

TWO NEW SPECIES OF *EPIDENDRUM* (ORCHIDACEAE: LAELIINAE) FROM THE *SCHISTOCHILUM* GROUP IN THE WESTERN ANDES OF COLOMBIA AND ITS VALUE IN ECOLOGICAL RESTORATION DECISIONS.

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Abstract. Two new species of *Epidendrum* from the Western Cordillera of the Colombian Andes are described and illustrated. The new species with red and orange flowers belong to the *Schistochilum* group, *Secundum* subgroup and are similar to *Epidendrum portokaliium* and *E. melinanthum* but differ by the color of the flowers and floral details, especially the calli. The new species were found in an open area with mild to severe erosion of the soil with a high clay content and high levels of insolation. The location was purchased with the aim of implementing ecological restoration strategies for its conservation with plans to recover the forest areas and allow connectivity within landscapes. The discoveries made it necessary to change the ecological restoration plans, the results being that it is not necessary to restore forest cover, but rather to maintain the area in its current state, making some changes that allow the conservation of the two new species and associated species.

Keywords: Taxonomy, Andes, Western Cordillera, Neotropics, Systematics, Conservation, Restoration Ecology

Resumen. Se describen e ilustran dos nuevas especies de *Epidendrum* de la Cordillera Occidental de los Andes colombianos. Las especies nuevas de flores rojas y anaranjadas pertenecen al grupo *Schistochilum*, subgrupo *Secundum* y son similares a *Epidendrum portokaliium* y *E. melinanthum* pero se distinguen por su el colorido de las flores y los detalles florales y callos. Las nuevas especies se encontraron en un área abierta con erosión leve a severa del suelo, con un alto contenido de arcilla y una alta exposición al sol. Este lugar fue adquirido con el objetivo de implementar estrategias de restauración ecológica para su conservación con la finalidad de recuperar las áreas boscosas y permitir la conectividad dentro del paisaje. Los hallazgos obligaron a cambiar los planes de restauración ecológica, considerando que no es necesario restaurar la cobertura forestal, sino mantener el área en su estado actual, realizando algunos cambios que permitan la conservación de las dos nuevas especies y las especies asociadas.

Palabras claves: Taxonomía, Andes, Cordillera Occidental, Neotrópico, Sistemática, Conservación, Restauración Ecología

Epidendrum L. is one of the most diverse genera within Orchidaceae, distributed from sea level to 4200 m elevation, ranging from the southeastern United States (North Carolina) to northern Argentina, with almost 2400 species described (Hágsater et al., 2016; Ocupa et al., 2021). The genus includes terrestrial, epiphytic, and lithophytic plants occurring in various types of habitats from tropical forest, dunes and scrubs to the Andean paramos (Hágsater and Wrazidlo, 2020).

Epidendrum has been organized into informal groups of species. These groups are aggregated based on vegetative and floral characteristics that allow the easy identification of several species (Ocupa et al., 2021).

The *Schistochilum* Group is recognized by the caespitose habit, the numerous coriaceous leaves, the generally and elongate peduncle to a pluri-racemose inflorescence, the brightly colored flowers generally pollinated by hummingbirds and butterflies, and the caudicles of the pollinarium granulate, the tetrads appearing like a loose pile of roof-tiles, without any spathaceous bracts. The *Secundum* Sub-group is recognized mainly by the non-resupinate flowers with a complex callus (Hágsater, Valenzuela and Cisneros, 2020).

This group of species has historically been confused and combined under the name of *Epidendrum secundum*

Jacq., mainly because of the similar flower morphology of non-resupinate flowers with a complicated system of calli (Hágsater and Wrazidlo, 2020). According to Hágsater (1993), the taxon name *Epidendrum secundum* applies only to plants with pink, non-resupinate flowers with a complicated callus restricted to the Antilles.

Here we describe two new species of *Epidendrum* found in an open area of dry soils that was purchased in 2021 with the purpose of being ecologically restored. The initial strategy of restoration was to restore the arboreal vegetation, the quality of the soils, and its connectivity by using intermediate pioneer plant species of rapid growth. This strategy would have allowed the recovery of the connectivity in the location with its reference ecosystem, but introducing rapidly growing species plants would cause the new species to disappear completely, in that the new species is now in its original habitat despite that being a disturbed ecosystem. The discovery of the new species forced changes in the conservation plans, maintaining and conserving the species within the purchased area. Finally, conservation and ecological information are provided as well as the taxonomical comparison between the two species.

The description of the two new species was financed by Celsia, through the project “Environmental Management Plan of the Calima Hydroelectric Power Plant.” We specially thank Ricardo Sierra, president of Celsia, and Marcelo Alvarez, vice president of Generation of the hydraulic generation team and the Calima plant team, for their technical and financial contributions.

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MATERIALS AND METHODS

Descriptions and illustrations

The descriptions were prepared from living specimens. Specimens were dissected and digital images were taken with a Nikon D750 with a Nikkor 105 mm f/2.8 macro lens. The resulting images were used for diagramming Lankester Composite Digital Plates in Adobe Photoshop® CS6.

Plant material

Epidendrum specimens in the following Herbaria AMES, AMO, B, G, K, NY, CAUP, CUVC and COL (online) were consulted but no additional material was found in these collections to include in the protologues of the new species described herein.

Study area

In 2021, the hydroelectrical company of Celsia, in association with the Corporation Paisajes Rurales, began an ecological restoration pilot project in a property bought as “La Lorena”, located in the municipality of Calima El Darién, in the department of Valle del Cauca, in Colombia, 3°52'05.1"N, 76°32'46.4"W (Fig. 1). This property was acquired by the Environmental Corporation of Valle del Cauca (CVC) in 1960 and 1997. The property became part of EPSA company through deed No. 972 of June 6, 2021 at the Candelaria, Valle del Cauca notary, Colombia. Finally, in 2006, it became to be part of Celsia company.



FIGURE 1. Study area of La Lorena where the two new species are found. A, Front aerial view in the Calima Lake. B, Vertical view showing the entire property purchased by Celsia. C, High clay content reaching the shores in the lake. White narrows and circles indicate the position where the two new species were found and the high clay content in La Lorena.

TAXONOMY

Epidendrum calimaense J.S. Moreno & Hágsater. *sp. nov.*
 TYPE: COLOMBIA, Valle del Cauca: Municipio de Calima El Darién, predio La Lorena, 1732 m, 15 Sept 2020. A. Zuluaga & J.S. Moreno 5621 (Holotype: CUV) (Fig. 2–5).

Epidendrum calimaense is most similar to *Epidendrum portokalium* Hágsater & Dodson (2004) which is found along the Amazonian corridor in eastern Ecuador, but the flowers are somewhat smaller, sepals 10–12.2 × 4–5.5 mm (vs. sepals 9–17 × 3.6–5.2 mm), petals are oblong-elliptic, acute (vs. narrowly obovate, apex rounded), and the lip with a distinctly different callus with a pair of spherical calli at its base, mid-callus formed by three unequal tubercles, lateral ones made up of two teeth, middle one made up of three teeth, central lobed and wide, arranged in the shape of a semi-circular crown (vs. callus formed by seven unequal tubercles, none forming a spherical basal body).

Terrestrial, sympodial, caespitose *herb*, to ca. 135 cm tall including inflorescence. *Roots* 0.8–3.2 mm in diameter, basal, terete, fleshy, thin, white. *Stems* 30–58 × 0.3–0.5 cm, simple, cane-like, straight, terete, thin, covered by foliar sheaths, papyraceous, white. *Leaves* 4.5–8.6 × 1.8–2.5 cm, articulate, elliptic, apex rounded, coriaceous, smooth, green, margins entire, aggregate along the apical half of stem. *Spathes* lacking. *Inflorescence* ca. 64–86 cm tall, racemose; peduncle 38–52 cm long, elongate, green, covered by 5–8 tubular bracts 3.0–3.8 cm long, white, scarious when dry, striated, papyraceous, imbricated, acute; rachis 30–35 cm long; producing keikis from sub-apical nodes of peduncle of inflorescence. *Floral bracts* 1–4 mm long, much shorter than ovary, decreasing in size, triangular, acuminate, embracing. *Flowers* ca. 60, successive 16–24 open at any time, non-resupinate, sepals and petals orange, lip orange turning to yellow at disc, callus yellow, column red, apical half yellow, anther green; fragrance none. *Ovary* 17–26 mm long, terete, thin, not inflated, orange tinged green towards base, slightly arched, furrowed. *Sepals* 10–12.2 × 4–5.5 mm, spreading, oblong, apex acute, minutely apiculate, 7-veined, margin entire, spreading; *lateral sepals* oblique, with low dorsal keel. *Petals* 9–11.4 × 3–3.8 mm, spreading, oblong-elliptic, acute, 5-veined, distal margin microscopically dentate, spreading. *Lip* 5.8–6.2 × 10.8–11.2 mm, basally united to column, 3-lobed, base slightly cordate, bicallose, callus massive, a pair of elevated spherical calli on sides at base, central callus lobed and wide, arranged in shape of a semi-circular crown formed by three unequal tubercles, lateral ones made up of two teeth, middle one made up of three teeth; lateral lobes 5.3–5.8 × 3.3–3.8 mm, ovate, distal margins broadly emarginate, slightly reflexed; mid-lobe 4.4–5.4 × 4.8–5.4 mm, basal half an isthmus, apical half sub-triangular, slightly bilobed, lobes divergent, distal margin short-laciniate, sides revolute. *Column* 9.5–10.3 mm long, terete, slightly thickened towards apex, a lateral wing on each side at apex, acute, margin minutely erose, embracing anther, margin minutely papillose, and a pair of finger-like wings curved upwards and attached to the callus. *Clinandrium-hood* reduced; margin irregular dentate. *Anther cap* ovoid, acute, rugose, 4-celled. *Pollinia* 4,

narrowly obovate, elongate, laterally compressed, of equal size; caudicles soft and granulose, forming elongate tetrads that appear as a pile of roof tiles; viscarium semi-liquid, transparent. *Rostellum* apical, slit. *Lateral lobes* of stigma very small. *Nectary* deep, penetrating half pedicellate ovary, minutely papillose, papillae arranged in longitudinal rows. *Capsule* oblong-elliptic.

Toponymy: *Epidendrum calimaense* is named after the Calima region in Calima-El Darién, a municipality in Valle del Cauca department of Colombia where the new species was found.

Habitat and ecology: The locations where these two species grow are open sites with mild to severe erosion, moderate to high slopes, high exposure to the sun and in the afternoons to strong moisture-laden winds. The soils are characterized by high clay content, low fertility, low content of organic matter, which promotes a low regeneration capacity of natural covers. These areas were deforested after the construction of the Calima dam in 1961, and their deterioration has intensified over the last 30 years, which is why Celsia bought this area designated to implement an ecological restoration project to recover forest areas and connectivity in the landscape. However, the discovery of *Epidendrum calimaense* and *E. celsiae* made it necessary to change the ecological restoration plans, as preservation of endemic species takes priority over restoring forest cover. The decision was made to maintain the area in its current state, making some changes that allow the conservation of the two new species and its associated diversity. This is an area subject to many pressures and the conservation of the two species of *Epidendrum* requires the establishment of flexible management strategies for the area. The importance of using and comparing detailed floristic characterizations that determined this to be a new endemic species, known only to this location, required the restoration processes be modified; if not modified, the areas would have been covered with forest and these species would have disappeared over time.

Conservation status: *Epidendrum calimaense* and *E. celsiae* are only known from their type locality and both species are protected since the area is protected from external threats. The species classified within the IUCN categories as data deficient (DD) because we lack adequate distribution and population information to make an assessment (IUCN Standards and Petitions Subcommittee 2017; IUCN 2021).

Epidendrum calimaense is recognized by the non-resupinate flowers, the sepals and petals orange, lip disc orange-yellow, callus yellow, column red, apical half yellow, anther green, the sepals 10–12.2 × 4–5.5 mm, oblong, widely acute, the petals 9–11.4 × 3–3.8 mm, spreading, oblong-elliptic, acute, 5-veined, distal margin microscopically dentate, and the lip 5.8–6.2 × 10.8–11.2 mm, united to column, 3-lobed, base slightly cordate, bicallose, callus massive, a pair of elevated spherical calli on sides at base, central callus lobed and wide, arranged in the shape of a semi-circular crown formed by three unequal tubercles, the lateral ones made up of two teeth, middle one made up of three teeth. It is similar to *Epidendrum*

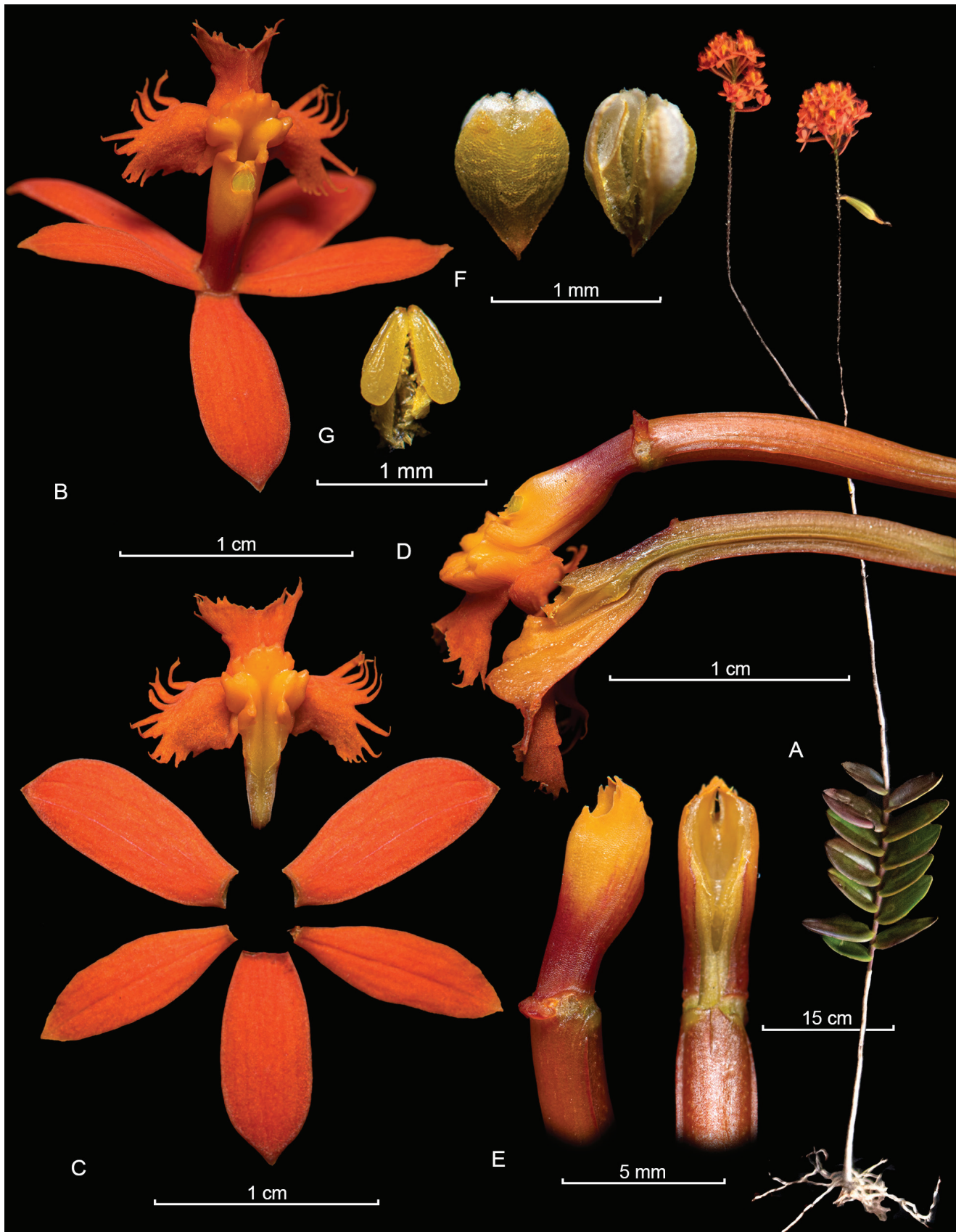


FIGURE 2. LCDP of *Epidendrum calimaense* J.S. Moreno & Hågsater. **A**, Habit; **B**, Flower; **C**, Dissected perianth; **D**, Lip and column lateral view, and transversal section; **E**, Column, ventral and lateral views; **F**, Anther cap; **G**, Pollinarium. LCDP by J. S. Moreno, based on A. Zuluaga & J. S. Moreno 1504.

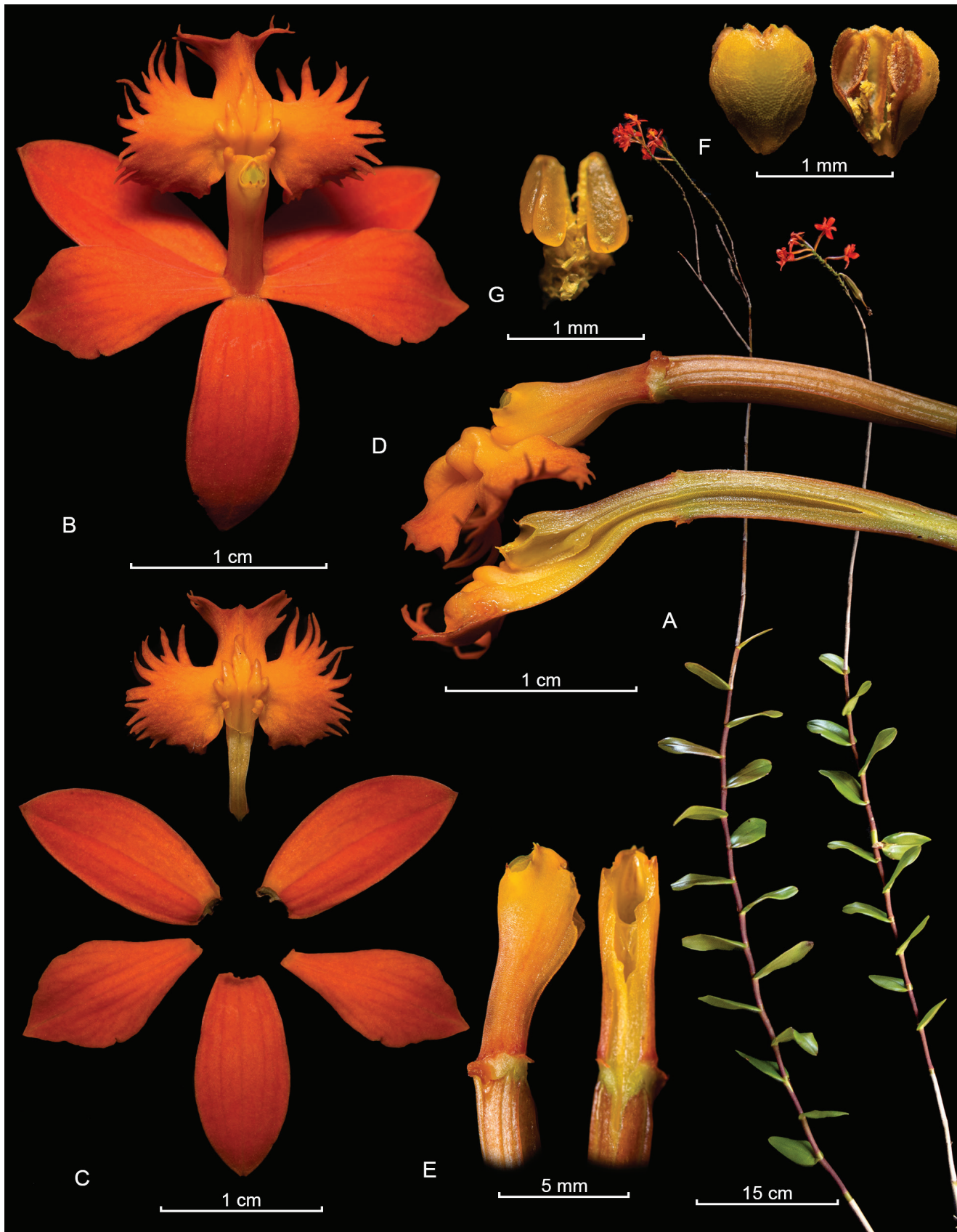


FIGURE 3. LCDP of *Epidendrum celsiae* J.S. Moreno & Hágsater. A, Habit; B, Flower; C, Dissected perianth; D, Lip and column lateral view, and transversal section; E, Column, ventral and lateral views; F, Anther cap; G, Pollinarium, based on A. Zuluaga & J.S. Moreno 1505.



FIGURE 4. Leaves comparison and stem between *Epidendrum calimaense* J.S. Moreno & Hágsater and *Epidendrum celsia* J.S. Moreno & Hágsater. **A**, Leaves and stem of *Epidendrum calimaense*; **B**, Leaves and stem of *Epidendrum celsiae*; **C**, Leaf shape of *Epidendrum calimaense*; **D**, Leaf shape of *Epidendrum celsiae*. Based on A. Zuluaga & J. S. Moreno 1505 and 1504.

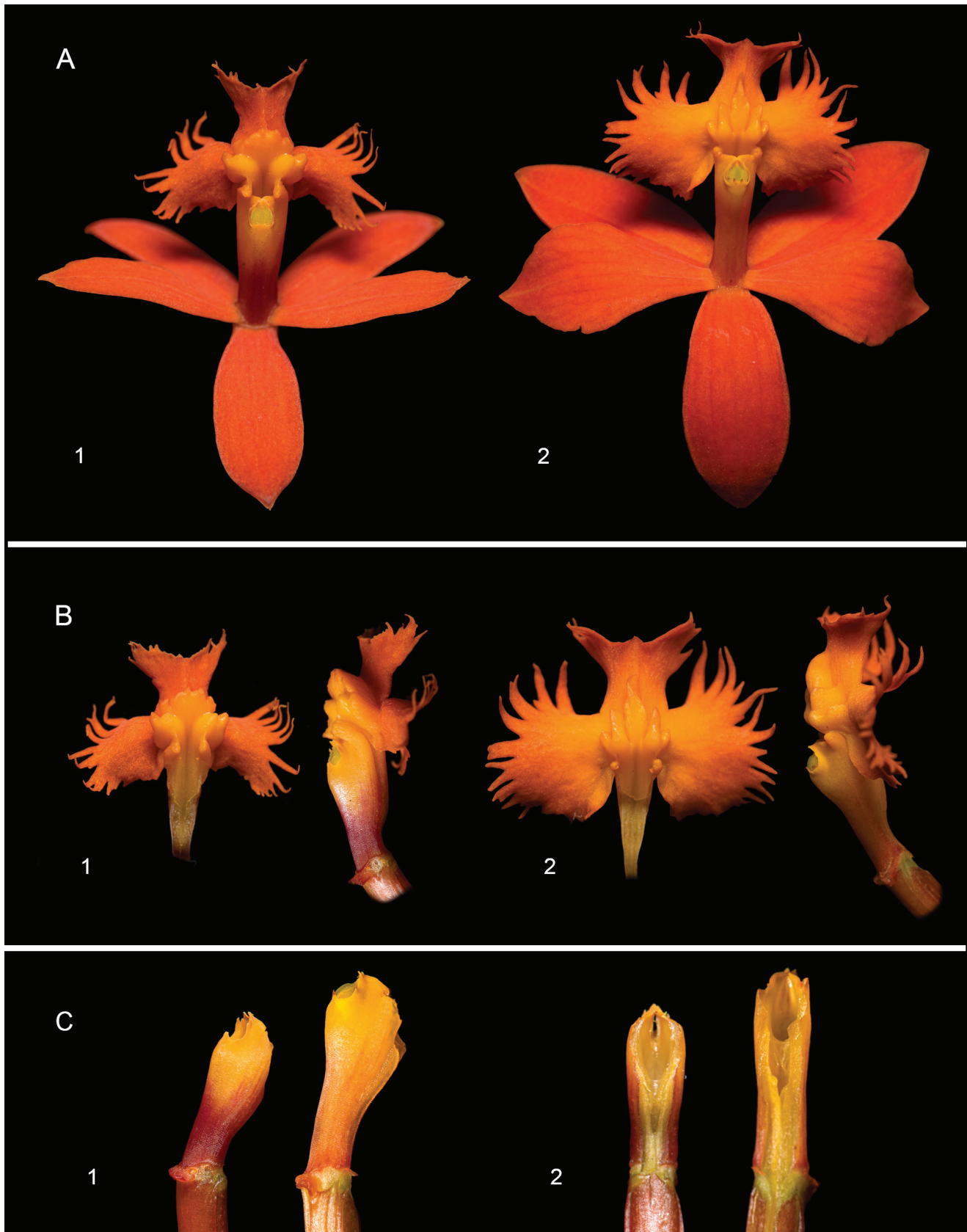


FIGURE 5. Flower comparison between *Epidendrum calimaense* J.S. Moreno & Hágsater (1) and *Epidendrum celsia* J.S. Moreno & Hágsater (2). A, Flowers; B, Lips, frontal and side views; C, Columns, side and ventral views. Based on A. Zuluaga & J. S. Moreno 1505 and 1504.

portokalium Hágsater & Dodson (2004), found along the Amazonian corridor in eastern Ecuador, which has larger flowers sepals 9–17 × 3.6–5.2 mm, the petals are narrowly obovate, apex rounded, and the lip with a distinctly different callus formed by seven unequal tubercles, none forming a spherical basal body. In herbarium specimens it can be confused with *Epidendrum melinanthum* Schltr. which was described from the same general area and is widespread in Colombia along the Cordilleras Occidental and Central, but has yellow flowers, the yellow callus turning orange in mature flowers, sepals 7–8 × 3.0–3.5 mm, oblanceolate, acute, the petals 8–9 × 2.5–3.0 mm, elliptic to sub-rhombic, acute, and the callus is formed by two sub-spherical calli at the base, extended beneath by a pair of sub laminar teeth which arch inwards partly embracing a central sub globose mid-callus (see Moreno & Hágsater, 2017).

Epidendrum celsiae J.S. Moreno & Hágsater, *sp. nov.* TYPE: COLOMBIA, Valle del Cauca: municipio de Calima El Darién, predio La Lorena, 1732 m, 15 Sept. 2020. A. Zuluaga & J.S. Moreno 5622 (Holotype: CUV) (Fig. 3–5).

Epidendrum celsiae is most similar to *Epidendrum portokalium* Hágsater & Dodson (2004) found along the Amazonian corridor in eastern Ecuador, but the flowers are similar in size, sepals 11.6–13.4 × 5.6–6.4 mm, (vs. sepals 9–17 × 3.6–5.2 mm), petals obtusulate-spatulate, acute, (vs. narrowly obovate, apex rounded), callus formed by three unequal tubercles, lateral ones made up of two teeth, unequal, the outer pair short, united, with the basal part slightly elevated, and mid-tubercle consisting of single elongate and thin, high keel, thickened on each side to about the mid-length (vs. callus formed by seven unequal tubercles).

Terrestrial, sympodial, caespitose *herb*, to ca. 162 cm tall including inflorescence. *Roots* 0.9–3.3 mm in diameter, basal, terete, fleshy, thin, white. *Stems* 70–100 × 0.3–0.7 cm, simple, cane-like, slightly sinuous, terete, thin, covered by foliar sheaths, papyraceous. *Leaves* 4.0–9.2 × 2.2–4.3 cm, articulate, ovate, apex acute, coriaceous, smooth, green, margins entire, distributed throughout stem. *Spathes* lacking. Inflorescence ca. 45–56 cm tall, racemose; peduncle 33–45 cm long, elongate, reddish, covered by 4–8 tubular bracts 3.0–12 cm long, white, scarious when dry, striated, papyraceous, imbricated, acute; rachis 8–21 cm long; producing keikis from sub-apical nodes of peduncle of inflorescence. *Floral bracts* 1.5–5 mm long, much shorter than ovary, decreasing in size, triangular, acuminate, embracing. *Flowers* ca. 40, successive 3–8 open at any time, non-resupinate, sepals and petals fiery orange, lip pale orange-yellow, callus orange-yellow, column yellow, anther green; fragrance none. *Ovary* 19–28 mm long, terete, thin, not inflated, orange, slightly arched, furrowed. *Sepals* 11.6–13.4 × 5.6–6.4 mm, spreading, elliptic, apex acute, minutely apiculate, 5-veined, margin entire, spreading; lateral sepals oblique, with low dorsal keel. *Petals* 11.8–12.6 × 6.7–7.2 mm, spreading, obtusulate-spatulate, acute, 3-veined (lateral veins short branched), distal margin irregularly erose, spreading. *Lip* 8.8–9.5 × 13.8–15.4 mm, united to column, 3-lobed, base cordate, callus massive, callus formed by

three unequal tubercles, lateral ones made up of two teeth, unequal, outer pair short, united, with basal part slightly elevated, and mid-tubercle consisting of single elongate and thin, high keel, which is thickened on each side to about middle; lateral lobes 6.3–7.2 × 5.5–6.6 mm, semi-orbicular, margin deeply lacinate, slightly revolute; mid-lobe 4.8–5.3 × 6.8–7.4 mm, basal half an isthmus, apical half slightly bilobed, lobes divergent, sub-quadrate, distal margin lacinate, lateral margins revolute. *Column* 7.8–9.3 mm long, slightly arched upwards at apical half, terete, slightly thickened towards apex, lateral lobe on each side at apex, acute, margin minutely erose, embracing anther, and a pair of very short finger-like wings at base, slightly arched upwards. *Clinandrium-hood* reduced; margin irregular dentate. *Anther cap* ovoid, acute, rugose, 4-celled. *Pollinia* 4, narrowly obovate, elongate, laterally compressed, of equal size; caudicles soft and granulose, forming elongate tetrads that appear as a pile of roof tiles; viscarium semi-liquid, transparent. *Rostellum* apical, slit. *Lateral lobes* of stigma very small. *Nectary* deep, penetrating half pedicellate ovary, minutely papillose, papillae arranged in longitudinal rows. *Capsule* elliptic.

Eponymy: The name honors the energy company CELSIA, the owner who purchased property “La Lorena” for conservation purposes where the new species was found.

Habitat and ecology: See *Epidendrum calimaense*.

Conservation status: See *Epidendrum calimaense*.

Epidendrum celsiae is recognized by the non-resupinate flowers, the sepals and petals fiery orange, lip pale orange-yellow, callus orange-yellow, column yellow, anther green, the sepals 11.6–13.4 × 5.6–6.4 mm, spreading, elliptic, apex acute, minutely apiculate, the petals 11.8–12.6 × 6.7–7.2 mm, spreading, obtusulate-spatulate, acute, and the lip 8.8–9.5 × 13.8–15.4 mm, united to column, 3-lobed, base cordate, callus massive, callus formed by three unequal tubercles, lateral ones made up of two teeth, unequal, the outer pair short, united, with the basal part slightly elevated, and mid-tubercle consisting of single elongate and thin, high keel, which is thickened on each side to about the middle.

The two new species shares similar traits in the habit and flower morphology. Vegetatively, *Epidendrum calimaense* has elliptical leaves with the apex rounded, aggregate along the apical half of the stem, while *Epidendrum celsiae* has ovate leaves with the apex acute, distributed throughout the stem (Fig. 4). The flowers of *Epidendrum celsiae* are larger compared with *E. calimaense*, the lip and callus of *E. calimaense* has the base slightly cordate, bicallose with a pair of elevated spherical calli on sides at base, central callus lobed and wide, arranged in shape of a semi-circular crown formed by three unequal tubercles, lateral ones made up of two teeth, middle one made up of three teeth. In contrast, *Epidendrum celsiae* which could be very similar in appearance has the lip base cordate, with the callus formed by three unequal tubercles, lateral ones made up of two teeth, unequal, outer pair short, united, with basal part slightly elevated, and mid-tubercle consisting of single elongate and thin, high keel, which is thickened on each side to about middle (Fig. 5).

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