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Lankesteriana, Lankester Botanical Garden's scientific journal, has been devoted since 2001 to the publication of articles on botany, with special attention to epiphytic plants and orchid systematics, ecology, evolution and physiology, along with book reviews and conferences on these subjects. Since 2007, the journal focused exclusively on scientific papers on orchidology. Lankesteriana is a peer-reviewed journal that publishes original works in English and Spanish, and it is distributed to more than 350 institutions worldwide.

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Originally devoted to the publication of articles on general botany, with special attention to epiphytic plants and orchid systematics, ecology, evolution and physiology, along with book reviews and conferences on these subjects, since 2007 Lankesteriana focuses exclusively on scientific orchidology.

A peer-reviewed journal that publishes original works in English and occasionally in Spanish, Lankesteriana is distributed to more than 350 libraries and institutions worldwide.

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EDITORIAL

LANKESTERIANA, A NO IMPACT JOURNAL ... OR IS IT?

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The word impact comes from the Latin *impactus*, to push against. It is defined by the Merriam-Webster dictionary as, among others, "to have a direct effect on". In the realm of scientific publishing, impact is measured in the sense of the journal Impact Factor (IF). The IF is calculated by "considering all citations in 1 year to a journal's content published in the prior 2 years, divided by the number of substantive, scholarly items published in that journal in those same 2 years". In other words, impact is defined as the direct effect in one year of the journal's content published the two preceding years. Easy and fair enough. Nevertheless, the Impact Factor has a copyright, and this mathematical calculation can be officially done only by one private entity, Thomson Reuters. And things go downhill from there.

In their procedures it is established that "the items counted in the denominator of the impact factor are identifiable in the Web of Science database by having the index field document type set as Article, Review, or Proceedings Paper". This means that the impact of a journal is restricted only to those items included in the Web of Science (WoS). Anything not in WoS does not count, even though their formula clearly states that it includes the "scholarly items". Nevertheless, surely it would be straight forward for any scientific journal to be included. In fact it would be expected, considering the growing importance given to Thomson Reuters' IF, that inclusion in the database is almost automatic for consistently published peer-reviewed, scholarly journals. In their words "A journal accepted for coverage in the Thomson Reuters citation database is reviewed by experts who consider the bibliographic and bibliometric characteristics of all article types published by that journal", but more importantly that "this journal-specific analysis identifies the journal sections, subsections, or both that contain materials likely to be considered scholarly works, and which therefore have the potential to be cited". Therefore, by their own standards, anything that is consistently cited in literature and thus has impact in science, should be included in their database and have an impact factor.

So, if journals like *Lankesteriana* are not accepted in the SCI index and provided an official impact factor, it must mean that they are not of common usage in scientific literature. But, is that really the case? With the printing of volume 15(3) in December, *Lankesteriana* celebrated 15 years of publishing, and 8 years dedicated exclusively to the Orchidaceae family. During those 15 years the journal published 465 papers and abstracts. In the year 2015 alone, materials published in *Lankesteriana* were cited, at least (I am sure I missed some publications), by 433 authors, and in 146 articles published by 89 different journals world wide. *Isn't that impact*? *

Where is Lankesteriana cited? *Lankesteriana* was cited in papers published by 89 different journals last year (Table 1). Our journal is, as expected, frequently featured in the popular orchid magazines like *Die Orchidee* and *Orchids*. Nevertheless, it is the leading journals in botany that actually cite our journal the most. The top three journals that cited *Lankesteriana* the most in 2015 were *Phytotaxa* (IF: 1.797), *Annals of Botany* (IF: 3.654) and *Botanical Journal of the Linnean Society* (IF: 2.534), all indexed by SCI. In

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* The original citation data used in the editorial can be obtained from the author upon request.

Table 1. Top three journals that cited Lankesteriana the most in 2015.

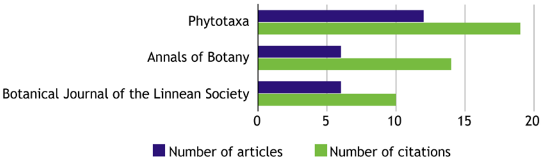
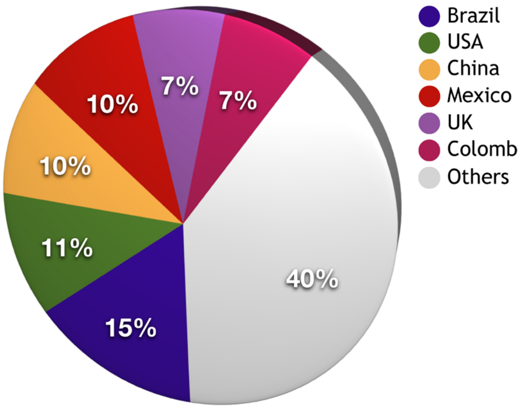


Table 2. Affiliation countries of the authors that cited Lankesteriana in 2015.

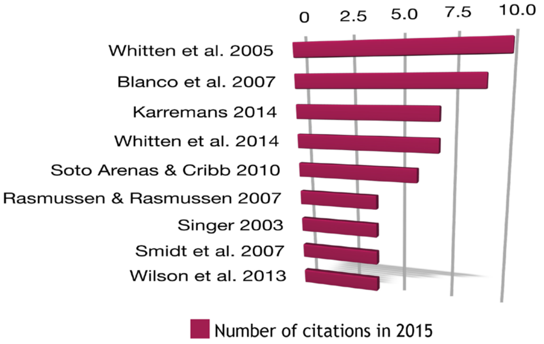


fact, only three out of the first ten journals that cited *Lankesteriana* most frequently this year are not indexed (including ourselves). The journal itself appears in the sixth position with only four of the published articles last year citing our own journal; about one fifth of all published articles.

Who cites Lankesteriana? Out of the 433 authors that cited *Lankesteriana* in 2015 the first three that cited it the most are associated with Lankester Botanical Garden. Nevertheless, from there on they are mostly external authors. Three external authors cited *Lankesteriana* in at least five of their publications this year alone, twelve others cited the journal at least three times, and almost 50 different authors cited *Lankesteriana* in at least two of their publications in 2015. The vast majority are, expectedly, orchid specialists.

The authors citing *Lankesteriana* in 2015 are also quite diverse in their provenance. According to their affiliations (not citizenship) they come from 43 different countries. The top countries are Brazil (68 authors), USA (50 authors), Mexico (45 authors), China (45 authors), the UK (31 authors) and Colombia (30 authors). Costa Rica, country of origin of the journal, does not even make the top ten. This shows that the readership of the journal is by no means merely national or even restricted to Latin America, but that it follows current international tendencies (Table 2).

Table 3. Top cited articles from Lankesteriana in 2015.



What is cited from Lankesteriana? Out of the 465 citable materials published in *Lankesteriana* from 2001 to 2015, about one fifth was cited at least once in 2015. The five articles that received most citations were, in order, Whitten *et al.* (2005), Blanco *et al.* (2007), Whitten *et al.* (2014), Karremans (2014) and Soto-Arenas & Cribb (2010), with more than five citations this year each (Table 3). These are all papers dealing with the systematics of specific groups within Orchidaceae.

How about the impact factor (IF)? We have shown in the previous lines that *Lankesteriana* is in fact found relatively commonly in botanical literature, especially in papers that deal with orchids. Nevertheless, in order to be comparable it is required to have a single value, the impact factor. The 2015 IF would be estimated by Thomson Reuters as all citations in 2015 to the journal's content published in 2013 and 2014, divided by the number of items published in that journal in those same two years. We are of course not allowed to calculate and provide this ourselves. Nevertheless, *Lankesteriana* published 42 papers in 2013 and 2014, and those papers were cited 28 times in papers indexed in the Web of Science (cited 45 times if also non WoS journals, like our own, were to be considered) in 2015, so its impact factor according to Thomson Reuters' criteria would be 28/42. That places *Lankesteriana*'s IF above journals like *Acta Botánica Mexicana, Botanical Sciences, Brittonia, Nordic Journal of Botany, Novon,* *Revista Mexicana de Biodiversidad* and *Revista de Biología Tropical*.

So, where do we stand? *Lankesteriana* has requested, on diverse occasions in the last several years, that it be considered for inclusion in WoS, and given an official IF. In fact, *Lankesteriana* was evaluated by Thomson Reuters and without any explanation included in their Zoological Records (ZR)index. When confronting them about the inclusion in ZR and exclusion from WoS we were told that "Zoological Records is also a good index" and that they "do not actively pursue titles already covered there [ZR] for additional coverage in Thomson Reuters products unless they are well cited". We nevertheless insisted that they reconsider, and we have not received any response for about two years. In summary, they choose who to consider and when, if considered you may end up in an index were you don't belong and can't be moved from there, and they do not need to give any explanation for exclusion, or respond at all for that matter.

Does it matter? Unfortunately it does. Even though we all know the journal's impact factor does not reflect the citation of our own article, that only a two-year time frame is considered, that the nature of the citation is ignored, that only citation in some journals are taken into consideration, that the data used for the calculations is not publicly available, and that they can be easily manipulated by self citation, researchers and students are evermore evaluated and compared by the IF of their publications, and as such pressured (I would say even bullied) into publishing in high impact journals. This also means that as not all good science has high immediate impact, only certain topics highly citable, trendy topics will be published by those journals. As a dear friend worryingly stated: "I don't even start writing a paper if it is not going to a journal of IF=2.5 or above". It is clear that the IF of a journal by no means reflects how valuable your work actually is, how much it is or will be cited, and even less if you are a good scientist. Nevertheless, it does determine who gets what position, who can access which grant, and even how much you get paid. This is clearly a tainted and biased system that either has to become more democratic and inclusive if it is to be used universally, or has to be eliminated altogether.

We hope for the time being that our authors can get passed the lack of IF and keep considering *Lankesteriana* for publishing the results of their research on the basis of the actual use and quality of the journal.

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ECOLOGÍA Y ESTRUCTURA POBLACIONAL DEL ENDEMISMO CUBANO *TETRAMICRA MALPIGHIARUM* (ORCHIDACEAE), EN EL PARQUE NACIONAL DESEMBARCO DEL GRANMA, CUBA

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Resumen. En Cuba se reconocen aproximadamente 315 especies para la familia Orchidaceae, de las cuales son endémicas alrededor de 32 %. Durante 2012 y 2013, se estudió una población del endemismo cubano *Tetramicra malpighiarum* (Orchidaceae), en el Parque Nacional Desembarco del Granma, Cuba. Se estudió la abundancia de la especie, clases de vida de los individuos (inmaduros y adultos), forófitos sobre los que crecían, micrositios que ocupaban en los mismos (tronco, ramas o ramillas), si los individuos estaban solitarios o agregados y orientación cardinal que tenían sobre los forófitos. Se encontraron 254 individuos de *T. malpighiarum*, distribuidos en 20 forófitos. Por primera vez se localizaron individuos de *T. malpighiarum* ocupando otras cinco especies de forófitos, además de *Malpighia incana* (Malpighiaceae) y *Erythroxylum havanense* (Erythroxylaceae). Fueron adultos 69.3 % de los individuos y en las ramillas crecía 93.7 % de la población. Es similar el número de individuos de *T. malpighiarum* creciendo agregados y creciendo solitarios. La población muestra una pequeña tendencia a crecer preferentemente con orientaciones sur y noroeste. Este trabajo es una primera aproximación a la ecología poblacional de *T. malpighiarum*, pero es fundamental realizar estudios genéticos y demográficos a largo plazo, que permitan monitorear el comportamiento poblacional y reproductivo de este endémico cubano, y averiguar los niveles de endogamia y variabilidad genética de los individuos, para conocer su posible comportamiento y permanencia en el futuro.

Abstract. In Cuba, there are 315 species of Orchidaceae family, approximately 32 % of these species are endemic. During 2012 and 2013 an endemic population of *Tetramicra malpighiarum* (Orchidaceae) was studied at the Desembarco del Granma National Park, Cuba. We determined the abundance of this species, life classes (immature and adult), phorophytes inhabited, vertical distribution (trunk, branches or twigs), solitary or aggregated growing, and its cardinal orientation on phorophytes. We found 254 individuals of *T. malpighiarum* distributed in 20 phorophytes. For the first time, were found individuals of *T. malpighiarum* grew on other five species of phorophytes, besides of *Malpighia incana* (Malpighiaceae) and *Erythroxylum havanense* (Erythroxylaceae). Of the total of individuals recorded, 69.3 % were adult and 93.7 % were growing on the twigs. The number of solitary individual and aggregated individuals was similar. The population shows a slight tendency to grow toward south and northwest orientations. This is the first study to describe the population ecology of *T. malpighiarum*, but it is recommended to conduct long-term genetic and demographic studies. These future studies should be explored the reproductive system (e.g., level of endogamy) and population genetic of this species endemic of Cuba in order to evaluate its permanency in the future.

Palabras clave: clases de vida, distribución vertical, forófito, *Malpighia incana*, orientación cardinal

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Introducción. Cuba constituye la cuarta isla con mayor diversidad de plantas del mundo (Whittaker & Fernández-Palacios 2007), y la primera en cuanto al número de especies por km^2 (González-Torres *et al*. 2013). Una de las características más distintivas de la flora cubana es su alto endemismo; 53 % de la flora nativa son especies endémicas (Berazaín *et al*. 2005). No obstante esta gran riqueza florística, sobre la flora del país pesan numerosas amenazas, tanto de origen natural como antrópico, lo que hace imprescindible elevar el conocimiento que se tiene de las especies de plantas cubanas y de su situación de conservación (González-Torres *et al*. 2013).

Particularmente para la familia Orchidaceae, en Cuba se reconocen aproximadamente 315 especies (Ackerman 2014a), de las cuales 71 % son epífitas (Díaz 1999), y el endemismo es de alrededor de 32 % (Ackerman 2014a). Una de las especies de orquídeas epífitas endémicas de Cuba es *Tetramicra malpighiarum* J.A. Hern. & M.A. Díaz (Fig. 1A - 1B) (Hernández & Díaz 2000, Llamacho & Larramendi 2005, Acevedo-Rodríguez & Strong 2012, Ackerman 2014b). De este taxón, catalogado como en peligro crítico (CR; Berazaín *et al*. 2005), solo se conocen dos poblaciones, de pocas plantas cada una y gran especificidad en la elección de forófito (Hernández & Díaz 2000, Llamacho & Larramendi 2005), creciendo fundamentalmente sobre *Malpighia incana* Mill. (Malpighiaceae; Hernández & Díaz 2000, Llamacho & Larramendi 2005, García-González *et al*. 2013). Habita en la costa norte de la provincia Ciego de Ávila y en la costa sur de la porción oriental de la isla, y su población más importante se localiza al oriente de Cuba, en El Guafe, Parque Nacional Desembarco del Granma (PNDG), provincia Granma (Hernández & Díaz 2000, Llamacho & Larramendi 2005, García-González *et al*. 2013).

Teniendo en cuenta que *T. malpighiarum* es una especie de orquídea con una distribución muy limitada, poblaciones muy reducidas y gran especificidad en

Figura 1. *Tetramicra malpighiarum* (Orchidaceae) en el Parque Nacional Desembarco del Granma, Cuba. A: Planta en su hábitat, B: Flor, C: Bosque transicional entre matorral xeromorfo costero y bosque semideciduo (hábitat).

la elección de sustrato (Hernández & Díaz 2000, Llamacho & Larramendi 2005). Se procedió a estudiar su abundancia y estructura poblacional, como una primera aproximación al conocimiento de su ecología poblacional y como una forma de contribuir a aumentar el escaso conocimiento que se tiene sobre esta especie, todo lo cual redundará en mejores acciones de conservación y manejo para garantizar la permanencia de este endémico cubano.

Materiales y Métodos. *Caracterización del sitio –*. El estudio se desarrolló durante 2012 y 2013, en el área donde se localiza la población tipo de *T. malpighiarum* (Hernández & Díaz 2000), una zona de transición entre matorral xeromorfo costero y bosque semideciduo (Fig. 1C; García-González *et al.* 2013), en los 19° 51´ 186´´ N; 77° 42´ 690´´ W, en El Guafe, PNDG, Cuba. En esta área el promedio anual de precipitaciones oscila entre 800 y 1200 mm, y la temperatura entre 30.5 y 22.9 °C (Palacio *et al.* 2012).

Toma de datos –. Con el objetivo de localizar nuevos individuos y forófitos de *T. malpighiarum*, se desarrolló un diseño radial cuyo centro fue el núcleo poblacional de la especie, reportado por Hernández & Díaz (2000). A partir de ese centro, se trazaron ocho transectos de 800 m² cada uno (10 x 80 m; 0.08 ha), dentro de los cuales se contaron los individuos de *T. malpighiarum.* Los esfuerzos de muestreo se concentraron en esta área, porque se consideró que era más factible encontrar nuevas plantas de *T. malpighiarum* en sitios cercanos a las plantas madres (Machon *et al.* 2003, Trapnell *et al.* 2004, Jersáková & Malinová 2007, Winkler *et al.* 2009, Chung *et al.* 2011).

Caracterización de los forofitos de T. malpighiarum. Se identificaron taxonómicamente todos los forófitos (MBG 2015a), se midió su diámetro a la altura del pecho (DAP; cm), y se estimó su altura (m) siguiendo la metodología propuesta por García-González *et al.* (2011). En este trabajo el término forófito sólo se utiliza para los arbustos y árboles sobre los que crecía *T. malpighiarum* (García-González & Pérez 2011).

Preferencias de establecimiento de T. malpighiarum –. Con el objetivo de conocer si existía una tendencia en el establecimiento de *T. malpighiarum* en los forófitos, se estimaron las alturas a las que se ubicaban los individuos en los arbustos y árboles, y se midieron los diámetros de las secciones de los tronco o de las ramas donde crecían. Además, se registró la distribución vertical de cada individuo dentro de su forófito, siguiendo la zonación vertical propuesta por García-González & Riverón-Giró (2014) para árboles de naranjo (*Citrus sinensis* (L.) Osbeck; Rutaceae). Es importante señalar que por un error de los autores, en García-González & Riverón-Giró (2014) aparece que el parámetro utilizado para clasificar los micrositios "ramas y ramillas" fue la circunferencia, cuando en realidad se utilizó el diámetro (comentario de los autores; García-González A. & Riverón-Giró F.B.). Se empleó esta clasificación porque es la que más se ajusta a las características ecológicas de los micrositios presentes en los arbustos y árboles encontrados en el área estudiada.

Clases de vida de los individuos de T. malpighiarum, orientaciones cardinales que tienen en los forófitos, y estado de agregación en el que crecen –. Siguiendo las metodologías y criterios establecidos por García-González & Riverón-Giró (2014), todos los individuos de *T. malpighiarum* se incluyeron en dos clases de vida (adultos o inmaduros), y se registraron las orientaciones cardinales en las que se encontraban ubicados en los forófitos. El estado de agregación de los individuos se determinó siguiendo los criterios utilizados por González *et al.* (2007) y Mújica (2007) para *Broughtonia cubensis* (Lindl.) Cogn. No obstante, teniendo en cuenta el menor tamaño promedio de *T. malpighiarum,* se desarrolló una versión específica para esta especie.

Los individuos de *T. malpighiarum* se dividieron en dos grupos o tratamientos:

- Individuos agregados: Aquellos que están a una distancia de 5 cm o menos de otro individuo de *T. malpighiarum* o de otras especies de epífitas vasculares.
- Individuos solitarios: Aquéllos que están a una distancia mayor de 5 cm de otro individuo de *T. malpighiarum*, de otras especies de epífitas vasculares o habitando en solitario en un forófito.

Se consideró la distancia mínima de 5 cm para determinar agregación, teniendo en cuenta el pequeño tamaño de *T. malpighiarum* (plantas sin pseudobulbos

TABLA 1. Especies de forófitos sobre los que crece *Tetramicra malpighiarum* (Orchidaceae), en el Parque Nacional Desembarco del Granma, Cuba; número de forófitos registrados por especie, y número de individuos de *T. malpighiarum* que se encontraron ocupando cada especie de forófito.

Especies de forófitos	**Familia**	**No. de forófitos registrados**	**No. de individuos de *T. malpighiarum***
Malpighia incana	Malpighiaceae	14	217
Erythroxylum havanense	Erythroxylaceae	1	2
Eugenia anthacanthoides	Myrtaceae	1	24
Guettarda elliptica	Rubiaceae	1	3
Plumeria obtusa	Apocynaceae	1	2
Randia aculeata	Rubiaceae	1	5
Stigmaphyllon sagreanum	Malpighiaceae	1	1
Total	----	20	254

y 4-6 cm de alto; Llamacho & Larramendi 2005). A pesar de que las raíces de los individuos se entrecruzan a mayor distancia, fue imposible incluir este parámetro para delimitar la distancia de agregación. Generalmente las raíces de estas plantas no son visibles fácilmente en toda su extensión, son muy delgadas (0.5-1 mm de diámetro), de color blanco a gris (Ackerman 2014b), y se extienden por dentro de las grietas de la corteza de los forófitos y por debajo de los líquenes que la cubren.

Análisis estadísticos –. Las medidas de tendencia central que se expresan en el texto son promedios, mientras que las medidas de variación son errores estándar. Se realizó una prueba de x^2 con tabla de contingencia para evaluar el efecto del estadio de vida de los individuos de *T. malpighiarum* sobre su estado de agregación. Así mismo, se comparó la frecuencia de establecimiento de los individuos en distintas categorías de altura y grosor de las ramas, con un modelo de distribución aleatorio generado con una tabla de contingencia. Finalmente, se realizó una prueba de Uniformidad Circular de Rayleigh, en el caso de la variable orientación cardinal de los individuos en los forófitos, utilizó el programa Oriana (Versión 1.01).

Resultados *Caracterización de la población de T. malpighiarum* –. Se encontraron 254 individuos de *T. malpighiarum* (Tabla 1), en los 6400 m² (0.64 ha) muestreados. Sin embargo, todos los individuos se concentraron en un área de tan solo 400 m², en los primeros metros de los transectos, en y alrededor del núcleo poblacional original de la especie. La población está formada principalmente por individuos adultos (69.3% de la población; 176 individuos; Fig. 2).

Se encontraron creciendo solitarios 51.18% de los individuos (130 individuos), y el resto crecían agregados (Fig. 2), principalmente con otras orquídeas de su misma especie (115 individuos de *T. malpighiarum* agregados entre ellos). No obstante, se registró agregación de *T. malpighiarum* con otras especies de epífitas vasculares como, *Tillandsia fasciculata* var. *clavispica* Mez (Bromeliaceae; 6 individuos de *T. malpighiarum* agregados con esta especie), *Tolumnia guibertiana* (A. Rich.) Braem (Orchidaceae; 2 individuos de *T. malpighiarum*

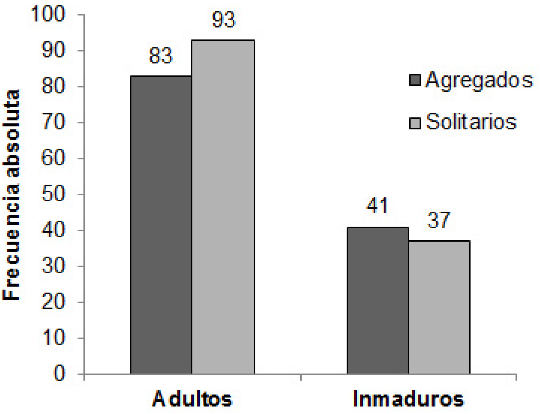

FIGURA 2. Frecuencia absoluta de individuos de *Tetramicra malpighiarum* (Orchidaceae) creciendo solitarios y agregados, según su estadio de vida, en el Parque Nacional Desembarco del Granma, Cuba.

agregados con esta especie) y *Broughtonia lindenii* (Lindl.) Dressler (Orchidaceae: 1 individuo de *T. malpighiarum* agregado con esta especie). También, se observó que la frecuencia de agregación no depende del estadio de vida de los individuos de *T. malpighiarum* (χ^2= 0.63, p= 0.42). Otras especies de epífitas vasculares y hemiepífitas, que aunque no se encontraron en agregación con *T. malpighiarum*, se observaron creciendo simpátricamente con esta orquídea, fueron: *Encyclia phoenicea* (Lindl.) Newmann, *Vanilla* sp. (Orchidaceae), *Tillandsia balbisiana* Schult. & Schult.f., *T. bulbosa* Hook., *T. flexuosa* Sw., *T. recurvata* (L.) L., *T. usneoides* (L.) L., *T. utriculata* L. (Bromeliaceae) y *Selenicereus grandiflorus* (L.) Britton & Rose (Cactaceae).

Caracterización de los forófitos de T. malpighiarum –. Se encontraron 20 forófitos, pertenecientes a siete especies y cinco familias botánicas (Tabla 1). La especie de forófito más importante fue *M. incana* (70% de todos los forófitos; 14 plantas), y sobres esta especie crecía la mayor parte de la población de *T. malpighiarum* (85.43% de la población; 217 individuos; Tabla 1). Los forófitos de la especie *M. incana* tuvieron en promedio 15.5 ± 6.77 individuos de *T. malpighiarum*, mientras que el resto de los forófitos en conjunto promediaron 6.16 ± 2.52 individuos por forófito. La altura promedio de los forófitos en general fue de 199.1 ± 32.4 cm y un diámetro de 2.73 ± 0.62 cm.

Preferencias de establecimiento de T. malpighiarum –. Los individuos de *T. malpighiarum* crecían fundamentalmente sobre ramillas (93.7% de la población; 238 individuos), únicamente 6.3% de la población (16 individuos) se encontró creciendo en troncos, y no se localizaron individuos creciendo en ramas. Los individuos se encontraron a alturas que iban desde 10 hasta 220 cm (Fig. 3A), y en troncos y ramillas cuyos diámetros iban de 0.22 a 12.48 cm (Fig. 3B). Sin embargo, la distribución de los individuos no fue aleatoria, ni en el grosor de las ramas (χ^2= 949.87, p< 0.0001), ni en la altura de las mismas (χ^2= 199.63, p< 0.0001). Los individuos se establecían principalmente en troncos y ramillas que se encontraban por debajo de 80 cm de altura (Fig. 3A), y que tuvieran menos de 2.22 cm de grosor (Fig. 3B).

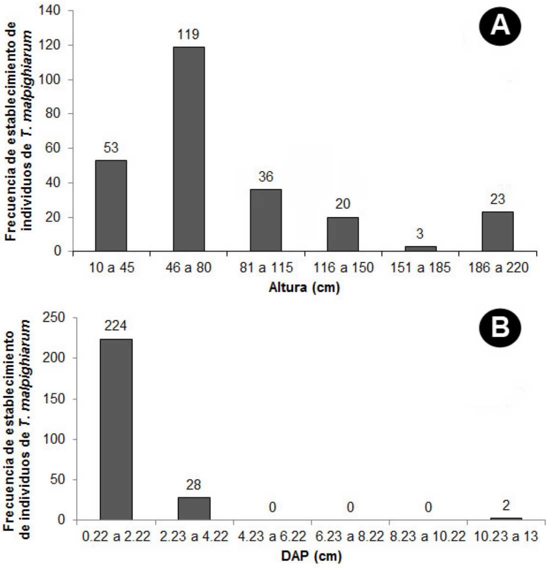

Figura 3. Frecuencia de establecimiento de individuos de *Tetramicra malpighiarum* (Orchidaceae) en ramas a distintas alturas (A) y grosores (B), en el Parque Nacional Desembarco del Granma, Cuba.

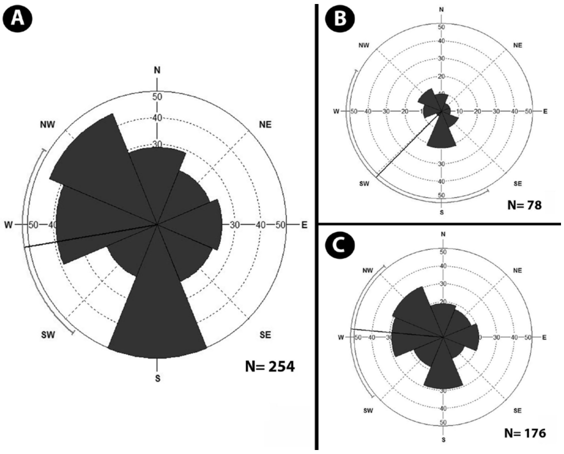

Figura 4. Diagramas de rosa de las orientaciones cardinales de *Tetramicra malpighiarum* (Orchidaceae), en el Parque Nacional Desembarco del Granma, Cuba. A: Población total; B: Individuos inmaduros; C: Individuos adultos. Los pétalos más largos representan las orientaciones más frecuentes. Intervalos de confianza del 95 %.

Por otra parte, se encontraron individuos de *T. malpighiarum* creciendo hacia las ocho orientaciones cardinales, (Fig. 4A), aunque existen diferencias significativas entre ellas (Uniformidad Circular de Rayleigh, z= 3.543, p= 0.029). La población muestra una tendencia a crecer preferentemente con orientaciones sur (19.68 % del total de individuos; 50 individuos) y noroeste (17.72% del total de individuos;

45 individuos), concentrándose en estas direcciones 37.4% de los individuos (95 individuos; Fig. 4A). Esta tendencia numérica también se mantiene cuando se analiza aisladamente el número de individuos inmaduros (sur: 26.92% del total de individuos en esta clase de vida; noroeste: 17.95%; en conjunto: 44.9%; Fig. 4B), aunque no se aprecian diferencias estadísticamente significativas (Uniformidad Circular de Rayleigh, z= 1.172, p= 0.31). En cuanto a los individuos adultos, también se mantiene la tendencia general (sur: 16.48% del total de individuos en esta clase de vida; noroeste: 17.61%; en conjunto: 34.09%; Fig. 4C), pero en este estadio en el número de individuos hacia las diferentes orientaciones si es estadísticamente significativo (Uniformidad Circular de Rayleigh, z= 3.036, p= 0.048).

Discusión. A pesar de que en la población estudiada, el número de individuos de *T. malpighiarum* continúa siendo bajo y se concentran en una área muy reducida, este número de efectivos poblacionales supera en 1.69 % al número aproximado de individuos (aproximadamente 150 individuos) encontrado por García-González *et al*. (2013), en un estudio preliminar desarrollado en este mismo sitio. El mayor número de individuos adultos en la población puede ser indicativo de una población antigua (Chung *et al*. 2011), y estos individuos pueden influir sustancialmente en la reproducción y expansión de la especie, al ser la etapa adulta la más importante en la vida de las orquídeas (Zotz 1998, Winkler & Hietz 2001, Mondragón 2009). Sin embargo, el bajo número de individuos inmaduros puede indicar una población relativamente “regresiva” o “senil” (Hutchings *et al*. 1998), lo cual, unido a su bajo número de efectivos poblacionales de forma general, haría vulnerable a la especie.

No obstante, es importante tener en cuenta, que en el caso de algunas especies de orquídeas, el número de individuos en cada estadio de vida puede ser dinámico a lo largo de los años. Pueden predominar los individuos inmaduros o adultos indistintamente, dependiendo de ciclos naturales de las poblaciones o determinado por factores externos, como el clima (fundamentalmente temperatura y humedad) y modificaciones naturales y/o antrópicas en el hábitat donde se desarrollan, modificaciones que pueden ser tanto perjudiciales como beneficiosas (Larson 1992, Hutchings *et al*. 1998, Olaya-Arenas *et al*. 2011, Mújica *et al*. 2013).

En la población de *T. malpighiarum* fueron mínimas las diferencias en el número de individuos creciendo agregados y creciendo solitarios, y este parámetro es independiente del estadio de vida de los individuos. Sin embargo, el crecimiento agregado es un fenómeno muy común en muchas especies de orquídeas epífitas (Ackerman 1995, Hietz & Hietz-Seifert 1995, Tremblay 1997). Por ejemplo, frecuentemente *I. utricularioides* y *B. cubensis* crecen en parches o en agregación, siendo ellas mismas las especies con las que más comúnmente se agregan (González *et al*. 2007, Raventós *et al*. 2011, García-González & Riverón-Giró 2014).

Aunque se plantea que las epifitas vasculares generalmente presentan bajos niveles de competencia intraespecífica (Zotz & Hietz 2001), lo que podría explicar que los individuos de *T. malpighiarum* crezcan indistintamente solitarios o en agregación, esta afirmación es contradictoria. Aunque las semillas de la mayoría de las especies (incluyendo *T. malpighiarum*) se dispersan por el aire y pueden recorrer largas distancias (Arditti & Abdul Ghani 2000, Hágsater *et al*. 2005), tienen más probabilidades de caer cerca de la planta madre (Machon *et al*. 2003, Trapnell *et al*. 2004, Jersáková & Malinová 2007, Winkler *et al*. 2009, Chung *et al*. 2011), lo que puede representar una ventaja, al tener mayores posibilidades de que encuentren los hongos micorrícicos que necesitan para germinar (Batty *et al*. 2001, Diez 2007).

En general, los patrones de dispersión de las semillas de orquídeas son determinados por la distribución espacial de los adultos, su lluvia de semillas y su sombra de semillas, mientras que el reclutamiento de plántulas depende principalmente de la probabilidad de llegada de las semilla y la disponibilidad de un micrositio adecuado (Nathan & Muller-Landau 2000). Estudios de varias especies de orquídeas terrestres han demostrado que muchas semillas caen a una distancia muy corta de la planta de origen (entre 15 cm y 7 m; Machon *et al*. 2003, Jacquemyn *et al*. 2007, Jersáková & Malinová 2007).

Es importante determinar la distancia promedio de caída de semillas de *T. malpighiarum* y comprobar con estudios a largo plazo, si la distancia de agregación considerada por los autores (≤ 5 cm) es adecuada. A pesar de que los individuos de *T. malpighiarum* crezcan o no agregados entre ellos o con otras especies de epífitas vasculares, su raíces son capaces de extenderse a mayores longitudes, pudiendo entrelazarse con las raíces de otras orquídeas de su misma especie o de otras epífitas vasculares, pudiendo establecer interacciones que probablemente puedan tener implicaciones positivas o negativas para los individuos. Por ejemplo, García-González & Riverón-Giró (2014), refieren que en el caso de *I. utricularioides*, los individuos que crecen en ramillas, agregados con otras plantas de su misma especie o con otras especies de epífitas vasculares, pueden tener mayores ventajas competitivas y mayores posibilidades de supervivencia. Sin embargo, en *T. malpighiarum*, al ser una especie mucho más pequeña, no se pudo observar tan claramente estos posibles beneficios.

Tetramicra malpighiarum manifiesta una fuerte tendencia a preferir como forófito a *M. incana*, una especie endémica de las Grandes Antillas, nativa de Cuba y Jamaica (Acevedo-Rodríguez & Strong 2012). Su nivel de ocupación es mucho mayor que el de las demás especies arbustivas y arbóreas del área, solo seis forófitos fueron de otras especies (30 % del total de forófitos). Esta preferencia de *T. malpighiarum* ya había sido reportada anteriormente por Hernández & Díaz (2000) y Llamacho & Larramendi (2005), que la habían encontrado creciendo exclusivamente sobre *M. incana*, aunque García-González *et al.* (2013) localizaron dos individuos creciendo también sobre *Erythroxylum havanense* Jacq. (Erythroxylaceae). En este estudio se reporta por primera vez a *T. malpighiarum* ocupando otras cinco especies de forófitos (además de *M. incana* y *E. havanense*), lo cual reafirma la rareza de la especificidad de hospedero (Benzing 1990) y la tendencia entre las epífitas a ocupar más de una especie de árbol o arbusto (Martínez-Meléndez *et al.* 2008).

Hipotéticamente se esperaría que las epífitas puedan establecerse en cualquier hospedero indistintamente (Callaway *et al.* 2002), no obstante, los estudios sobre este aspecto son pocos y no concluyentes (Trapnell & Hamrick 2006). Algunos autores han encontrado baja especificidad entre las epífitas y los forófitos que ocupan (Johansson 1974, Ackerman *et al.* 1989, Zimmerman & Olmsted 1992, Ackerman *et al.* 1996), mientras otros han encontrado una fuerte asociación (Went 1940, Frei 1973, Ter Steege & Cornelissen 1989, Tremblay *et al.* 1998, Cedillo *et al.* 2013).

En estudios desarrollados con *Laelia rubescens* Lindl., se encontró asociación entre esta especie y *Samanea saman* (Jacq.) Merr. (Fabaceae), aunque la orquídea puede crecer sobre otros forófitos (Trapnell & Hamrick 2006). En otro trabajo desarrollado con *Dendrophylax lindenii* (Lindl.) Benth. ex Rolfe, los autores encontraron que esta especie muestra una estrategia generalista en la selección del sustrato, pudiendo encontrarse creciendo en 19 especies de forófitos, aunque manifiesta una clara tendencia a preferir tres de ellos (Mújica *et al.* 2010). Igualmente la comunidad de forófitos ocupados por *B. cubensis* es diversa, con 14 especies, pero se observa una preferencia por dos de ellas (González *et al.* 2007). Sin embargo, la especificidad estricta de una especie de orquídea epífita con una especie de forófito es un fenómeno poco común (Tremblay *et al.* 1998). Por ejemplo, se observó que *Quercus desertícola* Trel. (Fagaceae) es el hospedero específico de *Prosthechea* aff. *karwinskii* (Martius) Soto-Arenas & Salazar (Cedillo *et al.* 2013), *Quercus elliptica* Née (Fagaceae) parece ser el único hospedero de *Hagsatera brachycolumna* (L.O. Williams) R. González (Hágsater *et al.* 2005), y Tremblay *et al.* (1998) encontraron que *Lepanthes caritensis* Tremblay & Ackerman solamente coloniza forófitos de la especie *Micropholis guyanensis* (A. DC.) Pierre (Sapotaceae).

Teniendo en cuenta que en el área de estudio las especies de forófitos crecen entremezcladas, se localizan principalmente en el sotobosque y generalmente presentan porte y arquitectura similares (excepto *Plumeria obtusa* y *Guettarda elliptica*, que son árboles pequeños, que puede alcanzar hasta 7.6 m y 6 m de altura respectivamente; Francis 2004, MBG 2015b), la presencia de *T. malpighiarum* sobre estas especies, fundamentalmente sobre *M. incana*, posiblemente estén asociadas a características particulares de estos taxones. Algunas de estas características pueden ser, el tamaño del hospedero, la estructura de copa poco densa y con abundancia de ramas finas, la textura y composición química de la corteza (Ter Steege & Cornelissen 1989, Hietz & Hietz-Seifert 1995, Callaway *et al.* 2002, González *et al.* 2007, Krömer *et al.* 2007), y la presencia probable del/los hongo/s micorrícico/s con los que necesariamente debe asociarse *T. malpighiarum* para germinar y desarrollarse (Otero *et al*. 2004, Trapnell & Hamrick 2006, Jersáková & Malinová 2007, Mújica 2007, Otero *et al*. 2007, Mújica *et al*. 2010, Chung *et al*. 2011).

Otro factor a tener en cuenta en la relación de *T. malpighiarum* con sus forófitos es lo planteado por Llamacho & Larramendi (2005), quienes mencionan que en *M. incana*, la orquídea se asocia con un liquen que crece en la corteza de esta especie, aunque no aclaran la identidad del liquen. Es fundamental realizar estudios que corroboren esta relación, que permitan identificar la especie de liquen y que permitan conocer si este taxón está presente también en las demás especies de forófito hacia las que se ha diversificado *T. malpighiarum*, facilitando su establecimiento en estos sustratos.

A pesar de que se requiere un estudio específico para poder descartar el posible efecto de un sesgo en la disponibilidad de ramas en los forófitos, y entonces poder hablar de preferencias, se puede inferir que existen ciertas tendencias de establecimiento en los individuos de *T. malpighiarum*. Más de 90 % de la población de *T. malpighiarum* crecía en las ramillas, distribución que probablemente esté relacionada con lo planteado por Johansson (1974) y Krömer *et al*. (2007), cuando afirman que las epífitas vasculares tienden a mostrar patrones de distribución vertical en sus forófitos que reflejan su rango de tolerancia a la luz, la humedad y otras adaptaciones ecofisiológicas. Las ramillas es el microhábitat más expuesto del forófito, con abundancia de ramas finas sometidas más directamente a las corrientes de aire, a mayor intensidad luminosa, a mayor desecación y con poca disponibilidad de nutrientes (Hágsater *et al*. 2005). *Tetramicra malpighiarum* probablemente encuentra en este microhábitat las condiciones más adecuadas para su desarrollo, presentando adaptaciones que facilitan su desarrollo y permanencia en este ambiente. Son plantas sin pseudobulbos, ligeras y pequeñas, de hasta 6 cm de alto, tienen hojas (entre 3-7) erectas o falciformes, cilíndricas, suculentas y de cutículas gruesas, que le permiten acumular y conservar agua en sus tejidos, hojas dispuestas en forma de roseta, y raíces delgadas (0.5-1 mm de diámetro) y numerosas (Hernández & Díaz 2000, Llamacho & Larramendi 2005, Ackerman 2014b), características todas típicas de las llamadas orquídeas de ramilla (Hágsater *et al*. 2005). De la biología de este tipo de epífitas aún se desconocen muchos aspectos, planteándose por ejemplo que florecen a muy temprana edad (unos meses o un año después de germinar) y que tienen tiempos generacionales muy cortos (de 1-5 años; Hágsater *et al*. 2005), por lo que se hace imprescindible sistematizar los estudios de *T. malpighiarum* para comprobar estos aspectos de gran relevancia para su conservación.

A pesar de que *T. malpighiarum* se localizó creciendo hacia las ocho orientaciones cardinales, no se encontró un factor específico que permitiera explicar la tendencia contrastante que presentaron los individuos, de ubicarse preferentemente hacia el sur y el noroeste. Este comportamiento poblacional puede ser aleatorio, consecuencia de un factor especifico que es necesario probar, o resultado de una combinación de factores como, la dirección y velocidad predominante de los vientos del área (González *et al*. 2007, Tremblay & Velázquez 2009), las necesidades particulares de luz y humedad de esta orquídea, y/o de la orientación de los sitios donde se encuentran las plantas en los forófitos, en relación con los demás árboles o arbustos que los rodean (Mújica 2007). En Puerto Rico, Tremblay & Velázquez (2009), encontraron que *Lepanthes eltoroensis* Stimson también manifiesta preferencia por crecer en el lado noroeste de los troncos de los árboles que ocupa, probablemente a consecuencia de los constantes vientos que suben del mar Caribe, principalmente vientos del este y del noreste. Sin embargo, para *Ionopsis utricularioides* (Sw.) Lindl., García-González & Riverón-Giró (2014), plantean que probablemente la orientación cardinal de las plantas es completamente aleatoria, siendo esta especie más susceptible a factores como la luz y el grosor de la rama. En el PNDG, los vientos son persistentes durante todo el año, predominantemente del este-sureste al sureste (excepto en temporada invernal, donde se presentan vientos del norte), y a ellos se asocian las mayores velocidades (Palacio *et al*. 2012). En El Guafe, con respecto al mar, la población de *T. malpighiarum* se localiza aproximadamente a 2.5 km en línea recta al sur, a 2.9 km en dirección sureste, a 3.7 km en dirección noroeste, y a 6.5 km en dirección norte, por lo que estos vientos probablemente sean una fuente importante de humedad para la especie durante todo el año.

Es fundamental continuar monitoreando esta especie y desarrollar estudios demográficos a largo plazo, para lograr obtener datos cuantitativos relativos a su tasa de floración, polinización, germinación y mortalidad en el PNDG; datos que permitirán apreciar exactamente el estado actual de la población y su viabilidad. También, es imprescindible emprender estudios similares en la otra población conocida de la especie, al centro de la isla (Hernández & Díaz 2000, Llamacho & Larramendi 2005), vinculados con estudios moleculares, que permitan conocer los niveles de endogamia y variabilidad genética de los individuos. Estos aspectos pueden tener grandes implicaciones en la conservación de la especie (Chung *et al*. 2011), más considerando que ambas poblaciones están aisladas y son muy reducidas (Hernández & Díaz 2000, Llamacho & Larramendi 2005, Ackerman 2014b).

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NOMENCLATURAL AND TAXONOMIC NOTES IN *PHYMATIDIUM GEISELII* (ONCIDIINAE, ORCHIDACEAE)

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Abstract. *Phymatidium glaziovii* is proposed as a new synonym for *P. geiselii*. A lectotype and an epitype are selected for *P. geiselii*. Illustrations and taxonomic discussions are also provided.

Key words: Brazilian endemic species, Caparaó National Park, typifications

Introduction. *Phymatidium* Lindl. belongs to the *Ornithocephalus* group of subtribe Oncidiinae Benth. (Orchidaceae). It was established in 1833 based on two species, *P. delicatulum* Lindl. and *P. falcifolium* Lindl., the former the designated lectotype, which was selected by Angely in 1973. The genus has been extensively studied during recent years. Data on root anatomy (Porembski & Barthlott, 1988), leaf anatomy and seed morphology (Toscano de Brito 1988, 1999), vegetative and floral morphology (Toscano de Brito 2001, Pacek *et al.* 2012), phytochemistry (Williams *et al.* 1994, Reis *et al.* 2006), pollination (Reis *et al.* 2006), phylogeny (Chase & Toscano de Brito 2009, Royer 2013), distribution (Royer, 2013) and reproductive biology (Cabral & Pansarin, 2013) are available in the literature. A taxonomic revision was published by Toscano de Brito (2007). According to this last author, the genus comprises ten species and two varieties, which are mainly restricted to southeastern Brazil with one species recorded from Uruguay and another from Argentina.

While preparing an account of the genus *Phymatidium* in the state of Paraná (Royer *et al.*, 2014), and performing a combined morphological and molecular analysis of the genus (Royer, 2013), the morphologies and identities of *P. geiselii* Ruschi *et al.* and *P. glaziovii* Toscano were investigated and elucidated. These species are discussed here.

Material and methods. This study is based on literature review, on examination of living and spirit collections, and herbarium specimens deposited in the following herbaria: AMES, BHCB, BR, C, HB, MBML, P and UPCB.

Results and Discussion

Phymatidium geiselii Ruschi *et al.*, Bol. Mus. Biol. Mello-Leitão, Sér. Bot. 85: 1. 1976. TYPE: Brazil. Minas Gerais (Espírito Santo, in error): Parque Nacional do Caparaó, Rio São Domingos, Várzea dos Congonhas (Macieira), 16 August 1975, *A. Albuquerque et al. s.n.* (holotype MBML—spirit 6220, lost). **Lectotype designated here**: Augusto Ruschi's illustration, which appeared in Boletim do Museu de Biologia Prof. Mello-Leitão, Série Botânica 85: 3. 1976. **Epitype designated here**: Brazil. Minas Gerais: Parque Nacional do Caparaó, entrada do ES, caminho entre Macieira e Cachoeira do Aurélio, 1915 m, 5 March 2010, *G. Heringer, T.M. Machado & S.B. Reis 295* (BHCB 135957!). Fig. 1–4.
Synonym: *Phymatidium glaziovii* Toscano, Kew Bull. 62: 538. 2007. TYPE: Brazil. Rio de Janeiro, *s.d.*, *A. Glaziou 3633* (holotype BR 658606!, isotypes: C 10016286! P 00436655!), ***syn. nov.***

Phymatidium geiselii was described in 1976 based on a specimen collected in Caparaó National Park, in the state of Espírito Santo, southeast Brazil. The specimen was collected by Antonio Francisco Marins de Albuquerque and later preserved in spirit at MBML.

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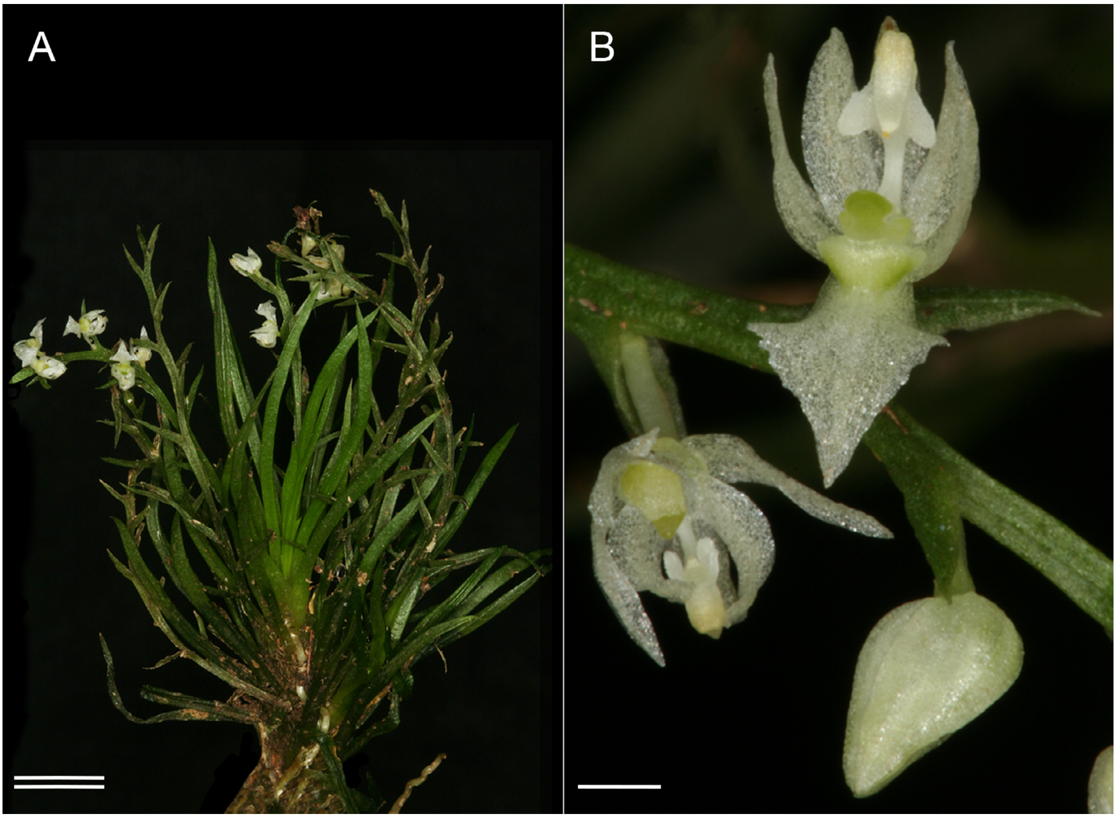

FIGURE 1. *Phymatidium geiselii*. A. Habit. B. Flower. Based on a specimen from Serra dos Orgãos National Park, Teresópolis, Rio de Janeiro (*M. Bolson et al. 505*). Photograph by E. Smidt. Single line = 1 mm. Double line = 1 cm.

The type species of *P. geiselii* has been reported as lost (Toscano de Brito, 2007), and a recent visit to MBML has confirmed this. According to MBML's staff, the specimen MBML 6220 is actually a member of the Bromeliaceae (T. Callot, pers. comm. 2015). Three other collections named as *P. geiselii* exist at MBML. These have no provenance or collectors. According to A. Albuquerque (pers. comm. 2015), collector of the holotype of *P. geiselii* and one of the co-authors of this taxon, the additional specimens might have been collected sometime between 1975 and 1977 and may have the same provenance as the type. Unfortunately, we have been unable to find any further evidence confirming this assumption. These specimens possess immature fruits with flower remnants at their apices. An illustration based on one of them (nr. 29, MBML 6127) was prepared and published in Toscano de Brito (2007, fig. 2A–K). The floral remnants of that specimen are unfortunately somewhat shrunk and distorted, especially the tabula infrastigmatica, as noticed by Toscano de Brito (2007).

Phymatidium geiselii is a small plant up to ca. 7 cm tall. (Fig. 1A; 4L). The roots are glabrous; the spirally arranged, non-articulated leaves are obscurely sheathing and shortly decurrent at base, unifacial, somewhat twisted and variable in cross-section: subtriangular to semiterete (Fig. 4K). The flowers do not open widely (Fig. 1B; 4A–C) and are usually not resupinate, but resupinate and non-resupinate flowers can occur in the same individual and on the same inflorescence; they are white with green tabula infrastigmatica and callus (Fig. 1B). The lip varies from broadly ligulate to broadly lanceolate in outline and obscurely to distinctively three-lobed, with lateral lobes usually placed in the middle; the basal, fleshy, concave callosity is provided with trichome-elaiophores within, and the apex of the lip is usually markedly acuminate (Fig. 4G). The column (Fig. 4H) is curved and obscurely sigmoid in side view, the apex is auriculate and the auricles papillose; the anther is

Figure 2. A. Epitype of *Phymatidium geiselii* proposed here: *G. Heringer, T.M. Machado & S.B. Reis 295* (BHCB). Photograph by A. Toscano de Brito. B. Holotype of *Phymatidium glaziovii* deposited at BR. Reproduced with permission. Copyright: Jardin Botanique Meise.

operculate, narrowly ovate in outline, slightly beaked, and shortly recurved and emarginated at apex (Fig. 4I–J); the tabula infrastigmatica is conspicuous and nose-shaped in side view.

The type specimen of *Phymatidium geiselii* was collected in the Caparaó National Park, which is located in the border of the Brazilian states of Minas Gerais and Espírito Santo, and it is said to have been collected in the Espírito Santo side of the Park. However, places such as Rio São Domingos, Várzea dos Congonhas, and Macieira are located, as far as we can ascertain, in the Minas Gerais portion of the Park. The area where the type specimen of *P. geiselii* was collected has been the subject of an ongoing dispute between these two states and the exact limits are open for discussion (A. Albuquerque, pers. comm. 2015). For the purpose of this article, we accept Minas Gerais as the state where *P. geiselii* has been first collected. The German botanist Alexandre C. Brade (1881–1971) has extensively botanized in this area. According to him (Brade, 1942), localities such as Várzea dos Congonhas may reach ca. 2000 m above sea level.

Phymatidium glaziovii was described by Toscano de Brito (2007) based on a collection by the French botanist Auguste F. M. Glaziou (1828–1906) in the city of Rio de Janeiro. Glaziou did not provide a precise locality or date for his collection. “Rio de Janeiro” certainly refers to what today is the city of Rio de Janeiro and its surroundings. The holotype of *P. glaziovii* is now deposited at BR (Fig. 2B) and an

FIGURE 3. A. Isotype of *Phymatidium glaziovii* deposited at C. Reproduced with permission of the Natural History Museum of Denmark. B. Isotype of *Phymatidium glaziovii* deposited at P. Reproduced with permission of the Muséum National d'Histoire Naturelle (Paris).

isotype is at C (Fig. 3A). More recently, one of us (ALVTB) located and studied an additional duplicate from *Glaziou 3633* at P (Fig. 3B).

The distorted floral segments of the *P. geiselii* specimens at MBML misled Toscano de Brito (2007), who considered *P. geiselii* and *P. glaziovii* distinct species. This author described the fruits of *P. geiselii* as "markedly 3-winged with alternating, usually less pronounced ridges", and used this character, along with lip shape, to distinguish *P. geiselii* from *P. glaziovii*. The latter would have subglobose fruits that are slightly 3-angled in cross section. The type specimens of *P. glaziovii* possess a few scattered, immature fruits that are still in an early stage of development. Therefore, correct size of ridges and wings of fully developed, mature fruits cannot be precisely determined and was misinterpreted in Toscano de Brito's revision. One collection from Rio de Janeiro, *J. Ferreira 1716*, with duplicates in several herbaria, carries fruits, which, although badly flattened in the drying process, are clearly ridged and apparently somewhat winged. The collection *J. Ferreira 1716* was erroneously identified and illustrated as a variant of *P. delicatulum* in Toscano de Brito (2007, fig. 1K–L). It actually refers to *P. geiselii* and this error is corrected here. Likewise, the specimen *O. Ames 108*, from Itatiaia, Rio de Janeiro, was also misidentified as a variant of *P. delicatulum* in Toscano de Brito (2007). It is in fact a specimen of *P. geiselii*.

We also studied eight additional collections, which fit well not only the fruiting specimens of *P. geiselii* illustrated in Toscano de Brito (2007), but also the types of *P. glaziovii*. Five collections come from the state of Rio de Janeiro: Two from the municipality of Itatiaia (*J. Ferreira 1716*, *O. Ames 108*), two from the municipality of Nova Friburgo (*A. Bonnet and E. Caglioni 127, F. Dungs s.n.*), and another from the municipality of Teresópolis (*Bolson et al. 505*). A sixth collection comes from Caparaó National Park (*G. Heringer et al. 295*) in the state of Minas Gerais. This last collection was found in the municipality of Espera Feliz, which is very close (if not the same) to the type locality of *P. geiselii*. Two others come from Domingos Martins, state of Espírito Santo. They were based on cultivated material and their actual provenance cannot be correctly ascertained. Study of all these additional specimens, including living, spirit, and herbarium material, has proved that *P. geiselii* and *P. glaziovii* are

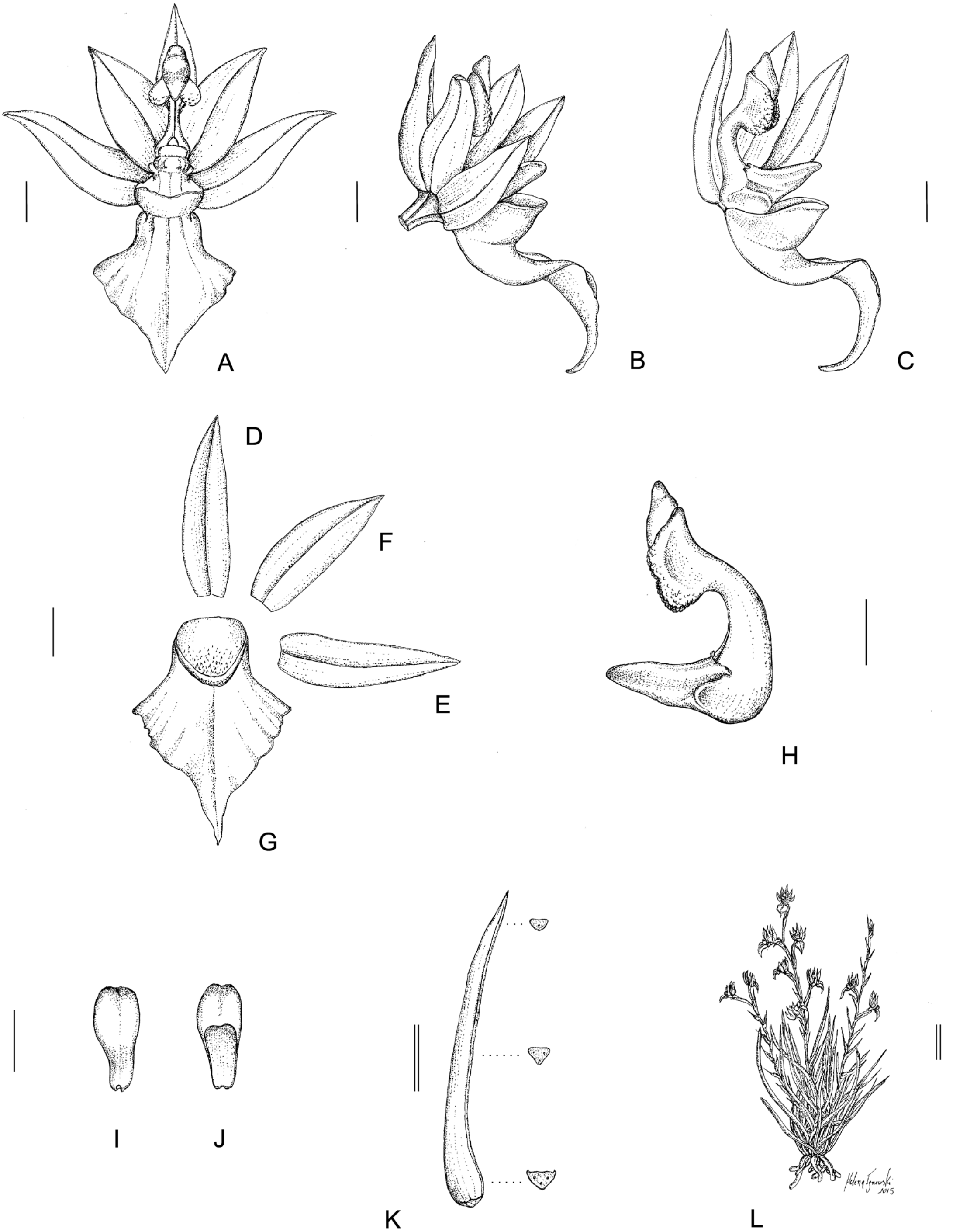

Figure 4. *Phymatidium geiselii*. A. Flower in front view. B. Flower in side view. C. Flower in side view, petal and proximal lateral sepal removed to show column and lip callus. D. Dorsal sepal. E. Lateral sepal. F. Petal. G. Lip. H. Column in side view. I. Anther in front view. J. Anther from behind. K. Leaf, transverse sections shown in approximate scale. L. Habit (*M. Bolson et.al. 505*, UPCB—spirit). Illustration by Helena Ignowski. Single line = 1 mm. Double line = 1 cm.

With exception of the collections from Domingos Martins (*R. Kautsky s.n.*; *F. Dungs s.n.*) and the type specimens of *P. glaziovii* collected in Rio de Janeiro, which unfortunately lack precise location data and altitude range, the material studied seems to indicate that *P. geiselii* grows on higher altitudes up to 2200 m.

In the absence of an actual specimen, the only original, extant materials of *P. geiselii* are the published description and illustration in the protologue. The illustration that appeared in the protologue is here designated as the lectotype. However, this illustration is crude and misleading. It cannot be used alone to recognize this species. Therefore, we select as an epitype the specimen *G. Heringer et al. 295*, which is deposited at BHCB (Fig. 2A). This specimen was collected in Caparaó National Park, the same locality as the type. The selection of this collection against the three spirit specimens at MBML (6125, 6126, 6127), previously mentioned here, is justified as these have no collection data and are already in fruiting stage, bearing only floral remnants.

Additional material examined: Brazil. Espírito Santo: Domingos Martins, flowered in cultivation, July 1969, *R. Kautsky s.n.* (HB!); same locality, flowered in cultivation, without date, *F. Dungs s.n.* (HB!). Rio de Janeiro: Itatiaia, vicinity of Macieiras, 1960 m, 7 Jan. 1929, *J. Ferreira 1716* (US!, S!, AMES!, G!, F!); Itatiaia, trail to meterological station, 25 Dec. 1915, *O. Ames 108* (AMES!); Nova Friburgo, Pico da Caledônia, 2200 m, 9 May 2012, *A. Bonnet and E. Caglioni 127* (UPCB!); Nova Friburgo, 26 March 1967, *F. Dungs s.n.* (HB!); Teresópolis, Parque Nacional da Serra dos Órgãos, Trilha Pedra do Sino, entre os abrigos 3 e 4, 1979 m, 23 March 2014, *M. Bolson et. al. 505* (UPCB!). Without locality and collector: number 26 (MBML—spirit 6125!); number 27 (MBML—spirit 6126!); number 29 (MBML—spirit 6127!).

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MORPHOMETRIC ANALYSIS OF *VANILLA* SEEDS (ORCHIDACEAE) BY MICROSCOPIC TECHNIQUES

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Abstract. Seed morphometric characters of four Colombian *Vanilla* species (*Vanilla odorata*, *Vanilla calyculata*, *Vanilla oroana* and *Vanilla rivasii*) were compared by using both light and electron microscopy. Seeds collected from mature fruits were studied by optical microscopy to characterize coat color, length and width of seeds in *Vanilla* species. Scanning electron microscopy (SEM) was used to characterize the seed surface and cell shape in these species. There were significant differences in length, width and length/width ratio. *Vanilla oronana* had the largest seeds (431 ± 17 µm long and 312 ± 27 µm wide) and differed from the other species by its dark brown seed coat and the presence of protrusions. *Vanilla odorata* was the species with smallest seeds (310 ± 15 µm long and 222 ± 18 µm wide) and light brown seed coat. Seeds of all studied species had smooth coat surfaces and were of oval to ellipsoid in shape. The characters evaluated in this work could serve as taxonomic diagnostic markers in *Vanilla* and these could explain important aspects of the seed biology of this genus.

Resumen. Se caracterizó y se comparó la morfometría de las semillas de cuatro especies de vainillas colombianas (*Vanilla odorata*, *Vanilla calyculata*, *Vanilla oroana* y *Vanilla rivasii*). Las semillas colectadas a partir de frutos maduros fueron estudiadas por microscopía óptica para caracterizar el color, la longitud y el ancho de las semillas. Además, por medio de microscopía electrónica de barrido (MEB) se identificaron las características de la superficie de la testa. Existieron diferencias significativas en la longitud, el ancho y en la relación longitud/ancho entre las especies. *Vanilla oronana* tuvo las semillas más grandes (431 ± 17 µm de largo y 312 ± 27 µm de ancho) y difirió de las otras especies por presentar la coloración parda en tono más oscuro y por la presencia de protuberancias en la testa. *Vanilla odorata* fue la especie con semillas más pequeñas (310 ± 15 µm de longitud y 222 ± 18 µm de ancho) de color pardo claro. En general, las semillas presentaron la testa lisa y una forma elipsoide. Los caracteres evaluados en este trabajo podrían servir como marcadores taxonómicos en *Vanilla* y podrían explicar aspectos importantes de la biología de las semillas de este género.

Key words: Colombia, morphology, traits, orchids, *Vanilla*, SEM

Introduction. Most orchid seeds are smaller than 2.0 mm in length with small embryos and have no endosperm (Baskin & Baskin 1998). Orchid seed length varies from 0.05 to 6.0 mm and there is a broad variation in the seed coat reticulation patterns, shape, size and color (Arditti & Ghani 2000). In many species of Orchidaceae, seeds have hyaline seed-coat with visible embryos at the dissection microscope resolution without staining. Nevertheless, some genera such as *Apostasia, Cyrtosia, Epistephium, Galeola, Neuwiedia, Palmorchis, Selenipedium* and *Vanilla* have sclerotized seed coat which does not allow embryo visualization (Molvray & Kores 1995).

Several studies has been performed on the

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TABLE 1. Source localities of *Vanilla* spp. seeds.

Species	Locality	Life Zone*	Elevation m.a.s.l	Department
Vanilla oroana	El Charco	Tropical wet forest	2	Nariño
Vanilla rivasii	Buenaventura	Tropical wet forest	7	Valle del Cauca
Vanilla calyculata	Atuncela	Tropical dry forest	800	Valle del Cauca
Vanilla odorata	Ríofrío	Tropical dry forest	1122	Valle del Cauca

* According to the classification by Holdridge (1947)

morphology of native Californian orchids including *Goodyera, Piperia, Platanthera* and *Spiranthes* species (Healey, Michaud & Arditti, 1980), *Paphiopedilum* and *Cypripedium* (Arditti *et al.* 1979), and *Calypso, Cephalanthera, Corallorhiza* and *Epipactis* (Arditti, Michaud & Healey, 1980). These studies suggest that variations in size seed, shape, color and patterns of the seed coat cells have served as taxonomic and/or phylogenetic markers on seeds of native California orchids and related species (Barthlott 1976, Arditti *et al*. 1979, Arditti *et al*. 1980, Healey *et al.* 1980).

Additionally, seed morphology may affect important biological and ecological aspects such as seed dispersion mechanisms. Most orchid seeds have traits that favor long distance wind dispersal due to their small size, shape and large air space (Arditti & Ghani 2000). On the other hand, the genera with lignified seed coats have contrasting dispersal mechanisms associated with endozoochory. For example, avian seed dispersal was reported in a mycoheterotrophic orchid *Cyrtosia septentrionalis* (Rchb.f.) Garay (Nakamura & Hamada 1978, Suetsugu *et al.* 2015). Additionally, it have been suggested that seeds of *Vanilla planifolia* Andrews are dispersed by birds (Arditti & Ghani 2000). Also, Schlüter, Soto-Arenas & Harris (2007) suggested that *Vanilla* fruits show a typical bat dispersal syndrome, being darkly colored, pendulous, and strongly scented. In all these cases, the lignified seed coat probably protects the seeds as they pass through the digestive tracts of dispersal animals.

Vanilla Mill is a genus with nearly 110 species with pantropical distribution (Purseglove *et al*. 1981). *Vanilla* extract is an important fragrant and flavor natural product, obtained from the curated fruit of the hemiepiphyte tropical orchid *Vanilla planifolia* and produced mainly in Madagascar and Indonesia. In Colombia, *Vanilla* species are distributed below 2000 m in all natural regions (Caribbean, Andean, Pacific, West plains and Amazon; Ordoñez-Osorio *et al.* 2011). Soto Arenas & Dressler (2010) reported 11 species; but lately, Molineros-Hurtado, González, Flanagan and Otero (2014) described a new species from the Pacific coast. More recently, the Colombian Catalog of Plants and Lichens reported 15 *Vanilla* species (Bernal *et al.* 2015).

Despite the growing interest about *Vanilla* cultivation, little is known about their ecology, and the seed morphometric studies of *Vanilla* species are scarce (Table 1). Fruit and seed trades of four *Vanilla* species from Mexico using light microscopy were reported showing morphological variation among species and even clones (Reyes-López *et al.* 2014). One species (*V. planifolia*) was studied using scanning electron microscopy (Barthlott *et al.* 2014). Developing seed morphometric studies of *Vanilla* species could be useful for dispersal studies, helping in the seed identification on fecal samples of the disperser potentials.

The potential use of seed morphology to support taxonomic studies has not been taken into account in the taxonomic treatment of *Vanilla* species. A recent revision of *Vanilla* for Central America includes 15 species, but only two species have information about their seeds: *V. martinezii* Soto-Arenas, and *V. trigonocarpa* Hoehne (Soto-Arenas & Dressler, 2010). The aim of this study was to characterize the seed morphometry of four Colombian *Vanilla* species, using light microscopy and scanning electron microscopy.

Materials and Methods. Seeds from mature fruits of four Colombian *Vanilla* species: *Vanilla calyculata* Schltr; *V. odorata* C.Presl; *V. oroana* Dodson; and *V. rivasii* Molineros *et al.* were collected from various locations of Colombia (Table 1). Seeds at the

Table 2. Length and width average of *Vanilla* seeds.

Species	**Mean Lenght** (µm)*	**Mean width (µm)***	**Lenght/width Ratio**
V. oroana	431.24 ± 17.24 a	312.12 ± 27.30 a	1.39±0.12 b
V. calyculata	393.41 ± 18.30 b	320.82 ± 14.78 a	1.23±0.06 a
V. rivasii	339.56 ± 15.97 c	228.21 ± 14.26 b	1.49±0.10 c
V. odorata	310.74 ± 15.62 d	222.10 ± 17.92 b	1.41±0.12 b

*The mean value ± standard deviation (±SD) is reported. Different letters indicate significant differences (P≤0.05) among species after a Tukey test.

Table 3. Reported seed size in others studies for *Vanilla* spp.

Specie	**Length (µm)**	**Width (µm)**	**Reference**
V. inodora	292.02	151.90	Reyes-López *et al.,* 2014
V. pompona	286.20	183.47	Reyes-López *et al.,* 2014
V. insignis	323.51	267.88	Reyes-López *et al.,* 2014
*V. planifolia**	286.08	232.17	Reyes-López *et al.,* 2014
V. planifolia	250	220	Bouriquet, 1947
V. trigonocarpa	600	-	Soto-Arenas & Dressler, 2010
V. planifolia	500	-	Barthlott *et al.*, 2014

*Average for 10 accessions

midsection of the fruit of at least two fruits per species were extracted and washed following Knudson protocol (Knudson 1950). Seeds were deposited in 5 mL Eppendorf tubes and dehydrated in 3 mL of absolute ethanol and shacked with ultrasound twice for five minutes. For optic microscopy, seeds were mounted over slides with gelatine-glycerine and sealed with paraffin. Slides were observed in an optical microscope (NIKON ECLIPSE NI-U90) at the Image laboratory at Universidad del Valle, Cali, Colombia. Seed length and width measurements, were obtained using a microscope imaging software (NIS-Elements Br) to 40 seeds per species. Additionally, a dissection microscopy (SEM; NIKON SMZ 800) was used for describing the seed color. For detailed observation of seed coat traits, cleaned seeds were dried at room temperature for 24 hours, then seeds were fixed on carbon tape and covered with gold-palladium for 80 seconds. Samples were observed using a SEM (HITACHI S4800) at the Image laboratory at Universidad de Valencia, Valencia, Spain. Statistical analysis (Descriptive statistics, ANOVA and Tukey test) of length, width and length/width ratio were performed using Statistica 7.0 and R 3.1.1 software. Comparison among means were done considering statistically significant differences if p<0.05.

Results. There were significant differences in seed length ($F_{3,\ 156}$ = 410.36, p<0.005), width ($F_{3,156}$ = 297.84, p<0.005) and length/width ratio ($F_{3,\ 156}$ = 48.35, p<0.005) among species. For seed length, the tukey test (Table 2) indicated that all species were different. *Vanilla oroana* had the largest seeds (431 ±17 µm x 312±27 µm), while *V. odorata* had the smaller ones (310±15 µm x 222±18 µm). For seed width, there were two groups significantly different from each other; the first form by *V. oroana* (312.12 ± 27.30) and *V. calyculata* (320.82 ± 14.78) and the second included *V. rivasii* (228.21 ± 14.26) and *V. odorata* (222.10 ± 17.92). The length/width ratio of *V. calyculata* (1.23±0.06) was close to one as a consequence of the circular shape pattern, while in *V. rivasii* that had ellipsoid seeds, its ratio was higher than one (1.49±0.10)-On the other hand, *V. oroana* (1.39±0.12) y *V. odorata* (1.41±0.12), which had an intermediate shape between spherical and ellipsoid, don't showed differences (Table 2).

Microscopic images of *V. calyculata* (Fig. 1), *V. oroana* (Fig. 2), *V. odorata* (Fig. 3) and *V. rivasii* (Fig. 4) are presented. *Vanilla calyculata*, *V. odorata* and *V. rivasii* had an oval-planar corpus (Figs. 1, 3 y 4, respect.), while *V. oroana*, had an oval-globular corpus with protuberances that gave an irregular appearance

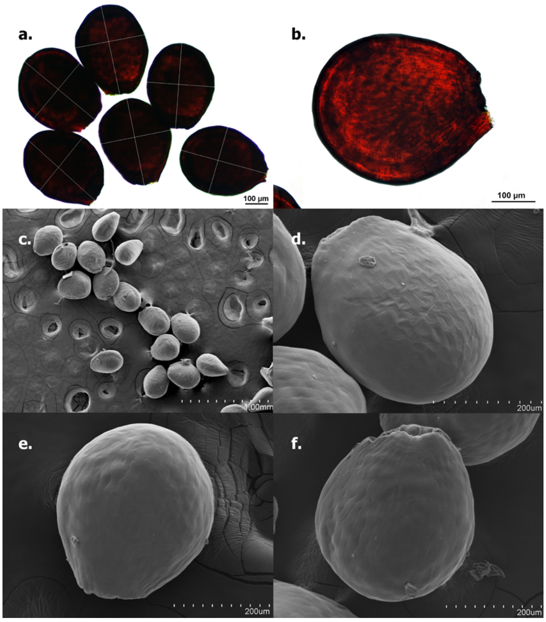

FIGURE 1. Seeds of *Vanilla calyculata*. a–b. Optic microscopy images. c–f. Scanning electron microscopy (SEM) images.

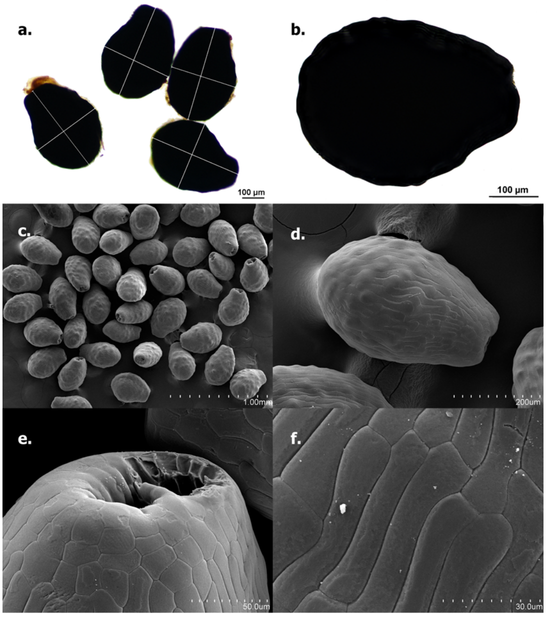

FIGURE 2. Seeds of *Vanilla oroana*. a–b. Optic microscopy images. c–f. Scanning electron microscopy (SEM) images.

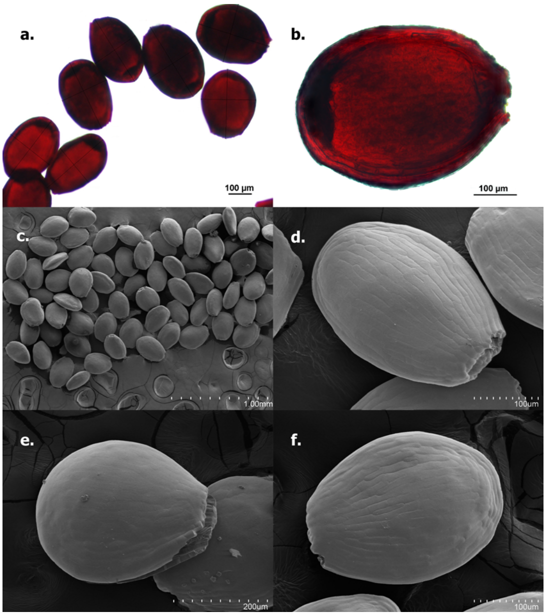

FIGURE 3. Seeds of *Vanilla odorata*. a–b. Optic microscopy images. c–f. Scanning electron microscopy (SEM) images.

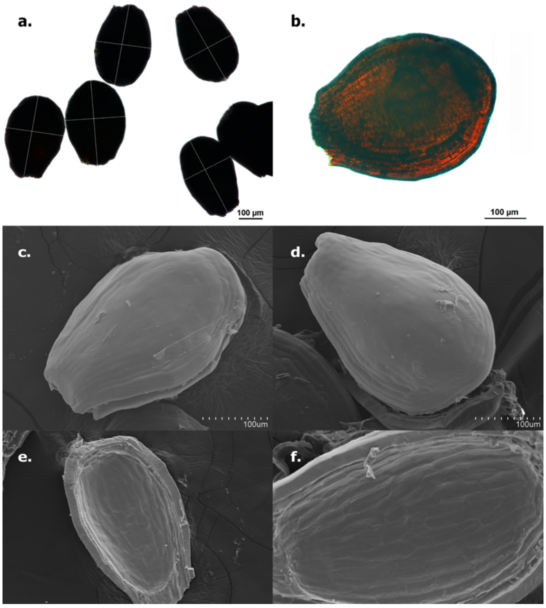

FIGURE 4. Seeds of *Vanilla rivasii*. a–b. Optic microscopy images. c –f. Scanning electron microscopy (SEM) images.

(Fig. 2c-d). The cells of the seed coats of the four studied species were smooth, with a longitudinal aperture and without reticulation patterns. In all studied species, the cells around the micropile are square or polygonal, contrasting with the rectangular shape of the cells in the central part of the seed (Figs. 1d, 2d, 3d, 4d). Relative to the seed color, all species had brown seeds; however, a tonality variation was observed. The darkest seeds were those of *V. oroana* and the lightest ones were from *V. odorata* (Figs. 1a-b, 2a-b, 3a-b, 4a-b).

Discussion. We found a seed morphological variation among *Vanilla* studied species that is consistent with other comparative studies (Table 3). The seeds of the Colombian *Vanilla* species were within the known seed size range. The smallest reported *Vanilla* seeds are those from *V. planifolia* (250 ± 80 µm x 220 ± 60 µm; Bouriquet 1947). However, Barthlott *et al.* (2014) reported seed length of 500 µm for *V. planifolia.* Thus, it is necessary to conduct rigorous studies to evaluate intraspecific variation. Other studies with mexican vanillas have reported that *Vanilla* species with the biggest seeds was *V. insignis* Ames (323.51 µm x 267.99 µm), while *V. inodora* Schiede had the smallest seeds 292.02 µm x 151.90 µm (Reyes-López *et al.* 2014; Table 3). Taking into account of color of the seeds, *Vanilla* species have been reported as dark-brown (Knudson 1950; Hernández-Hernández 2011). In our study we found that there is variation in the tonality from light to dark -brown, close to black among species. Given the kwon variation in *Vanilla* seed size, this parameters show the potential for *Vanilla* taxonomy. Nevertheless, it is necessary more studies on *Vanilla* seeds to cover the nearly 110 described species.

Vanilla seed morphology could be useful in dispersal mechanisms studies. The *Vanilla* dispersion mechanisms are not well known; however, some studies have suggested a possible dispersion through endozoochory, mainly by birds (Nakamura & Hamada 1978, Barthlott *et al.* 2014). In addition, it has been suggested that euglossinae bees disperse *Vanilla* seeds due to the collection of vanillin by the male of this species for female attraction (Soto-Arenas & Dressler 2010). Identification of *Vanilla* seeds from animal feces may shed light on this old and interesting question.

After dispersion, seeds require developing into the seedling stage, and morphological trades recognized in seeds may be related with the germination process. The thickness of the seed coat could be involved in dormancy process and development of seed banks (Baskin & Baskin 1998). Alternatively, it could help the seeds to survive passing through an animal's digestive system during seed dispersion as in other seeds with lignified seed coat (Traveset *et al.* 2007, Suetsugu *et al*. 2015). As with other orchids, *Vanilla* seeds require mycorrhizal fungi for germination under field conditions (Porras-Alfaro & Bayman 2007). In Colombia, *Ceratobasidium* and *Tulasnella* fungi were reported as mycorrhizal in *Vanilla* spp. (Mosquera-Espinosa *et al.* 2010, Alomía 2014).

Regarding the techniques used in this study, combining the optical microscopy with the use of permanent slides allowed to observe the coat color and take easily morphometric measurements, all at low cost. On the other hand, images in SEM at high resolution allowed the observation of the external structures of seeds, highlighting the smooth ornamentation in all studied species. Therefore, both approaches are complementary for a complete characterization of the seeds. Given the economic importance of *Vanilla*, this study reports new data about morphometric characteristics that may be useful for future taxonomic and ecological studies. Additionally, the techniques here reported could be applied for determining the species of *Vanilla* used on commercial vanilla products.

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EPIDENDRUM LASIOSTACHYUM (ORCHIDACEAE): A NEW COLOMBIAN SPECIES OF THE *EPIDENDRUM MACROSTACHYUM* GROUP

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ABSTRACT: In *Epidendrum*, considered a monophyletic genus, diverse groups can be recognized by their similar vegetative and floral characteristics. The revision of one of these groups, the *E. macrostachyum* group, recognized by the monopodial habit, with sub-apical branching, apical, erect inflorescence, non-resupinate, fleshy flowers, and entire lip, embracing the column, pubescent at least at the base, has led to the description of several new species, including a new species from Colombia that is here described and illustrated. The species is similar to *Epidendrum microrigidiflorum*, but differs in the inflorescence (distichous, 6 flowered vs. racemose, 8-16 flowered), the shape (trullate vs. widely rhombic) and ornamentation of the lip (sericeous vs. minutely papillose), and the lack of calli on the disc of the lip (ecallose vs. bicallose). In addition, a key to the 41 species of the group is provided.

RESUMEN: En *Epidendrum,* siendo considerado un género monofilético, se pueden reconocer diversos grupos de especies con características vegetativas y florales similares. La revisión de uno de estos grupos, el grupo *E. macrostachyum*, el cual se reconoce por su hábito monopodial con ramificaciones subapicales, inflorescencia apical, erecta y flores no resupinadas, carnosas con el labelo entero abrazando la columna y pubescente por lo menos en la base, ha permitido la descripción de varias especies nuevas, entre ellas la nueva especie que se describe y se ilustra aquí. Es una especie colombiana similar a *Epidendrum microrigidiflorum*, sin embargo difiere por la inflorescencia (dística, 6 flores vs. racemosa, 8-16 flores), en la forma (trulado vs. anchamente rómbico) y ornamentación del labelo (densamente seríceo vs. diminutamente papiloso) y en la ausencia de callos en el disco del mismo (ecalloso vs. bicalloso). Se presenta además una clave de las 41 especies del grupo.

KEY WORDS: Colombia, Orchidaceae, *Epidendrum,* new species, *Epidendrum macrostachyum* group

Introduction. The genus *Epidendrum* L. was described by Linnaeus in 1763. It originally included most of the tropical epiphytic orchids, presently placed in other genera of the Orchidaceae family such as *Arachnis* Blume, *Brassavola* R.Br., *Brassia* R.Br., *Prosthechea* Knowles & Westc., among others. The genus was conserved by the Botanical Congress of 1930 with *Epidendrum nocturnum* Jacq. chosen as the conserved type (Sprague 1929). In 2005 Hágsater and Soto calculated that *Epidendrum* included over 1500 species, distributed from southern United States to northern Argentina. Today we believe that the number is closer to 2400, of which over 1100 having been recently illustrated and described mostly in the series Icones Orchidacearum (Hágsater & Salazar 1993; Hágsater *et. al.* 1999; Hágsater & Sánchez 2001, 2004, 2006, 2007, 2008, 2009, 2010, 2013, 2015). It is considered one of the largest genera of Neotropical orchids, and includes terrestrial, epiphytic or lithophytic plants that grow in different types of vegetation ranging from tropical forest, dunes and scrubs to Andean páramos (Hágsater & Soto 2005; Chase *et al.* 2015). The classification of *Epidendrum* has been a difficult task for numerous authors due to the great variation of floral and vegetative characteristics, as well as the similarity of herbarium specimens. There

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have been various attempts throughout the years to separate numerous species included in the genus. Thus various authors have proposed some natural groups in *Epidendrum* as separate genera, as it the case of *Epidanthus* L.O.Williams (Williams 1940), or more recently *Takulumena* Szlach. (Szlachetko *et al.* 2006; Szlachetko *et al.* 2014), based on characteristics that seem simple, but which appear repeatedly in various groups of otherwise not closely related species, such as the number of pollinia, or the position of the inflorescence on the stem. With some 300 species sequenced in its DNA, the genus is monophyletic though diverse groups and sub-groups can be recognized (Hágsater & Soto 2005). Among these groups, the *E. macrostachyum* group with more than 41 recognized species is a difficult one because, the plants and flowers are all very similar at first sight, though careful study of vegetative and floral characteristics, as well as their distributional range, facilitates their identification, some species are sympatric.

They are distributed from Costa Rica to Bolivia and from 670 to 3600 m elevation. It is characterized by having monopodial plants with sub-apical branching from a primary stem, the inflorescence is erect and generally racemose (occasionally distichous), with variously colored, fleshy flowers, of different sizes, and the lip entire and generally more or less pubescent, at least near the base. Due to the lack of understanding of the group, authors such as Dunsterville and Garay (1972) reduced many species (*E. bangii* Rolfe, *E. chondrochilum* F.Lehm. & Kraenzl., *E. coordinatum* Rchb.f., *E. dermatanthum* Kraenzl., *E. magnibracteum* Kraenzl. *E. rigidiflorum* Schltr., *E. rostrigerum* Rchb.f., *E. xylostachyum* Lindl.) from Costa Rica, Colombia, Ecuador, Peru and Bolivia to synonyms of *Epidendrum macrostachyum* Lindl. (non *Epidendrum macrostachya* Thouars = *Beclardia macrostachya* (Thouars) A. Rich).

Detailed revision of numerous herbarium specimens, and photographs of live material, as well as personal field experience of the first author has led us to propose that all these the above mentioned names correspond to discrete entities (Santiago & Hágsater 2013, 2015a, b, c, d, e). In addition, a number of new species from Venezuela, Colombia, Ecuador and Peru have been recently added to the *E. macrostachyum* group: *E. borealistachyum* Hágsater, E.Santiago & C.Fernández (Hágsater *et al.* 2015) *E. brachyoothistachyum* Hágsater & E.Santiago (Hágsater & Santiago 2015a), *E. brachystelestachyum* Hágsater, E.Santiago & Reina-Rodr., (Hágsater *et al.* 2015), *E. cardiostachyum* Hágsater & E. Santiago (Hágsater & Santiago 2015b), *E. deltastachyum* Hágsater & E.Santiago (Hágsater & Santiago 2015c), *E. erikae* Hágsater & E.Santiago (Hágsater & Santiago 2015d), *E. macphersonii* Hágsater & E.Santiago (Hágsater & Santiago 2015e), *E. munchiquense* Hágsater, E. Santiago & García-Revelo, (Hágsater *et al.* 2015), *E. notostachyum* Hágsater & E.Santiago (Hágsater & Santiago 2015f), *E. odontostachyum* Hágsater & E.Santiago (Hágsater & Santiago, 2015j), *E. porphyrostachyum* Hágsater & E.Santiago (Hágsater & Santiago 2015k), *E. puracestachyum* Hágsater & E.Santiago (Hágsater & Santiago 2015l), *E. recurvitepalostachyum* Hágsater & E.Santiago (Hágsater & Santiago 2015m), *E.sarcostachyum* Hágsater, E.Santiago & E. Becerra, (Hágsater *et al.* 2015), *E.sigmostachyum* Hágsater, E.Santiago & D.Trujillo (Hágsater *et al.* 2015), *E. stenobractistachyum* Hágsater & E.Santiago (Hágsater & Santiago 2015n), and *E. sumacostachyum* Hágsater & E.Santiago (Hágsater & Santiago 2015o). The species described below is another example of such new entities.

Material and methods. A revision of nearly 700 herbarium specimens from numerous different collectors, years and countries including Venezuela, Costa Rica, Colombia, Ecuador, Peru and Bolivia was done. The specimens mostly shelved under *Epidendrum macrostachyum* are deposited in herbaria including AAU, AMO, AMES, C, CAUP, COL, CUVC, CUZ, F, G, GB, HPUJ, HUA, JAUM, K, L, LE, LOJA, MO, MOL, QCA, QCNE, RENZ, S, SEL, U, US, USJ, USM, VALLE, VEN, NY and W. For specimens on loan floral segments were drawn using a camera lucida mounted on a dissecting microscope. For selected specimens complete illustrations including vegetative and reproductive traits (e.g. floral segments, lip and nectary ornamentation) were prepared. Numerous photographs taken in the field and provided by numerous photographers and on internet were registered and analyzed. Eric Hágsater has travelled extensively in Ecuador, Colombia and

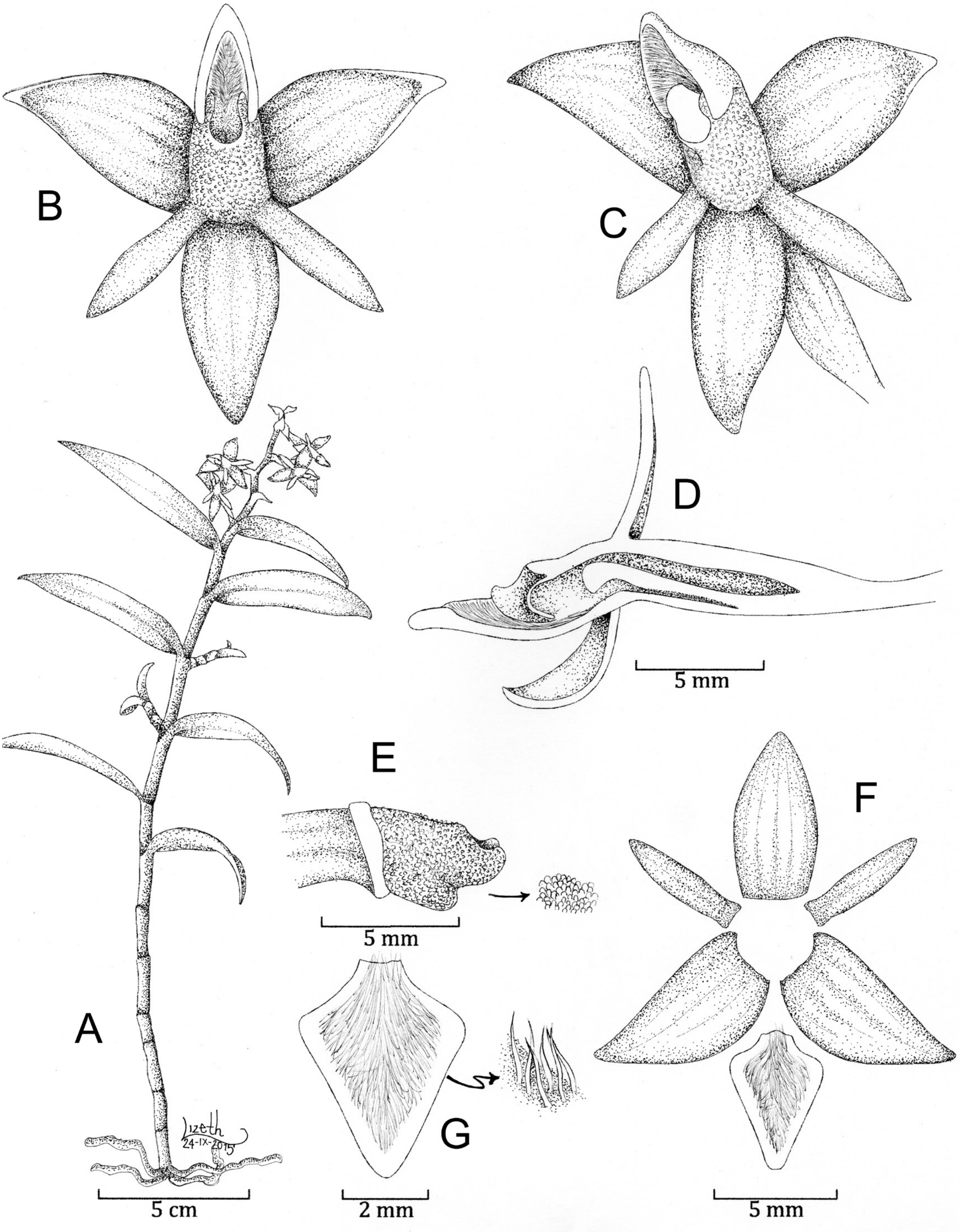

FIGURE 1. *Epidendrum lasiostachyum*. A. Habit. B. Flower, frontal view. C. Flower, lateral view. D. Flower, longitudinal section. E. Column details. F. Dissected perianth. G. Lip details. Drawn by Lizeth Rodríguez M. from the holotype (*L. Rodríguez-Martínez 254*).

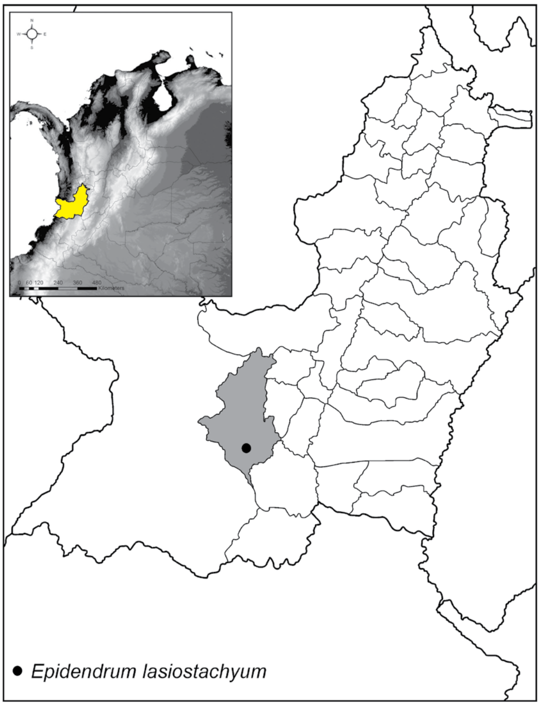

Figure 2. Distribution map of the species *Epidendrum lasiostachyum* in Colombia.

Peru between 1970 and 2016, collecting and studying the genus *Epidendrum*, photographing and collecting numerous specimens.

Lizeth Rodríguez Martínez, a student of agronomy at the Universidad Nacional de Colombia, campus Palmira, made several field trips during 2014 in the Department of Valle del Cauca, Colombia, discovering the population of the species here proposed and described. Individual plants were photographed, flowers were preserved in alcohol, and an illustration prepared (Fig. 1), prior to pressing and desiccation of one specimen and deposited at COL (holotype). Phenology data were recorded in the field. Morphological studies were carried out using a Zeiss stemi 2000 stereomicroscope. A distribution map was produced using ArcMAP (Fig. 2).

Taxonomic treatment

Epidendrum lasiostachyum Rodr.-Martínez, Hágsater & E.Santiago, *sp. nov.* (Fig. 3).

TYPE: Colombia. Valle del Cauca: Municipio Dagua, Corregimiento San José del Salado, relicto de bosque muy húmedo, epífita de árbol de *Tibouchina* sp., 1800-1900 m, 21 November 2014, *Lizeth Rodríguez-Martínez 254* (holotype: COL!).

Diagnosis: The species is similar to *Epidendrum microrigidifloum* Hágsater (Hágsater 2006), but the plants are smaller, 25-30 cm tall (vs. 60-100 cm tall) with a distichous, 6-flowered inflorescence (vs. racemose and 8-16-flowered); petals small, 4-5 mm long (vs. 6.8 mm long), and the lip is trullate, densely sericeous (vs. scarcely papillose), and ecallose (vs. bicallose).

Epiphytic, monopodial, caespitose, erect *herb*, 25–30 cm tall. *Roots* 1.5–2.0 mm in diameter, filiform. *Stems* 20–25 × 0.3–0.5 cm, cane-like, terete, erect, branching when mature, base covered by sheaths 1.2–1.6 cm long, tubular, non-foliar, scarious. *Leaves* 7, distributed throughout the stems, articulate to the foliar sheath, spreading with respect to the stem, similar in size and shape, green, concolor; sheaths 1.5–2.5 cm long, tubular, minutely striated, rugose, pale green; blade 4.5–6.0 × 0.8–1.0 cm, lanceolate, apex acute, margin minutely serrate. *Inflorescence* 6 cm long, apical, developing from mature stems, distichous, erect, laxly few-flowered; peduncle 5–7 × 1.5–2.0 mm, terete, thin, straight; rachis 5.0–5.5 × 0.1–0.2 cm, slightly flexuous, greenish. *Floral bracts* 5–7 × 2 mm, much shorter than the ovary, triangular-lanceolate, apex acute, margin slightly serrate, embracing, perpendicular to the rachis. *Flowers* 6, simultaneous, non resupinate, distichous, secund, distributed along the rachis; sepals and petals yellow, lip pale yellow, column greenish yellow with the apex purple; without fragrance. *Ovary* 15 × 2 mm, terete, thin, striated, lime green. *Sepals* 7–8 × 3–4 mm, free, spreading, fleshy, narrowly ovate, apex acute, 5-veined, margin entire, spreading; lateral sepals oblique, slightly falcate. *Petals* 4–5 × 1.5 mm, spreading, free, oblong-oblanceolate, apex acute, 1-veined, margin entire, spreading. *Lip* 7 × 4 mm, united to the column, entire, trullate, the base widely cuneate, apex narrowly rounded, embracing the column in natural position without covering it; ecallose, densely sericeous, the trichomes covering the entire surface of the lip except for the margin, and reclining towards the nectary. *Column* 4–5 mm long, short, thick, slightly arched at the base, apex deflexed, the surface minutely papillose. *Clinandrium* reduced,

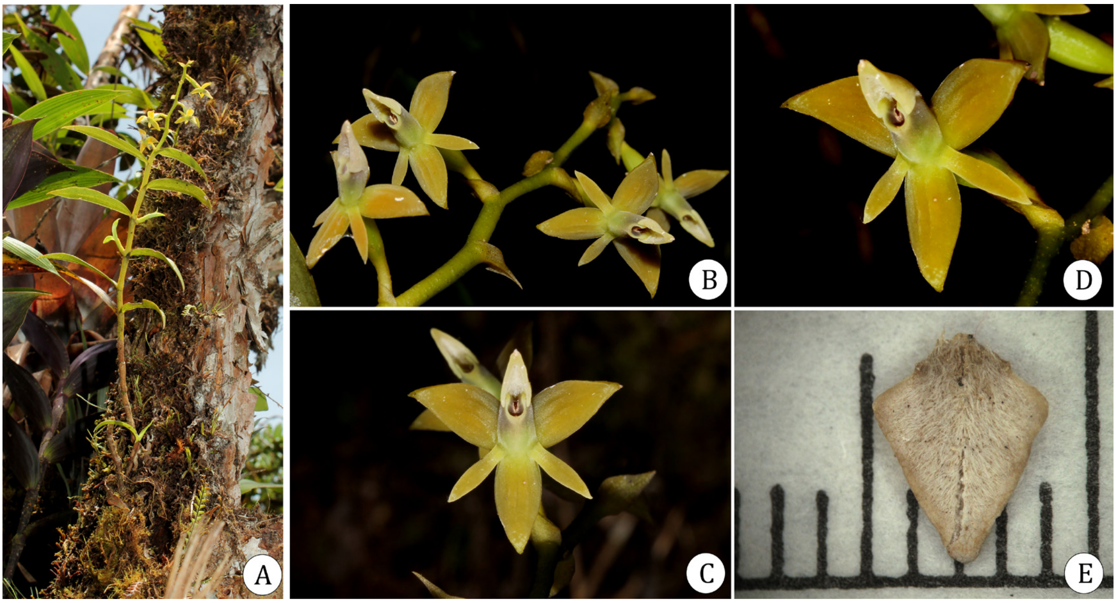

Figure 3. *Epidendrum lasiostachyum* photographed *in situ* by L. Rodríguez Martínez (based on the pretype: *L. Rodríguez Martínez 254*). A. Habit and complete plant. B. Inflorescence details. C & D show different angles of the flower. E. Lip details.

margin entire. *Anther* not seen. *Rostellum* apical, slit. *Nectary* penetrating 2/3 of the ovary, densely sericeous in front of the stigmatic cavity. *Capsule* not seen.

Distribution and Ecology: It is known presently from the western slope of the Western Cordillera of the Andes, only from one collection from the mountains of San José del Salado, Municipality of Dagua in the Department of Valle del Cauca, Colombia, at an elevation of 1850 m. It is found as an epiphyte in the cloud forests on the western mountain range. Two specimens were found growing on *Tibouchina* sp. (Melastomataceae). Flowering in November. Growing fully exposed to the sun, along the edge of the forest and pastures, as part of secondary vegetation. Annual mean precipitation is 2000 mm, with constant fog in the early morning and late afternoon. Mean temperature is 17°C, slopes are steep (50-75%). Nearby forests are 25 m tall. The best represented genera were *Palicourea* Aubl., *Psychotria* L., *Miconia* Ruiz & Pav., *Solanum* L., *Cavendishia* Lindl. and *Clusia* L. and the dominant species: *Otoba lehmannii* (A.C. Sm.) A.H. Gentry, *Ladenbergia oblongifolia* (Humb, ex Mutis) L. Andersson, *Myrsine coriacea* (Sw.) R. Br., *Saurauia scabra* (Kunth) D.Dietr., *Alchornea latifolia* Sw., *Ficus tonduzii* Standl., *Ficus andicola* Standl., *Meriania nobilis* Triana, *Clausia* sp., *Miconia* sp. and *Schefflera* sp. (Hágsater *et al.*, 2015).

Etymology: From the Greek λασιος, shaggy, woolly, and σταχυς, ear of corn; in reference to the lip which is completely (but not the margin) covered by long, straight trichomes reclining towards the nectary that distinguishes this species from others members of the *E. macrostachyum* group.

Discussion. The species is similar to *Epidendrum microrigidiflorum* Hágsater but differs mainly in the size of the plant (25-30 cm tall) (Fig. 3A), the few-flowered inflorescence, distichous, with the rachis slightly flexuous (Fig. 3B), the flowers somewhat smaller (Fig. 3C, 3D), and the trullate lip with the base widely cuneate and the apex obtuse, sericeous (Fig. 3E) and the column minutely papillose (Fig. 1E). *Epidendrum microrigidiflorum* has larger plants (60-100 cm tall), the inflorescence secund and many-flowered and the lip is widely rhombic with the apex apiculate, surface scarcely papillose on the disc and the column unornamented (Fig. 4). *Epidendrum notostachyum* Hágsater & E.Santiago (Fig. 5) differs in the color and size of the flowers,

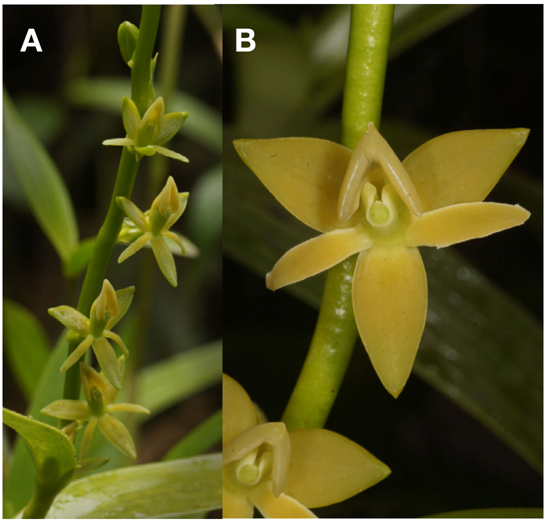

FIGURE 4. Inflorescence (A) and flower (B) of *Epidendrum microrigidiflorum*, photographed by Gary Yong. Panamá, Reserva de la biosfera La Amistad.

FIGURE 6. Plant and inflorescence of *Epidendrum polyanthostachyum*, photographed by Patricia Harding, Colombia, Chocó.

FIGURE 5. Inflorescence of *Epidendrum notostachyum*, photographed by Hugo Medina. Ecuador.

FIGURE 7. Inflorescence of *Epidendrum polyanthostachyum*, photographed by Duván Andrés García Ramírez, Colombia, Valle del Cauca.

Figure 8. Inflorescence of *Epidendrum macrostachyum*, photographed by David Haelterman, Colombia, Cauca.

sepals are 9.0-9.5 mm long, dorsally papillose and the lip scarcely pubescent at the base with the base truncate. *Epidendrum polyanthostachyum* Hágsater, E.Santiago & García-Ramírez has a densely cylindrical, many-flowered inflorescence (Fig. 6 and 7), the leaves lanceolate, (3.5-14 × 1.8-4.7 cm), the lip scarcely pubescent at the base, widely deltoid with the base cordate. Finally, *Epidenrum macrostachyum* Lindl. has large, triangular ovate floral bracts (8-18 mm long), with flowers the color of ripe olives or lack-brown and the leaves elliptic (12.5-13 × 3.0-3.5 cm) (Fig. 8).

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Key to the species of the macrostachyum group

1\. Floral bracts prominent (never shorter that the ovary to much longer that the flower) 11-40 mm long [the apical ones may diminish to 5–7 mm long] 11

1’. Floral bracts small (shorter that the ovary to rarely somewhat longer) 2.5–9[12] mm long 2

2(1’). Inflorescence densely flowered (35–70 flowers) 3

2’. Inflorescence laxly flowered (8–30 flowers) 4

3(2). Flowers small, sepals 5–8 mm long, dorsally muricate .... ***E. palaciosii***

3’. Flowers larger, sepals 11–15 mm long, dorsally unornamented .... ***E. polyanthostachyum***

4(2’). Flowers green, yellow or orange, inflorescence lax-flowered 5

4’. Flowers lilaceous white, rarely deep lilac, inflorescence dense .... ***E. borealistachyum***

5(4). Leaves elliptic or narrowly elliptic, 8–18 × [2.2]3–5 cm on the main stem; lip clearly cordiform; sepals 14–18 mm long .... ***E. cardiostachyum***

5’. Leaves lanceolate to linear lanceolate, 6–15 × 0.6–1.7 [2.3] cm on the main stem; lip deltoid, sub-deltoid to widely rhombic; sepals 6.5–13 mm long 6

6(5’). Inflorescence 20 cm long; sepals 12–13 mm long; lip sub-deltoid with the base cordate .... ***E. odontostachyum***

6’. Inflorescence 5–13 [15] cm long; sepals 6–12 mm long; lip deltoid or widely rhombic, base truncate, slightly sub-cordate or cuneate 7

7(6’). Lip densely pubescent throughout its ventral surface .... ***E. lasiostachyum***

7’. Lip sparsely pubescent on the disc of the lip 8

8(7’). Sepals 6–7.5 mm long 9

8’. Sepals 9–12 mm long 10

9(8). Inflorescence 5 cm long; flowers 8–12; petals 5 × 1 mm, linear, the apex obtuse; column 3 mm long .... ***E. microcarpum***

9’. Inflorescence 7–8 cm long; flowers 15–17; petals 6.7 × 1.5 mm, oblong, falcate, the apex acute; column 7 mm long .... ***E. sumacostachyum***

10(8’) Sepals 9.0–9.5 mm long, dorsally papillose; petals 8 × 1.5 mm; linear-oblanceolate; ovary 5-7 mm long .... ***E. notostachyum***

10’. Sepals 9–12 mm long, dorsally glabrous; petals 10 × 1.3 mm, linear; ovary 7–10 mm long ***E. grammipetalostachyum***

11(1). Petals obtrullate, spatulate or rhombic … 12

11’. Petals linear, oblong, elliptic or widely spatulate … 13

12(11). Leaves of the main stem 8.5–9.0 × 1.5–1.7 cm; lip 7 × 9 mm, trullate with the apex rounded, ecallose … ***E. trullichilum***

12’. Leaves of the main stem 9–17 × 2.8–4.5 cm; lip 9 × 12 mm, widely triangular cordiform with the apex subacute, bicallose … ***E. orthophyllum***

13(11’). Inflorescence short (1.5–3.0 cm long), with 3–4 flowers densely aggregate in a very short rachis; leaves linear-lanceolate … ***E. platystachyum***

13’. Inflorescence long (7–34 cm long), with 5–21 flowers distributed along the rachis; leaves lanceolate, elliptic to oblong-elliptic … 14

14(13’). Floral bracts proportionately nearly as wide as they are long, the apex acute or short-acuminate … 15

14’. Floral bracts proportionately longer than wide, the apex acute or long-acuminate … 23

15(14). Leaves narrowly elliptic-lanceolate, elliptic or oblong-lanceolate, 1.4–5 cm wide; lip 10–17 × 11–18 mm … 16

15’. Leaves lanceolate, 1.5–2.5 cm wide; lip 6–15 × 9-10 mm … 21

16(15). Mature inflorescence much longer than the apical leaf, many-flowered, with 18–20 flowers … 17

16’. Mature inflorescence as long or slightly shorter than the apical leaf, few-flowered, with 5–8 flowers … 20

17(16). Petals oblanceolate, widely spatulate or obovate-elliptic, flowers colorful, never green; anther with the apex obtuse; ovary 9–19 mm long … 18

17’. Petals oblong, flowers green, the lip greenish yellow; anther apically short acuminate; ovary very short 6 mm long … ***E. brachyoothistachyum***

18(17). Flowers white tinged with purple; petals 15 × 5 mm, oblanceolate … ***E. obovatipetalum***

18’. Flowers reddish orange to lilac; petals 13.2–14.0 × 6–8 mm, widely spatulate to obovate-elliptic … 19

19(18). Flowers 15–20, lilac; petals obliquely obovate-elliptic with the apex sub-obtuse; lip ecallose … ***E. erikae***

19’. Flowers ca. 45, reddish-orange; petals widely spatulate and the apex rounded; lip bicallose … ***E. ariasii***

20(16’). Inflorescence 6.5 cm long; sepals 15 × 9 mm; petals nearly as wide as the sepals; flowers greenish white … ***E. xylostachyum***

20’. Inflorescence 8-13 cm long; sepals 21 × 12.5 mm; petals half as wide as the sepals; flowers yellowish green … ***E. humeadorense***

21(15’). Lateral sepals partly spreading, slightly concave; petals linear-oblanceolate to lanceolate, spreading … 22

21’. Lateral sepals reflexed, convex; petals oblanceolate, reflexed … ***E. recurvitepalostachyum***

22(21). Rachis of the inflorescence straight; floral bracts 5–7 mm wide, the apex acute; lateral sepals very fleshy; petals linear-oblanceolate … ***E. sarcostachyum***

22’. Rachis of the inflorescence sinuous; floral bracts 8–12 mm wide, the apex acuminate and uncinate; lateral sepals slightly fleshy; petals lanceolate … ***E. chondrochilum***

23(14’). Floral bracts much longer than the total length of the flower … 24

23’. Floral bracts never much longer than the flower … 25

24(23). Leaf blade of the main stem 18–20 × 2-5 cm, elliptic-lanceolate; inflorescence pyramidal, the rachis straight; flowers successive 21–30; ovary 6–7 mm long; lip widely cordiform (proportionately wider than long); sepals ovate-elliptic, obtuse … ***E. magnibracteum***

24’. Leaf blade of the main stem 15-18 x 2-2.8 cm, narrowly lanceolate; inflorescence distichous with the rachis fractiflex; flowers mostly simultaneous, 11-12; ovary 9-12 mm long; lip cordiform (as wide as it is long); sepals triangular-ovate, acute … ***E. bractiacuminatum***

25(23’). Inflorescence of the main stem 2.5–9.0 [13-17] cm long … 26

25’. Inflorescence of the main stem 15–40 cm long … 33

26(25). Leaves 4.0–10.4 × 1.8–3.3 cm, elliptic to oblong-elliptic … 27

26’. Leaves 1.5-11.0 × 0.4–2.3 cm, lanceolate … 31

27(26). Anther with the apex acute or truncate, never surpassing the apex of the column; sepals 13.5–17 × 4-7 mm … 28

27’. Anther with the apex rostrate, surpassing the apex of the column; sepals 9–12 × 3–5 mm … 29

28(27). Flowers peach colored; petals linear-oblong; sepals dorsally glabrous; column sigmoid … ***E. sigmostachyum***

28’. Flowers green tinged brown, turning orange-brown when mature; petals oblong-elliptic; sepals dorsally echinate; column straight … ***E. deltastachyum***

29(27’). Lateral sepals with a high, laminar, dorsal keel, the apex erose; petals oblong, apex rounded; anther with a short, incipient apical rostrum shorter than the anther itself; flowers red … ***E. macphersonii***

29’. Lateral sepals with a low, incipient dorsal keel, the margin entire; petals linear, apex acute; anther with an apical rostrum much longer than the body of the anther; flowers green … 30

30(29’). Inflorescence 13 cm long; sepals 9–11 mm long, apex acute; lip 6.5-8.0 × 7–10 mm, semi-circular with the base sub-truncate, without ribs; column 5-6 mm long .... ***E. rostrigerum***
30’. Inflorescence 5–8 cm long; sepals 10–13 mm long, apex acute; lip 9–10 × 9–11 mm, deltoid with the base truncate, with a low rib down the middle; column 7–8 mm long .... ***E. probosantherum***
31(26’). Flowers small, sepals 7.5–7.8 mm long; inflorescence secund flowered; lip rhombic, the base cuneate .... ***E. microrigidiflorum***
31’. Flowers large, sepals 12–15 mm long; inflorescence distichous; lip deltate to deltate-cordiform 32
32(31’). Sepals 14–15 mm long, slightly recurved, the apex minutely apiculate; floral bracts narrowly oblong or triangular-lanceolate .... ***E. stenobractistachyum***
32’. Sepals 12.0–13.7 mm long, partly spreading to spreading, the apex uncinate; floral bracts ovate-lanceolate .... ***E. coordinatum***
33(25’). Sepals 15–23 mm long 34
33’. Sepals 10–12 mm long 38
34(33). Rachis of the inflorescence slightly flexuous; flowers 6–15; lip 14.5 × 14.4 mm .... ***E. bangii***
34’. Rachis of the inflorescence straight; flowers 15–27; lip 9–12 × 8–12 mm 35
35(34’). Sepals and petals long acuminate; sepals 15–23 mm long .... ***E. oxycalyx***
35’. Sepals and petals acute; sepals 14–18 mm long 36
36(35’). Inflorescence (of the main stem) 24–40 cm long; flowers wine-red 37
36’. Inflorescence (of the main stem) 11–14 cm long; flowers reddish brown .... ***E. dermatanthum***
37(36). Inflorescence lax flowered, 25-40 cm long; leaves green with the margin reddish; column wide and straight .... ***E. munchiquense***
37’. Inflorescence densely flowered, 24 cm long; leaves wine-red; column thin and slightly arched .... ***E. porphyrostachyum***
38(33’). Leaves narrowly lanceolate, apex acute to short acuminate, leaves of the main stem 1.6–2.5 cm wide; inflorescence 15–23 cm long, flowers yellow to greenish yellow or wine-red 39
38’. Leaves lanceolate elliptic, apex acute; leaves of the main stem 3.0–3.5 cm wide; inflorescence to 31 cm long, flowers the color of ripe black olives 40
39(38). Flowers wine-red; leaves 5.3–8.0 cm long, lanceolate, apex acute; petals oblong-triangular, never falcate .... ***E. puracestachyum***
39’. Flowers yellow to greenish yellow; leaves 7.5–18.0 cm long, lanceolate, apex acuminate; petals linear and falcate .... ***E. rigidiflorum***
40(38’). Petals linear-oblong, apex sub-obtuse; lip widely cordiform, base slightly cordate, column thin .... ***E. macrostachyum***
40’. Petals linear-triangular, apex sub-acute; lip triangular, base truncate; column thick .... ***E. brachystelestachyum***

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CLARIFICATION OF TWO TAXON NAMES IN *PHRAGMIPEDIUM* (ORCHIDACEAE, CYPRIPEDIOIDEAE)

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Abstract. The names of two subspecies of *Phragmipedium humboldtii* from Guatemala, *P. humboldtii* subsp. *monstruosum* and *P. humboldtii* subsp. *triandrum* (Orchidaceae, Cypripedioideae) were wrongly cited when proposed in Die Orchidee 66(3), 2015. The new status of these subspecies was based on an incorrect authorship of *P. humboldtii*, which instead of (Warsz. ex Rchb.f.) J.T. Atwood & Dressler, should be (Warsz.) J.T. Atwood & Dressler. The formal names of the subspecies are clarified here.

Key words: Guatemala, invalid names, Lady slippers, nomenclature, subspecies

The genus *Phragmipedium* Rolfe includes 22 species, four subspecies and three natural hybrids, ranging from Mexico to South America (Gruss 2003; Pérez-García & Mó Mó 2015). Most species occur in South America and only a few in Mexico and Central America. In Guatemala, only four subspecies of *P. humboldtii* (Warsz.) J.T.Atwood & Dressler have been formally recorded: *P. humboldtii* subsp. *humboldtii*, *P. humboldtii* subsp. *exstaminodium* (Castaño, Hágsater & E.Aguirre) J.T.Atwood & Dressler ex J.M.H.Shaw, *P. humboldtii* subsp. *triandrum* (Archila) Mó & Pérez-García and *P. humboldtii* subsp. *monstruosum* (Archila) Mó & Pérez-García (Pérez-García & Mó Mó 2015). However, the new status of these last two subspecies was wrongly cited by Pérez-García and Mó Mó (2015: 222), because previously Pupulin and Dressler (2011) indicated that the correct name for this species is *P. humboldtii* (Warsz.) J.T.Atwood & Dressler instead of *P. humboldtii* (Warsz. ex Rchb.f.) J.T.Atwood & Dressler. Hence, *P. humboldtii* (Warsz.) J.T.Atwood & Dressler subsp. *triandrum* (Archila) Mó & Pérez-García and *P. humboldtii* (Warsz.) J.T.Atwood & Dressler subsp. *monstruosum* (Archila) Mó & Pérez-García is how these subspecies have to be correctly named.

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LEPANTHES MIRACULUM (ORCHIDACEAE), A NEW ADDITION TO THE PERUVIAN ORCHID FLORA

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ABSTRACT. *Lepanthes miraculum*, formerly known from one area in Bolivia, is reported from Machu Picchu in southern Peru. Illustrations, figures, notes on the specimens found in Peru and an updated description are provided and compared to those known from Bolivia.

RESUMEN. *Lepanthes miraculum*, conocido de una localidad en Bolivia, es reportado en Machu Picchu al Sur del Perú. Se incluyen ilustraciones, figuras y notas sobre los especímenes encontrados en Perú y se les compara con los conocidos de Bolivia.

KEY WORDS: New record, *Lepanthes* species, Pleurothallidinae, Epidendreae, Epidendroideae, Peru

Introduction. The genus *Lepanthes* Sw. comprises more than 800 species (Luer 1996, Farfán *et al*. 2003) and is one of the largest orchid genera. Species of *Lepanthes* occur from southern Mexico through the Antilles to Bolivia and Brazil (Luer & Thoerle 2010) and from 100 up to 3300 m elevation (Pérez-Escobar *et al*. 2013). In Peru, the number of reported *Lepanthes* species has increased dramatically during recent decades: 14 species of *Lepanthes* were recorded by Schweinfurth (1958, 1970), but later increased to 46 species as reported by Brako & Zarucchi (1993) and Ulloa Ulloa *et al.* (2004). At this moment, the World Checklist of Selected Plants at Kew (Govaerts *et al.* 2015) and TROPICOS (www.tropicos.org) record 55 and 63 *Lepanthes* species for Peru, respectively. This number, however, would be a low estimation of the actual diversity in the country, since there is not yet any study of the genus in Peru. The monumental work of Carlyle A. Luer is mainly based on Ecuadorian and Colombian specimens; thus, in Ecuador and Colombia there are recorded more than 300 species each (Farfán *et al*. 2003, Thoerle & Hirtz 2015). If the number of the known species decline at the limits of *Lepanthes* distribution (Thoerle & Hirtz 2015), Peru may eventually present more species than Bolivia; however, the last revision of Bolivian *Lepanthes* recorded 67 species (Luer &Thoerle 2010). New species and records are expected to significantly increase the diversity of Peruvian *Lepanthes* as exploration continues.

During explorations in the Machu Picchu Historical Sanctuary (Cusco, southern Peru), the Inka Terra Association team discovered plants of a *Lepanthes* species with flowers unusual in their size and morphology, later determined to be *Lepanthes miraculum* Luer & R. Vásquez. This species was only known from a few collections in the province of Chapare (Cochabamba, Bolivia), and no further details have been given about this species since its publication (Luer 1983). Here, we report *L. miraculum* as a new addition to the orchid flora of Peru and provide details of the new population, including an updated description and distribution map, and a line drawing and *in situ* photographs based on the Peruvian specimens.

Material and Methods. Field work in Machu Picchu was conducted in April 2013. The specimen of

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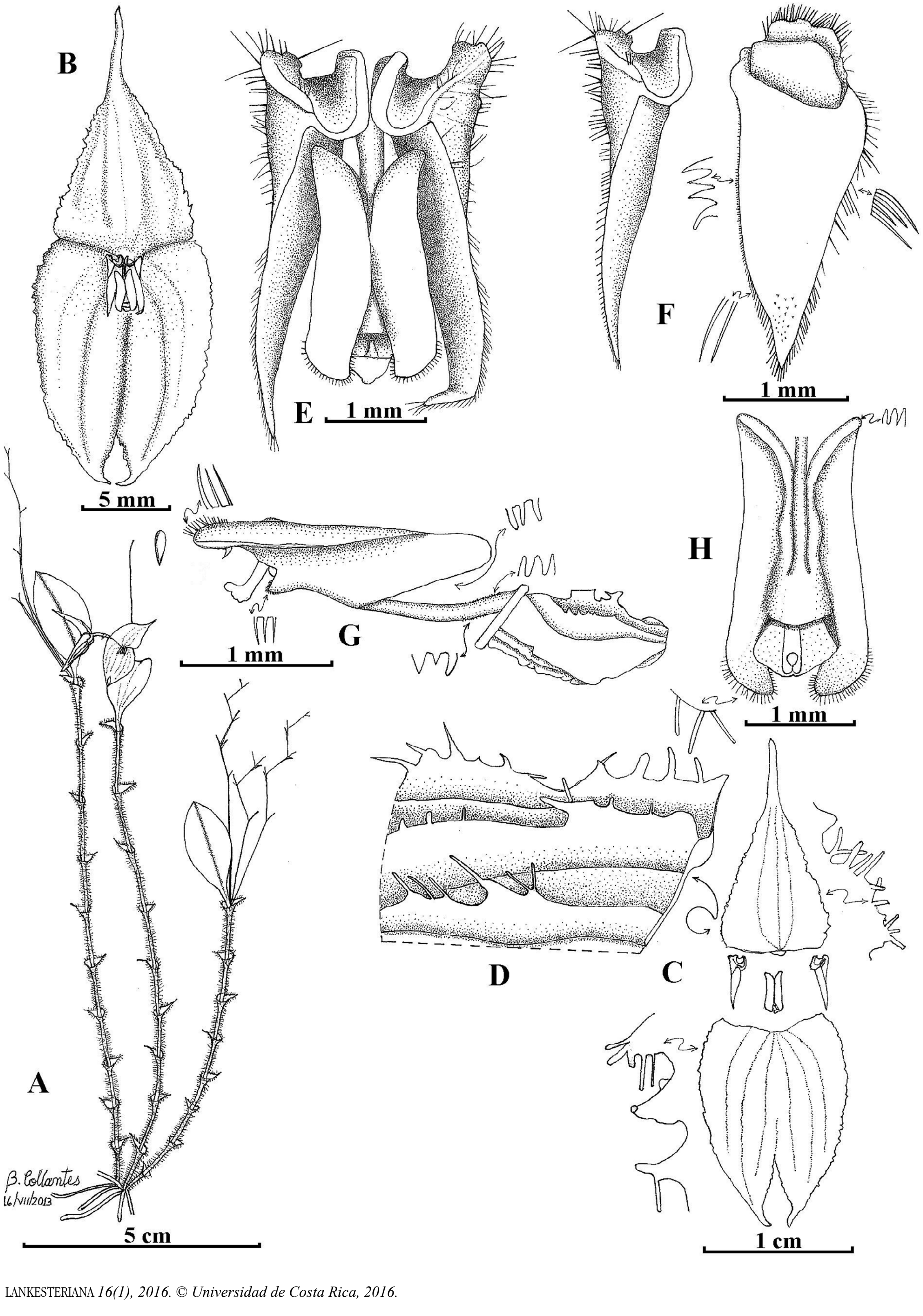
B
5 mm
E
1 mm
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H
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1 cm
A
B. Collantes
16/VII/2013
5 cm

Lepanthes miraculum was collected and preserved in spirit. Micromorphological characters were studied under stereomicroscope. Herbarium specimens from USM and SEL were examined (acronyms follow the Index Herbariorum). The software DIVA-GIS (Version 7.5) and Irfanview (Version 4.33, Irfan Skiljan) were used to prepare the distribution map.

Taxonomic treatment

Lepanthes miraculum Luer & R. Vásquez. Phytologia 54: 353. 1983. (Figs. 1, 2).

TYPE: Bolivia. Cochabamba, Prov. of Chapare, epiphytic in cloud forest between Cochabamba and Villa Tunari, elev. 2500 m, 22 Jan. 1980, *C. Luer, J. Luer & R. Vásquez 4906* (holotype: SEL!).

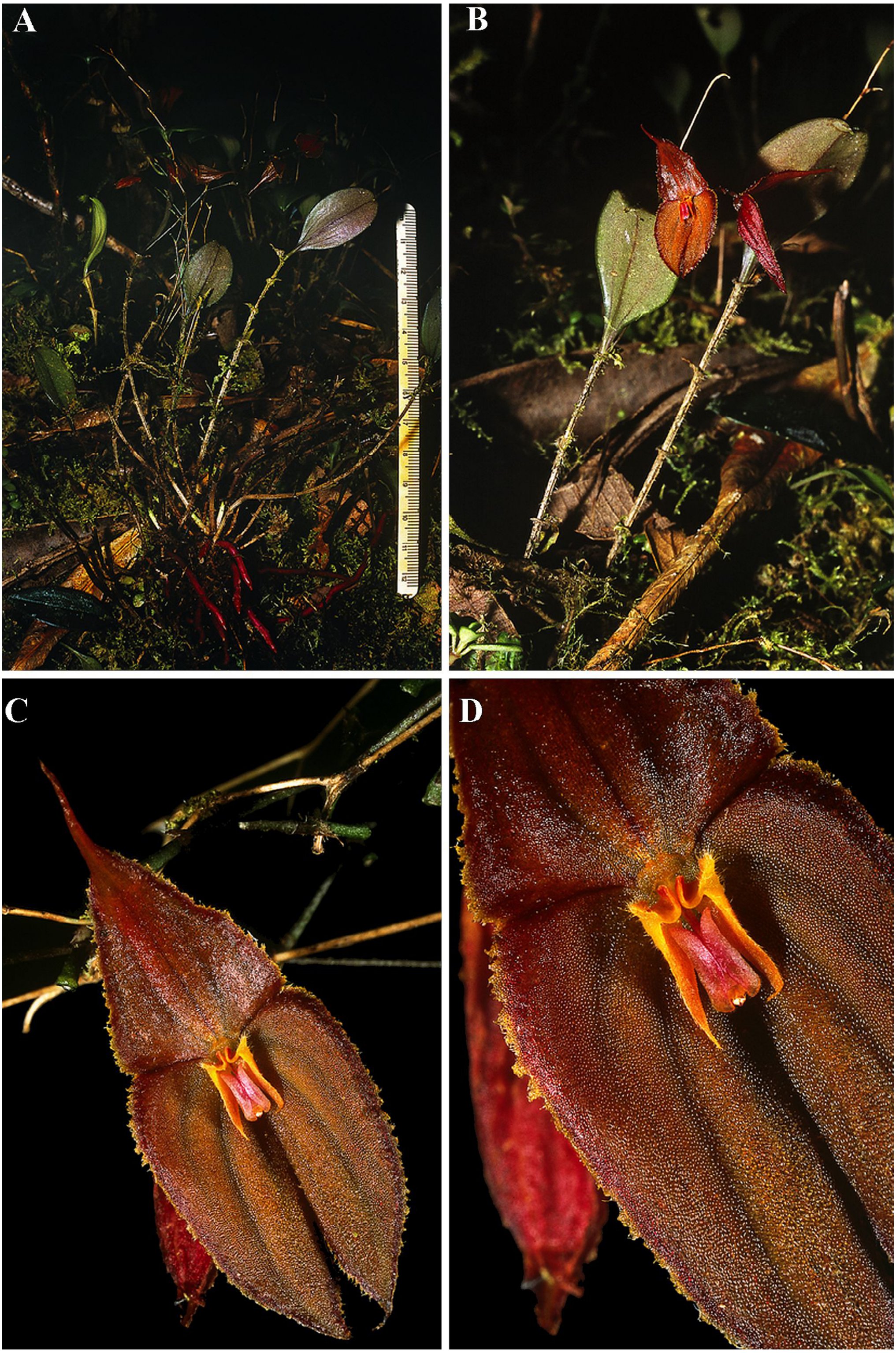
Epiphytic *herb*. *Plant* medium in size for the genus, 13–21 cm tall including the inflorescence, caespitose. *Roots* fuchsia, relatively coarse, 0.52–0.85 mm diameter. *Ramicauls* slender, erect to suberect, 3.0–11.0 cm long, enclosed by 6–11 ciliate or densely pubescent lepanthiform sheaths with ciliate, markedly dilated ostia. *Leaf* dark green to grayish green, suffused with purple or shiny green beneath, erect, coriaceous, elliptical, subacute, 2.0–3.0 × 0.9–1.2 cm, the base cuneate into a petiole 2.0–5.0 mm long. *Inflorescence* 1–3 fractiflex, successively flowered racemes bearing 2–13 flowers, borne above the leaf, up to 11 cm long including the slender, terete peduncle 2.5–4.0 cm long; *floral bracts* 1.5–2.0 mm long, ciliate; *pedicels* 2.5–4.0 mm long; *ovary* 6–winged, wings irregularly erose-dentate, 1.5–2.0 mm long. *Flowers* color of sepals dark brownish orange to dark red, veins brownish, margins orange; petals orange with golden yellow apices and anterior margins, or red; the lip dark, dull pink or bright purple; the column rose-purple; *sepals* spreading, noticeably papillose to shortly pubescent internally, externally carinate along the veins, carinae with irregularly erose-dentate margins with digitiform projections; *dorsal sepal* with margins erose-dentate with digitiform projections, triangular-ovate, the apex acuminate into a cauda *ca*. 5 mm long, 10.5–14.0 × 6.5–7.0 mm including the cauda, 3-veined; *synsepalum* with margins erose-dentate with conic apices, some with filiform projections, broadly ovate, basally concave, 11.5–14.0 × 8.5–10.0 mm including the caudae, with the distal third (*ca*. 4 mm) free, the apices acuminate into short caudae, 6-veined; *petals* transversely bilobed, the upper lobe reflexed, asymmetrically subcordate expanded, with short and long cilia, 1 mm in diameter expanded; the lower lobe narrowly triangular with cilia longer at the base, shorter toward the apex, 3.0–3.5 × 1.0 mm; *lip* bilaminate, the blades oblong-subsigmoid, 1.75–2.0 mm long, glabrous except for short cilia at the narrowly obtuse, inverted apices, the bases rounded, everted, with conic-digitiform papillae, the connectives broadly cuneate, connate to the column near the middle, the sinus obtuse with a broad, membranous, retuse, ciliate appendix in contact with a foot-shaped, clavate appendage from the stigma; *column* 2.0–3.0 mm long, the apical half dilated, the shaft microscopically papillose, terete, extremely slender; *anther* dorsal, *stigma* ventral; *pollinia* not observed.

Additional specimens. **Peru**. Cusco: Prov. Urubamba, Distr. Machu Picchu, Santuario Histórico de Machu Picchu; Pampaccahua, km 90 de la vía férrea Cusco-Machu Picchu, Sector El Palomar [bosque anexo a las inmediaciones del nevado Huaqayhuillca], elev. *ca*. 3,000 m, *B. Collantes, J. Ochoa & C. Soto 178*, 12 Apr. 2011 (USM!). **Bolivia**. Cochabamba: Prov. of Chapare, epiphytic in cloud forest between Cochabamba and Villa Tunari, elev. 2,600 m, 26 Nov. 1978, *C. Luer 3490* (SEL); same area, collected by B. Wuerstle, elev. 2,700 m, 13 Jan. 1981, *C. Luer 5662* (SEL); Pampa Tambo [in the department of Cochabamba, not Potosí], elev. 2,800 m, 24 Dec. 1979, *R. Vásquez 234* (SEL).

Etymology: From the Latin *miraculum*, "a marvel," referring to the features of the flower.

Distribution and Ecology. The species is known from two disjunct areas (Fig. 3). The earlier collections are from the Province of Chapare (central Bolivia) and the newest is from the high mountains of the Machu

Left: Figure 1. *Lepanthes miraculum*. A. Habit. B. Flower, frontal view. C. Dissected flower with details of the sepaline margins. D. Detail of a carina from the exterior of the dorsal sepal. E. Petals, lip, and column, frontal view. F. Right petal, frontal and lateral views. G. Ovary, lip, and column, with surface details, lateral view. H. Lip and column, ventral view. Drawn from *B. Collantes et al. 178* (USM) by B. Collantes.


A
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Picchu Sanctuary (southern Peru). Plants of *Lepanthes miraculum* occur in cloud forests at elevations from 2500 to 3000 m. The present report extends its distribution by *ca*. 800 linear km northward. Chapare and Machu Picchu cloud forests may formerly have been linked since another orchid species, *Vasqueziella boliviana* Dodson, which also has a very restricted distribution, was recorded to be present only in the same two areas (Jenny 2011). In Peru, plants of *L. miraculum* were observed growing on exposed trunks and branches of *Polylepys pauta* Hieron. (Rosaceae), which is the dominant tree species in the newly recorded habitat. An additional population was found inside the Machu Picchu Historical Sanctuary, on Cerro Poques, by the Inkaterra Association team (C. Soto 2013, pers. comm.).

PHENOLOGY. The population found in Peru flowers from March to April, whereas the collections from Bolivia have been recorded to bloom from November to January.

CONSERVATION STATUS. This species is presently known from only two places. The populations occurring in Bolivia are especially endangered and the species may even be extinct (Vásquez *et al*. 2003). The populations found in Peru occur inside a protected area (the Machu Picchu Historical Sanctuary); nevertheless, anthropic activities may imperil its small populations. According to the IUCN Red List (IUCN 2014), it can be listed as critically endangered (CR, criterion B1/extent of occurrence and C1/small population size and decline).

Lepanthes miraculum belongs to the section *Lepanthes* subsection *Lepanthes* (Luer & Thoerle 2010). The flowers are large for the genus, but most unusual are the folded petals and the long, thin column with the broad connectives of the lip connate at about the middle. The specimens found in Peru present a ramicaul enclosed in densely pubescent lepanthiform sheaths similar to those of *L. pubicaulis* C. Schweinf, rather than less densely ciliate like those of the Bolivian specimens. The flowers from the two areas also vary, those from Peru having a flower with larger sepals (14 mm long vs. 10.5-11.0 mm long in the Bolivian specimens) that are minutely but visibly papillose internally, rather than shortly pubescent. The color of the flowers differs: sepals of the Peruvian individuals are brownish orange to dark red, the petals orange and golden yellow, whereas the Bolivian ones are red to dark red, and red, respectively.

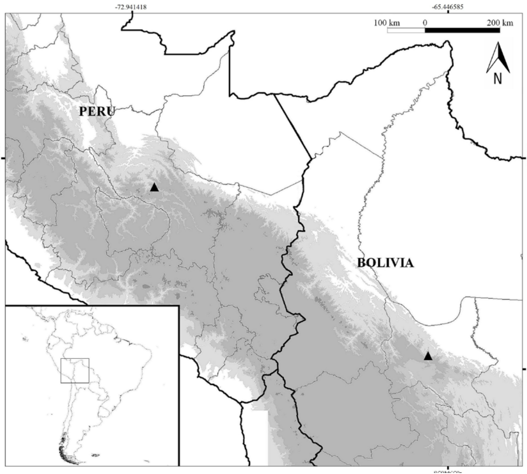

FIGURE 3. Geographical locations of *Lepanthes miraculum* (triangles) in Peru and Bolivia. Gray scale indicates elevation (white [0 m] to dark gray [6,500 m]). Produced by Carlos Martel.

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Left: FIGURE 2. *Lepanthes miraculum in situ.* A. Habit. B. Plant with inflorescences. C. Flower, frontal view. D. Closeup of the flower. Photographs by B. Collantes.

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FLORAL SEXUAL DIFFERENTIATION IN *CATASETUM FIMBRIATUM* (CATASETINAE, ORCHIDACEAE) EXPOSED TO DIFFERENT LIGHT INTENSITIES

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Abstract**.** To elucidate the factors which control the flower phenotypic plasticity of *Catasetum fimbriatum*, studies focusing the floral development of the species were performed. The treatments were: high light intensity (1613 µmol.m^{-2}.s^{-1}); low light intensity (454 µmol.m^{-2}.s^{-1}) and mean light intensity (827 µmol.m^{-2}.s^{-1}). The floral morphology and anatomy were analyzed to evaluate of the sequence of tissue development involved in the sexual differentiation. We found the presence of cell cluster with meristematic features in the ovaries and gynostemium of the male and female diclinous flowers. These are responsible for the definition of the sexual expression of the species, in the dependence of the environmental stimulus, related to the endogenous concentration of ethylene, allowing, consequently, the dedifferentiation and re-differentiation of those clusters in the sexual determination of the flowers. There were no anatomical differences in floral tissues in different treatments.

Key Words: Orchid, sexual expression, anatomy

Introduction. *Catasetum* L. C. Richard., with about 100 species (Barros *et al.* 2012), constitutes one of the main Brazilian orchid genera presenting high commercial value in markets due to the difficulty of sexual propagation and obtainment of hybrids (Pedroso-de-Moraes *et al.* 2007). Its great ornamental potential resulted in an extensive extraction in past decades, which culminated in population reduction and in the danger of extinction of countless species (Joly 1998, Moraes & Almeida 2004).

Representatives of the genus present sophisticated specializations for the acquirement of allogamy (Zimermam 1991), which, for several decades, raised academic interest in many orchidologists and zoologists, mainly due to their adaptations to entomophily and to its flower trimorphism (Hoehne 1938, Moraes & Almeida 2004). The difference between male and female diclinous flowers is so visual that they have already been described in distinct genera; the male ones as belonging to *Myanthus*, and the female ones as representatives of the *Monochantus* (Decker 1946).

Such phenotypical flower variations are found in the *Orthocatasetum* subgenus, which is characterized presenting plants in which female diclinous, male diclinous and incomplete monocline flowers take place, with such morphologic types being able to co-exist in the same floral stem (Hoehne 1938, Zimermam 1991, Bicalho & Barros 1998, Moraes & Almeida 2004). This floral form began several controversies concerning its derivational state and ecophysiological aspects due to the diverse range of results related to

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its sexual expression found by researchers (Zimermam 1991, Moraes & Almeida 2004).

Information about the anatomy of gynostemium is scarce in the literature, mainly due to the difficulty in preparing them for microscopy (Arditti 1992), which strongly limits the study of this extremely important structure in orchids. However, the current state of knowledge is that the gynostemium, comprising stamen filaments adnate to a syncarpous style, occurs in only three groups of monocots, all of them epigynous lilioids: Orchidaceae (Asparagales), *Pauridia* (Hypoxidaceae: Asparagales) and *Corsia* (Corsiaceae: Liliales). A new term, hyper-epigyny, was proposed to describe stamen adnation to the style, which may be a product of over-expression of genes controlling epigyny (Rudall & Bateman 2002).The studies on such organs were performed with orchids of *Bulbophyllum* (Rasmussen 1985) and *Phalaenopsis* (Arditti 1992) and with representatives of the Diurideae and Cranichideae tribes (Kurzweil *et al.* 2005).

The continuous destruction of the natural habitat of the genus sets its existence at risk justifying, therefore, more detailed studies on *Catasetum fimbriatum* (C. Morren) Lindl. Such endangered species is one of the most commercialized of the genera (Pedroso-de-Moraes *et al.* 2007, Brescasin *et al.* 2013), which implies in the need for elucidation of the questions related to their sexual expression. Such knowledge would enable the development of handling techniques which guarantee greater reproductive success in restoration and conservation projects and to obtain hybrids for commercial genetic improvement.

The objectives of the work are to perform the anatomical study of gynostemia and ovaries in different phases of development and to clarify the morphological mechanisms involved in flower development of this species, under the influence of different light intensities, which can act in the sexual determination of its flowers.

Material and methods. Forty-five plants of *Catasetum fimbriatum* from Nursery of the Escola Superior de Agricultura Luiz de Queiróz – ESALQ/USP, Piracicaba, SP, were used. A voucher specimen was prepared according to the usual herbarium techniques (Mori *et al.,* 1989) and stored at the Herbário Rio Clarense (HRCB), of the Instituto de Biociências de Rio Claro, Universidade Estadual Paulista – UNESP, under the number: 45344.

For the experiments, plants were analyzed at physiological maturity (with four pseudobulbs owning scars indicating the emission of inflorescences) and in dormancy period (without new pseudobulb development or any sign of new rooting) (Pedroso-de-Moraes 2000). The specimens were divided in three treatments containing 15 plants each. Treatment 1 (T1) was characterized by the exposure of the plants to monthly average intense light, 1613 $\mu mol.m^{-2}.s^{-1}$, obtained by the use of 20% shade cloth as the nursery covering. Treatment 2 (T2) was characterized by the exposure of the plants to monthly average low light intensity, 454 $\mu mol.m^{-2}.s^{-1}$, by the use of 80% shade cloth. And the third one, considered control, Treatment 3 (T3) was characterized by the study of the plants under natural phorophytes, *Acrocomia aculeata* (Jacq.) Lood. ex Mart. (Arecaceae), with mean height of 8 m, under mean natural light intensity of 827 $\mu mol.m^{-2}.s^{-1}$. The light intensities were measured once a week using a quantum sensor associated to a data-log (Li - 1400, LI-COR, Lincoln, NE, USA).

The gynostemia and the ovaries of male and female flowers were fixed in Karnovsky´s solution (Karnovsky 1965) and subjected to a vacuum pump for the removal of the air contained in the intercellular spaces for 2 hours. After the fixation, the samples were dehydrated in ethyl alcohol series and infiltrated with Reichert-Jung´s glycol-methacrylate resin. The sections were cut in hand rotary microtome (Leica, Solms, Germany) with type C knife at 5 micrometers of thickness, stained with 0.05% toluidine blue in citric acid phosphate buffer (O'Brien *et al.* 1964) and mounted on "Entellan" synthetic resin (Merck, Whitehouse Station, NJ, USA). The slides were photomicrographed, and the scales were obtained in the same optical conditions used for the slides. The epidermal analysis and the Protoplasm Nucleus Relation (PNR), occurred by use of Anati-Quanti software.

For each treatment, three samples were made in different stages: emergence of the floral bud (first week), intermediate stage (third week) and finally, the anthesis stage (five week). From bud differentiation to opening of the flower takes approximately five weeks (Joly 1998).

Table 1. Total number of female and male diclinous flowers occurring in *Catasetum fimbriatum*.

Treatment / Light Intensity (mmol.m^{-2}.s^{-1})	Total number of female diclinous flowers	Total number of male diclinous flowers
1 / 1613	33	72
2 / 454	5	270
3 / 827	16	183

By obtaining 15 flowers of both sexes on the installed treatments, subdivided into three lots, each containing five flowers, the morphometric analyses of the ovary and gynostemium were performed, in which the following flower characteristics were analyzed: mean length and diameter of the ovary; and mean length, width and thickness of the gynostemium. Means concerning the length and diameter of the fruit originated during the experiment were also obtained. The results acquired were subjected to ANOVA and compared through the Tukey test at 5% (Zar 1999). The total number of flowers of both sexes occurring in the treatment was also measured. As the chosen plants presents four pseudobulbs of similar size, was not included in the ANOVA covariates related to the size of the plants.

Results

Flower sexual differentiation influenced by light. – Treatments with higher light intensities (T1 and T3), promoted higher number of female diclinous flowers, 33 and 16, respectively, while the T2, with lower light intensity (T2), presented only 5 diclinous flowers. The total number of male diclinous flowers showed an opposite relationship with light intensities, with 270 male diclinous flowers obtained in T2, 183 in T3 and 72 in T1 (Tab. 1). In five plants of T3, the formation of female and male diclinous flowers took place in the same flower stem. The emergence of monoclinous flowers was not observed during the monitoring period.

Reproductive morphology and anatomy. – The ovaries of all flowers analyzed were cylindrical. However, in the female flowers were widely curved and had superficial indicative depressions in the place of carpel fusion, while the ovaries of the male diclinous flowers were completely smooth and straight (Figs 1-3).

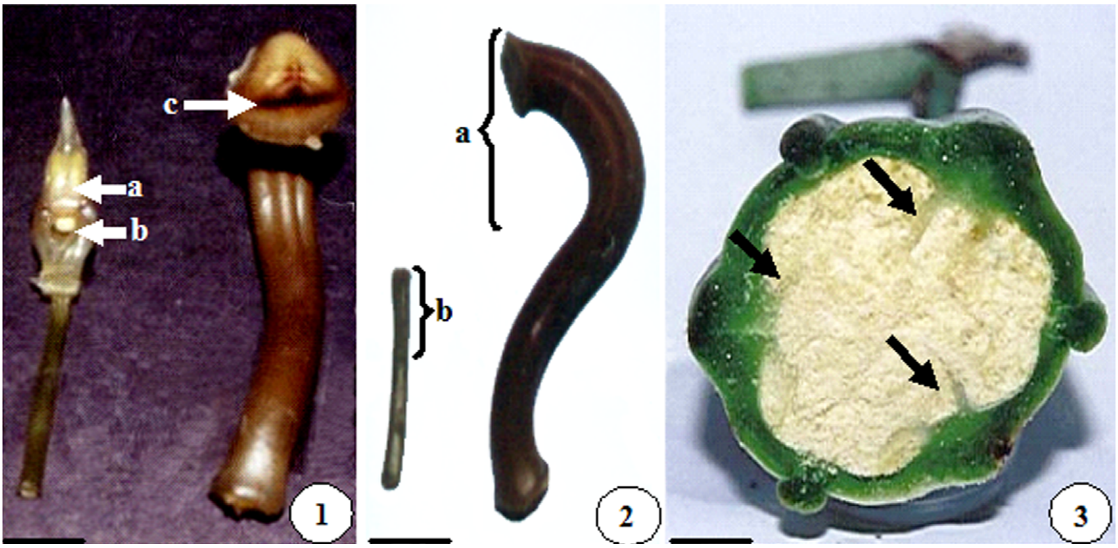
The statistical analysis performed for the flowers of all treatments indicated significant differences concerning the morphometric traits under the light settings evaluated. The plants treated with lower mean light intensity (T2) produced flowers with higher mean length of the ovaries and gynostemium of both sexes. Nevertheless, the plants treated with higher mean light intensity (T1), presented the greatest mean ovary diameter, thickness and width of the gynostemium of the female flowers. However, no statistically significant differences were found on the ovary diameter gynostemium and thickness and width, between the three light settings in the male flowers (Tab. 2).

The epidermis in all ovaries analyzed, independently of both the flower sexual expression and light intensity to which the flowers were exposed to, were one-layered and covered by thin cuticle (Figs. 4-5).

The loculi were totally filled with parenchyma tissue, in which, it observed collateral closed vascular bundles and aggregated to meristematic cells (Figs. 5-7-arrows). Can be observed in the cross and longitudinal sections, for all light intensities, in the mesophyll of the ovaries of female (Figs. 4-6) and male (Fig. 7) flowers there are areas where cell clusters are different from the rest of the tissue in the anthesis phase. In these areas, the cells divide themselves in a periclinal way and are isodiametric and with high Protoplasm Nucleus Relation (PNR). These are different from the rest of the parenchyma cells, in which anticlinal divisions predominate (Figs. 6a, 7a).

The fruits, characterized as capsules, with parietal placentation (Fig. 3), present inside an abundance of trichomes formed by 4-5 cells with mean length and diameter of 8.75 and 5.92 cm.

The gynostemia analyzed are formed by the pistil adnation in female diclinous flowers and by stamens in male diclinous flowers. Therefore, the gynostemia of female flowers are characterized by presenting body, rostellum and stigma (Figs. 8-10), while the ones of the male flowers present body, non-functional stigma, rostellum, stipe, caudicle and pollinaria (Figs. 11, 12).



FIGURES 1-3. Gynostemia and ovaries of male and female diclinous flowers in anthesis of *Catasetum fimbriatum* (C. Morren) Lindl. 1, Male flower (left); (a), pollinea; (b) non-functional stigma; (c) female flower stigma (right). 2, Ovary of male (smooth and straight) and female flowers; (a) ovary of the female diclinous flower; (b) non-functional ovary of the male flower (smooth and straight). 3, Cross section of the fruit capsule. Arrows = fusion of the carpel edges. The internal portion of the fruit is filled by seeds. Scales: 1 cm.

In the gynostemium of the female flowers there is a vascular bundle in the ventral portion of the structure (Fig. 8, arrow), while in the male one, a bundle is located in the dorsal portion.

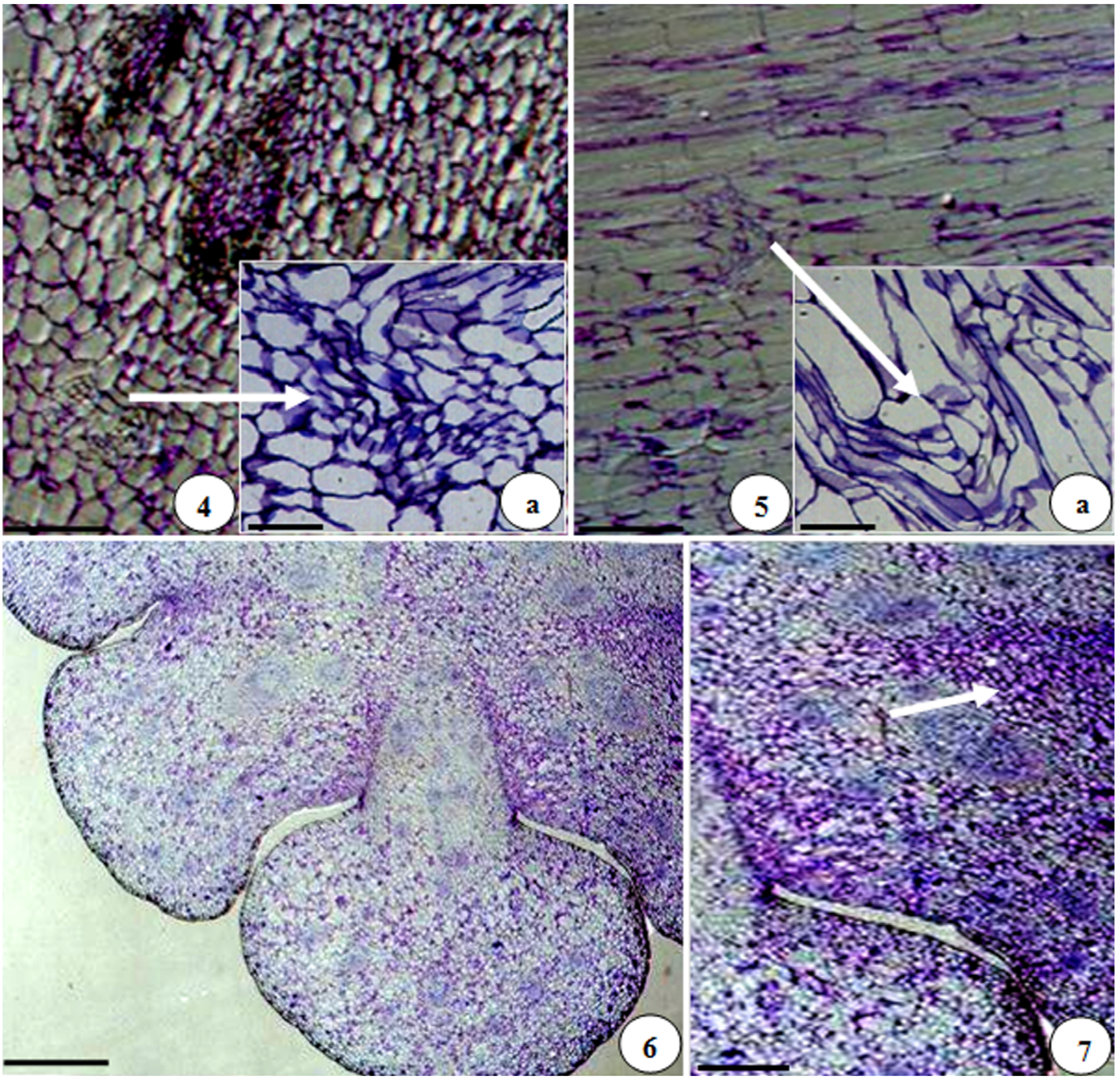
For all light intensities, the body of the gynostemia of flowers of both sexes consists of small isiodiametric cells (Figs. 8, 11, 13-15) which present dominance of anticlinal cell divisions. However, in the upper part of the gynostemium of female diclinous flowers, in the exact site where in the male flowers the pollinaria is originated, the presence of a cell cluster whose cells are isodiametric can be observed, which are divided in a periclinal way and present high PNR (Figs. 10, 10a). Concerning the stigmas, it can be seen that, in all the development phases, they presented the same shape and that between the mean development period and the

TABLE 2. Means of the reproductive morphometric traits of male and female diclinous flowers of *Catasetum fimbriatum* submitted to different light intensities. VC = Variation Coefficient.

	Female flowers				
Light intensity	**Ovary**		**Gynostemium**		
(μmol.m^{-2}.s^{-1})	**Length (cm)**	**Diameter (cm)**	**Length (cm)**	**Thickness (cm)**	**Width (cm)**
1613(T1)	3.73c	1.96 a	1.88 c	1.32 a	1.46 a
454(T2)	4.85 a	1.21 b	2.34 a	1.14 b	1.21 b
827(T3)	4.25 b	1.23 b	2.01 b	1.19 b	1.27 b
VC (%)	6.38	4.87	6.21	7.08	8.14

	Male flowers				
Light intensity	**Ovary**		**Gynostemium**		
(μmol.m^{-2}.s^{-1})	**Length (cm)**	**Diameter (cm)**	**Length (cm)**	**Thickness (cm)**	**Width (cm)**
1613(T1)	1.02 b	0.47 a	2.62 c	0.78 b	0.81 a
454(T2)	1.54 a	0.52 a	3.78 a	0.73 b	0.82 a
827(T3)	1.21 b	0.48 a	3.11 b	0.75 b	0.82 a
VC (%)	3.25	2.42	9.92	1.12	1.12

Numbers followed by same letters in the same column do not differ between themselves by the Tukey test at 5%.

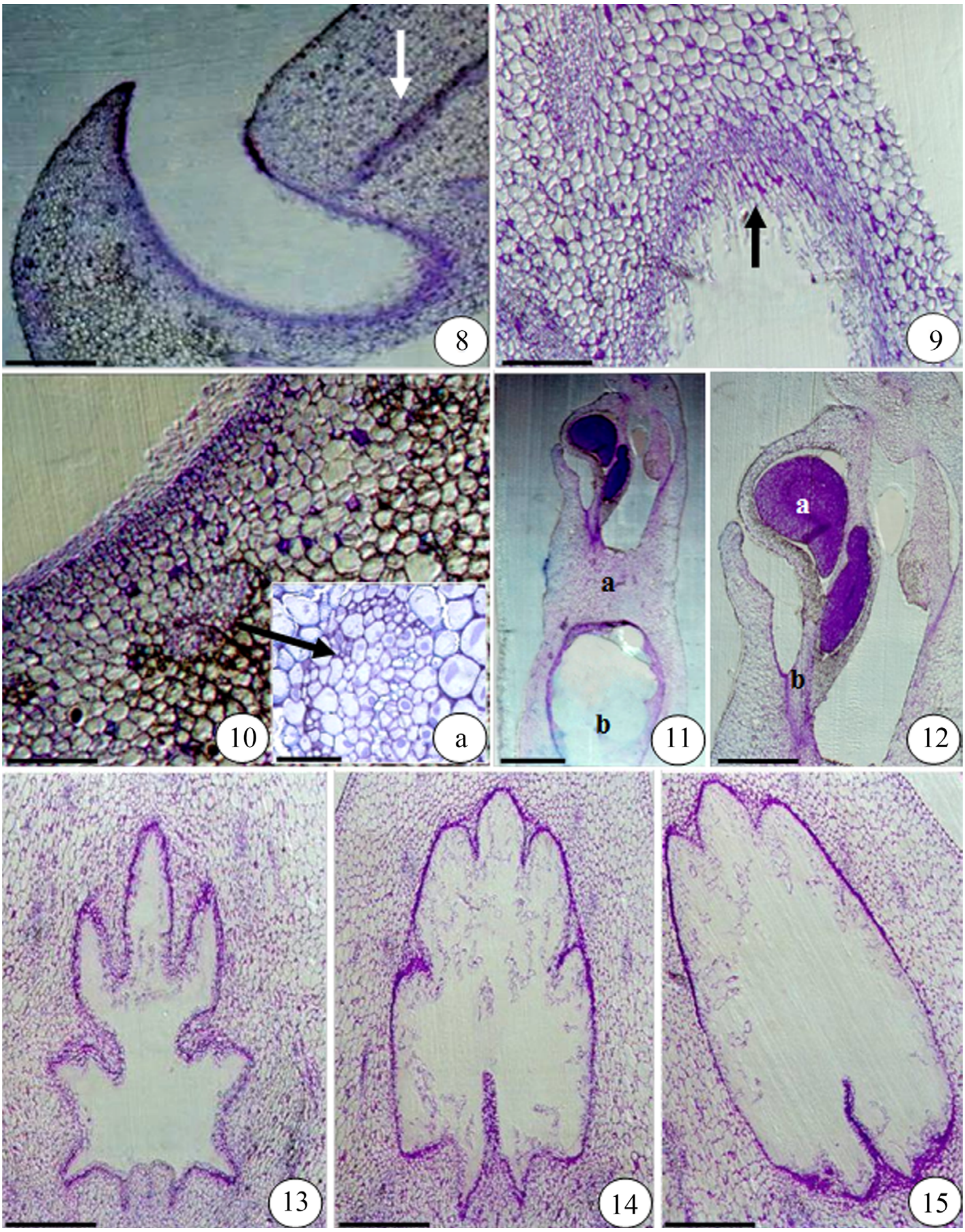


Figures 4-7. Cross and longitudinal sections of ovaries of mature flowers of *Catasetum fimbriatum* (C. Morren) Lindl. in the anthesis phase. 4, cross section in ovary of female diclinous flower. 5, detail of the cross section in ovary of a female diclinous flower, the arrow indicates the place of the ovule formation. 6, transversal section of the ovary of a female diclinous flower; (a) detail of evidencing meristematic cell cluster (arrow region). 7. longitudinal section of the ovary of a male diclinous flower. Detail evidencing meristematic cell cluster (arrow). Scales: 4,6,7 = 100 µm; 5 = 50 µm; a = 7µm.

anthesis, the genesis and subsequent maturation of the secreting cells of viscine took place (Fig. 9, arrow).

The gynostemium of male diclinous flowers present body, rostellum, stipe and caudicle formed by small parenchymatic isodiametric cells with small cell spaces, without any other cell detail (Figs. 11, 12). The pollinaria, inserted in upper projection of the caudicle, is formed by two groups of pollinia which appear in upper ventral position, and which presents small cells of dense intracellular content (Figs. 12).

Unlikely the female diclinous flowers, during the development of the gynostemium, stigmatic morphologic changes can be observed in the male flowers. In them, such structure, in the initial development period, presents infolds in the basal and medial portions and trident-like shape in the upper



Figures 8-15. Longitudinal sections in gynostemia of flowers of *Catasetum fimbriatum* (C. Morren) Lindl. 8-9, longitudinal section in distal portion of the gynostemium of a female diclinous flower; arrows evidence the vascular bundle from the rostellum (white) and secreting cells of viscine adhered to the stigma (black). 10, longitudinal section in the stigmatic portion of the female diclinous flower; (a) cell cluster. 11, longitudinal section of the gynostemium of a male diclinous flower in the anthesis phase; (a) rostellum; (b) non-functional stigma. 12, longitudinal section in gynostemium of a male diclinous flower in anthesis phase; (a) pollinaria; (b) stipe. 13-15, longitudinal section in stigmas of male diclinous flowers in different phases of development (openings in the center of the image). 13, primordium of the flower bud formation. 14, intermediate development phase. 15, anthesis. Scales: 8-15= 120 µm; a = 15 µm.

part (Fig. 13). It can be seen that such morphologies change gradually in the initial period, going through an intermediate development phase until they take the final shape in the anthesis, in which occurs the disappearance of the infolds in the medial and basal region and attenuation of the trident-like aspect of the stigma in the upper part (Figs. 14-15).

Discussion

Sexual floral differentiation influenced by light. — The ovarian depressions occurring in the female flowers, resulting in morphology similar to the flower display usually found in flowers of Orchidaceae. The results of the anatomical ovarian assessment of flowers of both sexes in different phases of development and light intensities allowed the classification of the ovaries as three-carpelated and unilocular, with the fruit formation taking place only after the pollination.

The results obtained suggest that the occurrence of sexual differentiation in *Catasetum fimbriatum* is directly influenced by the exposure to different light intensities. Such observation is corroborated by similar data found for some species of *Catasetum* and *Cycnoches* (Gregg 1975, Aronovitz & Aronovitz 1976, Batchelor 2001) and for: *Catasetum barbatum*, under cultivation (Soukup 1976) and *Catasetum viridiflavum*, in natural conditions (Zimmermam 1991). Thus, the exposure of *C. fimbriatum* to high light intensities induces, predominantly the differentiation of female diclinous flowers and the exposure to more shading settings, male diclinous ones. The monoclinic flowers, therefore, only appear when there is great variation in the light intensity of the environment (Moraes & Almeida 2004, Pedroso-de-Moraes 2004, Pedroso-de-Moraes & Almeida 2005, Brescansin *et al.* 2013). However, evidence shows that certain representatives of the Catasetinae subtribe generate female diclinous flowers not only when exposed to intense luminosity, but also, due to nutritional lack (Zimmerman 1990, Arditti 1992) and aging (Freeman *et al.* 1980), factors which may act synergistically with light.

Such statements are corroborated by the fact that plants with sexual dimorphism have their sexual expression influenced by their nutritional status, age states and by variations in the rates of exposure to solar radiation, independently of the genetic traits they present (Taiz & Zeiger 2006, Kerbauy 2009). The sexual reversion by hormonal action indicated in some plants, the genes required for the development of the androecium and gynoecium are functional, but silenced. Thus, the action of a hormone to feminize and masculinize flowers can have effects totally different in many plants, since this variation reflects the different mechanisms studied concerning the sexual determination (Dellaporta & Calderon-Urrea 1993).

From the observation that the *C. fimbriatum* is a monoecous species, with genetic-hormonal flower sexual determination system and, also, according to the results obtained in the treatments performed, it becomes possible to hypothesize that auxin and ethylene can be a component of the environment sensory mechanism associated with flower phenotypic plasticity of the species. Hence, the balance between the endogenous levels of these phytohormones triggers the floral sexual differentiation. In this species, it is worth investigating the mechanism in which the increase of the synthesis of auxins and the decrease of the ethylene levels determine the occurrence of male diclinous flowers, and the opposite situation, in relation to the phytohormones (Brescansin *et al* .2013), the occurrence of female diclinous flowers, as has been described for several species of monocotyledons (Taiz & Zeiger 2006, Kerbauy 2009). The monoclinic flowers, therefore, likely would only appear when the endogenous levels of auxins and ethylene occurred in extremes which are consistent with their appearance following by female, male or both diclinous flowers.

Reproductive morphology and anatomy. — The existence of one-layered epidermis and the presence of mesophyll before pollination, observed for all the ovaries of flowers of both sexes in different light levels, it`s in accordance with the descriptions made to orchids of different habitats in Orchidoideae and Epidendroideae subfamilies (Arditti 1992). Such features only differ in some representatives of the Apostasidoideae, where a collenchymatose hypodermis are found under the epidermal cells, related to the mechanical protection of ovaries under development (Solereder & Meyer 1930). Moreover, the parietal placentation is described according with the observed for innumerous species belonging to the phylogenetically more derived subfamilies, Cypripedioideae, Vanilloideae, Orchidoideae and Epidendroideae (Arditti 1992, Pridgeon *et al.* 2001, 2003, 2006, 2009) in relation to Apostasidoideae, in which the species present free central placentation (Solereder & Meyer 1930, Pridgeon *et al.* 1999).

Ovaries of many orchids of different subfamilies can present trichomes internally, which can vary widely in size and shape, and may or may not contain anthocyanin pigment (Arditti 1992). The function of the trichomes is not completely clear, but it is described as related, mainly, to the mechanical protection of the ovary and fruit (e.g., Arditti 1992). The presence of anthocyanin in these structures can be interpreted as protection against light occurs in fruits (Taiz & Zeiger 2006), since epiphyte species can be subjected to high light intensity (Perleberg *et al*. 2008).

The cell clusters found in the ovaries analyzed in the anthesis of female and male diclinous flowers, due to their features, can be classified as meristematic clusters (Esau 1980, Cutter 1992), capable of originating ovules under the appropriate hormonal stimulus. Such suggestion is corroborated by the fact that the orchids produce ovules through differentiation of the parenchymatic/meristematic tissue, only after pollination, and such differentiation is stimulated by chemical substances produced by the deposit of pollinia mass in the stigmatic cavities (Arditti 1992).

The vascular anatomy of the ovaries of the flowers of both sexes is in accordance with the one described for the Orchidaceae. Vascular bundles originated from the flower rachis develop through the whole extension of the pedicles and originate many vases which irrigate each one of the carpels (Swamy 1948).

The gynostemium feature is an extremely specialized structure which, consequently, defines the Orchidaceae. In this species, the gynostemium is formed by the partial fusion of the androecium and gynoecium in Apostasidoideae (Pridgeon *et al.* 1999) and total fusion in Vanilloideae, Cypripedioideae, Orchidoideae and Epidendroideae (Pridgeon *et al.* 2001, 2003, 2006, 2009). However, in Catasetinae (Epidendroideae) the exception is in diclinous flowers, found in plants such as *Catasetum fimbriatum*.

How described for the flowers analyzed in this work, anatomical studies in gynostemia of *Bulbophyllum*, *Cranichis*, *Diuris* and *Phalaenopsis* (Rasmussen 1985, Arditti 1992, Pridgeon *et al.* 2001, 2003) showed that in these taxa, this organ presents body, rostellum, stipe and caudicle without any clear anatomical detail and formed by small isodiametric parenchymatic cells which form the tissue which predominates anticlinal cell divisions and small intercellular spaces.

There are three basic patterns described concerning the origin and nature of the stamen and stigma vascularization for gynostemium in Orchidaceae. The most important vascular bundles described for the monoclinous gynostemium appear in the following way: - A1, bundle which ramifies from the main dorsal and which supplies the functional stamen; G1, G2 and G3, bundles which ramify from the main ventral and which extends to the inside of the rostellum and stigmas and, A2 and A3, which ramifies from the main dorsal and goes to the side stamens of the beginning of the verticil (Swamy 1948). Thus, in monoclinous flowers of the family, generally, two vascular bundles, a ventral one and a dorsal one, originate the secondary ramifications. With the first vascular bundle ramifying itself near the rostellum and stigma and the other one in the pollinia region (Arditti 1992, Romero 1992). Once more, the existing difference between the monoclinous and diclinous gynostemium is evidenced (Romero 1992). In the female diclinous gynostemium, unlikely the monoclinous, the only vascular bundle is near the stigma region. However, in the male diclinous gynostemium, the bundle gets closer to the pollinia, as in monoclinous gynostemium.

As described before, unlike the male diclinous flowers, secreting cells can be found in the stigma of the female flowers. This corroborates with the statement that the stigmas of several species of Orchidaceae are covered by pappilary secreting cells, which in general are enlarged, vacuolated, of prominent nucleus and which produce secretions of mucopolysaccharid acids (Arditti 1992, Kurzweil *et al.* 2005).

The stipe is an attachment of the pollinaria derived from the rostellum. The caudicles are found adhered to it, while it is joined in the final portion of the viscidium. In some orchids, the joint is easily seen, as in the studied species, but in others its distinction becomes extremely difficult (Arditti 1992).

As evidenced in this study, the caudicles, in general, do not have any cell detail and are very elastic. Their cells are viewed as a meristematic mass adjacent to the pollinia (Kurzweil *et al.* 2005). They are small, dense and of two kinds: cells of thick walls and cells of thin walls. In the center of the mass, the thick-wall cells are similar to the ones which develop the pollen. The cytoplasm of vegetative cells in the maturity is dense and contains a prominent nucleus, numerous mitochondria and plastids. The generative cells are small, have a prominent vacuole and dense nucleus, but a limited number of organelles. The exine of the caudicle, as the one of the pollinia, is composed at first of sporopollenin, as evidenced by its resistance to the acelolyses (Arditti 1992, Kurzweil *et al.* 2005).

The cell clusters formed by typically meristematic cells, found in the ovaries and located right above the female diclinous flower stigma, are evidence, once more, that the differentiation of flowers of both sexes is triggered by environmental stimulus, detected commonly in plants by phytochromes (Gates 1981, Nobel 1991), which determine the synthesis of phytohormones. Thus, in this area, when there is the appropriate phytohormonal stimulus, such cells differentiate to form the pollinia. This finding is supported by the detailed studies on morphogenetic sexual organs of many species, which evidences that either male or female diclinous flowers often go through a monoclinous stage, in which all the organs are initiated (Dellaporta & Calderon-Urrea 1993).

Therefore, the formation of diclinous flowers originated from monoclinous meristems requires the action of sex-determining genes (Dellaporta & Calderon-Urrea 1993), since the ability to reverse the mechanism of sexual determination through treatment with vegetal regulators (Taiz & Zeiger 2006), suggests that the flower prime has evidences of inappropriate sexes, being bipotent, and that the sex-determining genes regulate alternative programs of sexuality, possibility through signaling from translation mechanisms which modify the endogenous concentrations of phytohormones (Dellaporta & Calderon-Urrea 1993).

Conclusions. In face of the results obtained in the morphogical and anatomical flower analysis for the definition of the sequence of tissue development involved in sexual differentiation, it can be seen the presence of cell clusters with meristematic features in the ovaries and gynostemia of the female and male diclinous flowers, which are possibly responsible for the definition of sexual expression of the species, in the dependence of the environmental stimulus, related to the endogenous concentration of ethylene, allowing, therefore, the dedifferentiation and re-differentiation of those clusters in determining the flower sexes.

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*Camaridium brevilabium (*Ames & Correll) M. A. Blanco, ***comb. nov.*** — 7(3): 519. 2007. [143]

Camaridium burgeri (J. T. Atwood) M. A. Blanco, ***comb. nov.*** — 7(3): 519. 2007. [143]

Camaridium cacaoense (J.T.Atwood) Whitten, ***comb. nov.*** — 13(3): 388. 2014. [142]

Camaridium campanulatum (C. Schweinf.) M. A. Blanco, ***comb. nov.*** — 7(3): 520. 2007. [143]

Camaridium carinulatum (Rchb. f.) M.A. Blanco, ***comb. nov.*** — 8(1): 15. 2008. [44]

Camaridium cedralense (J. T. Atwood & Mora-Ret.) M. A. Blanco, ***comb. nov.*** — 7(3): 520. 2007. [143]

Camaridium cucullatum (Lindl.) M. A. Blanco, ***comb. nov.*** — 7(3): 520. 2007. [143]

Camaridium densum (Lindl.) M. A. Blanco, ***comb. nov.*** — 7(3): 520. 2007. [143]

Camaridium falcatum (Ames & Correll) M. A. Blanco, ***comb. nov.*** — 7(3): 520. 2007. [143]

Camaridium fragrans (J. T. Atwood) M. A. Blanco, ***comb. nov.*** — 7(3): 520. 2007. [143]

Camaridium gomezianum (J. T. Atwood) M. A. Blanco, ***comb. nov.*** — 7(3): 520. 2007. [143]

Camaridium grisebachianum (Nir & Dod) M. A. Blanco, ***comb. nov.*** — 7(3): 520. 2007. [143]

Camaridium haberi (J. T. Atwood) M. A. Blanco, ***comb. nov.*** — 7(3): 520. 2007. [143]

Camaridium hagsaterianum (Soto Arenas) M. A. Blanco, ***comb. nov.*** — 7(3): 520. 2007. [143]

Camaridium horichii (Senghas) M. A. Blanco, ***comb. nov.*** — 7(3): 520. 2007. [143]

Camaridium inauditum (Rchb.f.) M. A. Blanco, ***comb. nov.*** — 7(3): 520. 2007. [143]

Camaridium insolitum (Dressler) M. A. Blanco, ***comb. nov.*** — 7(3): 520. 2007. [143]

Camaridium lankesteri (Ames) M. A. Blanco, ***comb. nov.*** — 7(3): 520. 2007. [143]

Camaridium longicolumna (J. T. Atwood) M. A. Blanco, ***comb. nov.*** — 7(3): 520. 2007. [143]

Camaridium lutheri (J. T. Atwood) M. A. Blanco, ***comb. nov.*** — 7(3): 520. 2007. [143]

Camaridium meleagris (Lindl.) M. A. Blanco, ***comb. nov.*** — 7(3): 520. 2007. [143]

Camaridium micranthum M. A. Blanco, ***nom. nov.*** — 7(3): 520. 2007. [143]

Camaridium microphyton (Schltr.) M. A. Blanco, ***comb. nov.*** — 7(3): 520. 2007. [143]

Camaridium mombachoense (A. H. Heller ex J. T. Atwood) M. A. Blanco, ***comb. nov.*** — 7(3): 520. 2007. [143]

Camaridium monteverdense (J. T. Atwood & G. Barboza) M. A. Blanco, ***comb. nov.*** — 7(3): 521. 2007. [143]

Camaridium neglectum (Schltr.) M. A. Blanco, ***comb. nov.*** — 7(3): 521. 2007. [143]

Camaridium obscurum (Linden & Rchb.f.) M. A. Blanco, ***comb. nov.*** — 7(3): 521. 2007. [143]

Camaridium oestlundianum (L. O. Williams) M. A. Blanco, ***comb. nov.*** — 7(3): 521. 2007. [143]

Camaridium paleatum (Rchb.f.) M. A. Blanco, ***comb. nov.*** —7(3): 521. 2007. [143]

Camaridium praestans (Rchb.f.) M. A. Blanco, ***comb. nov.*** — 7(3): 521. 2007. [143]

Camaridium pygmaeum M. A. Blanco, ***nom. nov.*** — 7(3): 521. 2007. [143]

Camaridium ramonense (Schltr.) M. A. Blanco, ***comb. nov.*** — 7(3): 521. 2007. [143]

Camaridium rhombeum (Lindl.) M. A. Blanco, ***comb. nov.*** — 7(3): 521. 2007. [143]

Camaridium scalariforme (J. T. Atwood) M. A. Blanco, ***comb. nov.*** — 7(3): 521. 2007. [143]

Camaridium sigmoideum (C. Schweinf.) M. A. Blanco, ***comb. nov.*** — 7(3): 521. 2007. [143]

Camaridium soconuscanum (Breedlove & D. Mally) M. A. Blanco, ***comb. nov.*** — 7(3): 521. 2007. [143]

Camaridium standleyi M. A. Blanco, ***nom. nov.*** — 7(3): 521. 2007. [143]

Camaridium stenophyllum (Schltr.) M. A. Blanco, ***comb. nov.*** — 7(3): 521. 2007. [143]

Camaridium strumatum (Endres & Rchb.f.) M. A. Blanco, ***comb. nov.*** — 7(3): 521. 2007. [143]

Camaridium suaveolens (Barringer) M. A. Blanco, ***comb. nov.*** — 7(3): 521. 2007. [143]

Camaridium synsepalum (J. T. Atwood) M. A. Blanco, ***comb. nov.*** — 7(3): 521. 2007. [143]

Camaridium tigrinum (C. Schweinf.) M. A. Blanco, ***comb. nov.*** — 7(3): 521. 2007. [143]

Camaridium tricarinatum (J. T. Atwood) M. A. Blanco, ***comb. nov.*** — 7(3): 522. 2007. [143]

Camaridium tuberculare (J. T. Atwood) M. A. Blanco, ***comb. nov.*** — 7(3): 522. 2007. [143]

Camaridium tutae (J. T. Atwood) M. A. Blanco, ***comb. nov.*** — 7(3): 522. 2007. [143]

Camaridium vaginale (Rchb.f.) M. A. Blanco, ***comb. nov.*** — 7(3): 522. 2007. [143]

Camaridium valerioi (Ames & C. Schweinf.) M. A. Blanco, ***comb. nov.*** — 7(3): 522. 2007. [143]

Camaridium vittariifolium (L. O. Williams) M. A. Blanco, ***comb. nov.*** — 7(3): 522. 2007. [143]

Campylocentum palominoi M. Kolanowska, O. Pérez & E. Parra, ***sp. nov.*** — 12(1): 9. 2012. [250]

Chondroscaphe endresii (Schltr.) Dressler, ***comb. nov.*** — 3: 28. 2002. [243]

Christensonella cepula (Rchb.f.) S. Koehler, ***comb. nov.*** — 7(3): 522. 2007. [143]

Christensonella neowiedii (Rchb.f.) S. Koehler, ***comb. nov.*** — 7(3): 522. 2007. [143]

Christensonella pacholskii (Christenson) S. Koehler, ***comb. nov.*** — 7(3): 522. 2007. [143]

Christensonella squamata (Barb. Rodr.) Carnevali, ***comb. nov.*** — 7(3): 523. 2007. [143]

Cohniella amazonica Cetzal & Carnevali, ***sp. nov.*** — 13(3): 208. 2014. [248]

Comparettia sotoana Pupulin & G.Merino, ***sp. nov.*** — 9(3): 400. 2010. [54]

Coryanthes kaiseriana G. Gerlach, ***sp. nov.*** — 8: 23. 2003. [409]

Coryanthes maduroana G. Gerlach, ***spec. nov.*** — 4(1): 70. 2004. [410]

Crossoglossa sotoana Pupulin & Karremans, ***sp. nov.*** — 9(3): 444. 2010. [70]

Cryptocentrum Benth. subgenus *Anthosiphon* (Schltr.) Carnevali, ***comb. et stat. nov.*** — 7(3): 543. 2007. [143]

Cyrtochilum betancurii G.Giraldo & Dalström ***sp. nov.*** — 12(3): 137. 2012. [228]

Cyrtochilum carinatum (Königer & Deburghgr.) Dalström, ***comb. nov.*** — 12(3): 149. 2012. [425]

Cyrtochilum corniculatum Dalström, ***sp. nov.*** — 12(3): 147. 2012. [425]

Cyrtochilum deburghgraeveanum Dalström & S.Ruíz, ***sp. nov.*** — 12(2): 93. 2012. [424]

Cyrtochilum dunstervilleorum G.Morillo & Dalström, ***sp. nov.*** — 12(2): 101. 2012. [442]

Cyrtochilum fernandezii G.Morillo & Dalström, ***sp. nov.*** — 12(2): 103. 2012. [442]

Cyrtochilum miradorense (D.E.Benn. & Christenson) Dalström ex D. Trujillo., ***comb. nov.*** — 14(1): 79. 2014. [17]

Cyrtochilum ruizii Dalström & Deburghgraeve, ***sp. nov.*** — 12(2): 95. 2012. [424]

Cyrtochilum russellianum Dalström & Ruíz-Pérez, ***sp. nov.*** — 12(3): 149. 2012. [425]

Cyrtochilum soennemarkii Dalström ***sp.nov.*** — 15(1): 101. 2015. [229]

Cyrtochilum tricornis Dalström & Ruíz-Pérez, ***sp. nov.*** — 12(3): 151. 2012. [425]

Cyrtochilum violaceum Dalström, *sp. nov.* — 12(3): 143. 2012. [233]

Cyrtochilum xanthocinctum Dalström & S.Ruíz, *sp. nov.* — 12(2): 98. 2012. [424]

Daiotyla Dressler, ***gen. nov.*** — 145

Daiotyla albicans (Rolfe) Dressler, ***comb. nov.*** — 145

Daiotyla crassa (Dressler) Dressler, ***comb. nov.*** — 145

Daiotyla maculata (Garay) Dressler, ***comb. nov.*** — 145

Deiregyne densiflora (C.Schweinf.) Salazar & Soto Arenas, ***comb. nov.*** — 9(3): 502. 2010. [405]

Dendrophylax monteverdi (Rchb.f.) Ackerman & Nir, ***comb. nov.***— 4(1): 53. 2004. [269]

Dichaea elliptica Dressler & Folsom, ***sp. nov.*** — 3: 25. 2002. [243]

Echinella vittata (Pupulin & M.A. Blanco) Pupulin, ***comb. nov.*** — 4: 17. 2002. [41]

Echinorhyncha Dressler, ***gen. nov.*** — 5(2): 94. 2005. [145]

Echinorhyncha antonii (Ortiz) Dressler, ***comb. nov.*** — 5(2): 94. 2005. [145]

Echinorhyncha ecuadorensis (Dodson) Dressler, ***comb. nov.*** — 5(2): 94. 2005. [145]

Echinorhyncha litensis (Dodson) Dressler, ***comb. nov.*** — 5(2): 94. 2005. [145]

Echinorhyncha vollesii (Gerlach, Neudecker & Seeger) Dressler, ***comb. nov.*** — 5(2): 94. 2005. [145]

Echinosepala vittata (Pupulin & M.A. Blanco) C.O. Morales & N. Villal., ***comb. nov.*** — 4(3): 202. 2004. [430]

Elleanthus carinatus Dressler & Bogarín, ***sp. nov.*** — 9(3): 475. 2010. [404]

Elleanthus ligularis Dressler & Bogarín, ***sp. nov.*** — 7(3): 539. 2007. [101]

Encyclia cajalbanensis Mújica, Bocourt & Pupulin, ***sp. nov.*** — 4(3): 211. 2004. [102]

Encyclia monteverdensis M.A. Díaz & Ackerman, ***sp. nov.*** — 4(1): 50. 2004 [269]

Encyclia × nizanburyi Pérez-García & Hágsater, ***hyb. nat. nov.*** — 12(1): 1. 2012. [103]

Epidendrum alieniferum Karremans & Bogarín, ***sp. nov.*** — 12(1): 27. 2012. [246]

Epidendrum cancanae (P.Ortiz) Hágsater, ***comb. nov.*** — 5(1): 73. 2005. [434]

Epidendrum fuscinum (Dressler) Hágsater, ***comb. nov.*** — 5(1): 73. 2005. [434]

Epidendrum jalcaënse Chocce, Dalström, Hágsater & Arnaiz, ***sp. nov.*** — 9(3): 529. 2010. [109]

Epidendrum jorge-warneri Karremans & Hágsater, ***sp. nov.*** — 13(3): 260. 2014. [247]

Epidendrum macdougalli (Hágsater) Hágsater, ***comb. nov.*** — 5(1): 74. 2005. [434]

Epidendrum misasii Hágsater, ***nom. nov.*** — 5(1): 74. 2005. [434]

Epidendrum × monteverdense (Pupulin & Hágsater) Hágsater, ***comb. nov.*** — 5(1): 74. 2005. [434]

Epidendrum montis-narae Pupulin & L. Sánchez, ***sp. nov.*** — 1: 7. 2001. [4]

Epidendrum paruimense G.A. Romero & Carnevali, ***sp. nov.***— 4(3): 229. 2004. [241]

Epidendrum parviexasperatum (Hágsater) Hágsater, ***comb. nov.*** — 5(1): 74. 2005. [434]

Epidendrum × sandiorum Hágsater, Karremans & L.Sánchez, ***nothosp. nov.*** — 12(1): 32. 2012. [246]

Epidendrum sotoanum Karremans & Hágsater, ***sp. nov.*** — 9(3): 405. 2010. [57]

Epidendrum stolidium Hágsater, ***nom. nov.*** — 5(1): 74. 2005. [434]

Epidendrum zunigae Hágsater, Karremans & Bogarín, ***sp. nov.*** — 8(2): 63. 2008. [245]

Euryblema Dressler, ***gen. nov.*** — 5(2): 94. 2005. [145]

Euryblema anatonum (Dressler) Dressler, ***comb. nov.*** — 5(2): 94. 2005. [145]

Euryblema andreae (Ortiz) Dressler, ***comb. nov.*** — 5(2): 94. 2005. [145]

Fernandezia pastorelliae D. Trujillo. ***sp. nov.*** — 14(1): 59. 2014. [17]

Govenia viaria Dressler, ***sp. nov.*** — 3: 26. 2002. [243]

Guarianthe Dressler & W.E. Higgins, ***gen. nov.*** — 7: 37. 2003. [155]

Guarianthe aurantiaca (Bateman ex Lindl.) Dressler & W.E. Higgins, ***comb. nov.*** — 7: 38. 2003. [155]

Guarianthe bowringiana (Veitch) Dressler & W.E. Higgins, ***comb. nov.*** — 7: 38. 2003. [155]

Guarianthe patinii (Cogn.) Dressler & W.E. Higgins, ***comb. nov.*** — 7: 38. 2003. [155]

Guarianthe skinneri (Bateman) Dressler & W.E. Higgins, ***comb. nov.*** — 7: 38. 2003. [155]

Inti M. A. Blanco, ***gen. nov.*** — 7(3): 524. 2007. [143]

Inti bicallosa (Rchb.f.) M. A. Blanco, ***comb. nov.*** — 7(3): 524. 2007. [143]

Inti chartacifolia (Ames & C. Schweinf.) M. A. Blanco, ***comb. nov.*** — 7(3): 524. 2007. [143]

Ixyophora Dressler, ***gen. nov.*** — 5(2): 95. 2005. [145]

Ixyophora aurantiaca (Senghas & Gerlach) Dressler, ***comb. nov.*** — 5(2): 95. 2005. [145]

Ixyophora carinata (Ortiz) Dressler, ***comb. nov.*** — 5(2): 95. 2005. [145]

Ixyophora viridisepala (Senghas) Dressler, ***comb. nov.*** — 5(2): 95. 2005. [145]

Lankesterella glandula Ackerman, ***sp. nov.*** — 4(1): 49. 2004. [269]

Lankesteriana Karremans, ***gen. nov.*** — 13(3): 321. 2014. [187]

Lankesteriana abbreviata (Schltr.) Karremans, ***comb. nov.*** — 13(3): 326. 2014. [187]

Lankesteriana barbulata (Lindl.) Karremans, ***comb. nov.*** — 13(3): 326. 2014. [187]

Lankesteriana casualis (Ames) Karremans, ***comb. nov.*** — 13(3): 327. 2014. [187]

Lankesteriana caudatipetala (C.Schweinf.) Karremans, ***comb. nov.*** — 13(3): 327. 2014. [187]

Lankesteriana comayaguensis (Ames) Karremans, ***comb. nov.*** — 13(3): 327. 2014. [187]

Lankesteriana cuspidata (Luer) Karremans, ***comb. nov.*** — 13(3): 327. 2014. [187]

Lankesteriana duplooyi (Luer & Sayers) Karremans, ***comb. nov.*** — 13(3): 327. 2014. [187]

Lankesteriana edmeiae (F.J. de Jesus, Xim. Bols. & Chiron) Karremans, ***comb. nov.*** — 13(3): 327. 2014. [187]

Lankesteriana escalarensis (Carnevali & Luer) Karremans, ***comb. nov.*** — 13(3): 327. 2014. [187]

Lankesteriana fractiflexa (Ames & C.Schweinf.) Karremans, ***comb. nov.*** — 13(3): 327. 2014. [187]

Lankesteriana haberi (Luer) Karremans, ***comb. nov.*** — 13(3): 327. 2014. [187]

Lankesteriana imberbis (Luer & Hirtz) Karremans, ***comb. nov.*** — 13(3): 327. 2014. [187]

Lankesteriana inversa (Luer & R.Vásquez) Karremans, ***comb. nov.*** — 13(3): 327. 2014. [187]

Lankesteriana involuta (L.O.Williams) Karremans, ***comb. nov.*** — 13(3): 327. 2014. [187]

Lankesteriana millipeda (Luer) Karremans, ***comb. nov.*** — 13(3): 327. 2014. [187]

Lankesteriana minima (C.Schweinf.) Karremans, ***comb. nov.*** — 13(3): 327. 2014. [187]

Lankesteriana muricaudata (Luer) Karremans, ***comb. nov.*** — 13(3): 327. 2014. [187]

Lankesteriana rubidantha (Chiron & Xim.Bols.) Karremans, ***comb. nov.*** — 13(3): 327. 2014. [187]

Lankesteriana steinbuchiae (Carnevali & G.A.Romero) Karremans, ***comb. nov.*** — 13(3): 327. 2014. [187]

Lepanthes arenasiana Bogarín & M. Fernández, ***sp. nov.*** — 9(3): 487. 2010. [189]

Lepanthes erubescens Bogarín, Pupulin & Karremans, ***sp. nov.*** — 12(2): 108. 2012. [422]

Lepanthes gerardensis M.A. Blanco, ***sp. nov.*** — 8: 19. 2003. [190]

Lepanthes kabebatae Bogarín, Karremans & Mel. Fernández, ***sp. nov.*** — 12(1): 35. 2012. [246]

Lepanthes montis-narae Pupulin, Bogarín & C. Smith, ***sp. nov.*** — 9(3): 425. 2010. [443]

Lepanthes sandiorum Bogarín & Karremans, ***sp. nov.*** — 12(2): 108. 2012. [422]

Lepanthes sanjuanensis Bogarín & Karremans, ***sp. nov.*** — 12(2): 113. 2012. [422]

Lepanthes sotoana Pupulin, Bogarín & C. Smith, ***sp. nov.*** — 9(3): 427. 2010. [443]

Lepanthopsis trulliformis I.Jiménez, ***sp. nov.*** — 15(3): 192. [332]

Ligeophila gavilanensis Ormerod & G. A. Romero, ***sp. nov.*** — 9(3): 513. 2010. [278]

Lophiaris natalieae Balam & Carnevali, ***sp. nov.*** — 9(3): 522. 2010. [251]

Lycaste bruncana Bogarín, ***sp. nov.*** — 7(3): 543. 2007. [23]

Malaxis brevis Dressler, ***sp. nov.*** — 4(1): 97. 2004. [449]

Malaxis insperata Dressler, ***sp. nov.*** — 4(1): 97. 2004. [449]

Malaxis rostratula Dressler, ***sp. nov.*** — 4(1): 97. 2004. [449]

Malaxis triangularis Dressler, ***sp. nov.*** — 4(1): 97. 2004. [449]

Mapinguari Carnevali & R. Singer, **gen. nov.** — 7(3): 525. 2007. [143]

Mapinguari auyantepuiensis (Foldats) Carnevali & R. Singer, ***comb. nov.*** — 7(3): 525. 2007. [143]

Mapinguari desvauxianus (Rchb.f.) Carnevali & R. Singer, ***comb. nov.*** — 7(3): 525. 2007. [143]

Mapinguari foldatsianus (Carnevali & I. Ramírez) Carnevali & R. Singer, ***comb. nov.*** — 7(3): 525. 2007. [143]

Mapinguari longipetiolatus (Ames & C. Schweinf.) Carnevali & R. Singer, ***comb. nov.*** — 7(3): 525. 2007. [143]

Masdevallia fenestralis Dalström & Ruíz-Pérez, ***sp. nov.*** — 15(1): 59. 2015. [441]

Masdevallia fenestrellata Dalström & Ruíz-Pérez, ***sp. nov.*** — 15(1): 62. 2015. [441]

Masdevallia goettfertiana Dalström & Ruíz-Pérez, ***sp. nov.*** — 15(2): 141. 2015. [427]

Masdevallia hortilankesteriani Dalström & RuízPérez, ***sp. nov.*** — 13(3): 251. 2014. [423]

Masdevallia karelii Dalström & Ruíz-Pérez, ***sp. nov.*** — 13(3): 254. 2014. [423]

Masdevallia robineae Dalström & Ruíz-Pérez, ***sp. nov.*** — 15(2): 145. 2015. [427]

Masdevallia roseogena Dalström & Ruíz-Pérez, ***sp. nov.*** — 15(2): 146. 2015. [427]

Masdevallia rugosilabia Dalström & Ruíz-Pérez, ***sp. nov.*** — 13(3): 256. 2014. [423]

Masdevallia vilcabambensis L. Valenz. & Suclli, ***sp. nov.*** — 8(1): 17. 2008. [252]

Maxillariella M.A. Blanco & Carnevali, ***gen. nov.*** — 7(3): 543. 2007. [143]

Maxillariella acervata (Rchb.f.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 528. 2007. [143]

Maxillariella alba (Hook.f.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 528. 2007. [143]

Maxillariella anceps (Ames & C. Schweinf.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 528. 2007. [143]

Maxillariella appendiculoides (C. Schweinf.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 528. 2007. [143]

Maxillariella arbuscula (Lindl.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 528. 2007. [143]

Maxillariella brevifolia (Lindl.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 528. 2007. [143]

Maxillariella caespitifica (Rchb.f.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 528. 2007. [143]

Maxillariella cassapensis (Rchb.f.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 528. 2007. [143]
Maxillariella caucae (Garay) Bogarín, ***comb. nov.*** — 14(3): 225. 2014. [446]
Maxillariella caucana (Schltr.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 528. 2007. [143]
Maxillariella cobanensis (Schltr.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 528. 2007. [143]
Maxillariella costaricensis (Schltr.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 528. 2007. [143]
Maxillariella curtipes (Hook.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 528. 2007. [143]
Maxillariella densifolia (Poepp. & Endl.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 528. 2007. [143]
Maxillariella diuturna (Ames & C. Schweinf.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 528. 2007. [143]
Maxillariella elatior (Rchb.f.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 528. 2007. [143]
Maxillariella estradae (Dodson) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 528. 2007. [143]
Maxillariella foliosa (Ames & C.Schweinf.) Bogarín, ***comb. nov.*** — 14(3): 225. 2014. [446]
Maxillariella funicaulis (C. Schweinf.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 528. 2007. [143]
Maxillariella graminifolia (Kunth) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 528. 2007. [143]
Maxillariella guareimensis (Rchb.f) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 528. 2007. [143]
Maxillariella houtteana (Rchb.f.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 528. 2007. [143]
Maxillariella infausta (Rchb.f.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 529. 2007. [143]
Maxillariella lawrenceana (Rolfe) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 529. 2007. [143]
Maxillariella linearifolia (Ames & C. Schweinf.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 529. 2007. [143]
Maxillariella longibracteata (Lindl.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 529. 2007. [143]
Maxillariella luteorubra (F. Lehm. & Kraenzl.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 529. 2007. [143]
Maxillariella mexicana (J. T. Atwood) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 529. 2007. [143]
Maxillariella microdendron (Schltr.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 529. 2007. [143]
Maxillariella nitidula (Rchb.f.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 529. 2007. [143]
Maxillariella oreocharis (Schltr.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 529. 2007. [143]
Maxillariella pardalina (Garay) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 529. 2007. [143]
Maxillariella pastensis (Rchb.f.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 529. 2007. [143]
Maxillariella ponerantha (Rchb.f.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 529. 2007. [143]
Maxillariella procurrens (Lindl.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 529. 2007. [143]
Maxillariella prolifera (Sw.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 529. 2007. [143]
Maxillariella purpurata (Lindl.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 529. 2007. [143]
Maxillariella robusta (Barb. Rodr.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 529. 2007. [143]
Maxillariella sanguinea (Rolfe) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 529. 2007. [143]
Maxillariella spilotantha (Rchb.f.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 529. 2007. [143]
Maxillariella stenophylla (Rchb.f.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 530. 2007. [143]
Maxillariella stictantha (Schltr.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 530. 2007. [143]
Maxillariella tenuifolia (Lindl.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 530. 2007. [143]
Maxillariella tuerckheimii (Schltr.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 530. 2007. [143]
Maxillariella variabilis (Bateman ex Lindl.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 530. 2007. [143]
Maxillariella vinosa (Rolfe) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 530. 2007. [143]
Maxillariella vulcanica (F. Lehm. & Kraenzl.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 530. 2007. [143]
Maxillariella xanthorhoda (Schltr.) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 530. 2007. [143]
Maxillariella × yucatanensis (Carnevali & R. Jiménez) M. A. Blanco & Carnevali, ***comb. nov.*** — 7(3): 530. 2007. [143]
Mormolyca acutifolia (Lindl.) M. A. Blanco, ***comb. nov.*** — 7(3): 531. 2007. [143]
Mormolyca aureoglobula (Christenson) M. A. Blanco, ***comb. nov.*** — 7(3): 531. 2007. [143]
Mormolyca chacoensis (Dodson) M. A. Blanco, ***comb. nov.*** — 7(3): 531. 2007. [143]
Mormolyca cleistogama (Brieger & Illg) M. A. Blanco, ***comb. nov.*** — 7(3): 531. 2007. [143]
Mormolyca dressleriana (Carnevali & J. T. Atwood) M. A. Blanco, ***comb. nov.*** — 7(3): 531. 2007. [143]
Mormolyca hedwigiae (Hamer & Dodson) M. A. Blanco, ***comb. nov.*** — 7(3): 531. 2007. [143]
Mormolyca lehmanii (Rolfe) M. A. Blanco, ***comb. nov.*** — 7(3): 531. 2007. [143]
Mormolyca moralesii (Carnevali & J. T. Atwood) M. A. Blanco, ***comb. nov.*** —7(3): 531. 2007. [143]
Mormolyca pudica (Carnevali & Tapia-Muñoz) M. A. Blanco, ***comb. nov.*** — 7(3): 531. 2007. [143]
Mormolyca richii (Dodson) M. A. Blanco, ***comb. nov.*** — 7(3): 531. 2007. [143]

Mormolyca rufescens (Lindl.) M. A. Blanco, ***comb. nov.*** — 7(3): 531. 2007. [143]

Mormolyca sanantonioensis (Christenson) M. A. Blanco, ***comb. nov.*** — 7(3): 531. 2007. [143]

Mormolyca schlimii (Linden & Rchb.f.) M. A.Blanco, ***comb. nov.*** — 7(3): 531. 2007. [143]

Mormolyca sotoana (Carnevali & Gómez-Juárez) M. A. Blanco, ***comb. nov.*** — 7(3): 531. 2007. [143]

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Ornithidium affine (Poepp. & Endl.) M. A. Blanco & Ojeda, ***comb. nov.*** — 7(3): 532. 2007. [143]

Ornithidium cachacoense (J. T. Atwood) M. A. Blanco & Ojeda, ***comb. nov***. — 7(3): 532. 2007. [143]

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Ornithidium gualaquizense (Dodson) M. A. Blanco & Ojeda, ***comb. nov.*** — 7(3): 532. 2007. [143]

Ornithidium haemathodes (Ruiz & Pav.) M. A. Blanco & Ojeda, ***comb. nov.*** — 7(3): 532. 2007. [143]

Ornithidium lasallei (Foldats) M. A. Blanco & Ojeda, ***comb. nov.*** — 7(3): 532. 2007. [143]

Ornithidium machinazense (D. E. Benn. & Christenson) M. A. Blanco, ***comb. nov.*** — 7(3): 532. 2007. [143]

Ornithidium maldonadoense (J. T. Atwood) M. A. Blanco & Ojeda, ***comb. nov.*** — 7(3): 532. 2007. [143]

Ornithidium minutiflorum (D. E. Benn. & Christenson) M. A. Blanco & Ojeda, ***comb. nov.*** — 7(3): 533. 2007. [143]

Ornithidium nicaraguense (Hamer & Garay) M. A. Blanco & Ojeda, ***comb. nov.*** — 7(3): 533. 2007. [143]

Ornithidium oxapampense (J. T. Atwood) M. A. Blanco & Ojeda, ***comb. nov.*** — 7(3): 533. 2007. [143]

Ornithidium patellum (J. T. Atwood) M. A. Blanco & Ojeda, ***comb. nov.*** — 7(3): 533. 2007. [143]

Ornithidium patulum (C. Schweinf.) M. A. Blanco & Ojeda, ***comb. nov.*** — 7(3): 533. 2007. [143]

Ornithidium pseudonubigenum (J. T. Atwood) M. A. Blanco & Ojeda, ***comb. nov.*** — 7(3): 533. 2007. [143]

Ornithidium pustulosum (J. T. Atwood) M. A. Blanco & Ojeda, ***comb. nov.*** — 7(3): 533. 2007. [143]

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Ornithidium repens (L. O. Williams) M. A. Blanco & Ojeda, ***comb. nov.*** — 7(3): 533. 2007. [143]

Ornithidium rigidum (Barb. Rodr.) M. A. Blanco & Ojeda, ***comb. nov.*** — 7(3): 533. 2007. [143]

Ornithidium scandens (D. E. Benn. & Christenson) M. A. Blanco & Ojeda, ***comb. nov.*** — 7(3): 533. 2007. [143]

Ornithidium scullianum (J. T. Atwood) M. A. Blanco & Ojeda, ***comb. nov.*** — 7(3): 533. 2007. [143]

Ornithidium sillarense (Dodson & Vásquez) M. A. Blanco & Ojeda, ***comb. nov.*** — 7(3): 533. 2007. [143]

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Pleurothallis dressleriana Bogarín, ***nom. nov.*** — 14(3): 241. 2014. [446]

Pleurothallis folsomii (Luer & Endara) Bogarín, ***comb. nov.*** — 14(3): 241. 2014. [446]

Pleurothallis grammata Dressler, ***nom. nov.*** — 3: 28. 2002. [243]

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Rhetinantha cerifera (Barb. Rodr.) M. A. Blanco, ***comb. nov.*** — 7(3): 534. 2007. [143]

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Rhetinantha mariaisabeliae (J. T. Atwood) M. A. Blanco, ***comb. nov.*** — 7(3): 534. 2007. [143]

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Rhetinantha ophiodens (J. T. Atwood) M. A. Blanco, ***comb. nov.*** — 7(3): 535. 2007. [143]

Rhetinantha pastorellii (D. E. Benn. & Christenson) M. A. Blanco, ***comb. nov.*** — 7(3): 535. 2007. [143]

Rhetinantha schistostele (Schltr.) M. A. Blanco, ***comb. nov.*** — 7(3): 535. 2007. [143]

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Sauvetrea chicana (Dodson) M. A. Blanco, ***comb. nov.*** — 7(3): 535. 2007. [143]

Sauvetrea cornuta (C. Schweinf.) M. A. Blanco, ***comb. nov.*** — 7(3): 535. 2007. [143]

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Sauvetrea machupicchuensis (Christenson) M. A. Blanco, ***comb. nov.*** — 7(3): 535. 2007. [143]

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Sauvetrea sessilis (Lindl.) M. A. Blanco, ***comb. nov.*** — 7(3): 535. 2007. [143]

Sauvetrea trigona subsp. *amaroensis* (D. E. Benn. & Christenson) M. A. Blanco, ***comb. nov.*** — 7(3): 535. 2007. [143]

Scaphyglottis bidentata (Lindl.) Dressler, ***comb. nov.*** — 3: 28. 2002. [243]

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Selenipedium dodsonii P.J.Cribb, ***sp. nov.*** — 15(3): 181. 2015. [255]

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Sobralia fragilis Dressler & Bogarín, ***sp. nov.*** — 9(3): 477. 2010. [404]

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Sotoa confusa (Garay) Salazar, ***comb. nov.*** — 9(3): 501. 2010. [405]

Specklinia acoana Bogarín, ***sp. nov.*** — 13(3): 188. 2014. [172]

Specklinia berolinensis Bogarín, ***sp. nov.*** — 13(3): 191. 2014. [172]

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Specklinia dressleri (Luer) Bogarín & Karremans, ***comb. nov.*** — 14(3): 262. 2014. [446]

Specklinia icterina Bogarín, ***sp. nov.*** — 13(3): 201. 2014. [172]

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Stelis adriananijhuisae Bogarín & Serracín, ***nom. nov.*** — 14(3): 265. 2014. [446]

Stelis ariasii (Luer & Hirtz) Karremans, ***comb. nov.*** — 13(3): 328. 2014. [187]

Stelis asperilinguis (Rchb.f. & Warsz.) Karremans, ***comb. nov.*** — 13(3): 328. 2014. [187]

Stelis aurea (Lindl.) Karremans, ***comb. nov.*** — 13(3): 328. 2014. [187]

Stelis candida (Luer & Hirtz) Karremans, ***comb. nov.*** — 13(3): 328. 2014. [187]

Stelis catenata Karremans, ***nom. nov.*** — 13(3): 328. 2014. [187]

Stelis coripatae (Luer & R.Vásquez) Karremans, ***comb. nov.*** — 13(3): 328. 2014. [187]

Stelis dimidia (Luer) Karremans, ***comb. nov.*** — 13(3): 328. 2014. [187]

Stelis falcatiloba (Ames) Bogarín & Serracín, ***comb. nov.*** — 14(3): 267. 2014. [446]

Stelis furculifera (Dressler & Bogarín) Bogarín, ***comb. nov.*** — 14(3): 267. 2014. [446]

Stelis jesupiorum (Luer & Hirtz) Karremans, ***comb. nov.*** — 13(3): 329. 2014. [187]

Stelis lagarophyta (Luer) Karremans, ***comb. nov.*** — 13(3): 329. 2014. [187]

Stelis lamprophylla (Schltr.) Karremans, ***comb. nov.*** — 13(3): 329. 2014. [187]

Stelis lauta Karremans, ***nom. nov.*** — 13(3): 329. 2014. [187]

Stelis lennartii Karremans, ***nom. nov.*** — 13(3): 329. 2014. [187]

Stelis maguirei (Luer) Karremans, ***comb. nov.*** — 13(3): 329. 2014. [187]

Stelis mediocarinata (C.Schweinf.) Karremans, ***comb. nov.*** — 13(3): 329. 2014. [187]

Stelis megachlamys (Schltr.) Pupulin, ***nom. nov.*** — 4: 74. 2002. [41]

Stelis melanopus (F.Lehm. & Kraenzl.) Karremans, ***comb. nov.*** — 13(3): 329. 2014. [187]

Stelis meridana (Rchb.f.) Karremans, ***comb. nov.*** — 13(3): 329. 2014. [187]

Stelis montis-mortense (Karremans & Bogarín) Bogarín & Karremans, ***comb. nov.*** — 14(3): 270. 2014. [446]

Stelis montserratii (Porsch) Karremans, ***comb. nov.*** — 13(3): 329. 2014. [187]

Stelis papuligera (Schltr.) Karremans, ***comb. nov.*** — 13(3): 329. 2014. [187]

Stelis pertusa I.Jiménez, ***sp. nov.*** — 15(3): 194. 2015. [332]

Stelis regalis (Luer) Karremans, ***comb. nov.*** — 13(3): 329. 2014. [187]

Stelis scariosa (Lex.) Karremans, ***comb. nov.*** — 13(3): 330. 2014. [187]

Stelis schlimii (Luer) Karremans, ***comb. nov.*** — 13(3): 330. 2014. [187]

Stelis sclerophylla (Lindl.) Karremans, ***comb. nov.*** — 13(3): 330. 2014. [187]

Stelis soratana (Rchb.f.) Karremans, ***comb. nov.*** — 13(3): 330. 2014. [187]

Stelis sotoarenasii R.Solano, ***sp. nov.*** — 9(3): 450. 2010. [89]

Stelis spathilabia (Schltr.) Karremans, ***comb. nov.*** — 13(3): 330. 2014. [187]

Stelis spathuliformis (Luer & R.Vásquez) Karremans, ***comb. nov.*** — 13(3): 330. 2014. [187]

Stelis unduavica (Luer & R.Vásquez) Karremans, ***comb. nov.*** — 13(3): 330. 2014. [187]

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Stellilabium smaragdinum Pupulin & M.A. Blanco, ***sp. nov.*** — 5: 28. 2002. [258]

Stenia falcata (Ackerman) Dressler, ***comb. nov.*** — 5(2): 93. 2005. [145]

Stenotyla Dressler, ***gen. nov.*** — 5(2): 96. 2005. [145]

Stenotyla lankesteriana (Pupulin) Dressler, ***comb. nov.*** — 5(2): 96. 2005. [145]

Stenotyla lendyana (Rchb.f.) Dressler, ***comb. nov.*** — 5(2): 96. 2005. [145]

Stenotyla picta (Rchb.f.) Dressler, ***comb. nov.*** — 5(2): 96. 2005. [145]

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Telipogon acicularis (Dressler) N.H. Williams & Dressler, ***comb. nov.*** — 5(3): 168. 2005. [214]

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