

Notes on *Erycina*-complex with descriptions of new Colombian species

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Abstract The morphological differences between orchid genera synonymized recently under the name *Erycina*, i.e., *Psymorchis*, *Stacyella* and *Erycina* s.str. were evaluated. The results of the revision complemented with the available molecular data support the traditional recognition of three different genera. The morphological description of the taxa included in *Erycina*-complex and artificial keys to the subordinate taxa are provided. Two new species of *Psymorchis* are described and illustrated based on Colombian material and their taxonomic affinities are briefly discussed.

Keywords *Erycina* · Orchids · New species · *Psymorchis* · *Stacyella* · Taxonomy

Introduction

A numerous theoretical (Maynard Smith 1962, 1966; Rice 1987) and empirical (Thoday and Gibson 1970; Howard and Harrison 1984; Hua and Wiens 2013) studies were incorporated into a composite model of speciation via habitat specialization. It was shown that the selection on a habitat preference always leads to the maintenance of an adaptive polymorphism and to the evolution of prezygotic reproductive isolation as a correlated character (Rice 1987; de Meeûs et al. 1993).

The habitat restrictions apply to the majority of orchid species and due to the cosmopolitan distribution of those

plants, plenty of ecological groups may be distinguished within Orchidaceae. One of the most interesting of them, in aspects of evolution, ecology and taxonomy, consists of so-called “twig epiphytes”. The term refers to the plants growing on the smallest branches (<2.5 cm in diameter) of their phorophytes with weak attachment to them (Benzing 1990). This kind of habit is usually related to highest light levels and the greatest fluctuation in water availability (Gowland et al. 2011). The tolerance of twig epiphytes for the high humidity, that is common toward the trunk, is often low (Chase 1988; Zotz 2007). Plants are characterized by the short life cycle (often reaching maturity in one season), presence of hooks or projections on the seed testa (presumably for rapid water recruitment) and psymoid (paedomorphic) habit (Neubig et al. 2012).

The majority of orchid twig epiphytes belong to Angraecinae, Aeridinae and Oncidiinae. As suggested by Dressler (1981), the adaptation to such specific habitat as the small branches has arisen several times within groups of genera. Among Neotropical oncidoid orchids the twig epiphytes were placed within different subtribes (Pabst and Dungs 1977) and as suggested by Chase the habitat variation and morphological adaptations to those different environment conditions do not reflect phylogenetic relationships (Chase and Palmer 1997). The same authors advocated that the radiation of orchid twig epiphytes started with vegetative and life history traits and later moved on to floral diversification in a “leapfrog” pattern. The term “leapfrog radiation” is used to describe a sequence of events starting with the invasion of an adaptive zone (twigs) and succeeded by a secondary radiation involving floral diversification (Stanley 1990; Sanderson 1998).

The recent molecular studies on oncidoid orchids resulted in synonymization of three twig-epiphytic genera under *Erycina* Lindl. (Williams et al. 2001). While this

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concept was accepted in the latest genetic research on Oncidiinae (Neubig et al. 2012), no comprehensive morphological evaluation of *Erycina*-complex has been done so far. The main goal of the research presented here was to evaluate the morphological basis for the generic delimitation of the three genera included in *Erycina* s.l., i.e., *Erycina* Lindl., *Psygmorchis* Dodson and Dressler and *Stacyella* Szlach.

The genus *Erycina* (Fig. 1a)

The Neotropical genus *Erycina* was described by John Lindley in 1853 based on *Oncidium echinatum* Kunth which the author recognized substantially distinct from other oncioid orchids in its dwarf gynostemium, long sigmoid rostellum and prominent wing-like projections (“fleshy column arms”). Lindley noted similarity of *O. echinatum* to *Zygostates* Lindl. and *Leochilus* Knowles & Westc., but differing from the former in its conspicuously alate gynostemium, minute petals and the form of large lip. From the second genus it is easily distinguishable by its elongate, sigmoid rostellum as well as by the lip form.

The genus *Psygmorchis* (Fig. 1b)

In 1972 Dodson and Dressler, based on the distinctive, fan-shaped plant form, established genus *Psygmorchis* designating *Epidendrum pusillum* L. as the nominal species. The authors included in the new taxon species lacking pseudobulbs, producing ensiform leaves and characterized by the free perianth segments. Plants assigned to *Psygmorchis* were previously recognized by Kraenzlin (1920) as representatives of *Oncidium* sect. *Aphanobulbia* subsect. *Iridifolia*. In subsequent research, Dodson (1957) elevated this group to the sectional rank, but later Garay (1963, 1970) suggested that section *Iridifolia* of *Oncidium* should be united with *Lockhartia*. While the latter genus produces laterally flattened leaves like *Psygmorchis*, both differ in crucial characters. The inflorescence in *Lockhartia*

representatives is often terminal (vs lateral in *Psygmorchis*), the tabula infrastigmatica is absent (vs present) and the tegula is bifid (vs entire).

The genus *Stacyella* (Fig. 1c)

During the studies on the Ecuadorian orchids, Dressler and Williams (2003) found one more species of Reichenbach’s *Equitantia* group of *Oncidium* which generic affinity should be reconsidered and they transferred *O. crista-galli* to *Psygmorchis*. This reassignment was later evaluated by Szlachetko (2006) who found this species substantially different from other *Psygmorchis* species in both vegetative (presence of unifoliate pseudobulbs) and generative (oblong clavate, distinctly cleft pollinia, convex tegula) characters.

Materials and methods

In total, over 70 dried herbarium specimens and liquid preserved plants deposited or borrowed from AMES, COL, CUVC, FMB, HUA, K, P, PSO, VALLE and W were examined according to the standard procedures. Every studied specimen was photographed and the data from the label were taken. The presence and form of the pseudobulbs as well as the leaves shape and arrangement were studied first. The details of the inflorescence, e.g., the form of the floral bracts and ovaries were observed under a stereoscopic microscope. The perianth parts were studied after softened flowers in the boiling water.

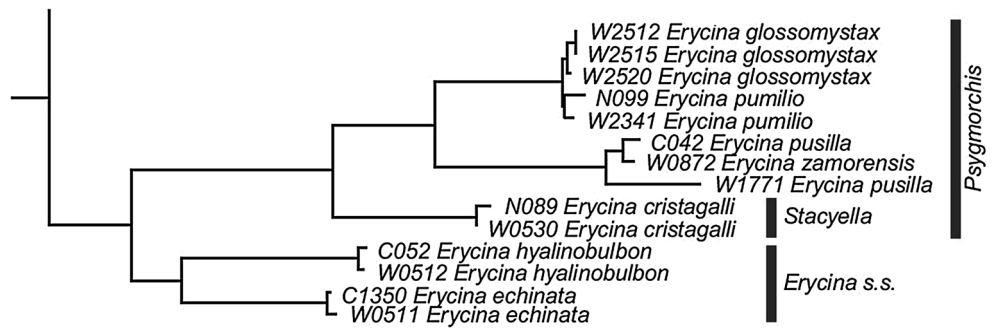
Taxonomic treatment

In the concept of *Erycina* proposed by Williams et al. (2001), the authors included *Psygmorchis* Dodson and Dressler and monotypic *Stacyella* Szlach. Surprisingly, despite the clear statement that all these three genera could be maintained, Neubig et al. (2012) decided to accept the



Fig. 1 a *Erycina diaphana* (J. Valdez Partida). b *Psygmorchis pusilla* (M. Kolanowska). c *Stacyella crista-galli* (J. M. Conejo Chaverri)

Fig. 2 Fragment of a single maximum likelihood tree presented by Neubig et al. (2012)



broad concept of the genus because of their similar floral morphology and modified habit. However, the phylogenetic trees presented by Williams et al. (2001) and Neubig et al. (2012, Fig. 2) show that all three discussed genera are accommodated in the separated clades. The pair *E. diaphana*-*E. echinata* is sister to “*E. pusilla*”-“*E. pumilio*” and those together are sister to “*E. crista-galli*”. Considering this tree structure and the significant differences in the vegetative and floral morphological characters between *Erycina*, *Psymorchis* and *Stacyella*, we postulate to maintain them as separate genera.

Key to the genera of *Erycina*-complex

1. Pseudobulbs absent, leaves arranged in a fan	<i>Psymorchis</i>
1* Pseudobulbs present, 1–2 foliate at the apex	2
2. Pseudobulbs unifoliate at the apex or leaf aborted, subtended by several foliaceous bracts, leaf without articulation	<i>Stacyella</i>
2* Pseudobulbs 1–2 foliate at the apex, subtended by several papyraceous sheaths, articulate at the base	<i>Erycina</i>

Psymorchis Dodson and Dressler

Phytologia 24(4): 288. 1972; Generitype: *Psymorchis pusilla* (L.) Dodson and Dressler [≡ *Epidendrum pusillum* L.].

Pseudobulbs absent. Leaves numerous, distichous, imbricating, equitant, arranged in a fan. Inflorescence lateral, arching, 1–4 flowered. Flowers often proportionately large, yellow, showy, widely opened. Dorsal sepal and petals subsimilar, free, spreading; lateral sepals somewhat larger and basally more or less connate. Lip prominently larger than tepals, three lobed with prominent callus at the base, sometimes hairy; lateral lobes much smaller, spatulate to broadly obovate; middle lobe bilobulate. Gynostemium short, straight, rather delicate. Column part as long as anther or slightly longer, broadly winged near the stigma, wings flabellate and entire or irregularly dissected on margins. Column foot absent. Anther subventral, incumbent, operculate, oblong obtriangular, thin-walled,

obscurely two chambered. Connective narrow, thin, apically elongate. Pollinia 2, clavate obovoid, hard, obscurely or shallowly cleft at the apex. Caudiculae sticky, amorphous. Apical clinandrium narrow. Stigma small, oblong elliptic, deeply concave, partially hidden by rostellum. Rostellum elongate, conical-cylindrical in the middle, blunt. Viscidium single, very small, thin. Tegula single, oblong to oblong deltoid, thin, lamellate, flat. Rostellum remnant bilobulate at the apex (Fig. 3).

Till present, the genus comprised five species distributed from Bolivia and Brazil to Mexico. During examination of the herbarium materials deposited in the Herbarium of National University in Bogotá (COL), we found specimens which, in our opinion, deserve to be described as new.

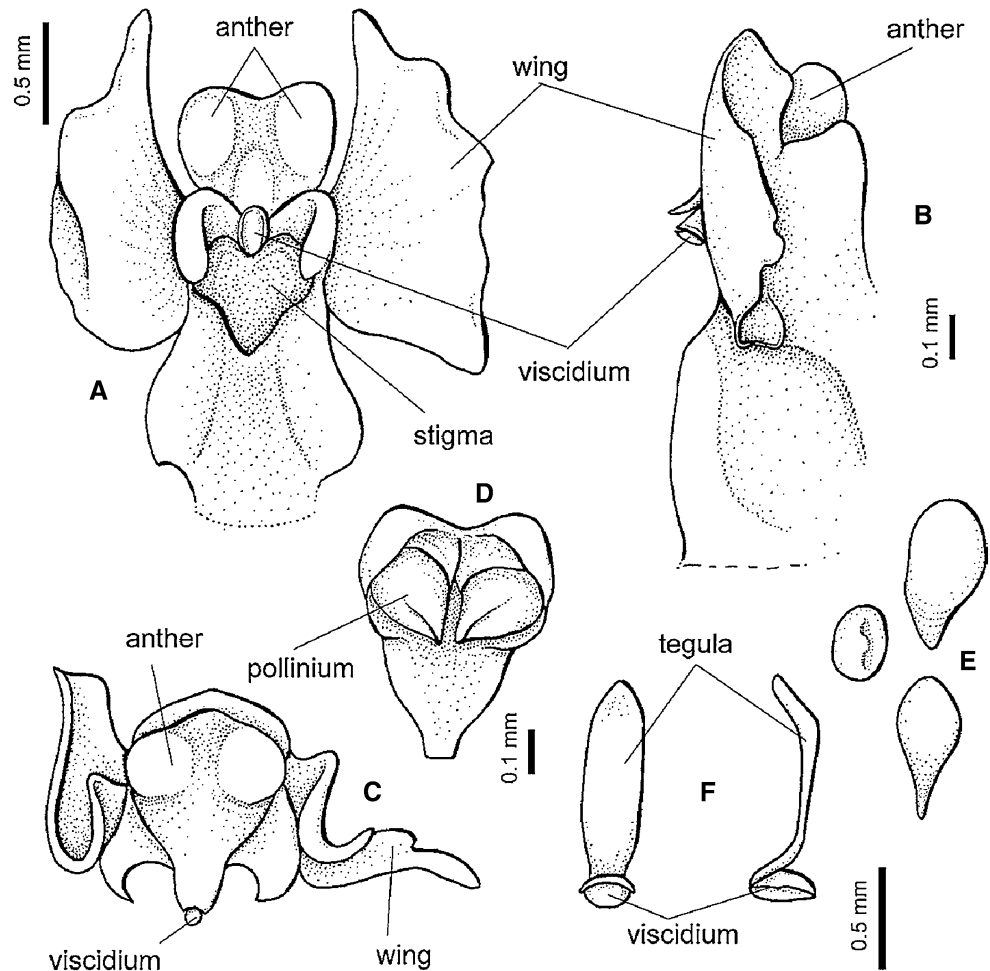
Key to the species

1. Lip lateral lobes large, overlapping the middle lobe lobules	<i>P. zamorensis</i>
1* Lip lateral lobes small, not overlapping the middle lobe lobules	2
2. Callus margins entire	3
2* Callus margins crenate, digitate or fimbriate	4
3. Lateral sepals very shortly connate	<i>P. pusilla</i>
3* Lateral sepals connate to the middle	<i>P. cuatrecasasi</i>
4. Lip longer than broad, lateral lobes quadrate	<i>P. pumilio</i>
4* Lip as long or broader than long, lateral lobes suborbicular	5
5. Flowers entirely yellow, lip broader than long	<i>P. gnomus</i>
5* Flowers spotted brown, lip equally long and wide	6
6. Isthmus between the lobules prominent	<i>P. glossomystax</i>
6* Isthmus between the lobules very short	<i>P. arevaloii</i>

Psymorchis cuatrecasasi Kolan. & Szlach., sp. nov (Fig. 4)

Similar to *P. pusilla* (L.) Dodson and Dressler distinguished by the lateral sepals connate to the middle and the complicated lip callus.

Fig. 3 Gynostemium of *Psymorchis glossomystax* (Rchb. f.) Dodson and Dressler. **a** Gynostemium, bottom view. **b** Gynostemium, side view. **c** Gynostemium, front view. **d** Anther. **e** Pollinia, various views. **f** Tegula and viscidium, various views (Schulz 7285, U; Szlachetko & Mytnik-Ejsmont 2009)



Type: *J. Idrobo* 8924-Colombia, Amazonas, (COL!, holotype)

Leaves 7–8, up to 2.5 cm long, 0.5 cm wide, equitant, fleshy, oblanceolate-linear, subfalcate, subobtuse. Inflorescences 1.7 cm long, four flowered. Flowers yellow. Ovary and pedicel about 5 mm long. Floral bract 4 mm long. Dorsal sepal about 5 mm long, 2.8 mm wide, elliptic-ovate, acuminate, obtuse. Petals about 6 mm long, 3.5 mm wide, elliptic, acute. Lateral sepals 4 mm long, about 1 mm wide, linear-lanceolate, united for about half their length, free apices obtuse. Lip 12 mm long, 12 mm wide, three lobed; basal lobes 3.2 mm long, orbicular-rectangular, dolabriform; isthmus 2.5 mm long; middle lobe 9 mm wide, deeply divided at the apical third (2.8 mm), hence quadrilobulate, lobules suborbicular; callus a fleshy subpan-durate pad, externally with two subtriangular, obtuse appendages. Gynostemium with a pair of conspicuous, dentate wings near the stigma.

Etymology Dedicated to J. Cuatrecasas (1903–1996), an eminent collector of Colombian plants.

Distribution and ecology So far this species is known from the Amazonian region of Colombia where it was

found growing epiphytically at about 200 m a.s.l. It was found flowering in August and November (Fig. 5).

Representative specimens *J. Idrobo* 8924-Colombia, Amazonas, Quebrada Aduche, alt. 200 m (5 Aug 1977), (COL!). *Cuatrecasas* 7384-Colombia., Vaupés, Selva entre Cano ran-de y San Jose del Guaviare, alt. 240 m (2 Nov 1939), (COL!).

Taxonomic notes This species resembles *P. pusilla* (L.) Dodson and Dressler, from which it may be easily distinguished by the complicated callus (vs callus simple in *P. pusilla*), and lateral sepals connate to about the middle (vs. lateral sepals connate only near the base).

Psymorchis arevaloi Kolan. & Szlach., sp. nov (Fig. 6)

Similar to *P. glossomystax* (Rchb.f.) Dodson and Dressler, but with the lip callus short, not fimbriate, the inconspicuous isthmus between the lip lobules, the large, dolabriform lip basal lobes and the suborbicular lobules of the middle lobe.

Type: *R. Arévalo* & *A. Tapasco* 579-Colombia, Risaralda. (COL! holotype)

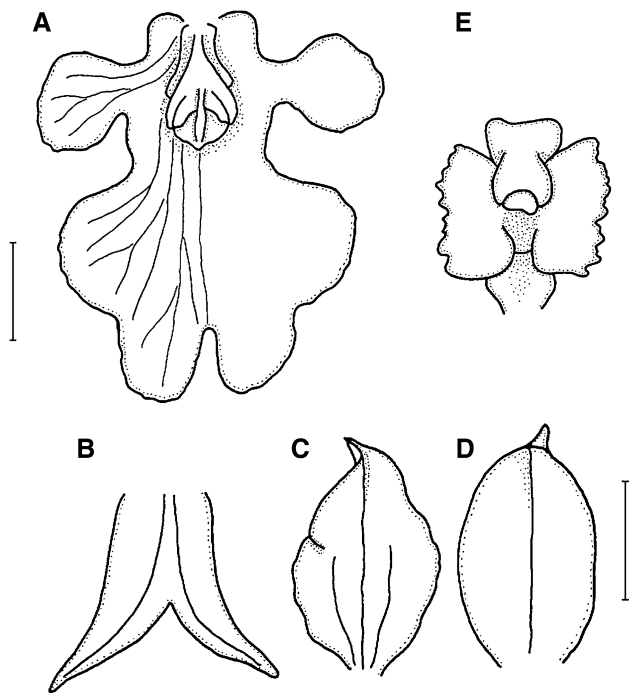


Fig. 4 *Psysmorchis cuatrecasasi*—dissected perianth: **a**—Lip. **b**—Lateral sepals. **c**—Petal. **d**—Dorsal sepal. **e**—Gynostemium. Scale bars 3 mm

Leaves 10–12, 25 mm long, 3.5 mm wide, equitant, fleshy. Inflorescence 2.5 cm long, 2–3 flowered. Ovary and pedicel about 6 mm long. Floral bract 2 mm long. Dorsal sepal about 3.5 mm long, 2 mm wide, elliptic-ovate, acuminate, acute. Petals about 3.5 mm long, 2 mm wide, obliquely elliptic, obtuse. Lateral sepals 3.5 mm long, about 0.7 mm wide, linear-lanceolate, united at the base for 0.5 mm, apices obtuse. Lip 10 mm long, 9 mm wide, three lobed; basal lobes 4 mm long, orbicular-subrectangular, dolabriform; isthmus inconspicuous, about 0.5 mm long; middle lobe 5.5 mm long, 9 mm wide, divided at the apical fourth (1.4 mm), hence quadrilobulate, lobules suborbicular; callus a fleshy, 4-lobulate pad, dentate at the apices. Gynostemium with a pair of conspicuous, entire wings near the stigma.

Etymology Dedicated to the co-collector of the type specimens

Distribution and ecology So far the localities of this species are known exclusively from Colombia, however as it was found also near the Ecuadorian border, it is expected to be found also in this country. The populations were found growing epiphytically in rainforest as well as in the humid premontane and montane forest at the altitudes

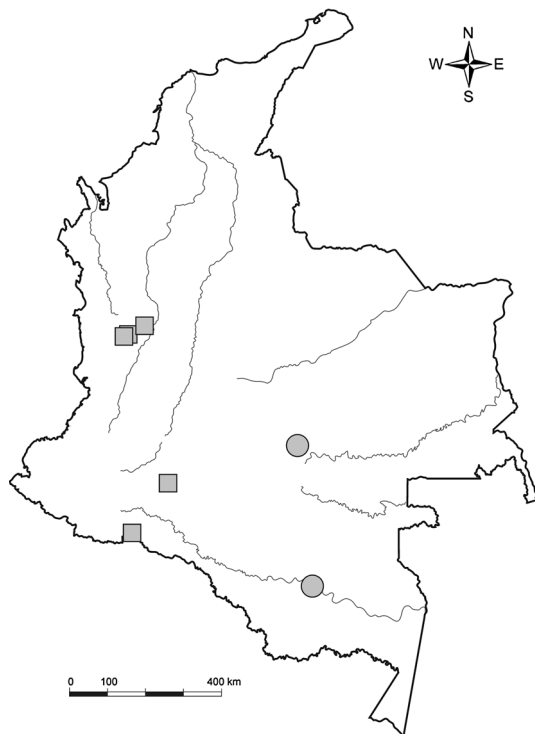


Fig. 5 Distribution of *P. cuatrecasasi* (circle) and *P. arevaloi* (square)

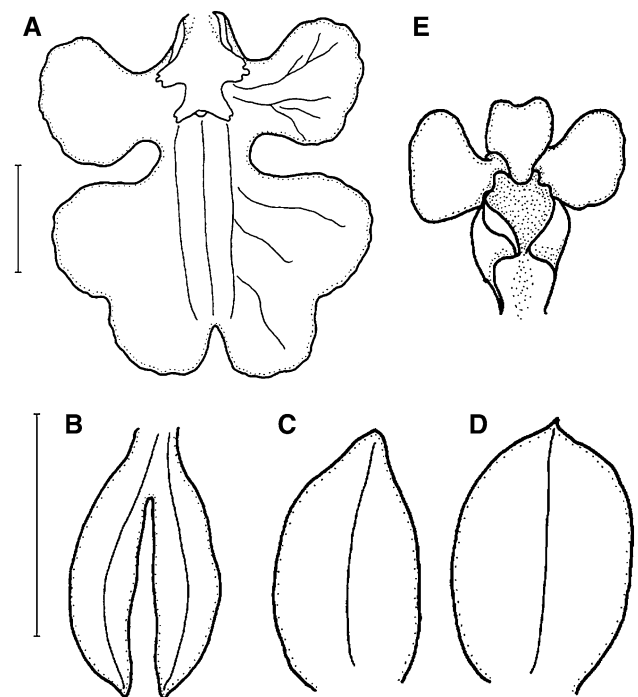


Fig. 6 *Psysmorchis arevaloi*—dissected perianth: **a**—Lip. **b**—Lateral sepals. **c**—Petal. **d**—Dorsal sepal. **e**—Gynostemium. Scale bars 3 mm

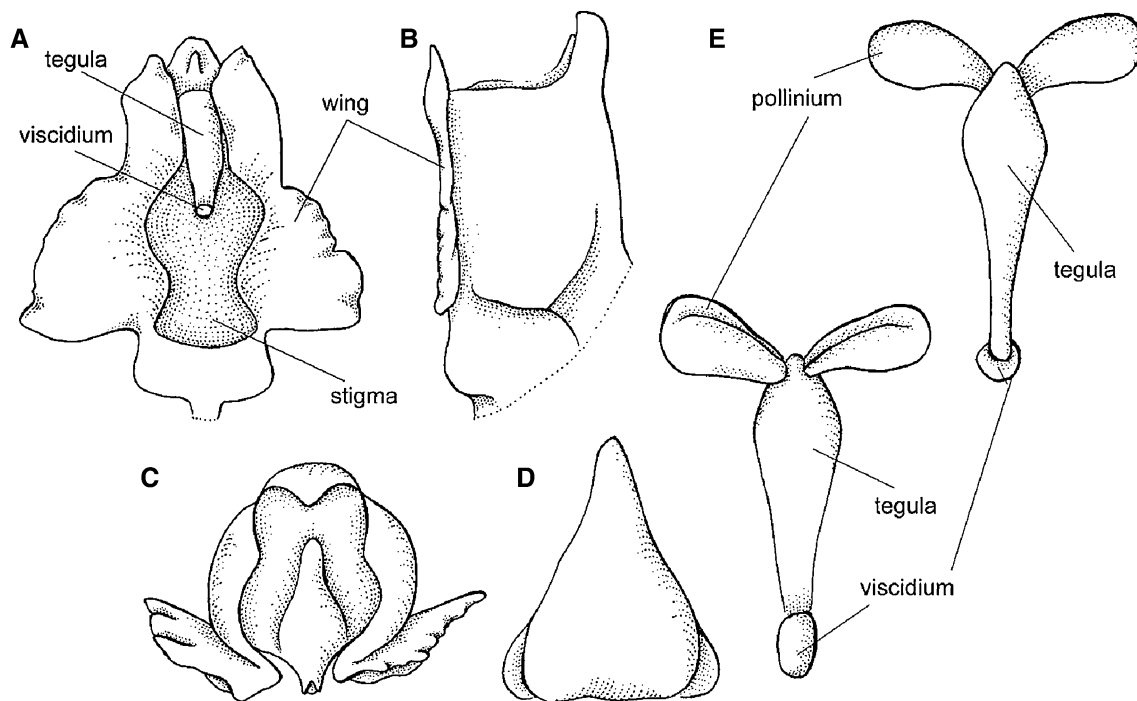


Fig. 7 Gynostemium of *Stacyella crista-galli* (Rchb. f.) Szlach. **a.** Gynostemium, *bottom view*. **b.** Gynostemium, *side view*. **c.** Rostellum remnant. **d.** Anther. **E.** Pollinarium, *various views* (Chase 84025, UGDA-DLSz; Szlachetko and Mytnik-Ejsmont 2009)

between 50 and 1,900 m. It was found flowering in January, April and October (Fig. 5).

Representative specimens *E.P.A. s.n.*-Colombia, Cauca. Florencia, alt. 420 m. (Dec 1930) (COL!); *S. Diaz 3864*-Colombia, Chocó, Mpio. San Jose del Palmar, Vereda La Badea, alt. 900 m (24 Jan 1983), (COL!); *E. Forero, R. Jaramillo & J. McElroy 1383*-Colombia, Chocó, Rio Serrano, afluente del Rio Atrato. 4–6 kms arriba de Guayabal, alt. 50 m (30 Apr 1973), (COL!); *H. Garcia Barriga, Y. Hashimoto & M. Ishikawa 18699a*-Colombia, Putumayo, Rio Putumayo, entre Puerto Asis y Puerto Leguizamo, frontera Colombo-Ecuatoriana, alt. 400 m (14–15 Oct 1965), (COL!); *R. Arevalo & A. Tapasco 579*-Colombia, Risaralda, Mpio. Pueblo Rico, Vereda Monte Bello, PNN Tatama. Trocha sobre la casa de la finca de A. Tapasco, 5°12'46"N 76°05'08"W, alt. 1,600–1,900 m (28 Apr 2006), (COL!).

Notes This species resembles *P. glossomystax* (Rchb.f.) Dodson and Dressler, from which is easily distinguished by the inconspicuously dentate lip callus (vs callus fimbriate in *P. glossomystax*), the isthmus between the lobules inconspicuous (vs isthmus long) and the orbicular-subquadrate, prominent lip basal lobes (vs basal lobes auriculate, small).

Stacyella szlach

Polish Bot. J. 51(1): 41. 2006; Generitype: *Stacyella crista-galli* (Rchb. f.) Szlach. [≡ *Oncidium crista-galli* Rchb. f.]

Pseudobulbs prominent, compressed, subtended by several foliaceous bracts, unifoliate at the apex or leaf aborted. Leaf thin, without articulation. Inflorescence lateral 1–4 flowered raceme, successively flowering. Sepals dissimilar, lateral sepals shortly connate. Petals similar to dorsal sepal. Lip deeply three lobed. Gynostemium short, straight. Column part as long as anther, broadly winged near the stigma, wings obliquely triangular, more or less dissected on margins. Column foot absent. Anther subventral, incumbent, operculate, oblong-obtriangular, thin-walled, obscurely two chambered. Connective narrow, thin, apically elongate to form a rostrate projection. Pollinia 2, oblong clavate, hard, distinctly and unequally cleft at the apex. Caudiculae sticky, amorphous. Apical clinandrium narrow. Stigma rather large, oblong elliptic, deeply concave. Rostellum elongate, rostrate in the middle, blunt. Viscidium single, very small, elliptic, thin. Tegula single, oblong with oblong deltoid apical part, thin, lamellate, convex. Rostellum remnant bilobulate at the apex, canalliculate on the dorsal surface (Fig. 7).

This is a monotypic genus known from Mesoamerica and northern South America.

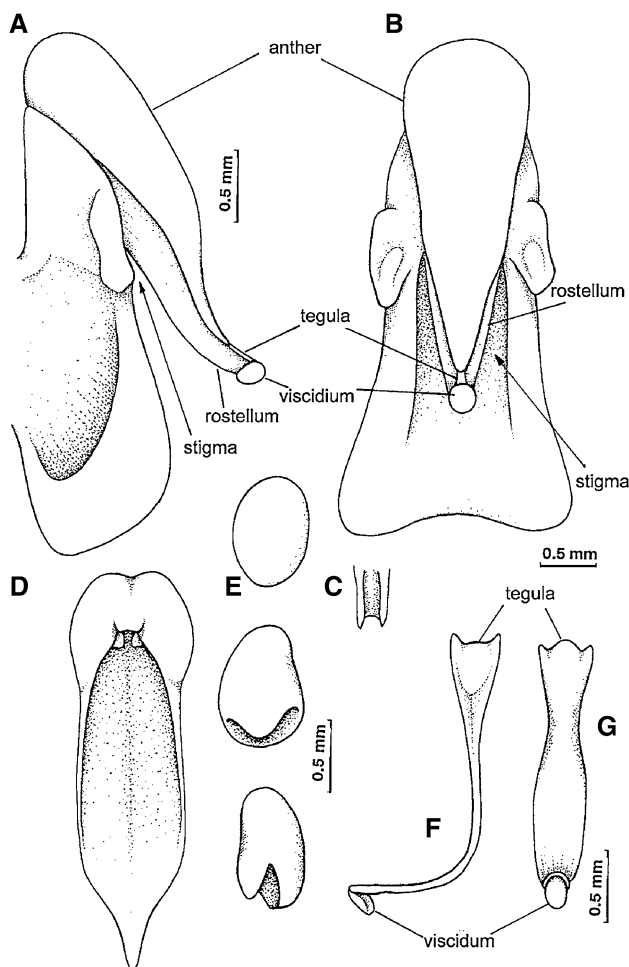


Fig. 8 Gynostemium of *Erycina diaphana* (Rchb. f.) Schltr. **a.** Gynostemium, side view. **b.** Gynostemium, front view. **c.** Rostellum remnant, apex. **d.** Anther, back view. **e.** Pollinia, various views. **f** and **g.** Tegula and viscidium, various views (Simmons 784, K; Szlachetko and Mytnik-Ejsmont 2009)

Erycina Lindl.

Fol. Orchid. *Erycina* 2. 1853; Generitype: *Erycina echinata* (Kunth) Lindl. [≡ *Oncidium echinatum* Kunth]

Pseudobulbs aggregated, laterally compressed, 1–2 foliate, subtended by several papyraceous sheaths. Leaves thin, articulate at the base. Inflorescences 1 to several, from the base of pseudobulb, racemose, paniculate, with several to over 20 flowers per raceme, flowering simultaneously. Sepals dissimilar, lateral sepals connate at the base, petals similar to dorsal sepal. Lip three lobed. Gynostemium swollen just above the base, glabrous. Column part half as long as anther, with two wing-like projections on both sides of rostellum (*E. echinata*), or with large, thick projection pendent below stigma (*E. diaphana*). Column foot absent. Anther subapical, incumbent, operculate, dorsiventrally

compressed, oblong, obscurely two chambered. Connective narrow, thin, papillate, forming prominent apical, roof-like projection, shortly apiculate at the apex. Pollinia 2, slightly almost elipsoid, shallowly cleft at the apex, hard. Caudiculae sticky, amorphous. Apical clinandrium obscure. Stigma small, elliptic, hidden by rostellum, deeply concave. Rostellum large, gently sigmoid, thick, narrowly cylindrical-conical, rounded at the apex. Viscidium very small, single, elliptic, thin. Tegula single, linear, slightly expanded at the apex, thin, lamellate. Rostellum remnant shallowly bilobed at the apex, canaliculate on the dorsal surface (Fig. 8).

The genus contains two Mexican species.

Key to the species

- | | | |
|----|---|--------------------|
| 1. | Pseudobulbs leafless, at anthesis encloded basally by leafy sheaths, lip lateral lobes as large as the middle lobe | <i>E. echinata</i> |
| 1* | Pseudobulbs with apical leaf, without leaf or leafy sheaths at anthesis, lip lateral lobes smaller than the middle lobe | <i>E. diaphana</i> |

Conclusions

Phylogenetic relationships among major orchid clades have long been controversial, with no general consensus. The incoming molecular data are often incompatible with the results of the morphological and anatomical studies and the superiority of the molecular data is often implied, especially in the case of the twig epiphytes which has undergone an intensive adaptive radiation. The importance of the morphological data was, however, recalled by numerous authors (e.g., Wiens 2004; Hill 2005). The synergistic approach of combining morphological and molecular outcomes seems to be the most appropriate in resolving the actual relations between the taxa.

We believe that in the case of the studied taxa, the synonymization of the three genera was done without this comprehensive resolution. Moreover, it seems that the presence of the separated clades within *Erycina*-complex was ignored when both *Psycmorchis* and *Stacyella* were lumped in *Erycina*. The traditional recognition of the three genera is, in our opinion, supported by both morphological and genetic differences between them.

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