



Two new records in Orchidaceae (Vanillinae) from southernmost Colombian Amazonia: *Vanilla javieri*, a new species, and *Vanilla appendiculata*

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Abstract

This paper deals with two new records for the genus *Vanilla* in the Colombian Amazonia. Both species are part of the *Vanilla planifolia* group and exhibit fleshy leaves with conspicuous petioles, greenish flowers with concave lips, a well-defined penicillate callus and recurved lip apices with small papillae. The new species, *Vanilla javieri*, is easily distinguished by its habit as a small understory hemiepiphyte vine with terminal inflorescences exhibiting a basal, non-floriferous, sub-cordate foliaceous bract; small greenish cream-colored flowers with a glabrous ventral surface of the column and a strongly reflexed lip apex adorned by few digitiform papillae; along with highly aromatic fruits that are pendant, basally arcuate, rather stout and obscurely calyculate. The new species is sympatric and closely related to *Vanilla appendiculata*, reported here for the first time in Colombia. Botanical descriptions and photographs are presented for both species.

Introduction

The genus *Vanilla* Plumier ex Miller (1754: without page number) is a Pantropical group of hemiepiphyte vines and comprises over 100 species in the Orchidaceae (Soto Arenas & Cribb 2010). Approximately half of the species in this genus occur in tropical America, with the Amazon Basin exhibiting the highest species richness (Portères 1954, Soto Arenas & Cribb 2010). Knowledge about the genus *Vanilla* in South America has had recent advances through the description of new taxa, especially in Brazil and Colombia. These species include *V. espondeae* Soto Arenas (2010: 281), *V. paludosa* Pansarin *et al.* (2012: 157), *V. rivisii* Molineros-Hurtado *et al.* (2014: 353), *V. arcuata* Pansarin & Miranda (2016: 84), *V. capixaba* Fraga & D.R. Couto in Fraga *et al.* (2017: 64), *V. paulista* Fraga & Pansarin in Fraga *et al.* (2017: 66) and *V. denshikoira* Flanagan & Ospina-Calderón in Flanagan *et al.* (2018: 250). This illustrates the high diversity of species of *Vanilla* that occur in South America, where additional novel species are expected from under sampled areas such as the Colombian Amazonia.

Colombia is one of the global hotspots for orchids with more than 4,200 species; however, information regarding the genus *Vanilla* is incipient (MADS-UNAL 2015). This is largely due to the rarity of individual *Vanilla* plants, and to the disperse nature of its populations; along with its hemiepiphyte canopy habit, and infrequent flowering events combined with the production of ephemeral flowers (Soto Arenas & Cribb 2010, Soto Arenas & Dressler 2010). Likewise, the reduced numbers of botanical collections that exist for the genus *Vanilla* make their study more challenging. Correspondingly, the total number of native *Vanilla* species in Colombia is unknown and ranges between 11 and 23 species based on the existing literature, herbarium records, and fieldwork observations (Soto Arenas & Cribb 2010, Bernal *et al.* 2015, MADS-UNAL 2015, Flanagan & Mosquera-Espinosa 2016, Flanagan *et al.* 2018). Particularly in the context of Amazonia, nine species of *Vanilla* have been reported for Colombia (Bernal *et al.* 2015, Flanagan *et al.* 2018), sixteen species for Brazil (Barros *et al.* 2015) and five species for Peru (Householder *et al.* 2010).

This paper presents two new records for the genus *Vanilla* in the southernmost Colombian Amazonia: *Vanilla javieri*, a new species, and *Vanilla appendiculata* Rolfe (1895: 178). These two species are closely related and make part of the *Vanilla planifolia* G. Jackson in Andrews (1808: t. 538) group, as both exhibit fleshy leaves with conspicuous petioles, greenish flowers with concave lips, a well-defined penicillate callus, and recurved lip apices with small papillae. According to Soto Arenas & Cribb (2010), this group includes *V. appendiculata*, *V. bahiana* Hoehne (1950:

108), *V. cristagalli* Hoehne (1944: 125), *V. dubia* Hoehne (1944: 126), *V. dungsii* Pabst (1975: 49), *V. fimbriata* Rolfe (1899: 133), *V. helleri* Hawkes in Heller & Hawkes (1966: 19), *V. insignis* Ames (1934: 101), *V. odorata* Presl (1830: 101), *V. phaeantha* Reichenbach (1865: 274), *V. planifolia*, *V. ribeiroi* Hoehne (1910: 28) and *V. schwackeana* Hoehne (1944: 125). *Vanilla* × *tahitensis* Moore (1933: 25) is also part of this group; however, it is now clear it corresponds to a hybrid of Neotropical origin that is cultivated in French Polynesia (Lubinsky *et al.* 2008). Recently, *V. labelopapillata* Koch *et al.* (2013: 975), *V. inornata* Sambin & Chiron (2015: 308), *V. aspericaulis* Sambin & Chiron (2015: 311), *V. sotoarenasii* Pignal *et al.* in Azofoifa-Bolaños *et al.* (2017: 17), *V. capixaba* and *V. paulista* were also included in this group. According to Fraga *et al.* (2017), the latter two species are thought to be closely related to *V. dubia*, *V. dungsii* and *V. cristagalli*. In this sense, Soto-Arenas & Cribb (2010) considered *V. cristato-callosa* Hoehne (1944: 126) to be conspecific with *V. cristagalli*, and will be treated as such in this paper. The most recent addition to this group is *V. denshikoira* from Eastern Colombia (Flanagan *et al.* 2018).

Material and methods

Living material was collected from two naturally occurring *Vanilla* individuals. The description and illustration of both species is based on fresh and spirit preserved flowers. A stereomicroscope (VWR-V10MP) was used for taking photographs of the labellum ornamentation and penicillate callus. Morphological characters are based on Soto-Arenas & Dressler (2010). Herbarium acronyms follow Thiers (2016). Voucher specimens deposited at K, RB, HB, NY, IAN and INPA herbaria were consulted via virtual herbaria for species identification. The virtual herbarium of COL and the COAH herbarium were consulted for *Vanilla* voucher specimens from Colombian Amazonia. The area where *V. javieri* and *V. appendiculata* were located is presented in a map with international borders and main cities, roads, and rivers made using ArcGIS 10.4 (Figure 1).

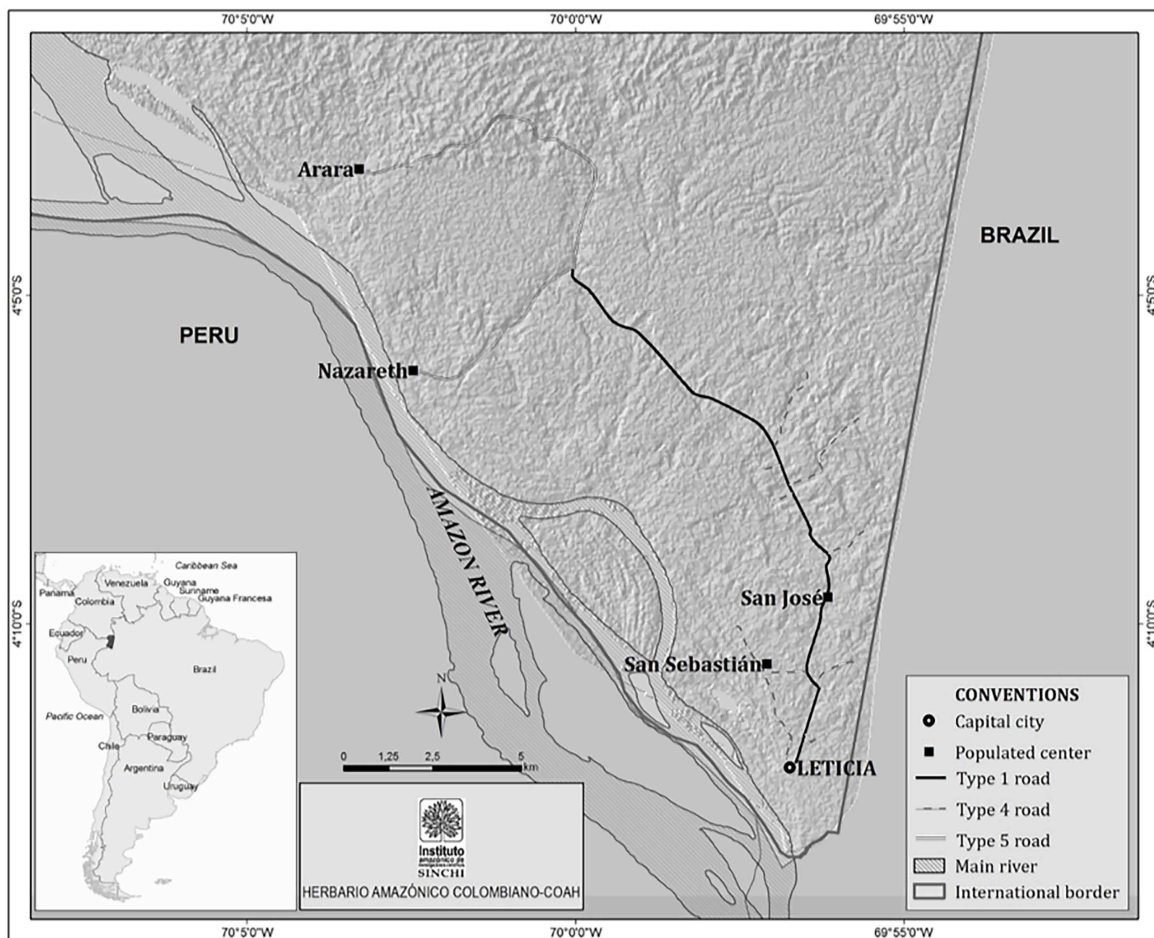


FIGURE 1. Map of the area of Leticia in the southernmost Colombian Amazonia, showing Leticia the capital city of the Amazonas department, populated centers, main rivers, roads and international borders. Both *Vanilla javieri* and *Vanilla appendiculata* were located along the main road. (Map prepared by Sonia Sua Tunjano).

Taxonomic treatment

Vanilla javieri Barona-Colmenares, *sp. nov.* (Figs. 2, 3, 5 & Table 1)

Diagnosis:—The new species resembles *V. appendiculata*; however, vines seem to be smaller and bear racemes with fewer, completely greenish cream-colored flowers. More importantly, the inner surface of the claw is lanuginose (vs. warty), the lip apex is adorned by fewer and smaller papillae, and the fruits are pendant (vs. erect). *Vanilla javieri* is easily distinguished by the following combination of characters within the *V. planifolia* group: small understory hemiepiphyte vine bearing oblong-elliptic and abruptly mucronate coriaceous leaves; terminal inflorescences with a basal, sub-cordate, non-floriferous foliaceous bract; small, greenish cream-colored flowers bearing a column with a glabrous ventral surface; a narrow, acute, strongly reflexed lip apex with two rows of digitiform papillae forming a V-shape along the margins of an inconspicuous cushion-like apical longitudinal crest; and pendant, arcuate, rather stout, obscurely calyculate fruits that are highly aromatic when dehiscent.

Type:—COLOMBIA, Departamento de Amazonas: Leticia, secondary forest on the road from Leticia to Tarapacá, 4° 03' S, 69° 59' W, 100 m elev., 19 May 2017, fl. & fr., *A.A. Barona-Colmenares & L. Pinedo 4666* (holotype COAH!).

Small, hemiepiphyte understory vine, ca. 1.2 m high. *Stems* 4–5 mm in diameter, dark green towards the base, fading to bright green towards the apex, cylindrical, smooth, flexuous, sinuous to zigzagging; *internodes* 30–54 mm long. *Leaves* 113–148 × 37–49 mm, alternate, oblong-elliptic, fleshy, coriaceous, shiny deep emerald green in color and with a conspicuous canaliculate petiole 3–12 mm long × 3–9 mm wide; *blade* longer than the internodes and bearing a conspicuous whitish collecting vein along the margins, widest at three quarters from the base and abruptly mucronate near the acute and recurved apex. *Inflorescence* terminal, racemose, with 6–20 successive flowers, generally one or occasionally two open at once; *scape* 30–80 mm long, green, erect, slightly sinuous, stouter than stem; *floral bracts* 4–6 mm long × 4–6 mm wide, small, triangular-ovate, coriaceous, canaliculate, patent, same green as scape with whitish margins; basal floral bracts distichous, up to 4 non-floriferous; the basal bract 9–11 mm long × 6–7 mm wide, foliaceous, green, subcordate with conspicuous longitudinal veins converging at apex; the remaining apical bracts floriferous and arranged spirally. *Flowers* resupinate, small, 3–5 cm in diameter, with partially spreading segments, completely greenish cream-colored and with a weak citrus odor. *Ovary* 32–35 mm long × 4–5 mm in diameter, slightly dorsiventrally compressed, white fading to green towards the apex, obscurely calyculate, with the calyculus margin broadly undulate. *Sepals* free, oblanceolate, narrow, cream-colored, merged at base with column for 9–10 mm, abaxially greenish cream-colored with the apex tinged with green, concave, margin involute, apex acute and with conspicuous crystal druses; *dorsal sepal* 91 × 12 mm, symmetric, smooth, concave with involute margins and ca. 13 veins; *lateral sepals* 84.5–86 × 12–13 mm, asymmetric, smooth, concave with involute margins and ca. 14 veins. *Petals* 86–89 × 11–12 mm, cream-colored, greenish cream-colored abaxially, merged at base with column for ca. 9–10 mm, narrow lanceolate, asymmetric, basally concave and convex towards the apex, with an externally prominent central rib, ca. 13 yellowish cream-colored veins, slightly rounded apex and conspicuous crystal druses. *Labellum* long unguiculate, inner surface of the claw lanuginose; labellum blade 42 × 31 mm when spread out, oval-shaped, with ca. 28 yellowish veins, cream-colored, obscurely trilobed, concave, with a conspicuous ventral groove and throat lined with yellow laterally; *lateral lobes* cream-colored, rounded, with ca. 12 yellowish cream-colored veins and forming a crest-like process at the column apex; lateral lobe margins entire, very slightly undulate, united to the column for 3/4 of its length (ca. 58 mm); *apical lobe* slightly rounded, ending in an acute, reflexed apex with an inconspicuous apical triangular cushion starting at 9 mm from the lip apex adorned with two lateral rows of digitiform papillae, each row with 8–12 papillae, and occasionally a third central row present with 3–4 papillae, lip apex tinged with green abaxially; apical lobe margin slightly undulate. *Penicillate callus* 4.5 mm long × 3 mm wide, well-defined at 22 mm from the apex, yellowish cream-colored, made up by 7 rows of flattened laciniae united to each other on the lateral margins, with the last row made up of multiple lines of grouped laciniae, forming a tuft. *Column* 62–67 mm long × 2–3 mm in diameter, merged at base with sepals and petals for 9–10 mm, cream-colored, slightly sinuous, thicker towards the apex and united to the labellum margins for the whole of its length (ca. 58 mm) and with a smooth ventral surface. *Stigma* 1 mm long × 2 mm wide, bilobed, each lobe quadrate-rectangular shaped, with digitiform lateral wings. *Rostellum* 3 mm long × 4 mm wide, yellowish cream-colored, convex and quadrate with rounded ends. *Anther* 5 mm long × 3 mm wide, versatile, saddle-shaped, yellowish cream-colored, with yellowish pollen grains aggregated in monads. *Fruits* 100–125 mm long × 9–13 mm in diameter, green, pendant, cylindrical, basally arcuate, appearance stout and rather short with a rounded and obscure calyculus when fully developed, dehiscent along two sutures, releasing a clear, brownish mucilaginous substance when dehiscent and strongly aromatic.

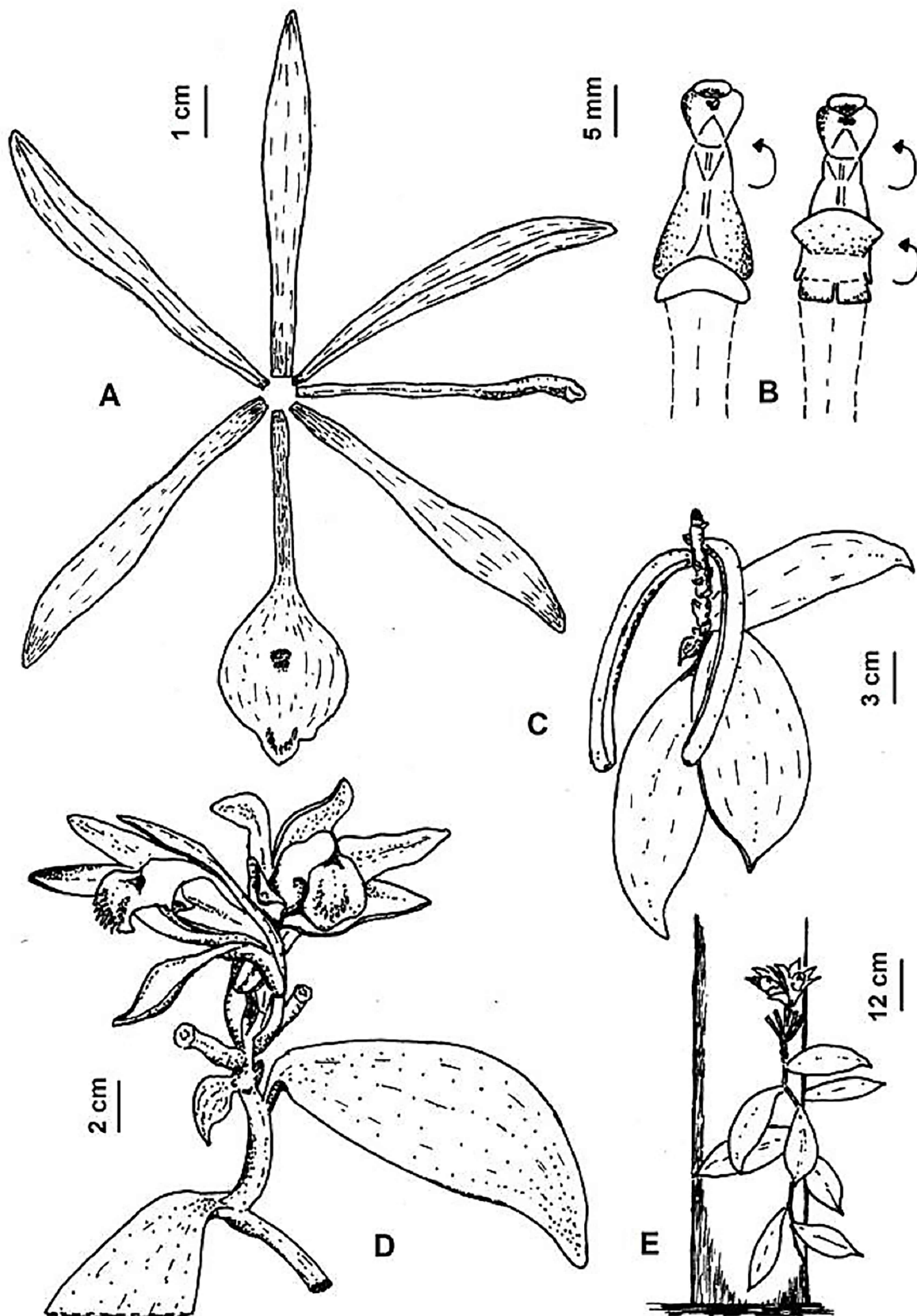


FIGURE 2. *Vanilla javieri* Barona-Colmenares. **A.** Dissected flower. **B.** Detail of column apex showing the versatile anther, rostellum and bilobed stigma (ventral view). **C.** Fruits. **D.** Terminal inflorescence with two flowers open simultaneously. **E.** Hemiepiphyte understory habit. (Drawn by the author from the holotype Barona-Colmenares & Pinedo 4666).



FIGURE 3. *Vanilla javieri* Barona-Colmenares. **A.** Greenish-cream colored flowers showing the ornamentation of the lip apex. **B.** Greenish flower buds exhibiting a basal, non-floriferous, subcordate foliaceous bract. **C.** Detail of coriaceous, abruptly mucronate leaves and pendant, arcuate, rather short and stout fruits. (Photographs by A.A. Barona-Colmenares).

TABLE 1. Comparison of closely related species in the *Vanilla planifolia* group. Characteristics in bold are shared with *Vanilla javieri* Barona-Colmenares. References taken from: (1) Rolfe 1895; (2) Soto-Arenas & Cribb 2010; (3) Soto-Arenas & Dressler 2010; (4) Householder *et al.* 2010; (5) RB 442822 (*V. dubia* Hoehne); (6) RB 37014 (*V. dubia* Hoehne holotype); (7) Fraga *et al.* 2017; (8) HB 59052 (*V. dungsi* Pabst holotype); (9) RB 14512 (*V. cristagalli* Hoehne holotype); (10) RB 504109 (*V. cristagalli* Hoehne); (11) RB 37468 (*V. cristato-callosa* Hoehne holotype); (12) Flanagan & Ospina-Calderón 2018.

SPECIES	HABIT	LEAVES	INFLORESCENCE	FLOWER COLOR	FLOWER NUMBER	COLUMN	COLUMN VENTRAL	MIDLOBE	LIP ORNAMENTATION	PAPILLAE COLOR	FRUIT
<i>V. javieri</i>	Small understory vine	Oblong-elliptic, widest at $\frac{3}{4}$ to apex, abruptly mucronate	Terminal	Greenish-cream	1-20	Sinusoidal	Glabrous	Narrow, acute, strongly reflexed apex, margin slightly undulate	Two rows of digitiform papillae forming a V-shape along margins of longitudinal apical crest	Yellowish cream	Pendant, arcuate, cylindrical, swollen towards apex, obscurely calyculate
<i>V. appendiculata</i>	Small understory vine (2, pers. obs.)	Spatulate, abruptly mucronate (2)	Terminal (2)	White (2, pers. obs.)	1-32 (Ruiz & Murphy 255 K)	Slightly sinuous (pers. obs.)	Glabrous (2, 5, pers. obs.)	Narrow, acute, strongly reflexed apex (2, pers. obs.)	Foliaceous appendages (1); papillose-barbellate appendages (2)	Yellow (1, pers. obs.)	Erect, straight, cylindrical, swollen towards the apex, calyculate (pers. obs.)
<i>V. capixaba</i>	Long scandent vine (7)	Linear lanceolate (7)	Axillary (7)	Whitish green (7)	10-16 (7)	Semi cylindrical, slender (7)	Glabrous (7)	Entire margins (7)	Suborbicular tuft of trichomes (7)	White (7)	
<i>V. cristagalli</i> / <i>V. cristato-callosa</i>	Small understory vine (4)	Obovate to elliptic (3, 10); oblanceolate (9)	Axillary and terminal (4, 9, 10, 11)	Pale yellow (4)	1-40 (4, 9, 10, 11)	Sinusoidal (4)	Puberulent (7)	Emarginate (2)	5-7 rows of tuberculate papillae (7)	Yellow (4)	Often occupies a terminal position in inflorescence (4)
<i>V. denshikoiira</i>	Long scandent (12)	Sub-oblanceolate (12)	Axillary (12)	Greenish-cream (12)	1-16 (12)		Trichomes in apical quarter (12)	Bi-lobed, cuneiformly reflexed apex (12)	Tuberculous keel covered by elongated trichomes (12)	Greenish-cream (12)	
<i>V. dubia</i>		Oblanceolate (5, 6)	Axillary (5)		Up to 12 (5, 6)		Lanuginose (7)	Entire, undulate margins (6, 7)	3-5 rows of tuberculate papillae (7)		Short and stout (6)
<i>V. dungsi</i>		Oblanceolate (8)					Puberulent (8)	Notched (8)	Clump-retorse papillae (2)		

Etymology:—*Vanilla javieri* is dedicated to local Amazonian *Vanilla* co-researcher Javier Pineda Ferreira, who located the only known individual and passed away shortly after. The epithet is permitted by article 23 of the International Code of Botanical Nomenclature, and follows recommendations 23A.1, 60.8.(a) and 60C.1.a (McNeill *et al.* 2012).

Distribution and habitat:—*Vanilla javieri* is only known from the type specimen. It was found growing in the understory of a 20–30 year old secondary growth forest near the road margin. The area where it occurs has been transformed since the construction of the road from Leticia to Tarapacá in the mid-1970's. This area currently exhibits a matrix of rural settlements, agricultural crops and pastures for cattle ranching, as well as secondary growth forest and original forest cover.

Phenology:—The only known individual of this species has been observed in flower in January, April, May and September. The development of the inflorescence takes approximately 30 days before flower anthesis initiates. Flowers are ephemeral and abscise the next day if not effectively pollinated. Immature fruits become pendant as soon as pollination occurs. Fruit sets are generally low and only two natural pollination events have been observed from at least 50 flowers. Development of the fruit takes ca. 90 days before dehiscence occurs.

Conservation:—The new species is only represented by the type individual found in an area with high anthropogenic activities. This species is part of the group bearing aromatic fruits and is therefore an important wild relative of the widely cultivated *V. planifolia*. As a result, this species could be potentially sought-after by vanilla growers. Due to the aforementioned characteristics, along with its apparent rarity and narrow distribution in an area with high anthropogenic activities, it would be reasonable to include this species in the Critically Endangered (CR) category based on IUCN criteria [CR: A3c; B1ab (i,ii,iii,iv)].

Comments:—Among the species in the *Vanilla planifolia* group, it shares the small understory vine habit with *V. appendiculata*, *V. cristagalli* and *V. ribeiroi*. Additionally, the shape and size of the perianth segments in dissected flowers is very similar to *V. appendiculata*. Furthermore, *V. javieri* exhibits a column with a glabrous ventral surface, a trait found exclusively in *V. appendiculata*, *V. capixaba* and *V. labelopapillata*, within the *V. planifolia* group (Flanagan *et al.* 2018). The combination of exclusively shared characteristics within the group suggests that its closest relatives are *V. appendiculata* and *V. cristagalli*. According to Fraga *et al.* (2017), *V. cristagalli* is a common species in the upper Solimões river area (adjacent to the study area presented in this paper); however, it exhibits notable differences when contrasted against *V. javieri*. A comparison of notable characteristics among closely related species is presented in Table 1.

Some of the most distinctive characteristics of *V. javieri* when compared with other closely related members of its group are as follows. *Vanilla appendiculata* exhibits white flowers with yellow, papillose-barbellate lip ornamentation, described by Rolfe (1896) as “foliaceous appendages”. *Vanilla appendiculata* is easily distinguished among members of the *Vanilla planifolia* group because it is the only species that exhibits erect fruits. In detail, it differs from *V. javieri* in the conspicuous rows of warty papillae connecting the apical callus to the penicillate callus (vs. absent), the conspicuous warty texture of the inner surface of the claw (vs. lanuginose texture), the number of rows, size and shape of the laciniae of the penicillate callus, the shape of the papillae and the ornamentation pattern of the lip apex (Fig. 4).

When compared with *V. javieri*, *V. cristagalli* bears leaves that are widest at half the blade length (vs. $\frac{3}{4}$ from the base in *V. javieri*), larger and more congested floral bracts, more flowers per inflorescence (up to 40 vs. up to 20), the inner surface of the claw is warty (vs. lanuginose), the ventral surface of the column is covered by puberulent papillae (vs. completely glabrous), the penicillate callus is connected to the apical callus by 5 to 7 rows of tuberculate papillae (vs. absent) and it exhibits an emarginated (vs. slightly undulate) midlobe to the lip (RB 14512, RB 504109, Fraga *et al.* 2017). Householder *et al.* (2010) report the formation of mucilaginous substance between the splitting valves of dehiscing fruits, a trait that is also observed in *V. javieri*; however, the fruits in *V. cristagalli* seem to occupy a terminal position. According to Soto-Arenas & Cribb (2010), *V. cristato-callosa* is synonymous with *V. cristagalli*, with the main difference in flower size. Furthermore, it differs from *V. javieri* in exhibiting oblanceolate leaves with longer petioles, more congested floral bracts, wider sepals and petals, notched lip apex and a shorter column (RB 37468).

Vanilla denshikoi is closely related to *V. cristagalli*; however, it differs from *V. javieri* in the numerous elongated trichomes that adorn the lip apex (Flanagan *et al.* 2018). *Vanilla dubia* is closely related to *V. appendiculata* and *V. cristagalli*, but it is easily distinguished by exhibiting oblanceolate leaves, an emarginated midlobe of the lip and thicker and shorter fruits when compared to the new species (RB 37014, Fraga *et al.* 2017). *Vanilla schwackeana* is a poorly known species that is also thought to be closely related to *V. cristagalli*, but with the lip ornamentation reduced to warty papillae (Soto Arenas & Cribb 2010). Additionally, it exhibits leaves with a long, acuminate apex and fruits that are longer and less stout than in *V. javieri* (RB 87015). *Vanilla dungsii* occurs exclusively in the Brazilian Atlantic

Forest and exhibits narrow-lanceolate leaves with a long-acuminate apex, internodes up to 16-18 cm, notched midlobe of the lip and rows of papillae connecting the lip apex with the penicillate callus (HB 59052, Fraga *et al.* 2017). *Vanilla capixaba* shares the glabrous ventral surface of the column with *V. javieri*; however, it exhibits white flowers with a densely barbellate lip apex (Fraga *et al.* 2017). *Vanilla paulista* exhibits a deeply emarginate midlobe to the lip and a column with a lanuginose ventral surface (Fraga *et al.* 2017).

The remaining species in the *V. planifolia* group are not included in Table 1 due to their geographic distribution and distinctiveness from *V. javieri*. In this sense, *Vanilla aspericaulis* exhibits flowers with more papillae and a lanuginose ventral surface of the column (Sambin & Chiron 2017). *Vanilla bahiana* is reported to occur exclusively in the Brazilian Atlantic Forest and exhibits short xerophytic leaves, stout stems and large, greenish-yellow flowers (Soto Arenas & Cribb 2010). *Vanilla fimbriata* and *V. odorata* are very closely related to each other and both exhibit oblanceolate leaves and fimbriate lip margins (Soto Arenas & Cribb 2010). *Vanilla helleri* has abundant wax on the stem apices and whitish flowers with a bright yellow lip adorned with orange appendages on the midlobe (Soto Arenas & Dressler 2010). *Vanilla inornata* exhibits lanceolate leaves and lacks papillae on the labellum (Sambin & Chiron 2017). *Vanilla insignis* is one of the largest members in the Orchidaceae family, with vigorous vines reaching up to 100 meters in length, flowers with apple-green tepals and dense, yellow-orange papillae covering the lip apex (Soto Arenas & Dressler 2010). *Vanilla labelopapillata* exhibits linear-lanceolate leaves and a lip with fimbriate margins that is completely covered by seven rows of tuberculate yellow-orange papillae (Koch *et al.* 2013). *Vanilla phaeantha* is common in the West Indies and has small xerophytic leaves and large flowers with a white lip adorned by yellow stripes (Soto Arenas & Dressler 2010). *Vanilla planifolia* does not occur naturally in South America and the ornamentation of the lip is reduced to numerous warty appendages (Soto Arenas & Cribb 2010). *Vanilla ribeiroi* presents reduced and xerophytic leaves, small greenish sepals and petals, concave column with a hirsute ventral surface and the distal half of the lip is completely covered by yellowish trichomes (Householder *et al.* 2010). Finally, *V. sotoarenasii* exhibits warty appendages on the lip apex (Azofeifa-Bolaños *et al.* 2017).

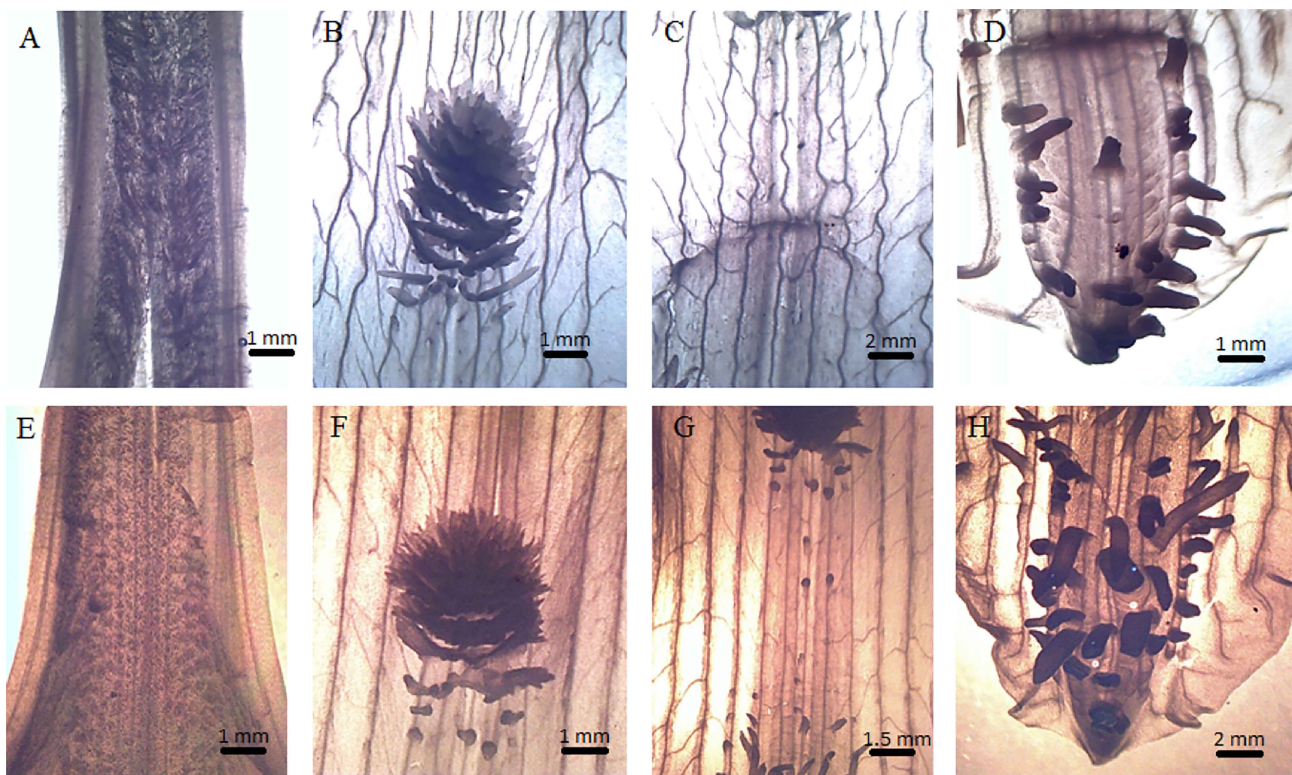


FIGURE 4. Stereomicroscope photographs of *Vanilla javieri* Barona-Colmenares (A, B, C, D) and *Vanilla appendiculata* (E, F, G, H). **A.** Labellum claw. The inner surface of the labellum claw of *V. javieri* is lanuginose (A) versus warty in *V. appendiculata* (E). **B.** Penicillate callus. The callus of *V. javieri* (B) is less congested than the callus of *V. appendiculata* (F), with thicker and less numerous laciniae forming a tuft. Additionally, the veins in *V. javieri* are sinuous and contrast against the parallel veins in *V. appendiculata*. **C.** *Vanilla javieri* lacks appendages between the penicillate callus and the lip apex (C) versus few warty appendages connecting both in *V. appendiculata* (G). **D.** Ornamentation of the lip apex. *Vanilla javieri* exhibits few, small, digitiform papillae (D) versus longer and more numerous foliaceous appendages in *V. appendiculata* (H). Photographs: A.A. Barona-Colmenares & N. Oviedo (*V. javieri*) and A.A. Barona-Colmenares & J. Potosí (*V. appendiculata*).

Vanilla appendiculata Rolfe (1895:178) (Figs. 4, 5 & Table 1)

Hemiepiphyte understory vine, up to 4 m high. *Aerial roots* 46–111 mm long and 2–3 mm in diameter, greenish-white when young turning greenish-grey when mature, flattened, with a villose ventral surface; *stems* 4–5 mm in diameter, pale green, cylindrical, smooth, flexuous, thicker towards the nodes; *internodes* 29–57 mm long. *Leaves* 140–177 × 42–49 mm, alternate, fleshy, shiny pale green when young, turning to deep emerald green when mature; *petiole* 1.2–1.3 mm long × 5–6 mm wide, canaliculate; *blade* longer than the internodes, spatulate with an abruptly mucronate apex. *Inflorescence* terminal, racemose, with 8–30 successive flowers, with generally one flower open at once; *scape* 30–80 mm long and 5–7 mm in diameter, pale green, erect, slightly sinuous and stouter than the stem; *floral bracts* 4–6 mm long × 4–6 mm wide, small, triangular-ovate, coriaceous, canaliculate, patent, pale green with whitish margins, the basal distichous and non-floriferous and the distal floriferous and arranged spirally. *Flowers* resupinate, medium-sized, 6–8 cm in diameter, with spreading segments, white, pedicellate and scentless. *Ovary* 25–26 mm long and 3–4 mm in diameter, slightly arcuate towards the base, white fading to green towards the apex, slightly dorsiventrally compressed and obscurely calyculate. *Sepals* free, oblanceolate, narrow, merged at base with column for ca. 6 mm, white with the apex tinged with green abaxially, concave with involute margins and acute apex; *dorsal sepal* 78 × 8 mm, white with the apex tinged with green abaxially, symmetric, smooth and with ca. 11 veins; *lateral sepals* 75 × 11 mm, asymmetric, smooth and with ca. 14 veins. *Petals* 76–77 × 7–8 mm, merged at base with column for ca. 6 mm, white with the apex tinged with green abaxially, narrow lanceolate, asymmetric, basally concave and convex towards apex, with ca. 15 veins, a conspicuous externally prominent central rib and acute apex. *Labellum* long unguiculate, inner surface of the claw warty; labellum blade 38 × 29 mm when spread out, oval-shaped, white, concave, obscurely trilobed, mid lobe slightly rounded. *Lateral lobes* white, very slightly cream-colored, rounded, with ca. 12 yellowish veins; lateral lobe margins entire, very slightly undulate, united to the column along the whole of its length (ca. 54 mm) and forming a flattened process at the column apex. *Apical lobe* narrow, acute-triangular, deeply recurved lip apex adorned with yellowish, flattened, foliaceous appendages covering most of the area along an inconspicuous, elevated, cushion-like, triangular apical keel. *Penicillate callus* 4 mm long × 4 mm wide, well-defined at 22 mm from the apex, yellowish-cream, made up by ca. 7 rows of flattened laciniae; the two most basal rows made up by few, separate, lacinate scales; the rest of the rows with laciniae united to each other on the lateral margins, with the apical row made up of multiple lines of grouped laciniae, forming a tuft. *Column* 61 mm long × 3 mm in diameter, whitish, merged at base with sepals and petals for ca. 6 mm, thicker towards the apex and slightly sinuous, united to the labellum margins for the whole of its length (ca. 54 mm) and with a smooth ventral surface. *Stigma* 1 mm long × 2.5 mm wide, bilobed, each lobe rectangular shaped, stigmatic region with digitiform lateral wings. *Rostellum* 1.5 × 4 mm, convex, yellowish-cream, quadrate, with rounded ends. *Anther* 4 mm long × 3 mm wide, saddle-shaped, versatile, yellowish-cream, with yellowish pollen grains aggregated in monads. *Fruits* 120–140 mm long × 12–15 mm in diameter, erect, pale green, cylindrical, basally recurved, swollen towards the apex and obscurely calyculate when fully developed.

COLOMBIA, Departamento de Amazonas: Leticia, km 15 on the road from Leticia to Tarapacá, 86 m elev., 4° 06' S, 69° 59' W, 10 April 2015, fl. & fr., A.A. Barona-Colmenares & L. Pinedo 3102 (COAH!).

Distribution and habitat:—*Vanilla appendiculata* occurs in Guyana, Surinam, Brazil and Peru, as a small understory hemiepiphyte vine (Soto Arenas and Cribb 2010). This species is reported to occur in the state of Loreto, Peru, and the state of Amazonas, Brazil, adjacent to the Colombian border. Based on the revision of the associated data in herbarium specimens, this species occurs in *igapó* and *várzea* floodplain forests, temporally flooded forests along small streams, around *Mauritia* palm wetlands, as well as in *terra firme* forests on sandy outcrops.

Additional specimens examined: Type:—GUYANA (British Guiana), Corentyne River, fr., October 1879, *im Thurn s.n.* (holo. K 463748); BRAZIL, Amazonas, road margins Camanaus-Uaupés road near Camanaus. Caatinga on white sand, terra firme, fr., 1 November 1971, *Prance, Maas, Woolcott, Monteiro & Ramos 15950* (NY 2695608); idem, Amazonas, Rio Negro, Ilha das Flores, caatinga alta, fl. & fr., 10 November 1953, *Rodrigues 100* (IAN 102121); idem, Amazonas, Municipio de São Paulo de Olivença, estrada Bomfim, vegetação tipo campinarana, solo arenoso, fl., 16 March 1981, *Monteiro & Lima 133* (INPA 99080); idem, Mato Grosso, Juará, proximidade do Río Arinos em floresta ombrófila, 11° 05' 01.0" S, 57° 45' 03.0" W, fr., 12 August 2014, *Saddi, Samor & Gomes 1007* (RB 612505); idem, Roraima, Caracarái, Parque Nacional do Viruá, 1° 28' 07.0" N, 61° 00' 27.0" W, fl. & fr., 17 September 2011, *Pessoa, Melo & Vasconcelos 639* (INPA 241015); idem, Roraima, Caracarái, Parque Nacional do Viruá, Río Barauana, 1° 20' 50.0" N, 60° 51' 01.0" W, fl. & fr., 21 September 2011, *Pessoa, Melo & Vasconcelos 696* (INPA 241058); idem, Roraima, Caracarái, Parque Nacional do Viruá, Río Barauana, mata de várzea, fl., 26 July 2010, *Pessoa, Delgado Junior, Melo & Cavalcanti 356* (INPA 235120); PERU, Departamento de Loreto, Provincia Maynas, Mishana Río Nanay, fl. & fr., 19 November 1981, *Ruiz & Murphy 255* (K).



FIGURE 5. *Vanilla appendiculata* Rolfe. **A.** Flower buds, showing white ovaries with a greenish apex. **B.** Flower and immature fruit. **C.** Lateral view of lip apex ornamentation with yellowish, barbellate, foliaceous appendages. **D.** The erect nature of the fruits. Photographs: A.A. Barona-Colmenares (A, B & D) and Goran Mihajlovic (C).

Comments:—In the original description of the type specimen from Guyana, Rolfe (1895: 178) mentions that *V. appendiculata* is “...remarkable for its narrow sepals and petals, and long narrow lip which terminates in a narrow recurved apex, covered with linear foliaceous appendages. The specimens were gathered in 1879 and both the fruits have opened, yet they retain a distinct aromatic perfume...”. The holotype at Kew exhibits two mature, fully open, calyculate fruits and it is not evident whether they were erect or pendant. Conversely, voucher specimens at RB and INPA herbaria clearly exhibit immature fruits that are erect, basally recurved, cylindrical, swollen towards the apex and calyculate. The associated data on herbarium tags confirms other observed characteristics such as the understory vine habit, white ovaries with a greenish apex, white flowers and lip with yellow appendages. Furthermore, the voucher specimens confirm other diagnostic characteristics such as terminal inflorescences and triangular-ovate, acute, canaliculate, coriaceous, patent bracts. Due to the numerous fruit sets observed, both *in situ* and in voucher specimens, self-pollination is not improbable.

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