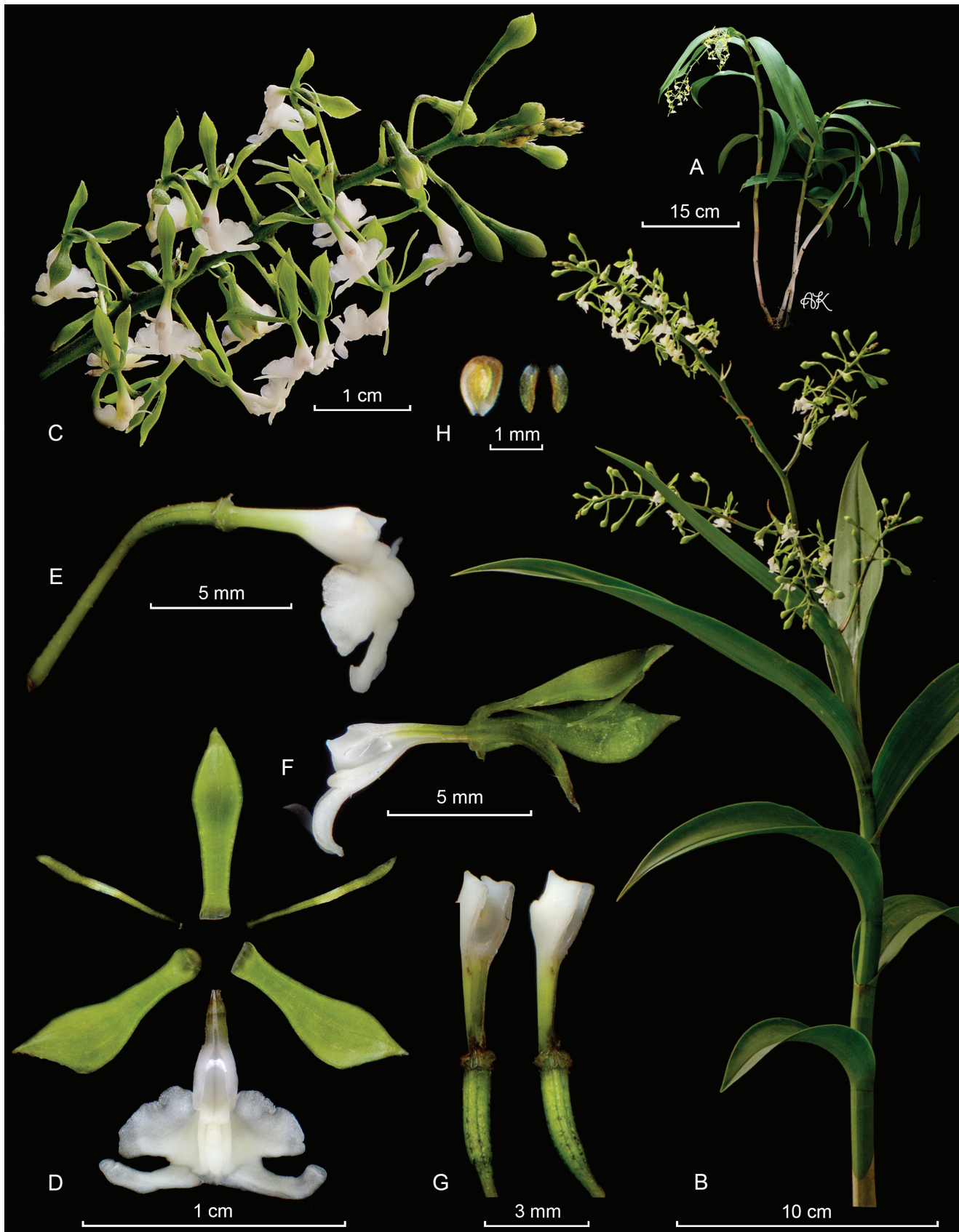


FIGURE 10. LCDP of *Epidendrum longibracteatum* Hágsater. **A**, Habit; **B**, Detail of the stem and inflorescence; **C**, Inflorescence; **D**, Dissected perianth; **E**, Lip and column lateral view; **F**, Lip and column transversal section; **G**, Column, ventral and lateral views; **H**, Anther cap and pollinarium. By APK based on *Pupulin 5844* (JBL-spirit).

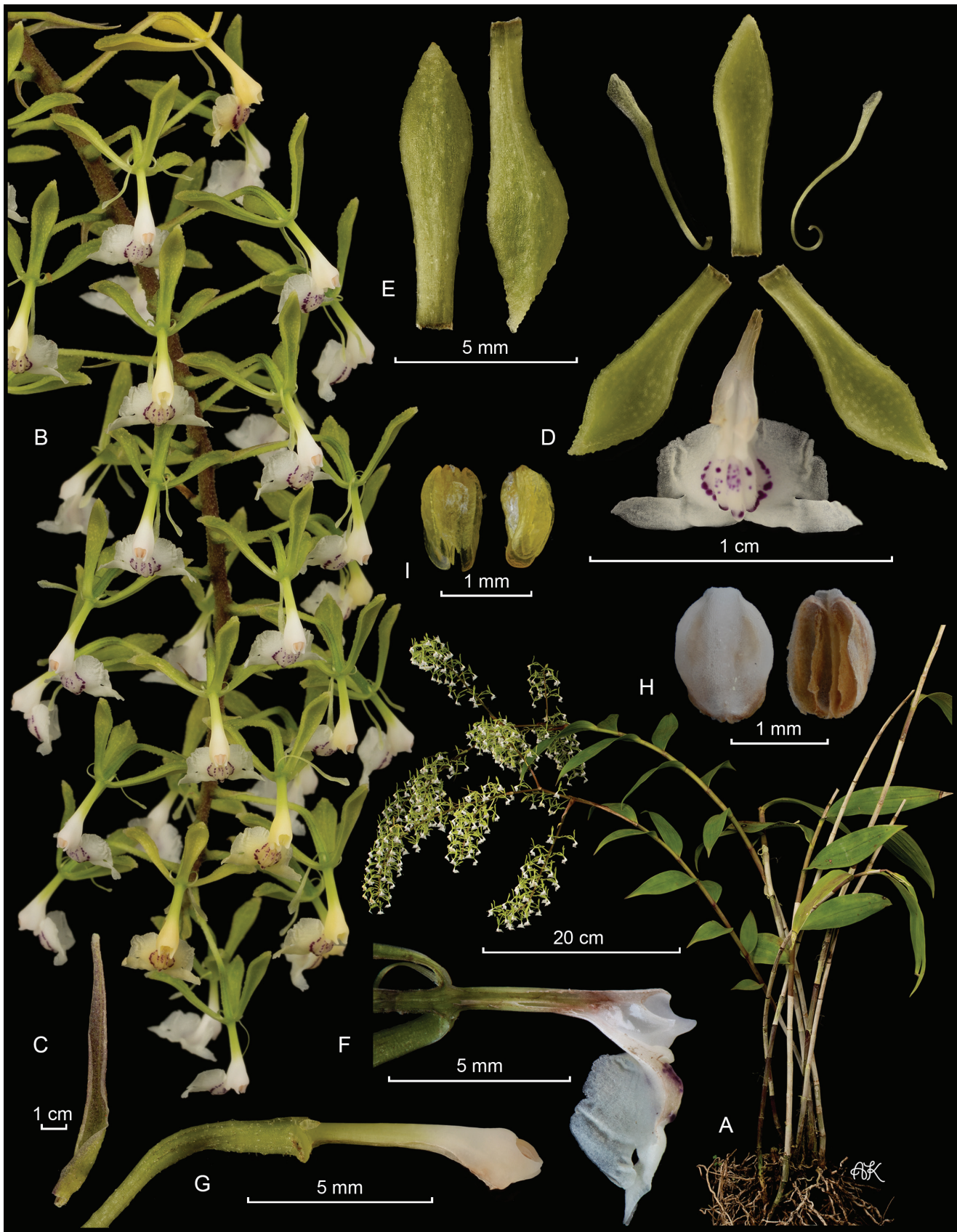


FIGURE 11. LCDP of *Epidendrum rossanae* Karremans. **A**, Habit; **B**, Detail of the inflorescence; **C**, Floral bract; **D**, Dissected perianth, **E**, Dorsal and lateral sepal external view; **F**, Lip and column transversal section; **G**, Column lateral view; **H**, Anther cap views; **I**, Pollinarium views. By APK based on Karremans 6662 (JBL-spirit).



FIGURE 12. Agricultural pastures and remnants of forest property of the Guayabo Lodge along the Aquiares river in Santa Cruz, Turrialba, Costa Rica, where *E. rossanae* Karremans grows. By APK.

Additional specimens examined: COSTA RICA. Cartago: Turrialba, Santa Cruz. En límite con el cantón de Alvarado, sobre la carretera a San José, al lado del río Turrialba, en potreros a orillas del río. 9°57'16"N, 83°46'12"W, 1500–2000 m, 5 August 2006, *A.P. Karremans and D. Karremans 1391* (JBL-D0787). [Cartago] Las Cóncavas, 27 February 1924, *C.H. Lankester 768* (AMES). Dulce Nombre, 27 February 1924, *P.C. Standley 35951* (AMES). Cerro de La Carpintera, February 1924, *P.C. Standley 34281* (AMES).

Epidendrum rossanae has long been confused with *E. piliferum*, which indeed has similar flowers in color and general shape. However, it can be distinguished by the shorter plants, the inflorescence with more and longer branches, the significantly smaller flowers, the sepals much more conspicuously papillose-tomentose externally, reflexed only about 45 degrees, the petals neatly twisting backwards around the lateral sepals before extending forward, the lip with the basal and apical lobes overlapping when extended, and the purple dots on the lip forming three lines. They are also geographically well separated, with *E. rossanae* being found in the Central Valley in Costa Rica and *E. piliferum* growing only on the Pacific slope

of the Talamanca mountain range in southern Costa Rica and neighboring western Panama. The new species is also similar to *E. horichii* Hágsater, but it can be distinguished by the dense inflorescence with up to +200 (vs. inflorescence lax, 20–60 flowers), the lip with many purple spots (vs. a solid pink blotch), the reflexed sepals (vs. non-reflexed), and the narrower petals (1.0 vs. 0.6 mm) and lip (7.0–7.8 vs. 10 mm). *Epidendrum horichii* is typically found on the mountains above Heredia, Costa Rica.

The species belonging to the *Epidendrum piliferum* alliance are notoriously variable in features that are typically more conserved in other *Epidendrum* species. No two lips are the same in shape and size, even within a single individual, and certainly among different individuals. The floral bracts in *E. horichii*, *E. longibracteatum* and *E. rossanae* vary notoriously in length, some individuals bear bracts that well exceed the ovary and can measure up to 2–3 cm at the base of the inflorescence, to bracts that are significantly shorter than the ovary, measuring 1–3 mm at the apex of the inflorescence. Besides the differences is size, other less traditionally used features such as the inflorescence shape, flower density, tepal disposition and coloration patterns may be much more informative to distinguish between species.

RAMOSUM GROUP-PLATYSTIGMA SUBGROUP

The “Platystigma subgroup” features *Vanda*-like plants when young before branching occurs, with strap-like leaves (Hágsater and Sánchez-Saldaña, 2008). Species of this group present a notorious plant habit dimorphism, young plants feature a single long, erect, thick, leafy stem, which with time completely transforms into a Christmas-tree-like habit with many side branches that are very long at the base and become shorter towards the apex. The long leaves of the main stem fall off, while smaller leaves appear as it branches. Other distinctive features include the short inflorescence, the long floral bracts that cover and involve the ovary, the membranaceous perianth which makes the flowers harder to dissect, and the thick, concave lip. The anther cap is very unique, dorsally it forms an elevated disk-like structure with a pair of small flap-like lobes.

Epidendrum nativitas Karremans, *sp. nov.*

TYPE: COSTA RICA. Alajuela: Upala, Bijagua. En la calle nueva desde el Celeste Mountain Lodge al Parque Volcán Tenorio, orillas del bosque y potrero al lado del camino, 10°43'8.46"N, 85°0'2.07"W, 729 m, collected 14 December 2016, prepared 23 December 2020, A.P. Karremans, M. Cedeño, I. Chinchilla, M. Díaz and G. Rojas-Alvarado 7490 (Holotype, JBL-spirit [J1087]; clonotypus 5 February 2019, JBL-spirit [B2016]; Fig. 13, 33a).

Similar to *E. villegastigma* but distinguished by the longer leaves on the main stem (up to 12.5 vs. 6 cm long), the inflorescence bearing 5 flowers (vs. 3), the straight column (vs. slightly arched), the larger (10.0–12.5 × 4.0–4.5 vs. 5.5–7.5 × 2.5–3.5 mm) oblong, acute sepals (vs. elliptic, obtuse), the larger (9.5–10 × 3.0–3.5 mm vs. 5.5–6.5 × 2.0–2.5 mm), sub-quadrate to oblong, acute (vs. elliptic, obtuse) petals, the longer (10 vs. 4–5 mm) lip and the longer column (4.0–4.3 mm vs. 2.5–3.0 mm).

Epiphytic, pseudo-monopodial, branching, erect *herb*, up to 40 cm tall. Roots 1 mm in diameter, fleshy. *Stems* branching, cane-like, terete, covered by rugose sheaths; main stem long, with short to medium branches. *Leaves* many, distributed along the stem, deciduous, concentrating towards the apex of the branches with age; leaf sheath up to 3.3 cm long, tubular, rugose, reddish-brown when young, becoming papery with age; leaf blade up to 12.5 × 1.6 cm on the main stems, typically much smaller on the branches 3.5–6.5 × 0.9–1.6 cm on the branches, narrowly-ovate to oblong, unequally bilobed. *Inflorescence* 2.5 cm long, short, sessile, from the branches, racemose, erect to suberect, flexuous. *Floral bracts* up to 1.8 cm long, longer than the ovary, acute. *Flowers* 5, greenish-bronze tepals and a white lip, with a pinkish haze at the base of the petals and lip, and apex of the sepals, especially abaxially, column white apically, green at the base and pinkish ventrally. *Ovary* 8 mm long, cylindrical, elongate. *Sepals* free, spreading, reflexed, oblong, acute, with a dorsal keel, elevated at the apex to form a short mucro; dorsal sepal 10 × 4 mm, apically reflexed; lateral sepals 11.5–12.5 × 4.2–4.5 mm, apically reflexed, divergent. *Petals* 9.5–10 × 3.0–3.5 mm, free, spreading, reflexed, sub-quadrate to oblong, notoriously oblique, acute. *Lip* 10 × 9 mm, fused to the column, in natural position reflexed, margins recurved, extended blade cordiform to

broadly ovate, obtuse, shortly apiculate, margins sinuous, with a tridentate callus near the base, and a slightly elevated keel in the middle. *Column* 4.0–4.3 mm long, short, stout, terete, straight with respect to ovary. *Anther* white, sub-orbicular externally, cellular-glandular, internally very thin, 4-celled, margins irregular. *Pollinia* 4, obovoid, laterally compressed, caudicles soft and granulose. *Capsule* not seen.

Etymology: From the Latin, *nativitas*, Christmas. The plant flowered on the 23rd of December 2020 and, with my wife’s kind consent, I took a few hours Christmas eve to prepare the complete photographic documentation of this undescribed species.

Habitat and distribution: Known only from the type plant collected in Bijagua, on the road to the Parque Nacional Volcán Tenorio in the Guanacaste Cordillera in northern Costa Rica, growing at an elevation of 729 m.

Phenology: Recorded to bloom from December to February.

RAMOSUM GROUP-RUGOSUM SUBGROUP.

Although not formally circumscribed, Hágsater and collaborators have grouped several closely allied Central American species under the “Rugosum subgroup” on the basis of the branched plant habit, the few-flowered distichous inflorescence from short secondary stems, rugose leaf-sheaths and the floral bracts shorter than the ovary in many species. To those features I might add that the flowers are typically glabrous, concolorous white, green, yellow, or purple, the sepals apically carinate, the petals narrowly lanceolate or linear, the anther cap frequently white with purple markings. They are generally found growing at mid to high elevations, large plants become bushy and, although many are restricted in distribution, they tend to be locally abundant. The Rugosum subgroup is especially species rich in Costa Rica and Panama, and despite the recognition of several new taxa recently its diversity continues to be highly underestimated. 14 additional novelties are proposed here.

Three alliances are recognized here. The *Epidendrum rugosum* Ames alliance featuring plants with multiple main stems with short branches, pink-purple plants and flowers, and a broad-flattened column. The *Epidendrum sanchoi* Ames alliance which features bushy plants with one or few central main stems with many long branches, green, yellow, or white flowers and the lip notoriously thickened on the apical margin. The *Epidendrum anoglossoides* Ames & C.Schweinf. alliance that includes bushy, irregular plants, ancipitose stems, bent inflorescences that are either ancipitose or filiform, with greenish-yellowish flowers.

Epidendrum rugosum Ames, *Schedul. Orchid.* 6: 74. 1923. TYPE: COSTA RICA: Without locality, received at the Royal Gardens, Kew, in 1923, *Charles H. Lankester s.n.* (Holotype, AMES [26978], Fig. 14; Isotype: K, Fig. 15).

Lithophytic, erect *herb*, up to 18 cm tall. Roots 1 mm in diameter, fleshy. *Stems* branching conspicuously, cane-like, terete, partially covered by rugose sheaths. *Leaves* up to 10, distributed along the stem, deciduous, concentrating close to the apex with age; leaf sheath 6–9 mm long, tubular, rugose, reddish when young, becoming papery

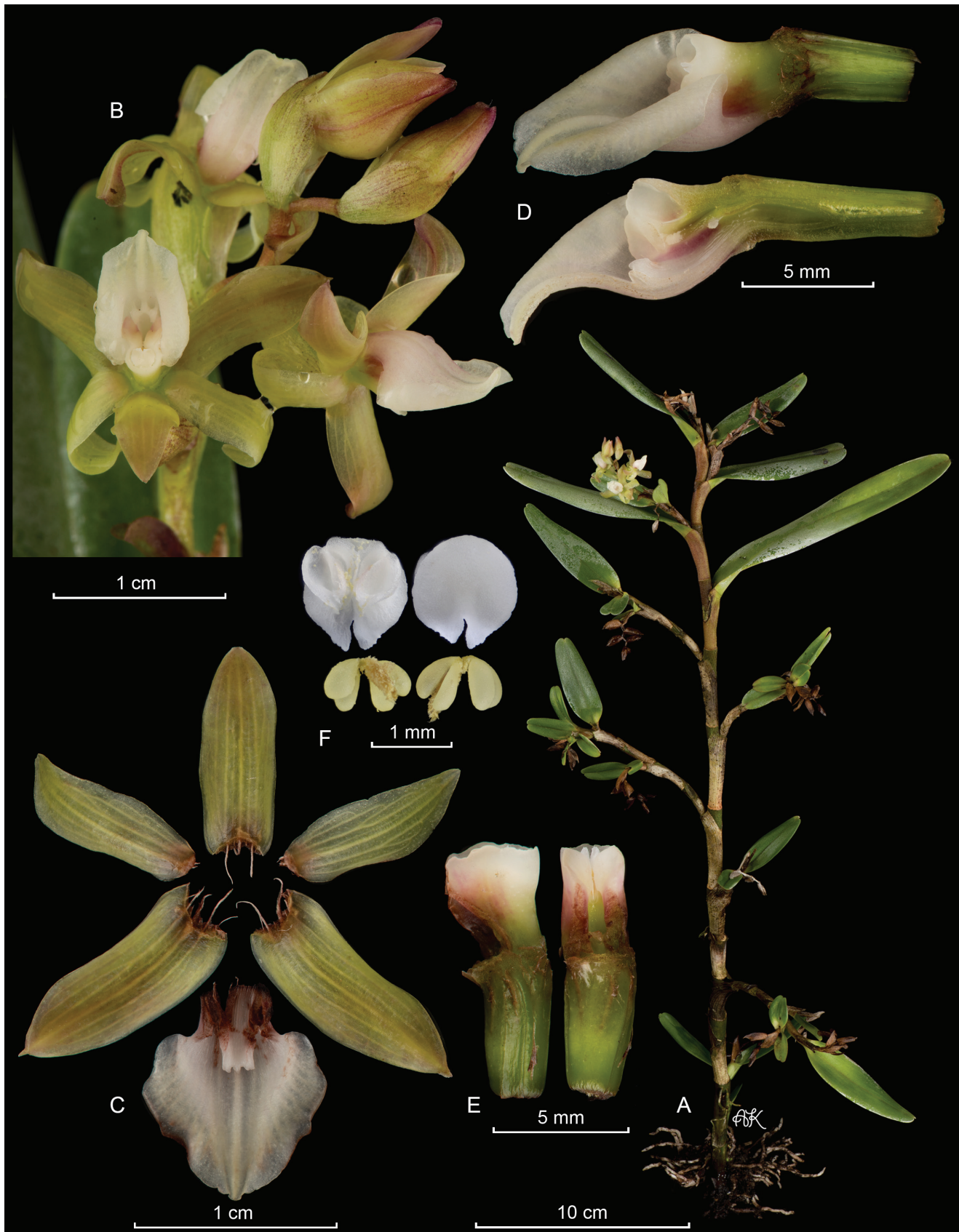


FIGURE 13. LCDP of *Epidendrum nativitatis* Karremans. **A**, Habit; **B**, Detail of the inflorescence and flower; **C**, Dissected perianth; **D**, Lip and column lateral view and transversal section; **E**, Column ventral and lateral views; **F**, Anther cap and pollinarium views. By APK based on Karremans 7490 (JBL-spirit).

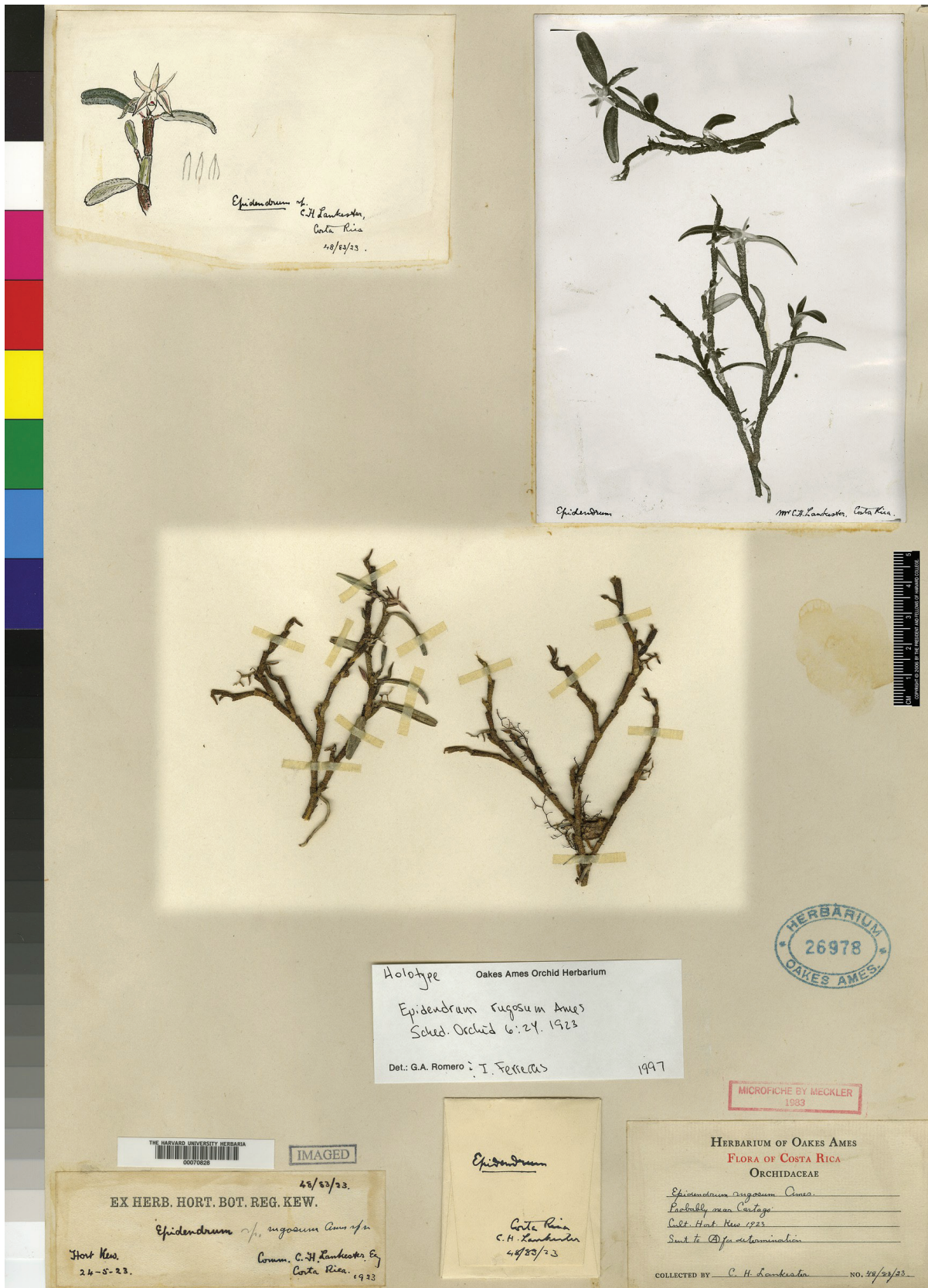


FIGURE 14. Holotype specimen of *Epidendrum rugosum* Ames collected by Charles H. Lankester (AMES 26978) © copyright of Harvard University, Cambridge.

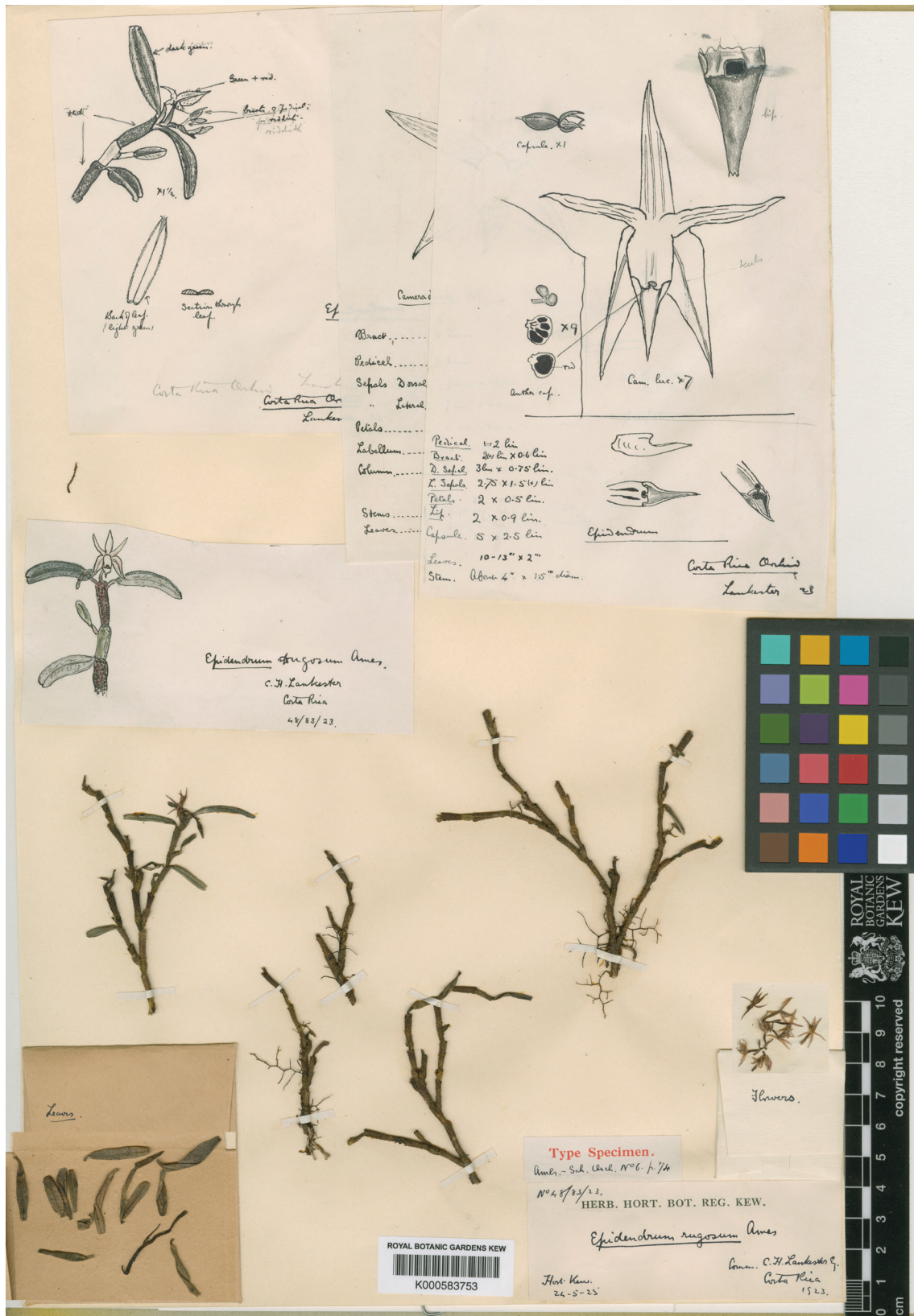


FIGURE 15. Isotype specimen of *Epidendrum rugosum* Ames collected by Charles H. Lankester (available at <http://specimens.kew.org/herbarium/K000583753>) © copyright of the Board of Trustees of the Royal Botanic Gardens, Kew.

with age; blade 1.3–1.8 × 0.3–0.5 cm, thick coriaceous, oblong, unequally bilobed. *Inflorescence* short, 5 mm long, from the branches, racemose, distichous, sub-secund, erect, congested. *Floral bracts* 2 mm long, much shorter than the ovary, acute. *Flowers* 1–3, with only one open at a time, a dull yellowish-pink color, anther dark purple. *Ovary* 6 mm long, cylindrical, tripartite, thin, elongate. *Sepals* free, spreading, free, ovate-elliptic, acute with an apical dorsal keel; dorsal sepal 6.0 × 2.0 mm; lateral sepals 5.2–5.8 × 2.1–2.2 mm. *Petals* 5.1–5.2 × 1.0 mm, free, spreading, lanceolate, acute. *Lip* 4.2 × 2.0 mm, fused to the column, short, fleshy, triangular, base truncate, corners rounded, apex acute, margins thickened and slightly elevated, with a tall transversal callus below the stigma, and a low central keel on the free portion. *Column* 3 mm long, thick, broad, with a strong bend of at least 45 degrees with respect to the ovary. *Anther* sub-trapezoid, very thin, 4-celled, margins irregular, elevated dorsally, flanking a dark-purple central depression. *Pollinia* 4, obovoid, laterally compressed, caudicles soft and granulose, viscidium translucent. *Capsule* not seen. *Description based only on *Karremans 8800*.

Etymology: From the Latin *rugosus*, rugose, in reference to the leaf sheaths.

Habitat and distribution: All specimens that correspond well with this taxon were collected in the same general area around Casa Mata, Estrella (Fig. 16) and Santa Clara in El Guarco, on the mountains overlooking the city of Cartago, Costa Rica. It grows as an epiphyte or lithophyte at elevations around 1676–1950 m.

Phenology: Registered to flower in April, June, July, and September.

Additional specimens examined: COSTA RICA. Cartago: El Guarco, San Isidro, Estrella, sobre la Carretera Interamericana Sur, 9°45'53"N, 83°58'57"W, 1890 m, creciendo como litófitas sobre el talud de la carretera, 25 June 2021, *A.P. Karremans and I. Chinchilla 8800* (JBL-spirit, Fig. 17). Cartago, [El Guarco], Santa Clara, July 1923, *C.H. Lankester 496* (AMES). Cartago, El Guarco, 1900 m, 26 September 1996, *García-Cruz 940* (AMO). Cartago, Casa Mata, 1 km sur, 1950 m, 13 March 1981, prepared 30 April 1981, *E. Hágsater and C. Horich 6340* (AMO). [Cartago: Guarco] San Cristobal Road, 9°47'N, 84°01'W, 5500 ft, 14 June 1928, *H.E. Stork 2552* (MO; AMO-photo).

The identity of *Epidendrum rugosum* has remained unclear since its description. Hágsater and Sánchez-Saldaña (2007) characterized the species as having large stems up to



FIGURE 16. Photograph of *Epidendrum rugosum* Ames in situ growing as a roadside lithophyte among mosses and other orchids, near Estrella, El Guarco, Cartago. By APK.

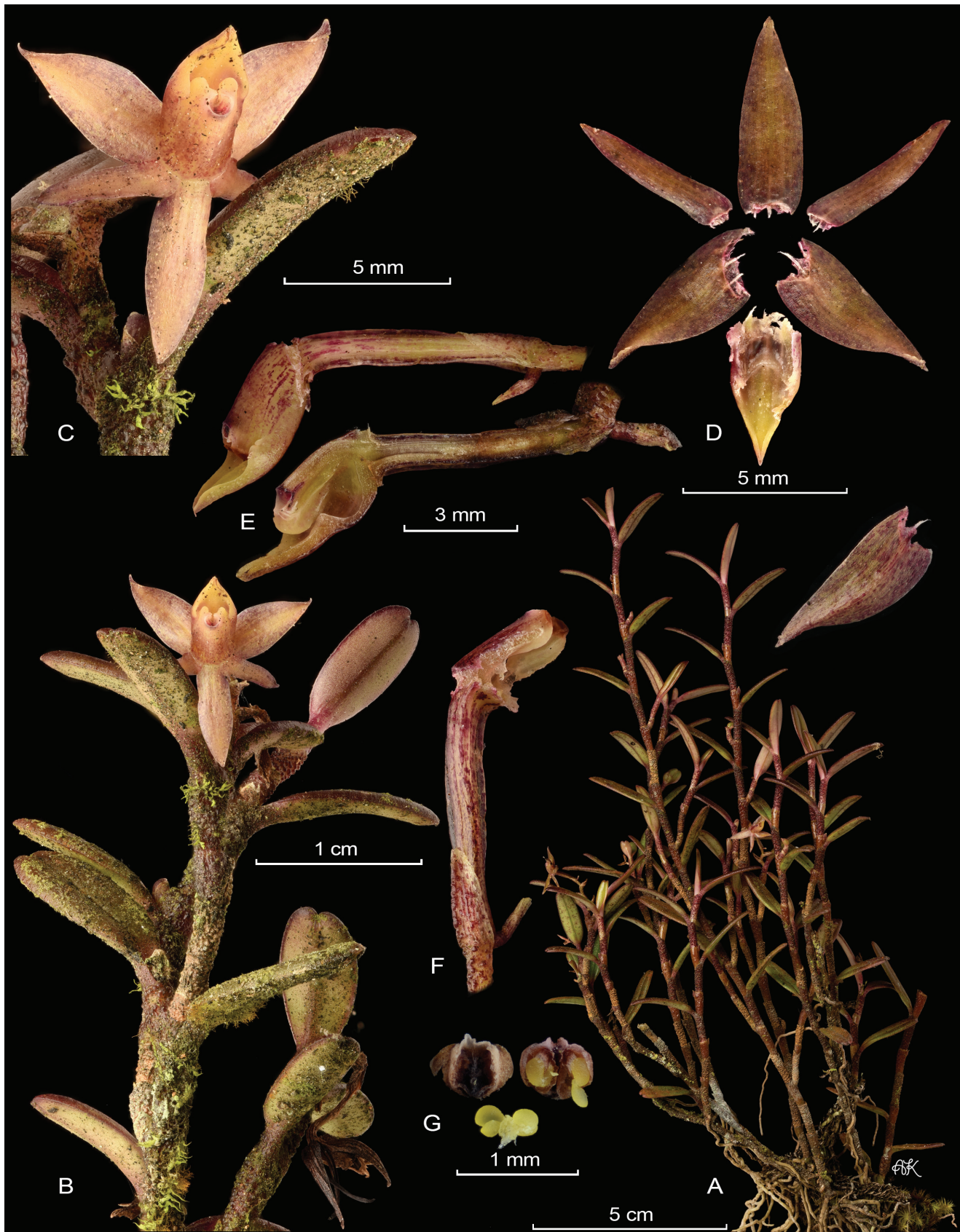


FIGURE 17. LCDP of *Epidendrum rugosum* Ames. **A**, Habit; **B**, Detail of the stem and inflorescence. **C**, Flower; **D**, Dissected perianth; **E**, Lip and column lateral view and transversal section; **F**, Column lateral view; **G**, Anther cap and pollinarium views. By APK based on Karremans 8807 (JBL-spirit).

50 cm tall, completely covered in rugose sheaths, bearing 4–6 simultaneous, whitish, greenish-white to green flowers. However, the type material and accompanying illustrations clearly feature a small plant of up to 10 cm tall, with reddish leaf sheaths that do not fully cover the stem, a few-flowered inflorescence with up to three flowers a single open flower, the flower is described as whitish, but the accompanying illustration shows hyaline yellowish-cream-pink sepals and petals, with a dark red anther, the column is broad, flattened, and the broad lip, with a very short, triangular, free apical portion. Unfortunately, certain type elements are discordant and it is likely they are mixed collections. The flowers in the envelope on the Kew specimen have very narrow, lanceolate segments and the lip has a relatively large free portion. They do not match the flowers of the specimens on the photograph accompanying the type at AMES, which have broader segments and a very small free portion of the lip as illustrated in the color drawing on both type sheets. Plants from the mountains in the vicinity of Cartago, Costa Rica, where Lankester profusely collected, correspond quite closely to the type illustration and photographed specimens on the holotype of *E. rugosum* (Hágsater and Sánchez-Saldaña, 2007, pl. 981; Fig. 9). This is unlikely to be the same species as the flowers in the envelope at Kew, which bears the longer narrower segments that were described by Ames. However, assigning the name to this entity, together with a good illustration and emended description, will hopefully give us more confidence in applying this troublesome name in the future.

Epidendrum rugosum as here circumscribed can be recognized by the reddish, relatively small plants, up to 18 cm tall, the stems are very much branched, covered in dark-red foliar sheaths, bearing thick leaves with a red margin, the inflorescence arises from the branches, it is erect, very short, bearing up to three flowers, the flowers are open one at a time, they have a hyaline-cream color with yellowish-pink tones, the tepals are free and spreading, the sepals are 5.2–6.0 × 2.0–2.2 mm, the petals 5.1–5.2 × 1.0 mm, and the lip is triangular, with a short free portion and a transversal callus one third the length from the base.

Specimens labeled *E. rugosum* in herbaria, including many of those listed under this species in Hágsater and Sánchez (2007), belong to several other species. Some have been listed here under other taxa but I am unable to determine many of them with confidence without examining the floral parts in detail. The Panamanian record of *E. rugosum* cited by Bogarín et al. (2014), *S.A. Mori and J.A. Kallunki 5948* (MO), is *Epidendrum curvisepalum* Hágsater & Dressler. I have not seen material from that country that is attributable to *E. rugosum* as here circumscribed and the species should be therefore excluded.

Epidendrum atrorugosum Hágsater, Icon. Orchid. 3: t. 309. 1999. TYPE: COSTA RICA. San José: Pan Am. highway between km. 18 and 20 from El Empalme to Villa Mills, 2700 m, 8 August 1960, *M. Cruz 179* (Holotype, F, larger specimen on the right [not seen]; Isotype, AMES).

Epiphytic, caespitose erect herb, up to 30 cm tall. Roots 1 mm in diameter, fleshy. Stems green, branching conspicuously, cane-like, terete, partially covered by rugose

sheaths. Leaves green. +10 distributed along the stem, deciduous, concentrating close to the apex with age; leaf sheath 7–15 mm long, tubular, rugose, green with red warts when young, becoming papery with age; blade 2.3–4.0 × 0.4–0.9 cm, thick coriaceous, oblong, unequally bilobed. Inflorescence 12–15 mm long, short, from the branches, racemose, distichous, sub-secund, erect, congested, notoriously sinuous, rachis twisting 90 degrees after each floral bract. Floral bracts 5 mm long, shorter than the ovary, acute. Flowers at least four, developing in very slow succession, with one or two open at a time, notoriously facing downwards in natural position, greenish diversely suffused with purple. Ovary 4.5 cm long, cylindrical, triolate, thin, elongate. Sepals free, spreading, very narrowly-ovate to lanceolate, shortly acuminate, with an apical dorsal keel; dorsal sepal 10.7 × 2.5 mm; lateral sepals 10.6–10.8 × 2.8–2.9 mm. Petals 9.2–9.3 × 1.4–1.6 mm, free, spreading, lanceolate, acute. Lip 7.8 × 2.7 mm, fused to the column, fleshy, triangular, base truncate, corners rounded, apex acute, margins thickened and slightly elevated, with a low transversal callus below the stigma, and a low central keel on the free portion. Column 3.5 mm long, thick, broad, with a strong bend of at least +45 degrees with respect to the ovary. Anther sub-trapezoid, very thin, 4-celled, margins irregular, elevated dorsally, flanking a dark-purple central depression. Pollinia 4, obovoid, laterally compressed, caudicles soft and granulose. Capsule not seen. *Description based only on *Karremans 8807*.

Etymology: From the Latin *atrans*, darkening, and *ruga*, wrinkle, in reference to the dark purple flowers and the close relationship with *E. rugosum*.

Habitat and distribution: Known from high elevations between 1900–3100 m growing in oak forests on the Talamanca mountain range in Costa Rica, down to ca. 1 km from the border with Panama where this species will surely be found as well.

Phenology: Registered to flowering from January to September.

Additional specimens examined: COSTA RICA. Cartago: El Guarco, San Isidro, Madreselva, Tres de Junio, Carretera Interamericana Sur, km 67, entrada a la finca El Jaular, 9°40'13"N, 83°51'56"W, 2610 m, bosque pluvial montano, en bosque secundario de Robles a orillas de la carretera, 25 June 2021, *A.P. Karremans and I. Chinchilla 8807* (JBL-spirit, Fig. 18). [El Guarco, San Isidro, Madreselva], Ciénega, Tres de Junio, 2700 m, 25 July 1960, *Cruz 11* (CR-41506; AMO-photo). La Cangreja, above and south of El Tejar, 1900 m, 20 May 1956, *L.O. Williams 20148* (INB-CR; AMO-photo). Cordillera de Talamanca, Ojo de Agua, 2900–3100 m, *J. Cuatrecasas and J. León 26545* (US; AMO-photo). El Guarco, San Isidro, Paso Macho (Macho Gaff), Parque Nacional Tapantí-Macizo de La Muerte, ca. 900 m después del puesto de guardaparques del sector La Esperanza, camino a las torres de transmisión eléctrica de Río Macho, 9°41'13.90"N, 83°52'9.65"W, 2748 m, epifitas en bosque pluvial montano, 30 September 2021, *D. Bogarín and E. Kaes 13484* (JBL-spirit). Copey, cloud forest area, Cordillera de Talamanca, 1900 m, 17 April 1949, *L.O. Williams 16370* (SEL-009757; SEL-009756; US-2024807; AMO-photos). Carretera panamericana km 66, trocha nueva

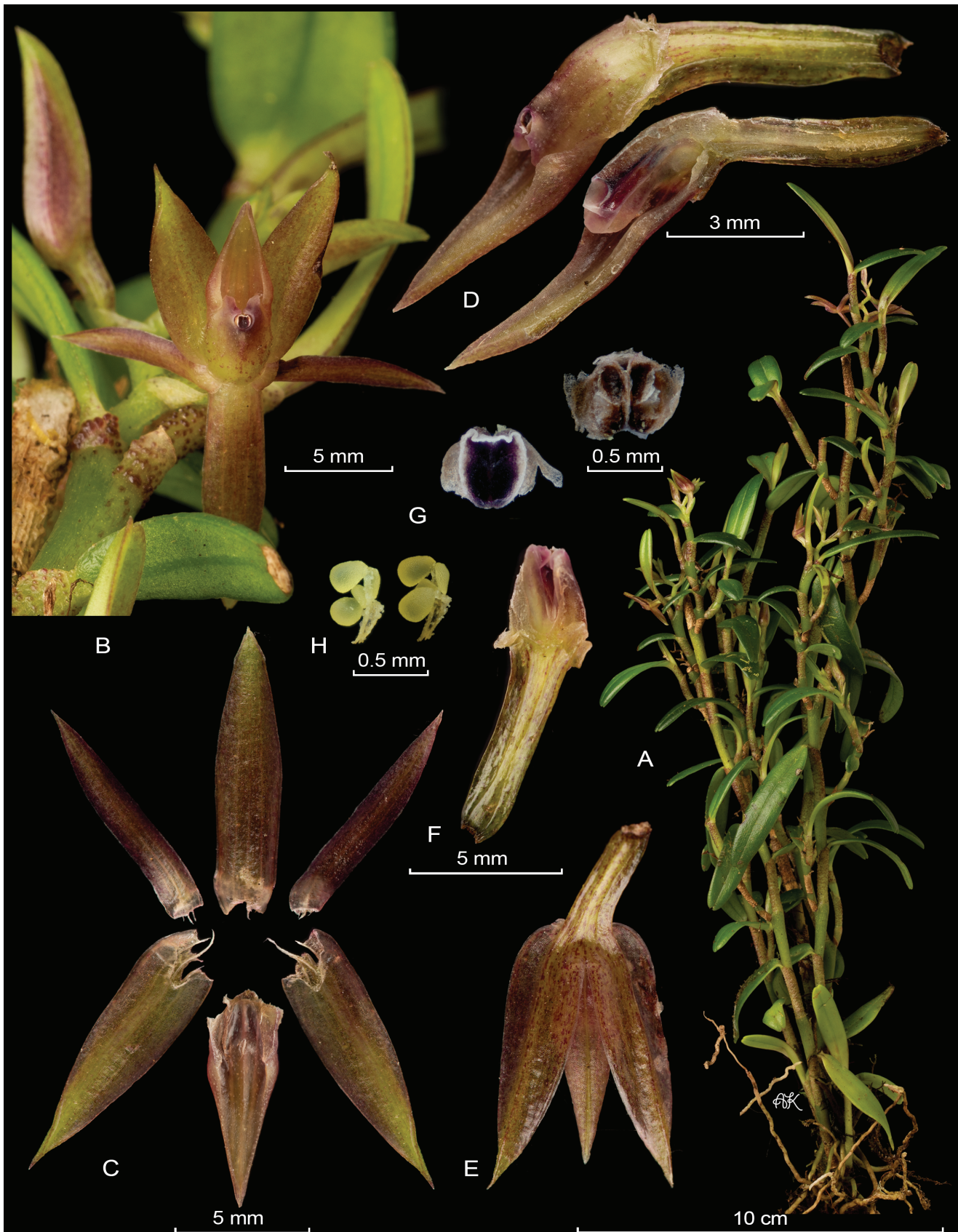


FIGURE 18. LCDP of *Epidendrum atrogosum* Hágsater. A, Habit; B, Detail of the stem, inflorescence and flower seen from below; C, Dissected perianth; D, Lip and column lateral view and transversal section; E, Lateral sepals and lip seen from behind; F, Column ventral view; G, Anther cap views; H, Pollinarium views. By APK based on Karremans 8807 (JBL-spirit).

al noreste, 18 August 1984, *R.L. Dressler 9* (USJ; AMO-photo). San Cristobal Road, 9°47'N, 84°01'W, 8000 ft, 27 May 1928, *H.E. Stork 2176* (MO; AMO-photo). San José: Cordillera de Talamanca, "The bog," elfin cloud forest area north of Cerro de la Muerte, 2600 m, 1 February 1963, *L.O. Williams et al. 24162* (AMES; CR-57625; F; AMO-photo). San José: Tres de Junio, Carretera Interamericana, 2600 m, 30 October 1979, *C. Todzia 795* (CR-72458; CR-84738; AMO-photo). San José: Dota, Copey, Salsipuedes, camino a Dos Amigos, Carretera Interamericana, km 70–71, en la entrada del Mirador de Quetzales, 9°39'05"N, 83°50'46"W, 2600–2800 m, 20 January 2008, *A.P. Karremans 2252* (JBL-D1541). Limón: Cordillera de Talamanca, Atlantic slope, Valle del Silencio, along the Río Terbi, 0.5–1.5 airline km W of the Costa Rican-Panamanian border; 9°08'N, 82°57'W, 2300–2400 m, 9 September 1984, *G. Davidse, G. Herrera and M.H. Grayum 28737* (MO; AMO-photo). N flank of Cerro Casma, along Ujarrás-San José Cabécar trail, Cordillera de Talamanca, 9°20'30"N, 83°13'30"W, 2250–2270 m, 17 March 1993, *M.H. Grayum 10334* (MO-4964304; MO-5620511; AMO-photo).

When originally described, *E. atrorugosum* was distinguished from the closely related *E. rugosum* by the larger purple flowers and the deflexed column forming a nearly 90 degree angle with the ovary (Hágsater et al., 1999). Relatively few specimens were known at the time, but a reexamination of the materials under *E. rugosum* in herbaria turned up many additional specimens. This species is easily recognized by the large, pendent, purple, or purple stained flowers that open in succession on a sinuous inflorescence.

***Epidendrum manta-birostris* Karremans, sp. nov.**

TYPE: COSTA RICA. Limón: Talamanca, Telire, cerca de la cumbre de Cerros Utyum, 9°19'39.04"N, 83°10'44.12"W, 3047 m, bosque pluvial montano, epífita en páramo dominado por *Blechnum* y *Diplostephium floribundum*, 19 January 2017, *A.P. Karremans, D. Bogarín, M. Cedeño, I. Chinchilla, M. Díaz-Morales, E. Kaes, P. Lehmann and O. Zúñiga 7638* (Holotype, JBL-spirit; Fig. 19).

Similar to *Epidendrum atrorugosum* but distinguished by the scandent, purple plant (vs. caespitose, green), the shorter leaves (1.7–2.2 vs. 2.3–4.0 cm), the straight (vs. sinuous), shorter inflorescence (5 vs. 12–15 mm long), the bent ovary with a straight column (vs. ovary straight, column bent), the shorter sepals (7.5–7.6 vs. 10.6–10.8 mm), petals (6.6–6.9 vs. 9.2–9.3 mm) and lip (5.7 vs. 7.8 mm), the sepals ovate-elliptic, acute (vs. very narrowly-ovate to lanceolate, shortly acuminate).

Lithophytic, semi-erect, scandent, *herb*, up to 28 cm tall. Roots 1 mm in diameter, fleshy. *Stems* purplish, branching conspicuously, cane-like, terete, partially covered by rugose sheaths; branches generally short. *Leaves* up to 10, distributed along the stem, deciduous, concentrating towards the apex with age; leaf sheath 7–13 mm long, tubular, rugose, reddish-purple when young, becoming papery with age; blade 1.7–2.2 × 0.4–0.7 cm, thick coriaceous, oblong, unequally bilobed. *Inflorescence* 5 mm long, short, from the branches, racemose, distichous, sub-secund, erect,

congested. *Floral bracts* 3 mm long, much shorter than the ovary, acute. *Flowers* 2–3, wine-colored throughout. *Ovary* 6 mm long, triquetrous, elongate, strongly arched almost 90 degrees with respect to the base. *Sepals* free, spreading, ovate-elliptic, acute with an apical dorsal keel; dorsal sepal 7.5 × 2.0 mm; lateral sepals 7.5–7.6 × 2.5 mm. *Petals* 6.6–6.9 × 1.5 mm, free, spreading, lanceolate, acute. *Lip* 5.7 × 2.5 mm, fused to the column, short, fleshy, triangular, base truncate, corners rounded, apex acute, margins thickened and slightly elevated, with a very low transversal callus below the stigma, and a low central keel on the free portion. *Column* 3 mm long, thick, broad, ovoid, virtually straight. *Anther* sub-trapezoid, very thin, 4-celled, margins irregular, elevated dorsally, flanking a dark-purple central depression. *Pollinia* 4, obovoid, laterally compressed, caudicles soft and granulose, viscidium translucent. *Capsule* not seen.

Etymology: Derived from the scientific name of the giant oceanic manta ray *Manta birostris* (= *Mobula birostris*), of which I am reminded by the unusual column shape.

Habitat and distribution: Only known from the type specimen collected above 3000 m on the paramo at the summit of Cerros Utyum (Fig. 20), on the Cordillera de Talamanca in southern Costa Rica.

Phenology: Found blooming in January.

When first documented the type specimen of this taxon was believed to be *E. atrorugosum* on account of the overall similarity of the dark purple flowers. However, *E. manta-birostris* can be distinguished by the scandent, purple plant, the shorter branches and leaves, the shorter, straight inflorescence, the ovary strongly arched and the column straight, the smaller flowers with shorter sepals, petals and lip, and the sepals ovate-elliptic, acute. The type specimen of *Epidendrum manta-birostris* was found growing in very particular ecological conditions at 3047 m in the paramo on the summit of Cerros Utyum (Fig. 20). Even though there is one record of *E. atrorugosum* allegedly growing at around 3000 m, it is more typically found in the oak forests just below the summit of mountain peaks on the Talamanca Cordillera.

***Epidendrum sanchoi* Ames, Schedul. Orchid. 4: 48. 1923.**

TYPE: COSTA RICA. Near Cartago, 6000 feet, *C.H. Lankester and A. Sancho 384* (Holotype, AMES [23158]; illustration of type, AMES [26877]).

Epiphytic, pseudo-monopodial, branching, *herb*, up to 65 cm tall. Roots 1 mm in diameter, fleshy. *Stems* branching conspicuously, cane-like, terete, covered by rugose sheaths; the main stem tall, with short branches. *Leaves* many, distributed along the stem, deciduous, concentrating towards the apex with age; leaf sheath up to 2.8 cm long, tubular, rugose, brownish when young, becoming papery with age; leaf blade 3.0–3.8 × 0.4–0.6 cm on the main stems, 0.8–1.4 × 0.2–0.4 cm on the branches, coriaceous, oblong, unequally bilobed. *Inflorescence* short, 1 cm long, from the branches, racemose, distichous, sub-secund, erect, congested, with two sharp angles on the side facing the ovary. *Floral bracts* 2.5–3.0 mm long, shorter than the ovary, acute. *Flowers* 2–4, typically 3 or 4, pale green throughout. *Ovary* 3.5–4.0 mm

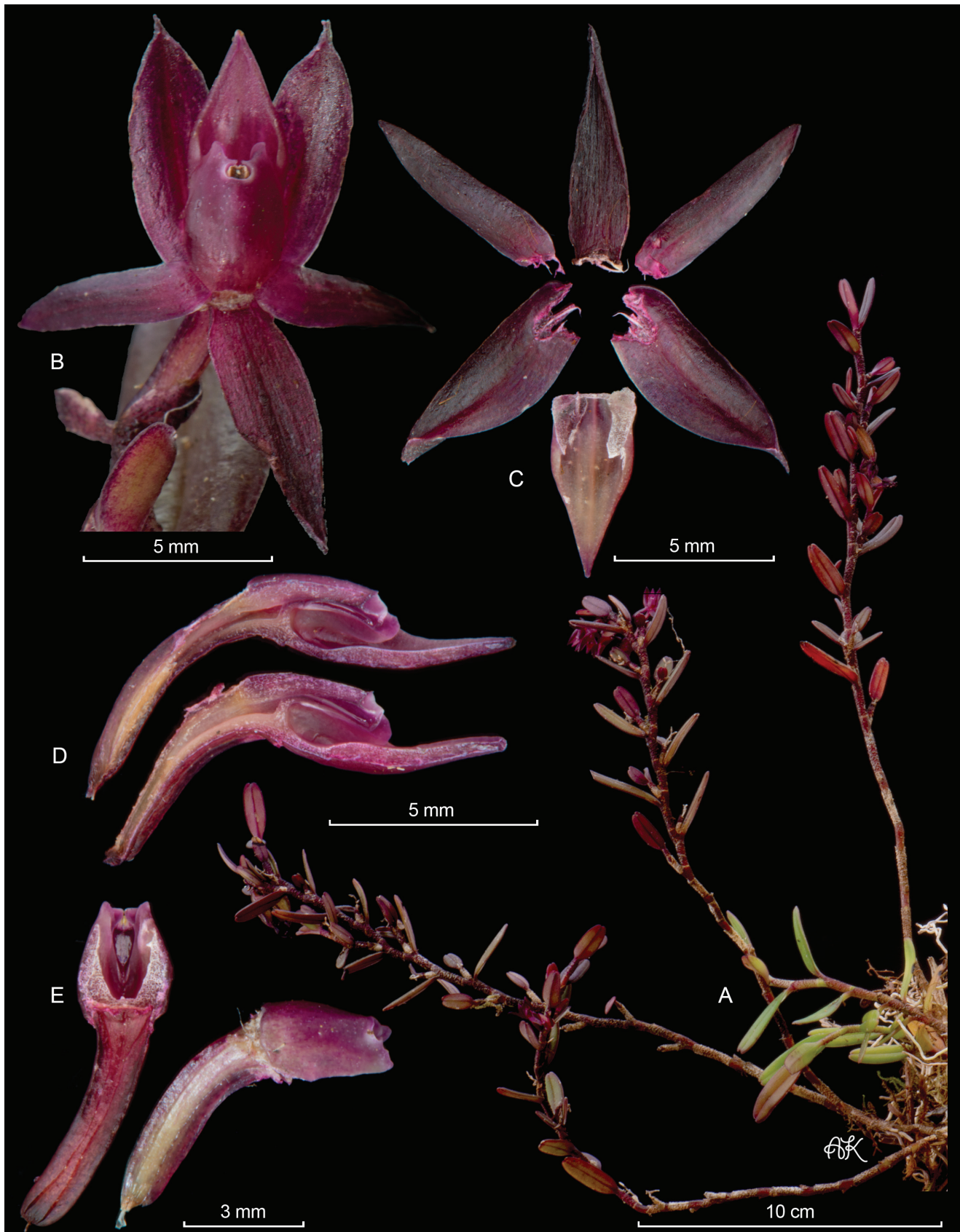


FIGURE 19. LCDP of *Epidendrum manta-birostris* Karremans. A, Habit; B, Flower; C, Dissected perianth; D, Lip and column transversal section; E, Column, ventral and lateral views. By APK based on Karremans 7638 (JBL-spirit).



FIGURE 20. Type locality of *E. manta-birostris* Karremans in the paramo close to the summit of Cerros Utyum in Costa Rica. By APK.

long cylindrical, elongate. *Sepals* free, spreading widely, ovate-elliptic, acute with an apical dorsal keel; dorsal sepal 4.8×1.6 mm; lateral sepals 5.0×1.9 – 2.0 mm, slightly bent outwards. *Petals* 4.2 – 4.3×0.5 mm, free, spreading, linear-ligulate, acute. *Lip* 4.4×2.2 mm, fused to the column, short, fleshy, triangular, base truncate, corners rounded, apex acute, thick, margins thickened and slightly elevated, ecallose but with a pair of longitudinal depressions flanking the mid-vein, with give the appearance of an elevated keel. *Column* 2.3 – 2.6 mm long, terete, with a very subtle bend with respect to the ovary, conspicuously embraced by the lip. *Anther* sub-trapezoid externally, cellular-glandular, internally very thin, 4-celled, margins irregular. *Pollinia* 4, obovoid, laterally compressed, caudicles soft and granulose. *Capsule* not seen. *Description based only on *Karremans 8795*.

Etymology: In honor of Alfredo Sancho (1876–1929), a close friend and companion of Charles Lankester on his field trips.

Habitat and distribution: The specimens that correspond well with this taxon were collected on the mountains just above the city of Cartago, Costa Rica at an elevation of about 1700 m.

Phenology: It was recorded blooming in June and July.

Additional specimens examined: COSTA RICA. Cartago: El Guarco, San Isidro, entre Cangreja y Muñeco, $9^{\circ}47'44''\text{N}$, $83^{\circ}56'21''\text{W}$, 1700 m, creciendo en árboles de potrero, 25 June 2021, *A.P. Karremans and I. Chinchilla 8795* (JBL-spirit, Fig. 21, 33b).

Like *Epidendrum rugsoum*, *E. sanchoi* was described by Ames in 1923 on the basis of plants collected by Lankester in Costa Rica. This name too has been and continues to be applied to several morphologically and ecologically dissimilar individuals that share the plants with a relatively large, much branched, bushy habit, bearing dozens of small white to green flowers, linear petals, and a thick, triangular lip. After careful inspection of living specimens from different localities it has become evident that there are in fact several species with these general features, some of which are proposed as new here. Therefore, it is essential to establish a new circumscription of *E. sanchoi*, by providing a new description and color plate, and expressly excluding the specimens cited by Hágsater and Sánchez-Saldaña (2008). The specimen illustrated and described here most closely resembles the original protologue, type and type illustration and was found growing at a similar elevation likewise on the mountains near the city of Cartago.

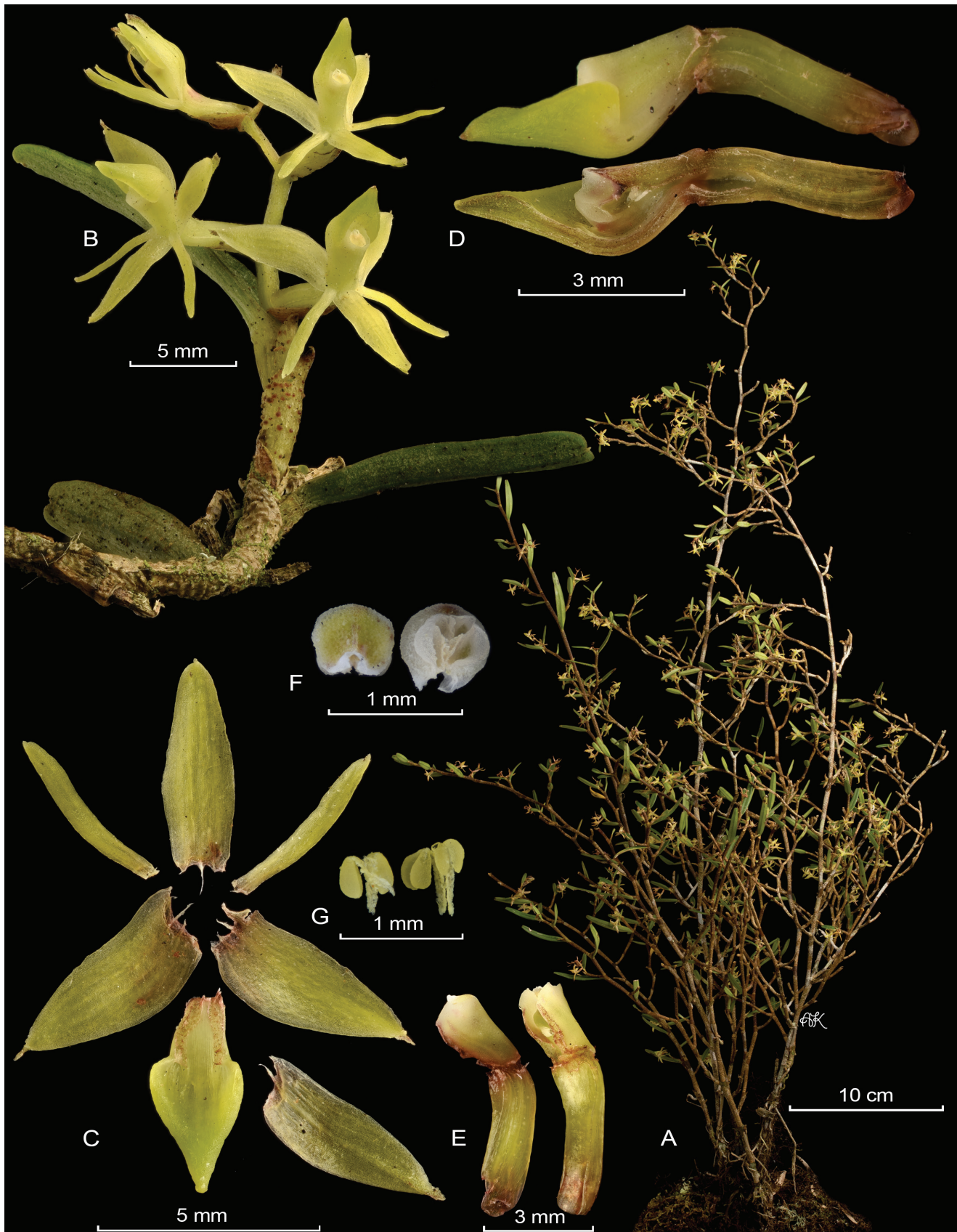


FIGURE 21. LCDP of *Epidendrum sanchoi* Ames. A, Habit; B, Detail of the stem, inflorescence and flower; C, Dissected perianth; D, Lip and column lateral view and transversal section; E, Column ventral and lateral views; F, Anther cap views; G, Pollinarium views. By APK based on Karremans 8795 (JBL-spirit).

Epidendrum aeolicum Karremans, *sp. nov.*

TYPE: COSTA RICA. Cartago: El Guarco, San Isidro, Casa Mata, sobre la carretera interamericana, 9°46'52"N, 83°59'41"W, 1960 m, en árboles de potrero a la par de las eólicas, 9 January 2021, prepared 13 January 2021, A.P. Karremans and M. Contreras Fernández 8640 (Holotype, JBL-spirit [K0108]; Fig. 22).

Similar to *E. sanchoi* but distinguished by the inflorescence typically bearing 2 flowers (vs. typically 3 or 4), the sepals narrowly lanceolate (vs. ovate-elliptic), the longer perianth segments, sepals 5.8–6.1 mm long (vs. 4.8–5.0), petals 5.5 mm long (vs. 4.2–4.3), lip 5.0 mm long (vs. 4.4), the lip lacking the longitudinal depressions flanking the midvein (vs. present, making the lip appear to have an elevated keel), column with a conspicuous 90 degree bend with respect to the ovary (vs. very slight bend), and anther cap purplish (vs. green).

Epiphytic, bushy, pseudo-monopodial, branching, *herb*, up to 60 cm tall. Roots 1 mm in diameter, fleshy. *Stems* branching conspicuously, cane-like, terete, somewhat flexuous, covered by rugose sheaths; the main stem tall, with short branches. *Leaves* many, distributed along the stem, deciduous, concentrating towards the apex with age; leaf sheath up to 3 cm long, tubular, rugose, brownish, becoming papery with age; blades 8.0 × 0.8 cm on the main stems, 1.8–2.1 × 0.2–0.5 cm on the branches, thick coriaceous, oblong-ligulate, unequally bilobed. *Inflorescence* produced from the branches, racemose, distichous, sub-secund, erect, congested, 1 cm long, with two sharp angles on the side facing the ovary, verruculose. *Floral bracts* 2.0–2.5 mm long, shorter than the ovary, acute. *Flowers* 1–3, typically 2, light green throughout, anther purplish. *Ovary* 4 mm long, cylindrical, elongate, bent. *Sepals* free, spreading to revolute, narrowly lanceolate, non-carinate, except for a prominent, thickened dorsal apiculum; dorsal sepal 6.0–6.1 × 1.5 mm, perpendicular to the column; lateral sepals 5.8–6.1 × 1.8–1.9 mm, notoriously bent outwards above the middle. *Petals* 5.5 × 0.4–0.5 mm, free, spreading, held out backwards, linear, acute. *Lip* 5.0 × 2.5 mm, fused to the column, free portion 3.5 mm, short, fleshy, triangular, base truncate, corners rounded, ecallose, apex thickened, acute, margins thickened and slightly elevated. *Column* 2.5 mm long, short, terete, with a strong bend of about 90 degrees with respect to the ovary. *Anther* sub-ovoid, thin, 4-celled, cellular-glandular, provided with a pair of triangular, thin appendages. *Pollinia* 4, obovoid, laterally compressed, caudicles soft and granulose, viscidium translucent. *Capsule* not seen.

Etymology: Derived from *Aeolus*, keeper of the winds in Greek mythology, in reference to the windy habitat of this species.

Habitat and distribution: The species is only known from around Casa Mata, on very windy slopes at 1960 m in elevation (Fig. 23).

Phenology: It was recorded blooming in January.

Additional specimens examined: COSTA RICA. Cartago: El Guarco, San Isidro, Casa Mata, sobre la carretera interamericana, 9°46'52"N, 83°59'41"W, 1960 m, en árboles de potrero a la par de las eólicas, 9 January 2021, A.P. Karremans and M. Contreras Fernández 8601 (JBL-spirit, F. 33c).

Of all the species here described *E. aeolicum* is the most superficially similar to *E. sanchoi*. However, when the floral details are carefully examined, they are easily distinguished. The inflorescences of *E. aeolicum* typically bear only 2 flowers, the flower segments are longer and much more lanceolate-acuminate, and the lip lacks the longitudinal depressions flanking the midvein. The most distinctive features are the conspicuous 90 degrees bend of the column with respect to the ovary and purplish anther cap.

Epidendrum utyumii Karremans, *sp. nov.*

TYPE: COSTA RICA. Limón: Talamanca, Telire, cerca de la cumbre de Cerros Utyum, 9°19'39.04"N, 83°10'44.12"W, 3047 m, bosque pluvial montano, epífita en páramo dominado por *Blechnum* y *Diplostegium floribundum*, 19 January 2017, A.P. Karremans, D. Bogarín, M. Cedeño, I. Chinchilla, M. Díaz, E. Kaes, P. Lehmann and O. Zúñiga 7640 (Holotype, JBL-spirit; Fig. 24).

Similar to *E. sanchoi* but distinguished by the compact, purplish plant (vs. plant bushy, tall, green), with white flowers with a purple column apex (vs. flowers green throughout), dorsal sepal oblong (vs. ovate-elliptic), the larger lateral sepals (5.3–5.5 × 2.3–2.4 vs. 5.0 × 1.9–2.0 mm) and wider petals (0.9–1.0 vs. 0.5 mm), that are narrowly oblong (vs. linear-ligulate) and the lip lacking the longitudinal depressions flanking the midvein (vs. present, making the lip appear to have an elevated keel) and anther cap purplish (vs. green).

Epiphytic, branching, *herb*, up to 38 cm tall. Roots 1 mm in diameter, fleshy. *Stems* branching conspicuously, cane-like, terete, covered by rugose sheaths; main stems tall, with short branches. *Leaves* many, distributed along the stem, deciduous, concentrating towards the apex with age; leaf sheath up to 2 cm long, tubular, rugose, reddish-purple when young, becoming papery with age; blade up to 1.5 × 0.5 cm, thick coriaceous, oblong to narrowly ovate, unequally bilobed, greenish-purple. *Inflorescence* 7.5 mm long, short, from the branches, racemose, distichous, sub-secund, erect, congested. *Flowers* 2–3, white throughout, except the column apex which is stained with purple and the center of the anther cap which is solid dark purple. *Ovary* 3.3 mm long, cylindrical, elongate, straight. *Sepals* free, spreading, apex recurved, acute with an apical dorsal keel; dorsal sepal 5.1 × 1.5 mm oblong, obtuse; lateral sepals 5.3–5.5 × 2.3–2.4 mm, ovate, acute. *Petals* 4.4–4.6 × 0.9–1.0 mm, free, spreading, held out backwards, narrowly oblong, acute. *Lip* 4.4 × 2.0 mm, fused to the column, short, fleshy, triangular, base truncate, corners rounded, apex acute, margins thickened and slightly elevated, without a callus. *Column* 1.6 mm long, thick, terete, straight with respect to the ovary. *Anther* sub-trapezoid, very thin, 4-celled, margins irregular. *Pollinia* 4, obovoid, laterally compressed, caudicles soft and granulose. *Capsule* not seen.

Etymology: Named after the area of Cerros Utyum in the Cordillera de Talamanca, the type locality of this species. The name comes from the native Bribri language and it is derived from *Ûyöm*: ù, home, and *yöm*, which is a word for oronym.

Habitat and distribution: The species is only known from the on the continental divide between 2600 and 2800 m

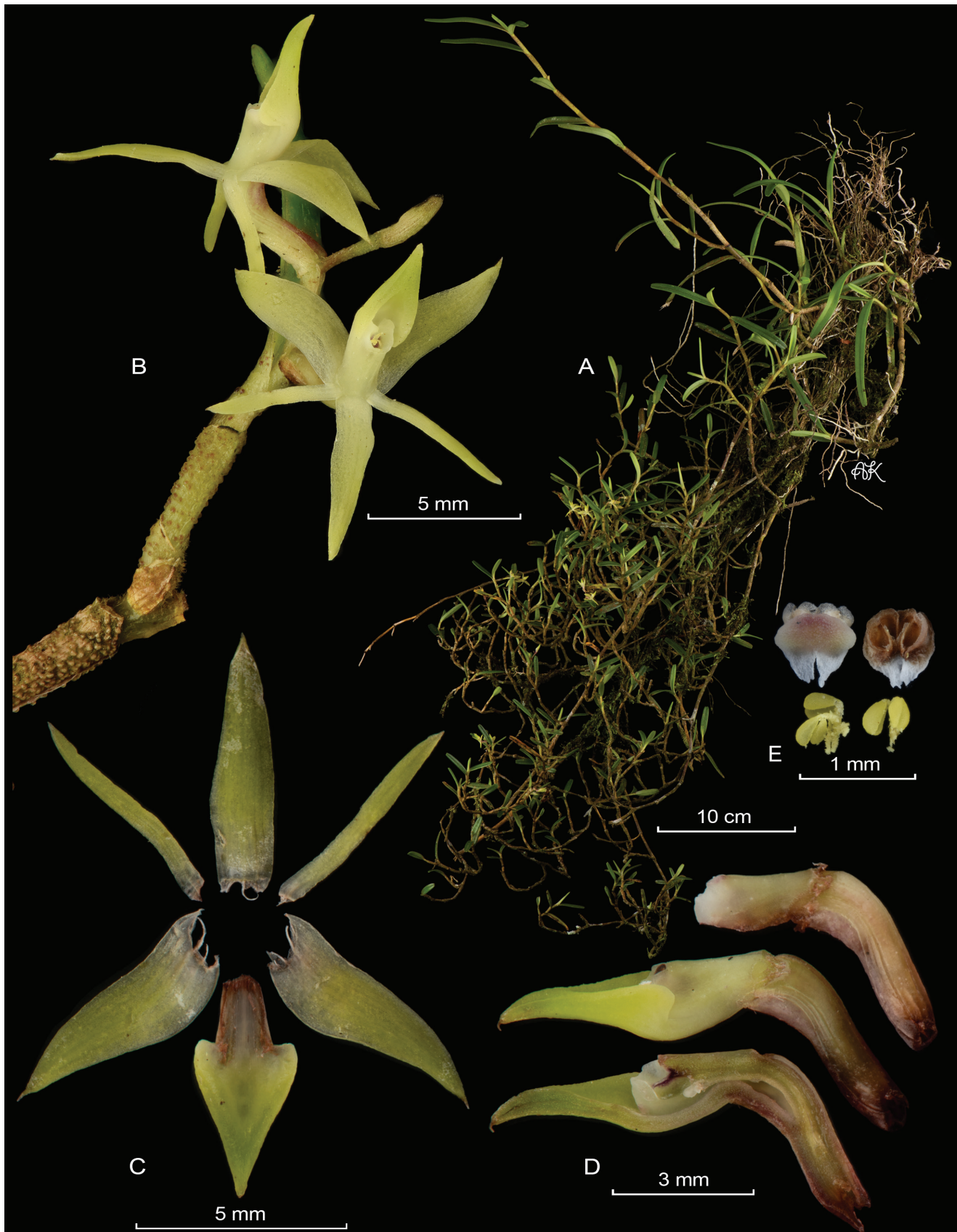


FIGURE 22. LCDP of *Epidendrum aeolicum* Karremans. **A**, Habit; **B**, Detail of the stem, inflorescence and flower; **C**, Dissected perianth; **D**, Lip and column lateral views and transversal section; **E**, Anther cap and pollinarium views. By APK based on Karremans 8640 (JBL-spirit).



FIGURE 23. Type locality of *E. aeolicum* Karremans, pastures surrounding the wind turbines above the city of Cartago in Costa Rica. By APK.

along the Carretera Interamericana around the Salsipuedes area and paramo at the summit of Cerros Durika and Utyum, on the Cordillera de Talamanca in southern Costa Rica (Fig. 25).

Phenology: It was recorded blooming between September and January.

Additional specimens examined: COSTA RICA. San José: Dota, Copey, Salsipuedes, camino a Dos Amigos, Carretera Interamericana, km 70–71, en la entrada del Mirador de Quetzales, 9°38'46.5"N, 83°50'49.8"W, 2767 m, 20 January 2008, *A.P. Karremans* 2267 (JBL-2267). San José: Dota, Copey, Salsipuedes, Dos Amigos, ca. 19 km del Empalme hacia San Isidro del General, Carretera Interamericana, km 69–70, entrada al Mirador de Quetzales, 9°38'46.5"N, 83°50'49.8"W, 2767 m, bosque pluvial montano, “*hoc plantae invenimus in sylvis palustribus alpinibus in loco typico Brachionidii cruzae*,” 30 January 2011, *A.P. Karremans, M. Contreras Fernández and D. Bogarín* 3492 (JBL-D4629). San José: Dota, Copey, Salsipuedes, Dos Amigos, ca. 19 km del Empalme hacia San Isidro del General, Carretera Interamericana, km 69–70, entrada al Mirador de Quetzales, 9°38'50"N, 83°50'48"W,

2750 m, bosque pluvial montano, collected 19 June 2021, prepared 26 October 2021, *A.P. Karremans and M. Contreras Fernández* 8778 (JBL-spirit). *Idem, A.P. Karremans and M. Contreras Fernández* 8784 (JBL-spirit). Cordillera de Talamanca, Salsipuedes, 2700 m, prepared 20 November 1982, *Horich sub. Hágsater* 6929 (CR; illustration). Copey, Salsipuedes, Dos Amigos, ca. 20 km del Empalme hacia San Isidro del General, Carretera Interamericana, calle al Cerro Vueltas, 9°38'27"N, 83°50'49"W, 2810 m, bosque pluvial montano, 26 September 2021, *A.P. Karremans and M. Contreras Fernández* 8872 (JBL-spirit). Copey, Salsipuedes, Dos Amigos, ca. 19 km del Empalme hacia San Isidro del General, Carretera Interamericana, km 69–70, entrada al Mirador de Quetzales, 9°38'54"N, 83°50'45"W, 2765 m, bosque pluvial montano, 26 September 2021, *A.P. Karremans and M. Contreras Fernández* 8873 (JBL-spirit). Cordillera de Talamanca, about 19 km S of El Empalme at 8750 ft. elevation, 6 March 1981, *F. Almeda and K. Nakai* 4769 (CR-232430). Limón: Talamanca, Telire, cerca de la división continental entre Cerro Arbolado y Cerro Durika, 9°19'15"N, 83°13'26"W, ca. 2600 m, *E. Kaes s.n.* (JBL-photo, Fig. 33d).

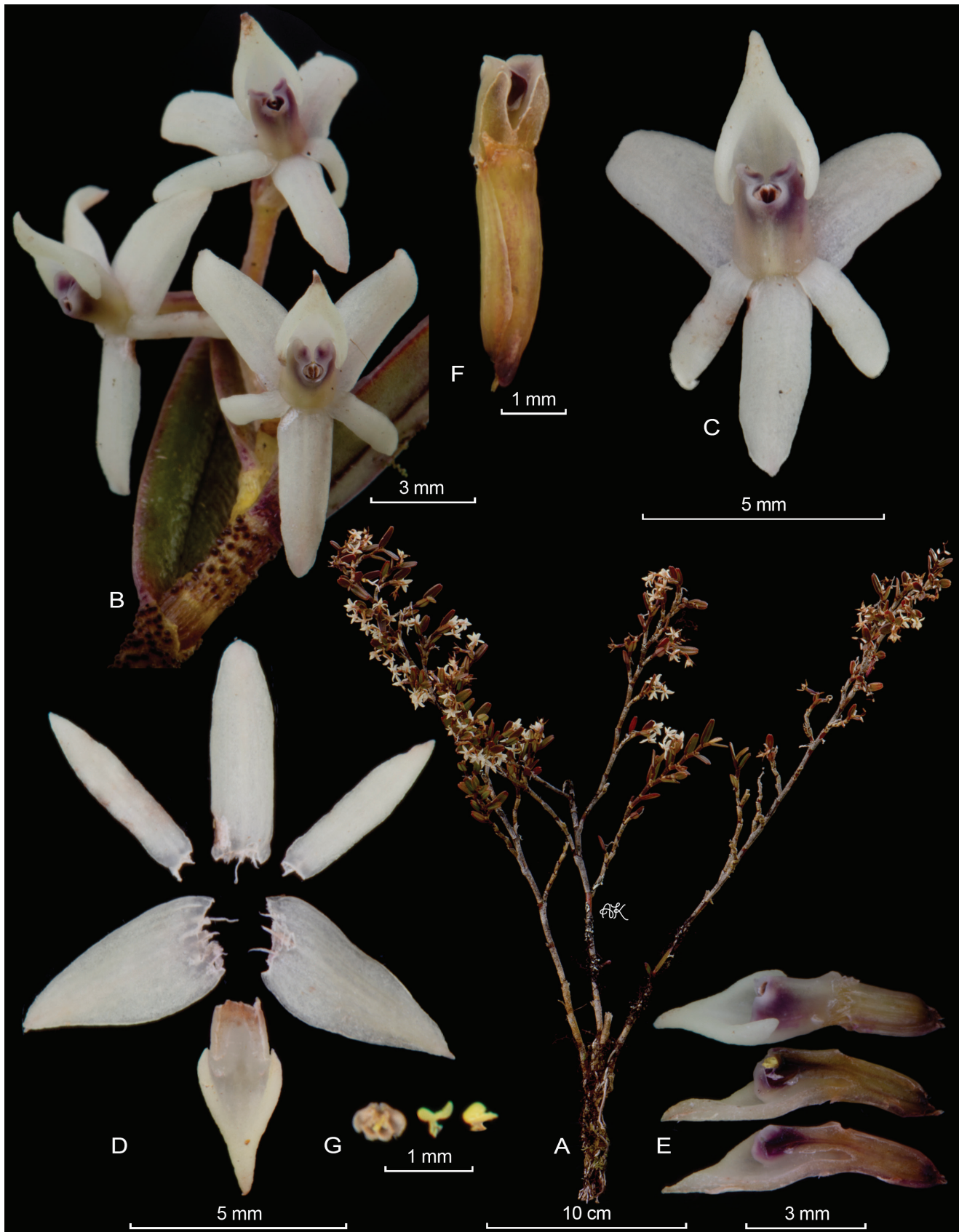


FIGURE 24. LCDP of *Epidendrum utyumii* Karremans. **A**, Habit; **B**, Detail of the stem, inflorescence and flower; **C**, Flower; **D**, Dissected perianth; **E**, Lip and column lateral view and transversal sections; **F**, Column ventral views; **G**, Anther cap and pollinarium views. By APK based on Karremans 7640 (JBL-spirit).



FIGURE 25. View of the Talamanca mountain range in southern Costa Rica and western Panama as seen from the type locality of *E. utyumi* Karremans, close to the summit of Cerros Utyum. By APK.

Epidendrum sidereum* Karremans, *sp. nov.

TYPE: COSTA RICA. San José: Perez Zeledón, Villa Mills, en bosque de roble al lado de la calle cerca de la Reserva Forestal Río Macho sector Villa Mills, 9°33'9"N, 83°41'49"W, 2820 m, 19 June 2021, A.P. Karremans and M. Contreras Fernández 8772 (Holotype, JBL-spirit; Fig. 26).

Similar to *E. sanchoi* in the pseudo-monopodial, large, bushy habit, but distinguished by the white flowers with purple sepal apices, the much bigger leaves, on the main stems 7.5 × 0.9 cm (vs. 3.0–3.8 × 0.4–0.6 cm) on the branches 3.0 × 0.5 cm (vs. 0.8–1.4 × 0.2–0.4 cm) and longer inflorescence 1.5–2.0 cm (vs. 1 cm), the flowers are longer and narrower, sepals 6.0–6.5 × 1.0–1.5 mm (vs. 4.8–5.0 × 1.6–2.0 mm) and the lip is 6.0 × 1.5 mm (vs. 4.4 × 2.2 mm), the sepals are narrowly lanceolate (vs. ovate-elliptic), and the lip is ecallose (vs. callus-like longitudinal depressions flanking the midvein) and acuminate (vs. triangular).

Epiphytic, bushy, pseudo-monopodial, branching, *herb*, up to 65 cm tall. Roots 1 mm in diameter, fleshy. *Stems* branching conspicuously, cane-like, terete, somewhat flexuous, covered by rugose sheaths; main stem tall, with short branches. *Leaves* many, distributed along the stem,

deciduous, concentrating towards the apex with age; leaf sheath up to 2.5 cm long, tubular, rugose, brownish, becoming papery with age; blades 7.5 × 0.9 cm on the main stems, 3.0 × 0.5 cm on the branches, thick coriaceous, oblong-ligulate, unequally bilobed. *Inflorescence* 1.5–2.0 cm long, produced from the branches, racemose, distichous, sub-secund, erect, congested, with two sharp angles on the side facing the ovary, verrucose. *Floral bracts* 4–5 mm long, shorter than the ovary, acute, verruculose. *Flowers* 3–5, typically 4, white with a green column, lightly suffused with purple within the column apex and on the apex of the keels on the sepals. *Ovary* 6 mm long, cylindrical, elongate, verruculose. *Sepals* free, spreading only partially, narrowly lanceolate, non-carinate, but with a prominent, thickened apiculum; dorsal sepal 6.0–6.5 × 1.0 mm, bent over the column; lateral sepals 6.5 × 1.5 mm, with a slight inward bend near the apex. *Petals* 5.5 × 0.7–0.8 mm, free, spreading, held out straight, perpendicular to the column, linear to narrowly-lanceolate, slightly, but consistently undulate, acute. *Lip* 6.0 × 1.5 mm, fused to the column, free portion 4 mm long, short, fleshy, triangular, base truncate, corners rounded, ecallose, apex thickened, acuminate, margins thickened and

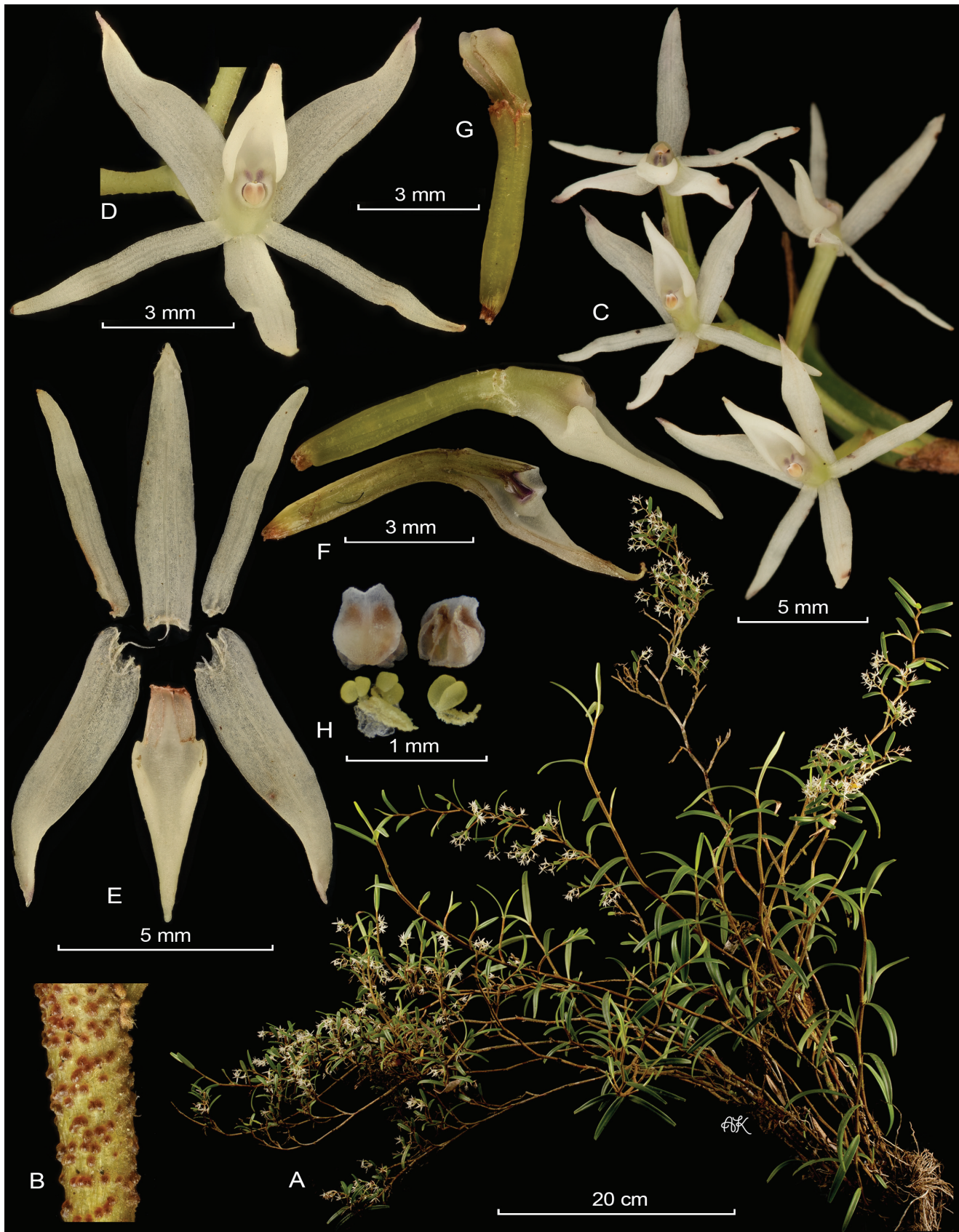


FIGURE 26. LCDP of *Epidendrum sidereum* Karremans. **A**, Habit; **B**, Detail of the rugose leaf sheaths; **C**, Inflorescence; **D**, Flower; **E**, Dissected perianth; **F**, Lip and column lateral view and transversal section; **G**, Column lateral view; **H**, Anther cap and pollinarium views. By APK based on Karremans 8772 (JBL-spirit).

slightly elevated. *Column* 2 mm, short, terete, with a slight bend with respect to the ovary. *Anther* sub-ovoid, thin, 4-celled, cellular-glandular. *Pollinia* 4, obovoid, laterally compressed, caudicles soft and granulose, viscidium translucent. *Capsule* 10 × 2 mm ellipsoid.

Etymology: The name comes from the Latin *sidereum*, starry, in reference to the appearance of a large, fully flowered plant with its dozens of delicate white flowers.

Habitat and distribution: The species is only known from the high elevation oak forests between 2600 and 2800 m along the Carretera Interamericana around Villa Mills (Fig. 27) and between Cerro Arbolado and Durika, in the Talamanca mountain range.

Phenology: It was recorded blooming in January, February, June and July.

Additional specimens examined: COSTA RICA. Limón: Talamanca, Telire, cerca de la división continental entre Cerro Arbolado y Cerro Durika, 9°19'15"N, 83°13'26"W, ca. 2600 m, *E. Kaes s.n.* (JBL-photo, Fig. 33e).

Epidendrum sidereum forms large bushy plants that become completely covered in small, white, star-shaped flowers. It is related to and has been confused with *E. sanchoi*. However, it can be distinguished from by the

flowers that are almost pure white with the exception of the purple coloration within the anther and stigma region in the column and the apices of the sepals, by the larger leaves, the flowers with longer and narrower segments and the ecallose lip. It also grows at higher elevations on the Talamanca mountain range. In the flower color it is similar to *E. utyumii* which is also a high elevation species from the same mountain range. However, that species has compact, purplish plants, and the flowers have shorter and wider sepals, petals and lip, the lateral sepals are ovate, rather than narrowly lanceolate and the petals are narrowly oblong rather than linear to narrowly-lanceolate.

Epidendrum saltatrix* Karremans, *sp. nov.

TYPE: COSTA RICA. San José: Dota, Copey, Salsipuedes, Dos Amigos, ca. 18 km del Empalme hacia San Isidro del General, 1 km antes de la entrada al Mirador de Quetzales, Carretera Interamericana, 9°39'10"N, 83°50'53"W, 2728 m, bosque pluvial montano, 19 June 2021, *A.P. Karremans and M. Contreras Fernández 8785* (Holotype, JBL-spirit; Fig. 28, 33f).

Similar to *E. sanchoi* but distinguished by the larger branch leaves, 2.3 × 0.5 cm (vs. 0.8–1.4 × 0.2–0.4 cm), the



FIGURE 27. Habitat at the type locality of *E. sidereum* Karremans, close to Reserva Forestal Río Macho in Villa Mills. By APK.

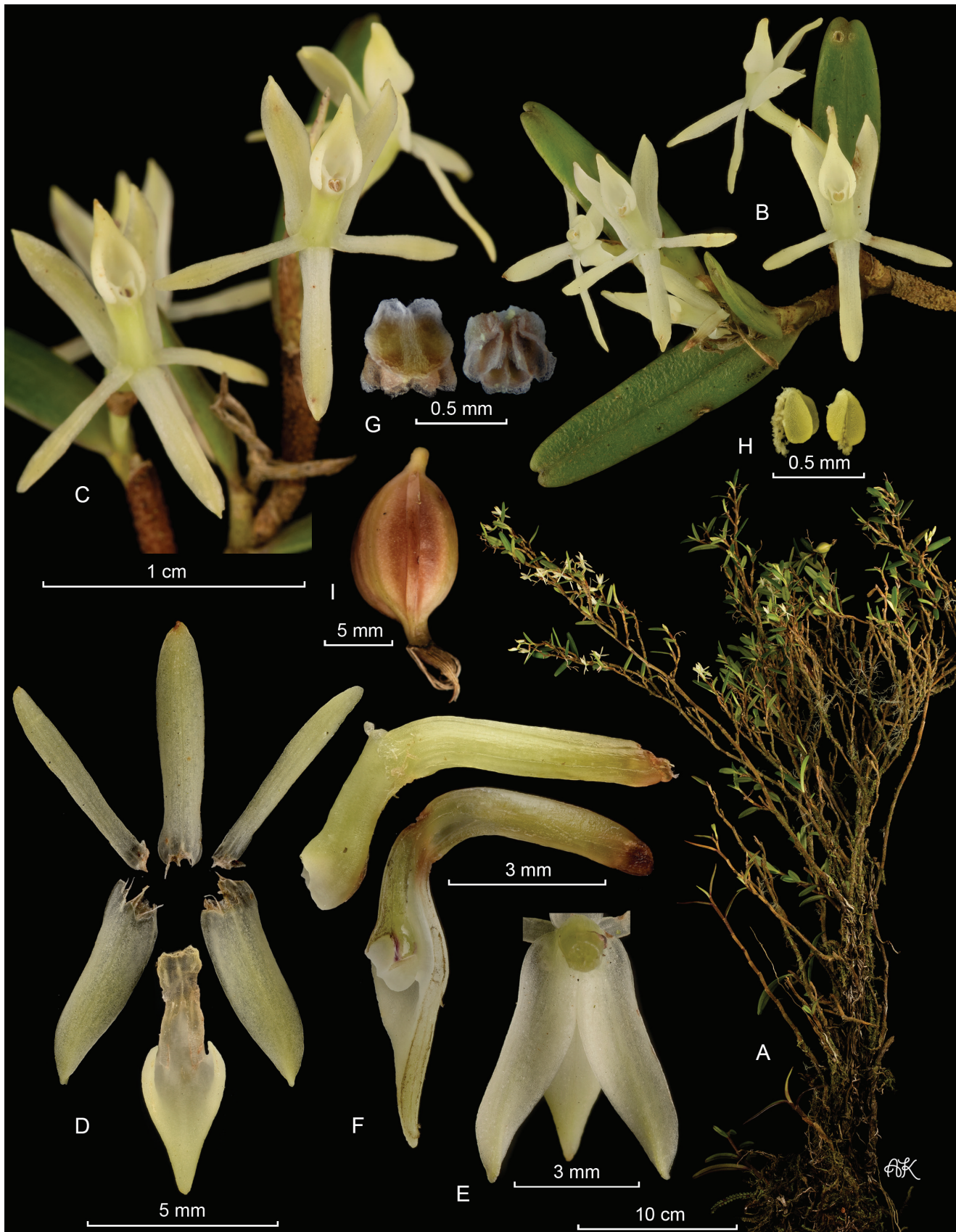


FIGURE 28. LCDP of *Epidendrum saltatrix* Karremans. **A**, Habit; **B**, Detail of the stem, inflorescence and flowers; **C**, Flowers; **D**, Dissected perianth; **E**, Lateral sepals fused at the base viewed from behind; **F**, Lip and column lateral view and transversal section; **G**, Anther cap views; **H**, Pollinarium views; **I**, Capsule. By APK based on *Karremans 8785* (JBL-spirit).

inflorescence that typically bears 2 cream-colored flowers (vs. typically 3 or 4, pale green), the longer floral bracts, 4.0 mm long (vs. 2.5–3.0 mm) and ovary, 5.0 mm long (vs. 3.5–4.0 mm), the lateral sepals which are fused at the base and flank the lip (vs. sepals free, spreading), the longer sepals (7.0 vs. 4.8–5.0 mm) and petals (6.0 vs. 4.2 mm), and the column with a notorious 90 degree bend with respect to the ovary (vs. column bend very subtle).

Epiphytic, bushy, branching, *herb*, up to 50 cm tall. Roots 1 mm in diameter, fleshy. *Stems* branching conspicuously, cane-like, terete, covered by rugose sheaths; the main stem tall, with short branches. *Leaves* many, distributed along the stem, deciduous, concentrating towards the apex with age; leaf sheath up to 2 cm long, tubular, rugose, reddish-brown when young, becoming papery with age; leaf blade 2.3 × 0.5 cm on the branches, coriaceous, oblong, unequally bilobed. *Inflorescence* 5–7 mm long, short, from the branches, racemose, distichous, sub-secund, erect, congested, with two sharp angles on the side facing the ovary, verrucose. *Floral bracts* 4.0 mm long, shorter than the ovary, acute, verrucose. *Flowers* 1–3, typically 2, greenish-cream colored throughout. *Ovary* 5.0 mm long, cylindrical, elongate, bent apically. *Sepals* spreading widely, with a small apical dorsal keel; dorsal sepal 7.0 × 1.5 mm, oblong, acute; lateral sepals 7.0 × 2.0 mm, falcate, broadly lanceolate, acute, fused for 2 mm at the base and therefore flanking the lip. *Petals* 6 × 0.9–1.0 mm, free, spreading, linear to narrowly oblanceolate, acute, somewhat held backwards. *Lip* 4.4 × 2.2 mm, fused to the column, short, fleshy, triangular, base truncate, corners rounded, apex acute, thick, margins thickened and slightly elevated, ecallose. *Column* 2.5 mm long, terete, with a 90 degrees downward bend with respect to the ovary, and slightly bent upwards near the apex. *Anther* sub-trapezoid cellular-glandular, very thin, 4-celled, margins irregular. *Pollinia* 4, obovoid, laterally compressed. *Capsule* 15 × 8 mm ellipsoid, three-winged, brownish-green.

Etymology: From the Latin *saltatrix*, “a woman dancer,” in allusion to the graceful flower.

Habitat and distribution: Only known from the type specimen collected at 2728 m in elevation in Dos Amigos on the Carretera Interamericana.

Phenology: It was recorded blooming in June and July.

Epidendrum saltatrix is related to *E. sanchoi*, *E. utyumii*, and *E. sidereum*, but is immediately distinguished by the sharp, 90 degree bend of the column with respect to the ovary and by the lateral sepals that flank the lip in natural position due to a 2 mm basal fusion. All other species in the group have free and spreading lateral sepals except for *E. suturatum* Hágsater & Dressler. However, that species is endemic to central Panama and has shorter plants, with inflorescences bearing 4 to 5 flowers that are brownish-green with the column apex purple, the dorsal sepal is lanceolate, a thick and much longer column, and shorter lip.

Epidendrum colibri Karremans, *sp. nov.*

TYPE: COSTA RICA. Puntarenas: Buenos Aires, Buenos Aires, camino a Cerros Utyum, 9°18'04.93"N, 83°12'51.59"W, 2157 m, bosque pluvial montano bajo, epifitas en bosque secundario, collected 16 January 2017, prepared 31 March 2017, A.P. Karremans, D. Bogarín, M.

Cedeño, I. Chinchilla, M. Díaz, E. Kaes, P. Lehmann and O. Zúñiga 7574 (Holotype, JBL-spirit [E1253]; Fig. 29, 33g).

Similar to *E. sanchoi* but distinguished by scandent (vs. bushy) plant, with a longer inflorescence (2 vs. 1 cm long), with conspicuous (vs. inconspicuous) floral bracts and typically 5 flowers (vs. 3 or 4), that have purple stripes radiating on the external surface of the lip (vs. pale green throughout), the floral bracts are larger (4.5–5.0 vs. 2.5–3.0 mm long), covering the ovary (vs. not covering the ovary) the longer sepals (5.7–5.9 vs. 4.5–5.0 mm) that are narrowly ovate to lanceolate (vs. ovate-elliptic), the longer and broader petals (4.9–5.0 × 0.9–1.0 vs. 4.2–4.3 × 0.5 mm) and ecallose lip (vs. lip with callus-like longitudinal depressions flanking the midvein).

Epiphytic, pseudo-monopodial, scandent, branching, *herb*, up to 60 cm tall. Roots 1 mm in diameter, fleshy. *Stems* branching, cane-like, terete, somewhat flexuous, covered by rugose sheaths; the main stems tall, with short branches. *Leaves* many, distributed along the stem, deciduous, concentrating towards the apex with age; leaf sheath up to 3.5 cm long, tubular, rugose, greenish-brown, becoming papery with age; blades 5.5 × 0.5 cm on the main stems, 1.2–1.7 × 0.2–0.4 cm on the branches, thick coriaceous, oblong-ligulate, unequally bilobed. *Inflorescence* 2 cm long, produced from the branches, racemose, distichous, sub-secund, erect to suberect, congested, rachis sinuous, with two sharp angles on the side facing the ovary, verruculose. *Floral bracts* 4.5–5.0 mm long, large, as long as the ovary, acute, notoriously dominating the inflorescence before anthesis. *Flowers* 4–5, greenish-cream throughout, lip externally with pale purple, radiating stripes, anther pale purple. *Ovary* cylindrical, elongate, 4.3 mm long, slightly bent. *Sepals* free, spreading widely, reflexed, narrowly ovate to lanceolate, with a thickened dorsal apiculum; dorsal sepal 5.7 × 1.6 mm; lateral sepals 5.7–5.9 × 2.2–2.3 mm, notoriously divergent. *Petals* 4.9–5.0 × 0.9–1.0 mm, free, spreading-reflexed, held out backwards, linear-ligulate, acute. *Lip* 4.5 × 2.7 mm, fused to the column, fleshy, triangular, base truncate, corners rounded, ecallose, apex thickened, acute, margins thickened and elevated, apex notoriously conically thickened, resulting in a deeply concave base. *Column* 2.3 mm long, short, terete, stout, apically truncate, slightly bent downwards with respect to the ovary. *Anther* sub-spherical dorsally, ventrally thin, with irregular margins, 4-celled. *Pollinia* 4, obovoid, laterally compressed, caudicles soft and granulose. *Capsule* not seen.

Etymology: From the Spanish *colibrí*, hummingbird, in reference to the disposition of the flowers.

Habitat and distribution: The species is only known from high elevations between 2157 and 2550 m in the southern part of the Cordillera de Talamanca.

Phenology: It was recorded blooming in March and September.

Additional specimens examined: COSTA RICA. Puntarenas: Buenos Aires, P.N. La Amistad, cuenca Térraba-Sierpe, puesto Tres Colinas, 9°09'42"N, 83°04'01"W, 2550 m, 15 September 1996, *Billen Gamboa R. and A. Picado 569* (CR-INB; AMO-photo).

Epidendrum colibri is florally similar to *E. sanchoi* but immediately distinguished by the scandent plant, with a

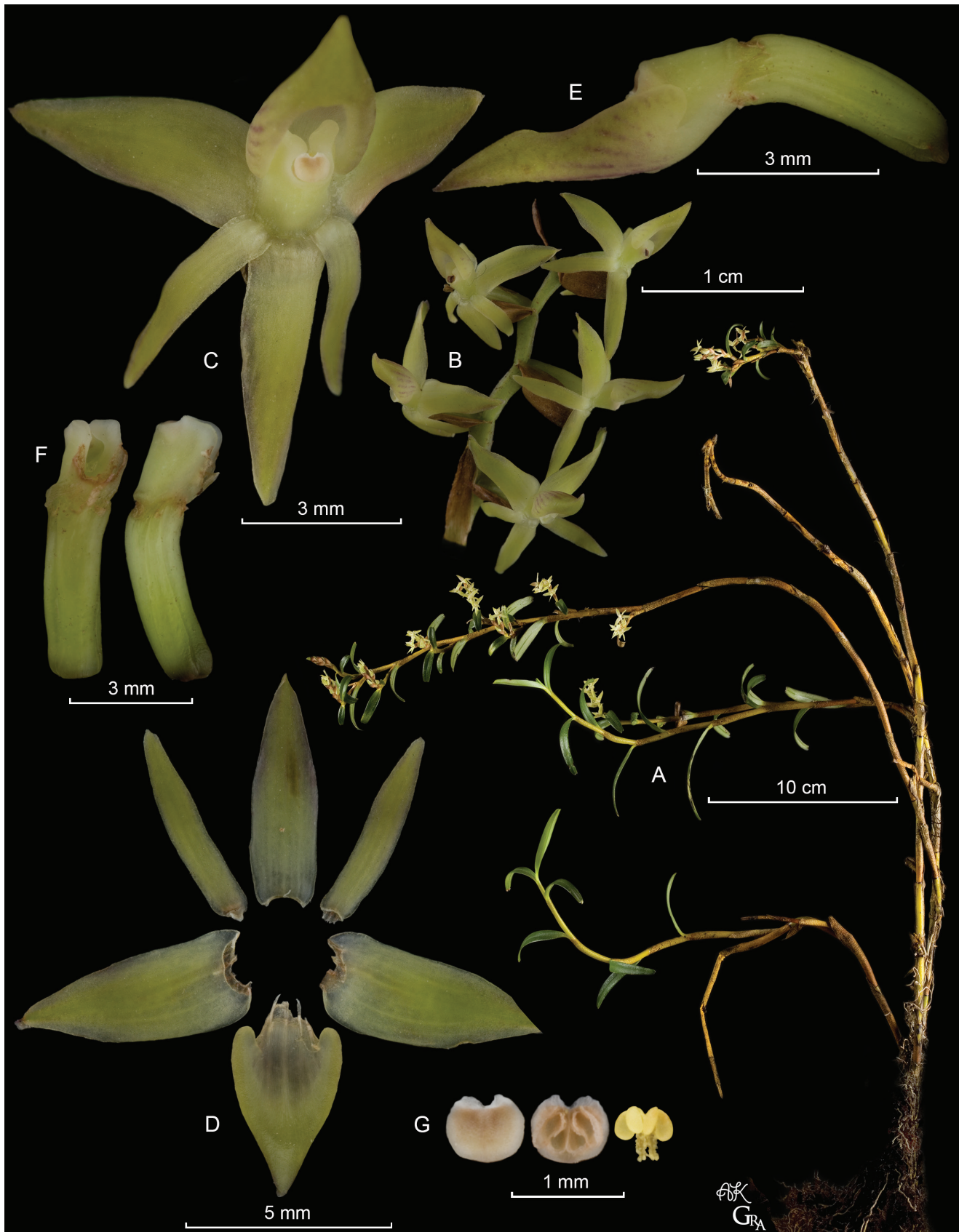


FIGURE 29. LCDP of *Epidendrum colibri* Karremans. **A**, Habit; **B**, Detail of the inflorescence; **C**, Flower; **D**, Dissected perianth; **E**, Lip and column lateral view; **F**, Column lateral and ventral views; **G**, Anther cap and pollinarium views. By G. Rojas-Alvarado and APK based on Karremans 7574 (JBL-spirit).

longer inflorescence typically bearing 5 flowers, conspicuous floral bracts that cover the ovary and by the lip with radiating purple stripes externally. It is also similar to *E. microcardium* but can be easily distinguished by the bird-like disposition of the flowers with the sepals and petals spreading-reflexed and held backwards, the larger flowers, with an externally striped lip and the notoriously thickened conical apex.

Epidendrum microcardium Schltr., Repert. Spec. Nov. Regni Veg. Beih. 19: 39. 1923. TYPE: COSTA RICA. Tablazo, 1921, *C. Wercklé III* [Holotype, B, destroyed; lectotype, AMES [39893], selected by Pupulin (2010)].

Epiphytic, bushy, branching, *herb*, up to 55 cm tall. Roots 1 mm in diameter, fleshy. *Stems* branching conspicuously, cane-like, terete, covered by rugose sheaths; main stem tall, with short branches. *Leaves* many, distributed along the stem, deciduous, concentrating towards the apex with age; leaf sheath up to 2.6 cm long, tubular, rugose, brownish when young, becoming papery with age; leaf blade up to 5.0 × 0.8 cm on the main stems, 1.7–3.6 × 0.4–0.6 cm on the branches, coriaceous, oblong, unequally bilobed. *Inflorescence* up to 2.5 cm long, sub-erect, from the branches, racemose, distichous, sub-secund, erect, congested, with

two sharp angles on the side facing the ovary. *Floral bracts* 4.0–4.5 mm long, as long as or slightly exceeding the ovary, acute. *Flowers* 5–10, tiny, pale green throughout. *Ovary* 4 mm long, cylindrical, elongate, bent at the apex. *Sepals* free, not spreading, more or less sub-parallel the column and lip, oblong-elliptic, acute with an apical dorsal keel; dorsal sepal 4.4 × 1.3 mm; lateral sepals 4.1–4.2 × 1.6 mm. *Petals* 3.7–3.8 × 0.5 mm, free, not spreading, rather sub-parallel to the column, linear-ligulate, acute. *Lip* 3.8–3.9 × 2.3 mm, fused to the column, short, fleshy, triangular, base truncate-subcordate, corners rounded, apex acute, thick, with the margins elevated and thickened, slightly elevated at the base, not quite forming a callus. *Column* 2.3–2.4 mm long, terete, with a very subtle bend with respect to the ovary, embraced by the lip. *Anther* sub-trapezoid, thin, 4-celled, margins irregular. *Pollinia* 4, obovoid, laterally compressed, caudicles soft and granulose. *Capsule* not seen. *Description based only on *Karremans 8420*.

Etymology: From the Greek *μικρός*, small, and *καρδιά*, heart, probably referring to the small heart-shaped lip.

Habitat and distribution: Currently known from el Tablazo and Cerro Chompipe (Fig. 30), in Central Costa Rica. It was found growing at around 2200 m in elevation.



FIGURE 30. View of the forest around Cerro Chompipe in Heredia, where *E. microcardium* Schltr. grows. By APK

Phenology: Flowering was registered in August and December.

Additional specimens examined: COSTA RICA. Heredia: Heredia-San Rafael, San Rafael-Vara Blanca, Cerro Chompipe, orillas del camino a la antena cerca de la cumbre, 10°5'4"N, 84°4'22"W, 2220 m, bosque pluvial premontano, 12 December 2020, A.P. Karremans and M. Contreras Fernández 8420 (JBL-spirit, Fig. 31, 33h). San José: Cordillera de Talamanca, Reserva Privada Cerros de Escazú, Finca El Cedral, 9°51'30"N, 84°08'40"W, 2200 m, 8 August 1996, A. Cascante, H. Gómez, M. Valerio et al. 1106 (CR-107093; AMO-photo).

Epidendrum microcardium was described as having a decurved, 5–10-flowered inflorescence, with bracts that exceed the ovary, oblong, acute sepals, ca. 4 mm long, linear-ligulate petals similar in length and an ovate-cordate lip. Those distinctive features can also be observed on the lectotype specimen. They correspond well with the specimen illustrated (Karremans 8420), and not with the concept of *Epidendrum microcardium* sensu Hágsater and Sánchez-Saldaña (2008), which is here described as *Epidendrum globuliferum* Karremans.

The plant habit and flower shape resemble those of the *E. sanchoi* alliance, but the elongate, decurved inflorescence, bearing 5–10 flowers with non-spreading segments, and large bracts that exceed the ovary, set *E. microcardium* aside immediately.

***Epidendrum globuliferum* Karremans, sp. nov.**

TYPE: COSTA RICA. Alajuela: San Carlos, Quesada, Volcán Platanar, 10°17'43"N, 84°22'18"W, 1890 m, 17 April 2021, A.P. Karremans, I. Chinchilla, K. Gil, G. Rojas-Alvarado and A. Serna 8665 (Holotype, JBL-spirit, Fig. 32, 33i).

Synonym: *Epidendrum sanchoi* Ames var. *exasperatum* Ames & C. Schweinf., Sched. Orchid. 10: 1930. TYPE: COSTA RICA. Heredia: Cerro de las Lajas, North of San Isidro, 2000–2400 m, March 7, 1926. P.C. Standley and J. Valerio 51488 (Holotype: AMES [33597]; US [139768]).

Similar to *Epidendrum sanchoi* but easily distinguished by the globose flower with reflexed tepals, the sepals are broader (2.2–2.6 vs. 1.6–2.0 mm wide) and obtuse (vs. acute), the petals are broader (1.0 vs. 0.5 mm wide), narrowly oblanceolate and obtuse (vs. linear-ligulate, acute), and the lip is sub-globose to broadly ovate, base somewhat cordate (vs. triangular, base truncate), and has a prominent hoof-like callus (vs. with a pair of longitudinal depressions flanking the mid-vein).

Epiphytic, pseudo-monopodial, branching, erect to pendent herb, up to 50 cm tall. Roots 1 mm in diameter, fleshy. Stems branching conspicuously, cane-like, terete, covered by rugose sheaths; the main stem long, with short to medium branches. Leaves many, distributed along the stem, deciduous, concentrating towards the apex of the branches with age; leaf sheath up to 2.0 cm long, tubular, rugose, green when young, becoming brownish and papery with age; leaf blade up to 4.2 × 0.5 cm on the main stems, typically much smaller on the branches 2.1–2.6 × 0.3–0.5 cm on the branches, coriaceous, oblong, unequally bilobed. Inflorescence 1.0–1.5 cm long, short, sessile,

from the branches, racemose, distichous, sub-second, erect to suberect, lax, with two sharp angles on the side facing the ovary, slightly sinuous. Floral bracts 2–3 mm long, shorter than the ovary, acute. Flowers 4–6, typically 5, pale green throughout, globose, with the tepals reflexed and somewhat revolute. Ovary 4–5 mm long, cylindrical, elongate. Sepals free, spreading widely, becoming reflexed, broadly elliptic, obtuse, with a short apiculum; dorsal sepal 4.6–4.7 × 2.2 mm; lateral sepals 4.8–5.0 × 2.4–2.6 mm, bent outwards, divergent. Petals 4.6–4.7 × 1.0 mm, free, spreading, reflexed, curved towards the dorsal sepal, narrowly oblanceolate, obtuse. Lip 4 × 2 mm, fused to the column, short, fleshy, sub-globose to broadly ovate, base somewhat cordate, corners rounded, apex acute, thick, margins significantly thickened and elevated, with a hoof-like elevated callus at the base of the blade. Column 3.0–3.1 mm long, terete, slightly bent downwards with respect to the ovary, conspicuously embraced by the lip. Anther sub-spherical externally, cellular-glandular, internally very thin, 4-celled, margins irregular. Pollinia 4, obovoid, laterally compressed, caudicles soft and granulose. Capsule not seen.

Etymology: From the Latin *globuliferus*, bearing small spherical clusters, in reference to the appearance of the multiple inflorescences with several tiny, globose flowers.

Habitat and distribution: All specimens that correspond well with this taxon were collected in the same general area on the slopes of the Barva, Poás and Platanar volcanos on the Cordillera Volcánica Central, in Costa Rica. The species grows in high elevation, humid forests at around 2000 m.

Phenology: Flowering from January to May in the field.

Additional specimens examined: COSTA RICA. Heredia: Cerro de las Lajas, North of San Isidro, 2000–2400 m, 7 March 1926. P.C. Standley and J. Valerio 51535 (AMES). Cerros de Zurquí, northeast of San Isidro, 3 March 1926, P. C. Standley and J. Valerio 50685 (AMES). Idem, P. C. Standley and J. Valerio 50722 (AMES). Cerro de las Caricias, north of San Isidro, 11 March 1926, P. C. Standley and J. Valerio 52326 (AMES). Idem, P. C. Standley and J. Valerio 52394 (AMES; US; AMO-photo). San Rafael, Concepción, Residencial El Castillo, Calle Lobo, falda oeste del Cerro Turú, 10°3'52.2"N, 84°03'43.2"W, 1840 m, bosque muy húmedo montano bajo, epífitas en potreros arbolados, 19 March 2009, D. Bogarín 6438, R.L. Dressler, R. Gómez, F. Pupulin and R. Trejos (JBL-D2814; JBL-D6157). San Rafael, Reserva Biológica “El Chompipe” adjacent to Parque Nac. Braulio Carrillo along forest/pasture edge on SE ridge of Río Segundo, 10°05'00"N, 84°05'00"W, 1950–2000 m, 9 January 1991, S. Ingram and K. Ferrell 842 (CR-148225; AMO-photo). Alajuela: Viento Fresco, 13 February 1926, P. C. Standley and R. Torres Rojas 47726 (AMES; US; AMO-photo). Laguna de Alfaro Ruiz, April 1923, O. Jiménez and C. H. Lankester 2009 (AMES). Alfaro Ruiz, Palmira, 2200 m, 2 March 1938, A. Smith H375 (SEL [9762]; AMO-photo). Alfaro Ruiz, Palmira, 2200 m, 9 May 1938, A. Smith H530 (SEL [9762]; AMO-photo).

This species was originally described as a variety of *Epidendrum sanchoi* Ames, and later treated as a synonym of *E. microcardium* Schltr. (Hágsater and Sánchez-Saldaña, 2008). However, *E. globuliferum* is quite distinct

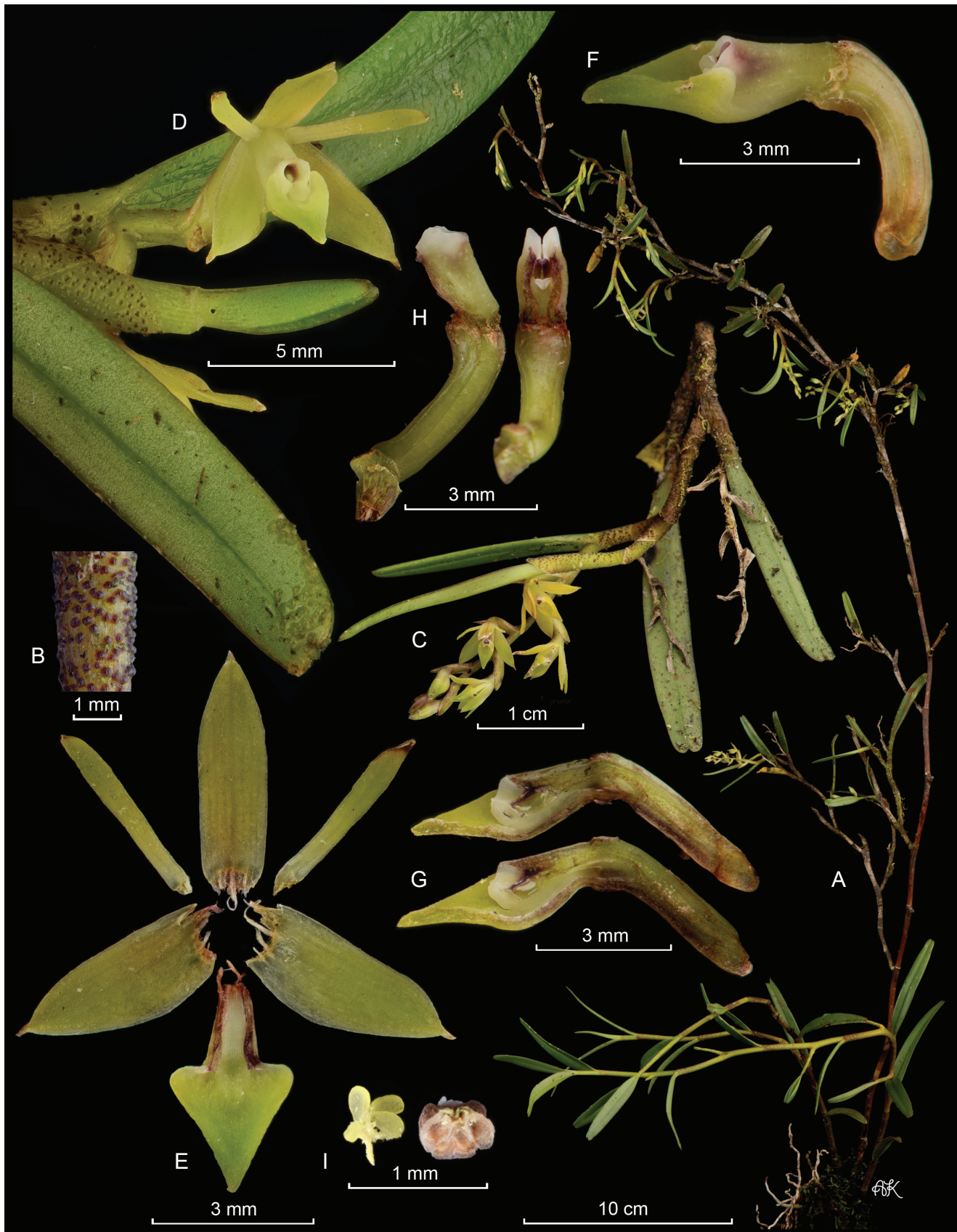


FIGURE 31. LDCP of *Epidendrum microcardium* Schltr. **A**, Habit; **B**, Detail of the rugose leaf sheaths; **C**, Detail of the stem and inflorescence; **D**, Flower; **E**, Dissected perianth; **F**, Lip and column lateral view and transversal section; **G**, Lip and column transversal section; **H**, Column lateral and ventral views; **I**, Anther cap and pollinarium. By APK based on *Karremans 8420* (JBL-spirit).

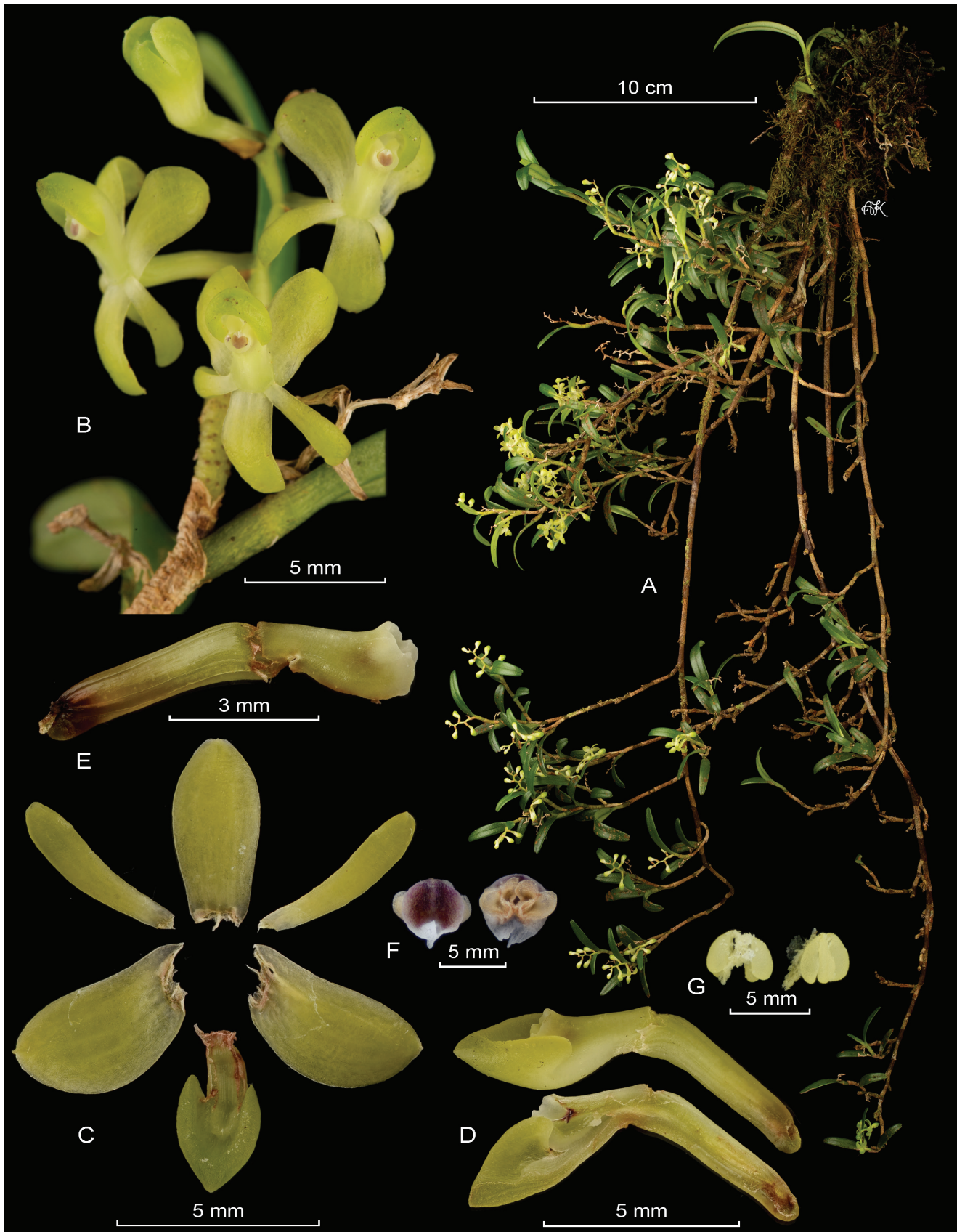


FIGURE 32. LCDP of *Epidendrum globuliferum* Karremans. A, Habit; B, Detail of the inflorescence; C, Dissected perianth; D, Lip and column lateral view and transversal section; E, Column lateral view; F, Anther cap views; G, Pollinarium views. By APK based on Karremans 8665 (JBL-spirit).

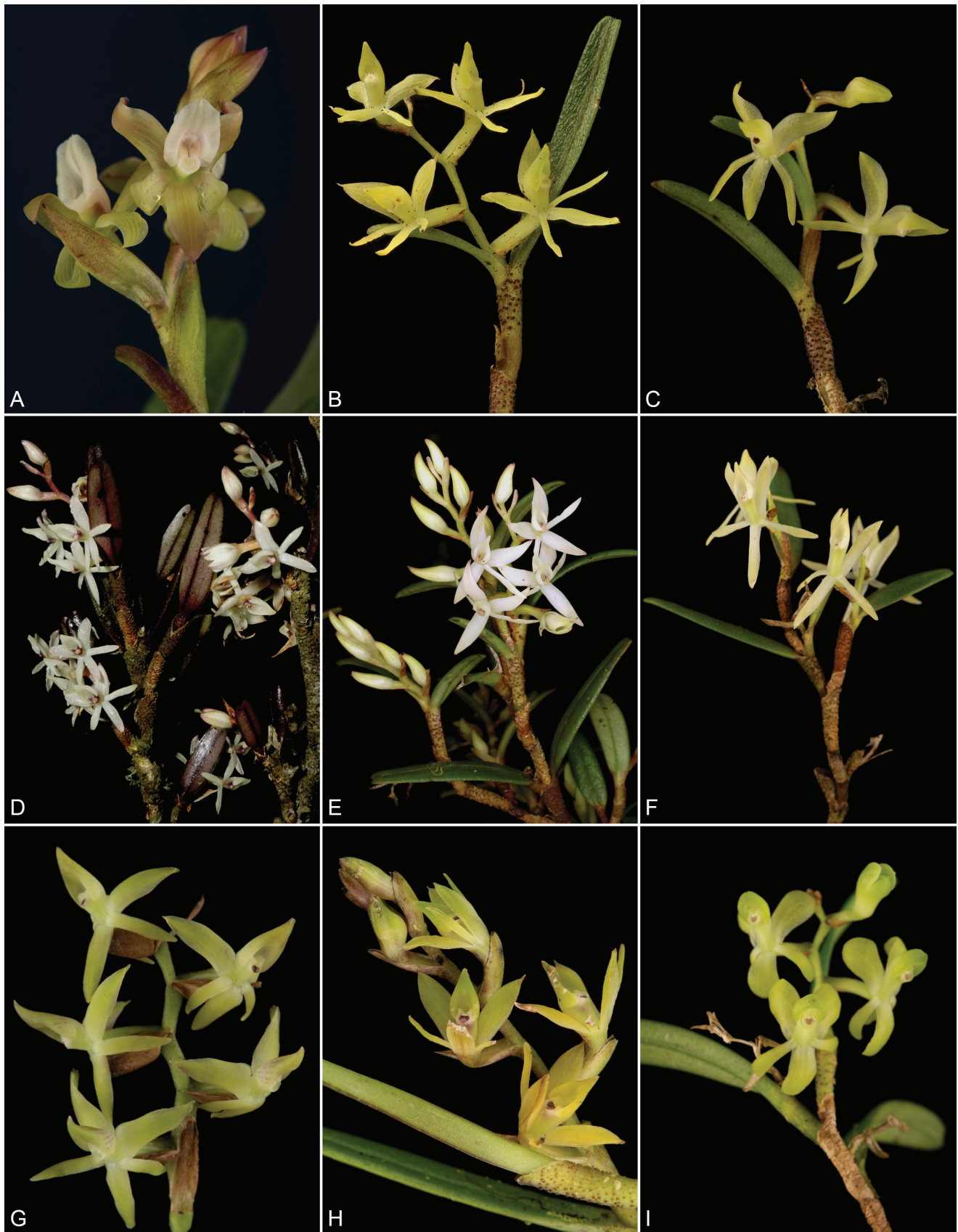


FIGURE 33. Inflorescence comparison of *Epidendrum* species. **A**, *E. nativitatis* (AK7490); **B**, *E. sanchoi* (AK8795); **C**, *E. aeolicum* (AK8601); **D**, *E. utyumii* (EKs.n.). **E**, *E. sidereum* (EKs.n.); **F**, *E. saltatrix* (AK8785); **G**, *E. colibri* (AK7574); **H**, *E. microcardium* (AK8420); **I**, *E. globuliferum* (AK8665). Photographs by APK (A–C, F–I) and E. Kaes (D–E).

from *E. sanchoi* and *E. microcardium*, both illustrated here. *Epidendrum microcardium* is described as having a decurved, 5–10-flowered inflorescence, with bracts that exceed the ovary, acute sepals, linear petals, whereas *E. globuliferum* features a 4–6-flowered inflorescence, bracts significantly shorter than the ovary, sepals broad and obtuse, and petals narrowly oblanceolate. These and other distinguishing features are easily observable on the lectotype specimen of *E. microcardium* (AMES-39893).

Epidendrum globuliferum is closely related *E. sanchoi* and its allies, but easily can be distinguished by the globose flower with reflexed tepals, the sepals are broad and obtuse, the petals are narrowly oblanceolate, wider above the middle and obtuse, and the lip is sub-globose to broadly ovate, with the base somewhat cordate and the blade margin notoriously thickened and provided with a prominent horse-shoe like callus. The new taxon should replace the concept of *Epidendrum microcardium* sensu Hágsater and Sánchez-Saldaña (2008). Nevertheless, not all the specimens cited therein refer to the newly proposed taxon, some are of different taxa, including the actual *E. microcardium*. Those that could be reliably assigned to *E. globuliferum* are cited here, they have all been collected in relatively nearby locations in the mountains of the provinces of Heredia and Alajuela, at around 2000 m in elevation. No collections have been made on the Cordillera de Talamanca, where most of its close relatives occur.

***Epidendrum conservatorium* Karremans, sp. nov.**

TYPE: COSTA RICA. Heredia: Heredia, Vara Blanca, Calle la Legua, epífitas en bosque a orilla del camino, bosque pluvial montano bajo, 10°15'21"N, 84°8'44"W, 1170 m, 13 October 2021, A.P. Karremans, I. Chinchilla and G. Rojas-Alvarado 8950 (Holotype, JBL-spirit; Fig. 34).

Similar to *E. monophlebium* Hágsater but distinguished by the inflorescence with a straight rachis (vs. flexuous) bearing 2–3 flowers (vs. 4–6), that open in slow succession (vs. simultaneous), the longer floral bracts (5.5–6.5 vs. 2–4 mm), the longer ovary (5 vs. 2–4 mm), larger flowers, the sepals 6.6–7.9 × 1.9–2.6 mm (vs. 4.0–5.0 × 1.2–1.5 mm), the petals 6.0–6.9 mm long (vs. 4.5–5.0) and longer blade of the lip (4.5 vs. 2.7–3.0 mm), the petals are 3-nerved (vs. 1-nerved) and the lip is narrowly triangular and acute (vs. triangular and acuminate), with a notoriously thickened, elevated apex (vs. fleshy, not elevated).

Epiphytic, pseudo-monopodial, branching, *herb*, up to 35 cm tall. Roots 1 mm in diameter, fleshy. *Stems* branching conspicuously, cane-like, terete, somewhat flexuous, covered by rugose sheaths; producing many short and long branches. *Leaves* many, distributed along the stem, deciduous, concentrating towards the apex with age; leaf sheath up to 1.3 cm long, tubular, rugose, reddish-brown, becoming papery with age; blades of a branched plant 2.4–4.3 × 0.4–0.5 mm, thick coriaceous, narrowly ovate to oblong, unequally bilobed. *Inflorescence* 1.4–1.9 cm long, produced from the branches, racemose, distichous, subsecund, sub-erect, congested, successive, rachis straight. *Floral bracts* 5.5–6.5 mm long, longer than the ovary, acute, verruculose. *Flowers* 2–3, typically 3, opening in slow succession with the first flower opening long before all buds

are developed, light green throughout, occasionally with a light copper hue on the sepals, especially on the apiculum, naturally facing more or less downwards. *Ovary* 5 mm long, terete, elongate, broadening apically. *Sepals* free, spreading widely, lanceolate, with a prominent, thickened apiculum; dorsal sepal 6.6–7.7 × 1.9–2.0 mm; lateral sepals 6.8–7.9 × 2.3–2.6 mm, margins somewhat recurved. *Petals* 6.0–6.9 × 0.6 mm, free, spreading, with a strong backwards bend, narrowly linear-lanceolate, slightly, straight, acute, 3-nerved. *Lip* 5.5–6.3 × 2.2–2.4 mm, fused to the column, free blade 4.5 mm long, short, fleshy, narrowly triangular, base truncate, corners rounded, with a three-lobed callus just above the base of the blade, apex notoriously thickened, acute, margins thickened and slightly elevated. *Column* 2.8–3.1 mm, short, terete, straight with respect to the ovary. *Anther* sub-ovoid, thin, 4-celled, cellular-glandular. *Pollinia* 4, obovoid, laterally compressed, caudicles soft and granulose.

Etymology: The epithet *conservatorium* collectively honors those people who have contributed to the conservation of biodiversity at every level. A thank you for their effort and dedication. They are aware that once any element of biodiversity is lost, it is lost forever.

Habitat and distribution: The species is only known from the humid Caribbean watershed of the Central Cordillera in the provinces of Alajuela and Heredia in Costa Rica, where it grows at mid elevations between 950 and 1170 m on the northern slopes of the Barva and Poás volcanos (Fig. 35).

Phenology: It was recorded blooming in October and November.

Additional specimens examined: COSTA RICA. Alajuela: Río Cuarto, ruta 708, hacia Pueblo Nuevo, epífitas en potrero arbolado a orillas del camino, bosque pluvial premontano, 10°16'24.42"N, 84°14'58.85"W, 1000 m, 13 October 2021, A.P. Karremans, I. Chinchilla and G. Rojas-Alvarado 8955 (JBL-spirit). Heredia: Forest between Río Peje and upper Guácimo, Atlantic slope of Volcán Barva, 10°17'N, 84°05'W, 950–1150 m, 11 November 1986, M.H. Grayum, G. Herrera and M. Santana 7791 (CR).

Epidendrum conservatorium seems to be relatively frequent, yet restricted in distribution to the northern-caribbean slopes of the Barva and Poás volcanos on the Central Cordillera in Costa Rica. The plant typically has a pseudo-monopodial habit with taller main stems that gradually branch, the few flowers open in slow succession and typically face downwards. It belongs to the *E. sanchoi* alliance, where the notorious three-dentate callus on the base of the lip blade places it close to the Costa Rican endemic *E. monophlebium* and the Panamanian endemic *E. hornitense* Hágsater & L.Sánchez. From the first, *E. conservatorium* can be distinguished by the inflorescence with a straight rachis, bearing 2–3 flowers, that open in slow succession, the longer floral bracts and ovary, the larger flowers, the petals that are 3-nerved and the lip that is narrowly triangular and acute, with a notoriously thickened, elevated apex. From the latter it can be distinguished by few-flowered inflorescence that is slowly successive (vs. up to 6 flowers, simultaneous), the larger flowers, with all perianth segments being notoriously longer and wider, the sepals (6.6–7.9 × 1.9–2.6 vs.

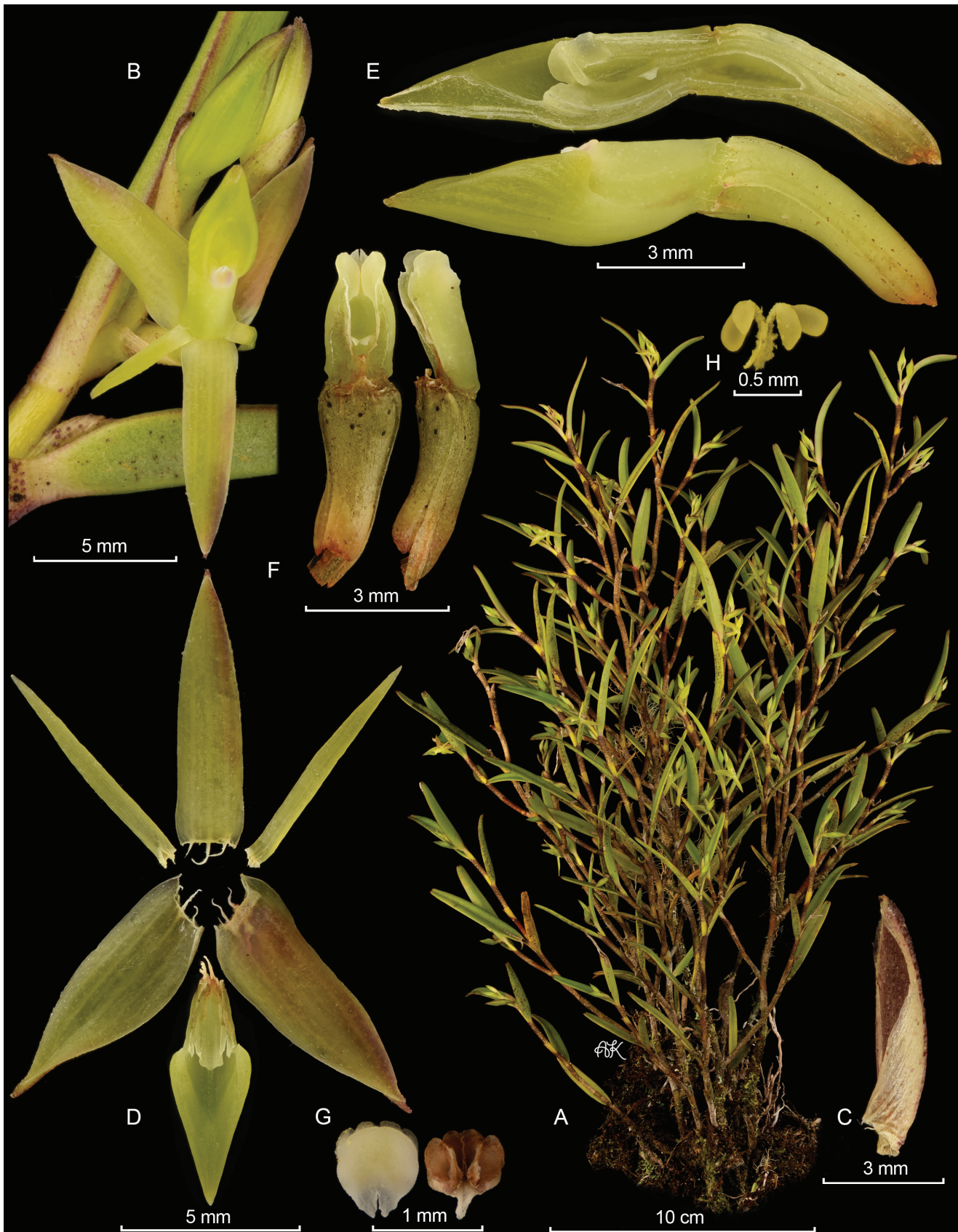


FIGURE 34. Illustration of *Epidendrum conservatorum* Karremans. A, Habit; B, Inflorescence; C, Floral bract; D, Dissected perianth; E, Lip and column lateral view; F, Column lateral and ventral views; G, Anther cap views; H, Pollinarium views. By APK based on Karremans 8950 (JBL-spirit).



FIGURE 35. *Epidendrum conservatorum* Karremans growing epiphytically in situ near Río Cuarto in Alajuela, Costa Rica. By APK.

4.2–4.5 × 0.9–1.1 mm), the petals (6.0–6.9 × 0.6 vs. 4.0–4.2 mm × 0.05–0.1 mm) and the lip blade (4.5 × 2.2–2.4 vs. 3.0–3.2 mm × 1.1–1.3 mm), the longer column (2.8–3.1 mm vs. 1.2–1.4 mm).

Epidendrum santaelenae Karremans, *sp. nov.*

TYPE: COSTA RICA. Costa Rica. Guanacaste: Abangares, Sierra, Selvatura, hacia la Reserva Bosque Nuboso Santa Elena, 10°20'15"N, 84°48'38"W, 1600 m, bosque nuboso de Monteverde, collected 18 April 2021, prepared 18 October 2021, A.P. Karremans, I. Chinchilla, K. Gil, G. Rojas-Alvarado and A. Serna 8710 (Holotype, JBL-spirit; Fig. 36).

Similar to *E. monopplebium* but distinguished by the inflorescence with a straight rachis (vs. flexuous), the longer ovary (4.7 vs. 2–4 mm), larger flowers, the sepals 5.6–6.1 × 1.7–2.1 mm (vs. 4.0–5.0 × 1.2–1.5 mm), the petals 5.0–5.1 mm wide (vs. 0.5) and longer blade of the lip (4.0 vs. 2.7–3.0 mm), the petals are 3-nerved (vs. 1-nerved), narrowly elliptic and obtuse (vs. linear and acute), and the lip is acute with a rounded apex (vs. acuminate), with a notoriously thickened, elevated apex (vs. fleshy, not elevated).

Epiphytic, bushy, pseudo-monopodial, branching, *herb*, up to 30 cm tall. Roots 1 mm in diameter, fleshy. *Stems* branching conspicuously, cane-like, terete, somewhat flexuous, covered by rugose sheaths; main stem tall, with short branches. *Leaves* many, distributed along the stem, deciduous, concentrating towards the apex with age; leaf sheath up to 1.1 cm long, tubular, rugose, reddish-brown, becoming papery with age; leaf blade 2.0–2.3 × 0.5 cm on the main stems, 1.0–1.5 × 0.3–0.4 cm on the branches, coriaceous, oblong, unequally bilobed. *Inflorescence* up to 1.8 cm long, produced from the branches, racemose, distichous, sub-secund, erect, congested, more or less simultaneous, rachis straight, with two sharp angles on the side facing the ovary, verrucose. *Floral bracts* 1.0–1.5 mm long, much shorter than the ovary, acute. *Flowers* 3–5, opening more or less simultaneously, light green throughout. *Ovary* 4.7 mm long, terete, elongate, straight. *Sepals* free, spreading widely, elliptic, with a prominent, thickened apiculum; dorsal sepal 5.6–5.7 × 1.7 mm; lateral sepals 5.9–6.1 × 2.0–2.1 mm. *Petals* 5.0–5.1 × 0.9–1.0 mm, free, spreading, narrowly elliptic, obtuse, apiculate, 3-nerved. *Lip* 5.2 × 2.6 mm, fused to the column, free blade 4.0 mm long, short, fleshy, triangular, base truncate, corners rounded, with a three-lobed callus on the first third of the blade, apical portion notoriously thickened, acute, rounded apex, margins thickened and slightly elevated. *Column* 2.2–2.3 mm, short, terete, bent with a 45 degree angle with respect to the ovary. *Anther* disk-like, 4-celled, cellular-glandular. *Pollinia* 4, obovoid, laterally compressed, caudicles soft and granulose.

Etymology: The name honors Santa Elena, the head town of the newly established Monteverde canton. Monteverde is a well-known tourist destination in Costa Rica thanks to its lush cloud forest and the immense national and international efforts to conserve its most unique biodiversity. The new species was collected on the road to one of its crown jewels, the Reserva Bosque Nuboso Santa Elena.

Habitat and distribution: This species is only known from the Monteverde Cloud Forest on the Guanacaste

mountain range in northern Costa Rica where it grows at around 1500–1600 m in elevation.

Phenology: It was recorded blooming between mid October and mid November (coincidentally specimens were prepared on the same date in 1963, 1978 and 2021).

Additional specimens examined: COSTA RICA. Puntarenas: Monteverde, 1400–1700 m, 18 October 1978, C. Todzia 485 (CR-72301). Monteverde, en propiedad de Mr. W. James, alt. 1500 m, 18 October 1963, A. Jiménez M. 1254 (CR-57539). Upper San Gerardo, 2 km NE Santa Elena on border of Monteverde Reserve, 10°21'N, 84°48'W, 1550 m, 20 November 1988, W. Haber and W. Zuchowski 8814 (CR-158644).

Epidendrum santaelenae is currently known only from the Monteverde area. The habit and greenish flowers with a fleshy, more or less triangular lip are similar to those of several other species in the *E. sanchoi* alliance. However, the notorious three-dentate callus near the base of the lip blade places it close to *E. monopplebium* from which it can be distinguished by the inflorescence with a straight rachis, the longer ovary and larger flowers, the petals that are narrowly elliptic, obtuse and 3-nerved, and the lip that is acute with a rounded apex, with a notoriously thickened, elevated apex.

Epidendrum spiculiferum Karremans & Bogarín, *sp. nov.*

TYPE: COSTA RICA. Puntarenas: Coto Brus, Sabalito, Zona Protectora Las Tablas, 15 km al noreste de Lucha, Sitio Tablas, Finca Sandí-Hartmann “El Chompipe,” camino a El Surá, 8°57'0.63"N, 82°44'59.72"W, 2017 m, bosque pluvial montano bajo, 10 December 2013, A.P. Karremans, D. Bogarín, M. Fernández and L. Sandoval 6079 (Holotype, JBL-spirit [D6337]; Isotype, JBL-spirit [D6610]; Fig. 37, 38a).

Reminiscent of *E. lancilabium* Schltr. in the compact plants with thick, semi-terete leaves and relatively large flowers borne on a short, few-flowered inflorescence. However, it may be distinguished by the green flowers (vs. purplish-brown), the longer and narrower sepals (9.0–9.9 × 2.5–2.7 vs. 8.0–9.0 × 2.8–3.2 mm) that are acuminate (vs. acute) and apically decurved (vs. straight), the longer (8.4 vs. 4.5–7.2), bent (straight) lip and the slender, terete column (vs. short and thick) that is notoriously bent (vs. straight).

Epiphytic, bushy, branching, *herb*, up to 15–20 cm tall. Roots 1 mm in diameter, fleshy. *Stems* branching, cane-like, terete, somewhat flexuous, covered by rugose sheaths; the main stem tall, with short branches. *Leaves* many, sticking out more or less erect, distributed along the stem, deciduous, concentrating towards the apex with age; leaf sheath up to 1.5 cm long, tubular, rugose, brownish-purple; blades thick coriaceous, linear-spiculate, subterete 1.5–4.0 × 0.2 cm. *Inflorescence* produced from the branches, racemose, distichous, sub-secund, very short, congested. *Floral bracts* shorter than the ovary, acute, verruculose. *Flowers* solitary, light green throughout, sepal apices purplish-green. *Ovary* cylindrical, bent. *Sepals* free, spreading, somewhat decurved apically, narrowly-elliptic to lanceolate, acuminate, margins apically thickened, forming a prominent, sharp apiculum; dorsal sepal 9.0 × 2.5 mm; lateral sepals 9.8–9.9 × 2.7 mm. *Petals* 7.4–7.6 × 0.2 mm, free, spreading, somewhat decurved apically, narrowly elliptic, acute. *Lip* 8.4 × 2.8–2.9

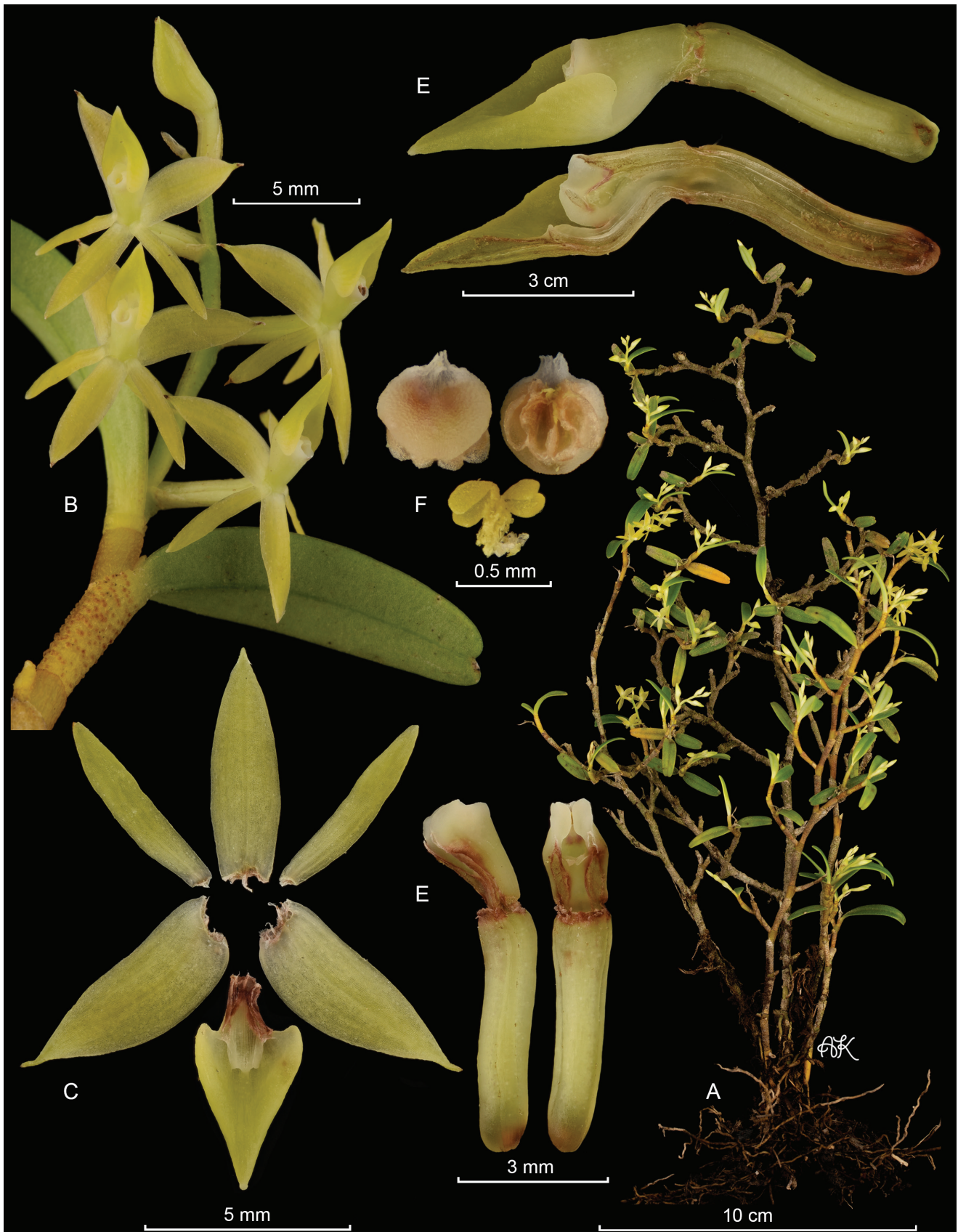


FIGURE 36. Illustration of *Epidendrum santaelenae* Karremans. A, Habit; B, Inflorescence; C, Dissected perianth; D, Lip and column lateral view and transversal section; E, Column lateral and ventral views; F, Anther cap and pollinarium views. By APK based on Karremans 8710 (JBL-spirit).

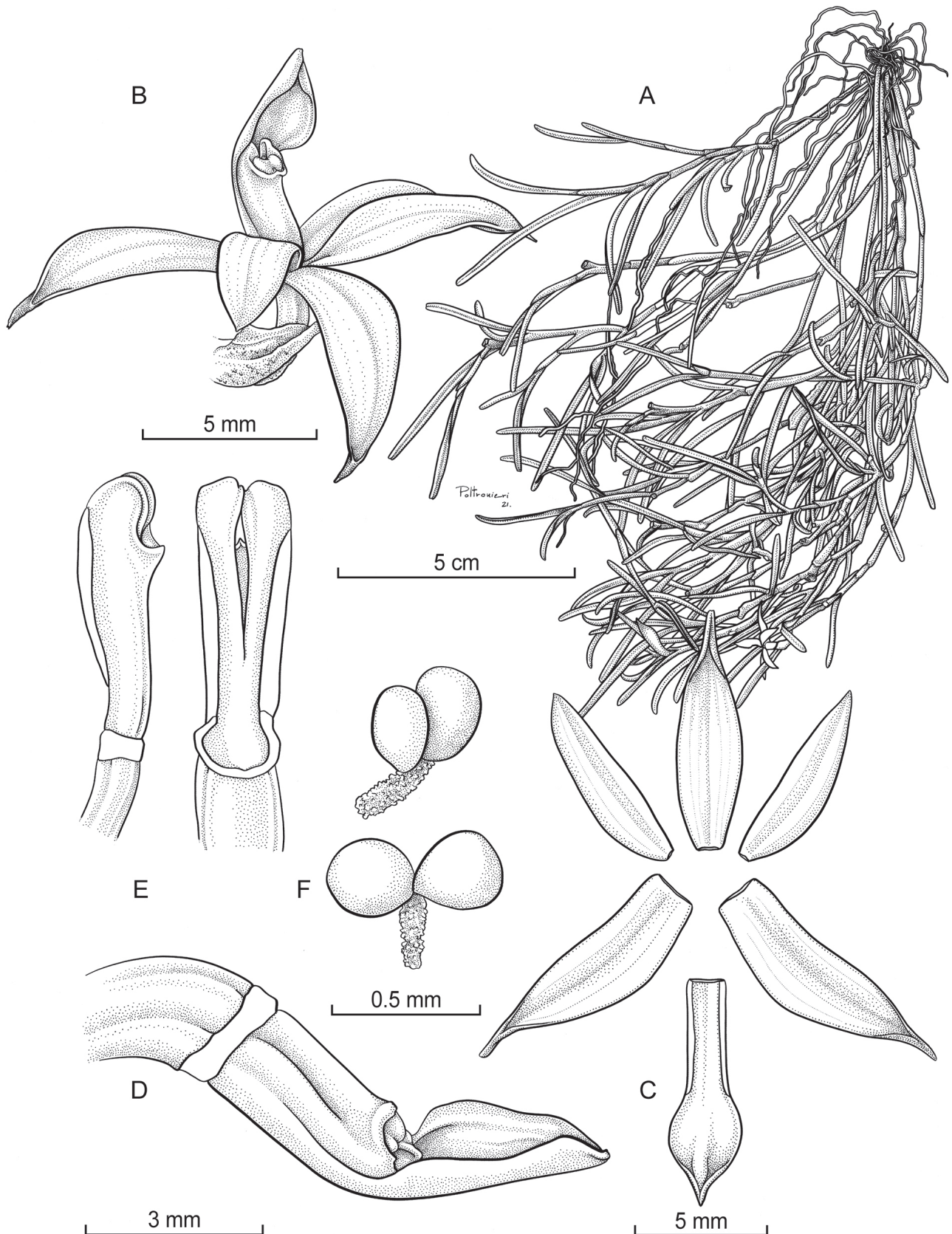


FIGURE 37. Illustration of *Epidendrum spiculiferum* Karremans & Bogarín. **A**, Habit; **B**, Flower; **C**, Dissected perianth; **D**, Lip and column lateral view and transversal section; **E**, Column lateral and ventral views; **F**, Pollinarium views. By D. Bogarín and S. Díaz Poltronieri based on Karremans 6079 (JBL-spirit).

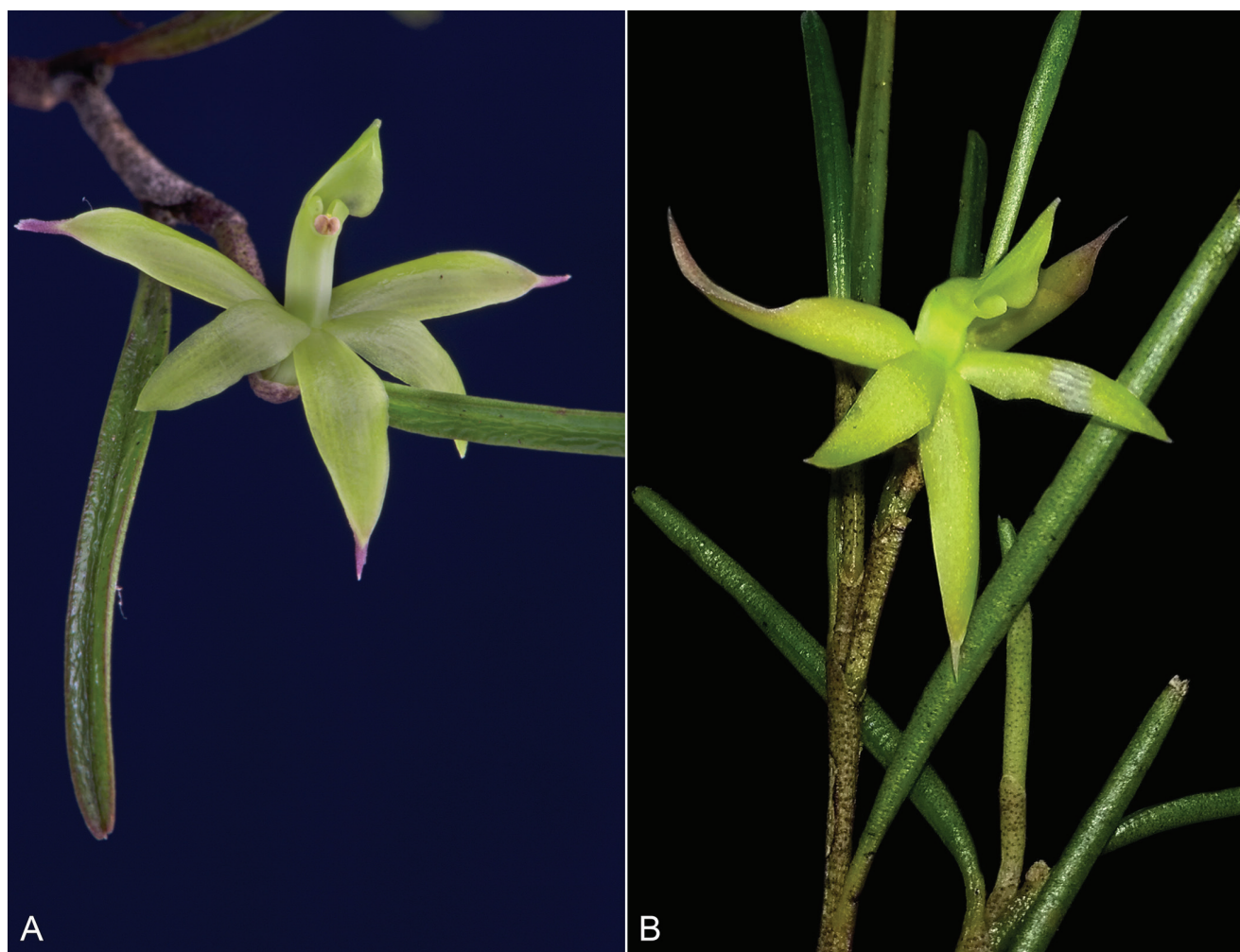


FIGURE 38. Photographs of *Epidendrum spiculiferum* Karremans & Bogarín. **A**, Karremans 6079 (JBL-spirit); **B**, Karremans 8050 (JBL-spirit). By D. Bogarín (A) and APK (B).

mm, fused to the column, bent, fleshy, lanceolate-spathulate, ecallose, apex thickened, shortly acuminate, margins thickened and slightly elevated. *Column* 4 mm long, terete, bent above 45 degrees with respect to the ovary at the base, and bent again in the opposite direction apically. *Anther* not seen. *Pollinia* 4, obovoid, laterally compressed, caudicles soft and granulose. *Capsule* not seen.

Etymology: From the Latin *spiculifer*, spicule bearing, in reference to the long pointy leaves and acuminate perianth parts.

Habitat and distribution: The species is only known from the Southern Talamanca range in Costa Rica where it has been found only on two occasions growing at elevations ca. 1900–2000 m.

Phenology: It was recorded blooming in February and April.

Additional specimens examined: COSTA RICA. Limón: Talamanca, Bratsi, antes de llegar a la fila Bugu, 9°24'38"N, 83°12'02"W, 1883 m. Transtalamanca, ruta de los conquistadores, día 4, 27 April 2017, A.P. Karremans, M. Cedeño, I. Chinchilla, E. Kaes, G.A. Rojas-Alvarado, O. Zuñiga 8050 (JBL-E1311; Fig. 38b).

Epidendrum capitalinum* Karremans, *sp. nov.

TYPE: COSTA RICA. San José: Moravia-Vásquez de Coronado, San Jerónimo-Jesús, sobre la antigua calle Carrillo entre San Jerónimo y el Alto La Palma. Parte más alta, antes de bajar al Bajo de La Hondura, 10°2'49"N, 83°59'15"W, 1530 m, 29 June 2021, A.P. Karremans and I. Chinchilla 8837 (Holotype, JBL-spirit; Fig. 39).

The tiny erect habit with many short branches and rugose sheaths is suggestive of members of the *E. rugosum* subgroup, but the inflorescence and flowers are rather reminiscent of the *E. ramosum* subgroup. The flowers are superficially similar to *E. pseudoramosum* Schltr. but easily distinguished by the much smaller habit and flowers, the plant up to 20 cm tall (vs. up to 55 cm), the inflorescence up to 1.5 cm long (vs. up to 3 cm), the floral bracts 3–4 mm long (vs. 9.5–13.5 mm), the sepals 3.0–3.1 × 1.3–1.5 mm (vs. 5.0–5.6 × 1.5–2.6 mm), the petals 2.6–2.7 × 0.4–0.5 mm (vs. 5.0–5.7 × 1.0–1.2 mm) and the lip blade 1.8 × 1.9 mm (vs. 3.5–4.0 × 3.0–4.2 mm), the sepals are lanceolate and acute (vs. oblong-elliptic and obtuse), and the column is shorter (1.4 vs. 2–3 mm).

Epiphytic, bushy, pseudo-monopodial, branching, *herb*,

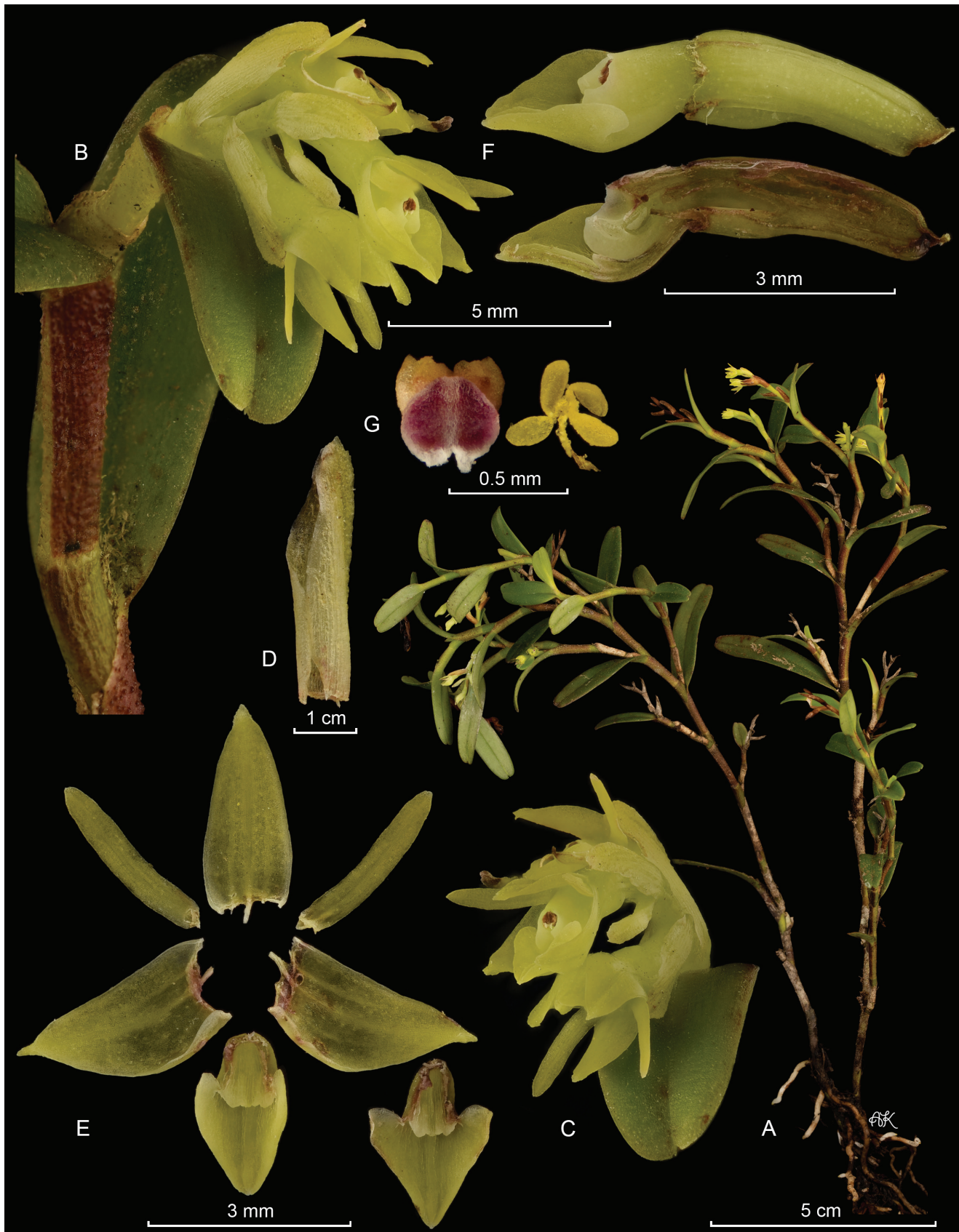


FIGURE 39. Illustration of *Epidendrum capitalinum* Karremans. A, Habit; B, Stem and inflorescence; C, Inflorescence detail; D, Floral bract; E, Dissected perianth; F, Lip and column lateral view and transversal section; G, Anther cap and pollinarium views. By APK based on Karremans 8837 (JBL-spirit).

up to 20 cm tall. Roots 1 mm in diameter, fleshy. *Stems* branching conspicuously, cane-like, terete, somewhat flexuous, covered by rugose sheaths; main stem tall, with many short branches. *Leaves* many, distributed along the stem, deciduous, concentrating towards the apex with age; leaf sheath up to 9 mm long, tubular, rugose, reddish-green, becoming papery with age; leaf blade 2.2–2.9 × 0.4–0.6 cm on the main stems, smaller on the branches, coriaceous, oblong, unequally bilobed. *Inflorescence* up to 1.5 cm long, produced from the branches, racemose, distichous, sub-secund, erect to sub-erect, congested, more or less simultaneous, rachis straight. *Floral bracts* 3–4 mm long, similar in length ovary, acute. *Flowers* 1–3, opening more or less simultaneously, light green throughout. *Ovary* 3 mm long, terete, elongate, straight, somewhat inflated towards the apex. *Sepals* free, spreading only very partially, lanceolate, with a thickened, verruculose apiculum, 3-nerved; dorsal sepal 3.0 × 1.3 mm; lateral sepals 3.0–3.1 × 1.4–1.5 mm. *Petals* 2.6–2.7 × 0.4–0.5 mm, free, spreading, linear-ligulate, acute, 1-nerved. *Lip* 2.4–2.5 × 1.9 mm, fused to the column, free blade 1.8 mm long, short, fleshy, triangular-cordate, base truncate, corners rounded, with a three-lobed callus at the base and an elevated keel to the apex of the blade, acute, rounded apex, with a short apiculum. *Column* 1.4 mm, short, terete, straight with respect to the ovary. *Anther* ovoid, 4-celled, cellular-glandular. *Pollinia* 4, obovoid, laterally compressed, caudicles soft and granulose.

Etymology: The name alludes to the capital of Costa Rica, the city of San José. The type locality of this species is in the outskirts of the city and the fact that botanical novelties may still be found only 16 km distance from the very center of the capital city is one of those features that make the country unique in the world. Its narrow distribution in the expanding metropolitan area raises immediate conservation concerns.

Habitat and distribution: This tiny species is currently known only from the Alto La Palma north-east of the city of San José in the Central Valley of Costa Rica, where it grows epiphytically at elevations between 1400–1530 m.

Phenology: It was recorded blooming between August and October.

Additional specimens examined: COSTA RICA. San José: Moravia-Vásquez de Coronado, San Jerónimo-Jesús, sobre la antigua calle Carrillo entre San Jerónimo y el Alto La Palma. Parte más alta, antes de bajar al Bajo de La Hondura, 10°2'49"N, 83°59'15"W, 1530 m, collected 29 June 2021, prepared 26 October 2021, *A.P. Karremans and I. Chinchilla* 8838 (JBL-spirit). Idem, prepared 18 November 2021, *A.P. Karremans and I. Chinchilla* 8831 (JBL-spirit). La Palma de San José, 1400–1500 m, 12 August 1979, *C. Todzia* 683 (CR-72282).

Epidendrum chespiritorum Karremans, *sp. nov.*

TYPE: COSTA RICA. Cartago: El Guarco, San Isidro, Madreselva, Tres de Junio, Carretera Interamericana Sur, km 67, entrada a la finca El Jaular, 9°40'13"N, 83°51'56"W, 2610 m, bosque pluvial montano, en bosque secundario de Robles a orillas de la carretera, 25 June 2021, *A.P. Karremans and I. Chinchilla* 8810 (Holotype, JBL-spirit; Fig. 40).

Similar to *E. anoglossoides* but distinguished by the flattened, ancipitose stems (vs. cylindrical), the notoriously arching-nutant, pendent inflorescence (vs. inflorescence erect to suberect, more or less straight), bearing few flowers 2–5 (vs. flowers several, up to 9), the floral bracts longer (7.0–8.5 vs. 5–7 mm), the longer sepals (9.8–10.0 vs. 8.0–9.5 mm) and petals (8.6–8.8 vs. 7.7–8.2 mm), and the longer and narrower lip (6.7–7.5 × 3.5–4.0 mm vs. 6 × 6 mm).

Epiphytic or terrestrial branching *herb*, up to 45 cm tall, scandent, producing roots well above the base, becoming entangled with the surrounding vegetation. *Roots* 1 mm in diameter, fleshy. *Stems* branching conspicuously, cane-like, terete at the base, becoming notoriously flattened-ancipitose towards the apex, covered by rugose, ancipitose sheaths. *Leaves* many, distributed along the stem; leaf sheath 1.5–2.5 cm long, flattened, ancipitose, rugose, green when young, becoming brownish with age; blade 24–37 × 6–10 mm, thick coriaceous, oblong, unequally bilobed. *Inflorescence* up to 6 cm long, arching-nutant, becoming pendent, from the branches, racemose, distichous, sub-secund, congested, compressed, ancipitose, rachis triquetrous-ancipitose, edges sharp. *Floral bracts* 7.0–8.5 mm long, completely covering and slightly exceeding the ovary, acute, decurrent on the rachis. *Flowers* +5, greenish-yellow throughout. *Ovary* 6.5–7.5 × 3.0 mm, cylindrical, inflated, straight. *Sepals* free, spreading, acute with an apical dorsal keel; dorsal sepal 9.8–10.0 × 2.3–2.5 mm, sub-parallel to the column, oblong to sub-lanceolate; lateral sepals 9.9–10.0 × 2.8–3.3 mm, recurved, twisted, lanceolate to narrowly ovate. *Petals* 8.6–8.8 × 0.9–1.0 mm, free, spreading, recurved, linear-narrowly lanceolate, margin undulate, acute. *Lip* 6.7–7.5 × 3.5–4.0 mm, fused to the column, fleshy, hard, triangular-cordate, base with corners rounded, apex acuminate, margins thickened and elevated, embracing the apex of column without covering it, with a tridentate callus below the stigma, and a low central keel on the free portion. *Column* 3.0 mm long, thick, straight, with a slight bend with respect to the ovary. *Anther* dorsally showing an elevated sub-trapezoid structure, with a pair of flap-like tails, ventrally reniform, thin, 4-celled, margins irregular. *Pollinia* 4, obovoid, laterally compressed, caudicles soft and granulose. *Capsule* not seen.

Etymology: *Los Chespiritos* are local food serving establishments that have become an obligatory stop for anyone doing fieldwork on the Cerro de la Muerte. I first became acquainted with this species while visiting *Los Chespiritos 1* as a college student. Their name derives from Chespirito, a Mexican sketch comedy show created by and starring comedian and actor Roberto Gómez Bolaños, whose nickname gave the show its title.

Habitat and distribution: Only known from high elevations above 2400 m growing in oak forests on the Talamanca mountain ranging south of Cartago in Costa Rica to Bocas del Toro province in Panama.

Phenology: It has been recorded blooming in January to July.

Additional specimens examined: COSTA RICA. San José: Perez Zeledón. Macizo de La Muerte. Sobre la carretera Panamericana, Ojo de Agua, frente a restaurante Los Chespiritos 1, a la derecha de la entrada del Parque

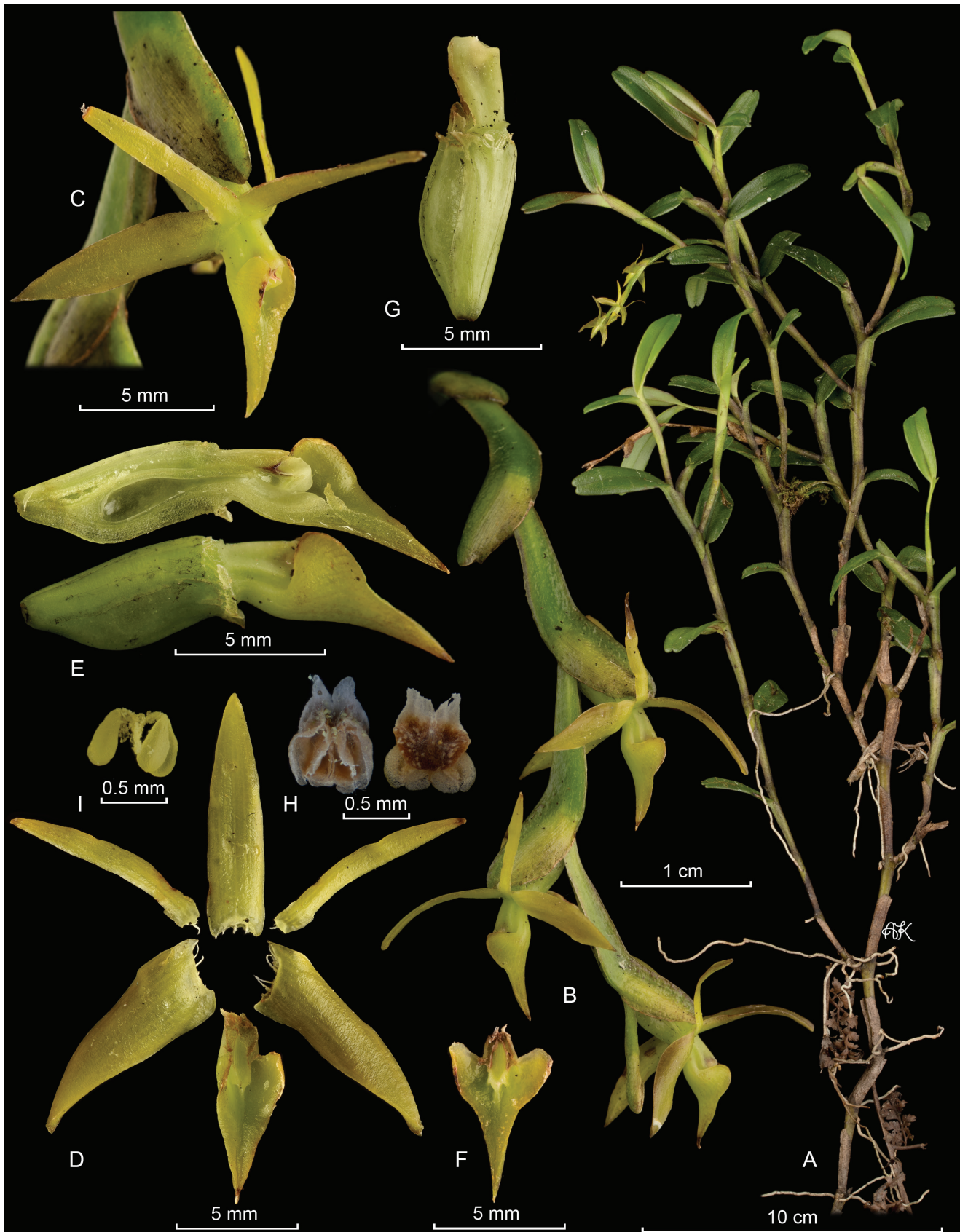


FIGURE 40. LCDP of *Epidendrum chespiritorum* Karremans. A, Habit; B, Detail of the inflorescence; C, Flower; D, Dissected perianth; E, Lip and column lateral view and transversal section; F, Lip flattened; G, Column lateral view; H, Anther cap views; I, Pollinarium. By APK based on *Karremans 8810* (JBL-spirit).

Nacional Los Quetzales, 24 May 2007, A.P. Karremans and Fruticultura SA-UCR 1769 (JBL-D1340; JBL-D1254). San José: Pérez Zeledón, Cerro de la Muerte, sobre sendero hacia antenas del ICE, 9°40'52.10"N, 83°51'20.11"W, 2715 m, bosque montano de robledales, 26 May 2016, A.P. Karremans, J. Alomía, N. Davin and M. Díaz 7207 (JBL-E1258). [San José: Pérez Zeledón]; Cordillera de Talamanca near Villa Mills, 9°33'N, 83°41'W, 2700 m, 15 January 1990, Merz and Bittner 660 (CR; AMO-photo). Estación Cuericí, camino a la Auxiliadora, 2 km E de Villa Mills, 9°33'15"N, 83°41'25"W, 2800 m, 8 July 1996, Billen Gamboa 459 (INB-CR; AMO-photo). Pan American Highway up Talamanca Range, km 57, 2400 m, 2 August 1967, R. Lent 1167 (CR-58051). Carretera panamericana (Cerro de la Muerte), km 65, 26 September 1984, R.L. Dressler 36 (AMO; USJ). Cartago: El Cañon Guarco, 2400–2500 m, 13 March 1981, prep. 30 April 1981, Hágsater and Horich 6461 (CR; AMO-2307; AMO-2308; color photos AMO; pl. 907 in Hágsater and Sánchez-Saldaña 2007). Idem, prep. 30 April 1981 (AMO-3045). South of Cartago, along Inter-American Highway, Cordillera de Talamanca, km. 69, A. Meerow, L. Besse and K. Tan 1173 (SEL-053592; AMO-photo). Cerro de la Muerte, "El Jardín," 2800 m, 20 May 1956, L.O. Williams 20204 (SEL-009573). Limón: Talamanca. P.N. Cordillera de Talamanca, flanco NE y cumbre Cerro Biricuacua entre Ujarrás y San José Cabécar, 9°23'55"N, 83°10'10"W, 2600 m, 6 April 1993, G. Herrera and W. Gamboa 6233 (AMO-17215; AMO-17216; MO-51550111). PANAMA. Bocas del Toro: headwaters of Río Colubre (Colubre camp.), 2400–2550 m, 3 March 1984, L.D. Gómez, I. Chacón, G. Davidse and D. Herrera 22373 (CR-103758; AMO-photo).

Epidendrum chespirtorum has been readily confused with *E. anoglossoides* (Hágsater and Sánchez-Saldaña 2007). Even though florally similar, *E. anoglossoides* in the sense of the type has terete stems and an erect to suberect inflorescence, whereas the stems of *E. chespirtorum* are conspicuously flattened and ancipitose and the inflorescence is notoriously arching-nutant, typically pendent. The floral segments are also longer, and the lip is narrower. *Epidendrum chespirtorum* grows on very high elevations above 2400 m on the Talamanca mountain range southwards into Panama, while *E. anoglossoides* is only known from lower elevations between 1600 and 2400 m on the mountains north of the Central Valley, in the provinces of Alajuela and Heredia in central Costa Rica.

Two Panamanian records for *E. anoglossoides* are cited in literature (Hágsater and Sánchez-Saldaña, 2007; Bogarín et al., 2014). Neither correspond to *E. anoglossoides* in the sense of the type, and the species is therefore here excluded from Panama. L.D. Gómez et al. 22373 is here included among the paratypes of *E. chespirtorum* Karremans, while G. McPherson 9418 (MO-3432762) is the first Panamanian record of *E. jorge-warneri* Karremans & Hágsater.

***Epidendrum sinac* Karremans, sp. nov.**

TYPE: COSTA RICA. Heredia: San José de la Montaña, Parque Nacional Braulio Carrillo, sector Volcán Barva, crater principal Laguna Barva, 10°8'00.5"N, 84°6'22.6"W, 2846 m, 12 October 2021, A.P. Karremans, I. Chinchilla, G. Rojas-Alvarado and Y. Mena 8900 (Holotype, JBL-spirit; Fig. 41).

Similar in habit to *E. anoglossoides* but distinguished immediately by the inflorescence bearing only 3–4 flowers (vs. up to 9), the glaucous, non-spreading floral parts (vs. pale green, spreading), the elliptic (vs. triangular-lanceolate) sepals that are much broader (dorsal sepal 3.8–3.9 vs. 2 mm, lateral sepals 4.7–4.9 vs. 3 mm), the narrowly elliptic to oblanceolate petals (vs. narrowly linear) and the larger (blade 7.0 × 7.3 mm vs. 6.0 × 6.0 mm), broadly ovate, obtuse lip (vs. 3-lobed, acuminate) with irregular margins (vs. straight), and the presence of a notorious, erect, tooth-like midlobe on the column (vs. absent).

Epiphytic, branching, herb, up to 100 cm tall, scandent, producing roots well above the base, becoming entangled with the surrounding vegetation. Roots 1 mm in diameter, fleshy. Stems branching conspicuously, cane-like, terete, becoming somewhat flattened towards the apex, covered by leaf sheaths. Leaves many, distributed along the stem; leaf sheath up to 3.2 cm long, flattened towards the apex, becoming ancipitose, rugose, green when young, turning brownish with age and disintegrating; blade 31–62 × 7–14 mm, coriaceous, oblong, unequally bilobed. Inflorescence up to 3 cm long, arching-nutant, from the branches, racemose, distichous, sub-secund, congested, compressed, ancipitose, rachis triquetrous-ancipitose, edges sharp. Floral bracts 7 mm long, completely covering and exceeding the ovary, acute, decurrent on the rachis. Flowers 3–4, opening in succession, light green throughout, with a glaucous hue. Ovary 6.5 mm long, terete, with a slight bend. Sepals free, spreading only partially, elliptic, obtuse, margin microscopically glandular, with a short apiculum; dorsal sepal 9.6–9.7 × 3.8–3.9 mm; lateral sepals 9.3–9.5 × 4.7–4.9 mm. Petals 9.0–9.2 × 2.2–2.6 mm, free, spreading only partially, narrowly elliptic to oblanceolate, margin glandular-irregular, apically truncate, with an inconspicuous apiculum to one side. Lip 9.0 × 7.3 mm, fused to the column, free blade 7 mm long, fleshy, broadly ovate, with a three-lobed callus from the base to the middle of the blade, and a fleshy central keel, margins irregular, apex notoriously thickened, obtuse, in natural position lateral lobes fully erect, stiff, completely enclosing the column. Column 4 mm, short, terete, slightly bent with respect to the ovary, with a tooth-like, central lobe. Anther sub-ovoid, with a pair of conspicuous flap-like tails, thin, 4-celled, cellular-glandular. Pollinia 4, obovoid, laterally compressed, caudicles soft and granulose.

Etymology: The name honors the Sistema Nacional de Áreas de Conservación (SINAC), an agency of the Costa Rican Ministry of Environment (MINAE) in charge of managing the protected areas in the country. Its mission is the conservation and sustainable use of biodiversity and natural resources, and I would like to take the opportunity to recognize the great efforts of its staff in protecting the country's biodiversity. The new species was discovered while exploring the area around the crater of Barva volcano within the Braulio Carrillo National Park, which is administered by SINAC. Our team of researchers was kindly allowed access and accompanied by the local rangers.

Habitat and distribution: The species is only known from the high elevation oak forests between 2600 and 2846 m around the main crater of the Barva volcano in the Braulio Carrillo National Park (Fig. 42).

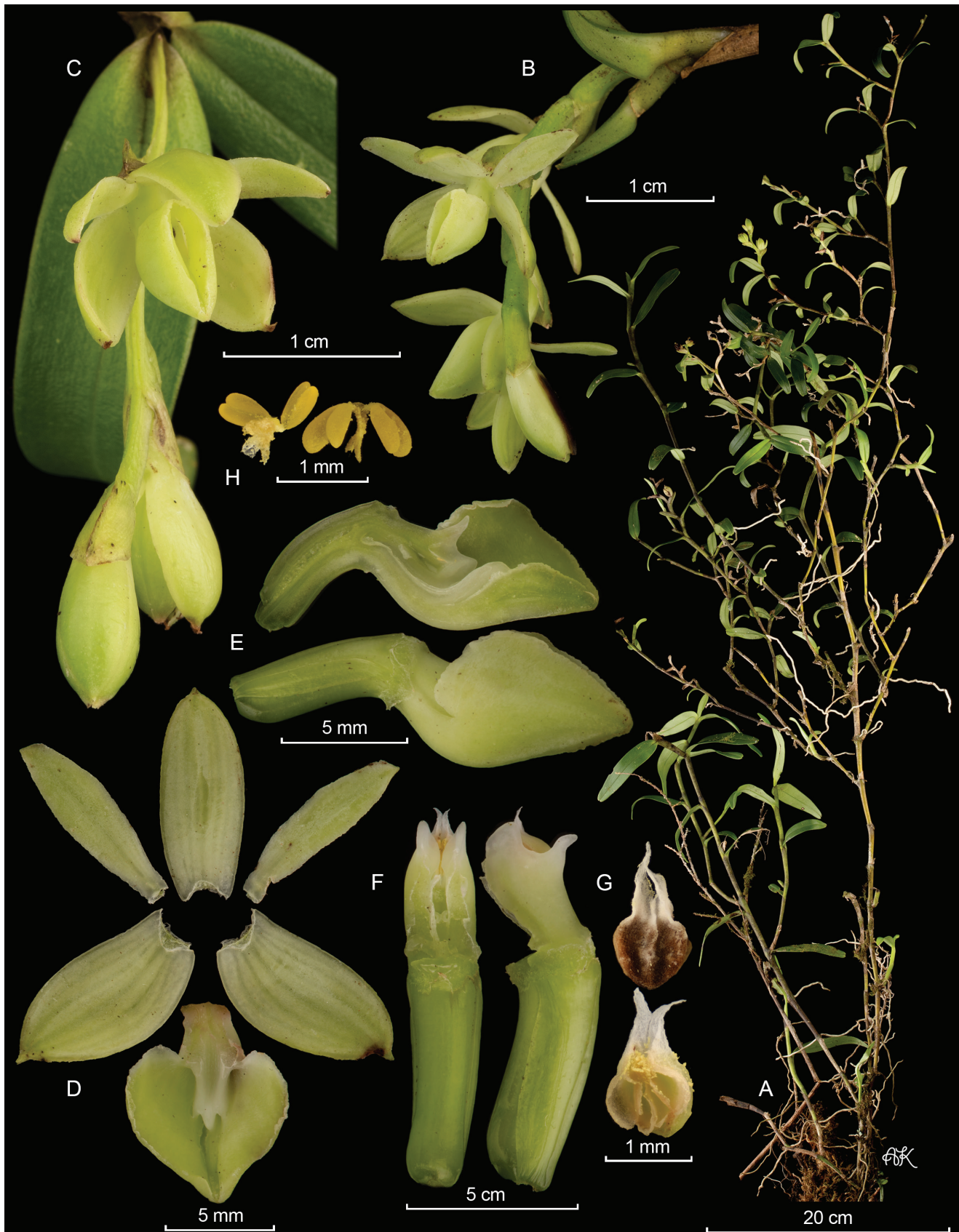


FIGURE 41. Illustration of *Epidendrum sinac* Karremans. A, Habit; B, Stem and inflorescence; C, Inflorescence detail; D, Dissected perianth; E, Lip and column lateral view and transversal section; F, Column lateral view; G, Anther cap views; H, Pollinarium views. By APK based on *Karremans 8900* (JBL-spirit).



FIGURE 42. Habitat at the type locality of *E. sinac* Karremans in the Braulio Carrillo National Park in Costa Rica, showing the Laguna Barva in the main crater of the Barva Volcano. By APK.

Phenology: It was recorded blooming in October.

Additional specimens examined: COSTA RICA. Heredia: San José de la Montaña, Parque Nacional Braulio Carrillo, sector Volcán Barva, sendero hacia el crater principal Laguna Barva, 10°8'8"N, 84°6'38"W, 2790 m, 12 October 2021, A.P. Karremans, I. Chinchilla, G. Rojas-Alvarado and Y. Mena 8899 (JBL-spirit). Heredia: Parque Nacional Braulio Carrillo, sendero Cerro Guararí, 10°7'35"N, 84°7'00"W, 2600 m, 9 October 1989, G. Rivera 128a (CR).

The general habit and inflorescence of *E. sinac* is reminiscent of *E. anoglossoides* and *E. chespiritorum*, however it is florally quite distinct. The flowers, especially the very broad, thick lip with rigid, erect, irregular margins and the column with a notorious, tooth-like midlobe are similar to *E. nutantirhachis* Ames & C.Schweinf. instead.

Epidendrum jorge-warneri Karremans & Hágsater, Lankesteriana 13: 260. 2014. TYPE: COSTA RICA. Puntarenas: Buenos Aires, Buenos Aires, Olán, cumbre del Cerro Tinuk, 9°17'29.1"N, 83°10'11.2"W, 2417 m, bosque pluvial premontano, epífitas en bosque de páramo, 25 July 2012, A.P. Karremans, D. Bogarín, D. Jiménez, and V.H.

Zúñiga 5545 (Holotype, CR; Isotype, JBL-spirit; Fig. 43).

Epiphytic, sympodial, caespitose, erect *herb*, up to 20 cm tall. *Roots* from the base up to above half the length of the stems, fleshy, filiform. *Stem* 15–20 cm tall, branching conspicuously, cane-like, laterally flattened, erect. *Leaves* up to 5, distributed along the stem, mostly close to the apex as the basal ones fall off with time; leaf sheath tubular, rugose, 1.5 cm long; blade 2.8–3.6 × 0.8–1.3 cm, elliptic to narrowly-ovate, obtuse bilobed, articulate. *Spathaceous bracts* lacking. *Inflorescence* apical, mostly from lateral branches, racemose, distichous, sub-secund, flowering only once; peduncle up to 2 cm long; rachis curved, laterally flattened. *Floral bracts* equal to longer than the ovary, acute, flattened, 1 cm long. *Flowers* 2–4, simultaneous, resupinate, brownish-yellow; fragrance sweet during the day. *Ovary* 8.0–8.5 mm, laterally compressed, prominently inflated throughout. *Sepals* free, spreading, the dorsal prominently bent inwards, narrowly-ovate to elliptic, acute, 9-veined, margin entire; the dorsal sepal 15 × 3.5 mm; the lateral sepals 15 × 4.0–4.5 mm, oblique. *Petals* 13.0–13.5 × 1.5–2.0 mm, spreading, strongly bent backwards, ligulate to narrowly-elliptic, obtuse, 3-veined, margin entire. *Lip* 12.5 × 5.5–6.0 mm, united to the column, ovate-lanceolate,

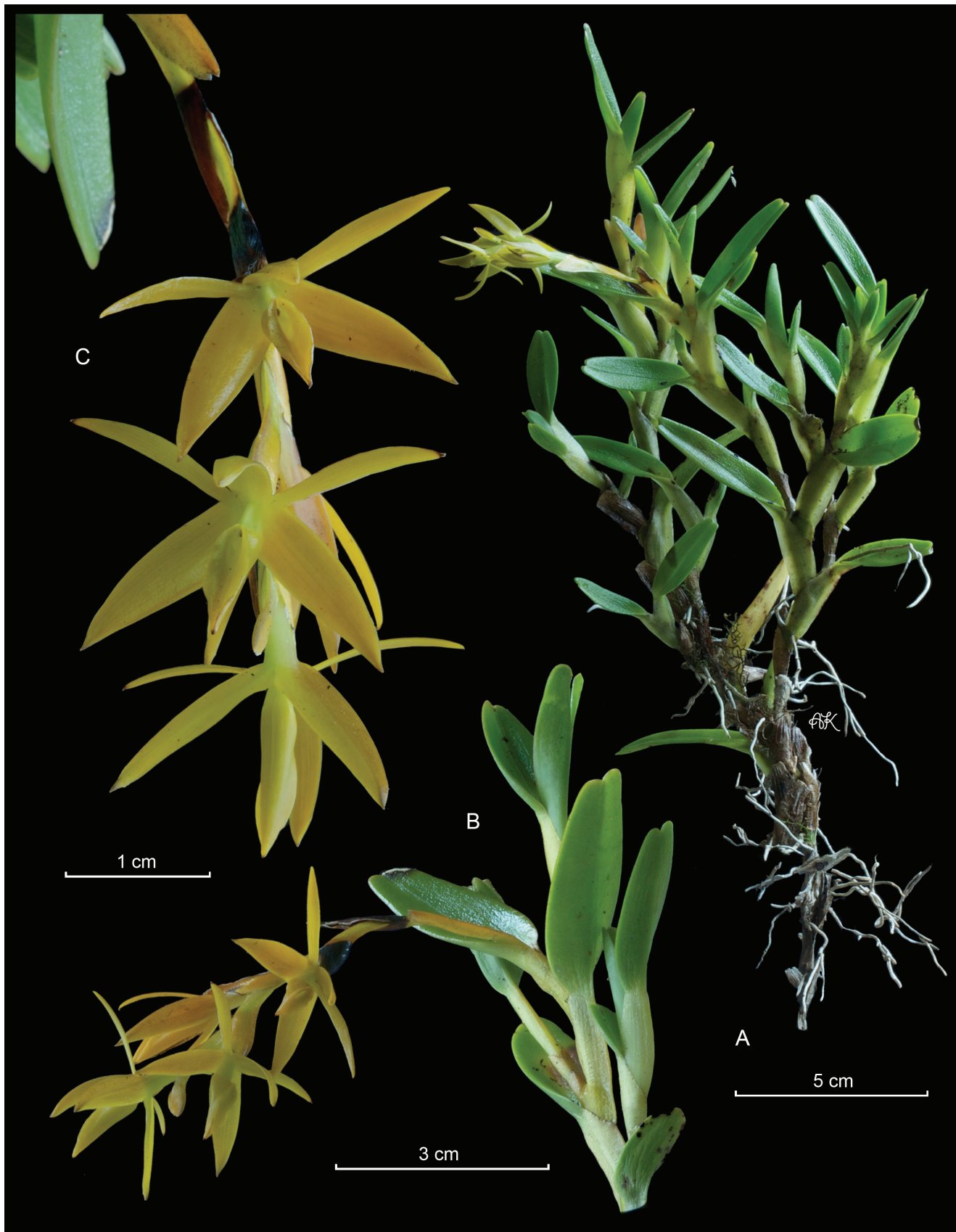


FIGURE 43. LCDP of *Epidendrum jorge-warneri* Karremans & Hågsater. A, Habit; B, Detail of the stem and inflorescence; C, Detail of the inflorescence and flower. By APK based on Karremans 5545 (JBL-spirit).

slightly 3-lobed, margin wavy, embracing the column, completely covering it; callus Y-shaped, prolonged into a central rib extending to the apex of the lip; lateral lobes hemirhomboid; midlobe triangular, acute, apiculate. *Column* 3.5 mm long, straight, with two apical somewhat rounded wings. *Clinandrium-hood* short. *Anther cap* narrowly ovate with a prominent central rib, 4-celled. *Pollinia* 4, obovoid, laterally compressed, caudicles granulose. *Rostellum* apical, slit. Nectary penetrating the ovary up to near the base. *Capsule* not seen.

Etymology: The name honors Jorge Warner, former Director of the Lankester Botanical Garden of the University of Costa Rica, who has played a key role in developing the garden into the research center it is today.

Habitat and distribution: Known only from the summit of Cerro Tinuk in Costa Rica and Cerro Punta in Panama, where it grows epiphytically and lithophytic at around 2400 m in elevation.

Phenology: It has been recorded blooming in June and July.

Additional specimens examined: PANAMA. Chiriquí: Vicinity of Cerro Punta, above Guadalupe, ca. 8°50'N, 82°35'W, 2300–2450 m, forested slopes above STRI cabin, 7 June 1986, *G. McPherson 9418* (MO-3432762).

Epidendrum jorge-warneri can be recognized by the laterally compressed stems, the laterally compressed rachis and ovary, the 2–4, large, brownish-yellow flowers and the lip which embraces the column completely. *Epidendrum chespiritum* is the most similar species, but has +5, greenish-yellow flowers, that are much smaller, sepals and petals 8.6–9.8 mm long, and lip 6.7 mm long. *Epidendrum anoglossoides* has much larger plants with the stems terete.

Epidendrum rudolfii* Karremans, *sp. nov.

TYPE: COSTA RICA. San José: Dota, Copey, Salsipuedes, Dos Amigos, ca. 19 km del Empalme hacia San Isidro del General, Carretera Interamericana, km 69–70, entrada al Mirador de Quetzales, 9°38'50"N, 83°50'48"W, 2750 m, bosque pluvial montano, 19 June 2021, *A.P. Karremans and M. Contreras Fernández 8782* (Holotype, JBL-spirit; Fig. 44).

Similar to *Epidendrum elcimeyae* Hágsater & García-Cruz, but distinguished by the coppery-yellow (vs. greenish) flowers that are much larger, the sepals 12.5–13.5 × 3.0–4.0 mm (vs. 6.5–7.0 × 2.0–2.7 mm), the petals 11.0 × 1.2–1.5 mm (vs. 6.0 × 0.9 mm), the lip 10 × 4.5 mm (vs. 4 × 3 mm), the ovary conspicuously bent apically (vs. straight), the lip is elliptic (vs. triangular-cordate), and the column very prominent, 5.0–5.5 mm long (2 mm long).

Epiphytic, pseudo-monopodial, branching, *herb*, up to 50 cm long. *Roots* 1 mm in diameter, fleshy. *Stems* branching, flexuous, ancipitose, covered by rugose sheaths. *Leaves* many, distributed along the stem, deciduous, concentrating towards the apex with age; leaf sheath 10–12 mm long, tubular, rugose, greenish when young, becoming papery with age; blade 15–23 × 3–5 mm, thick coriaceous, oblong to narrowly ovate, unequally bilobed. *Inflorescence* up to 5 cm long, peduncle and rachis thin-filiform, arching-nutant, becoming pendent, from the branches, racemose, distichous, sub-secund, rachis flexuous-filiform, each internode very

thin at the base of each bract and becoming broad and verrucose apically, below each floral bract. *Floral bracts* 4 mm long, much shorter than the ovary, acute. *Flowers* 2–3, coppery-yellow throughout. *Ovary* 9–10 mm long, cylindrical, elongate, bent 90 degrees apically. *Sepals* free, spreading, ovate-elliptic, acute with an apical dorsal keel; dorsal sepal 12.5–13.0 × 3.0 mm; lateral sepals 13.0–13.5 × 3.8–4.0 mm. *Petals* 11.0 × 1.2–1.5 mm, free, spreading, linear-ligulate, acute. *Lip* 10 × 4.5 mm, fused to the column, elliptic, acute, margins slightly elevated apically, with 3–5-lobed callus at the base, 3 low carinae in front of it, and one thickened central lamella at the apex. *Column* 5.0–5.5 mm long, thick, broad, straight with respect to the ovary. *Anther* sub-trapezoid, very thin, 4-celled, margins irregular, elevated dorsally. *Pollinia* 4, obovoid, laterally compressed, caudicles soft and granulose. *Capsule* not seen.

Etymology: The name honors Rudolf Jenny (26 July 1953–10 August 2021), well-known orchid taxonomist and historian, and a dear friend. Always enthusiastic about going to the field and discovering orchids, his planned trip to visit us at Lankester Botanical Garden in Costa Rica was postponed due to COVID-19 restrictions.

Habitat and distribution: Known only from the Cordillera de Talamanca in Costa Rica and Panama, growing at elevations between 2600–2850 m.

Phenology: It was recorded blooming in March and June.

Additional specimens examined: COSTA RICA. Cerro de la Muerte, 30 May 1987, *O.E. Achí 1* (USJ-37870). PANAMA. Bocas del Toro: Cordillera de Talamanca, 2–5 airline km NW of the peak of Cerro Echandi on the Costa Rican-Panamanian international border; 9°03'–04'N, 82°50'–51'W, 2600–2850 m, mixed *Quercus-Podocarpus* forest with *Chusquea* understory on steep slopes with quebradas, March 1984, *G. Davidse, L.D. Gómez, G. Herrera, R. Chacón and A. Chacón 25145* (MO-011485; AMO-photo).

SPATHIGER GROUP-CORIIFOLIUM SUBGROUP

Hágsater and collaborators have placed the “Coriifolium subgroup” within the “Spathiger group,” but it is not clear to me how species belonging to each of these groups are related and I find the association difficult to explain morphologically. In the “Coriifolium subgroup” the authors have included species with a sympodial growth habit, a distichous, secund inflorescence with large, conduplicate bracts, fleshy greenish flowers with narrow petals and reniform lip (Hágsater and Sánchez-Saldaña 2007, 2009). Other features include the extremely broad, leaf sheaths, the very large, ancipitose and acuminate floral bracts, the petals apically rounded, and the blade of the reniform lip is typically wider than long and apically emarginate.

Epidendrum usurpator* Karremans, *sp. nov.

TYPE: COSTA RICA. Alajuela: San Ramón, Piedades Sur, San Miguel (La Palma). Camino a San Bosco. A orillas y dentro de un pequeño bosque secundario. 10°07'18.8"N, 84°31'13.1"W, 1062 m. 21 December 2010. *A.P. Karremans, J.A.J. Karremans and M. Contreras Fernández 3237* (Holotype, JBL-spirit, Fig. 45).

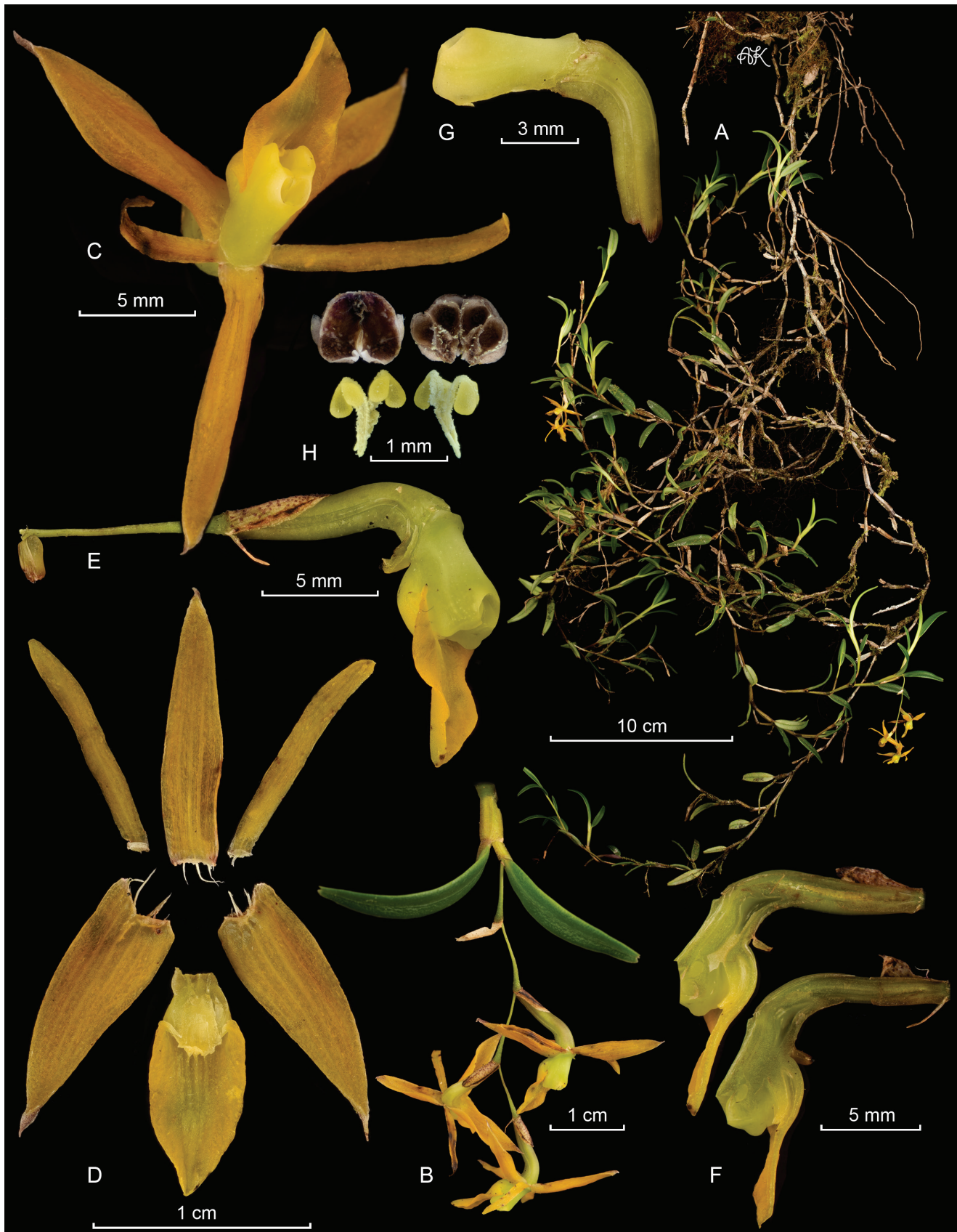


FIGURE 44. LCDP of *Epidendrum rudolfii* Karremans. **A**, Habit; **B**, Detail of the inflorescence; **C**, Flower; **D**, Dissected perianth; **E**, Lip and column lateral view; **F**, Lip and column transversal section; **G**, Column lateral view; **H**, Anther cap and pollinarium views. By APK based on Karremans 8782 (JBL-spirit).

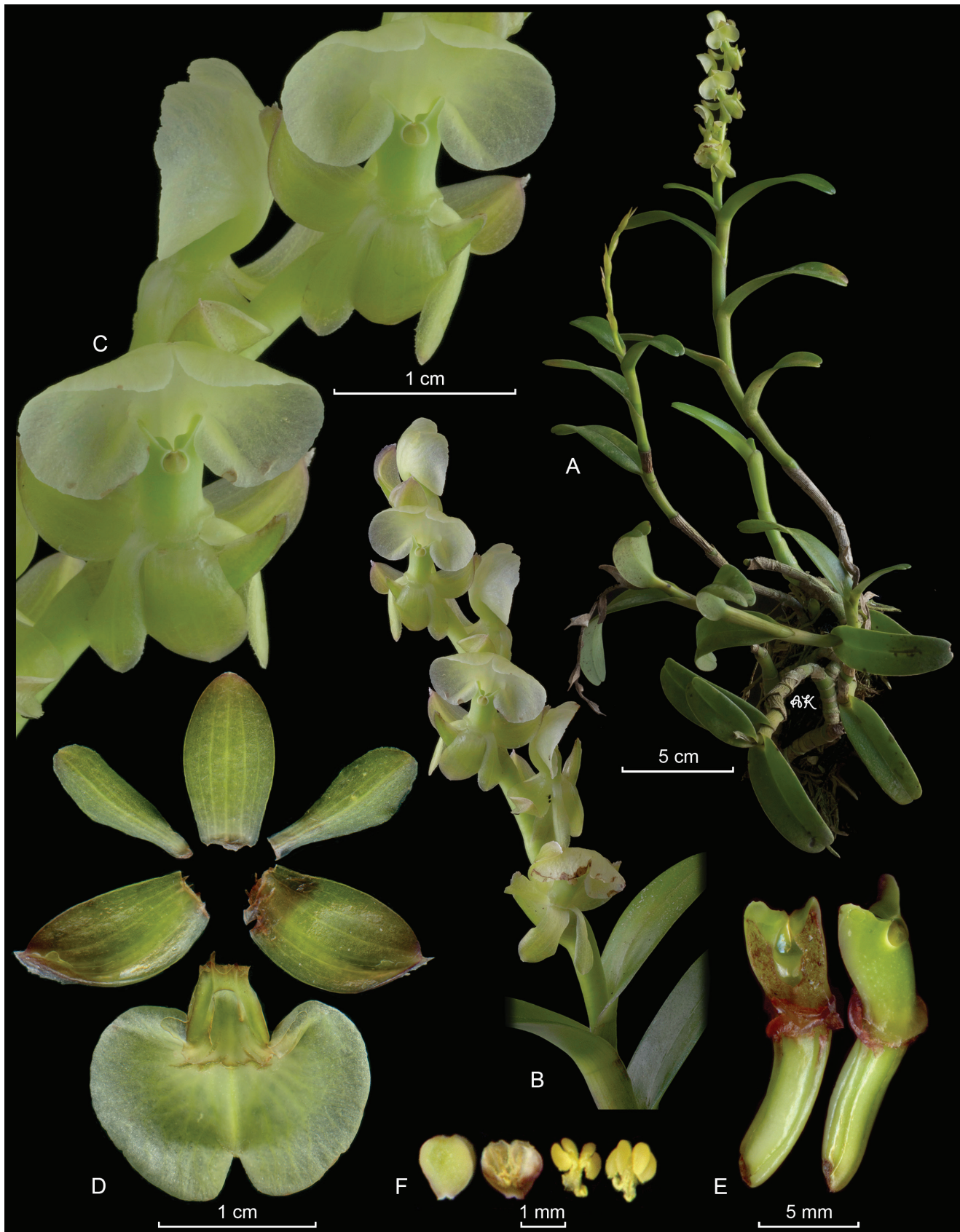


FIGURE 45. LDCP of *Epidendrum usurpator* Karremans. A, Habit; B, Detail of the inflorescence; C, Flower; D, Dissected perianth; E, Column lateral and ventral views; F, Anther cap and pollinarium views. By APK based on *Karremans 3237* (JBL-spirit).

Similar to *Epidendrum bilobatum* Ames, but the plants smaller, stems up to 20 cm long (vs. up to 30 cm long), leaves shorter, 4.0–6.0 cm (vs. leaves 11.0–12.5 cm), the flowers have a whitish lip (vs. apple green), the smaller dorsal sepal (11 × 3–4 mm vs. 14 × 6 mm), and the lip longer than wide, 18 × 15 mm (vs. lip slightly wider than long, 13.0–15.0 × 15.3 mm).

Epiphytic, sympodial, sub-caespitose, shortly repent herb, up to 32 cm tall including the inflorescence. Roots 1–2 mm in diameter, basal, produced along the short rhizomes, fleshy. Stems up to 20 cm tall, erect, simple, cane-like, terete at the base, separated along the rhizome which is 2.5–2.8 cm long, covered with tubular non-foliar sheaths at the base. Leaves 4–6, distributed on the upper half of the stem; sheaths 2.2–3.1 cm long, tubular, striated, scarious, green, turning papery brown with age; blade 4.0–6.0 × 0.9–2.0 cm, oblong-elliptic, flat, coriaceous, the apex bilobed. Inflorescence 6.5–8.5 cm long, apical, erect, distichous, produced from the mature stem; peduncle 1.0 cm; rachis ca. 5.5–7.5 cm long, sinuous to straight, laterally compressed. Floral bracts 1.5 cm, longer than the ovary, widely ovate, acuminate, conduplicate, apically bent inwards. Flowers 5–7, simultaneous, non-resupinate, sub-secund, the lip always oriented towards the rachis, sepals, and petals pale apple green, the lip whitish. Ovary 8.0–8.5 mm, slightly arched, slightly inflated behind the perianth. Sepals free, ovate to broadly elliptic, coriaceous; dorsal sepal 11 × 3–4 mm, reflexed, laying on the ovary, obtuse; lateral sepals 12 × 6–7 mm, spreading, slightly oblique, concave, obtuse, with a prominent dorsal keel towards the apex, the margin of the keel serrulate. Petals 10–11 × 3.0 mm, reflexed, narrowly oblanceolate, apex rounded, margin minutely dentate towards the apex. Lip 18 × 15 mm, united to the column at the base, membranaceous, thin, reniform in general form, concave, bilobed, the base cordate, apex deeply emarginate, margin minutely dentate, the lobes of the lip transversely ovate, rounded; bicallose, the calli not evident. Column 6–7 mm, thickened, straight, with a pair of prominent rounded wings. Clinandrium-hood reduced, margin entire. Anther ovoid, apex bilobed, the 4-celled. Pollinia 4, obovoid, sub-equal, laterally compressed; caudicles longer than the pollinia, soft and granulose, viscarium semi-liquid, transparent. Capsule not seen.

Etymology: From the Latin *usurpator*, usurper, tyrant, an individual who takes over power by illegitimate means, in reference to this species which has been known under the name *Epidendrum bilobatum*, and thus replaced the identity of that species.

Habitat and distribution: This is a relatively common species around San Ramón and Tilarán, where it is found forming large clumps on trees in roadside pastures (Fig. 46). It grows at elevations between 700 and 1150 m.

Phenology: Recorded flowering for October to January.

Additional specimens examined: COSTA RICA: Alajuela: La Palma de San Ramón, 1150 m, 30 October 1922, A.M. Brenes 379 (49) (AMES). La Palma de San Ramón, 10 November 1924, A.M. Brenes (89)1649 (AMES). Bosques del C. de Laguna, 7 November 1922, A.M. Brenes 101 (AMES). Guanacaste: Quebrada Serena, southeast of Tilarán, ca. 700 m, 27 January 1926, P.C. Standley 46292

(AMES). Ibid, P.C. Standley 46341 (AMES), Ibid, P.C. Standley 46341 (AMES). La Tejona, North of Tilarán, P.C. Standley and J. Valerio 45981 (AMES). Tilarán, Hágsater 7094 (AMO; pl. 914 in Hágsater and Sánchez-Saldaña 2007)

Epidendrum usurpator has long been confused with *E. bilobatum*. Perhaps this is because *E. usurpator* is a common epiphyte around San Ramón and Tilarán in Costa Rica where it forms large clumps, while *E. bilobatum* is quite rare and found only around the area of Cartago, and of which I know only two specimens: Lankester 509 (AMES) from Cachí and Karremans 664 (JBL) from Moravia de Chirripó. *Epidendrum usurpator* has similar flowers but can be distinguished from *E. bilobatum* by vegetative features, the plants are compact and denser, stems up to 20 cm long (vs. up to 30 cm long), the shorter leaves, 4.0–6.0 cm (vs. 11.0–12.5 cm), the flowers are different in color, the lip is whitish (vs. apple green), the smaller dorsal sepal larger (11 × 3–4 mm vs. 14 × 6 mm) and the lip is longer than wide (vs. wider than long).

Epidendrum usurpator as defined here should replace the concept of *E. bilobatum* of Hágsater and Sánchez-Saldaña (2007) and probably includes most of the specimens listed cited therein. However, those that I have not been able to personally inspect are not listed here.

Epidendrum vexillum Hágsater, Icon. Orchid. 3: t. 395. 1999.

TYPE: COLOMBIA: Risaralda: Itaurí, 1000 m, pressed 15 February 1993, González sub *E. Hágsater 8440* (Holotype, AMO).

Epiphytic, caespitose, herb, up to 21 cm tall including the inflorescence. Roots to 2 mm in diameter, basal, fleshy. Stems 5.7–11.2 cm long, simple, cane-like, laterally compressed, ancipitose, straight. Leaves 1–4, distichous, distributed on the apical half of the stems, coriaceous; leaf sheath 2.5–3.5 cm long, tubular, laterally compressed, ancipitose; blade 9.7–11.2 × 3.0 cm, blade articulated, elliptic, apex unequally bilobed. Inflorescence 9 cm long, apical, racemose, erect, congested; peduncle laterally compressed, ancipitose, bracts 2–3, sub-imbricate, conduplicate, acute. Floral bracts 2.5–3.5 cm long, imbricate, ancipitose. Ovary 1.7 cm long, inflated, cylindrical, elongate, clavate. Flowers 3–4, pale green throughout, nonresupinate, sub-secund. Sepals free, spreading, slightly revolute, broadly ovate, acute with an apical dorsal keel; dorsal sepal 1.1 × 0.6 cm; lateral sepals 1.3 × 0.7–0.8 cm. Petals 1.0 × 0.5 cm, free, spreading, elliptic, oblique, obtuse. Lip 1.5 × 1.5 cm, fused to the column, almost flat, sub-rectangular, sub-emarginate at the apex, ecallose, apically with a low carinate. Column 8 mm long, thick, broad. Anther ovoid, 4-celled. Pollinia 4, obovoid, laterally compressed, caudicles soft and granulose, viscidium translucent. Capsule not seen.

Etymology: From the Latin *Vexillum*, in military terms a military or naval ensign, in relation to the way the lip is positioned to exhibit it.

Habitat and distribution: Known to occur in Costa Rica, Panama, and Colombia.

Phenology: It was recorded blooming from October to February.



FIGURE 46. Photograph of *E. usurpator* Karremans in situ as it is commonly found covering solitary trees in pastures on the Tilarán mountain range. By APK.

Additional specimens examined: COSTA RICA. Alajuela: Upala, Bijagua, camino al P. N. Volcán Tenorio, potreros a orillas del camino con ascenso a parches de bosque, 10°43'22.4"N, 85°00'07.1"W, 720 m, bosque muy húmedo tropical transición a premontano, 14 December 2016, M. Díaz, M. Cedeño, I. Chinchilla, A.P. Karremans and G. Rojas-Alvarado 293 (JBL-spirit, Fig. 47). PANAMA. El Llano - Cartí road, 8–10 km. No. of El Llano, 2 October 1976, R.L. Dressler 5522 (AMO).

Pinheiro and Cozzolino (2013) suggest genus *Epidendrum* as a promising model system for evolutionary and ecological studies in the Neotropical region. Given its high species diversity, the broad biogeographical and ecological range, and the variation in morphology, chromosome numbers and ecological interactions, the genus presents a rich source for intriguing and yet unanswered questions. Considering the high degree of endemism, local radiation, and hybridization, *Epidendrum* is also a prime candidate to study speciation, divergence times and diversification patterns (e.g., Nóbrega et al., 2017; Pessoa et al., 2021). At the same time, it presents an enormous opportunity as a bioindicator, to study the effects of climate change and as a priority for local and global conservation efforts.

To achieve these goals, it is extremely important to correctly establish more precise species boundaries and diversity estimates in the genus. At the turn of the century, Hágsater et al. (1999) estimated genus *Epidendrum* included about 2000 species, despite only 1000 being formally described by then. Astonishingly, just two decades later we have reached 1800 described *Epidendrum* species, but the projection has also increased to about 2400 species since (Hágsater et al., 2016). Species that were previously thought to be common and variable across their broad distributions in the Neotropics, such as *Epidendrum difforme* Jacq., *E. nocturnum* Jacq. and *E. paniculatum* Ruiz & Pav., have turned out to represent large species complexes with many rare, local endemics. Similarly, *E. rugosum* and *E. sanchoi*, which have traditionally been considered common and broadly distributed taxa in Costa Rica, are shown here to represent many different species that are much more localized in their distribution.

On revising the Neotropical *Vanilla* species, Karremans et al. (2020) cautioned that the taxonomical inflation may have unexpected consequences that go beyond the exercise of formal naming species. Over-splitting of taxa hamper biogeographical and abundance studies and may also have serious implications for conservation biology. Taxonomic inflation may result in an overestimation in speciation rates, the underestimation of ecological preferences and distribution ranges, false interpretations of endemism and hotspots, skewed origin and diversification patterns, mistaken conservation priorities, and increased interest of collectors, among other issues. *Epidendrum* represents the exact opposite: a serious underestimation of the species diversity, which results in essentially the same issues regarding speciation, diversification processes, ecosystem development, and conservation priorities. Dealing with these undescribed and unrecognized species of *Epidendrum*

Epidendrum vexillum was previously known to occur in Colombia and Panama and is here reported from Costa Rica on the basis of a specimen collected close to Tenorio Volcano National Park in the north of the country. It is closely related to *E. circinatum* Ames and *E. concavilabium* C.Schweinf. but easily distinguished from both by the smaller flowers with a sub-rectangular lip, that is as long as wide, the slightly revolute, non-retrorse, sepals and petals, and the straight column and ovary.

DISCUSSION

is not merely a taxonomic problem, it rather has multiple unforeseen negative consequences and it is therefore a priority to close the gap between the described and projected diversity in the genus.

How does this relate to conservation? According to Fay (2018), one out of every 30 orchids species has been assessed for the IUCN Global Red List, and just over half of them fall into one of the categories of critically endangered, endangered, or vulnerable. Out of the 1800 species of *Epidendrum* currently recognized, only a very concerning 1.3 % have been assessed to date (IUCN 2021). The isthmus of Costa Rica and Panama has one of the highest concentrations of epiphyte species per area in the Neotropics and is a major evolutionary center for epiphytic plants in the world (Cascante-Marín and Nivia-Ruiz, 2013), and *Epidendrum* has been pointed out as the most important genus for endemics among flowering epiphytes in southern Central America. Ossenbach et al. (2007) estimated that 48% of the *Epidendrum* species registered for Costa Rica and Panama at the time had been recorded to occur within the limits of protected areas. Relatively speaking, those figures seem encouraging especially considering that only one out of every five species in the genus is listed as threatened by the authors. However, they emphasize on the necessity of updating species distribution information (Ossenbach et al., 2007). Cited among those species occurring in protected areas are *E. anoglossoides*, *E. bilobatum*, *E. microcardium*, *E. rugosum* and *E. sanchoi*, all of which have been recircumscribed here. As previously circumscribed these species were well covered in collections and protected areas, but all of the newly recognized species in these complexes are in fact quite poorly represented in both. They are a good example of how a different taxonomic interpretation can cause a sudden shift from a scenario where we have few broadly distributed and overall unthreatened species to a scenario where we have several potentially threatened species for which the population size, distribution and conservation status need to be urgently established.

Among the Orchidaceae, *Epidendrum* is consistently the most species rich genus in Neotropical countries (Table 2). Unexpectedly, this predominance is maintained on a local scale too, being the most diverse orchid genus occurring in and around protected areas across Costa Rica and Panama (Table 3). The total number of species clearly increases with elevation. But regardless of the mountain chain, watershed, elevational range, and forest type, *Epidendrum* is always the most species rich genus of the Orchidaceae. A recent checklist of vascular plants in La Amistad Biosphere Reserve, the third largest and most biodiverse biosphere

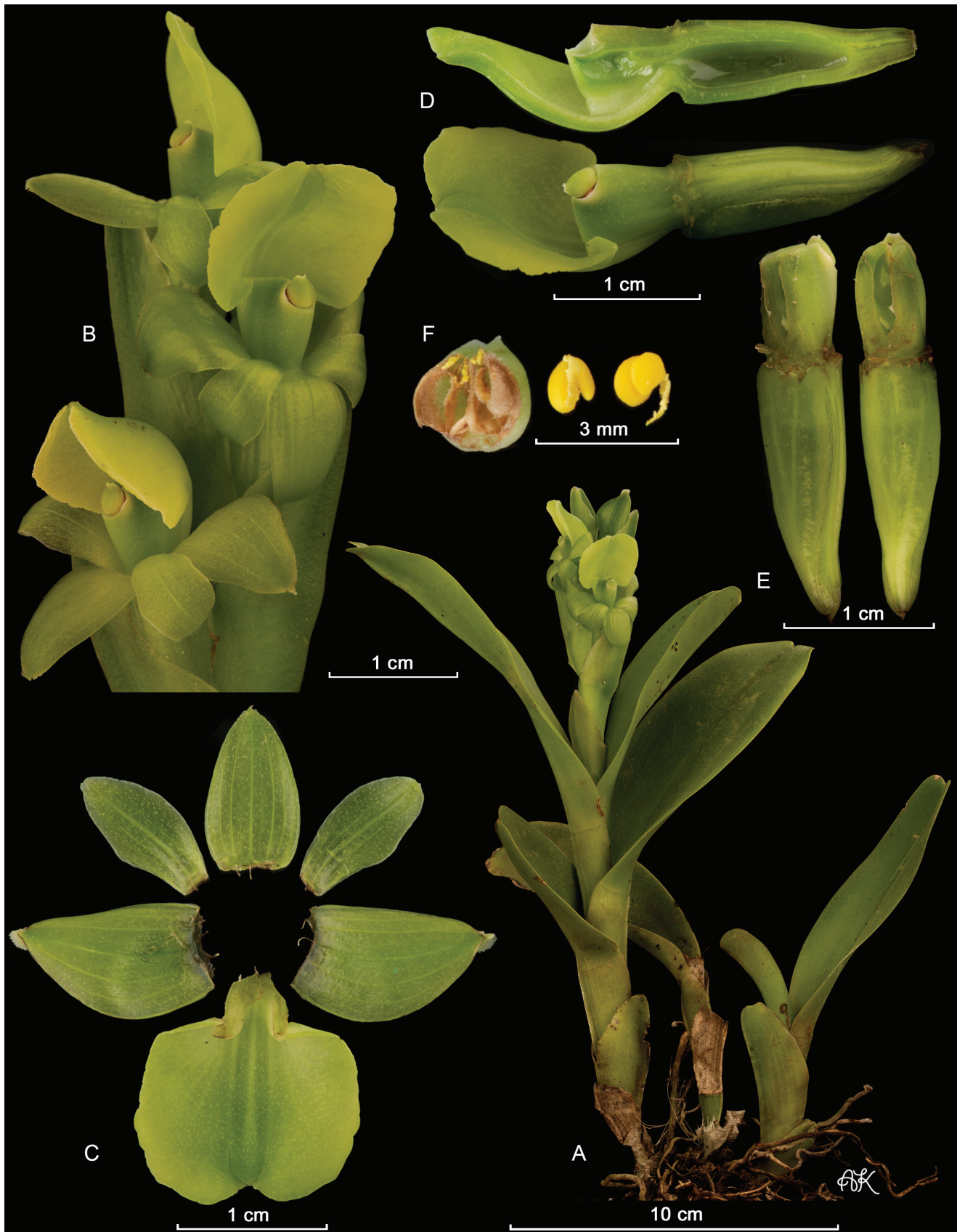


FIGURE 47. LCDP of *Epidendrum vexillum* Hágsater. **A**, Habit; **B**, Detail of the inflorescence; **C**, Dissected perianth; **D**, Lip and column lateral view and transversal section; **E**, Column lateral and ventral views; **F**, Anther cap and pollinarium views. By APK based on Díaz 293 (JBL-spirit).

TABLE 2. Total *Epidendrum* species per country and rank among Orchidaceae.

COUNTRY	SPECIES	RANK	REFERENCE
Colombia	456	1	Bernal 2016
Ecuador	455	1*	Dodson 2004
Peru	338	1	Navarro Romo et al., 2020
Costa Rica	247	1	Current paper
Panama	207	1	Current paper
Bolivia	174	1	Vásquez et al., 2003
Venezuela	159	1	Carnevali et al., 2008
Brazil	125	2	Pessoa 2020
Mexico	125	1	Solano et al., ined.
Honduras	74	1	Vega et al., ined.
French Guiana	45	1	Sambin and Ravet 2021

* Genus *Pleurothallis* R.Br. appears first, but more than half of the species listed are now recognized to belong to other genera.

TABLE 3: *Epidendrum* species reported in and around protected areas in Costa Rican and Panama.

MOST SPECIOUS ORCHID GENUS	NUMBER OF SPECIES	ELEVATION RANGE	AREA	LOCATION	REFERENCE
<i>Epidendrum</i>	3	0–575 m	24 km ²	Cocos Island National Park, Pacific Ocean, Costa Rica	Bogarín et al. (2011)
<i>Epidendrum</i>	4	up to 575 m	23 km ²	Barra Honda National Park, North Pacific, Costa Rica	Bogarín and Pupulin (2021)
<i>Epidendrum</i>	9	up to 200 m	*4 km ²	Manuel Antonio National Park and Quepos, Central Pacific coast, Costa Rica	Pupulin (2001); Pupulin and Bogarín (2018)
<i>Epidendrum</i>	10	sea level	11 km ²	Cahuita National Park, South Caribbean coast, Costa Rica	Pupulin and Bogarín (2018)
<i>Epidendrum</i> **	11	1500–1550 m	0.04 km ²	Monteverde cloud forest, Tilaran Mountain Range, Costa Rica	Ingram and Ferrell-Ingram (1996)
<i>Epidendrum</i> **	15	ca. 35 m	16 km ²	La Selva Biological Station, Northern Caribbean Plains, Costa Rica	Atwood (1987)
<i>Epidendrum</i>	17	0–745 m	?	Golfo Dulce, Osa Peninsula, South Pacific, Costa Rica	Rakosy et al. (2013)
<i>Epidendrum</i>	22	1600–1850 m	7.5 km ²	La Carpintera, Central Valley, Costa Rica	Cascante-Marín and Trejos (2019)
<i>Epidendrum</i>	24	1300–2450 m	20 km ²	Bosque de Paz Orchid Reserve, Central Volcanic Range, Costa Rica	Muñoz and Kirby (2007)
<i>Epidendrum</i>	24	990–1300 m	2.3 km ²	Monumento Nacional Guayabo, Central Volcanic Range, Costa Rica	Karremans et al., unpubl. data
<i>Epidendrum</i>	50	0–3800 m	6500 km ²	La Amistad Biosphere Reserve, Talamanca Mountain Range, in southern Costa Rica and western Panama	Monro et al. (2017)

* Includes only MANP, not the surrounding areas.
 ** Genus *Pleurothallis* R.Br. is listed as first, but more than half of the species listed are now recognized to belong to other genera.

reserve in Central America, lists only 50 species of *Epidendrum* (Monro et al., 2017). La Amistad International Park (PILA), shared by Costa Rica and Panama is at the core of the biosphere. The Talamanca Mountains, in which PILA is situated, cover an area of ca. 10,000 km² bound by the Cerro de la Muerte in Costa Rica to the north and west and the volcanic massif of Chiriquí in Panama to the east and south. La Amistad Biosphere Reserve itself includes 6,500 km² of continuous forest with an elevational range between 0 and 3800 m, covering an extremely broad set of life/biodiversity zones (Fig. 48). It is especially rich in tropical montane and cloud forests which hold the highest abundance and diversity of epiphytic orchids (Cascante-Marín and Trejos, 2019). Not surprising, it is in or around the PILA where most of the novelties in *Epidendrum* have originated in recent years, including the majority listed in the current paper (Fig. 1, 8, 20, 25). That only 16% of the *Epidendrum* species recorded for Costa Rica and Panama are found in

the largest and most biodiverse biosphere shared by the two countries surely is a wild underestimation. Especially when comparing the relative diversity of *Epidendrum* species found in much smaller areas (Table 3). It speaks about a pressing need of thorough sampling, identification, and estimation of distribution of *Epidendrum* species.

With the current changes incorporated, our estimates are 247 *Epidendrum* species for Costa Rica and 207 for Panama. In total, 310 different species of *Epidendrum* can be attributed to Costa Rica and Panama together, with 144 (46%) occurring in both countries. This places the countries of the isthmus only behind Colombia, Ecuador and Peru in absolute species numbers (Table 2), with these Andean countries spanning significantly larger territories. Bogarín et al. (2016) estimated the number of endemic *Epidendrum* species at 36.2% and 23.1% for Costa Rica and Panama respectively. However, when they are treated as a single biogeographical unit, we find that the percentage of



FIGURE 48. La Amistad Biosphere Reserve in the Talamanca mountain range in southern Costa Rica and western Panama is a well conserved and relatively unexplored biodiversity hotspot.

endemism increases to ca. 50% (Table 1). In other words, about 155 species of the *Epidendrum* found on the isthmus of Costa Rica and Panama grow nowhere else in the world. The assessment of threat level to these 155 endemic *Epidendrum* species, many of which grow at mid and high elevations in montane and cloud forests, should be a conservation priority for both countries. Especially considering that the effects

of climate change are suggested to be more pronounced at higher elevations (Karmalkar et al., 2008), that epiphytes are more vulnerable (Benzing, 1998), and that some important orchid diversity hotspots and potentially suitable habitats have been shown to occur outside of protected areas (Crain and Fernández, 2020; Watteyn et al., 2020). After all, with great biodiversity comes great responsibility!

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