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## A new epiphytic species of *Notopleura* (Rubiaceae) from Chucantí Nature Reserve, eastern Panama

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### ABSTRACT

The new species *Notopleura sallydavidsoniae* R.Flores & C.M.Taylor is here described and illustrated. It can be recognised by the following combination of characters: epiphytic habit, succulent stems and leaves, stipules sheathing at base and free portion ligulate with c. 8–10 glandular setae or appendages, well-developed bracts, five-merous flowers, rather well-developed calyx and fruits with two pyrenes. Eastern Panama is not well known botanically, but is part of the region that is the centre of species diversity for the epiphytic subgenus of *Notopleura* as well as for the genus overall.

### RESUMEN

Se describe e ilustra la nueva especie *Notopleura sallydavidsoniae* R.Flores & C.M.Taylor. Se reconoce por la combinación de los siguientes caracteres: hábito epífita, tallos y hojas suculentos, estípulas soldadas en la base con una porción libre ligulada con c. 8 a 10 setas o apéndices glandulares, brácteas bien desarrolladas, flores pentámeras, cáliz bien desarrollado y frutos con dos pirenos. El este de Panamá es botánicamente poco conocido, sin embargo forma parte de la región que es el centro de diversidad de especies del subgénero epífita, así como también del género *Notopleura*.

### ARTICLE HISTORY

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### KEYWORDS

Cerro Chucantí; eastern Panama; *Notopleura* subg. *Viscagoga*; Palicoureeae

## Introduction

*Notopleura* (Benth.) Bremek. includes about 110 species of small shrubs and large herbs found from Mexico and the Antilles to Brazil and Bolivia. *Notopleura* was revised by Taylor (2001, 2003) and is characterised by its generally succulent stem and leaves, tissues with raphides, stipules that are variously interpetiolar or united around the stem and usually glandular, four- or five-merous flowers, valvate corolla aestivation, ovaries with the ovules solitary and basal in each of two to four locules, and succulent drupaceous fruits with two to four pyrenes. According to recent molecular phylogenetic analyses, *Notopleura* is related to *Rudgea* Salisb., and is positioned in the tribe Palicoureeae (Razafimandimbison et al. 2014).

*Notopleura* includes two subgenera: *Notopleura* subg. *Notopleura*, with unbranched terrestrial plants that have inflorescences consistently borne below the stem apex in a pseudoaxillary position, and *Notopleura* subg. *Viscagoga* (Baill.) C.M.Taylor with epiphytic plants that are usually branched and have the inflorescences borne at the stem apex or sometimes in a pseudoaxillary position (Taylor 2001). Most of the species of the genus belong to *Notopleura* subg. *Notopleura*. Taylor (2003) included a total of 15 species in *Notopleura* subg. *Viscagoga* and found its centre

of species diversity is southern Central America (Panama and Costa Rica), where Lorence et al. (2012) reported eight species. The new *Notopleura* species described here represents a ninth species for this small area. Overall, about 40 species of *Notopleura*, more than a third of the entire genus, are found in southern Central America, making this a centre of diversity for the entire genus as well.

Eastern Panama is not well known botanically, but is of significant phytogeographic interest because of its position as a land bridge that connects Central and South America. This region has been variously included as part of the Mexico and Central America phytogeographic province, separated from South America (Gentry 1982); as part of the large Caribbean phytogeographic province that extends from western Mexico and the Antilles to Pacific coastal Ecuador (Takhtajan 1986); and as part of the Chocó-Darién phytogeographic province that includes eastern Panama, coastal Pacific Colombia and north-western Ecuador, and Caribbean Colombia (Sedio et al. 2013). Botanical exploration now under way in this region has documented numerous range extensions of known species and several new species to science, such as the one described here, that will clarify the biogeographic position of eastern Panama.

*Notopleura sallydavidsoniae* R.Flores & C.M. Taylor has been found in the lower montane rain forests of Chucantí Private Nature Reserve (c. 700 hectares), on the eastern edge of Serranía de Majé, an isolated mountain range about 60 km long (Figure 1). The range rises gradually towards the east, with the highest point, Cerro Chucantí (1439 m), at the eastern end (BirdLife International 2016). The reserve, which extends from around 800 m to the highest summit, harbours premontane and lower montane rain forests (Holdridge et al. 1971) (Figure 2A, B).

As part of a floristic inventory in the Chucantí region, c. 300 species have been identified from more than 600 collections (Flores and Ibáñez, personal communication). At least six of them have been recognised as species new to science (Ortiz et al. 2016; Flores et al. 2017; Valdespino, personal communication), including the new *Notopleura* described here. Endemic species of fauna have also been recently described from the area (Miranda and Bermúdez 2010; Bezark et al. 2013; Batista et al. 2014, 2016). All of these novelties highlight the importance for conservation of this under-collected region of Panama, where the extensive loss of forests due to cattle ranching activities is putting in peril its existence. Discovering, describing and conserving biodiversity is the purpose of the Asociación Adopta el Bosque Panamá (ADOPTA), which administers the Chucantí Private Nature Reserve.

## Materials and methods

Herbarium material collected in the field and deposited at the herbaria of The University of Panama (PMA), The Autonomous University of Chiriquí (UCH) and Missouri Botanical Garden (MO) was

examined with the help of a stereomicroscope. Living specimens were studied in the field, where 10 host trees were selected in order to describe plant habit and growth form. The map was made with the program ArcGIS version 10.1. The IUCN Red List Categories and Criteria (IUCN 2001) and GeoCAT (Bachman et al. 2011) were used to determine the conservation status of the new species.

## Taxonomic treatment

*Notopleura sallydavidsoniae* R.Flores & C.M. Taylor, *sp. nov.* (Figures 3 and 4)

## Diagnosis

Haec species a speciebus *Notopleura* subgeneris *Viscagoga* (Baill.) C.M.Taylor combinatione petiolorum 5–15 mm longorum cum floribus breviter pedicellatis, bracteis limbisque evolutis, calycibus corollisque pentameris, loculis ovariorum pyrenisque duobus, et praecipue stipulis cum ligulis 8–10 appendiculatis instructis distinguenda.

Type: Panamá, Darién, Cerro Chucantí, sendero al filo (Roca grande), 8°48'7.93"N, 78°27'9.36"W, 1300 m, 20 Diciembre 2009, A. Ibáñez, F. Hernández, R. Flores, J. Gudiño & H. Sarco 5975 AI (holotype PMA!).

## Additional specimens examined (paratypes)

**Panamá:** Darién, Serranía de Cañazas, Cerro Chucantí, Reserva Natural Privada Chucantí, cima del cerro, parte norte de la montaña, 8°48'17"N, 78°27'34"W, 1451 m, 4 Abril 2015, J. Batista, C. López, Y. Guadalupe, Z. Mijango & M. Palma 1310 (PMA, MO, UCH); Cerro Chucantí, sendero Helicóptero, 8°48'10.20"N, 78°27'32.40"W, 1400 m, 8 July 2010, R.

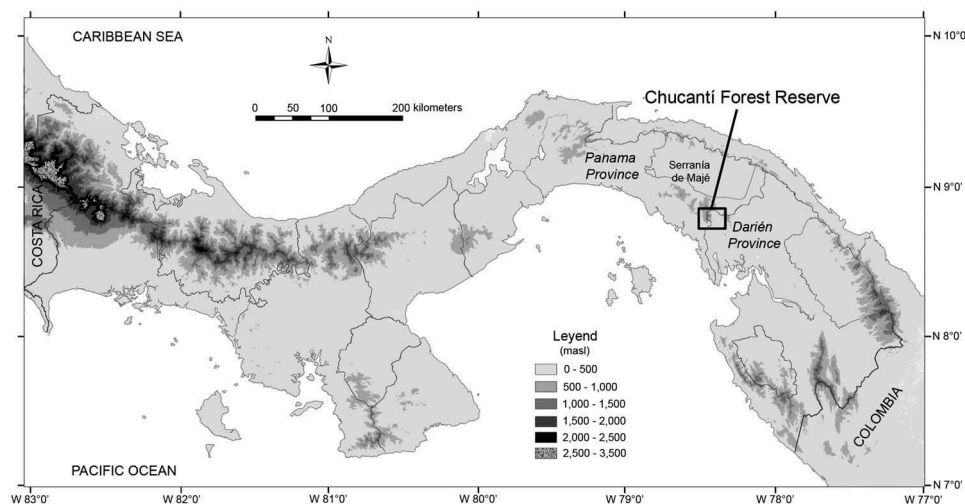


Figure 1. Elevation map of Panama, with location of Chucantí Private Forest Reserve.





**Figure 2.** (A) General view of the Chucantí forest. (B). Inside the forest at the ridge. (A) Photo by A. Ibáñez; (B) photo by E. Campos.

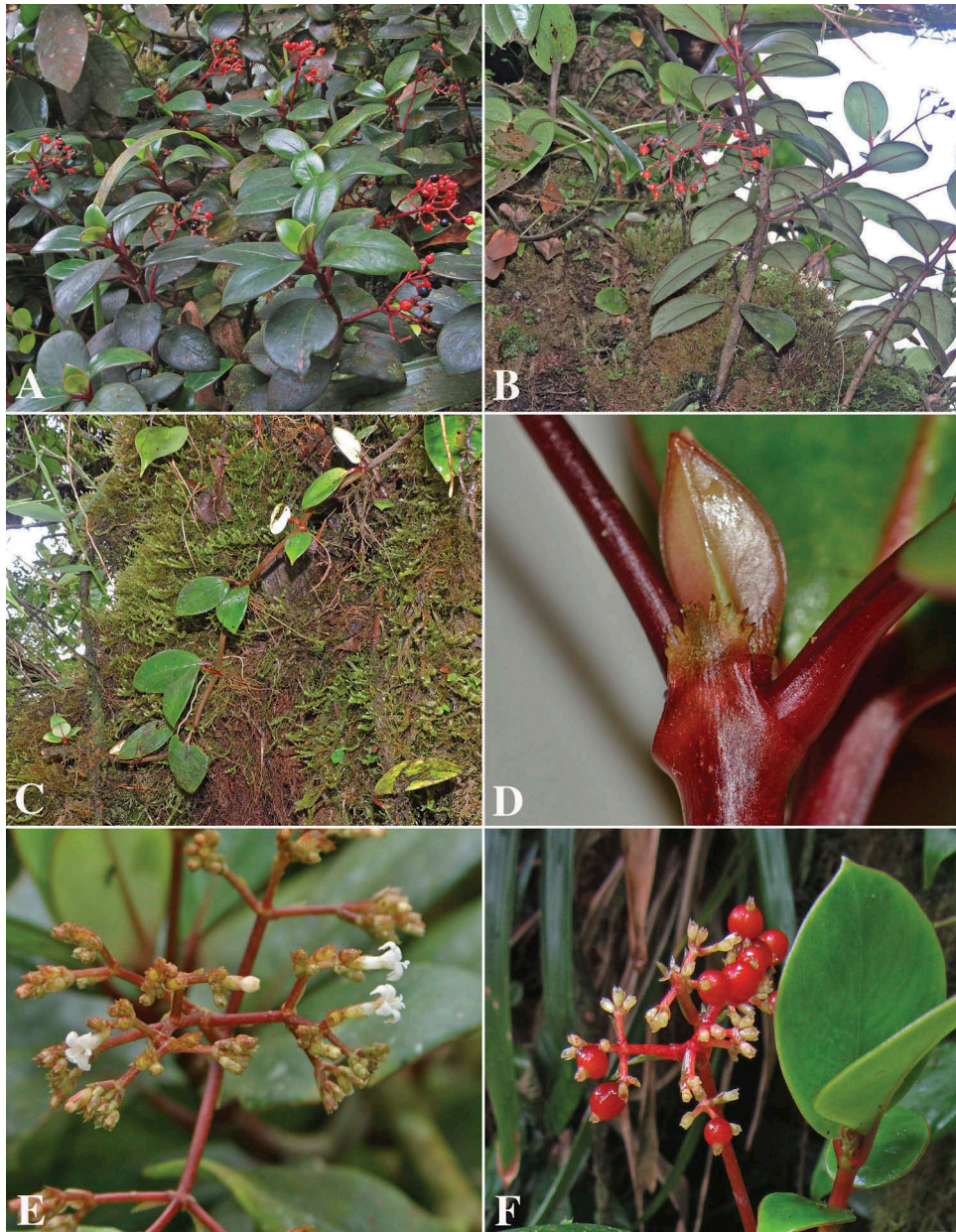
*Flores 495* RF (PMA); Cerro Chucantí, filo de la cordillera, 8°48'7.75"N, 78°27'7.46"W, 1338 m, 19 Septiembre 2012, A. Ibáñez, M. Ayala, A. Celis, S. Peris 8404 AI (PMA, MO); Darién, Distrito de Chepigana, Reserva privada Chucantí, en la cima del Cerro Chucantí, 8°48'17" N, 78°27'34" W, 1461 m, 23 Octubre 2015, E. Campos & R. Flores 598 (PMA, SCZ, MO); Darién, Reserva Natural Privada Chucantí, 8° 48'11.21" N, 78°27'37" W, 1442 m, 4 Abril 2018, V. Jiménez 50 (PMA, SCZ, MO, SEL, COL).

### Description

Epiphytic perennial herbs or small shrubs, branched; stems and leaves succulent. Stipules glabrous, united around stem into a tubular truncate sheath 1.5–2 mm long, with interpetiolar region bearing a ligulate lamina, this inserted near base of stipule sheath, becoming 2–3 x 2.0 mm, round to truncate at apex,

with c. 8–10 glandular appendages 0.4–1.5 mm long and deciduous glands at the apex of each segment (Figures 3D and 4B, C). Leaves opposite; petioles 5–15 mm long; blades elliptic-ovovate to elliptic, 4.5–8 x 2.0–4.0 cm, cuneate or sometimes shortly attenuate at base, acute or shortly acuminate at apex, glabrous, succulent when fresh, subcoriaceous when dry, somewhat discoloured; midrib red abaxially when fresh; secondary veins 7–10 on each side of midrib, evident on both surfaces in dried specimens. Inflorescences terminal, quickly displaced to pseudoaxillary by subsequent stem growth (by an axillary bud), paniculiform, glabrous, with axes red when fresh; peduncles 2.7–6 cm long; branched portion 2.5–4 x 6 cm, rounded; secondary axes 1–2 pairs; bracts linear, 7–8 mm long, acute, those subtending the flowers 1.5–3 mm long; terminal cymes of 3–9-flowered. Flowers distylous, pedicels c. 0.4 mm long.





**Figure 3.** *Notopleura sallydavidsoniae*. (A) Habit, view from above. (B) Habit, view from below. (C) Branch with adventitious roots. (D) Stipule with basal sheath and free portion with glandular appendages. (E) Detail of the inflorescence. (F) Infructescence. Photos by R. Flores.

Hypanthium c. 1 mm long, glabrous. Calyx 1.2–1.7 mm long, glabrous, green tinged with red when fresh, five-lobed for c. one-third of its length; lobes narrowly triangular, acute. Corolla salverform, white, externally glabrous, internally glabrous and with a pubescent ring at the base of the tube, covering part of the anthers when longistylous and part of the filaments when brevistylous; tube c. 4.5 mm long; lobes 5, triangular, c. 1.2 mm long, dorsally smooth. Anthers 5, (measured in open flowers), in longistylous flowers: 0.8–1.1 mm long, inserted with filaments c. 0.1 mm or exserted in brevistylous flowers (measured in buds) c. 1 mm with filaments c. 0.5 mm long. Style bifid, in longistylous flowers: exserted, (measured in open flowers), c. 2 mm long, stigma c. 0.7 mm long (Figures 3E and 4D-F) or inserted in

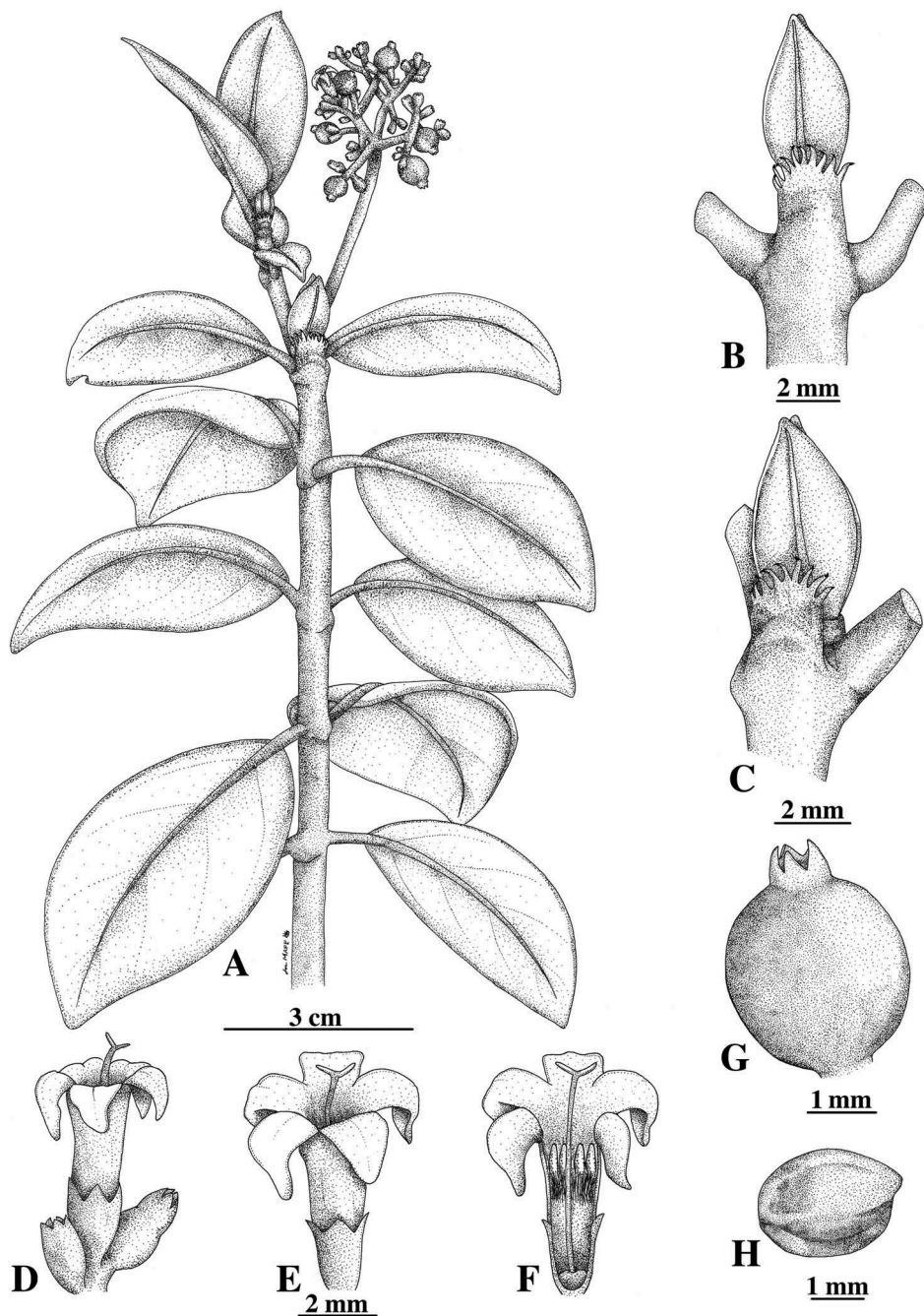
brevistylous flowers (measured in buds), c. 1.2 mm long, stigma c. 0.4 mm long. Fruits ellipsoid, c. 4 × 3 mm when dried, glabrous, passing from red to black when fresh (Figures 3A, F and 4G); pyrenes 2, weakly dorsally ridged, c. 2.5 × 2 mm (Figure 4H).

### Phenology

Specimens with mature flowers were collected in December and April, and with mature and immature fruits in April, July, September and October.

### Distribution and habitat

*Notopleura sallydavidsoniae* is endemic to the Serranía de Majé, eastern Panama. It is known only from the



**Figure 4.** *Notopleura sallydavidsoniae*. (A) Branch with infructescence. (B) Stem with intrapetiolar ligulate lamina. (C) Stipule with basal sheath and free portion with glandular appendages. (D) Flower in anthesis and flower bud. (E) Flower in anthesis. (F) Dissected flower in anthesis (longistylous flowers). (G) Fruit. (H) Pyrene. Drawing based on paratype A. Ibáñez, M. Ayala, A. Celis, S. Peris, 8404 AI (MO, PMA) Drawn by M. Cordero Pagoaga.

Chucantí Private Nature Reserve (Figure 1) where it inhabits lower montane rain forest at c. 1300–1439 m. It is very common along the ridge in mature cloud forest. The forest canopy in this area is 15–20 m tall; some common canopy species are *Billia rosea* (Planch. & Linden) C. Ulloa & P. Jørg., *Blakea* aff. *grandiflora* Hemsl., *Zinowiewia costaricensis* Lundell, *Clusia stenophylla* Standl., *Miconia aponeura* Triana and *Byrsonima nemoralis* Cuatrec. (Figure 2A, B).

### Conservation status

*Notopleura sallydavidsoniae* is known only from one population in the type locality, Chucantí Private Nature Reserve, at the highest elevation of the mountain ridge, where it is fairly common. The Chucantí reserve is an isolated and small private reserve where conservation efforts depend entirely on its owners and donors. The total of the forested areas in the region (private and not private) are completely



surrounded by cattle ranching, agriculture and illegal logging. This means that the range of the species may not be continuous.

Because of the restricted area of occupancy (AOO) estimated at 4 sq. km, and the severe threats, we consider that *N. sallydavidsoniae* fits the category of Critically Endangered [CR B2ab (ii, iii, iv)] of the IUCN Red List and criteria (IUCN 2001).

### Etymology

This species is named in honour of Sally Davidson of Washington, DC, USA, who is a passionate conservationist, philanthropist and long-serving board member of Rainforest Trust, an organisation that supports ADOPTA. It is an honour to thus recognise her contributions to furthering global conservation efforts and her unwavering support of the Rainforest Trust and their efforts to preserve the unique forests of Cerro Chucantí.

### Discussion

This new *Notopleura* species can be recognised by the combination of its epiphytic branched habit, dried leaves with the secondary veins clearly evident, tubular sheathing stipules with a free portion ligulate laminar (inserted near the base of the tube) with deciduous glands at the apex, pedunculate branched inflorescences with well-developed bracts, flowers distylous, shortly pedicellate, well-developed calyx, corolla c. 5.7 mm long and fruits with two pyrenes. This is the first discovered species of *Notopleura* subg. *Viscagoga* with stipules basally sheathing and a developed free blade (Figure 3D); all other species known have the stipules fused around the stem into a tubular sheath with a group of glands or conical appendages borne directly on the sheath.

All individuals of *N. sallydavidsoniae* showed an initial growth on a tree branch and stems going down branches and/or trunks, apparently never touching the ground (Figure 3C). The species can thus be considered as an epiphyte according to Zotz's (2013) definition based on Schimper (1903) and Moffett (2000).

*Notopleura sallydavidsoniae* is similar to *N. pithecolobium* (Standl.) C.M.Taylor and *N. epiphytica* (K.Krause) C.M. Taylor, which are also known from eastern Panama; however, both of them can be recognised by their stipules without a free portion, pedicels 1–5 mm, calyx 0.5–1 mm long, corolla c. 4–5 mm long and fruits with four to six pyrenes. *N. sallydavidsoniae* is also similar to *N. crassa* (Benth.) C.M.Taylor of Venezuela and the Guianas; *N. crassa* can be recognised by its stipules with a conical-triangular free portion shorter than the sheath, corolla c. 6–7 mm long and pyrenes that are dorsally smooth to broadly angled. At present *N. sallydavidsoniae* is apparently restricted to eastern Panama and its relationships

are unclear. It could be related with *N. pithecolobium* and *N. epiphytica*, which are found in Central America and western South America, or with *N. crassa* of north-eastern South America. Elucidation of *N. sallydavidsoniae*'s relationships will help clarify the origin of the flora of eastern Panama.

### Key to *Notopleura sallydavidsoniae* and similar species

Note: Based on Taylor (2001) with modifications.

1. Flowers with pedicels c. 0.4 mm long; stipules with a ligulate free portion ..... *N. sallydavidsoniae*
- 1'. Flowers with pedicels c. 0.5–5 mm long; stipules without a ligulate free portion .....
2. Fruits with 4–6 pyrenes; corolla c. 4–5 mm long.
3. Inflorescences pyramidal in outline, with axes well developed, at 90° or wider with respect to the main axis ..... *N. pithecolobium*
- 3'. Inflorescences corymbiform-rounded in outline, with axes well to poorly developed, ascending at less than 90° with respect to the main axis .....
- ..... *N. epiphytica*
- 2'. Fruits with 2 pyrenes; corolla c. 6–7 mm long .....
- ..... *N. crassa*

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### Disclosure statement

No potential conflict of interest was reported by the authors.

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