



A preliminary revision of *Piptadenia* Benth. (Leguminosae, Caesalpinioideae, Mimoseae) in Bolivia, based on Bolivian herbarium material

Una revisión preliminar de *Piptadenia* Benth. (Leguminosae, Caesalpinioideae, Mimoseae) en Bolivia, basado en material del herbario

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ABSTRACT

The genus *Piptadenia* Benth. in the Neotropics faces taxonomic challenges due to the scarcity of accessible collections, particularly those originating from under-sampled regions such as the Bolivian Amazon, and misidentified herbarium specimens. The current study reviews this genus in Bolivia using traditional methods based on the examination of Bolivian herbarium collections. We confirm the presence of six species: *Piptadenia anolidurus*, *P. boliviana*, *P. buchtienii*, *P. gonoacantha*, *P. peruviana* and *P. robusta*. Identification of sterile material is facilitated by extrafloral nectary shape and leaflet characteristics. A morphological matrix based on herbarium specimens aided in species delimitation and recognition. We include data on type specimens, nomenclature, distribution, and threat status. A key for Bolivian *Piptadenia* species is provided.

Key words: Diversity, endemism, Fabaceae, morphological, taxonomy.

RESUMEN

El género *Piptadenia* Benth. enfrenta un reto taxonómico en el neotrópico debido a la escasez de colecciones accesibles, en particular las procedentes de regiones poco muestreadas como la Amazonia boliviana y los especímenes de herbario erróneamente identificados. El presente estudio revisa este género en Bolivia, utilizando métodos tradicionales basados en la examinación de colecciones de herbarios bolivianos. Confirmamos la presencia de seis especies: *Piptadenia anolidurus*, *P. boliviana*, *P. buchtienii*, *P. gonoacantha*, *P. peruviana* y *P. robusta*. La identificación en material estéril se ve facilitada por la forma del nectario extrafloral y las características del foliolo. Una matriz morfológica basada en especímenes de herbario ayudó a distinguir las especies. Recopilamos datos sobre especímenes tipo, nomenclatura, distribución y estado de amenaza. Se proporciona una clave para las especies bolivianas de *Piptadenia*.

Palabras clave: Diversidad, endemismo, Fabaceae, morfología, taxonomía.

INTRODUCTION

The genus *Piptadenia* was first described by Bentham (1840); it is a member of tribe Mimoseae in the legume subfamily Caesalpinioideae (Borges *et al.*, 2024). The genus includes 23 taxa (22 species and one variety) all restricted to the Neotropics (Gomes, 2017) with an important diversity in the Amazon region and the Brazilian Atlantic Forest (Moura *et al.*, 2017).

In Bolivia, varying numbers of taxa have been reported, depending on the taxonomic concept and species delimitation followed by different authors. In herbaria, specimens of *Piptadenia* are often misidentified to species, and sometimes even to genus, and the exact number of species in Bolivia has not always been clear. The Catalogue of Vascular Plants of Bolivia (Jørgensen *et al.*, 2014) recognised 11 species of *Piptadenia*. With *Piptadenia viridiflora* (Kunth) Benth. having been transferred to the monospecific genus *Lachesiodendron* P.G. Ribeiro, L.P. Queiroz & Luckow (Ribeiro *et al.*, 2018), only 10 of the species in the Catalogue are now accepted as belonging to *Piptadenia*, and in this preliminary work, only six species of *Piptadenia* are identified and/or described based on the herbarium specimens available in Bolivia.

Piptadenia species present several diagnostic morphological characters (Barneby, 1986), although many collections in herbaria are not of a quality that has preserved those characters. We focused on specimens that present the greatest number of morphological characters (non-floral) that support the differentiation of species. We constructed a dichotomous identification key to the six species encountered in Bolivian herbaria and provided diagnostic descriptions for each species account.

MATERIALS AND METHODS

Traditional taxonomic methods were used, including the study and analysis of herbarium material. The morphological character matrix was prepared using specimens available to us in the LPB Herbarium (in March 2023), the Herbario Nacional Forestal "Martín Cárdenas" (BOLV), and Herbario del Oriente Boliviano (USZ) in 2024. We analysed and measured between ten and 70 specimens per species, depending on specimen availability. During the work at the LPB Herbarium, photographs of selected specimens were taken to reflect those characters that diagnosed the taxa. These were supplemented by online resources from the Field Museum of History (F), the Royal Botanic Gardens, Kew (K) and the Missouri Botanical Garden (MO), to help describe some diagnostic characters that were not well represented on herbarium specimens.

A matrix was prepared of the diagnostic morphological characters of the following six species: *Piptadenia anolidurus* Barneby, *P. boliviana* Barneby, *P. buchtienii* Barneby, *P. gonoacantha* (Mart.) J.F. Macbr., *P. peruviana* (J.F. Macbr.) Barneby and *P. robusta* Pittier. We have not included in this preliminary description the species *P. adiantoides* (Spreng.) J.F. Macbr. and *P. cuzcoensis* Barneby, because they are not present in the country, and their original identification for the Catalogue of Bolivia was based on misidentified material (Jørgensen *et al.*, 2015 onwards). Another species not included is *P. retusa* (Jacq.) P.G. Ribeiro, Seigler & Ebinger, due to a lack of material in the herbaria consulted in Bolivia. We also exclude *P. pteroclada* Benth. due to unresolved taxonomic confusion with *P. gonoacantha* (see discussion).

Regarding the conservation status of the species, a review of the IUCN Red List was carried out, where the main information on category, area of occupancy, and extent of occurrence was assessed. For the endemic species of Bolivia (*Piptadenia boliviana* and *Piptadenia buchtienii*), the team of the Tropical Important Plant Areas (TIPAs) project was consulted, which is currently evaluating the risk of extinction of endemic species of Bolivia. For the species that do not have a published conservation assessment, the extent of occurrence (EOO) and area of occupancy (AOO) were estimated, using available records or collections of the species, at a global level. These estimates were made using the Geospatial Conservation Assessment Tool (GeoCAT, Bachman *et al.*, 2011).

TAXONOMIC TREATMENT

Piptadenia Benth, J. Bot. (Hooker) 2:135 (1840).

Tipo: *Piptadenia latifolia* Benth.

Among the characteristics that diagnose *Piptadenia* are its shrub or tree habit, sometimes armed with thorns; presence of an extrafloral nectary which may be in the middle or at the apex of the leaf petiole; flowers hermaphrodite, aggregated into spikes or panicles; petals free (not united into a tube); stamens 10 per flower,

the filaments free; anthers with a caducous apical gland; and fruits laterally compressed pods, dehiscing along both margins (Killeen et al., 1993).

Since its first publication, the genus *Piptadenia* (Bentham, 1840) has undergone several taxonomic changes resulting in modifications in the number of species recognised. Many of the species included in the genus by Bentham (1840) have been transferred to other genera, such as *Anadenanthera* Speg., *Goldmania* Rose ex Micheli, *Newtonia* Baill, *Parapiptadenia* Brenan, and *Pityrocarpa* (Benth.) Britton & Rose (Ribeiro, 2018).

Key to the six species of *Piptadenia* in Bolivia analysed in this study

1. Prickles occasionally present on stems and leaves, petiolar nectary (approximately 10 mm from the base of the petiole) convex or prominent in the centre.
 2. Prickles absent, leaflets lanceolate, $3.5\text{--}6.7 \times 1\text{--}1.65$ mm..... 2. *P. boliviana*
 2. Prickles occasionally present on young branches, leaflets ligulate, $14\text{--}21 \times 2\text{--}3.5$ mm..... 6. *P. robusta*
1. Prickles always present on stems and leaves, petiolar nectary (approximately 10 mm from the base of the petiole) concave or depressed in the centre.
 3. Leaflets in 4–6 pairs per pinna, leaflets $30\text{--}60 \times 15\text{--}20$ mm 5. *P. peruviana*
 3. Leaflets in 8–53 pairs per pinna, leaflets $4\text{--}14 \times 0.8\text{--}5$ mm.
 4. Leaflets with venation evidently reticulate, main vein prominent on the abaxial surface, leaflets obovate to elliptic, apex obtuse to rounded (occasionally mucronulate)..... 3. *P. buchtienii*
 4. Leaflets venation not evidently reticulate, only the midvein prominent on the abaxial surface, leaflets falcate-oblique, apex acuminate
 5. Leaflets in 45–53 pairs per pinna, leaflets $4\text{--}7 \times 0.8\text{--}1.5$ mm 4. *P. gonoacantha*
 5. Leaflets in 13–22 pairs per pinna, leaflets $5.5\text{--}15 \times 2.5\text{--}3.5$ mm 1. *P. anolidurus*

1. *Piptadenia anolidurus* Barneby. Brittonia, 38(3): 222 (1986). Type: Brazil. Pará, 23 Jun. 1927 (fl, juvenile fr), *H. Zerny* s.n. (holotype: W-21812!; isotypes: W-21805!, NY Neg. 11555!, 11556!). Figure 1.

Tree, 8–20 m tall, or liana, prickles present. Leaves bipinnate, petiolar nectary elliptical-concave, longer than wide, 6.6×4 mm, pinnae 7–9 pairs per leaf, leaflets 20–22 pairs per pinna. Leaflets falcate-oblique, $7.5\text{--}11\text{--}22 \times 1.5\text{--}5.5\text{--}7$ mm, apex acuminate, base asymmetrical, midvein asymmetric on the blade, prominent on the lower surface, secondary venation not visible on either surface, indumentum dense, yellowish, mostly on the midvein. Inflorescences in spikes, flowers with petals yellowish or cream-coloured, calyx and corolla pubescent, bracts persistent, stamen filaments whitish. Fruit a plano-compressed legume with an undulate margin, $4\text{--}5.3 \times 1$ cm.

Selected material examined: BOLIVIA. **Cochabamba:** Prov. Chapare, 138 km on Cochabamba Chapare highway, Río Espíritu Santo valley, 22 Nov. 1997 (fl.), *J.R.I. Wood* 12883 (LPB); Indigenous Territory National Park Isiboro - Secure, community of El Carmen de la Nueva Esperanza, riverbank of Ichoa river, 16 Nov. 2004 (fl.), *E. Thomas & Berdeja* 1391 (LPB). **La Paz:** Prov. Franz Tamayo, Parque Madidi, to the left of the River Quendenque, origin of River Pascual 4 Feb. 2022 (fl.), *De La Quintana et al.*, 335 (LPB). **Santa Cruz:** Prov. Ichilo, Parque Nacional Amboró, along Río Saguayo, vicinity of Quebrada Yapoje 12 Dec. 1989 (fl.), *M. Nee* 38115 (LPB)

Distribution and ecology: *Piptadenia anolidurus* is native to Bolivia, northern Brazil, Ecuador and Perú. In Bolivia it occurs in Cochabamba: Chapare; La Paz: Franz Tamayo; Santa Cruz: Ichilo; (Figure 2A). It grows in well-developed secondary forest, rain forest, and Chiquitano semi-deciduous forest, between 230–700 m elevation.

Phenology: Specimens have been collected in flower from November to March

Common names: Cari-cari (M. Nee 38115).

Conservation status: *Piptadenia anolidurus* is a native tree species that has a very wide distribution. It is not currently experiencing any major threats and no significant future threats have been identified. The estimated extent of occurrence (EOO) of the species is 3,922,678 km², and the estimated area of occupancy

(AOO) is 136 km². Within its range of distribution, threats to its long-term survival are unknown and its population status is unknown. It is preliminarily assessed as being of Least Concern (LC), IUCN SSC & BGCI (2020).

Note: In the LPB herbarium there is no material of the species with fruits. A review of digital material of the species from Napo in Ecuador in the herbarium at F (e.g., Burnham, 1444) and with additional information from the species protologue, presents the fruit as being a plano-compressed legume with an undulate margin, 4–5.3 × 1 cm.

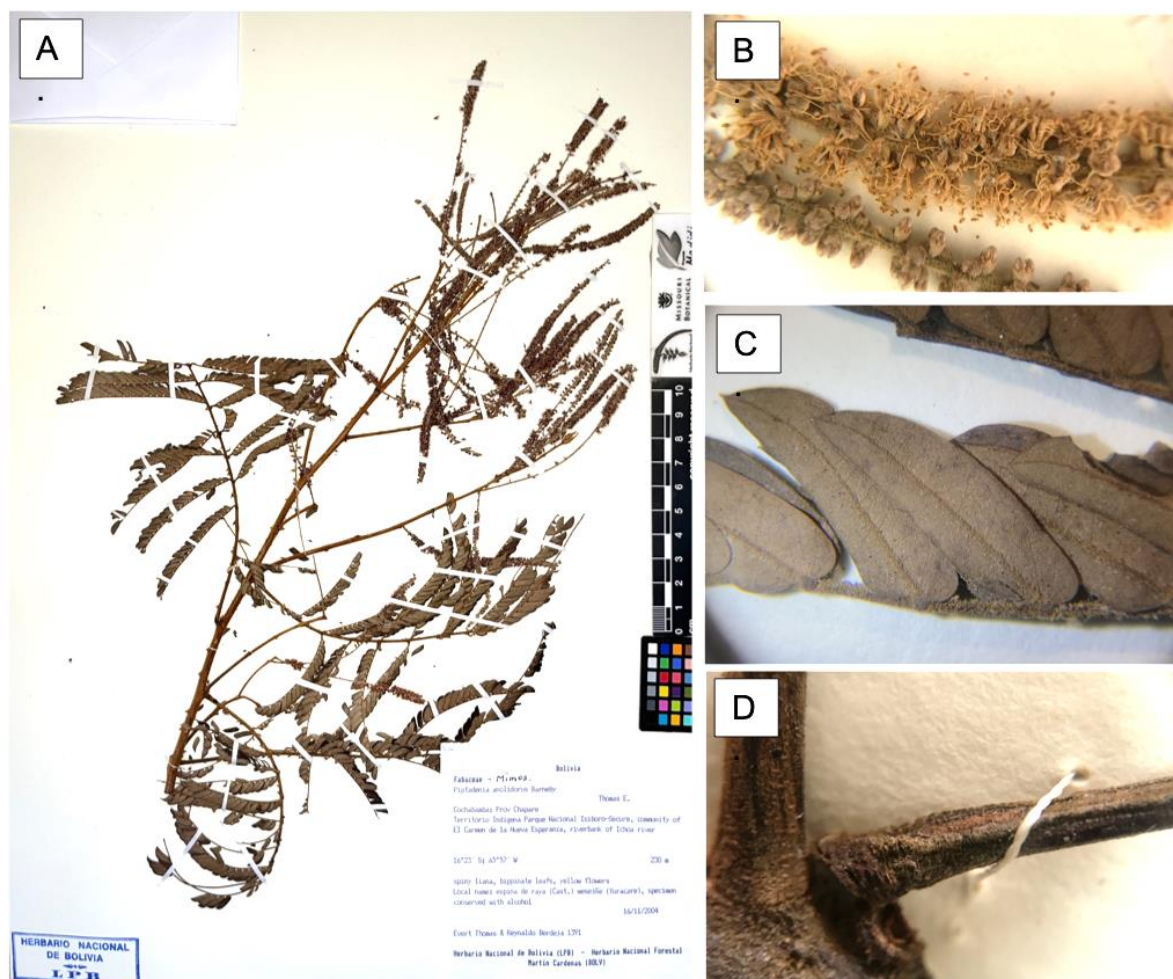


FIGURE 1. *Piptadenia anolidurus*. **A.** Herbarium specimen. **B.** Flowers. **C.** Leaflets. **D.** Petiole nectary (red arrow). From E. Thomas & R. Berdeja 1391 (LPB)

2. *Piptadenia boliviana* Benth., Trans. Linn. Soc. London 30(3): 370 (1875). Type: Bolivia. *Kelly s.n.* (holotype: K-504680!). Figure 3.

Treelet or tree, 2–9 m tall, stems terete, unarmed, with lenticels and a few longitudinal fissures. Leaves bipinnate, petiolar nectary elliptical-convex, 1.3–1.5 × 0.6–1 mm, 4–6 pairs of pinnae per leaf; leaflets in 30–37 opposite pairs per pinna, lanceolate, oblong, or elliptically obovate, 3.5–6.7 × 1–1.65 mm, apex rounded, acute or mucronate, base asymmetric, venation slightly reticulate, lamina glabrous. Inflorescences spikes, 5–6.5 cm long; flowers yellow to maroon, petals with a silky indumentum of stiff trichomes, bracts not persistent. Fruit a reticulate-veined legume, 10–15.5 × 1–1.6 cm.

Selected material examined: BOLIVIA. **Cochabamba:** Prov. José Carrasco, ca. 2 km south of Hoyadas on road from Aiquile to Totorá, 17°56'S, 65°06'W, 19 Nov. 2006 (fl.), J.R.I. Wood & N.P. Taylor 22501 (LPB). **Chuquisaca:** Prov. Oropeza, 23 km hacia Aiquile, 2600 m, 16 Nov. 1984 (fl.), St. G. Beck 8888 (BOLV, LPB, MO). **La Paz:** Prov. Sud Yungas, above the bridge over the Río La Paz, on the road to Miguillas, 16°32'S, 67°24'W, 1200 m, 15 Mar. 1999 (fr.), R.T. Pennington et al. 870 (BOLV, LPB); near bridge over Río Phuri, 19 km from Chulumani, on the road to Irupana, 16°25'S, 67°28'W, 1200 m, 14 Mar. 1999 (fr.), R.T. Pennington et al. 864 (LPB, MO). **Potosí:** Prov. Charcas, Toro Toro,

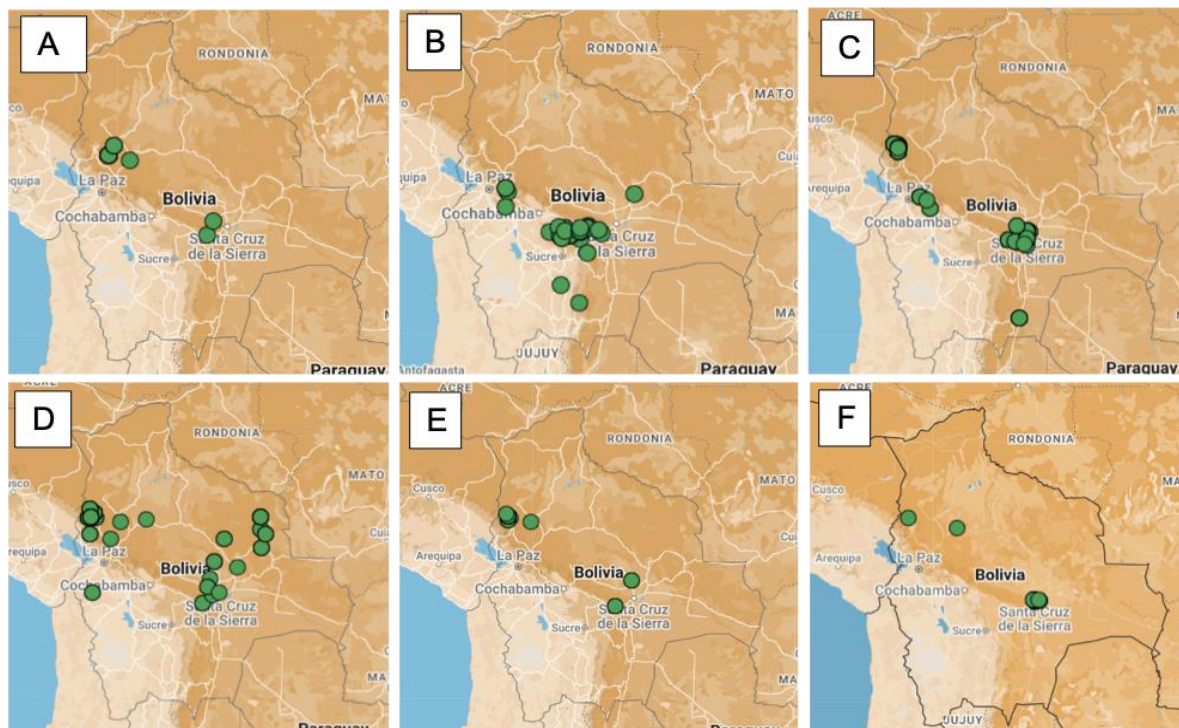


FIGURE 2. Distribution Map of *Piptadenia* species in Bolivia. **A.** *Piptadenia anolidurus*. **B.** *Piptadenia boliviana*. **C.** *Piptadenia buchtienii*. **D.** *Piptadenia gonoacantha*. **E.** *Piptadenia peruviana*. **F.** *Piptadenia robusta*.

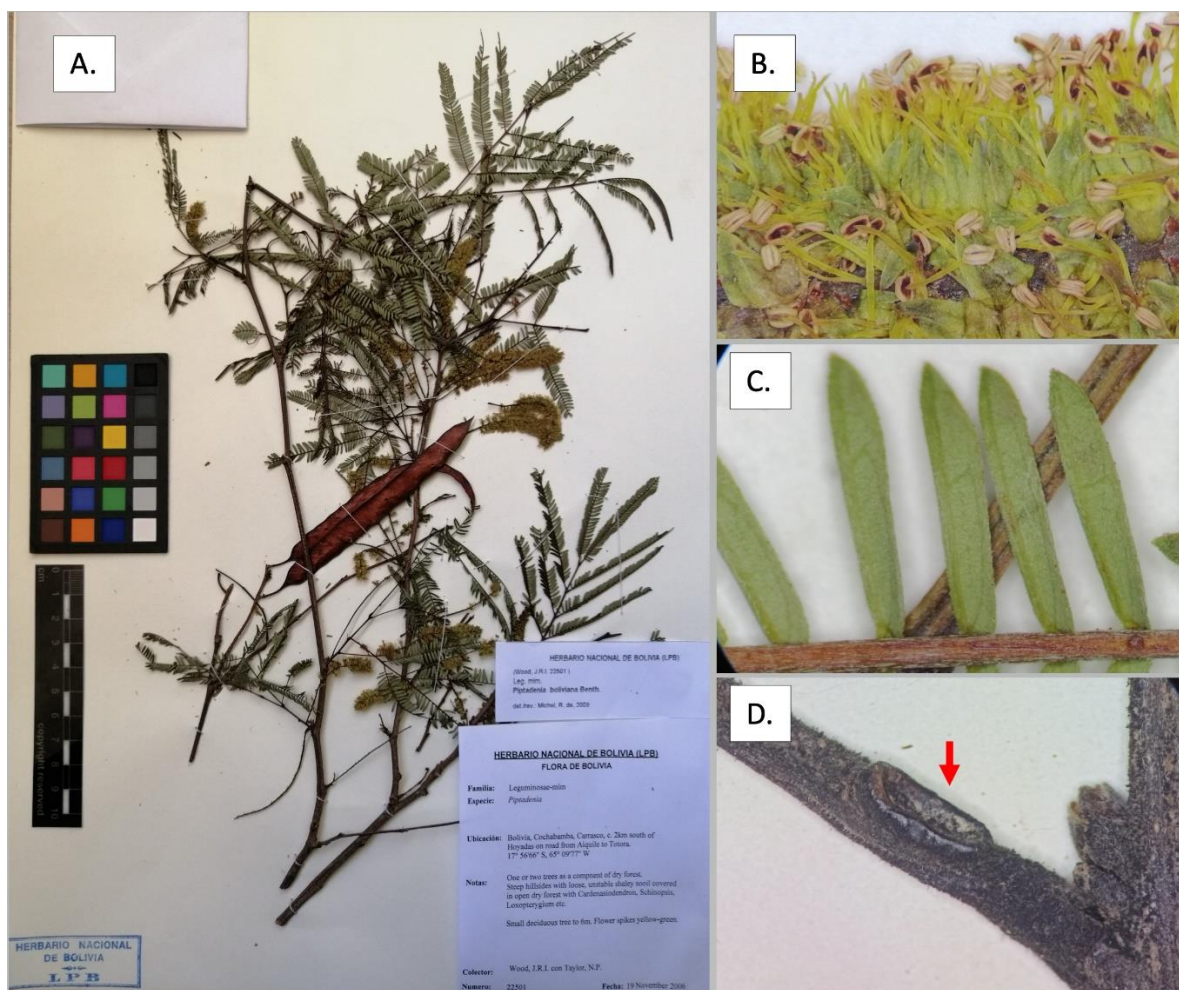


FIGURE 3. *Piptadenia boliviana*. **A.** Herbarium specimen. **B.** Flowers. **C.** Leaflets. **D.** Petiole nectary (red arrow). From J.R.I. Wood & N.P. Taylor 22501 (LPB).

subiendo del valle del Río Caine a Toro Toro, 18°05.75'S, 65°45.09'W, 2266 m, 25 Feb. 2003 (fr.), J.R.I Wood et al. 19205 (BOLV, LPB).

Distribution and ecology: *Piptadenia boliviana* is an endemic species of Bolivia's dry valleys in the west of the Cordillera Oriental; it occurs in the departments of Chuquisaca, Cochabamba, Potosí, Santa Cruz and at the southern end of La Paz (Figure 2B). It grows mainly in the seasonally dry valleys and forests of Bolivia, between 1000–2600 m elevation.

Phenology: Collected in flower from November to January and in fruit in March and May.

Conservation status: The species is mainly distributed in the Dry Forests and Inter-Andean Dry Valleys of Bolivia. Its extent of occurrence (EOO) is 83,675 km², the area of occurrence (AOO) is 108 km², and the entire population is found in 16 localities. Its habitat is in continuous decline due to threats such as agriculture, livestock, and fires. According to the available information and thresholds reached, this species is categorized according to its AOO and number of localities as Near Threatened B2ab(iii), (Atahuachi & Lino, 2023a).

3. *Piptadenia buchtienii* Barneby. Brittonia, 38(3): 224 (1986). Type: Bolivia. La Paz, Yungas Millihuaya, Dec. 1917 (fl.), O. Buchtien 4180 (holotype: NY-3203!; isotypes: US-5290!, HBG-519295!). Figure 4.

Shrub or tree, (2.5–) 10 m tall, stems with sparse indumentum, sparse and scattered spines sometimes present on leaf rachis and young trunks. Leaves bipinnate, petiolar nectary elliptic-depressed, (5–) 7 × 0.8 (–3.1) mm. Pinnae (4–) 7 pairs per leaf (commonly 5). Leaflets 8–12 pairs per pinna, obovate-elliptic, (4–) 10 × 1.5 (–7) mm, apex obtuse, mucronulate (occasionally retuse), base rounded, asymmetrical, venation evidently reticulate, secondary veins strongly reticulate and evident when dry, leaflet lamina pale green, pubescent. Inflorescences in axillary or terminal spikes; flowers yellow or greenish on fresh and dry material, calyces, corollas, and bracts pubescent. Fruit a laterally compressed, dehiscent legume, greenish or pale brown, base



FIGURE 4. *Piptadenia buchtienii*. **A.** Herbarium specimen. **B.** Flowers. **C.** Leaflets. **D.** Petiole nectary (red arrow). From M. Nee 48162 (LPB)

cuneate, apex semi-umbonate, surface with reticulate venation.

Selected material examined: BOLIVIA. **Cochabamba:** Prov. Sud Yungas, Chulumani 26 km hasta Asunta, pasando por Tajma, 27 Jun. 1985 (fl., fr.), *St. G. Beck* 12053 (LPB); Chulumani 30 km hasta Asunta-Colquechaca en la desembocadura del río Pirai Solocama, 29 Jun. 1985 (fl., fr.), *St. G. Beck* 12133 (LPB); Plazuela, near crossing on Rio La Paz from Sud Yungas to Inquisivi, 17 Dec. 1999 (fl.), *J.R.I. Wood & D. Goyder* 15496 (LPB). **Santa Cruz:** Prov. Florida, a lo largo del cañón del río Pirai y la carretera de Santa Cruz a Samaipata, 6 km (por carretera) al SO del puesto de control policial en Angostura, 18°11'S, 63°33'W, 30 Jan. 1998 (fl., fr.), *M. Nee* 48162 (LPB, NY); río Pirai entre La Angostura y Bermejo, 18°10'25.2"S, 63°34'18"W, 22 Jan. 2005 (fl., fr.), *J.R.I. Wood et al.* 21404 (LPB, USZ).

Distribution and ecology: *Piptadenia buchtienii* is endemic to Bolivia, occurring in the departments of La Paz and Santa Cruz (Figure 2C). It has been registered from upper evergreen forest and semi-deciduous forest of the Yungas of La Paz and xeric evergreen yungueño forest of the Yungas (Atahuachi & Lino, pers. comm., 2023) at 320–1400 m elevation.

Phenology: Collected in flower from October to June and in fruit from January to August.

Conservation status: *Piptadenia buchtienii* is endemic to Bolivia and has an extent of occurrence (EOO) of 161,835 km², an area of occupancy (AOO) of 172 km², and occurs in 20 localities. Its habitat is threatened by agricultural expansion, livestock, oil, and mining activities, which has led to a continuous decline and fragmentation of its habitat. As a result of this decline of habitats and their fragmentation, the species has suffered a decline in one of its localities. According to the available information, the thresholds reached, and the known threats, this species is categorized as Near threatened B2b(iii,iv), (Atahuachi & Lino, 2023b). On the other hand, part of its population grows within some national conservation areas, such as the Madidi National Park and Integrated Management Natural Area, PN-ANMI Aguargüe, near the ANMI Amboró, and PN-ANMI-Cotapata, La Paz (Duchen & Beck, 2012).

4. *Piptadenia gonoacantha* (Mart.) J.F. Macbr., Contr. Gray Herb. 59: 17 (1919). Type: Brazil, Feb. 1834 (fl.), *B. Luschnath. s.n.* (holotype: BR-6493127!). *Acacia gonoacantha* Mart., in Flora 20(2 Beibl.): 109 (1827); *Pityrocarpa gonoacantha* (Mart.) Brenan, in Kew Bull.10:176 (1955). Figure 5.

Piptadenia communis Benth., J. Bot. (Hooker) 4: 337 (1841); *Piptadenia communis* var. *inermis* Hassl., Repert. Spec. Nov. Regni Veg. 8: 552 (1910); *Piptadenia gonoacantha* var. *inermis* Burkart, Fl. Illustr. Catar. 1 (Leg.: Mim.): 279 (1979). Type: Brazil, Sep. 1959, *P.R. Reitz*. 9044 (holotype: K-504664!).

Tree, 5–16 m tall; stems quadrangular or terete, with or without narrow corky or woody wings and straight prickles. Leaves bipinnate, petioles with a pronounced pulvinus, rough and pubescent at the base; petiolar nectary solitary or two, sessile, concave, elliptic, 1.9 × 5.1 mm, with 8–13 pairs of pinnae, rachis slightly pubescent, with straight prickles on the lower edge (or these sometimes lacking), urceolate glands on the leaf rachis between the two terminal pairs of pinnae; leaflets in 31–53 pairs per pinna; falcate-oblique, (3.9–) 7.3 × 0.8 (–1.4) mm, base unequal, apex apiculate-attenuate, venation weakly reticulate, midrib prominent, leaflets brown and green, a hirsute indumentum over the whole surface. Inflorescence spikes aggregated into a terminal or axillary panicle; flowers with a pubescent calyx and corolla, the trichomes ferruginous; floral bracts persistent, stamens mostly yellow to greenish when fresh and when dry. Fruits fuscous, reticulate-veined, apex obtuse, margin slightly wavy, 11.2 × 1.9 cm.

Selected material examined: BOLIVIA. **Beni:** Prov. Vaca Diez, Riberalta, at junction of Rio Madre de Dios and Rio Beni, 11°00'S, 66°04'W, 125 m, 14 Aug. 1985 (fr.), *M. Nee* 31332 (LPB). **La Paz:** Prov. Franz Tamayo, Madidi, Azarianas, Resina, 14°19'47"S, 68°33'35"W, 700 m, 10 Jun. 2005 (fr.), *A. Araujo et al.* 1902 (LPB); Madidi, north of Apolo, 14°19'47"S, 68°33'35"W, 700 m, 10 Jun. 2005 (fr.), *A. Araujo et al.* 1924 (LPB!). Prov. Nor Yungas, 5 km de Coroico, 16°11'S, 67°44'W, 1580 m, 19 May. 1996 (fl.), *L. Vargas et al.* 1388 (LPB). **Santa Cruz:** Prov. Andres Baez, 9.7 km (by road) N of Urubó bridge over Río Pirai, W of Río Pirai, 17°41'18"S, 63°13'09"W, 400 m, 21 Abr. 2007 (fr., fl.), *M. Nee* 55117 (LPB); La Guardia, 5 km to the South, 17°30'S, 63°24'W, 630 m, 9 Jun. 1998 (fl.), *St. G. Beck* 23464 (LPB).

Distribution and ecology: *Piptadenia gonoacantha* is native to South America, including Colombia and Peru, and extending to Brazil in the east. In Bolivia, it occurs in the departments of Beni, Cochabamba, La Paz, and Santa Cruz (Figure 2D). Generally, it grows in humid tropical forests. In Bolivia it occurs in several different vegetation types, including semi-deciduous Andean Forest, Chaco transitional with semi-deciduous forest, and Chiquitano forest transitional with Yungas, at elevations between 125–1044 m.

Phenology: Collected in flower during the summer rainy season, from January to April, fruiting from April to August.

Common names: Curupaiciño (Jørgensen et al., 2015 en adelante).

Conservation status: *Piptadenia gonoacantha* has a very wide distribution in the forests of Bolivia, Brazil, Colombia, Paraguay, and Perú. The extent of occurrence (EOO) of the species is 6,425.618 km² and area of occupancy (AOO) is 1,236 km². Its population is stable and not under any significant threats. We assess the species to be of Least Concern (LC) following IUCN criteria (BGCI & IUCN SSC, 2019).

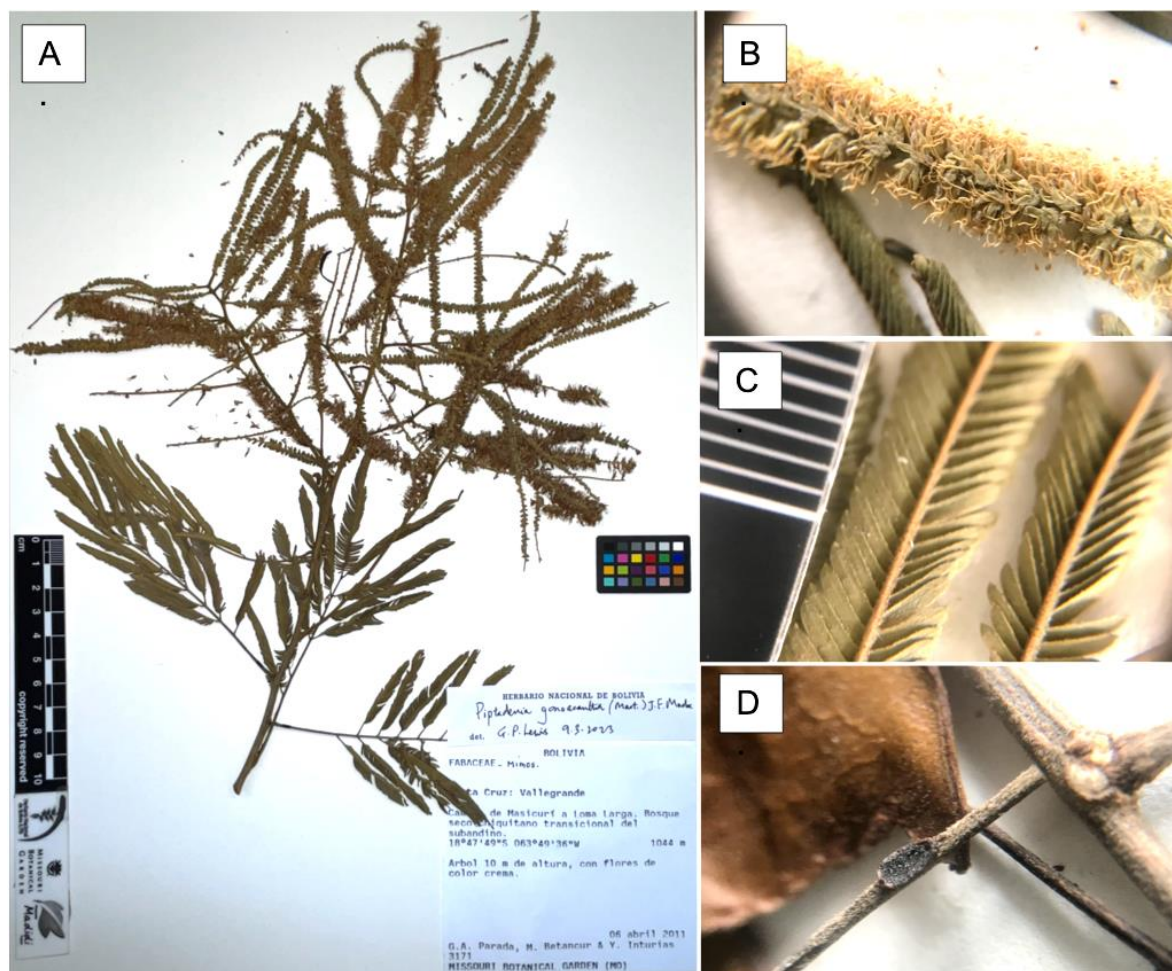


FIGURE 5. *Piptadenia gonoacantha*. **A.** Herbarium specimen. **B.** Flowers. **C.** Leaflets. **D.** Petiole nectary (red arrow). From G.A. Parada et al. 3171 (LPB)

5. *Piptadenia peruviana* (J.F. Macbr.) Barneby, Brittonia 38(3): 226 (1986). Type: Perú. San Martín Chazuta, Mar. 1935 (fl.), Klug 4018 (holotype: F-42928!; isotypes: K-504643!, MO-954395!, NY-3201!, S-008655!, UC-709953!, US-997082!). Figure 6.

Shrub, 2–3 m tall, or liana, 2–8 m long, stems terete, with prickles and lenticels. Leaves bipinnate, petiolar nectary oblong, 0.2–0.5 mm long, and urceolate nectaries between pinnae pairs and leaflet pairs, 4–5 pairs of pinnae per leaf; leaflets in 4–6 opposite pairs per pinna, obliquely ovate or elliptically obovate, 30–60 × 11–23 mm, apex rounded or emarginate, base asymmetric, venation slightly reticulate, lamina sparsely pubescent. Inflorescences spicate, 5–10 cm long; flowers yellow to green, petals with a silky indumentum of stiff trichomes, bracts not persistent. Fruit a reticulate-veined legume, 11.5–17.6 × 3–5.2 cm

Selected material examined: BOLIVIA. **Beni:** Prov. General Ballivián, Rurrenabaque, borde de la carretera al aeropuerto, 11 Mar. 1982, (fl.) St. G. Beck 8280 (K, LPB, MO, NY, USZ); cuenca del río aguas arriba de Rurrenabaque, Río Tuichi y Río Beni, 14°35'S, 67°35'W, 15 May. 1990 (fr.), D. Daly et al. 6471 (LPB, NY). **La Paz:** Prov. Sud Yungas, pasando campo Inicua hacia La Paz, 700 m., 9 Mar. 1987 (fl.), St. G. Beck 13271 (LPB, MO, NY, USZ). **Santa Cruz:** Prov. Obispo Santistevan, 6 km S del puente de Chané Independencia y 12 km N del centro de Mineros, 17°00'S, 63°13'W,

5 Apr. 1998 (fl.), M. Nee 48865 (LPB, NY); puente sobre el río Chane en la carretera Minero-San Pedro, 17°05'S, 63°15'W, 23 Aug. 1991 (fr.), M. Saldias & A. Lawrence 1460 (LPB, USZ).

Distribution and ecology: The geographical range of *Piptadenia peruviana* lies around the western periphery of Amazonia, from Loreto, Amazonas, Madre de Dios, and San Martín in Peru to the departments of Beni, La Paz, and Santa Cruz in Bolivia (Figure 2E). The species grows primarily in the wet tropical biome in semi-deciduous montane forests from Peru to Bolivia, at between 230–1000 m elevation.

Phenology: Collected in flower from March to April and in fruit in May, August, and September.

Conservation status: The species has a wide distribution in the forests of Peru and Bolivia. The extent of occurrence (EOO) is 370,027 km² and the area of occupancy (AOO) is 96 km²; the population status and specific threats are currently unknown. Therefore, the species is assessed as Data Deficient (DD).



FIGURE 6. *Piptadenia peruviana*. A. Herbarium specimen. B. Flowers. C. Leaflets. D. Petiole nectary (red arrow). From M. Nee 48865 (LPB).

6. *Piptadenia robusta* Pittier, Arb. Arbust. Venez. 6–8: 85 (1927). Type: Venezuela, Cotiza near Caracas. 12 Dec. 1918, H. Pittier 8297 (holotype: VEN-2768!; isotypes: F-58673!, F-360535!, NY-3241!, US-1050208!, US-1016!). Figure 7.

Tree, 11–20 m tall, usually without prickles, although these are occasionally present on young branches. Leaves bipinnate, petiolar nectary 4 mm long, usually convex and prominent, pinnae in 5–9 pairs per leaf, petiole base dark when dry, leaflets 25–35 pairs per pinna, ligulate, 14–21 × 2–3.5 mm, apex subobtusate, base asymmetric, venation brochidodromous, midvein asymmetric, prominent on the lower surface, secondary venation visible on lower surface, lamina mostly glabrous, trichomes (when present) only on margin. Inflorescence a spike, calyces greenish, with an indumentum, corollas whitish, glabrous, bracts not persistent,

stamen filaments purplish red (drying dark brown). Fruit a laterally compressed, reticulate-veined legume, margin repand, 11–15 × 1.8–2.5 cm.



FIGURE 7. *Piptadenia robusta*. **A.** Herbarium specimen. **B.** Flowers. **C.** Leaflets. **D.** Petiole nectary (red arrow). From M. Nee 55004 (LPB).

Selected material examined: BOLIVIA. **Beni:** Prov. General Ballivián, San Borja, 60 km to San Ignacio, Estancia Porvenir, biological station of Beni. 27 Sep. 2000 (fl.), St. G. Beck 27602 (LPB); **Santa Cruz:** Prov. Andrés Ibáñez, 3 km SE of centre of Cotoca. 7 Apr. 1998 (fl.), M. Nee 48894 (LPB); Campus Universidad Autónoma "Gabriel Rene Moreno", 3 Sep. 1990 (fr.), M. Nee 38618 (LPB); Prov. Chiquitos, 50 km north of San Jose de Chiquitos on the way to San Rafael, 8 Apr. 2008 (fl.), J.R.I. Wood et al. 24308 (LPB). Prov. Santiesteban, 1.5 km N of the centre of Mineros on road to Chané Independencia, 5 Apr. 1998 (fl.), M. Nee 48868 (LPB).

Distribution and ecology: *Piptadenia robusta* is native to Bolivia, Perú and Venezuela. In Bolivia it occurs in Beni: Gral. Ballivián, in La Paz: Franz Tamayo and in Santa Cruz: Chiquitos, Andrés Ibáñez, Santiesteban; (Figure 2F). Primarily growing in the seasonally dry tropical biome, at between 150 – 850 m elevation; in Bolivia in forests and savanna, in the Chaqueño, Chiquitano dry forests ecoregion, Benianas savanna, and dry valleys.

Phenology: Flowering from January to April, fruiting is recorded from late July to September.

Common names: Asotoc'o, asotocó, ozotoco (Jørgensen et al., 2015 en adelante).

Conservation status: *Piptadenia robusta* is a native tree in Bolivia, Perú and Venezuela. There are also reports of occurrences in Panama, although we have seen no material from there. The overall population size of the species is unknown, although it likely exceeds the threshold for a threatened category. The estimated extent of occurrence (EOO) of the species is 2,350,400 km², and the estimated area of occupancy (AOO) is 56 to 20,000 km². Within its range of distribution, threats to its long-term survival and its population status are unknown. We preliminarily assess the species to be of Least Concern (LC). However, its habitat is under continuous decline, at least in Bolivia, and the species could become threatened in the near future if pressure

on its habitat increases. Research is needed to determine the current population size of the species, together with monitoring to detect any decline (Canteiro & Klitgård, 2021).

DISCUSSION

The exclusion of *Piptadenia adiantoides*, *P. cuzcoensis*, and *P. retusa* from the Bolivian flora underscores the importance of rigorous verification of herbarium specimens. The absence of confirmed material highlights the need for additional field studies in geographically relevant areas. Likewise, we excluded *P. pteroclada* from this study, despite its mention in previous catalogues, because there is likely taxonomic confusion with *P. gonoacantha*, this emphasizing the need for a detailed morphological revision of the relationship between the two species.

Throughout this research, we observed a frequent misidentification of *Piptadenia pteroclada* on herbarium specimens; it is commonly misidentified as *P. gonoacantha* (based on the morphology of its ovaries and nectaries). However, upon an exhaustive review of digital material in databases such as Tropicos at the Missouri Botanical Garden (MOBOT), Plants of the World Online (POWO), and the Global Biodiversity Information Facility (GBIF), coupled with consultations with experts and examination of specimens at the National Herbarium of Bolivia (LPB), we found no conclusive evidence supporting the presence of *P. pteroclada* in Bolivia. The available data consistently indicate that material identified as *P. pteroclada*, at least in Bolivia, corresponds to *P. gonoacantha*. This finding is corroborated by the Catalogue of Bolivia, which, following a review of material cited as *P. pteroclada*, concluded that it should be identified as *P. gonoacantha*.

Our study highlights the concern about the conservation status of endemic species such as *Piptadenia boliviana* and *P. buchtienii*, which are primarily affected by habitat degradation. The former, restricted to the dry inter-Andean valleys, faces increasing pressures due to agricultural and livestock expansion. At the same time, *P. buchtienii* has experienced a notable decline in specific localities, attributable to anthropogenic activities. The implementation of conservation strategies is proposed, including the protection of critical habitats and environmental education programs to mitigate these threats.

This review of *Piptadenia* in Bolivia clarifies the taxonomic boundaries of the species included in the treatment and provides a solid foundation for future phylogenetic studies. The complexity of the genus, evidenced by the difficulty in distinguishing morphologically similar species, suggests the need to integrate molecular data to resolve phylogenetic relationships. Additionally, exploration of the Bolivian Amazon is recommended, where the presence of *Piptadenia* remains poorly documented and where, as yet undescribed diversity, is likely awaiting discovery.

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