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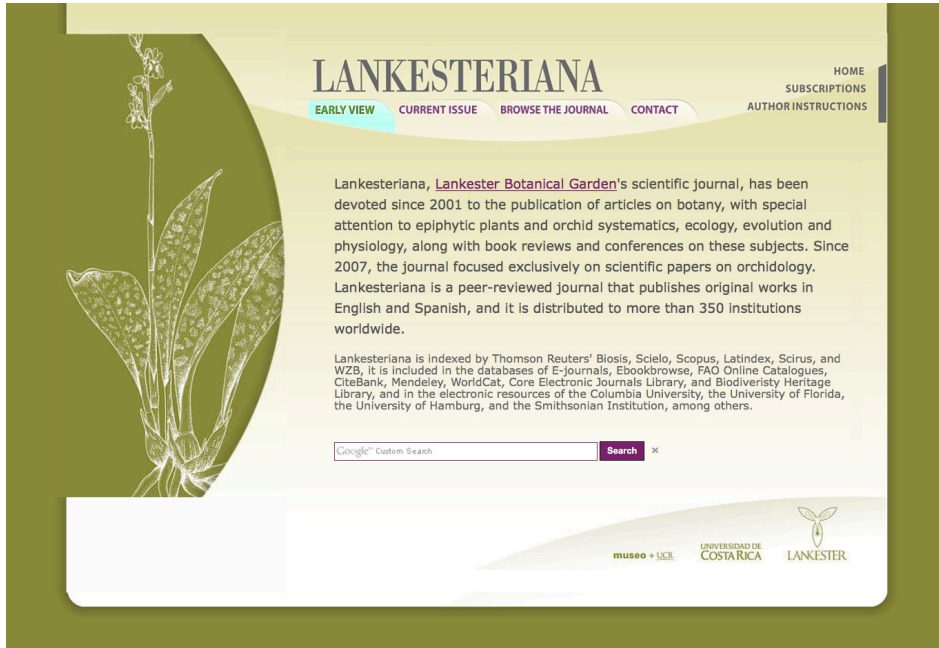


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OSMOPHORE DIVERSITY IN THE *CATASETUM CRISTATUM* ALLIANCE (ORCHIDACEAE: CATASETINAE)

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ABSTRACT. *Catasetum* is a neotropical orchid genus of 130 species characterized by its unisexual flowers. They are pollinated by male Euglossini bees. It is widely known that these bees collect volatile compounds in *Catasetum* from structures called osmophores. However, there is little information on morpho-anatomy and histochemistry of secretory tissues for this neotropical genus and data are lacking. Based on these arguments members of the *Catasetum cristatum* alliance, namely *C. arietinum*, *C. ariquemense*, *C. barbatum*, *C. carolinianum*, *C. cristatum*, *C. lanciferum*, *C. multifidum*, *C. multifissum*, *C. rivularium* and *C. semicirculatum* were analyzed. The labellum of male flowers of this alliance is elongate and with fimbriate margins, possessing two protuberances and a median saccate portion. The labellum of female flowers is galeiform and there is no ornamentation. The entire adaxial surface of the labellum is secretory in both sexes, including the fimbriae of male flowers. The structure of the secretory tissue is similar among species, and they are composed of a simple epidermis and five layers of underlying parenchyma. In most species the epidermis is flat, and cells are elongated in the saccate portion. In *C. ariquemense* and *C. carolinianum* the epidermal cells are papillous, while in *C. semicirculatum* they have convex surface (male flowers). The histochemical analysis detected lipophilic droplets and starch grains inside the secretory cells. All characteristics observed are encountered in secretory tissues with high-energy demand, as is common in osmophores.

KEY WORDS: Euglossini bees, floral glands, flower reward, pollination, volatile compounds

Introduction. Nectar is the most common and widespread floral reward among orchids (e.g., van der Pijl & Dodson 1966). However, a significant number of species reward their pollinators (i.e., male euglossine bees) with volatile compounds. These volatile oils are produced in structures called osmophores (Vogel 1990). In Orchidaceae, two types of osmophores have been reported, namely glandular and epidermal (e.g., Effmert *et al.* 2006). Osmophores are commonly formed by a single layer of epidermal cells, with uni- or multicellular papillae, or several layers of cells. According to Vogel (1990), osmophores cells have big nuclei, dense cytoplasm, large amount of starch and high number of mitochondria and other organelles. The majority of these characteristics can be found in tissues with high metabolic activity, which is related to the secretion process (Fahn 2000). Studies about osmophores anatomic structure has been conducted in a number of unrelated orchid genera, such as in *Restrepia* (Pridgeon & Stern 1983), *Scaphosepalum* (Pridgeon & Stern 1985), *Stanhopea* (Stern *et al.* 1987, Curry *et al.* 1988, Curry *et al.* 1991, Pansarin & Amaral

2009, Anton *et al.* 2012), *Sievekingia* (Curry *et al.* 1991), *Kegeliella* (Curry & Stern 1991), *Cymbidium* (Stpiczynska 1993), *Gymnadenia* (Stpiczynska 2001), *Bulbophyllum* (Teixeira *et al.* 2004, Nunes *et al.* 2014, 2015, Kowalkowska *et al.* 2015), *Ophrys* (Ascensão *et al.* 2005, Francisco & Ascensão 2013), *Cyrtopodium* (Pansarin *et al.* 2008), *Cyclopogon* (Wiemer *et al.* 2009), *Grobysa* (Pansarin *et al.* 2009), *Acianthera* (de Melo *et al.* 2010), *Cynoches* (Anton *et al.* 2012), *Chlorea* (Sanguinetti *et al.* 2012), *Vanilla* (Pansarin *et al.* 2014), *Cirrhaea* (Pansarin *et al.* 2014), *Gongora* (Adachi *et al.* 2015) and *Catasetum* (Vogel 1963).

Catasetum Rich. (Orchidaceae) has approximately 130 species distributed mainly through the tropical region of Central and South America (Romero *et al.* 2009). The majority of the species occur in the Brazilian Amazon, where this genus is well represented (Miranda & Lacerda 1992). The species are indistinguishable based on the morphology of their vegetative structures. The flowers are usually unisexual and, occasionally hermaphrodite (with no reproductive function). All three flower shapes (staminate, pistillate and hermaphrodite)

have distinct morphology and may occur in the same individual and sometimes in the same inflorescence (Romero & Nelson 1986, Romero 1992, Gerlach 2013). Within *Catasetum* some species alliances are recognized based on the morphology of male flowers and particularly on the relative position of the staminodes (Bicalho & Barros 1988). The “*C. cristatum* alliance” belongs to the subsection *Isoceras*, which has parallel or symmetrical antennae (i.e., staminodes). The species of this group exhibits a strong morphological similarity and new information are required for taxa delimitation (Lacerda 1998).

For more than fifty years is known that *Catasetum* species are pollinated by male Euglossini bees (Hymenoptera, Apidae), which collect volatile compounds at the flowers (Vogel 1963). In this case, the fragrance compounds are volatilized and act as an attractant and a resource for male euglossine bees that collect them with a hard hair structure present on their anterior legs and are stored into the hind tibiae (Eltz *et al.* 1999). These fragrances consist mainly on a variety of terpenoids and aromatics that sometimes possess a species-specific composition (Hills *et al.* 1972, Gerlach & Schill 1991). During fragrance collection, bees incidentally contact the antennae of staminate (male) flowers and the pollinarium is deposited on the bee’s body (mainly on the scutum). When visiting a pistillate (female) flower, the pollinia deposition in the stigmatic cleft can occur (Dodson 1962, Dressler 1968). Flower morphology and osmophore disposition on the labellum may guide the pollinator for a correct

position to the pollinarium adherence and deposition (e.g., Dressler 1993).

Since the work of Vogel (1963), none further information about flower anatomy of *Catasetum* has been published. Additionally, no information on secretory tissues of species belonging to the *Catasetum cristatum* alliance is available. Based on these arguments this present work aims to increase the knowledge on flower anatomy of *Catasetum*, giving details on the structures related to the resource production and the tissues involved in the fragrance secretion of selected species belonging to the “*C. cristatum* alliance”.

Materials and methods. Ten species of the *Catasetum cristatum* alliance were analyzed (Tab. 1). The specimens were collected in natural areas from Brazil or bought from commercial orchids cultivators and maintained in the Orchidarium LBMBP of the Department of Biology, FFCLRP, São Paulo University, in the city of Ribeirão Preto (approx. 21°10’S, 47°48’W; 546 m a.s.l.), state of São Paulo, southeastern Brazil. In some cases more than one individual of a same locality were potted with *Pinus* bark in a single pot. The vouchers material (living plants) was deposited at the orchidarium of the Molecular Biology and Plants Biosystematics Lab (Tab.1).

The morphological features of fresh flowers of *Catasetum cristatum* alliance were examined under a binocular stereomicroscope. To determine the osmophores location in each species, flowers were

TABLE 1. Species analyzed, locality (states of Brazil), flower sex (Male/Female), number of specimens analyzed (N) and reference number (RN) at LBMBP Orchidarium.

Species	Provenance	Flower sex	N	RN
<i>Catasetum arietinum</i> Miranda & Lacerda	PE	M	1	844
<i>Catasetum ariquemense</i> Miranda & Lacerda	RO	M	1	924
<i>Catasetum barbatum</i> (Lindl.) Lindl.	AM	M	1	952
<i>Catasetum carolinianum</i> Miranda & Lacerda	GO	M	1	946
<i>Catasetum cristatum</i> Lindl.	co*	M	1	990
<i>Catasetum lanciferum</i> Lindl.	MG	M	3	943
<i>Catasetum multifidum</i> Miranda	PA	M and F	2	815, 818
<i>Catasetum multifissum</i> Senghas	RO	M	1	916
<i>Catasetum rivularium</i> Barb.Rodr.	AM	M	1	955
<i>Catasetum semicirculatum</i> Miranda	RO	M	1	917

* Commercial orchidary.

collected during the fragrance production (2 to 5 days after flower opening in daylight period) from each specimen. The flowers were immersed in 0.1% (w/v) aqueous neutral red for 1-24 h (Vogel 1962). Additionally, they were longitudinally sectioned with a razor blade and immersed in a Lugol 1% solution for 1-10 min to localize tissue containing starch. The histochemical tests were made on transversal section of the labella stained with Sudan IV (Pearse 1985) to detect total lipids, and Lugol 1% (Hinchman 1973) for starch grains. To characterize the anatomical structure, flowers of each species were fixed in formalin-acetic acid-alcohol (FAA 50%) for 24 h (Johansen 1940) and stored in 70% ethanol. The fixed material was dehydrated in ethanol series and embedded in Histo-resin (Leica). It was sectioned at a thickness of 10-12 μm using a rotary microtome. The sections were stained with Toluidine Blue (O'Brien *et al.* 1964). Observations were carried by using a light microscope Leica DM500. Images with a minimum of 600 dpi resolution were captured with a digital camera Leica ICC50 attached to the microscope. The terminology on morphology of secretory cells follows Koch *et al.* (2008).

Results. The flower morphology is similar among species of the *Catasetum cristatum* alliance. The male flowers are resupinate, and the sepals and petals are membranous, green and generally brown-spotted. Sepals are oblong-lanceolate, concave and with acute apex. The dorsal sepal is erect, while the lateral sepals are reflexed. Petals are oblong-lanceolate, convex, erect, and with an acute apex. The labellum is elongate, fleshy, with a saccate cavity in the middle portion, and with fimbriate margins (Figs. 1A-S). The adaxial surface of the labellum possesses two protuberances, named basal and apical calluses. The female flowers are non-resupinate and the sepals and petals are membranous, strongly reflexed, and entirely green. The labellum is galeiform, and very fleshy (Fig. 2). Protuberances are absent and the surface is longitudinally ribbed due the presence of prominent vascular bundles.

In all species analyzed, the secretory tissue occurs on the adaxial surface of the labellum of male and female flowers. The osmophore covers the entire surface of the labellum, extending to the margins of this structure, including the fimbriae (Figs. 3A-F). In male flowers, the secretory tissue is very evident on both calli. These

protuberances are composed by a single tooth, three or numerous teeth. In some cases, the apical callus (*C. barbatum* and *C. cristatum*) or both calli (*C. rivularium*) split in a cluster of fimbriae. In *C. multifidum* and *C. multifissum* the apical portion of the labellum is tridentate and branched. In the rest of the labellum there is no evident ornamentation and the surface is smooth. In female flowers of *C. multifidum*, the secretory surface is smooth and the secretory tissue is homogeneously distributed.

The structure of the secretory tissue is similar among species belonging to the *C. cristatum* alliance. The osmophore has an epidermis and up to five subepidermal parenchymal layers. This structure is followed by vascular bundles, a non-secreting parenchyma and an abaxial epidermis (Fig. 4A). Variation in the epidermal cells morphology of male flowers was observed. In the majority of the studied species (i.e. *C. arietinum*, *C. barbatum*, *C. cristatum*, *C. lanciferum*, *C. rivularium*, *C. multifidum*, and *C. multifissum*) the epidermal cells surface are tabular (flat) and anticlinal walls are tetragonal (on the calluses) to tetragonal-elongated (on the saccate portion) (Figs. 4B-C). In *C. ariquemense* the cells surface is papillous (on the calluses) to tabular with convex hunches (on the saccate portion) (Fig. 4D). In *C. carolinianum* the cells surface is papillous (on the calluses) to convex (on the saccate portion). *Catasetum semicirculatum* has cells with a convex surface (Fig. 4E). In female flowers of *C. multifidum*, the epidermis shows a surface with tabular cells, where its anticlinal walls are tetragonal (Figs. 4F). A thick cuticle covers the epidermis of both male and female flowers. This cuticle, because of his hydrophobic characteristic, seems to prevent the neutral red staining of osmophores from all species analyzed. The subepidermal parenchyma cells of both male and female flowers are anisodiametric and bigger than epidermal cells. The non-secreting parenchymal cells of female flowers have large intercellular spaces, contrasting to male flowers with more compact tissues.

The fimbriate margins of male flowers seem to be specialized structures for volatile emission, being composed almost entirely by secretory cells. The epidermis are partially (*C. arietinum*, *C. barbatum*, *C. multifidum*, *C. multifissum*; Fig. 5A-B) or totally (*C. cristatum*, *C. rivularium*, *C. semicirculatum*) composed by flat cells or entirely composed by papillous cells



(*C. ariquemense*, *C. carolinianum*, *C. lanciferum*; Fig. 5C). Internally, the fimbriae possess thin vascular bundles (Fig. 5D).

In all species studied (male and female flowers) both epidermal and parenchymal cells of the secretory tissue are rich in oil droplets, which are stained with Sudan IV, confirming the lipophilic nature of the secretion in all the species analyzed (Figs. 6A-C). A large amount of starch grains is detected in the subepidermal parenchyma, but not in the epidermis (Figs. 6D). In the beginning of the scent production, the grains are aggregated and filled all the space inside the cells. After a few days those reserves are used, letting remain only small grains.

Discussion. *Catasetum* offer floral fragrances as a reward, attracting male euglossine bees as pollinators. In fact, its flowers are completely adapted to the euglossinophilous pollination syndrome. Their flowers possess big osmophores, where the chemical compounds produced inside the secretory cells volatilize to attract male bees from long distances. To do that, the secretory tissue covers the entire adaxial surface of the labellum. Vogel (1990), describing the male flowers (labellum with galeiform morphology) of *C. macrocarpum* Rich. ex Kunth, *C. fimbriatum* (Morren) Lindl. and *C. maculatum* Kunth, clarified the anatomy and the nature of the resource produced. He described the labellar tissues according to its function in the following order: emission layer (adaxial epidermis), plasma-rich production layer (secretory parenchyma), horizon of veins (vascular bundles), parenchyma (not-secretory parenchyma) and outer epidermis (abaxial epidermis). Warford and Harrell (1996) only indicated the location of the osmophores in male and female flowers of *C. pendulum* Dodson using a neutral red staining method. The same osmophore pattern described by Vogel (1990) has already been documented for another euglossinophilous species, but not at the same size and complexity, continually covering plain and sacciform areas, calluses and fimbriae of the labellum. Only one Catasetinae (*Cynoches chlorochilon*) and some genera of Stanhopeinae (*Cirrhaea*, *Gongora*,



FIGURE 2. Female flower of *Catasetum multifidum*. Note that the female flowers are non-resupinate. Scale bar = 1 cm.

Sievekingia and *Stanhopea*) have their osmophores pattern described in detail. *Cynoches chlorochilon* has the most similar structure of the secretory tissue comparing with what we recorded in members of the *C. cristatum* alliance, but the secretory tissue is localized only in an egg-shaped cavity of the labellum (Anton *et al.* 2012). In *Cirrhaea*, the secretory tissue is localized in a midlobe protuberance, and extends to the basal portion of the inner side of the lateral lobes of the labellum (Pansarin *et al.* 2006, Pansarin *et al.* 2014). The flowers of *Stanhopea* and *Gongora bufonia* are very specialized, presenting a differentiated hypochile in the labellum, region where the secretory tissue is located (Stern *et al.* 1987, Curry *et al.* 1991, Pansarin & Amaral 2009, Anton *et al.* 2012, Adachi *et al.* 2015). In *Sievekingia*, the labellum is less differentiated than *Stanhopea* and *Gongora*, presenting the osmophore in the base of a shallow pouch behind the callus (Curry *et al.* 1991). *Grobysa amherstiae* and *Cyrtopodium polyphyllum* are closely related to *Catasetum* (e.g., Freudenstein *et al.* 2004), but belong to another pollination syndromes. *G. amherstiae* (Catasetinae) is pollinated by females of *Paratetrapedia fervida* Smith (Anthophoridae) bees that collect edible oil from the elaiophores (Pansarin *et al.* 2009). This species produce volatile compounds only to attract effective pollinators to the flowers, and its osmophore is epidermal and located on abaxial surface of the labellum. *Cyrtopodium polyphyllum*

Left, FIGURE 1. Diversity in male flowers of the *Catasetum cristatum* alliance. A - B. *C. arietinum*. C - D. *C. ariquemense* (note the saccate cavity - SC). E - F. *C. lanciferum*. G - H. *C. carolinianum*. I - J. *C. semicirculatum*. K - L. *C. multifidum*. M - N. *C. multifissum*. O - P. *C. rivularium*. Q - R. *C. cristatum*. S. *C. barbatum*. Scale bars: A - S = 1 cm.



FIGURE 3. Arrangement of the secretory tissue (based on tests with Lugol 1%), in the labellum of male flowers of the *Catasetum cristatum* alliance. A. *C. arietinum*. B. *C. ariquemense*. C. *C. cristatum*. D. *C. carolinianum*. E. *C. multifidum*. F. *C. rivularium*. Note that in all species analyzed the secretory tissue is stained in black (arrows). Scale bars: A - F = 1 cm.

(Cyrtopodiinae) is pollinated by deceit by Centridini bees and produce scent as attractant (Pansarin *et al.* 2008). The osmophores are multicellular protrusions, more evident on the callus of the labellum.

The species of *C. cristatum* alliance show some variation in epidermal cell morphology. The meaning of these modifications can have several explanations. Whitney *et al.* (2011), comparing flowers with flat and papillous cells, showed that presence of conical epidermal cells in petals enhance pollination success. This cells shape affect significantly flower colour, flower wettability and the tactile handling of the flower by pollinators. However, have limited effect on floral temperature and might have an indirect effect on scent dispersal. Interspecific variation in epidermal cells was reported on *Stanhopea* by Curry *et al.* (1991).

These variations have an evolutionary relevance, were the selective pressure seems to have favoured the development of more elaborate osmophores with papillae, rugae and trichomes. In *Cirrhaea* spp. the osmophores do not show interspecific variation in epidermal cells (Pansarin *et al.* 2014). All the seven species analyzed by these authors have epidermal osmophores with tabular cells covered by a thin cuticle. However, comparative or evolutionary studies of secretory structures in different species of the same genus are still very scarce. The subepidermal parenchymal cells of *C. cristatum* alliance seem to follow the same morphology and size pattern, corroborating with Stern *et al.* (1987). They observed that the morphology and ultrastructure of all cells within this region was essentially the same in *Stanhopea wardii* and *S. oculata*.

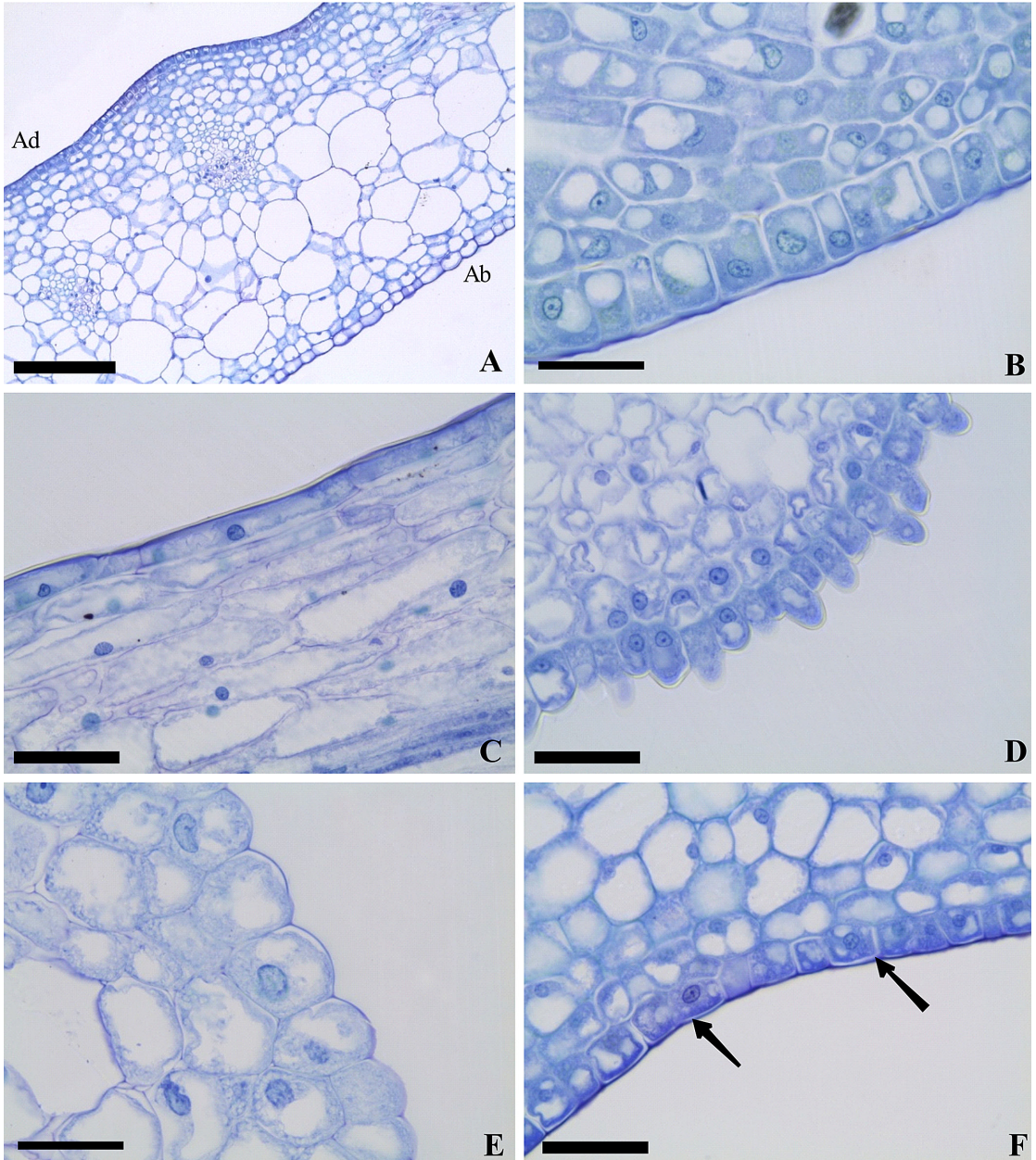


FIGURE 4. Labellum anatomy in the *Catasetum cristatum* alliance (stained with Toluidine blue). A. Transversal section of female flower labellum of *C. multifidum*; Note the secretory tissue of the adaxial surface (Ad), and the abaxial surface (Ab), with a thin epidermis and the parenchymal cells with large intercellular spaces. B. Epidermis on the apical callus of male flowers of *C. lanciferum*. C. Epidermis on the saccate portion of male flowers of *C. lanciferum*. D. Epidermis on the basal callus of male flowers of *C. ariquemense*. E. Epidermis of the basal callus of male flowers of *C. semicirculatum*. F. Epidermis of female flowers of *C. multifidum*; Note the thick cuticle (arrows). Scale bars: A = 200 μ m; B - F = 50 μ m.

The labellum morphology and anatomical features have an important function in pollination mechanism. The effectiveness of the pollination

mechanism depends critically on the precision of pollinarium emplacement on the bee (e.g., van der Pijl & Dodson 1966). To do that, the distribution of

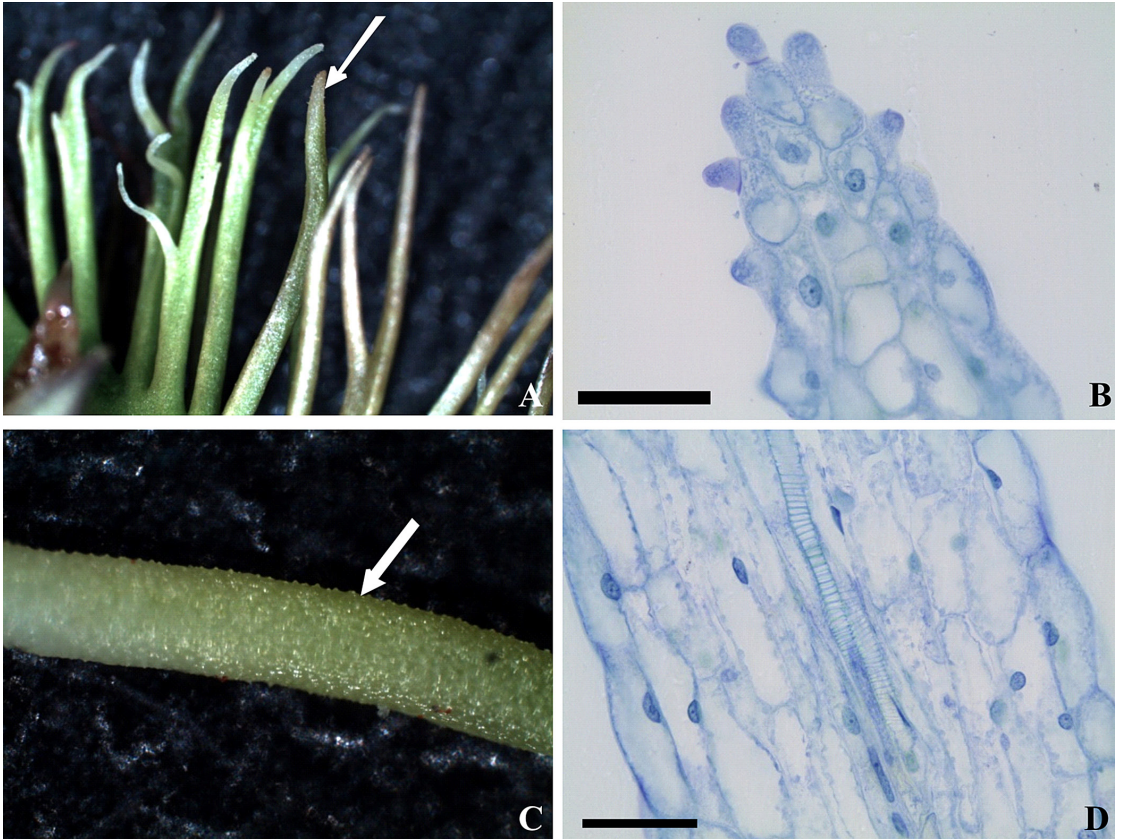


FIGURE 5. Fimbriae of male flowers of the *Catasetum cristatum* alliance. A. *C. arietinum*; Note the epidermis with papillous cells in the apex (arrow). B. Fimbriae apex of *C. multifidum*. C. *C. lanciferum*; Note the epidermis with papillous cells (arrow). D. Vascular bundle internally on the fimbriae of *C. multifidum*. Scale bars: B and D = 50 μ m.

the secretory tissue must guide the bee below the column. According to Dodson (1962), there is a relation between the position of the antennae (the trigger of pollinarium ejection mechanism) and the secretory tissue. Dodson (1962), cited for *Catasetum macroglossum*: “the antennae are located just over the deepest point of the saccate labellum where the strongest odour is emitted”. In addition, the thicker secretory tissue of basal callus in male flowers has the function to produce resource for collection, which results in a correct bee positioning below the column and allow the contact with the antennae. According to Vogel (1990), this resource does not stay available for a long time, and evaporate rapid. The fragrance produced in thinner secretory tissue, in the rest of lip areas, not seem to produce a collectible amount of resource. It probably have only attraction function for pollinators in these areas. The pollinia

reception on the stigma is passive, and the secretory tissue distribution in female flowers stimulates the bee to enter in the galeiform labellum for resource collection. The pollinia is deposited on the stigmatic cleft of the column when the bee finish the collection and leaves the labellum interior (e.g., Dodson 1962). The female flowers have longer longevity (e.g., Milet-Pinheiro *et al.* 2015). However, we have not noticed any relevant modification in the secretory tissue of female flowers when compared to male flowers.

The *C. cristatum* alliance have the most complex lip morphology among *Catasetum*. The labellum is open and shows extraordinary structures, such as calluses and fimbriae. The three species analyzed by Vogel (1963, 1990) have more simple labellum morphology. However, both species (analyzed by him and us) show similar structure of the secretory tissue. Finally,

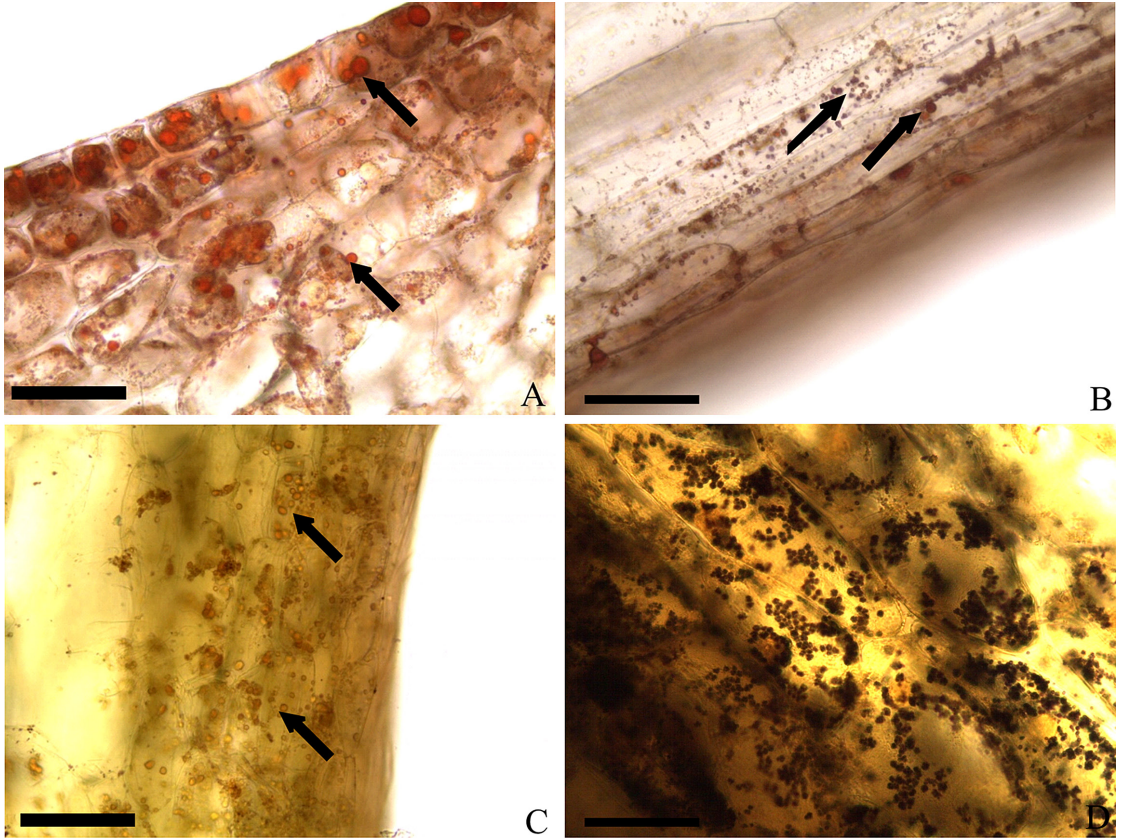


FIGURE 6. Histochemical tests on the labellum of male flowers of the *Catasetum cristatum* alliance. A. Lipids droplets in *C. rivularium* callus (arrows) - stained with Sudan IV. B. Lipids droplets in *C. carolinianum* saccate portion (arrows) - stained with Sudan IV. C. Lipids droplets into a fimbriae of *C. barbatum* (arrows) - stained with Sudan IV. D. Starch grains in *C. semicirculatum* - stained with Lugol 1%. Scale bars: A - D = 50µm.

we were able to increase knowledge to the genus, highlighting the role of the osmophores in pollination mechanism. The characteristics described here can also be useful in the taxonomy of this neotropical and diverse orchid genus.

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LITERATURE CITED

- Adachi, S. A., Machado, S. R. & Guimarães, E. (2015). Structural and ultrastructural characterization of the floral lip in *Gongora bufonia* (Orchidaceae): understanding the slip-and-fall pollination mechanism. *Botany*, 93, 759-768.
- Anton, S., Kaminska, M. & Stpiczynska, M. (2012). Comparative structure of the osmophores in the flower of *Stanhopea graveolens* Lindley and *Cycnoches chlorochilon* Klotzsch (Orchidaceae). *Acta Agrobotanica*, 65, 11-22.
- Ascensão, L., Francisco, A., Cotrim, H. & Pais, M. S. (2005). Comparative structure of the labellum in *Ophrys fusca* and *O. lutea* (Orchidaceae). *American Journal of Botany*, 92, 1059-1067.
- Bicalho, H. D. & Barros, F. (1988). On the taxonomy of *Catasetum* subsection *Isoceras*. *Lindleyana*, 3, 87-92.
- Curry, K. J., Stern, W. L. & McDowell, L. M. (1988).

- Osmophore development in *Stanhopea anfracta* and *S. pulla* (Orchidaceae). *Lindleyana*, 3, 212-220.
- Curry, K. J. & Stern, W. L. (1991). Osmophore development in *Kegeliella houtteana* (Stanhopeinae – Orchidaceae). *American Journal of Botany*, 78, 22-23.
- Curry, K. J., McDowell, L. M., Judd, W. S. & Stern, W. L. (1991). Osmophores, floral features, and systematics of *Stanhopea* (Orchidaceae). *American Journal of Botany*, 78, 610-623.
- Dodson, C. H. (1962). Pollination and variation in the subtribe Catasetinae (Orchidaceae). *Annals of the Missouri Botanical Garden*, 49, 35-56.
- Dressler, R. L. (1968). Pollination by euglossine bees. *Evolution*, 22, 202-210.
- Dressler, R. L. (1993). *Phylogeny and classification of the orchid family*. Oregon, USA: Discords Press Portland.
- Eltz, T., Whitten, W. M., Roubik, D. W. & Linsenmair, K. E. (1999). Fragrance collection, storage, and accumulation by individual male orchid bees. *Journal of Chemical Ecology*, 25, 157-176.
- Effmert, U., Buss, D., Rohrbeck, D. & Piechulla, B. (2006). Localization of the synthesis and emission of scent compounds within the flower. In: Dudareva N, Pichersky E. (Eds.), *Biology of floral scent* (pp. 105-124). Boca Raton, USA: CRC Press.
- Fahn, A. (2000). Structure and function of secretory cells. *Advances in Botanical Research*, 31, 37-75.
- Francisco, A. & Ascensão, L. (2013). Structure of the osmophore and labellum micromorphology in the sexually deceptive orchids *Ophrys bombyliflora* e *Ophrys tenthredinifera* (Orchidaceae). *International Journal of Plant Sciences*, 174, 619-636.
- Freudenstein, J. V., van den Berg, C., Goldman, D. H., Kores, P. J., Molvray, M. & Chase, M. W. (2004). An expanded plastid DNA phylogeny of Orchidaceae and analyses of Jackknife branch support strategy. *American Journal of Botany*, 91, 149-157.
- Gerlach, G. & Schill, R. (1991). Composition of orchid scents attracting euglossine bees. *Botanica Acta*, 104, 379-391.
- Gerlach, G. (2013). La pesadilla de Lindley - La biología sexual de *Catasetum* y *Cynoches*. *Lankesteriana*, 13, 39-46.
- Hills, H. G., Williams, N. H. & Dodson, C. H. (1972). Floral fragrances and isolation mechanisms in the genus *Catasetum* (Orchidaceae). *Biotropica*, 4, 61-76.
- Hinchman, R. R. (1973). A permanent iodine stain-mountant combination for starch in plant tissues. *Stain Technology*, 48, 344-346.
- Johansen, D. A. (1940). *Plant microtechnique*. New York, USA: McGraw Hill.
- Koch, K., Bhushan, B. & Barthlott, W. (2008). Diversity of structure, morphology and wetting of plant surfaces. *Soft Matter*, 4, 1943-1963.
- Kowalkowska, A. K., Koziaradzka-Kiskurno, M. & Turzynski, S. (2015). Morphological, histological and ultrastructure features of osmophores and nectary of *Bulbophyllum wendlandianum* (Kraenzl.) Dammer (B. section *Cirrhopetalum* Lindl., Bulbophyllinae Schltr., Orchidaceae). *Plant Systematics and Evolution*, 301, 609-622.
- Lacerda, K. G. (1998). Estudos em *Catasetinae* (Orchidaceae), complexo *C. cristatum* Lindl. - I. *Bradea*, 8, 88-96.
- de Melo, M. C., Borba, E. L. & Paiva, E. A. S. (2010). Morphological and histological characterization of the osmophores and nectaries of four species of *Acianthera* (Orchidaceae: Pleurothallidinae). *Plant Systematics and Evolution*, 288, 141-151.
- Milet-Pinheiro, P., Navarro, D. M. A. F., Dötterl, S., Carvalho, A. T., Pinto, C. E., Ayasse, M. & Schlindwein, C. (2015). Pollination biology in the dioecious orchid *Catasetum uncatum*: How does floral scent influence the behaviour of pollinators? *Phytochemistry*, 116, 149-161.
- Miranda, F. E. & Lacerda, K. G. (1992). Estudos em *Catasetinae* (Orchidaceae) – I. *Bradea*, 6, 45-60.
- Nunes, E. L. P., Smidt, E. C., Stützel, T. & Coan, A. I. (2014). What does floral anatomy and micromorphology tell us about Neotropical *Bulbophyllum* section *Didactyle* (Orchidaceae: Bulbophyllinae)? *Botanical Journal of the Linnean Society*, 175, 438-452.
- Nunes, E. L. P., Smidt, E. C., Stützel, T. & Coan, A. I. (2015). Comparative floral micromorphology and anatomy of species of *Bulbophyllum* section *Napelli* (Orchidaceae), a Neotropical section widely distributed in forest habitats. *Botanical Journal of the Linnean Society*, 177, 378-394.
- O'Brien, T. P., Feder, N. & McCully, M. E. (1964). Polychromatic staining of plant cell walls by toluidine blue O. *Protoplasma*, 59, 367-373.
- Pansarin, E. R., Bittrich, V. & Amaral, M. C. E. (2006). At daybreak - Reproductive biology and isolating mechanisms of *Cirrhaea dependens* (Orchidaceae). *Plant Biology*, 8, 494-502.
- Pansarin, E. R. & Amaral, M. C. E. (2009). Reproductive biology and pollination of southeastern Brazilian *Stanhopea* Frost ex Hook. (Orchidaceae). *Flora*, 204, 238-249.
- Pansarin, E. R., Aguiar, J. M. R. B. V. & Pansarin, L. M. (2014). Floral biology and histochemical analysis of *Vanilla edwallii* Hoehne (Orchidaceae: Vanilloideae): an orchid pollinated by Epicharis (Apidae: Centridini). *Plant Species Biology*, 29, 242-252.
- Pansarin, L. M., Pansarin, E. R. & Sazima, M. (2008). Reproductive biology of *Cyrtopodium polyphyllum* (Orchidaceae): a Cyrtopodiinae pollinated by deceit. *Plant Biology*, 10, 650-659.

- Pansarin, L. M., Castro, M. M. & Sazima, M. (2009). Osmophore and elaiophores of *Grobya amherstiae* (Catasetinae, Orchidaceae) and their relation to pollination. *Botanical Journal of the Linnean Society*, 159, 408-415.
- Pansarin, L. M., Pansarin, E. R. & Sazima, M. (2014). Osmophore structure and phylogeny of *Cirrhaea* (Orchidaceae, Stanhopeinae). *Botanical Journal of the Linnean Society*, 176, 369-383.
- Pearse, A. G. E. (1985). *Histochemistry: theoretical and applied*. 4th ed. Edinburgh: Churchill Livingstone.
- van der Pijl, L. & Dodson, C. H. (1966). *Orchid flowers: Their pollination and evolution*. Miami, USA: Coral Gables.
- Pridgeon, A. M. & Stern, W. L. (1983). Ultrastructure of osmophores in *Restrepia* (Orchidaceae). *American Journal of Botany*, 70, 1233-1243.
- Pridgeon, A. M. & Stern, W. L. (1985). Osmophores of *Scaphosepalum* (Orchidaceae). *Botanical Gazette*, 146, 115-123.
- Romero, G. A. & Nelson, C. E. (1986). Sexual Dimorphism in *Catasetum* Orchids: Forcible Pollen Emplacement and Male Flower Competition. *Science*, 232, 1538-1540.
- Romero, G. A. (1992). Non-functional flowers in *Catasetum* orchids (Catasetinae, Orchidaceae). *Botanical Journal of the Linnean Society*, 109, 305-313.
- Romero, G. A., Carnevali, G. & Pridgeon, A. M. (2009). Catasetinae. In: A. M. Pridgeon, P. J. Cribb, M. W. Chase & F. N. Rasmussen (Eds.), *Genera Orchidacearum, Epidendroideae - Part II, Volume 5* (pp. 13-18). New York: Oxford University Press.
- Sanguinetti, A., Buzatto, C. R., Pedron, M., Davies, K. L., Ferreira, P. M. A., Maldonado, S. & Singer, R. B. (2012). Floral features, pollination biology and breeding system of *Chloraea membranacea* Lindl. (Orchidaceae: Chloraeinae). *Annals of Botany*, 110, 1607-1621.
- Stern, W. L., Curry, K. J. & Pridgeon, A. M. (1987). Osmophores of *Stanhopea* (Orchidaceae). *American Journal of Botany*, 74, 1323-1331.
- Stpiczynska, M. (1993). Anatomy and ultrastructure of osmophores of *Cymbidium tracyanum* Rolfe (Orchidaceae). *Acta Societatis Botanicorum Poloniae*, 62, 5-9.
- Stpiczynska, M. (2001). Osmophores of the fragrant orchid *Gymnadenia conopsea* L. (Orchidaceae). *Acta Societatis Botanicorum Poloniae*, 70, 91-96.
- Teixeira, S. P., Borba, E. L. & Semir, J. (2004). Lip anatomy and its implications for the pollination mechanisms of *Bulbophyllum* species. *Annals of Botany*, 93, 499-505.
- Vogel, S. (1962). Die Duftdrüsen der Orchideen. *Akademie der Wissenschaften und der Literatur, Mainz, Abhandlung der Mathematisch - Naturwissenschaftliche Klasse*, 10, 598-763.
- Vogel, S. (1963). Das sexuelle Anlockungsprinzip der Catasetinen- und Stanhopeen-Blüten und die wahre Funktion ihres sogenannten Futtergewebes. *Österreichische Botanische Zeitschrift*, 100, 308-337.
- Vogel, S. (1990). *The role of scent glands in Pollination*. New Delhi, India: Amerind Publishing Co.
- Warford, N. M. & Harrell, B. (1996). Pollination, osmophores, and gender expression of *Catasetum pendulum*. *Orchid Digest*, 60, 74-78.
- Whitney, H. M., Bennett, K. M. V., Dorling, M., Sandbach, L., Prince, D., Chittka, L. & Glover, B. J. (2011). Why so many petals have conical epidermal cells? *Annals of Botany*, 108: 609-616.
- Wiemer, A. P., Moré, M., Benitez-Vieyra, S., Cocucci, A. A., Raguso, R. A. & Sérsic, A. N. (2009). A simple floral fragrance and unusual osmophore structure in *Cyclopogon elatus* (Orchidaceae). *Plant Biology*, 11, 506-514.

A NEW SPECIES OF *CATASETUM* (ORCHIDACEAE, EPIDENDROIDEAE, CYMBIDIEAE) FROM THE SOUTHERN BRAZILIAN AMAZON

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ABSTRACT. *Catasetum colidense*, from margins of the Teles Pires River, Mato Grosso State, Brazil, is described and illustrated. The new species is compared with morphologically similar species.

RESUMO. É descrita e ilustrada *Catasetum colidense*, oriunda das margens do rio Teles Pires, estado de Mato Grosso, Brasil. A nova espécie é comparada com as espécies morfológicamente próximas.

KEY WORDS: Amazon, *Catasetum*, epiphyte, Mato Grosso State, Neotropics, Teles Pires River.

PALAVRAS CHAVE: Amazônia, *Catasetum*, epífita, Mato Grosso, Neotrópico, rio Teles Pires.

Introduction. The genus *Catasetum* Rich. ex Kunth has a controversial number of species, 130 according to Romero (2009), versus circa 200 species according to Govaerts (2016). They are found from Mexico to Paraguay and Argentina (Govaerts 2016). In Brazil circa 105 species are known to occur, they are distributed all around the country, however, a higher richness is found in the Amazonian biome. The Mato Grosso State is highly representative, with 34 species and two natural hybrids (Petini-Benelli & Grade 2008, 2010, Koch & Silva 2012, Petini-Benelli 2012, BFG 2015, Petini-Benelli *et al.* 2015, Petini-Benelli & Soares-Lopes 2015).

The North region of Mato Grosso is on the Austral limit of Amazonia and has a rich flora, that is scarcely known (Zappi *et al.* 2011, 2016). Recently it has produced many novelties, including new records of geographic distribution (eg. Vilela-Santos *et al.* 2013, Petini-Benelli *et al.* 2015, Engels & Ferneda Rocha 2016a,b) and new species (eg. Petini-Benelli & Grade 2008, 2010, Vanderplank & Zappi 2011, Petini-Benelli & Soares-Lopes 2015).

The new species of *Catasetum* that is here described and illustrated was found during the flora rescue of the hydroelectric power plant of Colider, in the Teles Pires River, North-Central Mato Grosso State.

RESULTS

Catasetum colidense M.E.Engels, L.C. Ferneda Rocha & A. Petini-Benelli *sp nov.* Type: BRAZIL. Mato Grosso: Colíder, Flora Rescue from UHE Colíder, (♂), 22 January 2015, *M.E. Engels 4640* (Holotype MBM!; Isotypes HERBAM!, RB!, TANG! [spirit collection]). FIG. 1–2.

Catasetum albovirens Barb.Rodr. *et C. matogrossense* Bicalho *similis sed resupinata stamineae floribus, subquadrate labelum medium lobus et labelum ostium apertum magis differt. Catasetum cotylicheilum* D.E.Benn. & Christenson *similis sed labellum basis absque callum, carinatum labellum centrum, subquadrate labelum medium lobus et antennae intra labelum ostium differt.*

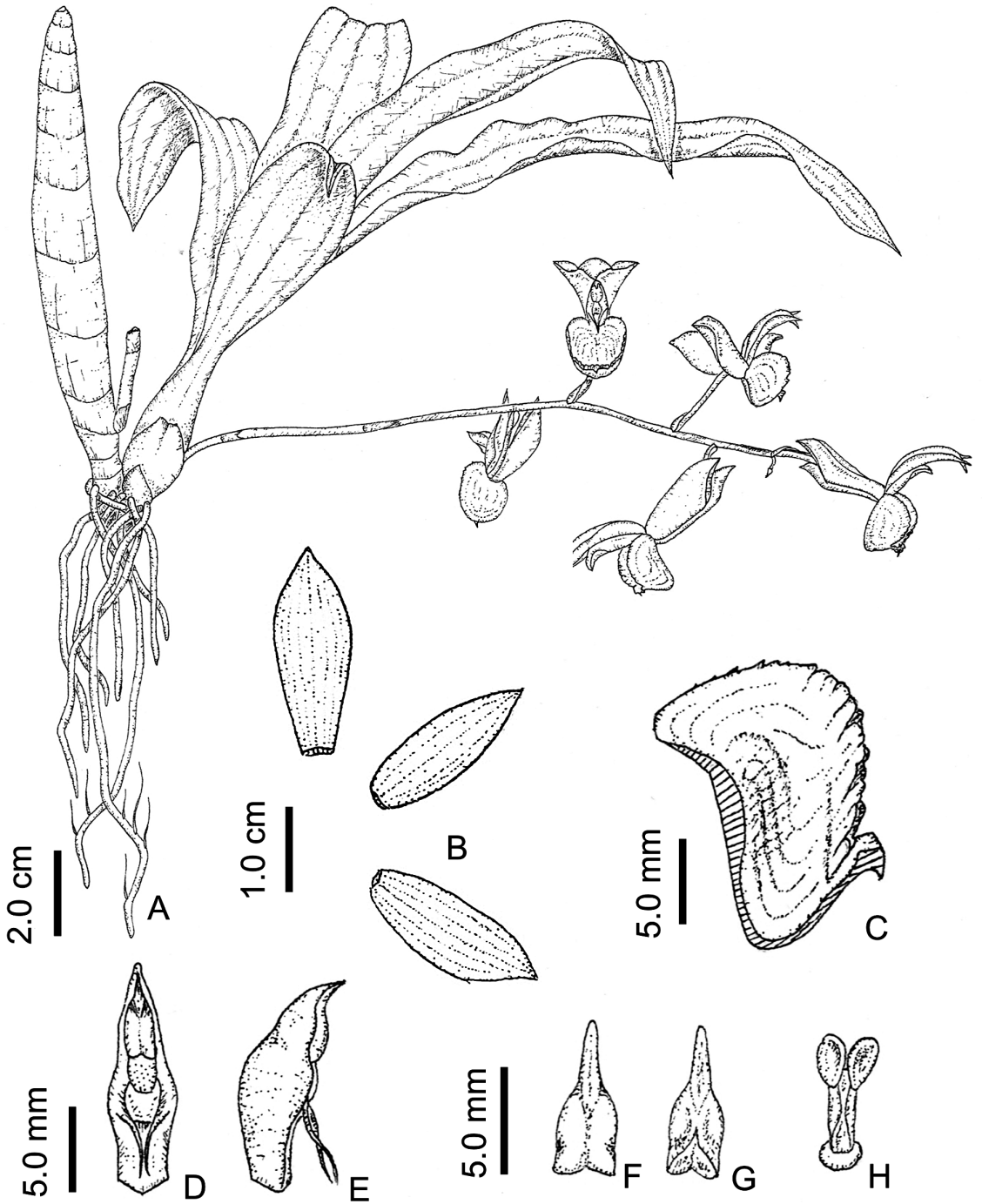


FIGURE 1. *Catasetum colidense*. A. Habit. B. Flattened perianth. C. Sectioned lip in lateral view. D. Column in frontal view. E. Column in lateral view. F. Anther in dorsal view. G. Anther in ventral view. H. Pollinarium (M.E.Engels 4639). Illustration by M.E.Engels.

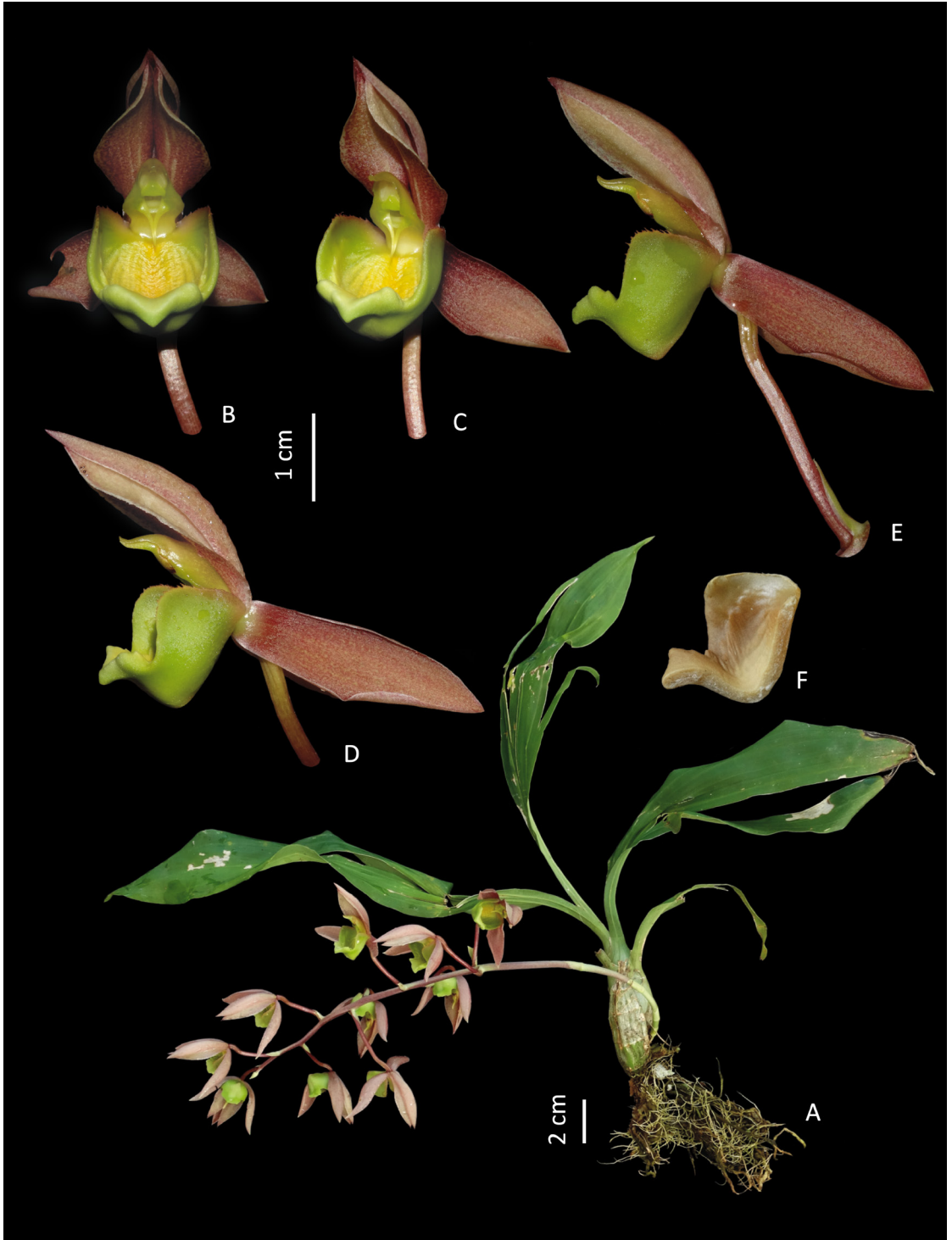


FIGURE 2. *Catasetum colidense*. A. Habit. B. Flower in frontal view. C–D. Flower in diagonal view. E. Flower in lateral view. F. Lateral view of lip in sagittal section (A. *M.E.Engels* 4638, B–F. *M.E.Engels* 4640). Photos by M.E.Engels.

Epiphytic herbs, caespitose. *Roots* 1–3 mm thick, terete, whitish. *Rhizomes* ca. 5 mm thick, 0.5–1.0 cm between pseudobulbs, terete. *Pseudobulbs* 4.8–16.3 × 1.0–4.7 cm, heteroblastic, fusiform, green when foliated to brownish when mature. *Leaves* 16.6–50.5 × 3.4–7.0 cm, elliptic, flat, nerves sunken adaxially and prominent abaxially, green, slightly discolor. *Inflorescence* basal, curved, 5–34 flowers; peduncle 8–24 × 0.2–0.5 cm, terete, brown-pinkish; peduncle bracts 1.0–1.8 × 0.6–1.4 cm, amplexive, obovate, obtuse, pale green; rachis 5.9–42.3 × 0.1–0.3 cm, terete, brown-pinkish; floral bracts 0.3–1.5 × 0.3–0.4 cm, deltoid to triangular, acute, pale green. *Staminate flowers*, resupinate; ovary and pedicel 2.2–4.8 × 0.1–0.2 cm, terete, brown-pinkish to brown-reddish; *dorsal sepal* 2.5–3.2 × 0.4–0.6 cm, elliptic-oblancheolate, base cuneate, margin entire, apex acute, brown-pinkish to brown-reddish; *lateral sepals* 2.3–3.2 × 0.8–0.9 cm, elliptic-lanceolate, base cuneate, margin entire, apex acute, brown-pinkish to brown-reddish; *petals* 2.5–3.2 × 0.6–0.7 cm, oblanceolate, base acute, margin entire, apex acute, brown-pinkish to brown-reddish; *lip* 1.5–1.7 × 2.0–2.2 cm, stiff, fleshy, globose, 1.0–1.3 cm length, trilobate, pale green, adaxial surface yellow in center; lateral lobes 1.1–1.2 × 0.5–0.6 cm, rounded, margin serrate in proximal third, dentate at ca. $\frac{2}{3}$ distal; central lobe 0.2–0.4 × 0.6–0.8 cm, sub quadrate, margin dentate-callous, apex obtuse to sub truncate; central portion of lip with longitudinally keels and stretch transversal slightly verrucose, the longitudinal keel may extend into the margins of the central portion of the lip, it is slightly dentate-callous and very similar to margin of the central lobe, this keel can be more or less developed. *Column* 1.5 × 0.3–0.5 cm, pale green; antennae 2, ca. 5 mm length, equal, filiform, whitish, enclosed by the lip cavity in a side view; anther ca. 6–7 × 3 mm, elliptic, apiculate, pale green-yellowish; viscidium ca. 1.5 × 1.5 mm, rounded, pale brown; stipe ca. 3 × 1.0–1.5 mm, oblanceolate, white-brownish; pollinia 2, ca. 2 × 1 mm, obovate, flattened, yellow. Pistillate flowers not seen. *Fruits and seeds* not seen.

ADDITIONAL EXAMINED MATERIAL (PARATYPES). BRAZIL. Mato Grosso: Colíder, Flora Rescue from UHE Colíder, (♂), 12.XII.2014, *M.E. Engels 4637* (MBM!); Idem (♂), 31.I.2015, *M.E. Engels 4638* (MBM!); Idem (♂), 11.I.2016, *M.E. Engels 4639* (TANG! spirit collection).

ETYMOLOGY. The specific epithet refers to the type locality, county of Colíder, Mato Grosso State, Brazil.

Catasetum colidense is morphologically similar to the Brazilian species *C. albovirens* and *C. matogrossense*. However, it differs from those by the staminate flowers resupinate (vs. non-resupinate) and the central lobe of lip sub quadrate (vs. rounded to sub deltoid). Besides that, the ostium of the lip is more open in *C. colidense* than in the compared species. Another species very close is *Catasetum cotylicheilum* D.E.Benn. & Christenson, endemic of Peru, but there are several differences between them, including the staminate flowers without callous in the lip base (vs. lip base with callous), the central lobe sub quadrate and slightly thickened (vs. central lobe deltoid and strongly thickened), the central portion of the lip with longitudinally keels and stretch transversal slightly verrucose (vs. keels and stretch absent), and the column antennae enclosed by the lip cavity in a side view (vs. totally outside of the lip cavity). *Catasetum colidense* belong to subgenus *Catasetum*, section *Isoceras*, subsection *Convergens*, with antennae first converging near the base and then parallel at the apex, directed towards the center of the lip.

This species is found as an epiphyte in forests at the margins of the Teles Pires River, in Seasonal Evergreen Alluvial Forest. Flowers were observed from December to January. The flowering occurs when the pseudobulb is already developed and before the leaves fall (for types of flowering see Faria *et al.* 2016).

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LITERATURE CITED

- BFG (The Brazil Flora Group). (2015). Growing knowledge: an overview of Seed plants diversity in Brazil. *Rodriguésia*, 66(4), 1085–1113.
- Engels, M.E. & Ferneda Rocha, L.C. (2016a). *Maxillaria aureoglobula* (Orchidaceae, Maxillariinae): a new record from Brazil. *Lankesteriana*, 16(2), 119–122. doi: <http://dx.doi.org/10.15517/lank.v16i2.25395>.

- Engels, M.E. & Ferneda Rocha, L.C. (2016b). *Vanilla appendiculata* (Orchidaceae): primeiro registro para o estado do Mato Grosso, Brasil. *Rodriguésia*, 67(3), 855-858.
- Faria, R.T., Colombo, R.C., Oliveira, L.V.R. & Camolesi, M.R. (2016). Orquídeas do gênero *Catasetum* no Brasil. Londrina, Mecenas, p. 160.
- Govaerts, R. (2016). World Checklist of Selected Plant Families. Facilitated by the Royal Botanic Gardens, Kew. Available in: <www.kew.org/wcsp/monocots> Access: 17 July 2016.
- Koch, A.K. & Silva, C.A. (2012). Orquídeas nativas de Mato Grosso. Cuiabá, Carlini & Caniato Editorial, p. 112.
- Petini-Benelli, A. (2012). Orquídeas de Mato Grosso – Genus *Catasetum* L.C. Rich ex Kunth. Rio de Janeiro, Pod, p. 130.
- Petini-Benelli, A. & Grade, A. (2008). A new species of *Catasetum* (Orchidaceae) for the State of Mato Grosso, Brazil. *Edinburgh Journal of Botany*, 65(1), 27–34. doi: <https://doi.org/10.1017/S0960428608004824>
- Petini-Benelli, A. & Grade, A. (2010). Novo Híbrido Natural de *Catasetum* L. C. Rich ex Kunth (Orchidaceae) para o Norte de Mato Grosso, Brasil. *Orquidário*, 24(4), 124–132.
- Petini-Benelli, A. & Soares-Lopes, C.R.A. (2015). A new species of *Catasetum* (Cymbidieae, Epidendroideae, Orchidaceae) from the Southern region of the Brazilian Amazon. *Phytotaxa*, 204(1), 75–79. doi: <http://dx.doi.org/10.11646/phytotaxa.204.1.6>
- Petini-Benelli, A., Soares-Lopes, C.R.A., Silva, D.R. & Ribeiro, R.S. (2015). Novos registros de epífitas vasculares para o estado de Mato Grosso, Brasil. *Enciclopédia Biosfera*, 21(11), 2340–2351.
- Romero, G.A. (2009). Distribution [of *Catasetum*]. In: Pridgeon, A.M., Cribb, P.J. & Chase, M.W. (Eds.) *Genera orchidacearum 5, Epidendroideae (part two)* (pp. 1–14). Oxford: Oxford University Press.
- Vanderplank, J. & Zappi, D.C. (2011). *Passiflora cristalina*, a striking new species of *Passiflora* (Passifloraceae) from Mato Grosso, Brazil. *Kew Bulletin*, 66(1), 149–153. doi: 10.1007/s12225-011-9255-2
- Vilela-Santos, M.C., Barbosa, L., Santos, Q.C., Bao, F. & Rodrigues, D. (2013). New records of *Sciaphila* Blume, *Sciaphila purpurea* Benth; *Triuris* Miers and *Triuris hyalina* Miers in the southern Amazon forest, Mato Grosso, Brazil. *Check List*, 9(4), 867–869.
- Zappi, D.C., Milliken, W., Soares-Lopes, C.R.A., Lucas, E., Piva, J.H., Frisby, S., Biggs, N. & Forzza R.C. (2016). Xingu State Park vascular plant survey: filling the gaps. *Brazilian Journal of Botany*, 39(2), 751–778. doi: 10.1007/s40415-016-0262-2
- Zappi, D.C., Sasaki, D., Milliken, W., Iva, J., Henicka, G.S., Biggs, N. & Frisby, S. (2011). Plantas vasculares da região do Parque Estadual Cristalino, norte de Mato Grosso, Brasil. *Acta amazonica*, 41(1), 29–38.

THE GENUS *VANDA* (ORCHIDACEAE: AERIDINAE) IN THE PHILIPPINES: TWO NEW SPECIES AND A KEY TO THE SPECIES IN THE ARCHIPELAGO

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ABSTRACT. Two Philippine *Vanda* species long confused with the Javanese species *V. limbata* and *V. helvola* are here described as *V. mariae* and *V. cootesii*. A key to the genus *Vanda* in the Philippines is provided.

KEY WORDS: Java, new species, Philippines, *Vanda*

Subsequent to the seminal work of Eduardo Quisumbing (Valmayor 1981), a good deal of confusion has ensued in the identification of Philippine *Vanda* species. The recognition of *V. ustii* Golamco, Claustro & de Mesa (Golamco *et al.* 2000) and *V. barnesii* W.E.Higgins & Motes, as distinct species (Higgins & Motes 2012) has contributed to clarify the taxonomy of the group. The recent description of *V. mindanaoensis* Motes, L.M.Gardiner & D.L.Roberts (Motes *et al.* 2015) has resolved the identity of this species, which has long been misidentified. Two more Philippine species which have been ascribed to superficially similar Javanese species need to be described as species in their own right. *Vanda cootesii* and *V. mariae* are described here, and a key to the Philippine species is provided.

Including the two species described hereafter, the genus *Vanda* is represented in the Philippines by 12 species. These fall into four different sections. Section *Ascocentrum* (Schltr.) L.M.Gardiner has one Philippine species, *V. aurantiaca* (Schltr.) L.M.Gardiner ssp. *philippinesis* (Christenson) L.M.Gardiner, as does Section *Dactylobata* W.Suarez & Cootes, with *V. mindanaoensis*. Section *Deltoglossa* Christenson is represented by 5 species (*V. cootesii* [described here], *V. luzonica* Loher ex Rolfe, *V. mariae* [also described in this paper], *V. merrillii* Ames & Quisumb., and *V. ustii*). Section *Lamellata* is also represented by five species (*V. barnesii*, *V. javierae* D.Tiu, *V. lamellata* Lindl., *V. robelingiana* Rolfe, and *V. sanderiana* Rchb.f.). As would be expected of an archipelago, all but two of the species are endemic.

Vanda lamellata is the most cosmopolitan of any species in the genus, ranging as far north as

Taiwan, as far east as Ryukyu islands of Japan and the Mariana Islands and as far west as Borneo. The species distinct keeled lip doubtless makes it readily pollinated by some insect or group of insect species. The plants of the various forms exhibit quite varied plant architecture, ranging from the deeply V-shaped leaves of var. *boxallii* (Rchb.f.) Rchb.f. to the broad flat leaves of var. *remediosa* Ames & Quisumb. Flowering seasons also vary. Most varieties are known to bloom throughout the year, but some are completely indeterminate, while var. *boxallii* is predominately a short day plant and transmits this quality to its hybrid progeny. The possibility exists that more precise DNA research will separate several species from this wide ranging and various species.

Vanda aurantiaca ssp. *philippinesis*, long mistakenly identified as *Ascocentrum miniatum* (Lindl.) Schltr. (an Indonesian species which ranges northward to Malaysia), is endemic to the Philippines, but *V. aurantiaca* ssp. *aurantiaca* occurs in Sulawesi.

Vanda limbata Blume has long been thought to occur in the Philippines. Jeffrey B. Comber, in his *Orchids of Java*, described the range of *V. limbata* as “also in the Philippines” (Comber 1990, Motes & Roberts 2008). The present author’s first encounter with the “Philippine *V. limbata*” occurred in the mid-eighties. The late Fred Fuchs had brought back plants labeled *V. limbata* from a cultivated source in Singapore. One of these plants was depicted as *V. limbata* “Singapore” in *Vandas: Their Botany, History and Culture* (Motes 1997). The numerous differences in plant architecture, inflorescence, and flower color were obvious, but the uncertainty of the true origins of the plants left open the possibility that the plants might



FIGURE 1. *Vanda mariae*. Note the leaves narrower and more deeply furrowed than those of *V. limbata*. Photograph by Greg Allikas.



FIGURE 2. *Vanda mariae*. Flowers from the plant that served as the holotype. Photograph by Martin Motes.

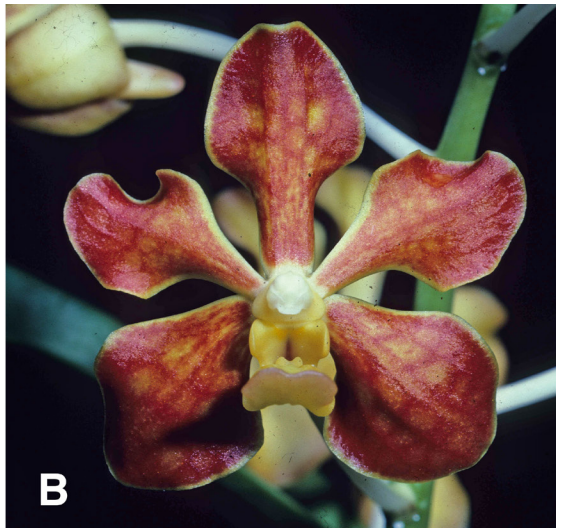


FIGURE 3. A. *Vanda limbata* from Java. The lavender lip, broad at the base and gently tapering, with a large callus, distinguishes this species from *V. mariae*. B. *Vanda mariae* differs from *V. limbata* by its narrow, straight lip with two small calli, as well as by its orange-red color. Photographs by Alan Hoffman.

be of hybrid derivation. During a trip to Luzon last year I was able to observe several nearly identical plants in private collections. These corresponded with a number of pictures on the internet of the “Philippine *V. limbata*” or the “orange *V. limbata*” (Pagdato 2016, Shaun 2016). Although no one is certain of (or willing to reveal) the location of origin, plants periodically appear for sale in horticultural venues in the Philippines. The Philippine plants are of much smaller stature than *V. limbata* from Java, with harder and more deeply furrowed leaves (Fig. 1). The flowers, while superficially similar to those of *V. limbata*, are usually yellow, overlaid with reddish brown, as opposed to the solid deep chestnut brown of typical *V. limbata* (Figs. 2, 3A–B). Unlike the Javanese *V. limbata*, in which there is a barely discernible pattern of underlying tessellation, the sepals and petals of the Philippine plants are distinctly tessellated (Fig. 4). In *V. limbata* the violet mid-lobe is narrow and straight (Fig. 3A). In the Philippine plants the yellow overlaid with red midlobe is deltoid but rolled at the margins (Fig. 3B), making it somewhat resemble *V. limbata*'s lip. *Vanda limbata* has a single prominent callus at the base of the mid-lobe and two small calli on the column foot at the entrance to the spur. In the Philippine plants there are two small calli at the base of the mid-lobe and the calli on the column foot are lacking. The mid-lobe of *V. limbata* is smooth while the mid-lobe of the Philippine flowers is adorned with three low ridges. Based on these ample differences, the Philippine plants are here described as:

Vanda mariae* Motes, *sp. nov.

TYPE: Philippines. Without locality, cult., May 2012, *M. Motes* 2 (holotype, FTG). Figs. 1–2, 3B, 4–5.

Similar to *Vanda limbata* Blume but distinguished by the yellow color with red brown tessellation of sepals and petals, and the yellow lip overlaid with red.

A climbing monopodial, epiphytic *herb.* 30–45 cm or more tall, 35–40 cm wide between leaf apices. *Leaves* glabrous, waxy, sessile, distichous, linear, 20–21 × 2.0–2.5 cm, the margins entire, the apex praemorse. *Inflorescence* axillary, an erect, cylindrical raceme, loosely 6–11 flowered, 15–20 cm long. *Flowers* pale yellow strongly overlaid with red brown, with stronger red brown tessellation. 5.1–5.2

cm horizontally, 5.1–5.2 cm vertically. *Dorsal sepal* spatulate, clawed, yellow, tessellated with red brown distally, spotted red brown basally, the margins clear yellow, 2.8 × 1.7 cm. *Lateral sepals* spatulate, clawed, yellow heavily overlaid with red brown tessellations, the margins clear yellow, 2.9 × 2.0 cm. *Petals* clawed, spatulate, obtuse, entire, yellow tessellated and spotted with red brown, the margins clear yellow, 2.9 × 1.7 cm. *Labellum* yellow suffused with red brown, three-lobed; midlobe deltoid, rolled longitudinally along the margins appearing narrowly pandurate in natural position, yellow suffused with red brown, with low longitudinal ridges and two small calli at base, 1.7 × 0.6 cm; lateral lobes lobes trapezoidal, yellow, 0.4 × 0.3 cm; spur slightly flattened, 0.5 × 0.2 cm. *Column* white, slightly thickened at base, 0.9 × 0.2 cm. *Anther cap* white, 0.2 × 0.2 cm. *Pollinia* 2, spherical, stiped.

DISTRIBUTION: Philippines. No specific locality recorded (Cootes 2011).

EPONYMY: Named for Mary Motes, noted for her long support of botanical and horticultural research.

CONSERVATION STATUS: Data deficient.

Plants from the Philippines identified as *V. helvola* Blume have long been reported (Chan *et al.* 1994: 307). Plants more recently discovered on Mindanao have initially been identified as *V. helvola*. James Cootes identifies the species' locality as Cotabato where “It grows as an epiphyte at elevations of between 400 and 1500 metres” (Cootes 2011) The author obtained two plants of the species from Purification Orchids in the Philippines two years ago. These Philippine plants are of a much larger size than the Javanese *V. helvola*, with longer and narrower leaves (Fig. 6). The flowers, like the Javanese *V. helvola* (Fig. 7), are brown but tinged with green at the apices of the tepals (Fig. 8), whereas in *V. helvola* the color is uniform without the green apices and underlying stripes found in the Philippine plants. The lip of the Philippine plants is also superficially similar, with prominent appendages at the base of the mid-lobe but unlike the distinctly deltoid lip of *V. helvola*, the Mindanao plants have a narrowly pandurate mid-lobe darkest at the apex where *V. helvola* is light green (Roberts & Motes 2009). The Mindanao plants are here described as:



FIGURE 4. *Vanda mariae* occurs in various tones of red and orange. Photographs by Nelson Geraldino (A, B) and Rommel Arriola (C).

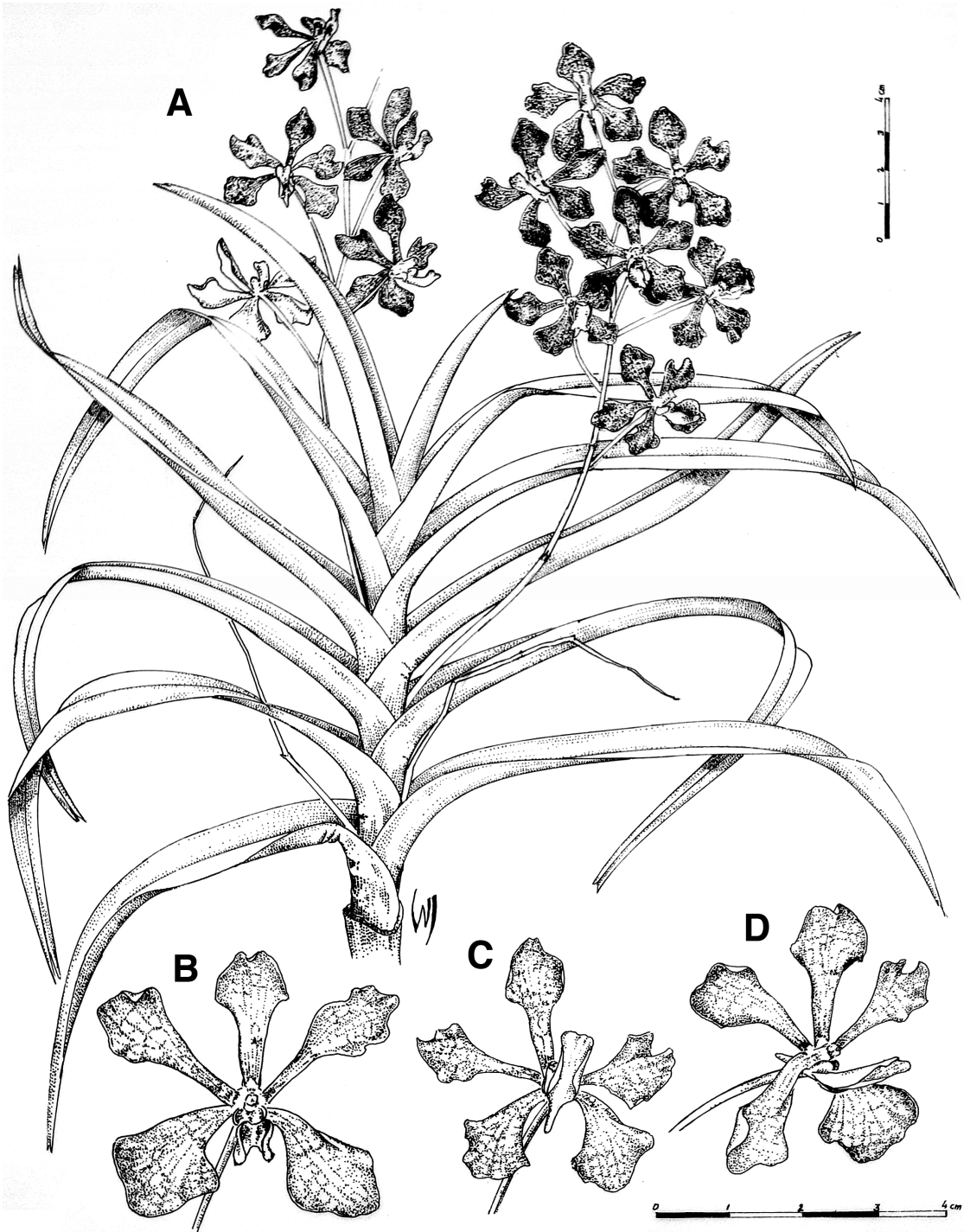


FIGURE 5. *Vanda mariae* Motes. A. Habit. B–D. Flower in frontal view, from below, and three quarters view. Drawing by Wes Jurgén based on the holotype.



FIGURE 6. *Vanda cootesii* is a taller plant with narrower leaves than *V. helvola*. The flowers appear non-resupinate here because the plant flowered after a recent importation. Photograph by Greg Allikas.



FIGURE 7. *Vanda helvola*. The lip of *V. helvola* is the most distinctly triangular in the genus. Photograph by Alan Hoffman.

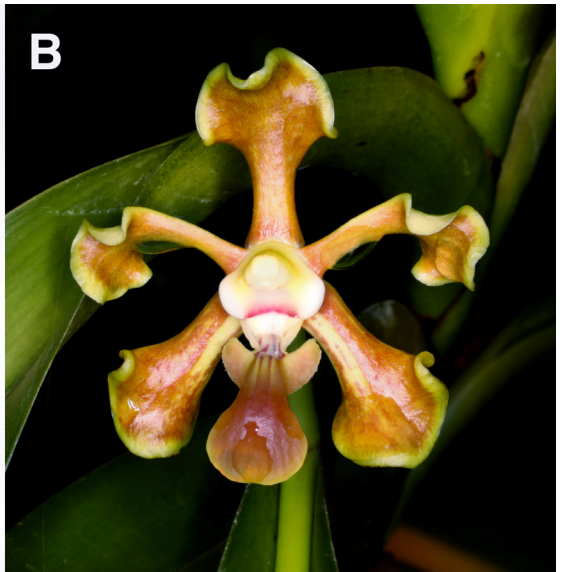
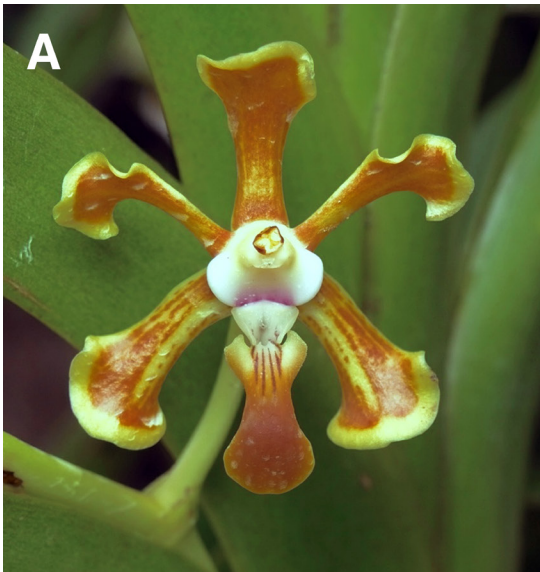


FIGURE 8. *Vanda cootesii* varies slightly in the proportion of yellow green to brown in the flowers. Photographs by Miguel de Leon (A) and Jim Cootes (B).

Vanda cootesii* Motes, *sp. nov.

TYPE: Philippines. Mindanao: Cotabata, cult. May 2014, *M. Motes 13* (holotype, FTG). Figs. 6, 8-9.

Similar to *Vanda helvola* Blume to which it bares superficial resemblance in color and lip shape. Distinguished by the green margins of sepals and petals and the narrow pandurate lip with flared base and the apex of the midlobe dark brown.

A climbing monopodial, epiphytic *herb.* 45–100 cm or more tall, 40–50 cm wide between leaf apices. *Leaves* glabrous, waxy, sessile, distichous, linear, 21–23 × 3.3–3.5 cm, the margins entire, the apex praemorse. *Inflorescence* axillary, a laxly 7-9 flowered raceme, 14-15 cm long. *Flower* yellow green with longitudinal ochre brown stripes, 3.5 cm horizontally, 4.0 cm vertically. *Dorsal sepal* spatulate, narrowly clawed, yellow green with ochre brown stripes coalescing to solid brown in the blade, with wavy

green margins, 2.0 × 1.2 cm. *Lateral sepals* narrowly clawed, spatulate, yellow green with ochre brown stripes coalescing to solid brown in blade, the margins green, wavy, 2.0 × 1.4 cm. *Petals* clawed, spatulate, yellow green with ochre brown stripes coalescing to solid brown in blade, with wavy green margins, 1.9 × 0.9 cm. *Labellum* yellow green overlaid with ochre brown, 1.0 × 1.5 cm, three-lobed; midlobe pandurate, narrower in the middle and broader at apex, the base narrowly flared, marked with very fine stripes of red brown; lateral lobes cream, oblong, curved inward at apex, 0.4 × 0.6 cm; spur oblong, flattened, 0.7 cm long. *Column* white, thickened at base, 0.3 × 0.6 cm. *Anther cap* white, 2 × 2 mm. *Pollinia* 2, spherical, stiped.

DISTRIBUTION: Philippines. Cotabata on Mindanao, 400-1500 m (Cootes 2011).

EPONYMY: Named for James Cootes, noted expert on Philippine orchid species.

CONSERVATION STATUS: Data deficient.

KEY TO THE SPECIES OF *VANDA* IN THE PHILIPPINES

- 1. Flowers smaller than 2 cm *V. aurantiaca* spp. *philippinesis*
- 1a. Flowers larger than two cm 2
- 2. Flowers with cylindrical columns 3
- 3. Midlobe of lip with distinct lobules (Section *Dactylobatae*): *V. mindanaoensis*
- 3a. Midlobe of lip without lobules (Section *Lamellata*) 4
- 4. Flowers with longitudinal blades on mid-lobe of lip (*V. lamellata*) 5
- 5. Flowers with distinctly two toned marking in lateral sepals 6
- 6. Leaves, V-shaped, flowers deep yellow *V. lamellata* var. *boxallii*
- 6a. Leaves flat, flowers pale yellow nearly white *V. lamellata* var. *remediosa*
- 5a. Flowers with mottled or indistinctly shaped brown markings 7
- 7. Lip yellow overlaid or striped with brown *V. lamellata* var. *lamellata*
- 7a. Lip pink *V. lamellata* var. *calayana*
- 4a. Flowers without longitudinal blades on lip 8
- 8. Flowers predominantly brown/red *V. roeblingiana*
- 8a. Flowers predominantly white 9
- 9. Flowers without flared base to mid-lobe of lip *V. sanderiana*
- 9a. Flowers with the base of lip midlobe flared 10
- 10. Side lobes of lip large, nearly solid red *V. barnesii*
- 10a. Side lobes of lip small, spotted red *V. javierae*
- 2a. Flowers with the column thickened at base (Section *Deltoglossa*) 11
- 11. Flowers predominantly white or cream 12
- 12. Sepals and petals marked with red *V. luzonica*
- 12a. Sepals and petals unmarked *V. ustii*
- 11a. Flowers yellow, brown or red 13

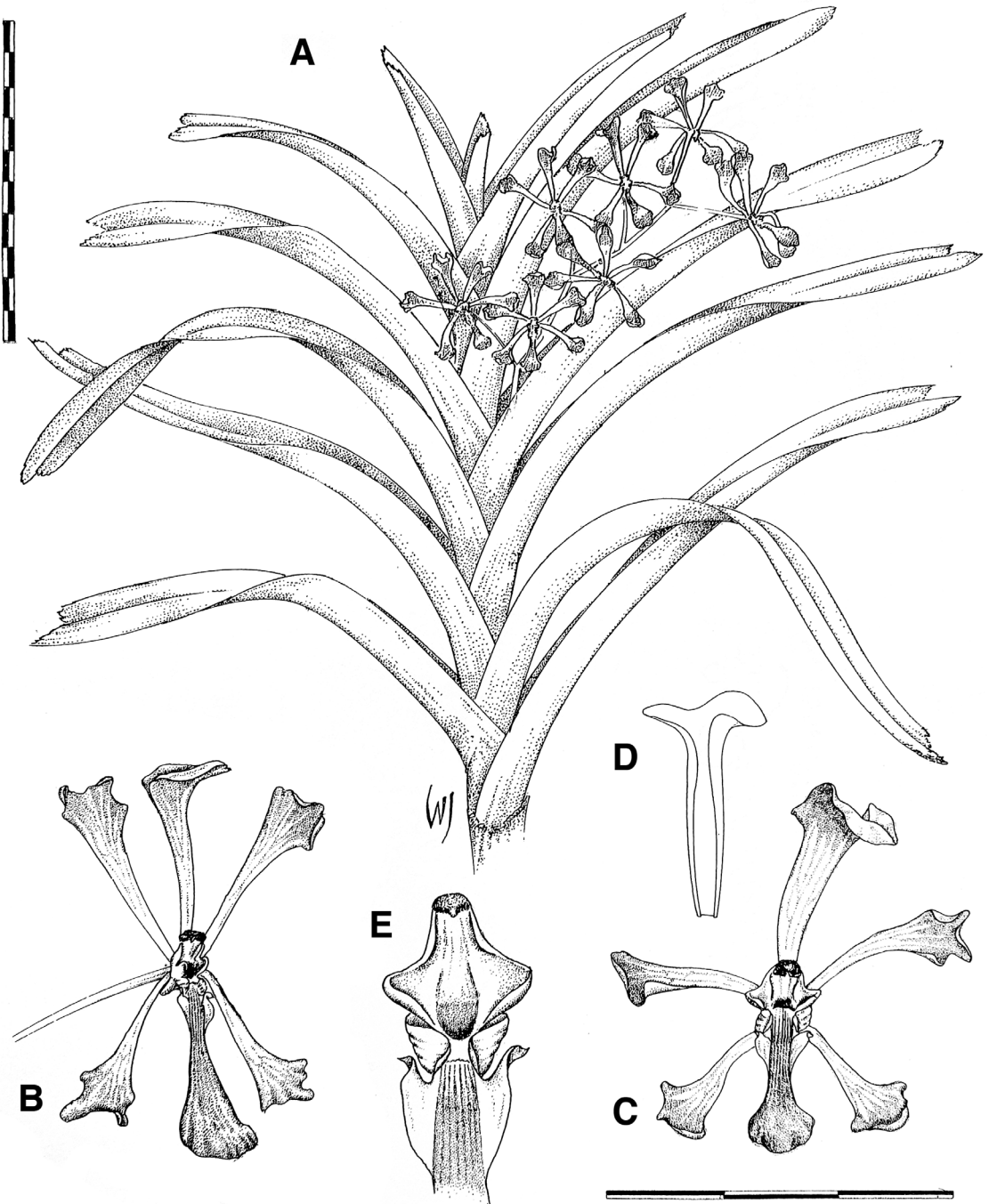


FIGURE 9. *Vanda cootesii* Motes. A. Habit. B–C. Flowers. D. Dorsal sepal, abaxial view. E. Base of the lip. Drawing by Wes Jurgén.

- 13. Flowers tessellated *V. mariae*
- 13a. Flowers spotted or concolorous lacking tessellation 14
- 14. Flowers solid red *V. merrillii* var. *rotorii*
- 14a. Flowers yellow or yellow-brown 15
- 15. Flowers yellow spotted red *V. merrillii* var. *merrillii*
- 15a. Flowers concolorous 16
- 16. Flowers golden yellow *V. merrillii* var. *immaculata*
- 16a. Flowers concolor yellow brown tinged with green *V. cootesii*

LITERATURE CITED

Chan, C. L., Lamb, A., Shim, P. S., & Wood, J. J. (1994). *Orchids of Borneo Vol. 1*. Kota Kinabalu, Natural History Publications, Borneo and Royal Botanic Gardens, Kew.

Comber, J. B. (1990). *Orchids of Java*. Kew, Royal Botanic Gardens, Kew.

Cootes, J. E. (2011). *Philippine native orchid species*. Quezon City, Katha Publishing.

Golamco, A. S., Claustro (de), L. A. & Mesa (de), P. (2000). *Vanda ustii* Golamco, Claustro et de Mesa *sp.nov.*, a new orchid species from the Cordillera region of Luzon island, Philippines. *Waling-Waling Review*, 8(1), 9–15.

Higgins, W.E. & Motes, M.R. (2012). A new *Vanda* (Orchidaceae) from the Philippines: *Vanda barnesii*. *Orchid Digest*, 76, 240–242.

Motes, M. (1997). *Vandas: their botany, history and culture*. Portland, OR, Timber Press Inc.

Motes, M., Gardiner, L. & Roberts, D. (2015). *Vanda* Section *Dactylobata*: a summary, two new Species and a key to identification. *Orchid Digest*, 79, 96-102.

Motes, M. & Roberts, D. L. (2008). *Vanda furva*: three centuries of confusion. *Orchid Digest*, 72, 174-178.

Pagdato, M. A. C. (2016). Phyto Images. Orchidaceae. *Vanda limbata*. Retrieved at: http://phytoimages.siu.edu/imgs/pelserpb/tr/Orchidaceae_Vanda_limbata_52908.html, consulted December 2016.

Roberts, D. L. & Motes, M. (2009). *Vanda helvola*, probably the most widespread species from the genus *Vanda*. *Orchid Review*, 117(1288), 196-199.

Shaun, L. (2016). PickAnOrchid. Vandaceous. *Vanda limbata*. Retrieved at: <http://pickanorchid.com/vanda-limbata/>, consulted December 2016.

Valmayor, H. L.(ed.)(1981). *The complete writings of Dr. Eduardo Quisumbing on Philippine orchids*. Manila, Eugenio Lopez Foundation, Inc.

A NEW *OLIVERIANA* (ORCHIDACEAE: ONCIDIINAE) FROM ECUADOR

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ABSTRACT. A new species of *Oliveriana* is described and illustrated. It is compared with and distinguished from all other listed members of the genus by a unique combination of distinct features, such as the extremely elongate and narrow leaves, and a flower with a fleshy triangular lip. It is speculated here that this new species may be self-pollinating due to the high success of seed pod production, which is unusual among genera in Oncidiinae.

KEY WORDS: Ecuador, new species, *Oliveriana*, Oncidiinae, Orchidaceae

Introduction. The genus *Oliveriana* Rchb.f. was described in 1877, according to the title page of the publication of *Linnaea* where the description occurs, but was actually published in December 1876 according to Moore and Wood (1965). It was based on the description of *Oliveriana egregia* Rchb.f. (Reichenbach 1876). The type plant was originally collected by Gustav Wallis who provided a dried inflorescence carrying six flowers to Reichenbach in Hamburg. The type specimen appears to have been collected somewhere near Medellín in Colombia like so many others of Wallis' collections. A drawing of what appears to represent the holotype can be seen in *Xenia Orchidacea* (Reichenbach 1883: 63, pl. 230; figs. 1-4) (Fig. 1).

Reichenbach placed *Oliveriana egregia* somewhere between *Bifrenaria* Lindl., and *Stenocoryne* Lindl., in the original description (the latter genus currently considered to be part of *Bifrenaria* as well, according to the World Checklist of Selected Plant Families). *Oliveriana egregia* has also been considered to belong to *Trichopilia* Lindl., by Bentham (1881). Leslie Garay disagreed with Bentham and placed *Oliveriana egregia* “in the Tribe Oncidiinae” (Garay 1963). Recent molecular evidence shows that *Oliveriana* indeed belongs to Oncidiinae (Chase *et al.* 2009), as a sister clade to *Systeloglossum* Schltr., and they together form a sister clade to *Cischweinfia* Dressler & N.H. Williams (Chase *et al.* 2009). The plant and flower morphologies of *Oliveriana* and *Systeloglossum* are very similar and the genera are basically separated only by the

presence of a columnar mentum for *Systeloglossum* species, while flowers of *Oliveriana* generally lack a distinct chin. Since *Systeloglossum costaricense* Schltr. lacks a distinct mentum, and *Oliveriana brevilabia* (C.Schweinf.) Dressler & N.H.Williams does display a short but distinct chin, the separating definition for these genera breaks down, and this has led authors to mention that the two genera can be merged (Dressler & Williams 1970, Chase *et al.* 2009). The morphological similarities between members of the *Oliveriana-Systeloglossum* clade versus members of *Cischweinfia* is less convincing, however, which supports maintaining these clades as separate genera.

For almost a century *Oliveriana* was a monotypic and apparently very little known genus, with *O. egregia* as its only species. Leslie Garay (1963) then described *Oliveriana lehmannii* Garay from Colombia, which he believed was a second species. There was already a second species described, however, but hiding under the name of *Odontoglossum brevilabium* C.Schweinf. (Schweinfurth 1949). It was transferred to *Oliveriana* by Robert Dressler and Norris Williams (1970). One year before this transfer Pérez (1969) described another Colombian species as *Oliveriana ortizii* A.Fernández, followed two decades later by *Oliveriana ecuadorensis* Dodson (1989) from Ecuador, and *Oliveriana simulans* Dodson & R.Vásquez (1989) from Bolivia. Then in 2014 six more species were added to the genus. They were *Oliveriana guariniaae* Szlach., Kolan. & Oledrz., *O. pseudoegregia* Szlach., Kolan. & Oledrz., and *O. puracensis* Szlach., Kolan. & Oledrz. (Szlachetko



FIGURE 1. Illustration of *Oliveriana egregia* in *Xenia Orchidacea*, from Reichenbach 1883.

et al. 2014), and *O. chocoana* Szlach. & Kolan., *O. luerorum* Szlach. & Kolan., and *O. pazii* Szlach. & Kolan. (Szlachetko & Kolanowska 2014).

Including the new species described in this paper, and the 12 species in the World Checklist of Selected Plant Families (WCSP 2016), the number of described *Oliveriana* species adds up to 13. This number will no doubt shrink, however, because a couple of the species described in 2014 show more or less clear features that may place them in other genera. For example, *Oliveriana puracensis* has all the characteristics of a *Caucaea* Schltr., and *O. guarinae* is

suspiciously similar to some members of *Cyrtochilum* Kunth. Several species are also morphologically very similar to each other and it seems possible that some will be considered as synonyms when more material becomes available for study. Examples are *Oliveriana chocoana*, *O. pazii*, and *O. pseudoegregia*, which all have very similar flowers and differ in details of the lip callus only, from what can be seen in the drawings of the type specimens (Szlachetko & Kolanowska 2014, Szlachetko *et al.* 2014). In addition, *Oliveriana eadorensis* is very similar to *O. egregia* and may prove conspecific when and if more material can be analyzed with regard to natural variation. Because very few preserved specimens exist, and few plants appear to be cultivated, we will probably have to wait for a while before these taxonomic question-marks can be straightened out with certainty.

Taxonomic treatment

Oliveriana hirtzii Dalström, *sp. nov.*

TYPE: Ecuador. Tungurahua: Rio Negro, 1500 m, without collecting date, *A. Hirtz* 007 (holotype, SEL). Fig. 2.

Oliveriana hirtzii differs from all other species in the genus by the extremely elongated and narrow leaves in combination with a flower that has lateral sepals fused for about half of their length, a lip that is only indistinctly tri-lobed and with a fleshy triangular acute front-lobe, and a distinct column hood.

Epiphytic, caespitose herb with a semi-pendent habit. *Pseudobulbs* narrowly ovoid, almost linear, trifoliate, surrounded basally by 6–7 distichous sheaths, the uppermost foliaceous, *ca.* 6.0 × 0.4–0.5 cm. *Leaves* narrow and grass-like, pendent, subpetiolate, conduplicate, linear, acuminate, 55.0–65.0 × 0.4–0.6 cm. *Inflorescence* very slender and probably semi-pendent, 35–37 cm long on type specimen; *bracts* appressed, acute to acuminate, scale-like, 3–5 mm long; *peduncle with ovary* 12–15 mm long. *Flower* light green, semi-closed, possibly self-pollinating; *dorsal sepal* basally truncate, then narrowly ovate with a blunt apex, *ca.* 12 × 3 mm; *lateral sepals* truncate, fused for *ca.* 6 mm, then obliquely narrowly ovate with a blunt acuminate apex, *ca.* 12.0 × 2.0–2.3 mm; *petals* cuneately truncate, elongate triangular with an

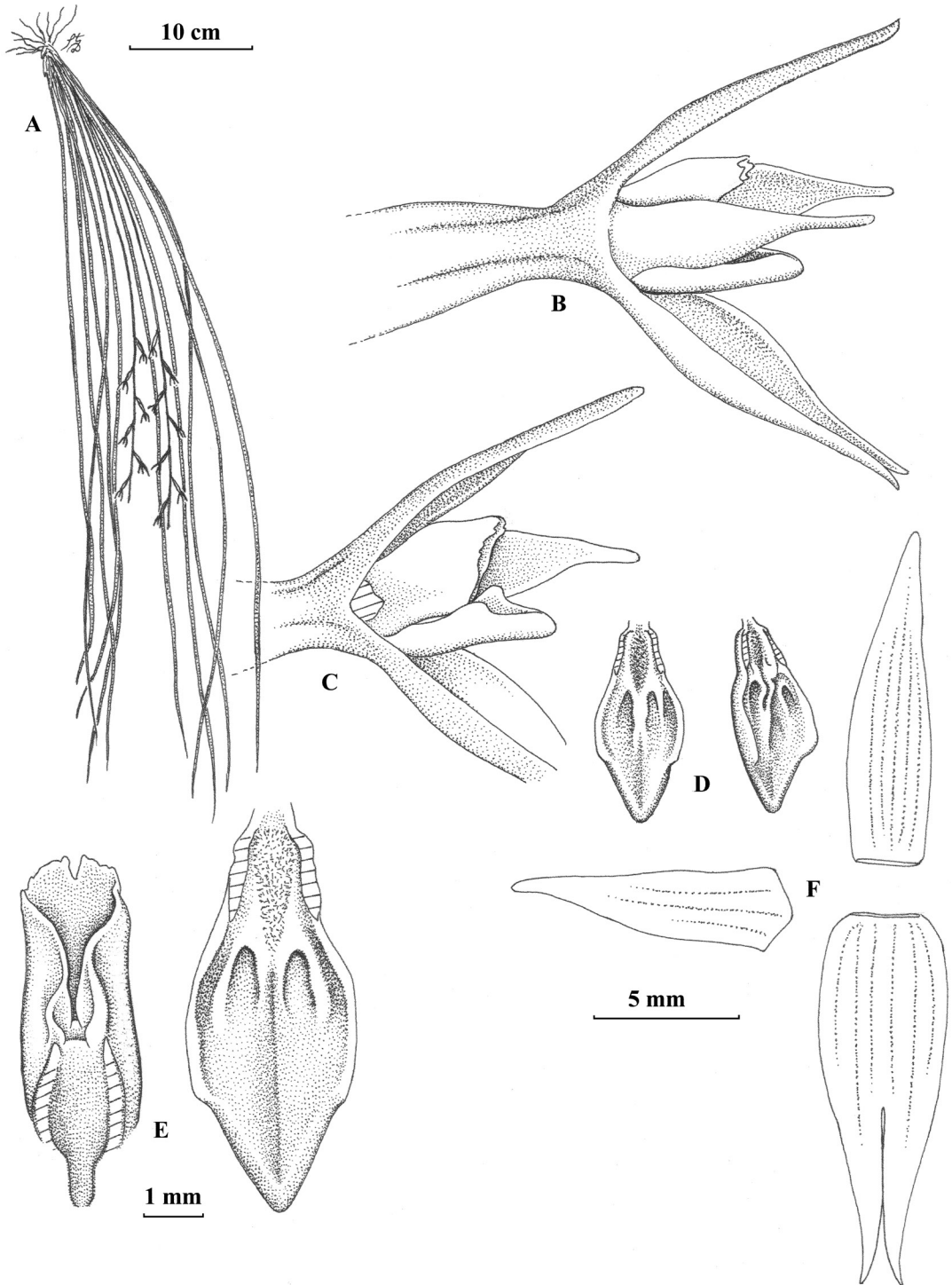


FIGURE 2. *Oliveriana hirtzii*. A. Plant habit. B. Flower, lateral view. C. Flower, lateral view with petal removed. D. Lip, dorsal and slightly angled views. E. Column, ventral view (left) and lip, dorsal view. F. Dissected flower. Drawn from holotype by Stig Dalström.

indistinctly oblique, rounded apex, *ca.* 10.0 × 2.2 mm; *lip* rigidly fused against the column along the lateral basal edges for *ca.* 1.6 mm, indistinctly trilobate with blunt side-lobes and a bluntly acute front-lobe, rather fleshy, *ca.* 6 × 3 mm; *callus* composed by a basal micro-pubescent cushion, then a fleshy, central, longitudinal short bi-lobed ridge, uniting apically into a single ridge, with a lateral, shorter and lower ridge on each side that create a shallow cavity at the base and against the central ridge; *column* short, straight and thick, with a well-developed dorsal hood, which obscures the stigmatic surface by the lateral flanks, 5.0–5.8 mm long, including the hood; *anther cap* not seen; *pollinarium* not seen.

DISTRIBUTION: Known only from the type collection near where Río Verde joins the Río Pastaza in central Ecuador, in dense tropical forest at *ca.* 1500 m elevation.

EPONYMY: This species is named in honor of Alejandro “Alex” Hirtz of Quito, Ecuador, who discovered this species very early in his amazing plant discovery career.

The only plant ever found of this unusual but rather unattractive species is a native of the lush, and in terms of biodiversity, extremely rich forests along the Río Pastaza in central Ecuador. No other material has been seen of this species despite several searches in the original area.

Because that all flowers of the type specimen have been successfully pollinated, which is unusual in Oncidiinae in general, it is speculated here that *Oliveriana hirtzii* may be self-pollinating. Many plant collectors, including this author, have visited the type area during many years without ever finding or reporting having seen this probably very difficult to spot orchid. Fortunately, large areas in this region are protected today thanks to a significant degree to the hard work by private individuals such as Lou Jost and his friends and supporters of the nearby town of Baños and elsewhere.

ACKNOWLEDGMENTS. I wish to thank Wesley Higgins for commenting on the manuscript, and two anonymous reviewers for their suggestions.

LITERATURE CITED

- Bentham, G. (1881). Notes on Orchideae. *Botanical Journal of the Linnaean Society*, 18, 281–360.
- Chase, M. W. (2009). *Oliveriana*. In A. M. Pridgeon, P. J. Cribb, M. W. Chase & F. H. Rasmussen (eds.). *Genera Orchidacearum*, vol. 5: Epidendroideae (306–308). Oxford: Oxford University Press.
- Dodson, C. H. (1989). *Oliveriana ecuadorensis*. *Icones Plantarum Tropicarum*, ser. 2, 6, t. 558.
- Dodson, C.H. & Vásquez, R.. (1989). *Oliveriana simulans*. *Icones Plantarum Tropicarum*, ser. 2, 3, t. 270.
- Dressler, R. L. & Williams, N. H. (1970). The genus *Systeloglossum*. *American Orchid Society Bulletin*, 38(4), 323–329.
- Garay, L. A. (1963). *Oliveriana* and its position in the Oncidiaceae. *American Orchid Society Bulletin*, 32(1), 18–24.
- Moore, H. E. & Wood, C. E. (1965). Dates of publication of the journal *Linnaea*: further evidence. *Journal of the Arnold Arboretum*, 46, 68–73.
- Pérez, A. F. (1969). El género *Oliveriana*. *Orquideologia*, 4(2), 85–89.
- Reichenbach, G. H. (1876). Orchideae Wallisianae novae. *Linnaea*, 41, 99–118.
- Reichenbach, H. G. (1883). *Xenia orchidacea. Beiträge zur Kenntniss der Orchideen. Dritter Band*. F. A. Brockhaus, Leipzig.
- Schweinfurth, C. (1949). A novel member of a popular genus. *American Orchid Society Bulletin*, 18, 578–580.
- Szlachetko, D. L. & Kolanowska, M. (2014). Three new species of *Oliveriana* (Orchidaceae-Oncidiinae) from Colombia. *Phyton* (Horn), 54(2), 197–204.
- Szlachetko, D. L., Kolanowska, M. & Ołędryńska, N. (2014). Three new *Oliveriana* from Colombia. *Annales Botanici Fennici*, 51, 69–74.
- WCSP (2016). World Checklist of Selected Plant Families. Facilitated by the Royal Botanic Gardens, Kew. Published on the Internet at <http://apps.kew.org/wcsp/>. Retrieved November 2016.

THREE NEW SPECIES OF *PLEUROTHALLIS* (ORCHIDACEAE: PLEUROTHALLIDINAE) IN SUBSECTION *MACROPHYLLAE-FASCICULATAE* FROM NORTHERN SOUTH AMERICA

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ABSTRACT. The history of the taxonomy of *Pleurothallis* R.Br. subsection *Macrophyllae-Fasciculatae* and recent descriptions in that group are summarized. The phylogenetic position of the group based on preliminary molecular data and the appropriateness of the proposed genera *Acronia* C.Presl. and *Zosterophyllanthos* Szlach. & Marg. for this group are discussed. Three new species from northern South America are described: *Pleurothallis rubrifolia* from southeastern Ecuador and northeastern Peru; *Pleurothallis nangaritzae* from southeastern Ecuador; and *Pleurothallis castanea*. Labellar micromorphology examined by scanning electron microscopy for *P. rubrifolia* and *P. nangaritzae* is discussed in relation to taxonomy and possible pollinator interactions.

KEY WORDS: *Acronia*, *Macrophyllae-Fasciculatae*, Pleurothallidinae, *Pleurothallis*, SEM, *Zosterophyllanthos*

Introduction. In his initial reorganization of the genus *Pleurothallis* R.Br., Luer (1986) retained section *Macrophyllae-Fasciculatae* of subgenus *Pleurothallis*, created by Lindley (1859). Subsequently, *Macrophyllae-Fasciculatae* was demoted to a subsection within section *Pleurothallis*, joining subsections *Acroniae*, *Antenniferae*, *Longiracemosae* and *Macrophyllae-Racemosae* (Luer 1988). However, a few years later Luer (2005) elevated subsections *Acroniae* and *Macrophyllae-Fasciculatae* to generic level under the resurrected name *Acronia* C.Presl., creating under it sections *Acronia*, *Amphigya* and *Macrophyllae-Fasciculatae*. Luer (2005) recognized 213 species in *Acronia* section *Macrophyllae-Fasciculatae* at that time.

In an alternate approach, Szlachetko and Margonska

(2001) created the genus *Zosterophyllanthos* Szlach. & Marg. for *Pleurothallis* subsection *Macrophyllae-Fasciculatae*, based in part upon the bilobed stigma, a characteristic trait of this group. A total of 189 species were transferred to that genus (Kolanowska, Pérez-Escobar, Sánchez & Szlachetko 2011, Szlachetko & Kulak 2006 a, b, Szlachetko & Margonska 2001, Szlachetko, Veyret, Mytnik-Ejmsmont, Sawicka, Rutkowski & Baranow 2012). Apart from *Pleurothallis allenii* L.O. Williams, species of *Pleurothallis* subsection *Acroniae* were not moved to the new genus, this being the major distinction between the taxonomies of Luer (2005) and the Szlachetko group (Szlachetko & Margonska 2001, Szlachetko & Kulak 2006 a, b).

The molecular phylogenetic study of the

Pleurothallidinae by Pridgeon, Solano & Chase (2001) included only three species from *Pleurothallis* subsection *Macrophyllae-Fasciculatae*, *Pleurothallis cardiantha* Rchb.f., *Pleurothallis cardiothallis* Rchb.f. and *Pleurothallis teaguei* Luer. In the phylogeny based on nrDNA ITS these species grouped closely with the type of genus *Pleurothallis*, *Pleurothallis ruscifolia* R.Br. Consequently, *Pleurothallis* subsection *Macrophyllae-Fasciculatae* was included in the circumscription of *Pleurothallis* (Pridgeon & Chase 2001, Pridgeon, Cribb, Chase & Rasmussen 2005). The ongoing phylogenetic studies of *Pleurothallis* by Wilson *et al.* (2011, 2013) and Wilson (unpubl. data), incorporating a much more extensive sampling of species from the subgenera included in this circumscription, support the inclusion of subsection *Macrophyllae-Fasciculatae* within *Pleurothallis*. In other words, the available evidence does not support the elevation of subsection *Macrophyllae-Fasciculatae* to the level of genus, either along with subsection *Acroniae* under genus *Acronia* (Luer 2005) or alone as genus *Zosterophyllanthos* (Kolanowska *et al.* 2011, Szlachetko & Kulak 2006 a, b, Szlachetko & Margonska 2001, Szlachetko *et al.* 2012)

In the decade or so since the revision of *Pleurothallis* subsection *Macrophyllae-Fasciculatae* (Luer 2005) ten new species have been described in this group: four under *Pleurothallis* (*Pleurothallis anthurioides* A.Doucette; *Pleurothallis adventurae* Karremans & Bogarín; *Pleurothallis gigiportillae* A.Doucette & J.Portilla; and *Pleurothallis oscarii* Archila & Chiron); five under *Acronia* (*Acronia barbosa* Luer & Thoerle; *Acronia miniatura* Luer, Thoerle & F.Werner; *Acronia rinkei* Luer; *Acronia rhinocera* Luer & Sijm; and *Acronia tobarii* Luer & Hirtz); and one under *Zosterophyllanthos* (*Zosterophyllanthos dariensis* Kolan. & Szlach). All these species described under *Acronia* and *Zosterophyllanthos* have subsequently been transferred to *Pleurothallis*. Depending on synonymy, there are currently between 223 and 297 species attributable to *Pleurothallis* subsection *Macrophyllae-Fasciculatae*.

While labellar micro-morphology has been examined in some Pleurothallidinae, such as in Brazilian *Octomeria* species (Cardoso-Gustafson

2014) and *Stelis* species (Ignowski 2015, Ignowski, de Brito, Bona & de Camargo Smidt 2015), labellar micro-morphology has not been examined to date in *Pleurothallis* subsection *Macrophyllae-Fasciculatae*. Of particular interest in the labellar micro-morphology of some Pleurothallidinae is the so-called “glenion”, described by Luer (1986) as a “well-demarcated, more or less circular structure, on the front surface of the lip just above the base and positioned beneath the stigma”. Luer (1986) speculated that “in all likelihood it plays an important role in attracting the pollinator” and Duque (2008) that “perhaps the glenion facilitates the entry of the visitor to this area”. While in *Stelis* some progress has been made in the understanding of the morphology and function of the glenion at the base of the hypochile (Ignowski *et al.* 2015), almost nothing is known about the glenion of *Pleurothallis* subsection *Macrophyllae-Fasciculatae*.

In this paper we describe three new species of *Pleurothallis* from subsection *Macrophyllae-Fasciculatae* and present preliminary data on labellar micro-morphology and glenion structure.

Materials and Methods

Collections of plant material —. Material collected in Ecuador (collections #2020, #2095 and #2050) were made under investigation permit #018-2016-IC-FLO-FAU-DPAZCH-UPN-VS/MA granted to EcuaCorriente S.A. (ECSA). Specimens were moved under the transportation permit #UPN-VS-GM-025-2016 granted to and managed by Ecotono, Ecuador. Material from Peru was collected under a permit #N 292-2016-SERFOR/DGGSPPFS granted to Marcos Salas Guerrero by the Servicio Nacional Forestal y de Fauna Silvestre (SERFOR), Peru. Plants were also imported into the U.S.A. through purchases from Ecuagenera (Gualaceo, Ecuador), Equaflora (Cuenca, Ecuador) and Mundiflora (Cuenca, Ecuador) and grown in the collections of Wilson and Werner. Material from these latter plants was used for the creation of herbarium specimens accessioned into the herbarium at Colorado College (COCO). Flowers were preserved in Kew Mix (5% formalin [37.6% formaldehyde], 53% methanol, 5% glycerol, 37% deionized water).

Morphology and taxonomic comparisons —

Living material of each collected species was examined by the first author in the collections of Ecuagenera, EquaflorA, and Mundiflora, as well as in the collection of imported plants at Colorado College. These materials were used for creation of the Lankester composite digital plates (LCDPs) and for morphological and taxonomic comparisons. Photographs were taken with a Canon EOS 40D using a Canon 100 mm f2.8 macro-lens and extension tubes as required. In order to determine novelty, these species were compared to a database of species descriptions, photographs and scans of types amassed by the first author over a 10-year period, as well as all pertinent literature, including but not limited to: Bennet and Christenson (1993); Dodson (2003); Dodson and Dodson (1980, 1982, 1991); Escobar (1994, 2006); Luer (1974, 1975a, b, 1976, 1977, 1986, 1988, 2005, 2009, 2011); Luer and Thorerle (2013); Schweinfurth (1959, 1970); and Zelenko and Bermudez (2009). Floras and other taxonomic materials from Colombia and Peru were included, because of the possibility that some of the species in the collections of Ecuagenera, EquaflorA and Mundiflora may be originally derived from those two countries and do not in fact occur naturally in Ecuador. Such appears to be the case with *Pleurothallis neorinkei* A.Doucette (from Colombia) Doucette *et al.* (2016) and *Pleurothallis papillingua* A.Doucette and J.Portilla (from Peru) (Wilson, unpubl. data). Species were compared in detail to those with which they may be confused, such as the *Pleurothallis cardiostola* Rchb.f. complex (Fig. 1–2), or have been confused, such as *Pleurothallis canidentis* Luer & R.Escobar.

Scanning electron microscopy —. Fresh-harvested flowers were preserved in Kew Mix. For scanning electron microscopy (SEM) flowers were dehydrated in successively higher concentrations of ethanol (80%, 95%, 100%, 100%) for 15 min each before being placed in freshly-opened 100% ethanol. Specimens were dehydrated in a critical point dryer (EMS 850) prior to mounting and sputter coating. Specimens were imaged using a Jeol JSM-6390LV scanning electron microscope with an accelerating voltage of 10–15 kV.

Results

The labellum or “lip” of *Pleurothallis rubrifolia* is quite unique, even when imaged with conventional macro-photography (Figs. 3c, 4b, 5b, 6). The “glenion”, a small depression in the hypochile just in front of the anther, is oval in shape and is elevated significantly above the surrounding depression on a callus. In SEM (Fig. 7) the glenion appears to consist of three concentric layers of different cell types, surrounded by a depression with cells forming a smooth surface. The elevated areas of the lip consist of papillae which increase in packing density outward from the depression, creating another smooth surface. With conventional macro-photography the lip of *Pleurothallis nangaritzae* is observed to possess a bilobed glenion, a rare character in *Pleurothallis* subsection *Macrophyllae-Fasciculatae*, and a few papillae along the outer edges. In SEM, it is apparent that papillae cover a significant portion of the lip surface and surround a triangular area of smooth tissue, with the glenion at the base (see images under the Discussion). The cellular structure of the glenion itself was not visible due to a covering of dehydrated liquid, presumably from the secretions of the glenion. The lip of *Pleurothallis castanea* was not imaged.

Taxonomy

Pleurothallis rubrifolia Mk.Wilson, Tobar & Salas Guerr., *sp. nov.* (Figs. 2–8).

TYPE: Ecuador. Vivero ECSA, Tundayme, Gualaquiza, Morona Santiago, elevation, 822 m, 78°25'52.18"W 3°34'3.14"S, Sept. 2016, *F. Tobar & M. Jiménez 2020* (holotype: QCNE!; isotype: QCA!).

Pleurothallis rubrifolia is superficially similar to the species of the *Pleurothallis cardiostola* complex, including the species *Pleurothallis adelphe* Luer & Hirtz, *Pleurothallis perforata* Luer & Hirtz (syn. *Acronia adelphe* (Luer & Hirtz) Luer) and *Pleurothallis lanigera* Luer & Hirtz and can be distinguished by several factors. *P. rubrifolia* can be distinguished from *P. perforata* by the absence of a circular cavity in the mesochile or “disc” of the lip; the abaxial surface of the leaf reddish in *P. rubrifolia* vs. green in all the *P.*

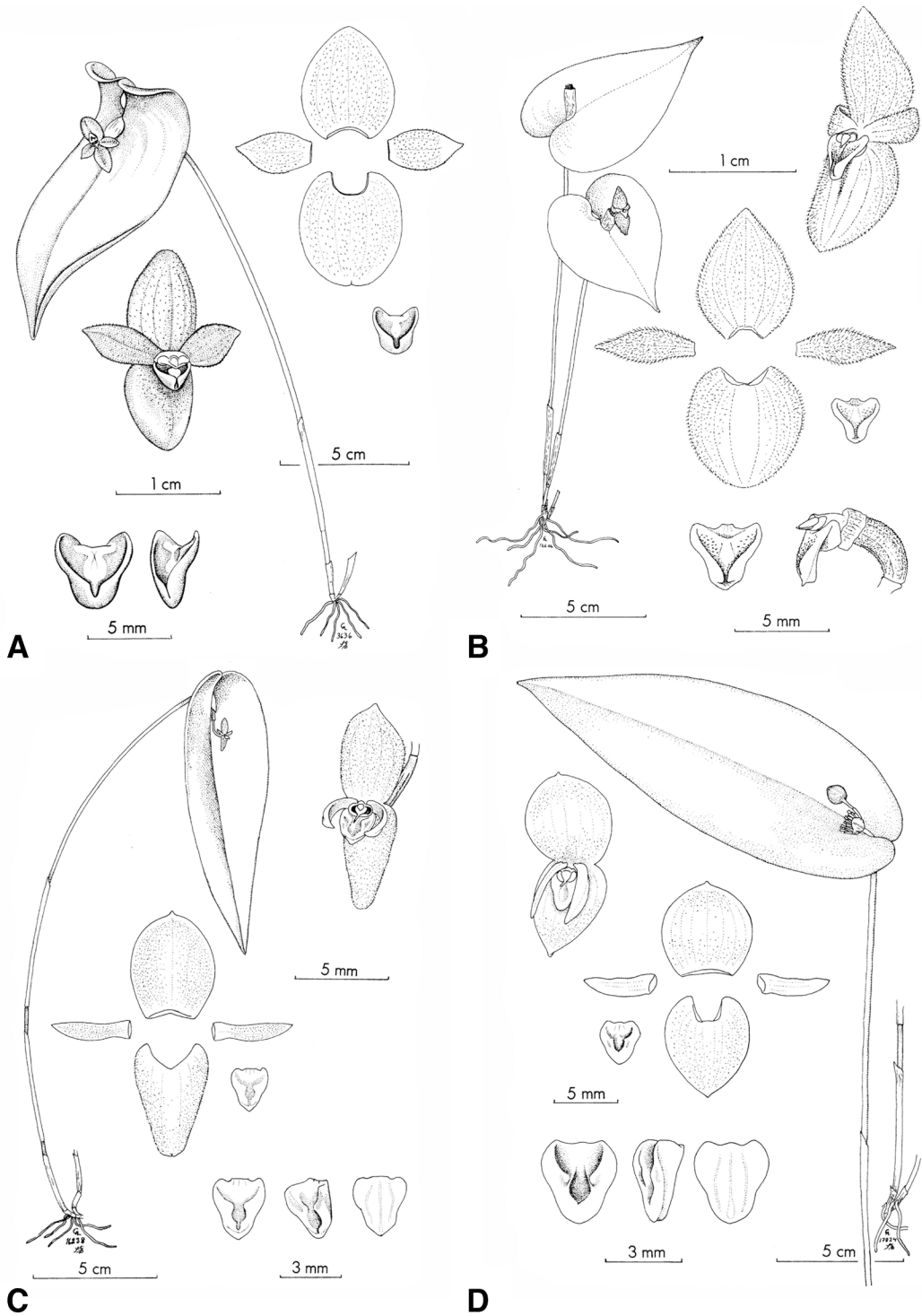


FIGURE 1. Drawings of *Pleurothallis cardiostola*-complex species: A. *Pleurothallis cardiostola*; B. *Pleurothallis lanigera*; C. *Pleurothallis adelphe*; D. *Pleurothallis perforata*. From Luer 2005. Courtesy of Missouri Botanic Gardens Press.



FIGURE 2. Comparison of *Pleurothallis castanea* (A) and *Pleurothallis lanigera* (B). Photographs by Mark Wilson.

cardiostola complex species; the mature leaf with a channel or depression towards the base in which the flower rests in *P. rubrifolia* vs. no depression in *P. cardiostola* complex species.

Plant medium in size, to ca. 29 cm tall, epiphytic, caespitose; *Roots* fibrous; *Ramicaul* terete, 7.2-19.0 cm long, enclosed by papyraceous basal sheath 3.0-3.8 cm long; *Leaves* sub-erect/ascendant, ovate, 8.3-11.5 × 3.9-5.8 cm, acute, cordate, slightly revolute along margins, coriaceous, adaxially mottled dark green, abaxially red-brown, channeled about midrib in basal half; *Inflorescence* one-flowered, from reclining spatheaceous bract 11-13 mm long, pedicel 6-9 mm long; *Flower* 1.4-1.7 × 1.4-1.5 cm, resupinate, flower resting in depression formed by channel in leaf; *Dorsal sepal* yellow-brown with maroon-burgundy infused along veins to darker brown with extensive maroon-burgundy at base and along veins, ovate, subacute, entire along the margins, 6.5-8.0 × 6.0-7.5 mm, glabrous, 5-veined; *Synsepal* yellow-brown with maroon-burgundy infused along veins, ovate, obtuse, entire along the margins, 4.0-6.0 × 6.5-8.0

mm, glabrous, 7-veined; *Petals* yellow-brown to darker brown, moderately to heavily infused with maroon-burgundy along vein, oblanceolate, slightly falcate, acute, entire along the margins, 2.0-2.3 × 6.0-6.4 mm, glabrous, 1-veined; *Lip* brown to intense burgundy-brown, triangular, obtuse, entire along the margins, 3.0-4.0 × 3.5-4.5 mm, glenion oval with raised callus surrounded by a depressed area, central channel; *Column* burgundy-brown with pale edge, stout, 1.5-2.5 × 1.5 mm, bilobed stigma, apical anther, anther cap yellow, viscidium pale yellow; *Capsule* 4.6 cm long.

ADDITIONAL MATERIAL STUDIED: Ecuador. Natural forest near the waste dump in the northeast of project ECSA, Tundayme, Gualaquiza, Morona Santiago, elevation, 1466 m, 78°25'52.18"W 3°34'3.17"S, Sept. 2016, F. Tobar & M. Jiménez 2095 (paratype: QCNE!; paratype: QCA!). Plant flowered in cultivation at Ecuagenera as *Pleurothallis canidentis*, without collection data M. Wilson & J. Portilla PL0971 (paratype: HA!). Plants purchased from Ecuagenera as *P. canidentis* and flowered in cultivation at Colorado

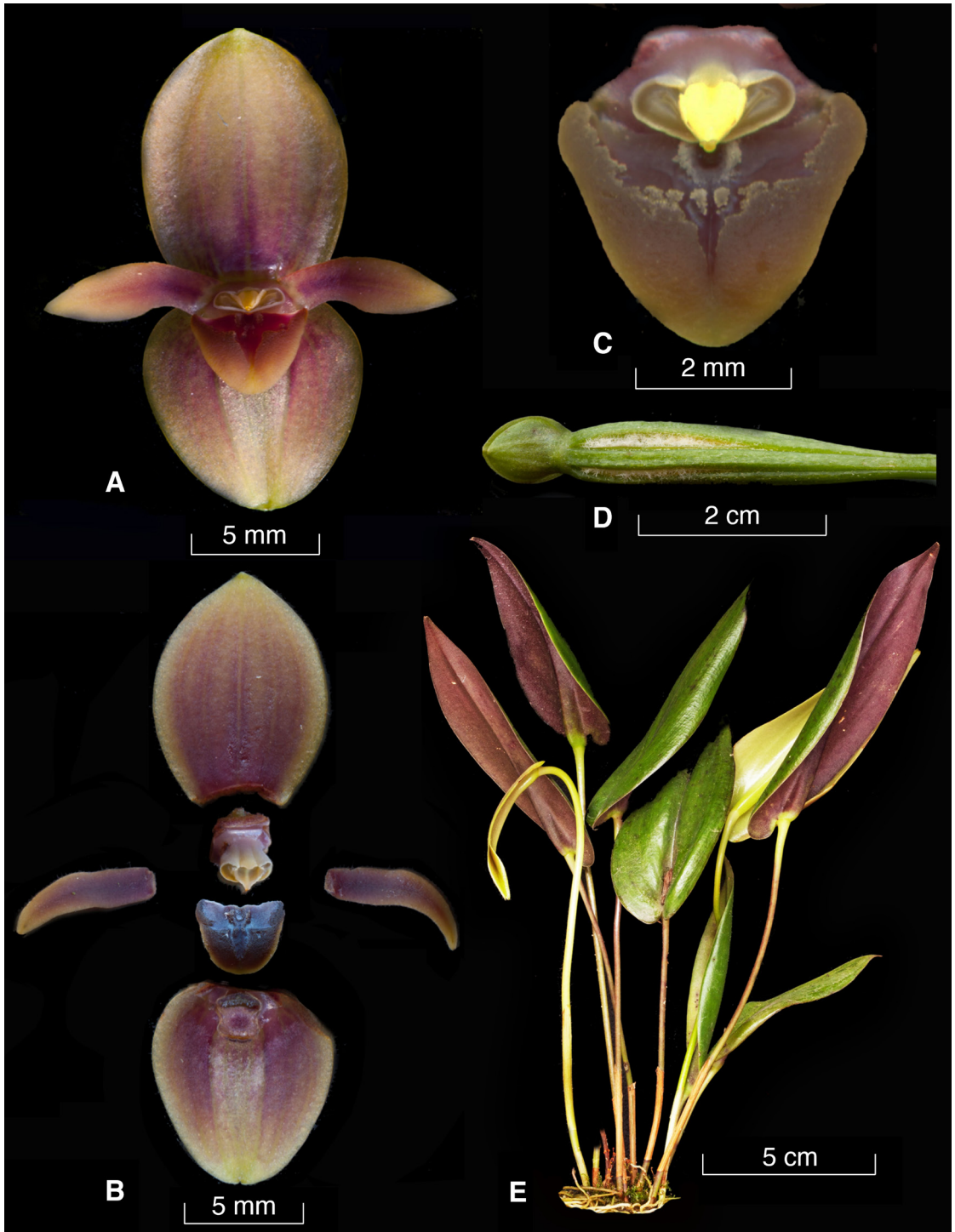


FIGURE 3. Lankester composite digital plate of *Pleurothallis rubrifolia*: A. Whole flower. B. Floral dissection. C. Lip and column. D. Partially dehiscent capsule. E. Whole plant illustrating red abaxial leaf surface. Prepared by Mark Wilson from the paratypes *Wilson & Portilla PL0748* and *Wilson & Portilla PL0971*.

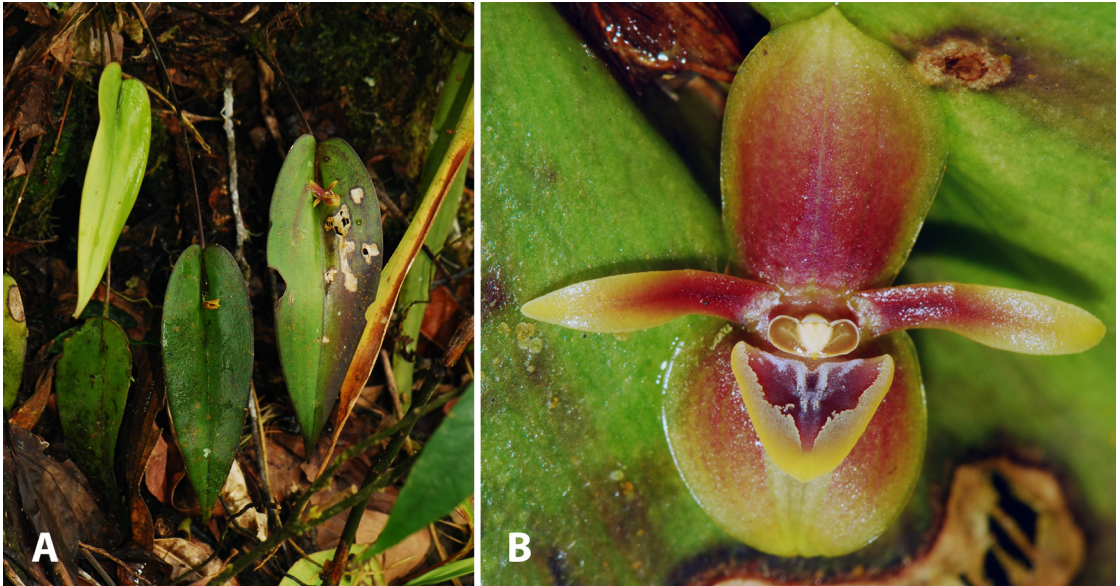


FIGURE 4. *Pleurothallis rubrifolia* in situ near Tundayme, Ecuador. A. Whole plant among roots of Areaceae. B. Flower. Photographs by Francisco Tobar.

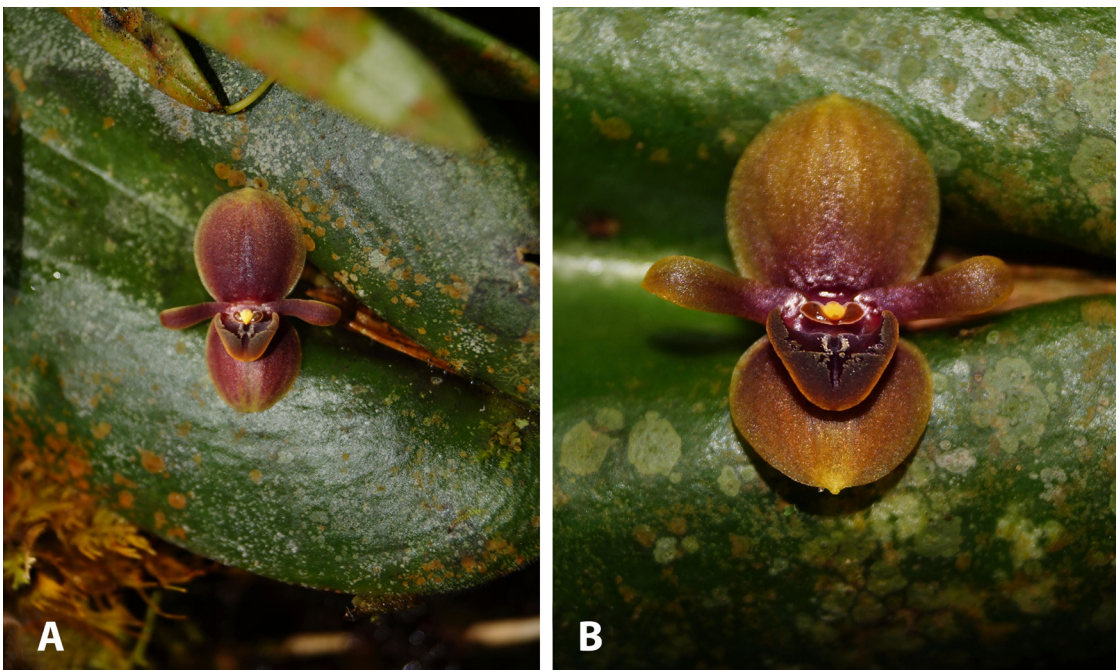


FIGURE 5. *Pleurothallis rubrifolia* in situ in Valle de Los Chilchos, Leimebamba, Peru. A. Flower on leaf. B. Flower detail. Photographs by Marco Salas.

College *M. Wilson & J. Portilla* PL0177 and PL0748 (paratypes: COCO!). Peru. Albazo, Valle de Los Chilchos, Leimebamba, Cachapoyas, *Salas Guerr.* 0127 (paratype:USM!).

ETYMOLOGY: In reference to the unique red coloration on the abaxial leaf surface.

DISTRIBUTION AND HABITAT: *Pleurothallis rubrifolia* has been recorded for Tundayme, Ecuador (Fig. 13)



FIGURE 6. Lip and column detail for *Pleurothallis rubrifolia* (A. glenion; B. callus). Photograph by Mark Wilson.

and Leimebamba, Chachapoyas, Amazonas, Peru. In Ecuador, the species grows in very humid premontane and montane forests in the Cordillera del Cóndor from ~800-1700 m elevation, among the roots of *Areceaceae*. In Peru, it grows in very humid lower montane forest on the eastern slope of the Andes, from 1478-2015 m elevation, in association with plants from family *Clusiaceae*.

CONSERVATION STATUS: The type locality of *Pleurothallis rubrifolia* in Ecuador (Fig. 14) is within a conservation zone associated with EcuCorriente copper-mining concession, Project Mirador, that may or may not be secure in the future. However, the abundance and breadth of distribution from southeastern Ecuador into northeastern Peru suggest that the species is not threatened *in situ* at this time. The species is widely distributed in collections in the U.S.A. and Europe under the name *Pleurothallis canidentis*, but the level of genetic diversity in these plants is probably very low, most of the plants originating from Ecuagenera, hence there is some concern regarding the *ex situ* conservation status of *P. rubrifolia*.

Pleurothallis rubrifolia is easily distinguished from *Pleurothallis canidentis*, with which it has been confused in the commercial trade, by the smaller plant size; slightly smaller leaf size; the lip brown-burgundy, triangular and planar in *P. rubrifolia* vs. red-brown or orange, oblong and convex in *P. canidentis*; the glenion raised, surrounded by callus in *P. rubrifolia* vs. slightly raised with no distinct surrounding callus in *P. canidentis*; and petals, dorsal sepal, synsepal yellow-brown to darker brown, moderately to heavily infused with maroon-burgundy along the veins in *P. rubrifolia* vs. dorsal sepal canary yellow, petals and synsepal red-brown in *P. canidentis*.

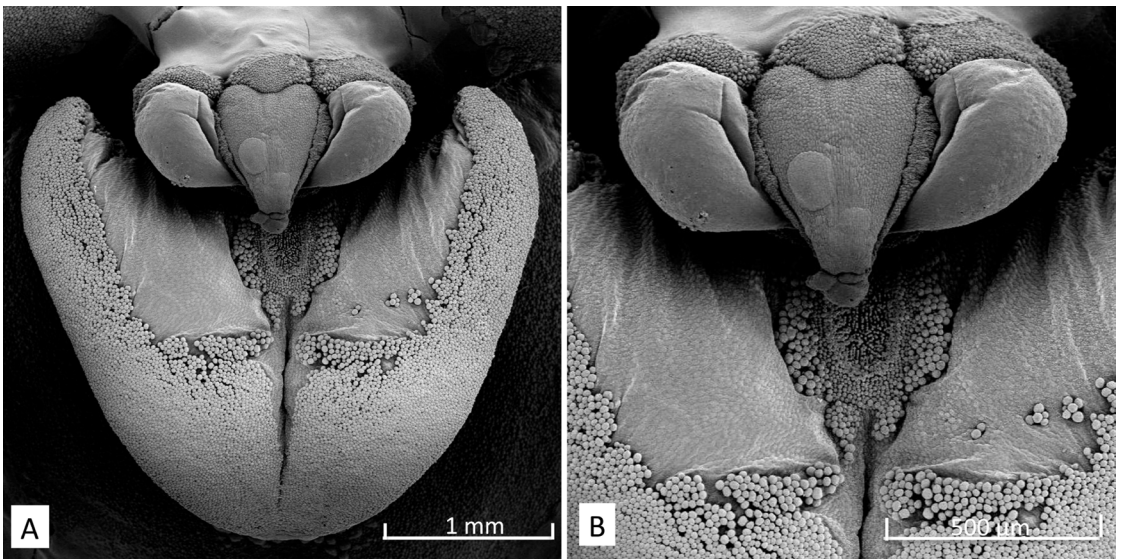


FIGURE 7. A–B. Scanning electron micrographs of lip and column of *Pleurothallis rubrifolia*. SEM images by Katy Dupree.

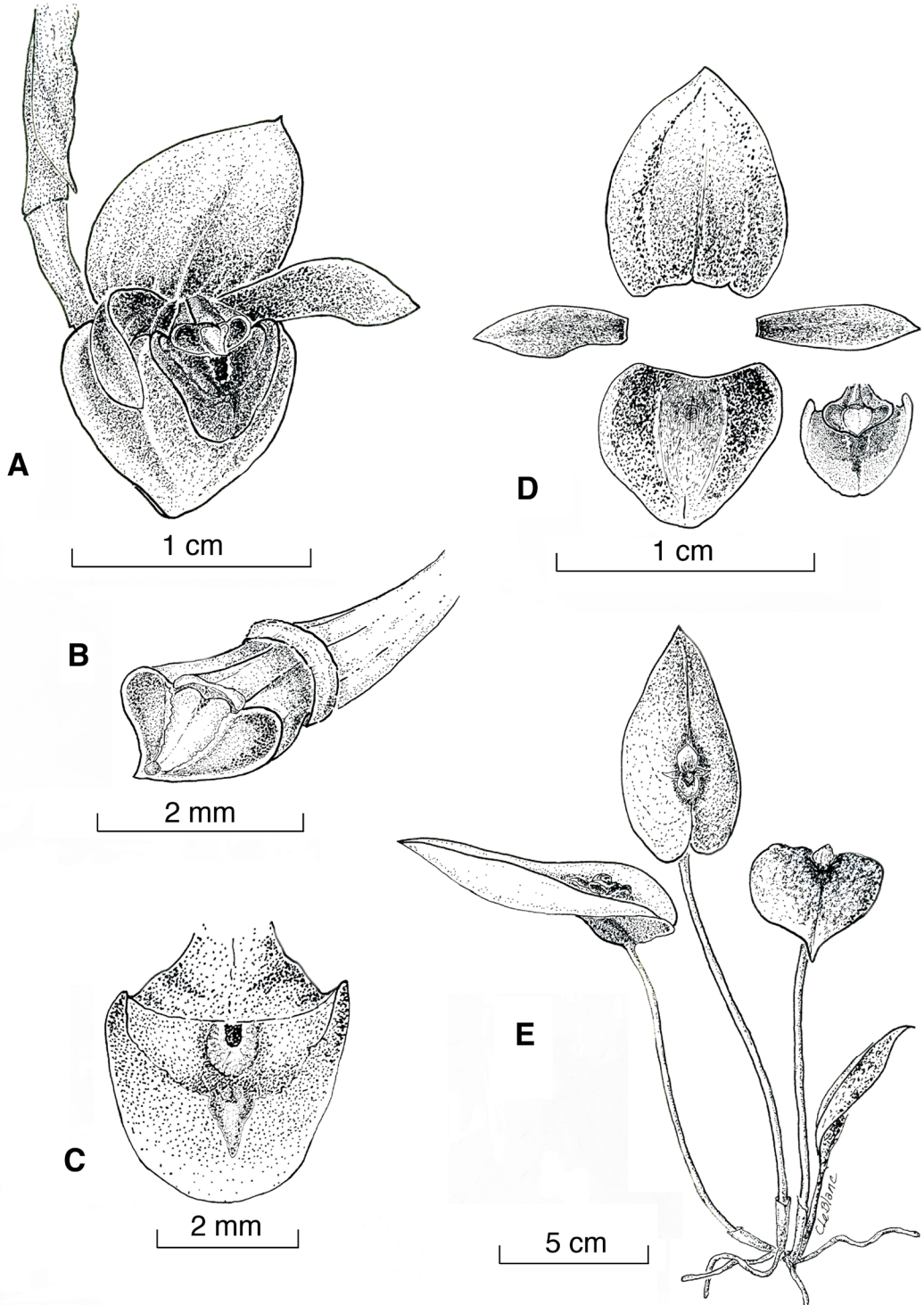


FIGURE 8. Drawing of *Pleurothallis rubrifolia*: A. Whole flower. B. Column (3/4 view). C. Lip (top view); D. Floral dissection. E. Whole plant. Drawing by Cheryl Marie LeBlanc, prepared from the paratype Wilson & Portilla PL0748.

Pleurothallis castanea Mk.Wilson, G.Merino & J.D.Werner, *sp. nov.* (Figs. 2A, 9–10)

TYPE: Ecuador. Flowered in cultivation at Equaflora, without collection data, October 20, 2016, *M. Wilson & G. Merino PL0981* (holotype: HA!).

Pleurothallis castanea can be distinguished from *Pleurothallis cardiostola* by the glabrous sepals and petals in *P. castanea* vs. cellular-glandular to coarsely pubescent in *P. cardiostola*; the longer sepals and petals in *P. castanea*; and the leaf ovate in *P. castanea* vs. ovate to lanceolate in *P. cardiostola*. *P. castanea* is also similar to *Pleurothallis lanigera* Luer & Hirtz, but differs in the sepals and petals, glabrous in *P. castanea* vs. markedly pubescent in *P. lanigera*.

Plant medium in size, to ~16–30 cm tall, caespitose; *Roots* fibrous; *Ramical* 13–29 cm long, enclosed by papyraceous basal-sheath 4 cm long and mid-sheath 4 cm long; *Leaves* deflexed, spreading, cordate, apex long acuminate, entire along the margins, 6.9–10.0 × 4.3–7.0 cm, glabrous, coriaceous, the blade slightly concave; *Inflorescence* one-flowered from sub-erect spathe 1.5 cm long; *Flower* non-resupinate, 2.8–3.0 × 1.8–2.5 cm; *Dorsal sepal* chestnut, broadly ovate, obtuse, slightly revolute along apical and lateral margins, 1.8 × 1.5 cm, glabrous, 9-veined; *Synsepal* chestnut, ovate, obtuse, shortly apiculate, slightly revolute along the apical and lateral margins, 1.8 × 1.5 cm, glabrous, 7-veined; *Petals* chestnut, obovate-unguiculate, truncate-rounded, 12 × 5 mm, glabrous, 3-veined; *Lip* chestnut, ovate-triangular, 1.0 × 1.0 cm, with a prominent broadly triangular depression, the surface of which is verrucose, the glenion a small and bilobed cavity in front of the anther; *Column* cream-beige suffused with pink at base, stout, 8 × 8 mm, with a bilobed stigma, anther apical, anther cap pale yellow, viscidium orange.

ADDITIONAL MATERIAL STUDIED: Ecuador. Flowered in cultivation at Ecuagenera, without collection data, *Mk.Wilson & J.Portilla PL0958* (paratype: COCO!). Purchased from Equaflora as *Pleurothallis cardiostola* Rchb.f. and flowered in cultivation by Jon Werner in U.S.A., November 2016, *M. Wilson & J. D. Werner PL0980* (paratype: COCO!).

ETYMOLOGY: In reference to the color of the sepals and petals which resemble the color of a “chestnut”, nut

of European and North American trees of the genus *Castanea* Mill.

DISTRIBUTION AND HABITAT: At this time, *Pleurothallis castanea* is only known from live collections in Ecuador. When describing species from greenhouse collections which have no locality information or accompanying *in situ* observation one must consider the possibility of a greenhouse hybrid. We believe that the characteristics of this *Pleurothallis* are sufficiently distinct from the other species of the *Pleurothallis cardiostola* complex to make the possibility that this represents a hybrid between two species of the complex highly unlikely. Further, all the plants observed at Ecuagenera and Equaflora were very consistent in morphology, which would not be the case were they seedlings from an unintentional or intentional greenhouse hybrid. We are convinced, therefore, that *P. castanea* represents a novel species and we will continue to seek field records to confirm that this species occurs *in situ* and to determine a distribution for the species. The species should not, however, be added to the flora of Ecuador at this time, since it is conceivable the species was obtained from Colombia or Peru and does not occur naturally in Ecuador.

CONSERVATION STATUS: In the absence of locality data we cannot assess the *in situ* conservation status of *P. castanea*. The *ex situ* conservation status is of concern, since while the species occurs in two collections in Ecuador, it is known from only one collection in the U.S. and it is quite likely that all of these plants originated from a single original plant.

Pleurothallis nangaritzae M.Jiménez, Tobar & Mk.Wilson, *sp. nov.* (Figs. 11–13).

TYPE: Ecuador: Near the Nangaritza River, Zamora-Chinchipec, Ecuador, 1500 m, October 16th, 2016, *F. Tobar and M. Jiménez 205* (holotype: QCNE!).

Pleurothallis nangaritzae is recognized by its large leaf size to flower size ratio; glossy, heavily veined leaf; broad petals; and papillate acute lip with shallowly bilobed glenion.

Plant small-to-medium in size, to ca. 15 cm tall, epiphytic, caespitose; *Roots* fibrous, slender; *Ramical* 10.2–12.1 cm long, enclosed by two sheaths, the upper

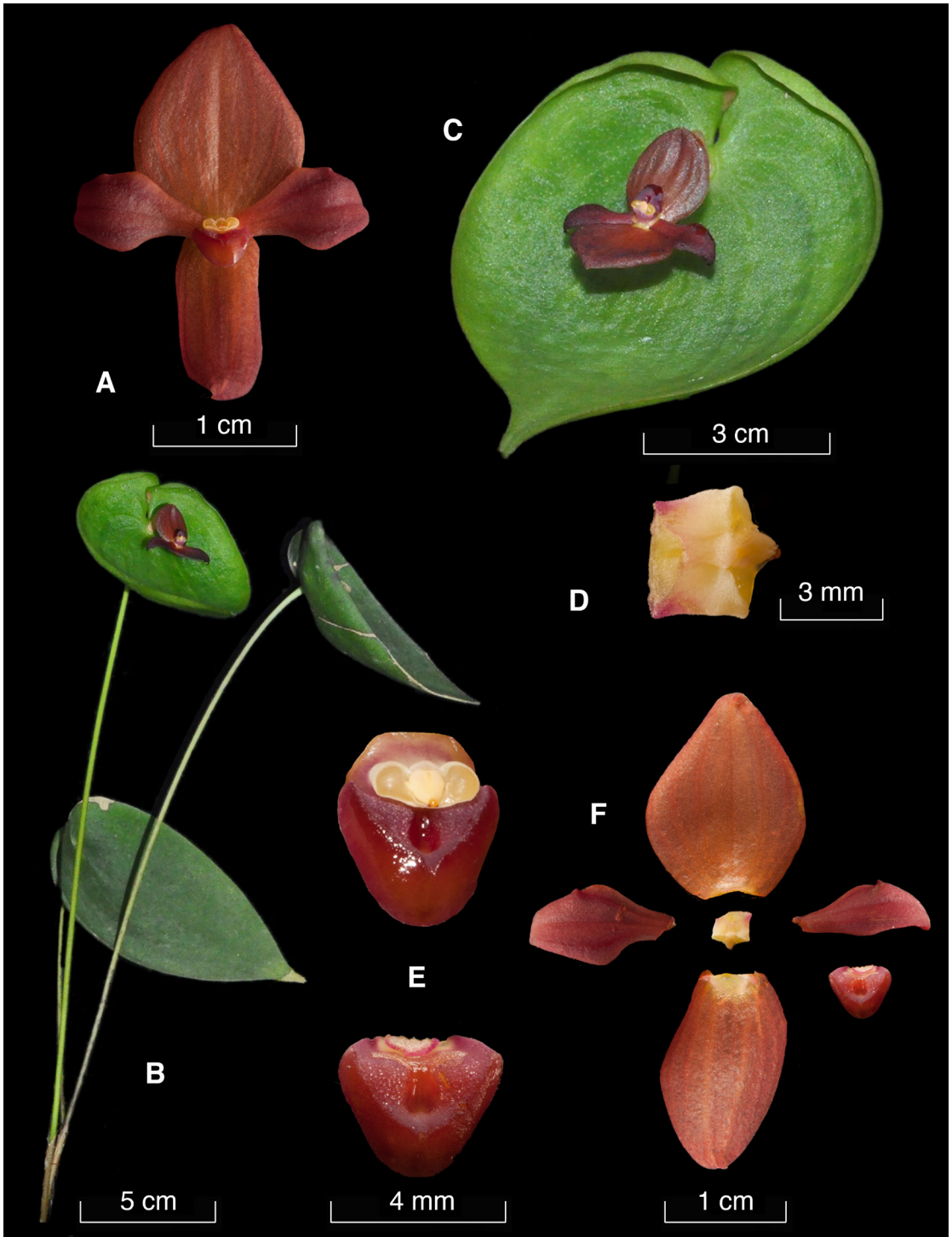


FIGURE 9. Lankester composite digital plate of *Pleurothallis castanea*: A. Whole flower. B. Whole plant. C. Leaf with flower. D. Lip with and without column. E. Column top view. F. Foral dissection. Prepared by Mark Wilson from the paratype Wilson & Portilla PL0958.

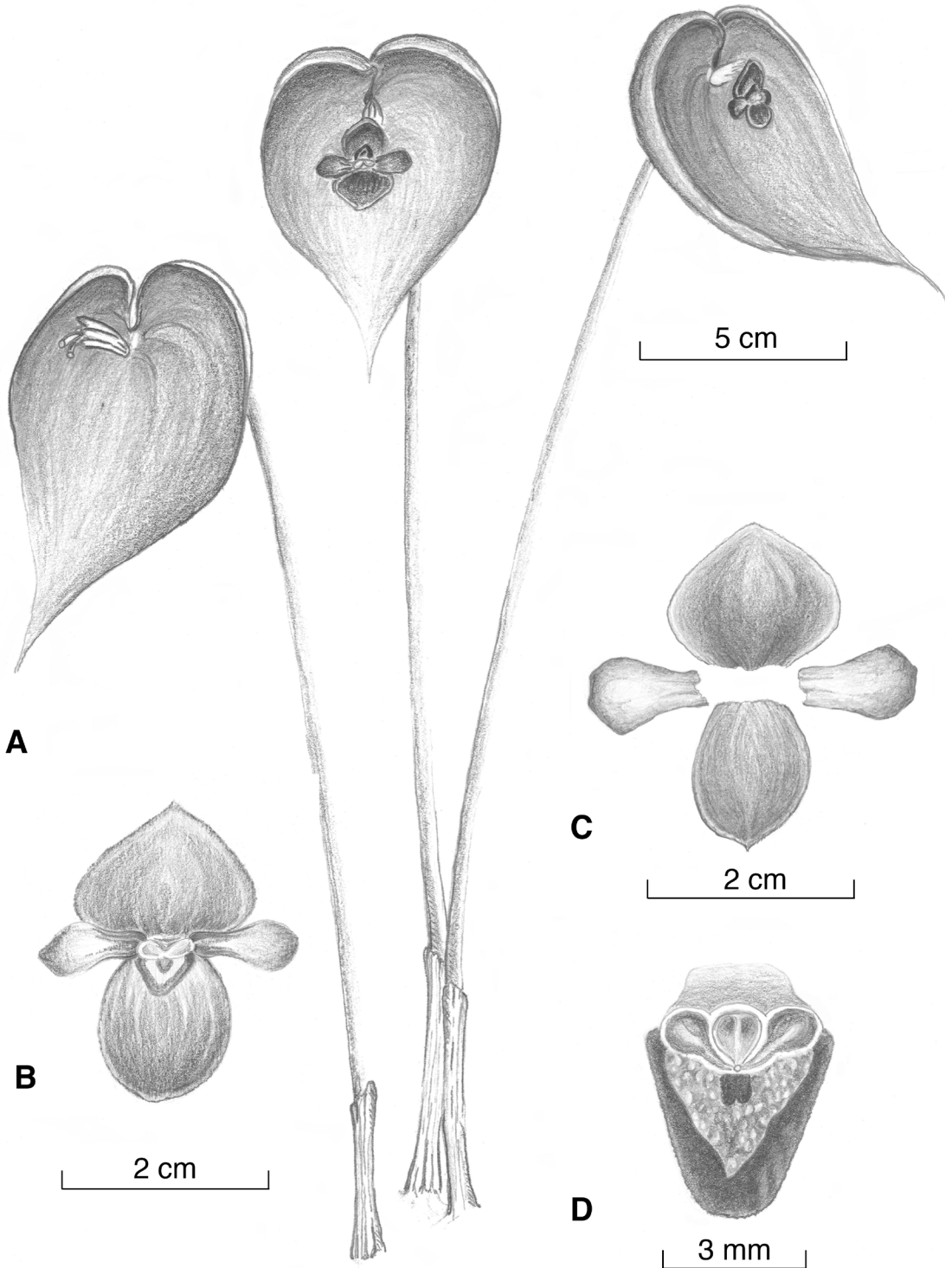


FIGURE 10. Drawing of *Pleurothallis castanea*: A. Whole plant. B. Whole flower. C. Floral dissection. D. Lip detail. Drawing by Jon Werner prepared from the paratype *Wilson & Werner PL0980*.

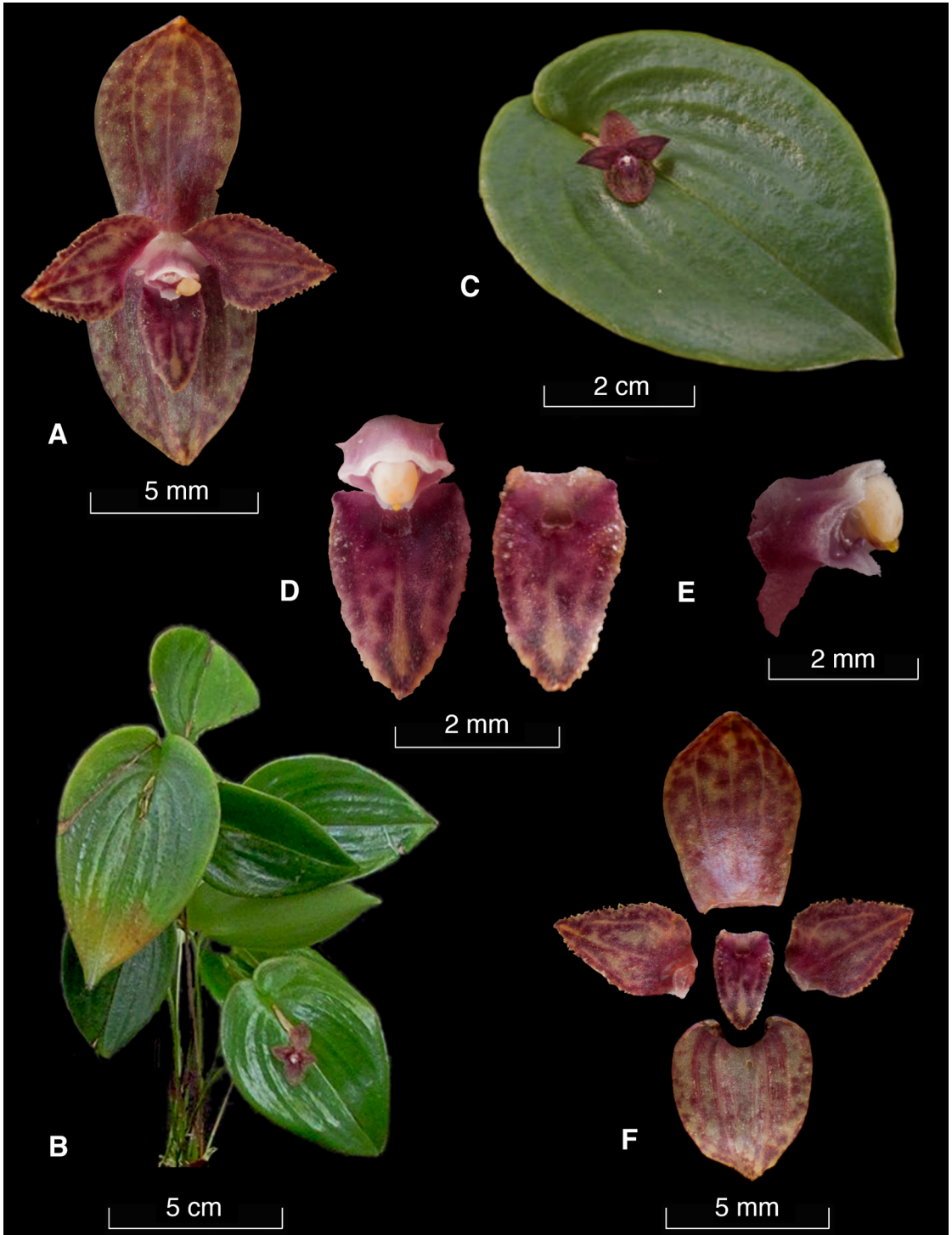


FIGURE 11. Lankester composite digital plate of *Pleurothallis nangaritzae*: A. Whole flower. B. Whole plant. C. Leaf with flower. D. Lip with and without column. E. Column side view. F. Floral dissection. Prepared by Mark Wilson from the paratype *Wilson & Werner PL0977*.

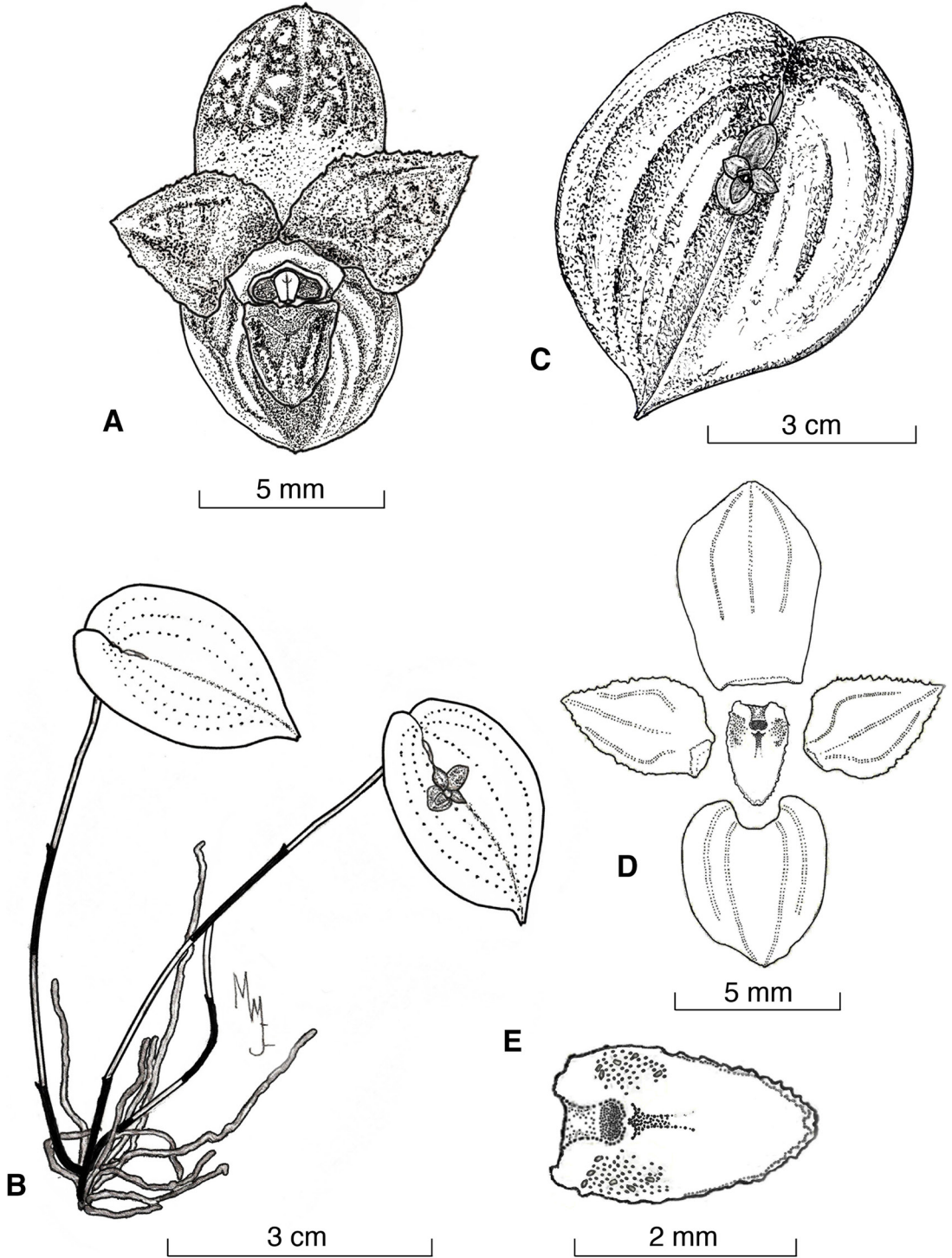


FIGURE 12. Drawing of *Pleurothallis nangaritzae*: A. Whole flower. B. Whole plant. C. Leaf with flower. D. Floral dissection. E. Lip. Drawings by Marco Jiménez and Luis Baquero prepared from holotype *Tobar and Jiménez 2050*.

sheath 0.85-1.3 cm long and the lower 2-4 mm long; *Leaves* deflexed, almost totally plain, ovate, acute, apiculate, shallowly cordate, 3.5-6.8 × 1.4-3.85 cm, glossy, coriaceous and heavily veined; *Inflorescence* one-flowered from reclining spathe 5-8 mm long, peduncle 2-3 mm long, pedicel 4-5 mm long, floral bract 3-4 mm long; *Flower* 10.7-13.3 × 7.8-10.0 mm, resupinate; *Dorsal sepal* beige with burgundy mottling, somewhat concave in apical half, elliptical-obovate to oblong-obovate, obtuse, entire along the margins, 5.0 × 3.0 mm, glabrous, 3-veined; *Synsepal* beige partially mottled with burgundy, slightly concave, ovate, obtuse, entire along the margins, 4.0 × 3.0 mm, glabrous, 5-veined; *Petals* beige mottled with burgundy, base entirely burgundy, ovate and shortly unguiculate, acute, marginally dentate, 4.5 × 3.2 mm, glabrous, 3-veined; *Lip* beige heavily mottled with burgundy, narrowly obovate, acute, marginally papillate-dentate, 3 × 2 mm, the glenion a small area in front of the anther, bilobed, surrounded by narrow callus; *Column* pink to pale burgundy with white along the edge of the clinandrium, stout, somewhat compressed dorsiventrally, 1.0 × 1.5 mm, with a bilobed stigma, anther apical, anther cap pale yellow, viscidium drop-like, orange.

ADDITIONAL MATERIAL STUDIED: Ecuador. Purchased from Mundiflora and flowered in cultivation by Jon Werner in U.S.A., *M. Wilson & J. D. Werner PL0977* (paratype: COCO!).

ETYMOLOGY: Named for the type locality near the Nangaritza River in Zamora Chinchipe Province, Ecuador.

DISTRIBUTION AND HABITAT: So far, *Pleurothallis nangaritzae* is known in the wild from only the type locality near the Nangaritza River, Province of Zamora Chinchipe, Ecuador (Fig. 13): it has not, to date, been reported outside this Province and may be endemic to that region. *P. nangaritzae* grows as an epiphyte adpressed to tree trunks in a lower montane forest at an elevation of ~1500 m and occurs sympatrically with orchids such as *Masdevallia strobilii* H.R.Sweet & Garay, *Maxillaria pachyacron* Schltr., *Oncidium tipuloides* Rehb.f. and *Pleurothallis cordata* Lindl.

CONSERVATION STATUS: The type locality of *Pleurothallis nangaritzae* occurs in an area in which a road has been

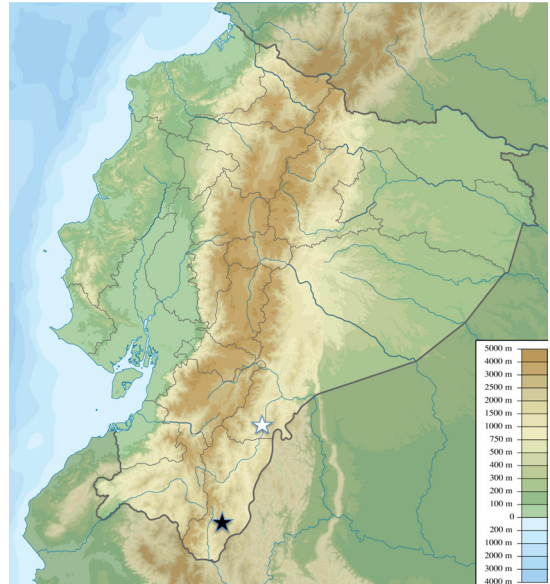


FIGURE 13. Collection locations of *Pleurothallis nangaritzae* (black star) and *Pleurothallis rubrifolia* (white star) in southeastern Ecuador (map from Wikimedia commons.)

opened and at this time cannot be considered secure. Whether the species occurs within the Bosque Protector Alto Nangaritza is unknown. The *ex situ* conservation status is also of concern, since while the species occurs in two collections in Ecuador, it is known from only one collection in the U.S. and likely all of these plants originated from a single original plant.

Discussion

Pleurothallis subsection *Macrophyllae-Fasciculatae* is the most speciose group within genus *Pleurothallis* as circumscribed by Pridgeon *et al.* (2005), with between 223 and 297 species, depending on synonymy. The first author estimates that, even conservatively, only ~60-70% of the species in the subsection have been described. Hence, a significant amount of work will be required in this group in order to describe the extant biodiversity before it is lost to deforestation and climate change. Efforts should be directed to areas of high biodiversity and endemism which have received little attention by orchidologists to date: the northwest of Ecuador (Endara, Williams & León-Yáñez 2009) and the southwest of Colombia, particularly the Department of Nariño (Orejuela Gärtner 2011), part of the Chocó bioregion; and

the southeast of Ecuador (Endara *et al.* 2009) and adjoining areas of Amazonas, Peru. Unfortunately, the description of new species is somewhat hampered by the large number of superficially similar species in this group.

We believe that the micro-morphology of the labellum and in particular the glenion, the structures with which the pollinator interacts directly, may be the most useful for distinguishing otherwise morphologically similar species in *Pleurothallis* subsection *Macrophyllae-Fasciculatae*. In this group, nearly all of which possess such a structure, the glenion is a small area of the hypochile, of distinct tissue structure, often depressed, but occasionally elevated on a callus, surrounded by tissue of completely different texture. While often mentioned in descriptions of species in the *Macrophyllae-Fasciculatae*, to our knowledge, it has not been examined in detail using SEM in this or any other group within *Pleurothallis* *sensu* Pridgeon *et al.* (2005). We hypothesize that it acts not just to attract the pollinator but that it serves to position the pollinator in the optimal position for pollinarium acquisition or deposition.

All three of the species described herein possess a glenion, but we were only able to obtain detailed images of the glenion of *Pleurothallis rubrifolia*. The glenion of *P. rubrifolia* was very distinctive, being somewhat elevated on a callus; apparently consisting of three cell types; and being surrounded by a smooth, somewhat depressed area of the hypochile/mesochile (Fig. 6–7). The glenion of *Pleurothallis nangaritzae* is bilobed, (Fig. 11b), a rare character in *Pleurothallis* subsection *Macrophyllae-Fasciculatae*, with few papillae along the outer edges. The papillae cover a large portion of the lip and surround a triangular area of smooth tissue, with the glenion at the base (Fig. 14). The *P. rubrifolia* glenion was quite different from that in *Stelis*, in which Ignowski (2015) observed the glenion to consist of a less well-defined area of tall, slender, loosely packed, papillate cells. Based upon the observations of Ignowski (2015) in *Stelis* and the preliminary observations here, the utility of the glenion in taxonomic discrimination of morphologically similar species and its specific role in the reproductive ecology of *Pleurothallis* subsection *Macrophyllae-Fasciculatae* deserves further study.

Although *Pleurothallis rubrifolia*, *P. castanea* and



FIGURE 14. Scanning electron micrographs of lip and column of *Pleurothallis nangaritzae*. SEM image by Katy Dupree.

P. nangaritzae are present in hobbyist, commercial and botanic collections in North and South America, *ex situ* conservation is a very poor substitute for *in situ* conservation in tropical montane forests (Orejuela Gärtner 2011). These forests, however, are extremely vulnerable due to deforestation and climate change (Orejuela Gärtner 2011) and while modest orchid conservation efforts are underway through organizations such as the Orchid Conservation Alliance (OCA), EcoMinga in Ecuador and Salvamontes in Colombia, significantly more effort and funding will be required to conserve even a small fraction of the diversity of these species in the coming decades.

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permit for the species described; to Adam Karremans and Diego Bogarín for instruction in preparation of LCDPs; to the anonymous reviewers for extremely valuable suggestions to improve the species descriptions; and the Editors of *Lankesteriana* for other suggestions to improve the manuscript.

LITERATURE CITED

- Bennett, D. E. & Christenson, E. A. (1993). *Icones Orchidacearum Peruvianum*. St. Louis: Missouri Botanical Gardens Press.
- Cardoso-Gustafson, P. (2014). Desenvolvimento floral em espécies de Pleurothallidinae (Orchidaceae) com ênfase nas estruturas secretoras. Ph.D. Thesis, Instituto de Botânica da Secretaria do Meio Ambiente, São Paulo, Brazil.
- Dodson, C. H. (2003). *Native Ecuadorian orchids, vol. 4: Oncidium to Restrepiopsis*. Sarasota, FL, U.S.A.: Dodson Trust.
- Dodson, C. H. & Dodson, P. M. (1980). Orchids of Ecuador, Series 1, Fascicles 1-4, *Icones Plantarum Tropicarum*. Sarasota, FL, U.S.A.: Marie Selby Botanic Gardens.
- Dodson, C. H. & Dodson, P. M. (1982). Orchids of Ecuador, Series 1, Fascicles 5, *Icones Plantarum Tropicarum*. Sarasota, FL, U.S.A.: Marie Selby Botanic Gardens.
- Dodson, C. H. & Dodson, P. M. (1991). Orchids of Ecuador, Series 2, Fascicles 5-6, *Icones Plantarum Tropicarum*. Sarasota, FL, U.S.A.: Marie Selby Botanic Gardens.
- Doucette, A., Wilson, M., Portilla, J., Kay, A., Moreno, J. S., & Cameron, K. M. (2016). Two new species of *Pleurothallis* and a new name for *Acronia rinki*. *Orquideología* 23(2): 123-139.
- Duque, Ó. (2008). Orchidaceae *Stelis* Swartz compendium. Medellín, Colombia: Editorial Universidad de Antioquia.
- Endara, L., Williams, N. H. & León-Yáñez, S. (2009). Patrones de endemismo de orquídeas ecuatorianas: perspectivas y prioridades para la conservación. In: A. M. Pridgeon & J. P. Suárez, (Eds.) *Proceedings of the Second Scientific Conference on Andean Orchids* (63-70). Loja, Ecuador: UTPL.
- Escobar, R. (1994). *Native Colombian orchids, vol. 3, Maxillaria-Ponthieva*. Medellín, Colombia: Compañía Litográfica Nacional S.A.
- Escobar, R. (2006). *Native Colombian orchids, vol. 6, supplement: Leucochyle-Zootrophion*. Medellín, Colombia: Compañía Litográfica Nacional S.A.
- Ignowski, H. (2015). *Stelis* Swartz (Orchidaceae) no estado do Paraná e estudos micro-morfológicos florais do gênero. Ph.D. Thesis, Universidade Federal do Paraná, Brazil.
- Ignowski, H., Toscano de Brito, A. L. V., Bona, C. & de Camargo Smidt, E. (2015). Nomenclatural notes on *Stelis ciliaris* (Pleurothallidinae, Orchidaceae). *Phytotaxa* 218(1): 030-038. <http://dx.doi.org/10.11646/phytotaxa.218.1.2>
- Kolanowska, M., Pérez-Escobar, O. A., Sanchez, E. P. & Szlachetko, D. (2011). *An illustrated field guide to the orchids of the Yotoco Forest Reserve (Colombia)*.
- Lindley, J. (1859). *Folia Orchidaceae Pleurothallis* 9-12.
- Luer, C. A. (1974). *Icones Pleurothallidarum: Pleurothallis of Ecuador (Orchidaceae)*. *Selbyana* 1(1), 56-100.
- Luer, C. A. (1975a). *Icones Pleurothallidarum (Orchidaceae): Pleurothallis of Ecuador II*. *Selbyana* 1(2), 172-195.
- Luer, C. A. (1975b). *Icones Pleurothallidarum (Orchidaceae): Pleurothallis of Ecuador III*. *Selbyana* 1(3), 220-303.
- Luer, C. A. (1976). *Icones Pleurothallidarum: Miscellaneous species of Pleurothallis*. *Selbyana* 3(1-2), 38-201.
- Luer, C. A. (1977). *Icones Pleurothallidarum (Orchidaceae): Miscellaneous species in the Pleurothallidinae*. *Selbyana* 3(3-4), 203-407.
- Luer, C. A. (1986). *Icones Pleurothallidarum III: Systematics of Pleurothallis*. *Monographs in Systematic Botany from Missouri Botanical Garden* 20, 1-109.
- Luer, C. A. (1988). A revision of some sections of subgenus *Pleurothallis*. *Lindleyana* 3(3), 133-149.
- Luer, C. A. (2005). *Icones Pleurothallidarum XXVII: Dryadella and Acronia section Macrophyllae-Fasciculatae*. *Monographs in Systematic Botany from Missouri Botanical Garden* 103, 1-311.
- Luer, C. A. (2009). Miscellaneous new species in the Pleurothallidinae (Orchidaceae). *Selbyana* 30(1), 1-71.
- Luer, C. A. (2011). Miscellaneous new species in the Pleurothallidinae (Orchidaceae) excluding species from Brazil. *Harvard Papers in Botany* 16(2), 311-360.
- Luer, C. A. & Thoele, L. (2013). Miscellaneous new species in the Pleurothallidinae (Orchidaceae). *Harvard Papers in Botany* 18(2), 173-196.
- Orejuela Gärtner, J. E. (2011). *Orchids in the Mist: Orchids of the cloud forests of southwestern Colombia*. Cali, Colombia: El Color de Colombia Ediciones Artísticas.
- Pridgeon, A. M., Cribb, P.J., Chase, M. W. & Rasmussen, F. N. (2005). *Genera Orchidacearum. Vol. 4. Epidendroideae (Part one)*, (385-390). Oxford, U.K.: Oxford University Press
- Pridgeon, A. M. & Chase, M. W. (2001). A phylogenetic reclassification of Pleurothallidinae (Orchidaceae). *Lindleyana* 16, 235-271.
- Pridgeon, A. M., Solano, R. & Chase, M. W. (2001). Phylogenetic relationships in Pleurothallidinae (Orchidaceae): Combined evidence from nuclear and

- plastid DNA sequences. *American Journal of Botany* 88, 2286–2308.
- Schweinfurth, C. (1959). Orchids of Peru. *Fieldiana – Botany* 30(2), 261–531.
- Schweinfurth, C. (1970). First Supplement to the Orchids of Peru. *Fieldiana – Botany* 33, 1–85.
- Szlachetko, D. L. & Kulak, M. (2006a). Nouvelles combinaisons dans le genre *Zosterophyllum* Szlachetko & Margónska (Orchidaceae, Pleurothallidinae). *Richardiana* (3), 131–135.
- Szlachetko, D. L. & Kulak, M. (2006b). Nouvelles combinaisons dans le genre *Zosterophyllum* Szlachetko & Margónska (Orchidaceae, Pleurothallidinae). *Richardiana* (4), 183–196.
- Szlachetko, D. L. & Margonska, B. H. (2001). Genera et species orchidaliium. *Polish Botanical Journal* 46(2), 113–121.
- Szlachetko, D. L., Veyret, Y., Mytnik-Ejsmont, J., Sawicka, M., Rutkowski, P. and Baranow, P. (2012). *Orchids of French Guiana*. Liechtenstein: A. R. G. Gartner, Ruggell.
- Wilson, M., Belle, C., Dang, A., Hannan, P., Kenyon, C., Low, H., Stayton, T. & Woolley, M. A. (2011). A phylogenetic analysis of the genus *Pleurothallis*, with emphasis on *Pleurothallis* subsection *Macrophyllae-Fasciculatae*, using nuclear ITS and chloroplast DNA sequencing. *Lankesteriana* 11(3), 369. <http://dx.doi.org/10.15517/lank.v11i3.18304>
- Wilson, M., Belle, C., Dang, A., Hannan, P., Kellogg, L., Kenyon, C., Low, H., Mochizuki, A., Nguyen, A., Sheade, N., Shan, L., Shum, A., Stayton, T., Volz, C., Vosburgh, B., Wellman, H. & Woolley, M. A. (2013). Preliminary phylogenetic analysis of *Pleurothallis sensu lato* based upon nuclear and plastid sequences. *Lankesteriana* 13(1–2), 139. <http://dx.doi.org/10.15517/lank.v0i0.11568>
- Zelenko, H. & Bermúdez, P. (2009). *Orchids: Species of Peru*. Quito, Ecuador: Imprenta Mariscal.

A NEW *MASDEVALLIA* (ORCHIDACEAE: PLEUROTHALLIDINAE) FROM A DEFORESTED AREA IN THE HUANUCO REGION OF PERU

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ABSTRACT. A new and showy species of *Masdevallia* from the Huanuco region in Peru is described and illustrated with a line drawing and color photographs. It belongs to the subgenus *Masdevallia*, section *Masdevallia*. The new species is compared to several more or less morphologically similar species, such as *M. burianii*, *M. cranion* and *M. popowiana* that appear to be closely related. The new species differs from them by a combination of features, including the rather fleshy leaves and the bell-shaped flowers covered internally with magenta to white pubescence.

KEY WORDS: Huanuco, *Masdevallia*, new species, Peru, Pleurothallidinae

Introduction. The genus *Masdevallia* Ruiz & Pav. is one of the more well-known and popular orchid genera in cultivation. It has therefore also been of interest to many taxonomists over the years. Several groups of species that were originally described as *Masdevallia* have been separated since the genus was established and generally been accepted as genera of their own, such as *Dracula* Luer, *Porroglossum* Schltr., *Scaphosepalum* Pfitzer and *Trisetella* Luer. Despite these and other transfers from *Masdevallia*, the genus is still large today with over 600 species, classified into numerous subdivisions (Luer 1986, 2000a,b, 2001, 2002, 2003). This vast number of species, in combination with molecular investigations (Pridgeon & Chase 2001, Abele *et al.* 2005), eventually encouraged Luer to split the genus into 16 new genera, in addition to the remaining *Masdevallia* (Luer 2006). This latter treatment has not been generally accepted (Dalström & Ruiz Pérez 2014) so the genus is more generally accepted in a broader sense, basically as it was earlier circumscribed by Luer.

and flowered in cultivation by Perúflora, Nov. 2015 (*Masdevallia* sp. 401020) S. Dalström 3785 (holotype: USM). Figs. 1–4.

Masdevallia tatianae belongs to the subgenus *Masdevallia*, section *Masdevallia*, and appears most similar to *M. burianii* Luer & Dalström, *M. cranion* Luer and *M. popowiana* Königer, but differs from *M. burianii* in having much sturdier and thicker leaves, petals with a truncate apex versus a rather narrow and oblique acute apex for the petals of *M. burianii*, a lip with a distinctly narrowed apical part versus an almost truncate apex for the lip of *M. burianii*, and *M. tatianae* differs from *M. cranion* in the erect inflorescence versus a subhorizontal and *ca.* half as long inflorescence, by a lip with a distinctly narrowed apical part versus an evenly ovate lip lamina for *M. cranion*, and densely pubescent inner surfaces of the sepals versus cellular-papillose inner surfaces of the sepals for *M. cranion*, and *M. tatianae* differs from *M. popowiana* by the pubescent inner surfaces of the sepals versus basically glabrous inner surfaces of the sepals, and by the rounded cupulate flowers versus flowers with a distinct ventral mentum formed by the lateral sepals in *M. popowiana*.

TAXONOMIC TREATMENT

Masdevallia tatianae Dalström & Ruiz-Pérez, *sp. nov.*

TYPE: Peru. Huanuco. Along and above the road between Uchiza and Huacrachuco, in a patch of dense and scrubby cloud forest west of San Pedro de Chonta, alt. *ca.* 2500 m, collected by S. Ruiz on 1 Dec. 2013,

Epiphytic *herb.* *Plant* medium sized for the subgenus, caespitose. *Ramicauls* erect, rather thick, *ca.* 2.8–3.2 cm long, enclosed basally by 3 tubular sheaths. *Leaf* erect, coriaceous, petiolate, blade basally

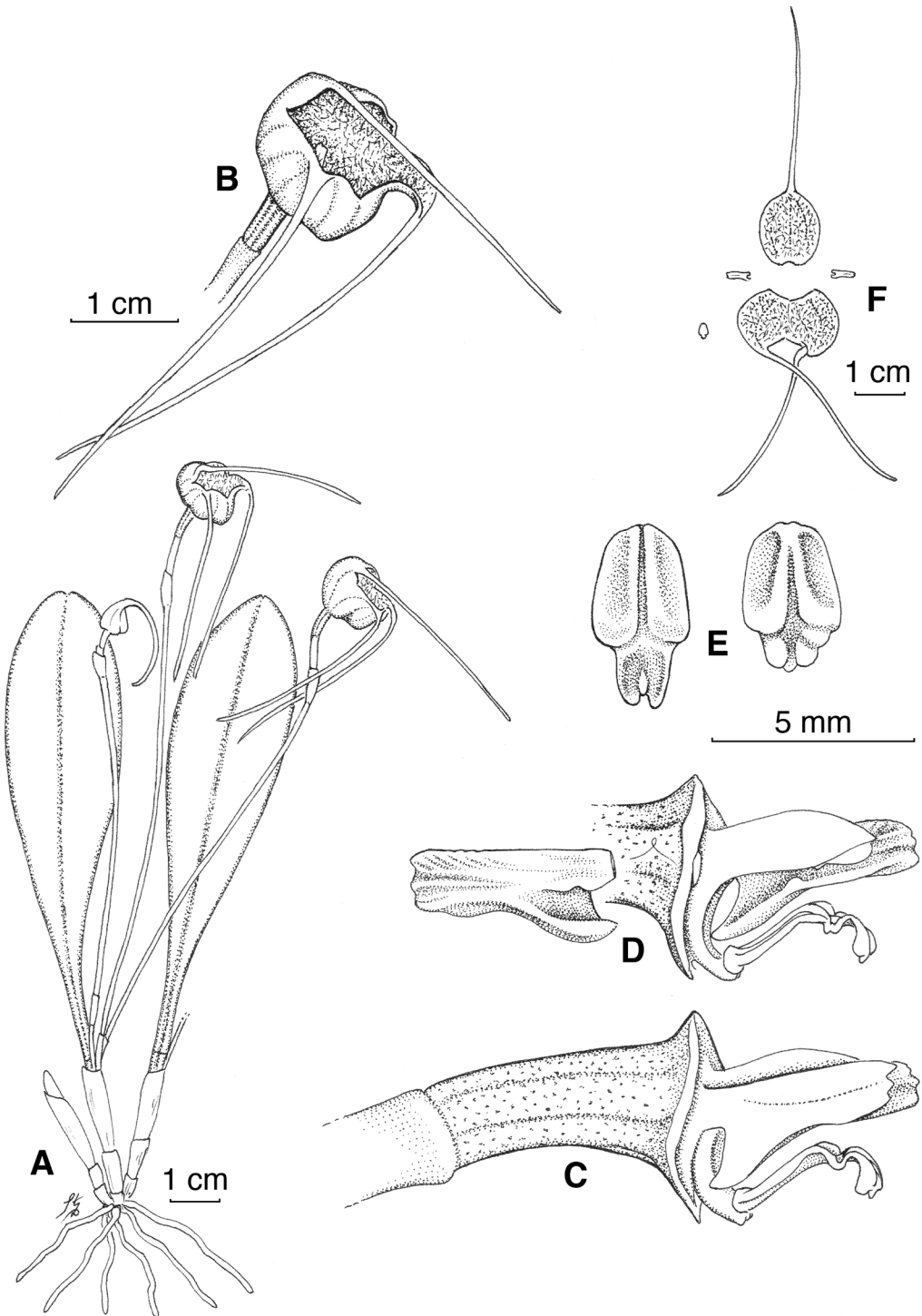


FIGURE 1. *Masdevallia tataniae* Dalström & Ruiz-Pérez. A. Plant habit. B. Flower. C. Ovary, lip and column, including the petal, lateral view. D. Ovary, lip and column, with removed and flipped petal, lateral view. E. lip normal and flattened dorsal views. F. Dissected flower. Drawn from holotype by Stig Dalström.

conduplicate and cuneate, ovate to elliptic, obtuse, to ca. 10.0 × 2.5 cm, including the ca. 2 cm long petiole. *Inflorescence* erect, terete, single flowered, with an up to ca. 10 cm long peduncle; *peduncular bract* 1, tubular, near the base of the peduncle, ca. 6 mm long; *floral bract* appressed, tubular, ca. 7 mm long; *pedicel* excluding the ovary to ca. 15 mm long; *ovary* shallowly sulcate, smooth, with scattered tiny “fungal pits” (tiny pits where it is speculated here, but not proven, that some fungi establish, based on visual observation only), ca. 4–5 mm long. *Flower* deeply cupulate, forming a ca. 10 mm long sepaline cup; *dorsal sepal* pale yellow with basal magenta spots and the apical tail gradually turning purplish, connate to the lateral sepals for ca. 5–6 mm, then obtuse, internally covered by magenta to whitish hairs, ca. 15 × 12 mm, with a slender apical, more or less forward to downward pointing, basally yellowish turning gradually purplish ca. 38–40 mm long tail; *lateral sepals* similar in texture and coloration, connate for ca. 8 mm, then obliquely ovate and obtuse, ca. 12–13 × 10–11 mm, with apical, slender, yellowish and purplish ca. 38–40 mm long tails; *petals* translucent, glass-like and colorless, cartilaginous, unguiculate with a distinct lateral, triangular and involute fleshy lobe, extending from the base to the middle of the length, then rather linear with a truncate and indistinctly tridentate apex, ca. 5.0 × 1.5 mm; *lip* basally pale yellow, then with pale purple hue and specks, the apical part brownish to purplish with a dark purple apicule, hinged on the hook-shaped column foot by a minute strap-like tissue, basally broadly ovate with a minor longitudinal furrow, then distinctly angled into a narrower epichile that is linear when flattened and apically bilobed with a small fleshy rounded knob in between. ca. 4.5 × 2.5 mm when flattened; *column* pale yellow with magenta lower edges, straight, ca. 4 mm long, with an equally long, curved and apically hook-shaped foot; *anther cap* pale yellow and campanulate; *pollinia* not seen.

PARATYPE: Peru. A small population of plants without flowers was observed in the same location as the holotype. No other collections known.

DISTRIBUTION: *Masdevallia tatianae* is only known from the type locality.

EPONYMY: This species is named in honor of Tatiana



FIGURE 2. *Masdevallia tatianae*. Front view of the flower. Flowered in cultivation and photographed by Perúflora.



FIGURE 3. *Masdevallia tatianae*. Three quarters view of the flower. Flowered in cultivation and photographed by Perúflora.



FIGURE 4. *Masdevallia tatiana*. Lateral view of the flower. Flowered in cultivation and photographed by Perúflora.

Leyla Ruíz Sanchez, the daughter of the discoverer and second author, on his request.

Masdevallia tatiana was originally discovered by Saúl Ruíz and his brother Moises during a field trip in October 2013. A few plants were growing epiphytically in a small patch of remaining scrubby cloud forest in an otherwise heavily deforested area (Fig. 5). Very little remains of the original forest in that entire region and many plant species are without a doubt doomed to disappear in a near future. *Masdevallia tatiana* appears to be most closely related to species such as *M. burianii*, *M. cranion* and *M. popowiana*, due to the rounded and bell-shaped flower. But the rich internal pubescence also reminds of features displayed by members of the subsection *Saltatrices*.

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FIGURE 5. The deforested habitat of *Masdevallia tatiana*, in Huanuco, Peru. Photograph by S. Dalström.

LITERATURE CITED

- Abele, C., Rudolph, B., Thiede, J. & Rohwer, J. G. (2005). Phylogeny of the genus *Masdevallia* Ruiz & Pav., based on morphological and molecular data. Proceedings of the 18th World Orchid Conference, Dijon, France, 111–115.
- Dalström, S. & Ruíz Pérez, S. (2014). Three new *Masdevallia* species (Orchidaceae: Pleurothallidinae) from Peru. *Lankesteriana*, 13(3), 251–258. Doi: <http://dx.doi.org/10.15517/lank.v13i3.14362>
- Luer, C. A. (1986). Icones Pleurothallidinarum 2, Systematics of *Masdevallia* (Orchidaceae). *Monographs in systematic botany from the Missouri Botanical Garden* 16. Missouri Botanical Garden Press.
- Luer, C. A. (2000a). Icones Pleurothallidinarum 19. Systematics of *Masdevallia* part one. *Monographs in systematic botany from the Missouri Botanical Garden*, 77, 1–264. Missouri Botanical Garden Press.
- _____. (2000b). Icones Pleurothallidinarum 21. Systematics of *Masdevallia* part two. *Monographs in systematic botany from the Missouri Botanical Garden*, 82, 265–518. Missouri Botanical Garden Press.
- _____. (2001). Icones Pleurothallidinarum 22. Systematics of *Masdevallia* part three. *Monographs in systematic botany from the Missouri Botanical Garden*, 86, 510–780. Missouri Botanical Garden Press.
- _____. (2002). Icones Pleurothallidinarum 23. Systematics of *Masdevallia* part four. *Monographs in systematic botany from the Missouri Botanical Garden*, 87, 781–1047. Missouri Botanical Garden Press.
- _____. (2003). Icones Pleurothallidinarum 25. Systematics of *Masdevallia* part five. *Monographs in systematic botany from the Missouri Botanical Garden*, 91, 1049–1293. Missouri Botanical Garden Press.
- _____. (2006). Icones Pleurothallidinarum 28, A reconsideration of *Masdevallia*, Systematics of *Specklinia* and vegetatively similar taxa (Orchidaceae). *Monographs in systematic botany from the Missouri Botanical Garden*, 105, 1–6. Missouri Botanical Garden Press.
- Pridgeon, A. M. & Chase, M. W. (2001). A phylogenetic reclassification of Pleurothallidinae. *Lindleyana*, 16(4), 235–271.

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