



A new species and a new natural hybrid of *Laelia* (Orchidaceae) from Oaxaca, Mexico

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Abstract

A new species, *Laelia halbingeriana*, and a new natural hybrid, *Laelia ×oaxacana*, both from the Sierra Madre Oriental in northern Oaxaca, Mexico, are described and illustrated. *Laelia halbingeriana* is similar to *L. superbiens*, from Chiapas through Nicaragua, differing in the proportionately shorter, stouter pseudobulbs, low, entire, distally white keels of the labelum and obscurely bilobed anther. *Laelia ×oaxacana* is applied to a hybrid swarm between *L. halbingeriana* and sympatric *L. anceps*. The hybrid can be distinguished from *L. halbingeriana* by the distichous (vs. spiral) raceme and the spreading petals oriented vertically (vs. distinctly arcuate and oriented horizontally), and from *L. anceps* in the stouter plants with two-leaved pseudobulbs and the proportionately narrower, waved sepals and petals.

Key words: endemism, extinction risk, *Laelia anceps*, *Laelia halbingeriana*, *Laelia ×oaxacana*, *Laelia superbiens*

Introduction

As currently delimited, the genus *Laelia* Lindley (1831: 115), including *Schomburgkia* Lindley (1838: t. 10), encompasses about 25 species of Neotropical epiphytic orchids with its main centre of diversity in Mexico (Soto 2005). The laelias, as they are colloquially referred to, constitute some of the most conspicuous elements of the epiphytic orchid flora of many Mexican forests. Some species, such as *L. anceps* Lindley (1836: t. 1751), are widely cultivated in Mexico and abroad and this and other native laelias have been used locally as ornament or in religious ceremonies from pre-Columbian times to this day (Soto 1993; Halbinger & Soto 1997; Hágsater *et al.* 2005).

The taxonomy of the Mexican laelias was revised by Halbinger & Soto (1997), who recognized eleven species, several infraspecific taxa and a few natural hybrids. Regarding the plants of the state of Oaxaca assigned by them to *L. superbiens* Lindley (1840: 46), a species otherwise known only from the Mexican state of Chiapas and from Guatemala, Honduras and Nicaragua, Halbinger & Soto (1997: 148) noted that they “are very distinct, apparently they have a strong introgression from *L. anceps*.” Those authors returned to the issue in their discussion on natural hybrids of *Laelia*, stating that there seemed to be a series of intermediates between *L. anceps* and plants “closer to *L. superbiens*” in northern Oaxaca and that “typical” or “pure” forms of *L. superbiens* have never been found there.

In the course of the last decade, and as part of our field and herbarium studies aimed at producing an orchid flora of the Tehuacán-Cuicatlán region of Oaxaca and adjacent Puebla (G.A. Salazar, unpubl. data), we have had the opportunity to study a number of specimens of *Laelia* from northern Oaxaca and our observations allowed us to corroborate the existence of both an entity similar to, but consistently distinguishable from, *L. superbiens*, and a series of natural hybrids between the former entity and sympatric *L. anceps*. The entity similar to *L. superbiens* has been referred to in published works as “*Laelia halbingeriana* Salazar & Soto Arenas” (Salazar *et al.* 2006; Soto *et al.* 2007), but it has not yet been formally described. Below we describe the new species and its natural hybrid with *L. anceps*.

Materials and methods

Morphological observations:—We studied live, ethanol-preserved and herbarium specimens of *L. anceps*, *L. superbiens*, the new species (henceforth referred to as *L. halbingeriana* Salazar & Soto Arenas; see Taxonomy, later) and the natural hybrid between *L. anceps* and *L. halbingeriana* (hereafter referred to as *L. ×oaxacana* Salazar & R. Jiménez). Measurements of floral parts were made mostly on fresh and alcohol-preserved flowers; flowers from herbarium material were boiled prior to record their measurements. We studied the collections of the following herbaria: AMES, AMO, K, MEXU MO and SERO.

Modelling of geographical distributions:—To model the potential distribution areas of the *Laelia* species discussed in the text, we assembled a database of 62, eight and 12 unique locality records of *L. anceps* subsp. *anceps*, *L. halbingeriana* and *L. superbiens*, respectively. We omitted all records of *L. anceps* subsp. *dawsonii* (Anderson 1868: 27) Rolfe (1922: 2012), a taxon restricted to the Pacific watershed of Mexico not directly relevant to the matters discussed here (Soto 1993; Halbinger & Soto 1997). All records were georeferenced and their taxonomic identity verified by examination of the actual specimen or at least a photograph or drawing prepared from it. Cultivated material of unspecified origin, as well as specimens of dubious identity, were excluded. Modelling was conducted with the software package GARP (Stockwell & Noble, 1992), one of the most commonly used methods to model distributions from environmental data (e.g. Peterson & Holt 2003; Sánchez-Cordero *et al.* 2005; Peterson *et al.* 2006; Peterson & Nakasawa 2008; Haverkost *et al.* 2010; Monterrubio-Rico *et al.* 2011; Almazán-Núñez *et al.* 2013), and processed with ArcGis 9.3 (ESRI, 2008). We chose GARP since it has demonstrated its predictive ability in comparative studies (Peterson *et al.* 2007; Ortega-Huerta & Peterson 2008). Additionally, recent studies such as those of Papes & Gaubert (2007), Batista *et al.* (2014) and Huerta (2014) have found that GARP is less likely to overpredict modelled distributions than another widely used algorithm, i.e. Maxent (Phillips *et al.* 2004) when the number of point records is low. We selected six climatic (isothermality, temperature annual range, annual precipitation, precipitation seasonality, precipitation of warmest quarter, precipitation of coldest quarter) and three topographic variables (elevation above the sea level, orientation and slope) from WorldClim (Hijmans *et al.* 2005). Such variables were not significantly correlated, according to a Pearson's correlation coefficient test ($r \leq 0.7$) conducted following the procedures explained in Elith *et al.* (2006), Murphy & Lovett-Doust (2007) and Yañez-Arenas *et al.* (2012). The extent of occurrence, defined as the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon (IUCN 2012) was determined and mapped by selecting the ten best models (out of 100) for each species; a species was considered as present in a pixel when there was consensus among the ten best models. The predictions were assessed using the AUC (area under the curve) statistics, the main descriptive index of the plot of the receiver operating characteristic curve (ROC). AUC values range from 0 to 1, where values close to 1 indicate a greater ability of the model to identify correctly the sites of presence of a species. Additionally, the area models were visually evaluated according to what is known of the distribution and natural history of each species.

Risk status assessment:—We assessed the risk of extinction of *L. halbingeriana* using the MER (“Método de Evaluación del Riesgo de Extinción de Plantas en México”), which is the official instrument for risk assessment for plants established in the Mexican environmental law (SEMARNAT 2010), as well as IUCN's (2012) red list criteria and categories.

Taxonomy

Laelia halbingeriana Salazar & Soto Arenas, *sp. nov.* (Figs. 1, 2D–F).

Similar to *Laelia superbiens* Lindl., but differing in the proportionately shorter, stouter pseudobulbs, low, entire, distally white keels of the labellum and obscurely bilobed anther.

Type:—MEXICO. Oaxaca: Portillo de Coyula, unos 2 km antes del poblado de Coyula subiendo desde Quiotepec, donde la línea eléctrica cruza el camino, 1,160 m elevation, collected 11 July 2004, pressed in cultivation 17 October 2006, *Salazar et al.* 6695 (Holotype MEXU!).

Epiphytic *herb* 40–60 cm tall excluding the inflorescence. *Roots* simple, produced from the nodes of the rhizome, white or greyish, 1.4–3.1 mm in diameter. *Rhizome* conspicuous, made up of 4–5 internodes, 4–7 cm long between

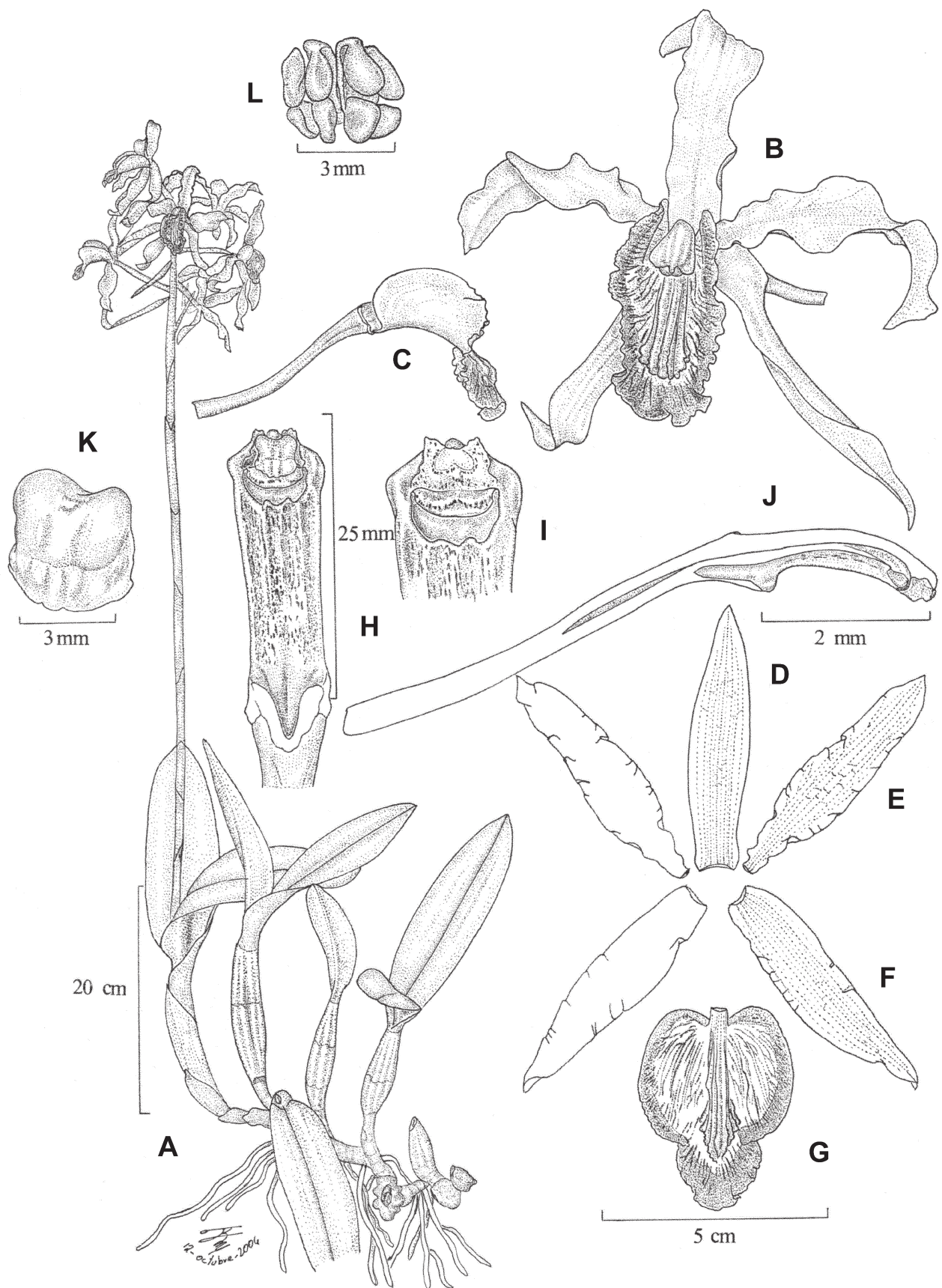


FIGURE 1. *Laelia halbingiana*. A. Flowering plant. B. Flower. C. Labellum and column from side. D. Dorsal sepal. E. Petal. F. Lateral sepal. G. Labellum. H. Column, ventral view. I. Column apex, ventral view after removal of the pollinarium. J. Ovary and column, longitudinal section. K. Anther. L. Pollinarium. Drawn by Rolando Jiménez-Machorro from Guzmán *sub* Soto 7934.

consecutive pseudobulbs, 1.5–2.5 cm in diameter; internodes covered when young by adpressed, tubular, obtuse, scarious sheaths, these at first straw yellow but turning blackish with time and then falling off. *Pseudobulbs* 15–41 cm long, 3–4.2 cm wide above the middle, fusiform, stipitate, slightly compressed laterally, made up of 4–5 internodes, often sulcate longitudinally; internodes partially covered by scarious sheaths 7–14 cm long, whitish but often turn blackish brown and eventually disintegrate (after 2–3 years). *Leaves* two per pseudobulb, 15–29 × 5–9 cm, rigidly coriaceous, oblong-lanceolate to oblong-elliptic, carinate, rounded and shortly apiculate at apex, conduplicate at the cuneate base. *Inflorescence* 48–70 cm long, from the new, mature pseudobulb, apical, erect to erect-arcuate, racemose, long-pedunculate; peduncle subterete, 27–50 cm long, 4.5–11 mm in diameter, without basal spathe but provided with strict, tubular, scarious, obtuse to acute bracts 8–9 cm long, which cover most part of the internodes; raceme up to 30 cm long, with 6–13 flowers, these simultaneous and arranged in a spiral. Floral bracts 5–10 cm long, up to 2.5 cm wide, spreading, herbaceous to scarious at anthesis, greenish-yellow, oblong-elliptic, acuminate, margins involute. *Flowers* showy, resupinate, odourless, sepals and petals lilac with reticulate magenta veining, labellum deep magenta with the centre yellow and provided with radiating dark purple veins, column green with purple lines and dots; dorsal sepal 6.4–8.2 × 1.2–1.7 cm, linear-elliptic, acute, margins wavy; lateral sepals 6–8 × 1.3–1.6 cm, lanceolate-falcate, acute, margins wavy; petals 6–8 × 1.1–1.5 cm, lanceolate-falcate, acute, somewhat clawed, conspicuously arcuate and positioned in a horizontal plane, margins wavy; labellum 4.3–4.5 cm total length, 3.4–3.8 cm wide across the lateral lobes, adnate at base to the base of the column for ca. 4 mm, arcuate, deeply three-lobed; lateral lobes 2.4–3.3 × 1.2–1.8 cm, in natural position vertical at each side of the column, obliquely ovate, rounded, undulate, when spread out without distinct sinuses separating them from the mid-lobe; mid-lobe 1.6–2.3 × 1.6–2.3 cm, orbicular to shortly elliptic, rounded and inconspicuously apiculate, margins wavy, callus consisting of 7 low keels running from the base of the labellum to about the middle of the mid-lobe, where they are more prominent (2–3 mm tall); column 2.6–2.8 cm long, 7.2–9 mm wide near the apex, oblong, slightly arcuate, trigonous, ventrally concave, provided at base with an excavation (cunniculus) that penetrates the apex of the ovary for ca. 5 mm but lacks nectar; anther 4–6 × 4–5 mm, ventral, subquadrate, slightly bilobed, white; rostellum retrorse, rounded, provided on the internal surface with a lunate viscarium; pollinarium ca. 4 mm long and wide, made up of 8 laterally compressed, obliquely ovate, yellow pollinia arranged in two rows and attached to yellow granular caudicles; ovary 5.3–7 cm long, 4.5–5 mm in diameter near the apex, subterete, twisted, provided with three longitudinal ribs above the middle, these with winged, undulate margins. *Capsule* 65 mm long including the 10 mm long apical beak, 30 mm in diameter, ellipsoid, pale green, with three sulcate ribs alternating with three rounded ribs, pedicel 45 mm long, 3.5 mm in diameter.

Distribution and ecology:—Endemic to Mexico and known only from the Sierra Madre Oriental in northern Oaxaca (Fig. 4). Epiphytic, in tropical semi-deciduous forest, *Quercus* forest, moist *Pinus-Quercus* forest and mountain rain forest, from 800 to 2,000 m elevation.

Etymology:—The specific epithet honours the late Federico Halbinger, Mexican orchid student and life-long member of the Asociación Mexicana de Orquideología, who made seminal contributions to the taxonomy of the genera *Rhynchostele* Reichenbach (1852: 770), *Barkeria* Knowles & Westcott (1838: 7–8) and *Laelia*.

Phenology:—Flowering has been observed in the field in late October and early November; in cultivation from October to December.

Conservation status:—According to the MER, which evaluates four main criteria (characteristics of the geographic distribution, characteristics of the habitat, intrinsic biological vulnerability and impact of human activities), *L. halbingeriana* qualifies as a species “subject to special protection”, a category that includes “those species that could be endangered by factors that influence negatively their viability, for which it is required to propitiate their recovery and conservation, or the recovery and conservation of populations of associated species” (SEMARNAT 2010). Following the IUCN Red List Criteria and Categories (IUCN 2012), *L. halbingeriana* should be considered as “endangered” according to criterion B1, since extent of occurrence is estimated to be <5,000 km², besides the fact that the modelled distribution area has been severely fragmented and reduced (the actual surface was estimated as 1,826 km², taking as basis the consensus model but considering only those areas suitable for the presence of the species, i.e. in which tree cover has not been eliminated by human activities; see Huerta 2014). Several populations are located within the Tehuacán-Cuicatlán biosphere reserve, which confers them some degree of protection, although the most accessible populations, such as those near Coyula and El Faro, have been subjected to a certain amount of extraction of plants from orchid growers, and the species is moderately common in cultivation in Mexico. Moreover, local peasants of the village of Coyula have been observed collecting the inflorescences of *L. halbingeriana* to adorn their homes and altars during the celebrations of All Saints and the Day of the Death (November 1st and 2nd; G. A. Salazar pers. obs.; Salazar *et al.* 2006). It is not known to what extent these extractive activities may be affecting the natural populations.

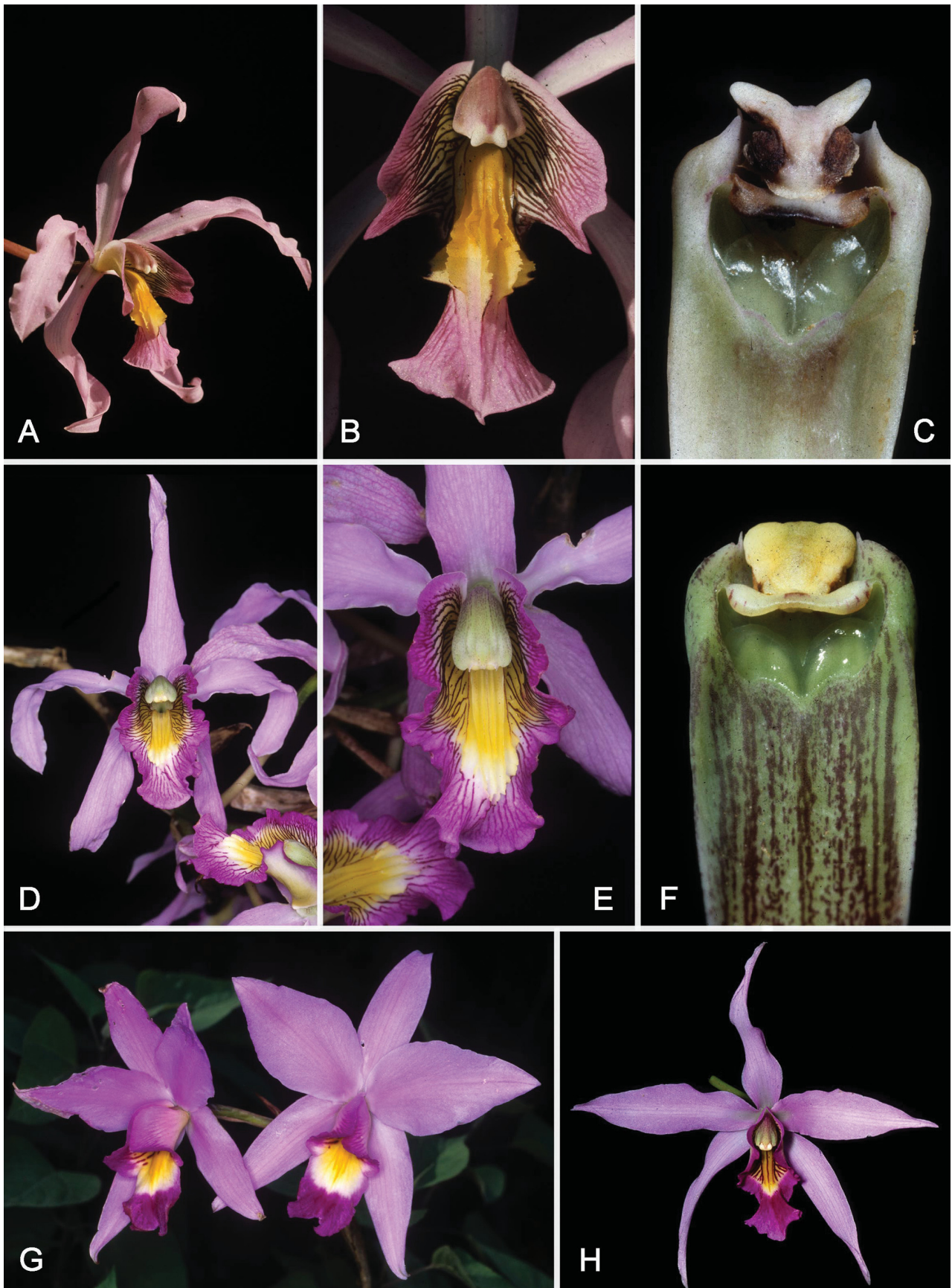


FIGURE 2. Taxa of *Laelia* discussed in the text. A–C. *Laelia superbiens* (Chiapas, Miller s.n., AMO). A. Flower. B. Close-up of labellum and column. C. Ventral view of column apex. D–F. *Laelia halbingiana* (Oaxaca; D–E from Salazar et al. 6695; F from Jones s.n.). D. Flower. E. Close-up of labellum and column. F. Ventral view of the column apex. G. Flowers of *Laelia anceps* (Oaxaca, Salazar et al. 6685). H. Flower of *Laelia* × *oaxacana* (Oaxaca, Lau sub Hágsater 9359). Photographers: Eric Hágsater (A, B); Edward W. Greenwood (C, F); Gerardo A. Salazar (D, E, G); Rolando Jiménez-Machorro (H).

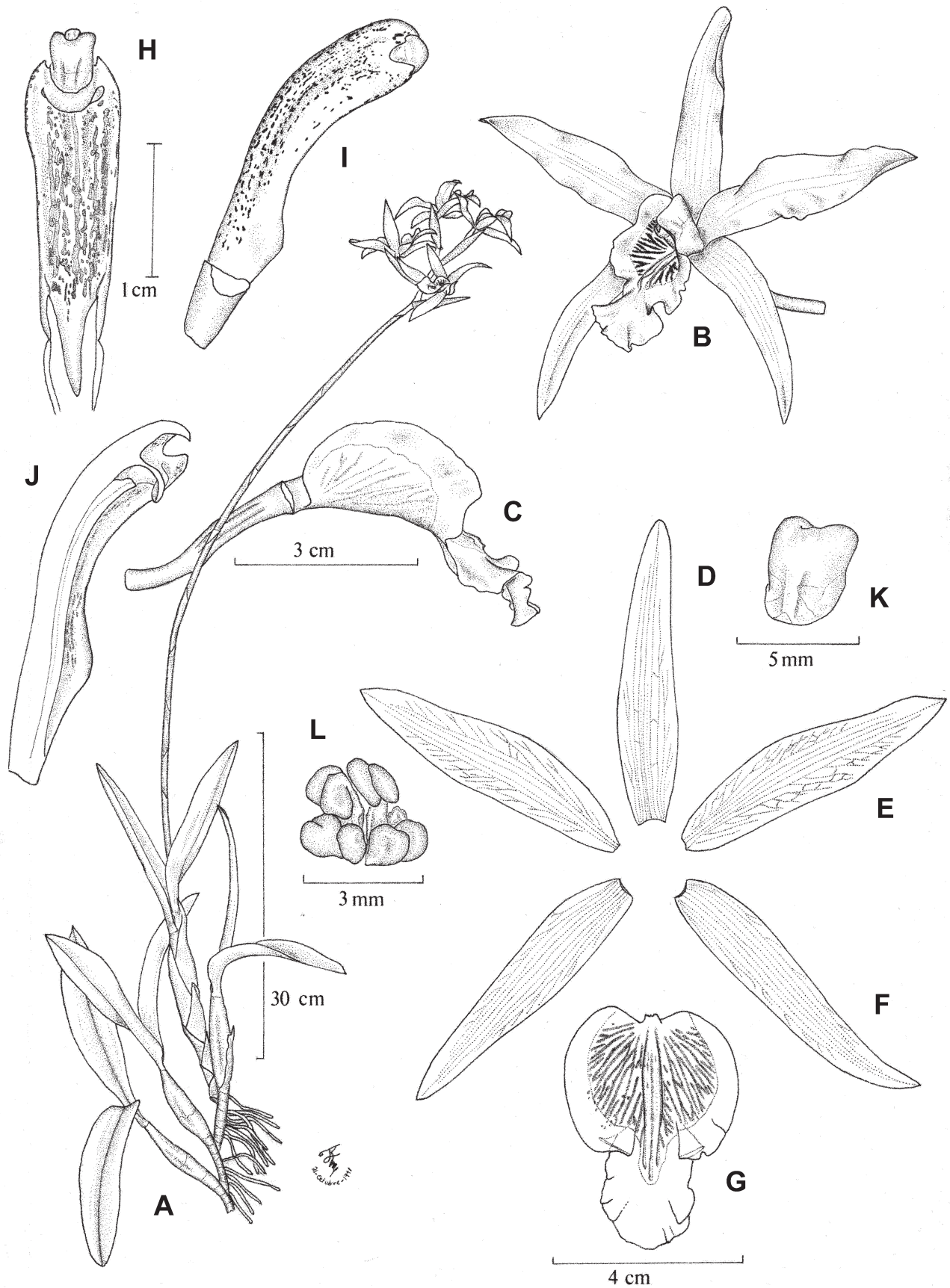


FIGURE 3. *Laelia* \times *oaxacana*. A. Flowering plant. B. Flower. C. Labellum and column from side. D. Dorsal sepal. E. Petal. F. Lateral sepal. G. Labellum. H. Column, ventral view. I. Column, side view. J. Column in longitudinal section. K. Anther. L. Pollinarium. Drawn by Rolando Jiménez-Machorro from *Lau sub Hágsater* 9539.

Additional specimens examined:—MEXICO. Oaxaca: Sierra de Cuicatlán, Portillo de Coyula, 1,450 m, collected 23 September 1937, pressed in cultivation 30 October 1937, *Conzatti sub Östlund 7074* (MO!, drawing AMO!); Coyula, collected 1 June 1996, pressed in cultivation January 2007, *Guzmán sub Soto 7934* (AMO!); Portillo de Coyula, unos 2 km antes del poblado de Coyula subiendo desde Quiotepec, donde la línea eléctrica cruza el camino, 1,160 m elevation, collected 24 October 2004, pressed in cultivation 13 December 2011, *Salazar et al. 6740* (AMO!, MEXU!, SERO!); same locality, collected 11 July 2004, pressed in cultivation 28 October 2011, *Jiménez et al. 2463* (AMO!); near Teopoxco, ENE of Teotitlán del Camino, cultivated in Oaxaca, *A. Jones s.n.* (AMO!); San Juan Bautista Cuicatlán, cañada, 10 km al E de Quiotepec, 1,240 m, 6 December 1993, *Salas 612* (AMO!); cerca de El Faro, ca. 1,000 m elev., collected 13 May 2006, pressed in cultivation 7 November 2011, *Salazar et al. 7208* (MEXU!).

Discussion:—As already mentioned, *L. halbingeriana* is similar in overall appearance to *L. superbiens*, which is most probably its sister species. However, the former can be distinguished from the latter by the proportionally shorter, stouter pseudobulbs, the low, entire keels of the labellum, which are white at their apices (vs. prominent, waved and entirely yellow) and the anther obscurely bilobed (vs. prominently bilobed, with the appearance of a cloven hoof; Fig. 2A–F). Our distribution models indicate differences in the environmental conditions preferred by *L. halbingeriana* and *L. superbiens*, since, in spite of a small area of predicted distribution for *L. superbiens* in northern Oaxaca, field exploration in the area (G.A. Salazar, pers. obs.) and previous monographic work (Halbinger and Soto 1997) demonstrate that genuine *L. superbiens* does not occur there. In fact, most of the predicted distribution for *L. halbingeriana* does not overlap with the potential distribution of *L. superbiens* (Fig. 4). Such apparent habitat differentiation supports the morphological criteria (see earlier) on which we differentiate the two species.

Laelia ×oaxacana Salazar & R.Jiménez, *hybr. nat. nov.*

Vegetatively similar to *Laelia halbingeriana* Salazar & Soto Arenas, differing in the distichous (vs. spiral) raceme and the proportionally narrower and more pointed sepals and petals.

Type:—MEXICO. Oaxaca. Barranca del Río Santo Domingo, muy al E de Tecomavaca, cerca de Buenos Aires (entre Coyula y el río Santo Domingo), ca. 1,600–1,700 m elev., collected June 1986, flowered in cultivation 4 November 1991, *Lau sub Hågsater 9539* (holotype AMO!, isotypes MEXU!, SERO!).

Epiphytic *herb* vegetatively similar to *L. halbingeriana* (see above). *Inflorescence* 80–135 cm long, from the mature pseudobulb, apical, erect-arcuate, racemose, long-pedunculate; peduncle 65–110 cm long, 5–6 mm in diameter, subterete, without basal spathe but provided with strict, tubular, scarious, obtuse to acute bracts 6–10 cm long, which cover most part of the internodes; raceme 15–30 cm long, with 4–9 flowers, these simultaneous and arranged distichously, floral bracts 4.2–7 cm long, up to 1.5 cm wide, sheathing the ovaries, scarious at anthesis, whitish but often suffused and dotted with brown, oblong-elliptic, acute to acuminate, margins involute. *Flowers* showy, resupinate, odourless, sepals and petals rose-lilac, labellum deep magenta with the centre yellow and provided with radiating dark purple veins, column green with purple lines and dots; dorsal sepal 5.8–7.3 × 1–1.3 cm, lanceolate, acute, margins somewhat recurved and slightly waved; lateral sepals 5.5–7 × 1–1.2 cm, obliquely lanceolate, acute, margins slightly waved; petals 5.7–7.2 × 1.2–1.8 cm, obliquely oblong-lanceolate, acute, spreading and oriented in a vertical plane, margins slightly waved; labellum 4–4.8 cm total length, 2.6–4 cm wide across the lateral lobes, adnate to the base of the column for ca. 3 mm, arcuate, deeply three-lobed; lateral lobes 2.5–3 × 1.3–1.6 cm, vertical at each side of the column and touching each other above it in natural position, obliquely ovate, rounded, undulate, when spread out without distinct sinuses separating them from the mid-lobe; mid-lobe 1.6–2.1 × 1.6–2.3 cm, obovate to obcordate, rounded to shallowly emarginated at apex, mucronulate, margins waved; callus consisting of an oblong thickening bearing 3 low keels running from the base of the labellum to the basal one-third of the mid-lobe, where they are slightly more prominent (1–1.5 mm tall); column 2–2.6 cm long, 6.5–7 mm wide near the apex, oblong, slightly arching, trigonous, ventrally concave, apex three-toothed with the central tooth more prominent and somewhat incurved over the anther, base provided with an excavation (cuniculus) that penetrates the apex of the ovary for ca. 3 mm but lacks nectar; anther ca. 4.5 × 3.5 mm, ventral, sub-quadrangle, slightly bilobed; rostellum retrorse, rounded, provided on the internal surface with a lunate viscarium; pollinarium ca. 3.5 mm long and wide, with 8 laterally compressed, obliquely ovate, yellow pollinia arranged in two rows; pollinia with yellow granular caudicles; ovary 3.7–5 cm long, 4–5 mm in diameter near the apex, sub-terete, twisted, provided with three smooth longitudinal ribs above the basal one-third. *Capsule* not seen.

Distribution and ecology:—Known only from the Sierra Madre Oriental in northern Oaxaca (Fig. 4). Epiphytic, in an ecocline of tropical deciduous/semideciduous forest and oak forest at 1,100–1,700 m elevation.

Etymology:—This natural hybrid swarm is named after the Mexican state of Oaxaca.

Phenology:—Plants in bloom have been observed in the field in late October and early November, and from September to December in cultivation.

Conservation status:—So far this natural hybrid has only been recorded from the surroundings of the village of Coyula, in northern Oaxaca, in which *L. halbingiana* and *L. anceps* coexist. The hybrids seem to represent an unusual, local phenomenon that, if required, could be easily replicated *ex situ*. Therefore, we do not consider it as a conservation concern.

Discussion:—At first glance, *L. ×oaxacana* looks like a plant of *L. halbingiana* bearing an inflorescence of *L. anceps* by virtue of the distichous arrangement of the flowers in the raceme, instead of the spiral raceme of *L. halbingiana*. The spreading petals oriented vertically are similar to those of *L. anceps* (although proportionately narrower; Fig. 2G–H), in contrast with the distinctly arcuate petals of *L. halbingiana*, which are oriented horizontally (Fig. 2 D). The stout plants with two-leaved pseudobulbs and the proportionately narrower, waved sepals and petals easily allow for the separation of hybrid specimens from *L. anceps*.

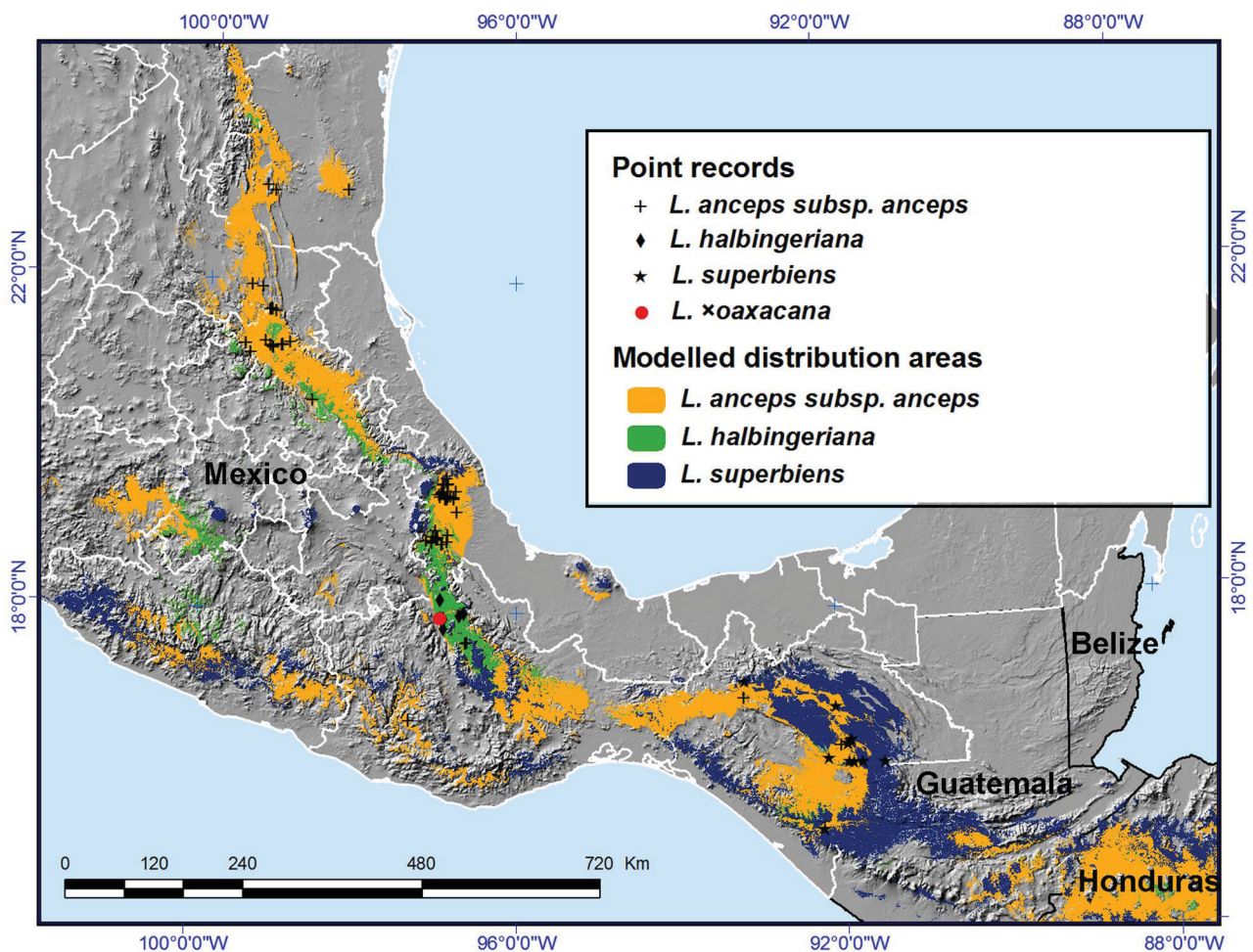


FIGURE 4. Distribution of *Laelia anceps*, *L. halbingiana*, *L. superbiens* and *L. ×oaxacana*. Symbols indicate point locality records of each species; colours indicate potential distribution areas according to the best models obtained with GARP (see text).

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