TWO NEW SPECIES OF *MONOPYLE* (GESNERIACEAE) FROM NORTHERN ECUADOR

Jeremy Keene
Dept. of Env. & Plant Biology
Porter Hall 315
Ohio University
Athens, Ohio 45701, U.S.A.
jk301809@ohio.edu

Harvey E. Ballard Jr.
Dept. of Env. & Plant Biology
Porter Hall 315
Ohio University
Athens, Ohio 45701, U.S.A.
ballardh@ohio.edu

John L. Clark
Dept. of Biological Sciences
Box 870345
The University of Alabama
Tuscaloosa, Alabama 35487, U.S.A.
jlc@ua.edu

ABSTRACT

Two new species of *Monopyle* Benth. are described from the pluvial lowland forests of northwestern Ecuador in the province of Esmeraldas. They are both locally endemic and are of conservation concern. The two species are segregated from other *Monopyle* species by axillary inflorescences and indument type. **Monopyle uniflora** J.L. Clark & Keene is distinguished by having basally appressed inflorescence bracts, glandular trichomes on the calyx, and a singular axillary flower. The densely villous indument and inflorescence of multiple flowers differentiate **Monopyle multiflora** Keene & J.L. Clark from *Monopyle uniflora*.

RESUMEN

Dos especies de *Monopyle* son descritas de los bosques de lluvia en las tierras bajas del noroeste de Ecuador en la provincia de Esmeraldas. Estas especies son endémicas locales así como de interés para su conservación. Las dos especies son segregadas de otras especies de *Monopyle* debido a sus inflorescencias axilares y tipo de indumento. **Monopyle uniflora** J.L. Clark & Keene se distingue por tener brácteas basalmente adpresas, tricomas glandulares en el cáliz, y una sola flor axilar. El indumento densamente velloso y la inflorescencia con flores múltiples diferencian **Monopyle multiflora** Keene & J.L. Clark de *Monopyle uniflora*.

KEY WORDS: *Monopyle*, Gesneriaceae, Systematics, Ecuador

INTRODUCTION

The family Gesneriaceae is a basal lineage in the order Lamiales, with a hypothesized origin of ~ 65 million years ago (Bremer et al. 2004). The family comprises approximately 3,500 species in 150 genera, with a significant proportion being epiphytes (Weber 2004). The Gesneriaceae can be distinguished, from other families in the Lamiales, by a suite of characters including reduced pair-flowered cymes, five-lobed corollas, parietal placentation, and presence of endosperm. Some of these traits, however, are variable within the family and found in other closely related families (Weber 2004).

The Gesnerioideae is the largest subfamily of Gesneriaceae in the Neotropics with approximately 50 genera and 1,500 species (Weber 2004). The subfamily is neotropical in distribution and recognized by having isocotylous seedlings (Burtt & Wiehler 1995). The most current circumscription of the tribes (Roalson et al. 2005) further divides the Gesnerioideae into seven tribes, including Beslerieae, Gesnerieae, Sinningieae, Gloxinieae, Napeantheae, Episcieae, and Sphaerorhizeae. The Gloxinieae is characterized by having "scaly" rhizomes, a feature separating it from other tribes in the subfamily. These "scaly" rhizomes are modified underground stems with reduced succulent leaves that allow the plants to survive through periods of drought (Kvist & Skog 1992).

Monopyle Benth. (Gloxinieae: Gesneriaceae) is a genus of neotropical terrestrial understory herbs, comprising over 20 species (Weber 2004). These plants are distributed from Guatemala southward through northern South America. The genus was revised for South America by Morton (1945), but limited material was examined and he doubted some of his own determinations. The genus is characterized morphologically by anisophyllous opposite leaves, campanulate flowers, and the presence of uncinate trichomes (Roalson et al. 2005; Weber 2004). Preliminary investigations, by the first author, of *Monopyle* for a revisionary work show that these characters along with indument type, density, and inflorescence architecture are diagnostic for the genus. We focus here on the description of two new species with axillary inflorescences that are morphologically

similar to *Monopyle sodiroana* (Keene, unpublished data). These taxa have been misplaced within *Monopyle sodiroana* and are here segregated from that species. A distribution map (Fig. 3), a table of characters (Table 1), figures of five live collections, and a dichotomous key are provided to distinguish the newly described taxa.

Monopyle multiflora Keene & J.L. Clark, sp. nov. (**Figs. 1 & 2; Table 1**). TYPE: ECUADOR. ESMERALDAS: Cantón San Lorenzo, Parroquia Santa Rita, Tundaloma Lodge, km 17 Hwy San Lorenzo–Ibarra, Sector Calderón, 01°10'59"N, 78°45'3"W, 31 m, 29 May 2008, *J.L. Clark, B. Bisvicuth, S. Ginzbarg, & J. Melton 10407* (HOLOTYPE: US; ISOTYPES: K, MO, NY, QCNE, SEL).

Species nova Monopyles a speciebus aliis axillaribus multifloris inflorescentiis, villosis trichomatibus in abaxialibus foliorum lateribus, et absentia glandulosorum trichomatum in inflorescentiis differt.

Terrestrial or **epiphytic herb,** roots fibrous, shoots dorsiventral, ca. 60 cm tall, densely villous with long straight trichomes intermixed with minute uncinate trichomes throughout; lateral shoots absent in the axils of leaves. **Leaves** opposite, strongly anisophyllous; larger leaf with petioles 8–12(–18) mm long (length decreasing towards stem apex), pubescence same as above; lamina asymmetrical elliptic to ovate, base oblique, apex acuminate, (8.7–)10.5–15.9 × 3.3–7.8 cm, base entire becoming shallowly serrate to deeply serrate towards apex; adaxially dark green to maroon, sparsely villous with long straight trichomes, abaxially maroon, dense puberulent uncinate trichomes intermixed with long straight trichomes (mostly on the veins); smaller leaf with petioles 4(–9) mm long, some appearing sessile, densely villous with long straight trichomes intermixed with minute uncinate trichomes; lamina orbicular to ovate, base subequilateral to oblique, apex acuminate to cuspidate, 1.0–3.4(–5) × (0.70–)1.1–2.7(–3.4) cm, entire to serrate; adaxially densely puberulent with minute uncinate trichomes intermixed with long straight trichomes; abaxially same as larger opposite leaf. **Inflorescence** axillary with two or more flowers per axil; peduncles 1–2 mm long, densely villous with long straight trichomes intermixed with minute uncinate trichomes, floral bracts, 1.6 × 0.8 mm not basally appressed on the peduncle, persistent, opposite, adaxially densely villous, abaxially sparsely villous; pedicel to 2.8 mm long, villous with long straight trichomes intermixed with uncinate trichomes. **Calyx** green to maroon, lobes five, 6.0–10(–13) × 0.7–2(–4) mm, connate 2–3(–6) mm from base, apex acuminate, abaxially villous with long straight trichomes intermixed with minute uncinate trichomes, adaxially few long straight trichomes. **Corolla** white with yellow patch at the base of the throat, 18.3 × 9.6 mm, villous with long straight trichomes intermixed with uncinate trichomes on the outer surface, short gland-tipped papillae on the inner surface of the tube confined to the yellow patch at the base of the throat; limb glabrous, upper lobes 6.1 × 5.3 mm, lower lobe to 11 mm wide and always significantly wider than upper lobes. **Androecium** four stamens, didynamous, anthers connivent for 1.4 mm. **Nectary** usually absent, some flowers with small amounts of raised tissue dorsally at the base of the ovary. **Gynoecium** ovary half-inferior, to 2 mm wide, sparsely pubescent with minute uncinate trichomes, style to 4 mm long, sparsely pubescent with minute uncinate trichomes, stigma stomatomorphic. **Fruits** 7–10 × 3–5 mm, accrescent, dehiscing along dorsal surface, calyx persistent in fruit; seeds numerous, oblong, with tubular and bell-shaped protuberances, 0.6 × 0.4 mm, dark brown to black.

Phenology.—Collected in flower and fruit in May and September.

Distribution and Ecology.—*Monopyle multiflora* has been collected from areas noted on herbarium labels as tropical humid forest and transitional montane/premontane to lowland wet forest. It is also noted to be growing in the understory of the following canopy trees: *Carapa guianenesis* Aubl. (Meliaceae), *Humiriastrum procerum* (Little) Cuatrec. (Humariaceae), *Jacaranda copaia* (Aubl.) D. Don (Bignoniaceae), and *Jessenia bataua* (Mart.) Burret. This species is known from the Esmeraldas province in Ecuador. It is likely that additional populations will be discovered near the type locality in pluvial forests in adjacent Colombia where limited fieldwork has been conducted.

Conservation and IUCN Red List category.—*Monopyle multiflora* is known from two populations in the Esmeraldas province along the foothills of the eastern Andean slopes of northern Ecuador (Fig. 3). The type collection was made in Tundaloma Lodge, a small private reserve located 17 km east of the town San Lorenzo (sector Calderón) in northern Ecuador. The Tundaloma Lodge is owned and managed by Andres Chiriboga and it is a destination for bird watchers. Most of the forest along the San Lorenzo-Ibarra highway has been converted to African Palm plantations as a result of the recent completion of the highway. Some patches of

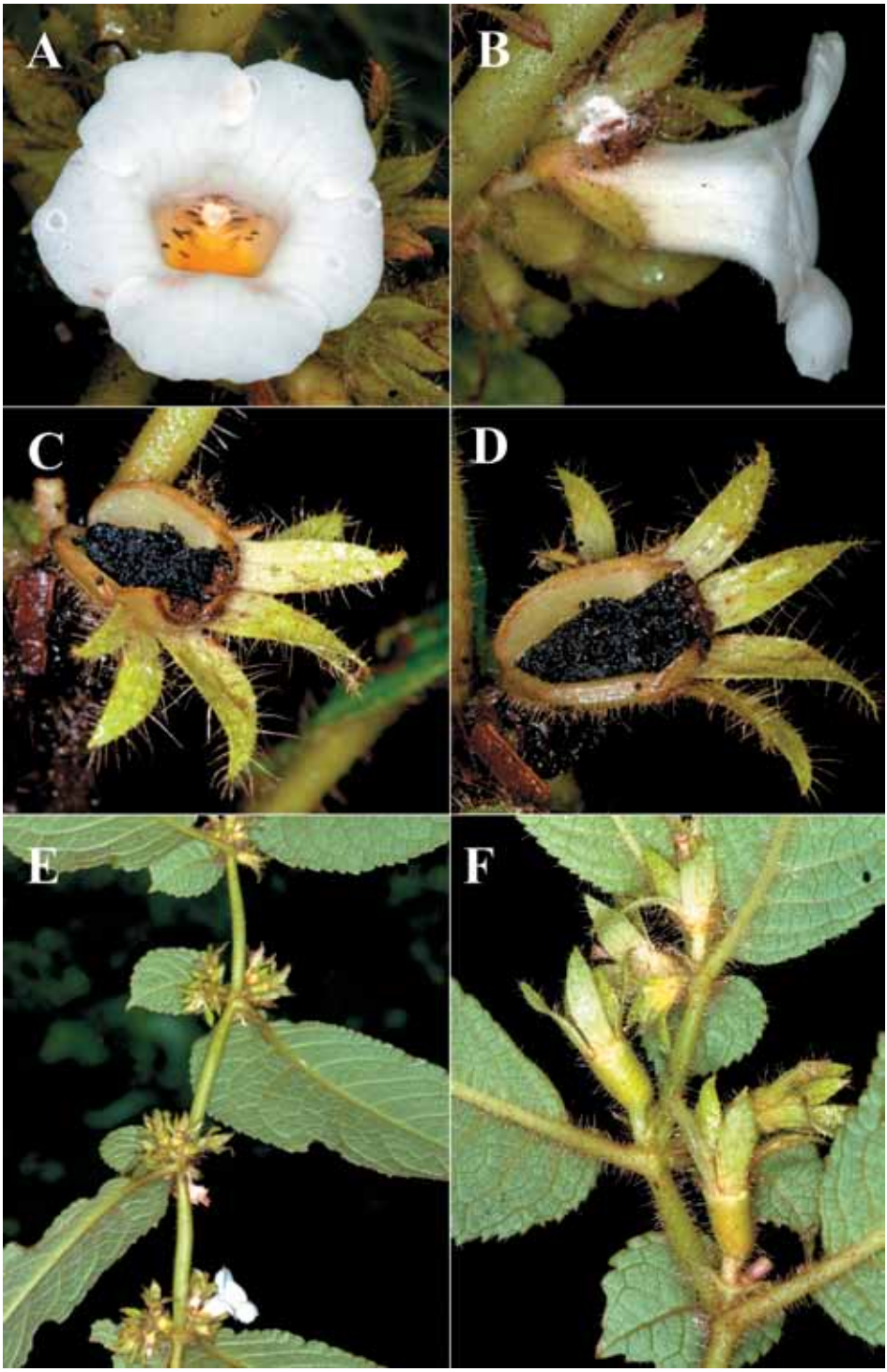

Fig. 1. *Monopyle multiflora*. **A.** Face view of flower (yellow patch). **B.** Lateral view of flower. **C & D.** Mature fruit. **E.** Habit showing strongly anisophyllous leaves. **F.** Immature Fruits (Photos by J.L. Clark; voucher from the holotype: *J.L. Clark, B. Bisvicuth, S. Ginzbarg & T. Melton 10407* at US).

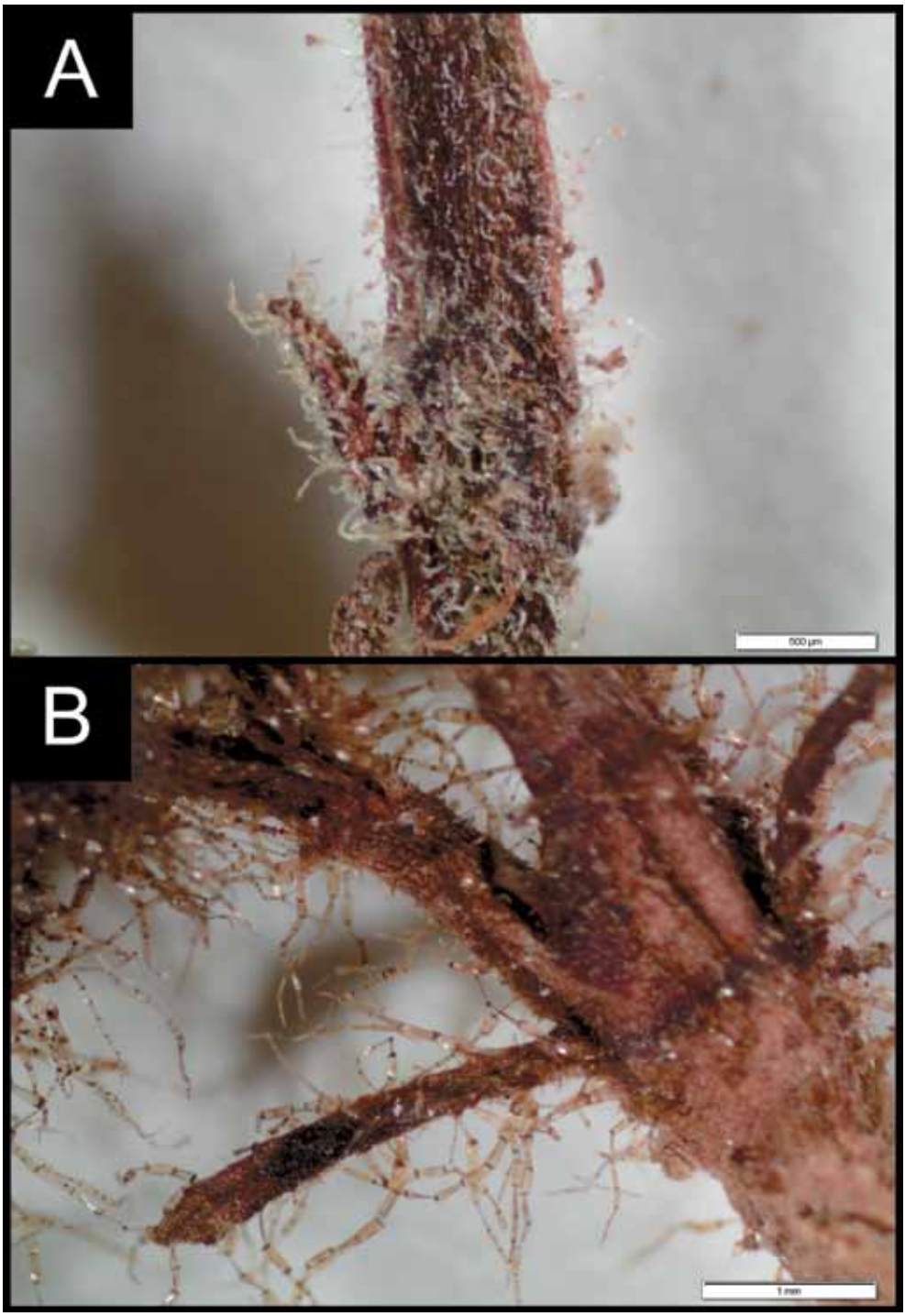

Fig. 2. A. *Monopyle uniflora* showing peduncle with basally appressed bracts (voucher from holotype: *J.L.Clark & Gesneriad Research Expedition Participants 11162* at US). B. *Monopyle multiflora* showing peduncle with the bracts not basally appressed. (Photos by Jeremy Keene; voucher from the holotype: *J.L. Clark, B. Bisvicuth, S. Ginzbarg, & J. Melton 10407* at US).

TABLE 1. Main diagnostic features between *Monopyle multiflora, M. uniflora,* and *M. sodiroana.*

Diagnostic character	*Monopyle multiflora*	*Monopyle uniflora*	*Monopyle sodiroana*
Glandular trichomes on the calyx	Absent	Present	Absent
Stem indument	Villous	Puberulent	Puberulent
Inflorescence	Axillary	Axillary	Terminal
Inflorescence bract base	Not appressed	Appressed	Not appressed

isolated forest exist in the hilly areas along the highway, but the habitat that is most threatened is the lowland flat areas near San Lorenzo where *Monopyle multiflora* is located. It is not found in any formally protected area in Ecuador and additional fieldwork in adjacent forests in Colombia may result in the documentation of additional populations. According to the IUCN Red List criteria (IUCN 2001) for limited geographic range (B2a, less than 10 km^2 and known to exist at only a single location) and considering the uncertain future of habitat conservation along the San Lorenzo-Ibarra highway, *Monopyle multiflora* should be listed in the category CR (Critically Endangered).

Etymology.—The specific epithet, *multiflora*, reflects the species typically having many flowers per axillary inflorescence.

PARATYPES. **ECUADOR. ESMERALDAS:** Entre el Estero Molina–Hcda. Montero Riera [between the Molina stream and the Montero Riera Farm], San Marco, 140 m, 7 Sep 1991, *J. Jaramillo, E. Grijalva & M. Grijalva 13811* (NY).

Monopyle uniflora J.L. Clark & Keene, sp. nov. (**Figs. 2 & 4; Table 1**). TYPE: ECUADOR. ESMERALDAS: Cantón San Lorenzo, flat forest near highway Ibarra–San Lorenzo, near Rio Durango, Centro de Manejo Lote #1 (Fundacion Sirua), Sendero Hola, 1°5'5"N, 78°41'12"W, 87 m, 4 Jun 2009, *J.L. Clark & Gesneriad Research Expedition Participants 11162* (HOLOTYPE: US; ISOTYPES: K, MO, QCNE, SEL).

Species nova *Monopyles* a speciebus aliis axillaribus inflorescentiis singulari flore cum amplectenti bractea, et praesentia uncinatorum et glandulosorum trichomatum in inflorescentiis differt.

Terrestrial herb, roots fibrous, stems dorsiventral to erect, 40–80 cm tall, puberulent with loosely appressed uncinate trichomes throughout, green with some red coloration. **Leaves** opposite, strongly anisophyllous; larger leaf with petioles 5.1–15.9 mm (length decreasing towards apex), densely puberulent with short uncinate trichomes intermixed with scattered long straight trichomes; lamina elliptic to falcate, base oblique, apex falcate-acuminate, 5.6–8.5(–14.2) × (2.5–)3.4–6.7 cm, shallowly serrate to deeply serrate towards apex; adaxially dark green, sparsely puberulent with minute uncinate trichomes intermixed with scattered long straight trichomes, abaxially light green, minute uncinate trichomes (mainly on the veins); small leaf with petioles 1.6–4.6 mm, dense puberulent uncinate intermixed with long straight trichomes; lamina orbicular to ovate, base subequilateral to oblique, apex cuspidate, (1.0–)1.9–2.8(–5.5) × 3.3–4.9 cm, serrulate to serrate; adaxially bullate, evenly spaced minute uncinate trichomes intermixed with sparse long straight trichomes; abaxially sparse to somewhat dense puberulent uncinate trichomes. **Inflorescence** axillary, a reduced pair-flowered cyme with one to two flowers; peduncles 0.9–2.1 mm, puberulent with uncinate trichomes, bracts 1.1–1.3 mm × 0.4 mm appressed basally on the peduncle, persistent, opposite, sparsely to densely villous; pedicel 2.2–4.5 mm, puberulent with uncinate trichomes intermixed with long glandular trichomes. **Calyx** light green, lobes five, equal, 5.1–6.3 × 0.9–1.7 mm, connate 1.8–2.4 mm from base, apex acuminate, puberulent with uncinate trichomes intermixed with long straight glandular and non-glandular trichomes, adaxial surface with few long straight trichomes. **Corolla** white to light lavender with broad yellow patch in the base of the throat, 14.8–17.3 × 7.2–10 mm, sparsely pubescent with short sharply pointed trichomes on the outer surface, short gland-tipped papillae confined to the yellow patch on the inner surface of the tube; limb glabrous, upper lobes 5–7 × 7–9 mm, lower lobe to 13 mm long, always significantly wider than upper lobes. **Androecium** with four stamens, didynamous, anthers connivent for 1.1 mm. **Nectary** usually absent, some flowers with small amounts of raised tissue at base of ovary. **Gynoecium** ovary half-inferior, to 1.6 mm wide, puberulent with uncinate trichomes, style to 4 mm long, sparsely pubescent with uncinate trichomes, stigma stomatomorphic. **Fruits**

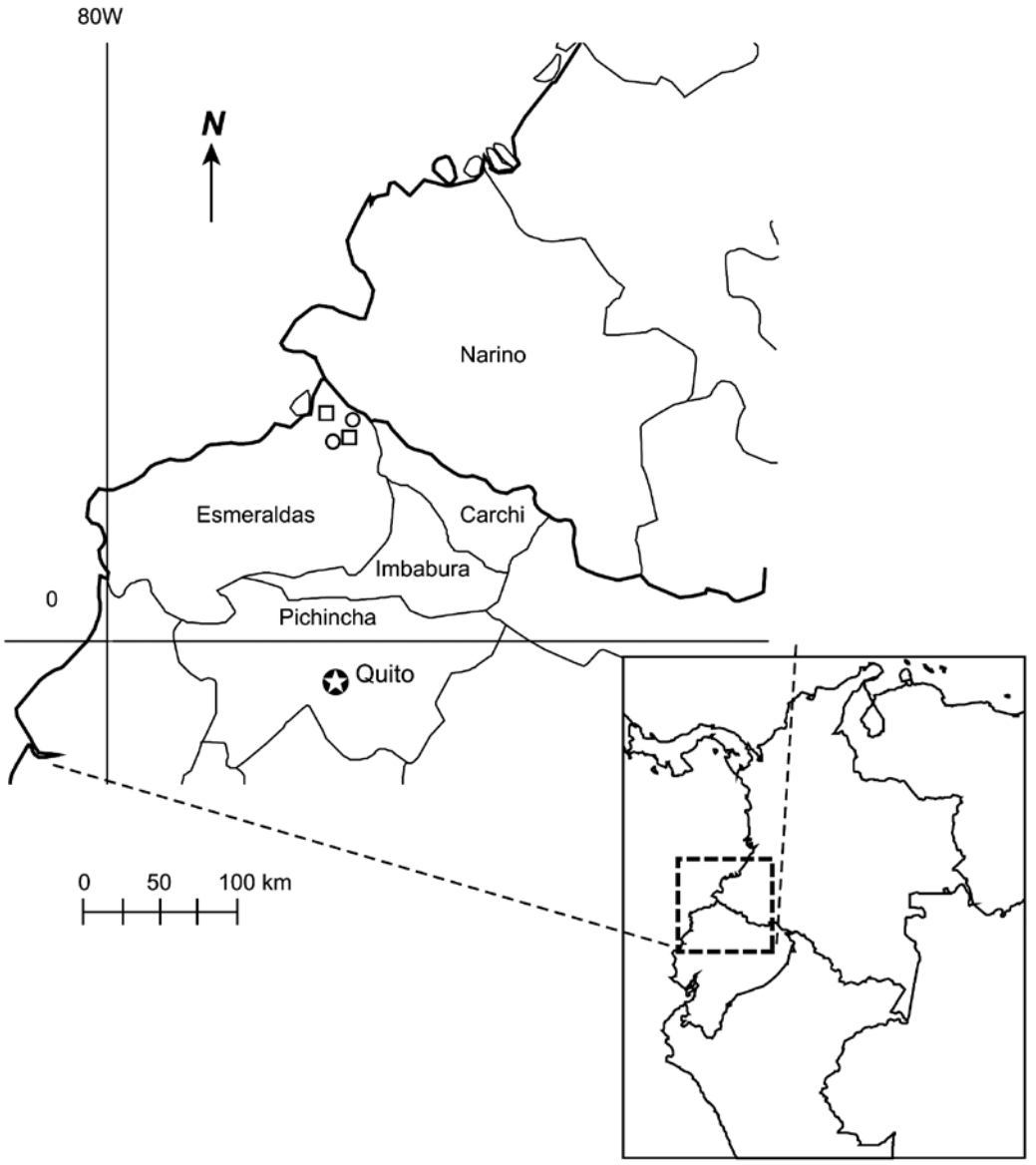

Fig. 3. Distribution map of *Monopyle uniflora* (open circle) and *Monopyle multiflora* (open square).

6–9 × 2–4 mm, accrescent, dehiscing on dorsal side only, calyx persistent in fruit; seeds numerous, oblong, with tubular and bell-shaped protuberances, 0.4 × 0.2 mm, cream to light tan.

Phenology.—Collected with flowers and fruits in June and October.

Distribution and Ecology.—*Monopyle uniflora* has been collected from areas noted as flat forest and humid tropical primary forest on herbarium labels. It is likely that additional populations will be discovered near the type locality in pluvial forests in adjacent Colombia where limited fieldwork has been conducted.

Conservation and IUCN Red List category.—*Monopyle uniflora* is known from two collections in the Esmeraldas province along the foothills of the eastern Andean slopes of northern Ecuador (Fig. 3). The type

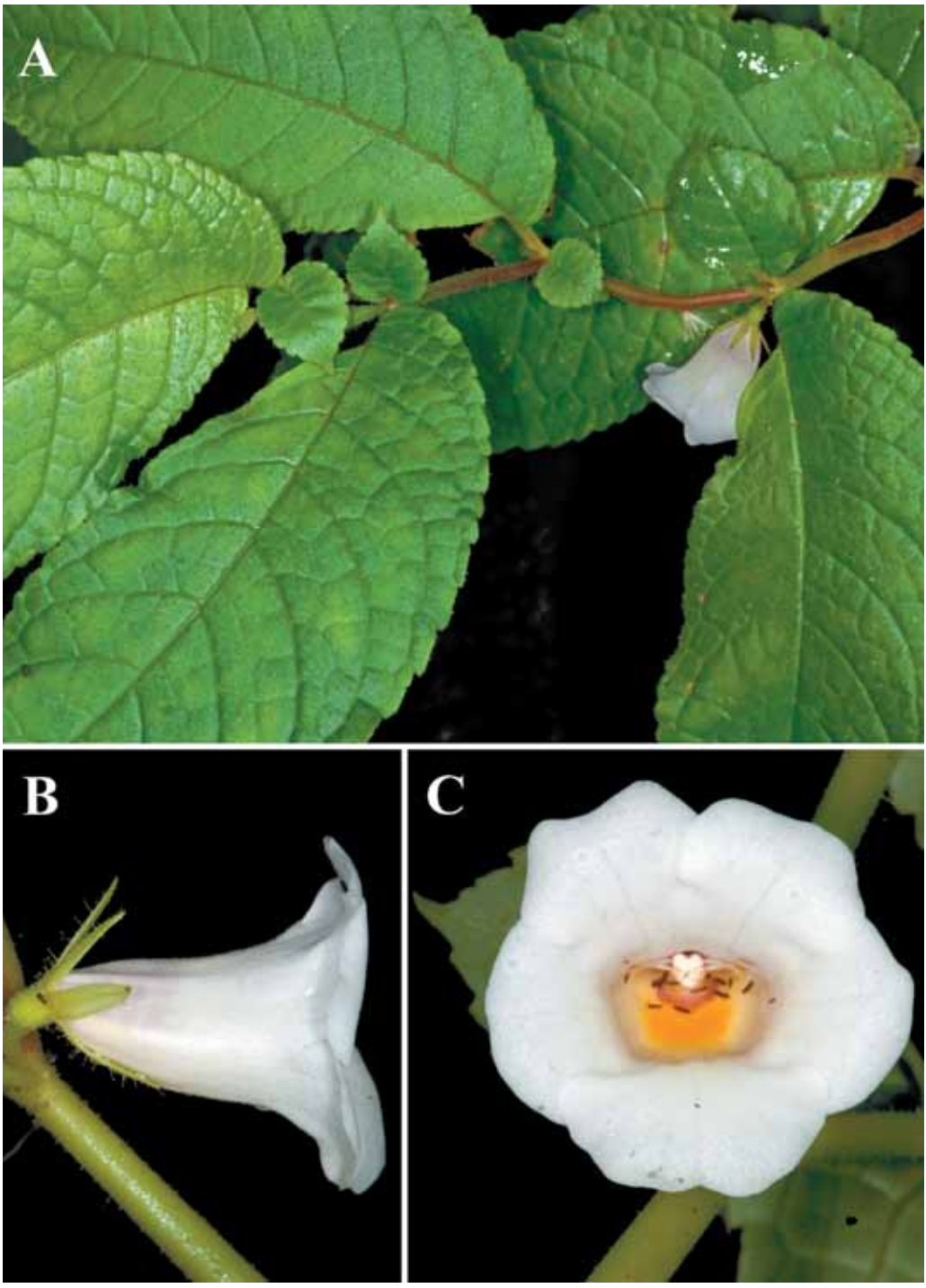

Fig. 4. *Monopyle uniflora*. **A.** Habit showing strongly anisophyllous leaves and single axillary flower. **B.** Lateral view of Flower. **C.** Front view of flower showing yellow patch at base of tube (Photos by J.L. Clark; voucher from the holotype: *J.L. Clark & Gesneriad Research Expedition Participants 11162* at US).

collection is from a remnant patch of lowland flat forest that is managed by Fundacion Sirua, a foundation dedicated to the conservation of biodiversity along the Ibarra–San Lorenzo highway. According to the IUCN Red List criteria (IUCN 2001) for limited geographic range (B2a, less than 10 km^2) and considering the uncertain future of habitat conservation along the San Lorenzo-Ibarra highway, *Monopyle uniflora* should be listed in the category CR (Critically Endangered).

Etymology.—The specific epithet, *uniflora,* comes from the species typically producing a single flower per axillary inflorescence.

PARATYPES: **ECUADOR. ESMERALDAS:** San Lorenzo Cantón, Reserva Etnica Awá, Centro Ricaurte, 01°10'N, 78°32'W, 300 m, 27 Oct 1992, *G. Tipaz, C. Aulestia, & M. Pascal 2218* (MO, QCNE, US).

KEY TO DIFFERENTIATE NEW SPECIES FROM *MONOPYLE SODIROANA*

1. Inflorescences terminal ____ **Monopyle sodiroana**
1. Inflorescences axillary.
   2. Calyx with glandular trichomes and bracts basally appressed ____ **Monopyle uniflora**
   2. Calyx lacking glandular trichomes and bracts not basally appressed ____ **Monopyle multiflora**

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REFERENCES

BREMER, K., E. FRIIS, AND B. BREMER. 2004. Molecular phylogenetic dating of asterid flowering plants shows early Cretaceous diversification. Syst. Biol. 53:496–505.

BURTT, B.L. AND H. WIEHLER. 1995. Classification of the family Gesneriaceae. Gesneriana 1(1):1–4.

IUCN. 2001. IUCN Red List Categories and Criteria, Version 3.1. Prepared by the IUCN Species Survival Commission. Gland, Switzerland and Cambridge: International Union for Conservation of Nature and Natural Resources.

KVIST, L.P. AND L.E. SKOG. 1992. Revision of *Kohleria* (Gesneriaceae). Smithsonian Contr. Bot. 79:1–83.

MORTON, C.V. 1945. Las especies sudamericanas del genero Monopyle. Revista Univ. (Cuzco) 30:98–116.

ROALSON, E.H., J.K. BOGGAN, AND L.E. SKOG. 2005. Reorganization of tribal and generic boundaries in the Gloxinieae (Gesneriaceae: Gesnerioideae) and the description of a new tribe in the Gesnerioideae, Sphaerorrhizeae. Selbyana 25:225–238.

WEBER, A. 2004. Gesneriaceae. In: K. Kubitzki and J.W. Kadereit, eds. The families and genera of vascular plants. Vol. 7. Flowering plants, dicotyledons: Lamiales (except Acanthaceae including Avicenniaceae). Berlin & Heidelberg, Germany: Springer-Verlag. Pp. 63–158.

WIEHLER, H. 1983. A synopsis of the neotropical Gesneriaceae. Selbyana 6:1–219.