

CONFIRMATION OF THE PRESENCE OF *VANILLA CALYCVLATA* SCHLTR. (ORCHIDACEAE) IN MEXICO: EXTENSION TO NORTHERNMOST DISTRIBUTION

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Abstract

Background: Nine *Vanilla* species have been reported in Mexico. *Vanilla calyculata* has been formally documented in Brazil, Colombia, El Salvador, Guatemala, Honduras, and Nicaragua. Its presence in Mexico has been suggested based on a single sterile specimen but its identity has not been confirmed, and no further records are known.

Questions: Do the live individuals of *Vanilla* sp. found in Western Mexico correspond to *Vanilla calyculata*?

Studied species: *Vanilla calyculata*.

Study site and dates: Western Mexico, 2019-2025.

Methods: Specimens of *Vanilla* sp. were collected and determined taxonomically using specialized literature. Mexican herbaria were widely consulted. The conservation status was assessed using the IUCN Red List criteria.

Results: We confirmed the presence of *Vanilla calyculata* in Mexico based on wild specimens and herbarium records. This species is now known from three localities in Western Mexico, which increases its distribution up to 1,800 km northwards. The number of species of the *Vanilla* genus reported for Mexico increases to 10 and to three for the west of the country. The conservation status of *V. calyculata* in Mexico is C2a(i), "Critically Endangered - CR", based on the IUCN criteria.

Conclusions: This work contributes to the knowledge on the geographic distribution of the genus *Vanilla* in the Neotropical region, Mexican orchid diversity, and emphasizes the need for immediate actions to ensure the conservation of this important component of agrobiodiversity in Mexico.

Keywords: Crop wild relatives, IUCN Red List, Neotropical region, section *Xanata*, tropical dry forest.

Resumen:

Antecedentes: Nueve especies de *Vanilla* han sido reportadas en México. *Vanilla calyculata* está oficialmente documentada en Brasil, Colombia, El Salvador, Guatemala, Honduras y Nicaragua. Su presencia en México fue sugerida a partir de un ejemplar estéril, pero no se ha confirmado su identidad ni se conocen más registros.

Preguntas: ¿Los individuos vivos de *Vanilla* sp. encontrados en el occidente de México corresponden a *Vanilla calyculata*?

Especie de estudio: *Vanilla calyculata*.

Sitio y años de estudio: Occidente de México, 2019-2025.

Métodos: Individuos de *Vanilla* sp. fueron colectados y determinados taxonómicamente usando literatura especializada. Los herbarios mexicanos fueron ampliamente consultados. El estado de conservación fue evaluado de acuerdo con los criterios de la IUCN.

Resultados: Confirmamos la presencia de *Vanilla calyculata* en México a partir de individuos silvestres y registros de herbario. Esta especie es ahora conocida en tres localidades en el occidente mexicano, lo cual aumenta su distribución en más de 1,800 km hacia el norte. El número de especies de *Vanilla* documentadas en México se eleva a 10 y a tres para el occidente del país. El estado de conservación de *V. calyculata* en México es C2a(i), "Peligro Crítico - CR", con base a los criterios de la IUCN.

Conclusiones: Este trabajo contribuye al conocimiento de la distribución geográfica del género *Vanilla* en la región Neotropical, en la diversidad de orquídeas mexicanas y enfatiza en la necesidad de tomar acciones inmediatas para asegurar la conservación de este importante componente de la agrobiodiversidad en México.

Palabras clave: Bosque seco tropical, Lista Roja de la UICN, parientes silvestres de cultivo, región Neotropical, sección *Xanata*.

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Vanilla ex Mill. (Orchidaceae) is a pantropical genus with about 120 accepted species (POWO 2025). Soto Arenas & Cribb (2010) classified the genus into two subgenera, *Vanilla* subgenus *Vanilla* Soto Arenas & P.J.Cribb, and *Vanilla* subgenus *Xanata* Soto Arenas & P.J.Cribb. The latter is further divided into two sections, *Tethya* Soto Arenas & P.J.Cribb and *Xanata* Soto Arenas & P.J.Cribb. The species of section *Xanata* represent valuable components of agrobiodiversity, comprising the secondary gene pool of the main cultivated species, *Vanilla planifolia* Andrews (Flanagan *et al.* 2018). Natural vanilla flavor is obtained from the cured fruits of *V. planifolia*, and from some of its wild relatives (Soto Arenas 1999). This agrobiodiversity offers potential for promoting diversified incomes in local economies (Bramel & Frey 2021).

In the Neotropical region, two lineages of the genus *Vanilla* naturally occur, subg. *Vanilla* and subg. *Xanata*, section *Xanata* (Soto Arenas & Cribb 2010). The tropical humid forest of the Amazon basin in South America is the centre of diversity for *Vanilla* (Barona-Colmenares 2018, Flanagan *et al.* 2018, Pansarin & Menezes 2023). Three countries concentrate the highest species diversity of the genus, Brazil with 40 species (Ferreira *et al.* 2020, Pansarin & Menezes 2023, Pansarin 2024), Colombia with 27 species (Flanagan *et al.* 2018, 2022, 2025), and Peru with 18 species (Damián 2020, Damián & Mitidieri 2020, Damián *et al.* 2022).

In Mexico, the presence of nine *Vanilla* species have been confirmed to date: *V. cribbiana* Soto Arenas, *V. hartii* Rolfe, *V. helleri* A.D.Hawkes, *V. insignis* Ames, *V. odorata* C.Presl, *V. phaeantha* Rchb.f., *V. planifolia* Andrews, and *V. pompona* Schiede, members of the subgenus *Xanata*, and *V. inodora* Schiede in the subgenus *Vanilla* (Soto Arenas 1999, Soto Arenas & Dressler 2010, Villanueva-Viramontes *et al.* 2017, Ulloa-Ulloa *et al.* 2023). For Western Mexico, which includes the states of Colima, Jalisco, Michoacan and Nayarit, only two species have been reported, *V. pompona* and *V. inodora* (Soto Arenas 1999, Soto Arenas & Cribb 2010). Soto Arenas & Dressler (2010) suggested the presence of *V. calyculata* Schltr. in Mexico based on a sterile specimen collected in 1901 at Hacienda de Coahuayula, Michoacan (*G.M. Emrick 16*, F-95476). Subsequently, Karremans *et al.* (2020) included Mexico within the natural range of *V. calyculata* based on the suggestion mentioned above, but did not present additional information to support the presence of this species in the country. These authors also synonymized *V. calyculata* with *V. columbiana* Rolfe; however, Flanagan *et al.* (2025) have recently revalidated the former.

Here, we confirm the presence of *Vanilla calyculata* in Western Mexico, presenting fertile material from two localities found during ongoing fieldwork to characterize the Mexican *Vanilla* species, as well as findings from an exhaustive review of specimens of the *Vanilla* genus in national herbaria. Details of morphology, distribution, ecology, and conservation status based on Mexican specimens are provided here for this species. Finally, we discuss the taxonomic uncertainty of the genus *Vanilla* in Mexico.

Materials and methods

Study site. The central region of Western Mexico comprises Colima, Jalisco, Michoacán and Nayarit. In this region, three major mountain systems converge, Sierra Madre Occidental, Sierra Madre del Sur and the Transmexican Volcanic Belt, with two coastal plains to the North and South (Morrone 2019). This topography confers a great diversity of biomes in the region, including temperate forest, tropical seasonally dry forest, tropical humid forest, and mountain rainforest (Villaseñor & Ortiz 2013). Nayarit is one of the states with the least land use transformation in Mexico, with 37.7 % of its surface still covered by natural vegetation. The climate of more than 90 % of the area is tropical sub-humid with an average annual rainfall of 1,140 mm. The average annual temperature is 23 °C but ranges between 12 °C in January and 35 °C in May and June (INEGI 2013, 2016). In a botanical exploration in Western Mexico, we found and collected undetermined and morphological distinct *Vanilla* individuals in two localities from Nayarit; one in the municipality of Tepic, another in the municipality of Ruiz. Precise coordinates for these localities are not presented here, to avoid illegal extraction of the plants.

Collection, processing and morphological description. Plant material was collected from two individuals, one per locality. Voucher specimens were deposited in CITRO (Universidad Veracruzana) and IBUG (Universidad de Gua-

dalajara) herbaria. Also, two portions of sterile material were collected and cultivated at the germplasm bank of the University Orchidarium of the Universidad Veracruzana (UMA-SEMARNAT-In-viv-0129-Ver/11) in Xalapa, Veracruz, Mexico. Once specimens bloomed, their taxonomic identity as *Vanilla calyculata* Schtrl. was confirmed, according to the taxonomic treatment and descriptions of Soto Arenas & Cribb (2010), Soto Arenas & Dressler (2010), Karremans *et al.* (2020) and Flanagan *et al.* (2025). We elaborated a photographic plate illustrating the habit, and vegetative and floral traits of the species. The photographs were taken with a professional camera (Nikon D3000) on a black background and edited in PowerPoint Office365 v. 16.89.1.

Distribution in Mexico. As part of a taxonomic revision of the *Vanilla* genus in Mexico, we consulted widely in national herbaria: AMO, CEDESU, CH, CHAPA, CHIP, CIB, CICY, CIMI, CITRO, CORU, EBUM, ECO-CH-H, ECO-TA-H0, ENCB, GUADA, HEM, HUAP, IBUG, IEB, IMSS, MEXU, OAX, QMEX, SERBO, SLPM, UABJO, UADY, UAGC, UAMIZ, UAM-I, UAM-X, UAT, UCAM, UCOL, UJAT, XAL, XALU, XOLO and ZEA (acronyms follow Thiers (2025)). We generated a distribution map using the new records of *Vanilla calyculata* found in Mexico and previous records from Guatemala. This later is considered the northernmost limit of the distribution for this same species. In addition, we examined the specimen collected by *G.M. Emrick 16* (F-95467) suggested as *V. calyculata* by Soto Arenas & Dressler (2010), to verify its identity and compare it with our findings. The geographic distribution map was elaborated using QGIS v. 3.34.7 (QGIS 2023). Political boundaries were downloaded from DIVA-GIS (diva-gis.org).

Conservation status. The assessment of species conservation status of *Vanilla calyculata* in Mexico was determined according to the guidelines proposed by the IUCN RedList (IUCN 2012). Using the *ConR* package (Dauby *et al.* 2017), we calculated the Area of Occupancy (AOO) and Extent of Occurrence (EOO). AOO was estimated using a 2 × 2 km standard grid (Bachman *et al.* 2011).

Results

We confirm the presence of *Vanilla calyculata* Schltr. in Mexico from fertile specimens found in Nayarit ([Figure 1](#)). These records represent a considerably increase of the known natural distribution of this species, extending approximately 1,800 km north from the previous northernmost record in Chiquimula, Guatemala ([Figure 2A](#)). After an exhaustive herbaria revision, we found 143 specimens of *Vanilla* genus in 20 national herbaria out of 39 reviewed. In the herbarium IBUG, a specimen with fruits of *V. calyculata* (*José Carrillo Torres s.n.* IBUG-15677), collected in Aquila, Michoacán, was found misidentified as *V. pompona* Schiede ([Figure 3](#)). In addition, after examination of the specimen *G.M. Emrick 16* (F-95476, [Figure 4](#)) suggested as *V. calyculata* by Soto Arenas & Dressler (2010), we found that it was not a sterile specimen due to the presence of fruits. Furthermore, this specimen can be more appropriately referred to *V. planifolia*, from lengthened and fairly narrow fruits, the petiolate and sub-acuminate leaves, as well as small dimensions of the bracts ([Table 1](#)).

Vanilla calyculata Schltr., Repert. Spec. Nov. Regni Veg. Beih. 7: 42-43. 1920

Type. Colombia, Cauca, 1,000 m, *M. Madero s.n.* (Holotype: B†). Neotype (designated by Soto Arenas & Dressler 2010): Colombia, Valle del Cauca, municipio Tuluá, Corregimiento Mateguadua, Jardín Botánico Juan María Céspedes, laderas en vía de repoblación natural, 1,100 m, Enredadera; sépalos verdes claro, pétalos amarillo claro, labello amarillo intenso, frutos maduros color marron, muy fragantes, 29 September 1984, *W. Devia 815* (TULV-003790!, Isoneotype NY-04170480!).

= *Vanilla esquipulensis* Archila & Chiron, *Richardiana* 13: 6. 2012. Type: Guatemala, Chiquimula, Esquipulas, La aldea El Barrial, poussant sur una plante d'annone, 900 m, April 2012, *F. Archila 1300* (Holotype: BIGU, Isotype: BIGU).

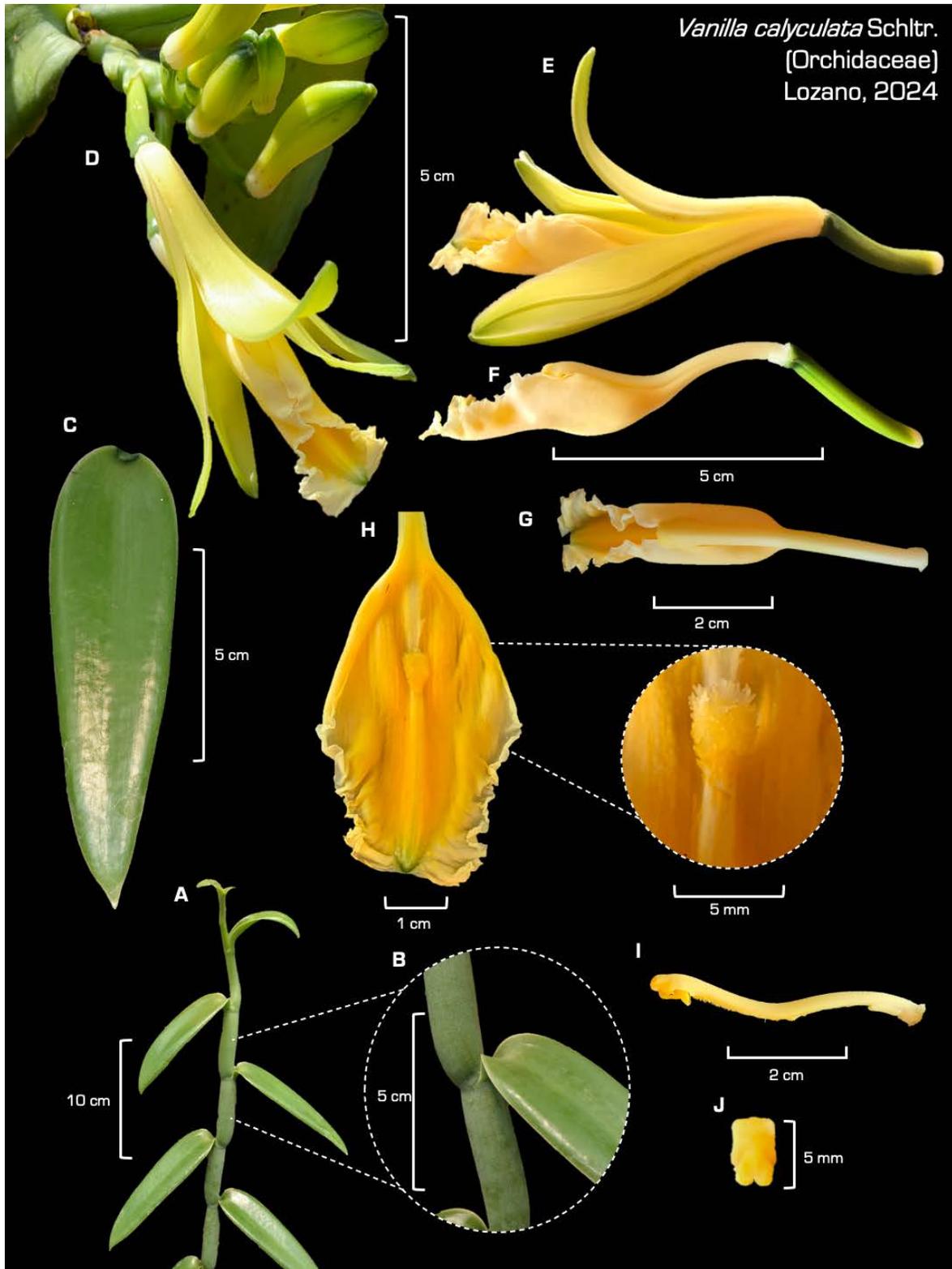


Figure 1. Botanical digital plate of *Vanilla calyculata* Schltr. A. Habit; B. Segment of the stem; C. Leaf, adaxial view; D. Inflorescence; E. Flower, lateral view; F. Pedicelate ovary with lip envolving the column, lateral view; G. Lip involving the column, frontal view; H. Extended lip and zoom of the penicillate callus; I. Column, lateral view; J. Anther. Photographs by M.A. Lozano-Rodríguez based in M. Lozano MALR030.

Vanilla calyculata in Mexico

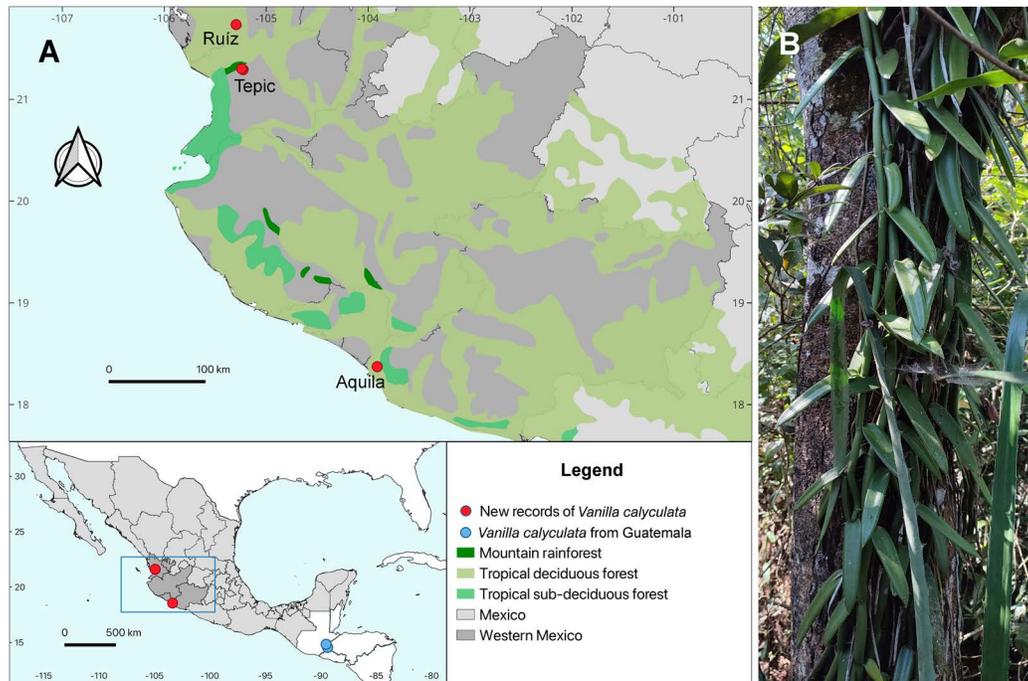


Figure 2. Distribution of *Vanilla calyculata* Schltr. in Mexico. A. The red dots represent the new records reported in this study. The blue dots are records of *V. calyculata* from Guatemala, northernmost distribution previously documented for this species. Map by A. Navia-Samboni; B. Living individual from the municipality of Ruiz, Nayarit. Photograph by A.T. Nuño-Rubio (B), based in A. Nuño ANTR130.

Description. Hemiepiphytic vine, branching, leafy up to 8 m length. Stem flexuose, terete, constricted at each node and lustrous green, 1.28-1.52 cm in diameter; internodes 5.69-6.71 cm long. Aerial roots terete, attached ones dorsally compressed, one per node emerging laterally to the leaf, up to 5.76 cm long, pale green or brownish. Leaves sessile to subpetiolate, petioles 6.5-11.1 mm long; blade oblong to oblong-elliptic, base rounded to obtuse, apex apiculate to acuminate, coriaceous, stiff, margins slightly revolute, 11.7-14.8 × 3.3-3.9 cm. Inflorescence a raceme with up to 10 flowers, 5.0 cm long; rachis ca. 5.2 cm long. Floral bracts ovate to obtuse, concave, reducing in size from the base to the apex, up to 8.2 × 5.2 mm. Flowers successive, pendant, very showy, spreading, sepals and petals white-cream and yellowish green towards the apex, lip deep yellow, lobe margins white-cream, green apex, ca. 10 cm long; strongly fragrant. Ovary straight to arcuate, sulcate, light to dark green, 2.5-3.8 × 0.5 cm. Dorsal sepal oblanceolate to narrowly elliptic, acute to obtuse, recurved, 10 veined, 6.27 × 1.24 cm; lateral sepals oblong-elliptic, obtuse, recurved, incurved at the middle, 10 veined, 6.29-6.82 × 0.99-1.06 cm. Petals oblanceolate, recurved, acute, long attenuate toward the base, flat keel on the abaxial surface, 11 veined, 6.22-6.43 × 1.08-1.28 cm. Lip attached to the column along the margins of the basal half, trumpet-shaped, trilobed, when spread out ca. 6.39 × 3.18 cm; long unguiculate at the base, the claw 1.91 × 3.2 cm; the blade cymbiform, deepest at the middle, obovate when spread out, 38 veined, veins branched; lateral lobes subrounded, incurved forming a gullet around the column, margins entire to crenulate near the midlobe, 2.50-2.87 × 15.3-15.8 cm; the midlobe canaliculate, subquadrate to oblong, bilobed, margins undulate to crenate, veins thickened, 1.76 × 2.25 cm. Penicillate callus at 3.62 cm from the base of the lip, ca. 4.4 × 3.9 mm, made up by 7 flabellate, lacerated scales, from deep to light yellow. Column subterete, slightly sigmoid, 46.0 × 3.2 mm, ventrally flattened, lanuginose at the distal half. Stigma trilobed, the lobes emergent; rostellum trapezoid, flabellate, 3.2 × 4.4 mm. Anther attached to the clinandrium, triangular to ovate, 4.4 mm long and 3.6 mm wide; pollen masses ca. 4.5 mm. Fruit not seen. Seed not seen.

New records. Mexico, Nayarit, municipio Ruiz, Los Planes, 21° 58' N, 104° 54' W, 624 m asl, 23 February 2025, Ana Nuño ANTR130 (IBUG-222454); Nayarit, municipio Tepic, Rinconcitos, 21° 35' N, 104° 55' W, 725 m asl, 15 May 2019, flowers, Miguel Lozano MALR030 (CITRO-6300VER).



Figure 3. *Vanilla calyculata* Schltr., specimen collected by J. Carrillo Torres *s.n.* (IBUG-159677) from Michoacán, Mexico.

Additional specimens examined. Guatemala, Chiquimula, 900 m asl, without geographic coordinates, April 2012, Fredy Archila FA1300 (BIGU!).

Distribution and ecology. *Vanilla calyculata* has been record from Brazil, Colombia, El Salvador, Guatemala, and Honduras. The presence in Mexico of this species is confirmed here from living individuals found in two localities approximately 40 km apart in Nayarit (Figure 2A). Firstly, close to the town of Tepic, six individuals were recorded, separated by 1 km and growing in sympatry with *V. pompona*. The vegetation in this locality is tropical dry forest, including arboreal species as *Bursera* sp., *Cochlospermum vitifolium* (Willd.) Spreng., *Ipomoea* spp., *Jacaratia mexicana* A.DC. and, *Quercus* spp., surrounded by extensive crops of *Agave tequilana* F.A.C.Weber and *Citrus × latifolia* Tanaka ex Q.Jiménez. This site occurs on steep slopes, near seasonal streams, in the Santiago River basin. The second locality is situated in the municipality of Ruiz, Nayarit, at an altitude of 624 m asl. Here, a single individual of *V. calyculata* (Figure 2B) was recorded, also growing sympatrically with *V. pompona*. This is a semi-open, well-lit area near the edge of a temporary water course, within a transitional forest between a medium subperennial tropical forest an oak forest. Associated vegetation in this transitional forest includes *Ardisia compressa* Kunth, *Calophyllum brasiliense* Cambess., *Clusia salvinii* Donn.Sm., *Magnolia* sp., *Quercus* sp., and *Syzygium jambos* (L.) Alston. The site is moderately affected by cattle grazing and temporary crops.

Conservation status. The estimation of the EOO for *V. calyculata* in Mexico was 1,968 km² and its AOO was 12 km². Under criterion B (geographic range), this AOO yields a status very close to Critically Endangered “CR” (AOO < 10

km²). Given that only eight individuals are known so far in the country, under criterion C (small population size and decline), *V. calyculata* can be clearly classified as Critically Endangered “CR”: C2a(i) in Mexico, with less than 250 individuals in total, and less than 50 in each population. Furthermore, from the degraded and unprotected nature of the habitat in the localities where this species occurs, and our direct observation of host trees of these plants being cut down, we can infer continuing population decline, if no conservation actions are implemented.

Discussion

Vanilla calyculata was described by Schlechter (1920) from a specimen collected by M. Madero in the Cauca region of Colombia and deposited in the Herbarium Berolinense (Holotype B†). Karremans *et al.* (2020) synonymized *V. calyculata* with *V. columbiana* due to the similarity between both species as suggested by Soto Arenas & Dressler (2010), but no additional information supporting was provided by the authors. Recently, Flanagan *et al.* (2025) provided evidence confirming *V. calyculata* as an accepted species. Herbarium specimens of *Vanilla* are often misidentified, with a common confusion between *V. calyculata*, *V. phaeantha*, *V. pompona* and *V. planifolia*



Figure 4. *Vanilla planifolia* Andrews, specimen collected by G.M. Emrick 16 (F-95476) from Michoacán, Mexico, and previously suggested as *V. calyculata* Schltr.

(Soto Arenas & Cribb 2010, Flanagan *et al.* 2025), as seen with the specimens *J. Carrillo Torres s.n.* and *G.M. Emrick 16* examined in this study (Table 1). This latter specimen was identified as *V. calyculata* (Soto Arenas & Dressler 2010); however, we consider it has a greater affinity to *V. planifolia*. *Vanilla planifolia* does not have a natural distribution in Western Mexico (Soto Arenas & Dressler 2010), and this specimen likely represents a cultivated individual at Hacienda de Coahuayula, Michoacán, where it was collected. Nonetheless, we recommend future explorations of this property.

Vanilla calyculata is recognized by its sessile to subpetiolate leaves, pedant, yellowish flowers, a lip conspicuously longer than tepals, and a transversely oblong central lobe with entire to crenulate margins (Flanagan *et al.* 2025). Mexican specimens show a slight variation compared to those from Colombia, including the deep yellow coloration of the lip (see Figure 1C, Flanagan *et al.* 2025), smaller flowers, the penicillate callus with one scale less, and a shorter column. These differences are likely a consequence of population genetic variation, particularly given the isolated distribution of the Mexican populations. The lip color in Mexican specimens closely resembles the specimens from Guatemala, the closest occurrence (see Figure 2, Archila & Chiron 2012).

In Mexico, *Vanilla calyculata* is easily distinguishable from the other two species occurring in the west of the country, *V. inodora* and *V. pompona* by its vegetative characteristics (Table 1), but there are other morphologically similar taxa distributed in the east of the country with noticeable differences in the flowers: *V. insignis* Ames and *V. phaeantha* Rcbh.f. (Table 1). *Vanilla calyculata* is often indistinguished with *V. chamissonis* Klotzsch and *V. vellozoi* Rolfe, also members of the *V. pompona* morphological group (Soto Arenas & Cribb 2010). However, both *V. chamissonis* and *V. vellozoi* are restricted to South America (Soto Arenas & Cribb 2010).

Distribution and ecology. *Vanilla calyculata* is associated with tropical dry forest and subxerophytic zones of Brazil, Colombia, El Salvador, Guatemala and Honduras (Soto Arenas & Cribb 2010, Archila & Chiron 2012, Flanagan *et al.* 2025), and now in Mexico. *Vanilla calyculata* is often found in sympatry with *V. odorata*, *V. pompona* or *V. phaeantha* (Flanagan *et al.* 2025). In Western Mexico, the predominant vegetation is the tropical sub-deciduous forest, which is characterized by plant communities with intermediate environmental requirements between the tropical dry forest and tropical humid forest (Rzedowski 2006). All *Vanilla* species that have been reported for this area are often associated with riparian microhabitats with high incidence of humidity, shade, and water tributaries (Soto Arenas 1999).

Table 1. Morphological comparison among *Vanilla calyculata* Schltr., *V. insignis* Ames, *V. phaeantha* Rcbh.f., *V. planifolia* Andrews, and *V. pompona* Schiede.

Character	<i>V. calyculata</i>	<i>V. insignis</i>	<i>V. phaeantha</i>	<i>V. planifolia</i>	<i>V. pompona</i>
Leaf petioles	Sessile to subpetiolate	Subpetiolate	Subpetiolate	Short petiolated	Subsessile
Leaf morphology	Thickened coriaceous, oblong-elliptic	Thickened coriaceous, oblong-elliptic	Thickened coriaceous, oblong-elliptic	Thickened coriaceous, oblong-elliptic to ovate, flattened	Thickened coriaceous, broad elliptic
Leaf size (cm)	11.7-14.8 × 3.3-3.9	4.2-19.5 × 1.5-3.4	9.5-18.0 × 2.4-3.2	2.0-20.0 × 0.8-6.2	6.0-33.0 × 3.0-13.7
Internode to leaf length	Equal or larger leaves	Equal or smaller	Smaller leaves	Equal or larger leaves	Equal or larger leaves
Tepals	Recurved	Spreading	Spreading	Arcuate or spreading	Spreading
Lip	Trumpet-shaped, trilobed with crenulate margin, whitish-cream, no appendages	Bell-shaped, trilobed, white and yellow ciliate appendages	Funnel-shaped, trilobed, white with yellow margins, warty appendages	Trumpet-shaped, trilobed, pale yellowish-green to white, warty appendages	Trumpet-shaped, inconspicuously trilobed, yellow, no appendages

Most of the species in section *Xanata* are widespread across the Neotropical region but are locally rare, because of their very low population densities (Soto Arenas 1999, Soto Arenas & Cribb 2010, Flanagan *et al.* 2022, Barberena *et al.* 2023, Pansarin & Menezes 2023). In addition, infrequent ephemeral blooms have meant that herbarium specimens are frequently sterile and poorly represented (Soto Arenas & Cribb 2010, Karremans *et al.* 2020, Flanagan *et al.* 2025). With these new records of *V. calyculata* in Mexico, we further our understanding of the diversity and distributions of the genus *Vanilla*. The northernmost known distribution of this taxon is now located in Nayarit.

Conservation status. The species of *Vanilla*, subgen. *Xanata*, sect. *Xanata*, which includes *Vanilla calyculata*, represent a valuable source of agrobiodiversity with economic potential in local economies (Bramel & Frey 2021). All crop wild relatives are prioritized in the Global Strategy for Plant Conservation (CBD 2011). Mexico has been the only country in the Neotropical region to formally assess the conservation status of the vanilla crop wild relatives reported in the country up to 2020 (Goettesch *et al.* 2021). These assessments followed the IUCN criteria (IUCN 2022) and are published on the IUCN Red List of Threatened Species platform (www.iucnredlist.org). Seven of nine *Vanilla* species previously reported from Mexico are categorized as Endangered “EN”, while *V. hartii*, was catalogued as Critically Endangered “CR” (Wegier *et al.* 2020a), and *V. helleri* as Data Deficient “DD” (Wegier *et al.* 2020b). The addition of *V. calyculata*, with a conservation status of Critically Endangered “CR” at the national level, represents the tenth *Vanilla* species assessed and the second in this category of extinction risk. After extensive survey in herbaria, we consider this category is appropriate, given that only three populations and eight mature individuals are known in the country so far. However, more botanical explorations are needed in other localities where *V. calyculata* is likely to occur, particularly in the Pacific region, from Nayarit to Chiapas.

Notes for conservation actions. *Vanilla calyculata*, as a critically endangered crop wild relative, is an urgent priority for conservation actions in Mexico, and particularly in Nayarit. We recommend that an integrated conservation strategy be developed (Flanagan & Mosquera-Espinosa 2016), including actions for conservation *in situ*, *ex situ* and *circa situm*. In parallel with these actions, further research is needed to understand the ecology of this species in Mexico, in particular, research should focus on phenology, pollination biology, interactions with phorophytes and microbial symbionts, and an assessment of the effects of climate change and land use change on its current populations.

Although the state of Nayarit presents some of the best conserved habitats in Mexico, the immediate vicinity of the localities for this species are heavily degraded from land use change, which we observed was ongoing. Thus, there is an urgent need for translocation of material to nearby protected areas in the municipalities of Tepic and Ruiz, for example, the Biosphere State Reserve Sierra de San Juan, which may confer a greater protection. We also recommend an extinction risk assessment of *Vanilla calyculata* according to the MER criteria (Sánchez-Salas *et al.* 2013), in order to subsequently include this species in NOM 059 SEMARNAT-2010 (SEMARNAT 2010). The NOM-059 aims to identify species or populations of wild flora and fauna at risk of extinction in Mexico and to offer immediate attention for their protection.

Conservation *ex situ* is an important additional safeguarding measure to preserve agrobiodiversity (Mounce *et al.* 2017). Material from *Vanilla calyculata* plants in both localities in Nayarit has been introduced into at germplasm bank of the Orquidario Universitario at Universidad Veracruzana (UMA-SEMARNAT-In-viv-0129-Ver/11), where they are subject to propagation under *in vitro* conditions, and to seed conservation measures. Propagated material will be used for population augmentation in both the source locations, as well as introduction to further localities within the predicted ecological niche distribution.

Finally, we recommend *circa situm* conservation actions for *Vanilla calyculata* and other *Vanilla* species. By promoting a sustainable use and management of the plants within the natural range, the number of localities and the density of individuals may be increased, in those areas where conditions are suitable for the species to occur (Maxted *et al.* 2015). In Colombia, this species is used as an aroma for tobacco, liquor and clothes storage, and offers a potential small-scale crop in local communities in Nayarit. For this, a study of the organoleptic properties of the species would be informative, similar to that undertaken for other vanilla crop wild relatives (Pérez-Silva *et al.* 2025).

To date, based on correctly identified herbarium specimens and living plant material, we confirm 10 species of *Vanilla* genus occurring in Mexico, nine of them in subgenus *Xanata*, and one in subgenus *Vanilla*. Also, we confirm the presence of three species for the west of the country. Based on IUCN criteria, we proposed an assessment of the conservation status of *V. calyculata* in Mexico as Critically Endangered - CR: C2a(i). This work contributes essential knowledge on the diversity and distribution of the genus *Vanilla* in the Neotropical region and Mexican orchid diversity, proposing conservation strategies to be developed and implemented for *V. calyculata*.

Taxonomic uncertainty in Mexican Vanilla. In the last 10 years, a renewed interest in the exploration of *Vanilla* section *Xanata* is reflected in the description of seven new species (Sambin & Chiron 2015, 2017, Barona-Colmenares 2018, Karremans & Lehmann 2018, Pansarin & Menezes 2023), a natural hybrid (Pansarin 2025b) and three revalidations (Pansarin 2024, 2025a, Flanagan *et al.* 2025), for a total of 42 accepted species in this section. Further studies have increased our knowledge about the distribution of these Neotropical species (*e.g.*, Krahl *et al.* 2020, 2025, Engels & Koch 2021, Flanagan *et al.* 2022, Barberena *et al.* 2023, Damián-Parizaca & Mitidieri 2023). However, misidentification of herbarium and living specimens is very common for groups without fertile material that show similar vegetative morphology. This represents a major challenge because it reduces taxonomic certainty and correct knowledge of the natural distribution of species (Coca-de-la-Iglesia *et al.* 2024), thereby hindering conservation efforts.

Among the 143 records of the genus *Vanilla* reviewed from Mexican herbaria, only one accession was determined as *V. calyculata*, which was previously identified as *V. pompona*. This emphasizes the low occurrence and abundance of this species in Mexico, and the scarce botanical work in the west of the country due to insecurity problems that restrict access to certain areas where more specimens of *V. calyculata* are likely to be found. Furthermore, amongst the 143 specimens, more than 50 % were misidentified, most commonly mis-assigned to *V. planifolia*. The likelihood of misidentification increases when records are taken from non-curated online databases. For example, *V. sprucei* Rolfe was reported for Chiapas by Flores Jiménez *et al.* (2017), a species restricted to the Colombian Amazon (Soto Arenas & Cribb 2010, Flanagan *et al.* 2018), the Guiana Shield (Damián-Parizaca & Mitidieri 2023) and northwestern Brazil (Krahl *et al.* 2025). The specimen from Chiapas misidentified as *V. sprucei* shows affinity to *V. hartii*, from the same morphological group, which is confirmed in this state (Soto Arenas & Dressler 2010).

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