A NEW ENDEMIC SPECIES FROM THE GUIANA SHIELD, *SMILAX BREVIPEDUNCULATA* (SMILACACEAE)

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Abstract. Ongoing taxonomic revision of the genus *Smilax* is revealing that species diversity is underestimated in the Neotropics. While reviewing specimens from the Guiana Shield, a relatively poorly studied region of *Smilax* diversity, we found multiple specimens possessing a consistent combination of morphological characters that do not match any described species. Here, we describe these specimens as a new species known only from the Guiana Shield, *Smilax brevipedunculata sp. nov.*, based on herbarium specimens. This new species has previously been confused with a morphologically similar taxon from the Guiana Shield, *S. lasseriana*, and bears resemblance to the Amazonian species, *S. magnifolia*. An illustration and distribution map of *S. brevipedunculata* are provided along with detailed comparison with similar species. *Smilax brevipedunculata* is only known from six collections, the most recent of which were collected more than three decades ago, making it of conservation concern.

Keywords: endemic species, Guiana Shield, Neotropics, new species, *Smilax*

Resumen. La revisión taxonómica en curso del género *Smilax* está revelando que la diversidad de especies se subestima en el Neotrópico. Mientras revisábamos especímenes del Escudo de Guayana, una región de diversidad de *Smilax* relativamente poco estudiada, encontramos varios especímenes que poseen una combinación consistente de caracteres morfológicos que no coinciden con ninguna especie descrita. Aquí, describimos estos especímenes como una nueva especie conocida solo del Escudo Guayanés, *Smilax brevipedunculata sp. nov.*, basado en especímenes de herbario. Esta nueva especie se había confundido previamente con un taxón morfológicamente similar del Escudo Guayanés, *S. lasseriana*, y se parece mucho a la especie amazónica, *S. magnifolia*. Se proporciona una ilustración y un mapa de distribución de *S. brevipedunculata* junto con una comparación detallada con especies similares. *Smilax brevipedunculata* solo se conoce de seis colecciones, la más reciente se recolectó hace más de tres décadas, por lo que es motivo de preocupación para la conservación.

Palabras claves: especies endémicas, Escudo de Guayana, neotrópico, *Smilax*

Smilax L. is the sole genus that comprises Smilacaceae and exhibits widespread and near-global distribution, occupying tropical to temperate regions. Estimates of the number of the *Smilax* species has varied from ca. 200–350 (Andreata, 1997; Cameron and Fu, 2006; Ferrufino-Acosta, 2010; Qi et al., 2013). The uncertainty in species diversity is due to both the lack of taxonomic research and difficulty inferring species limits in the genus. This taxonomic uncertainty, as partly noted by Cameron and Fu (2006), is likely driven by: 1) a high degree of morphological variation within species, populations, and individuals, 2) lack of adequate collections in herbaria leading to incomplete knowledge of morphological variation, especially in lower stems and reproductive structures, and 3) sexual dimorphism, associated with dioecy, is another possible source of complexity–-one that has not been systematically assessed in *Smilax* but is clearly an important factor to consider in other dioecious groups, such as *Clusia* L. (Clusiaceae; Luján, 2019), *Leucadendron* L. (Proteaceae), and *Sagittaria* L. (Alismataceae; Barrett and Hough, 2012).

Phylogeny, inferred from plastid and nuclear ribosomal DNA, has recovered a well-supported New World clade, in which all neotropical species are putatively placed (Qi et al., 2013, 2023). Neotropical *Smilax* is widely distributed and is ubiquitous throughout its range, consisting of around 100 species (T. Murphy, unpubl. data), but basic knowledge about species limits remains highly uncertain and is in need of intensive study. Taxonomic and phylogenetic knowledge of the neotropical species lags behind what is known of East Asian and North American taxa, as seen in the most recent phylogeny by Qi et al. (2023), which included 23 species from the Neotropics. In addition to lack of taxon sampling in published phylogenies, preliminary research on neotropical *Smilax* has shown that basic information on morphological variation is lacking. As we conduct fieldwork in new areas and review specimens, morphological variation not previously documented for named taxa is being uncovered. Species limits are poorly resolved with numerous undescribed species and species complexes in need of further study.

In the New World, the Guiana Shield is arguably the most poorly understood, taxonomically, for *Smilax*. Taxonomic treatments are available for smaller regions within the Guiana Shield, such as Central French Guiana (Mitchell, 1997), Suriname (Sipman, 1979), and Venezuelan Guayana (Gaskin and Berry, 1998, 2005). Regional treatments of

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Smilax outside of the Guiana Shield (Andreata, 1997; Botina-Papamija., 2008; Ferrufino-Acosta, 2010) have substantially contributed to understanding species limits in the Neotropics. Still, taxonomic treatments and herbarium specimen determinations indicate a great amount of conflict in interpretation of species limits, nomenclatural priority, and application of names. A modern and comprehensive treatment of *Smilax* of the Guiana Shield is needed to capture the complexities and nuances of morphological variation and for application of a consistent species concept.

While reviewing herbarium specimens, the authors found six collections, represented by eight specimens, that exhibited a unique morphology not known in any other *Smilax* species in the Neotropics but which had previously been mistaken as several species that are known from the Guiana Shield. Subsequently, we found the treatment of *Smilax* for Suriname by Sipman (1979) also noted this as a distinct but unnamed taxon "*Smilax* sp. II," which represents the second species that we independently discovered (Murphy et al., in press) from herbarium specimens also noted by Sipman. Due to its morphological distinctiveness, based on multiple vegetative and reproductive characters in *Smilax*, we describe these specimens as a new species, *S. brevipedunculata sp. nov*.

Materials and Methods

We examined physical specimens from BBS, F, FLAS, IVIC, JBSD, MER, MO, NY, PMA, PORT, and USM and photos of specimens from CAY, HOXA, U, and US (acronyms follow Thiers, continuously updated). All measurements were made with a digital caliper from dry herbarium specimens except for flowers and fruits, which were rehydrated prior to measurement. Rehydration entailed boiling water with dish soap in a beaker and placing material in the solution for two minutes. We then removed the material and placed it in a petri dish with a small amount of the soap water solution to keep it from drying out during examination, collecting measurements, and photographing. We compared the new species to species it has previously been determined as, *S. lasseriana* Steyerm., and the morphologically similar taxon, *S. magnifolia* Macbr., which included examination of the type specimens of these species.

The distribution of the species described herein was mapped with R 4.1.2 (R Core Team, 2021), implemented in RStudio 2021.09.1 (RStudio Team, 2021), using the packages 'cowplot' (Wilke, 2020), 'ggplot2' (Wickham, 2016), 'ggsn' (Baquero, 2019), and 'rnaturalearth' (South, 2017). International Union for Conservation of Nature (IUCN) Red List assessments were conducted by calculating extent of occurrence (EOO) and area of occurrence (AOO) to assess threatened categories under Criterion B1, which is based on geographic range. We used the R package 'red' (Cardoso, 2020) to calculate EOO and AOO. When EOO and AOO inferred different threatened categories, we chose the more severe category.

Here, we apply a phenetic species concept (Judd, 2007). This was applied by assigning species based on a combination of characters while also considering secondary evidence from distributions and habitat. We did extract DNA from specimens for sequencing, but the DNA was too degraded to recover usable sequence data, likely due to field preservation techniques using ethanol. Tissue sampled from specimens from the wet tropics tend to yield the poorest quality sequence data based on multiple metrics (Brewer et al., 2019).

For specimens cited below, numbers in brackets refer to unique identifiers, either accession numbers or barcodes. For specimens cited from BBS, MO, and PORT, numbers refer to accession numbers. For specimens cited from NY and U, numbers refer to barcode numbers.

Taxonomy

Smilax brevipedunculata T. Murphy & S. M. Niño, *sp. nov.*, Fig. 1.

TYPE: VENEZUELA. Bolívar: selva pluvial del Río Ikabaru, cerca del Campo Diamantífero de Uai[-P]arú, 400–450 m, 16 abril 1957, (fr), *A. L. Bernardi 6561* (Holotype: NY [barcode 04204354]).

Smilax brevipedunculata is similar to *S. lasseriana* Steyerm. with its peduncles shorter than the petioles and a textured stem, but differs by its stem being lightly verrucose-tuberculate with inconspicuous projections (vs. distinctly verrucose-tuberculate with conspicuous projections), single basal cataphyll (vs. two overlapping basal cataphylls), reniform-shaped receptacles (vs. globose to broadly ovoid), receptacle scales papery and rounded (vs. stiff and acuminate), and anthers 0.5–0.6 mm (vs. [0.6–]0.7–1.0 mm) that are shorter than the filaments (vs. longer than the filaments).

Dioecious climbing vines. Stems to 4 mm wide, unarmed. Branches terete in cross section, surface densely verrucose-tuberculate with inconspicuous and short projections covering the surface, one cataphyll on axial side of basal internode of lateral branches, weakly flexuous to straight on terminal fertile branches, basal internodes of branches 13.1–35.4 mm, shorter than following internodes 17.2–39.7 mm, ratio of basal to following internode length 0.36–1.14. Leaves 9.6–17.2 (–25.0) cm × 2.8–7.7(–12.3) cm, length to width ratio 2.1–3.7, coriaceous, light brown to yellow when dry, glabrous; narrowly elliptic to elliptic, rarely ovate in shape; bases cuneate to rounded, rarely subcordate, apices short-acuminate to apiculate; apex angle obtuse, rarely; adaxial surface lustrous with distinctly raised primary, secondary, and first-order tertiary veins, and higher order veins visible but becoming immersed and somewhat obscured, 4–6 first-order tertiary veins branching directly from midrib in middle 5 cm segment, 7.3–17.9 mm apart; abaxial surface with all vein orders conspicuously raised; venation comprised of midrib with four secondary lateral veins and two additional outer secondary intramarginal veins; petiole 10.0–30.5 mm, darker than lamina when dry, gradually tapering from lamina to petiole. Inflorescences

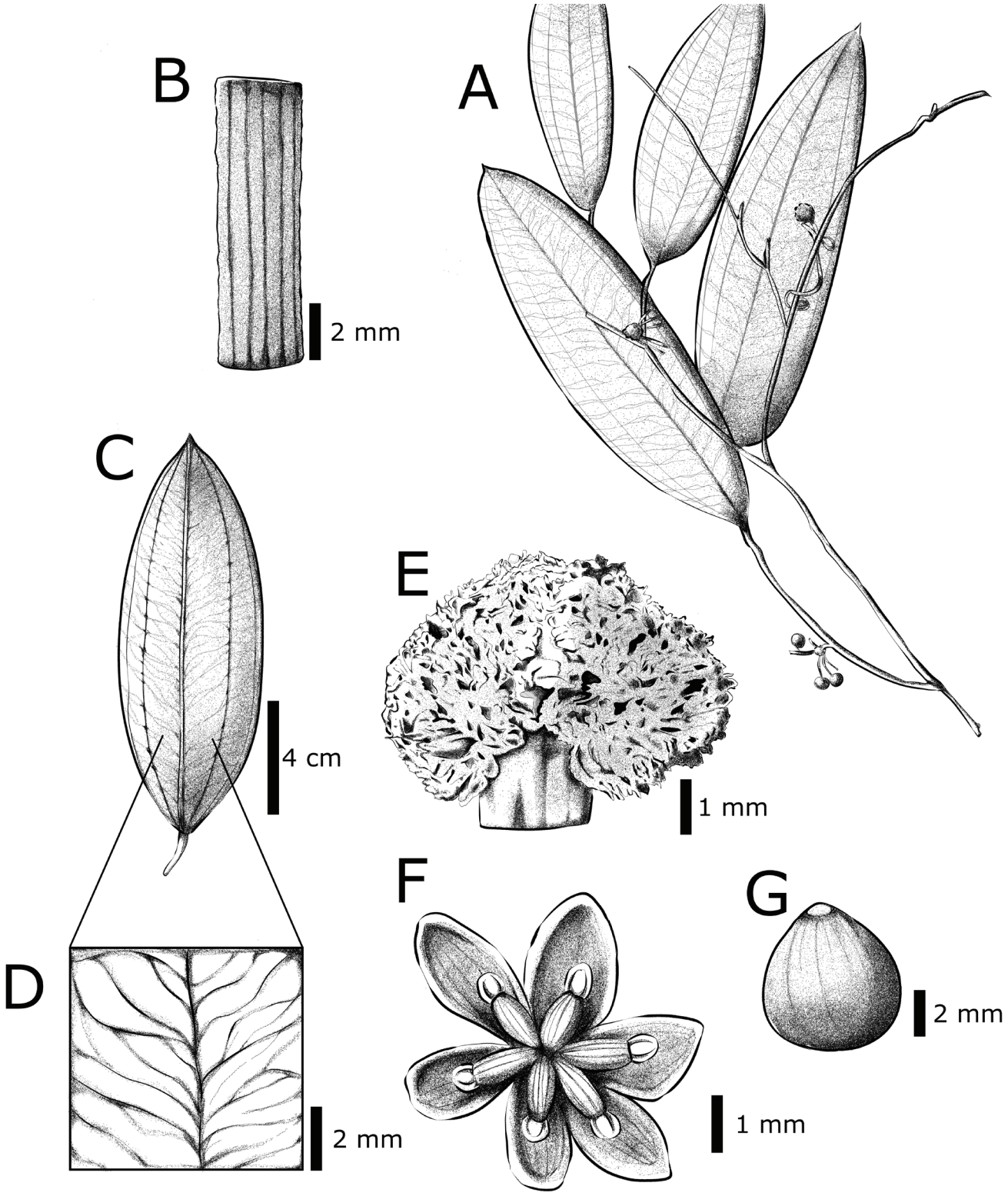

FIGURE 1. Illustration of *Smilax brevipedunculata* T. Murphy & S. M. Niño. **A**, habit; **B**, stem; **C** and **D**, leaf; **E**, receptacle; **F**, staminate flower; **G**, seed. A, C, D, and G drawn from *Bernardi 6561* (NY); B and E drawn from *Bernardi s.n.* (NY); F drawn from *Field No. F1453/ Record No. 4189* [NY]. Illustrations by Kelly Ho.

solitary axillary umbels; peduncles 2.5–12.2 mm long, to ca. 3 mm wide, always shorter than subtending petioles, peduncle to petiole ratio 0.12–0.53 (–0.82), conspicuously flattened, surface verrucose-tuberculate; receptacles distinctly reniform, 2.2–6.2 mm × 4.0–10.8 mm, always wider than long, length to width ratio 0.46–0.78; receptacle scales papery and obtuse, surface smooth; pedicels 7.8–12.1 mm long, surface smooth. Staminate flowers ellipsoid in immature bud, with six tepals divided into two whorls, each consisting of three tepals, tepals oblong-lanceolate, larger tepals 2.3–2.6 mm × 1.2–1.8 mm, smaller tepals ca. 2.0 mm × 0.9–1.0 mm wide with distinct wings, ca. 0.3 mm wide, apices acuminate; stamens 1.4–1.7 mm long, filaments 1.0–1.2 mm × 0.4 mm, anthers 0.4–0.5 mm × 0.5 mm, distinctly shorter than filaments. Carpellate flowers not seen. Fruit a 1- or 2-seeded berry, color unknown, globose, 6.6–8.3 mm long, 6.5–11.7 mm wide, the 2-seeded berries wider than long and the 1-seeded berries ca. as wide as long, seeds ovoid to ellipsoid, 5.8–6.9 mm long, 4.2–5.9 mm wide.

Etymology: The epithet refers to the relatively short peduncles that never exceed the petioles in length which, in part, is a distinguishing character for this species.

Distribution and habitat: *Smilax brevipedunculata* is known from six collections, four of these from Bolívar, Venezuela, one from the region disputed between Guyana and Venezuela, and one from Suriname (Fig. 2). Considering the proximity to the Brazil-Venezuela border, *S. brevipedunculata* may also be found in Brazil. Efforts to locate a population based on the only known specimen from Brokopondo District, Suriname (*Donselaar 2983*, [BBS, NY]) was not successful during fieldwork in 2022. Considering the paucity of collections, this may indicate that it is locally rare, despite its distribution covering a widespread area. Habitats where *S. brevipedunculata* has been collected have been described as high, pluvial, or riverine forests at elevations of 100–850 meters. The most recent collections, *Fernández 4300* (PORT) and *Stergios 12123* (MO, PORT, US), were made in 1988, about 35 years ago. Additional fieldwork is needed to determine if *S. brevipedunculata* is still extant.

The EOO of *S. brevipedunculata* is 56,331 km^2, and the estimated area of occupancy (AOO) is 24 km^2. Under IUCN Criterion B1 (geographic range), the AOO would classify *S. brevipedunculata* as endangered with an AOO < 500 km^2.

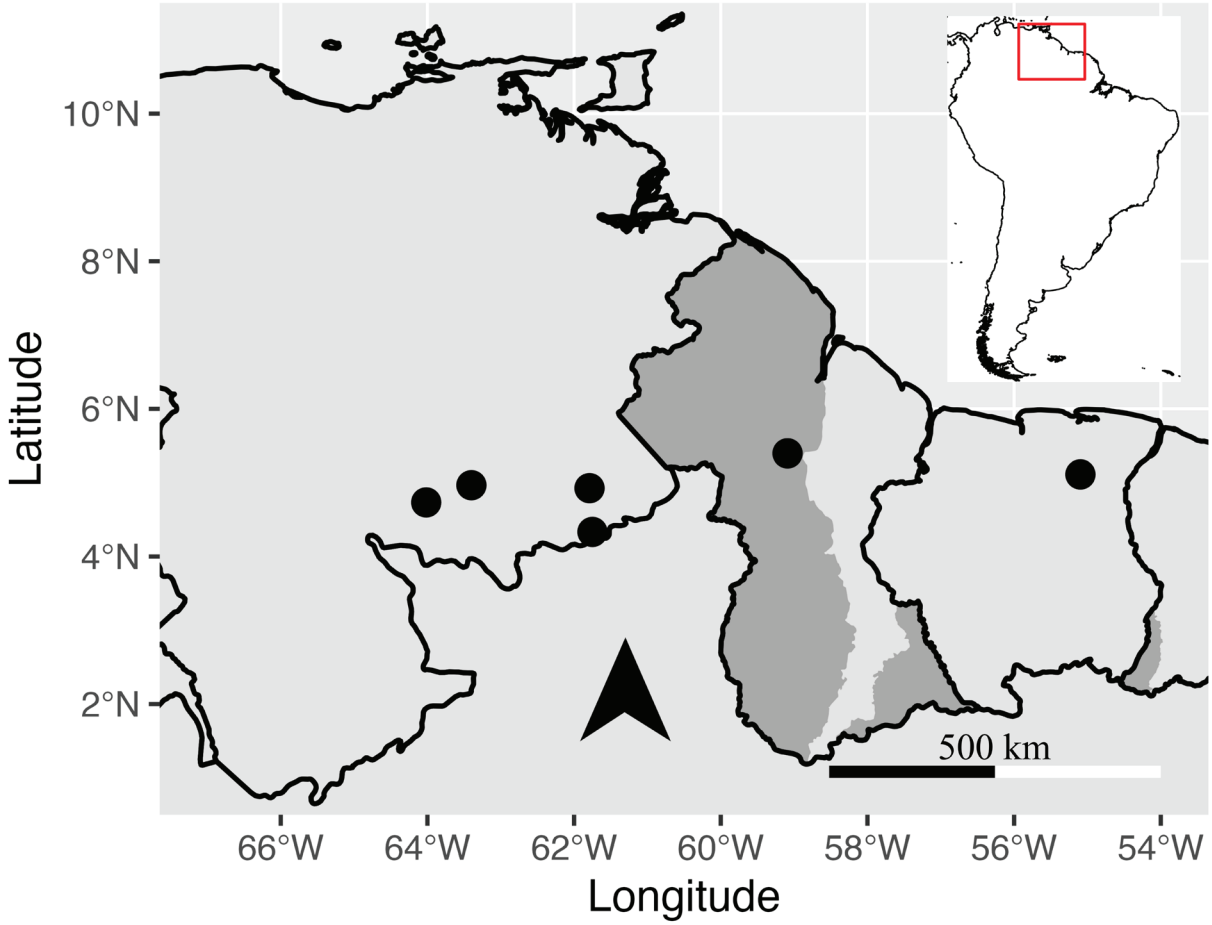

FIGURE 2. Distribution of *Smilax brevipedunculata* T. Murphy & S. M. Niño. Black dots indicate known localities based on herbarium specimens. Disputed territories are shown in dark grey.

The EOO, however, would not classify *S. brevipedunculata* under any of the threatened categories with an EOO>20,000 km^2. Under criterion for B2, *S. brevipedunculata* would fulfill, in part, the requirements for vulnerable status based solely on the number of known occurrences being six. However, there is no data to assess decline or fluctuations, so there is not enough data for the assessment under Criterion B2. Considering there are just six known populations, the most recent population was documented more than three decades ago, and the AOO indicates IUCN endangered status, *S. brevipedunculata* should be considered for conservation efforts and planning.

Phenology: A single specimen with mature fruit, the holotype (*Bernardi 6561* [NY]), was collected in April, and a single specimen with mature flowers was collected in November (*Field No. F1453/ Record No. 4189* [NY]). Three other specimens, *Donselaar 2983* (BBS, NY, U), *Stergios 12123* (MO, PORT, US), and *Fernández 4300* (PORT), bear immature flower buds and were collected in the months of January and April.

Additional specimens examined: Disputed Region Between Guyana and Venezuela. Bartica-Potaro Road, 107 m, 12/11/43, *Field No. F1453/ Record No. 4189* (NY [barcode 04204353]); Suriname. Brokopondo: between villages Afobaka and Brownsweg, high forest, 11 January 1966, *J. van Donselaar 2983* (BBS [accession 0031466], NY [barcode 04204340], U [photo; 2 sheets; barcodes 0072279 and 0072280]); Venezuela. Bolívar: región de los ríos Icabaru, Hacha y cordillera sin nombre a 280˚ de las cabeceras del Río Hacha, 450–850 mts s.n.m., selva pluvial o sabana natural, 23 diciembre 1955–15 de enero 1956, *A.L. Bernardi s.n.* (NY [barcode 04204341]); selvas ribereñas del Río Caura, aprox. 2 km abajo del Caño Guacamaya (Guaya), 04˚44'N 064˚01'W [4.7333333, -64.0166667], 13 al 26 de abril 1988, *Basil Stergios 12123* (MO [accession 05090734; barcode MO-1320221], PORT [accession 52666], US [barcode 00889871]); Municipio Raúl Leoni, bosque a 25 km al Norte del Macizo Ichun Alto Río Paragua, alt. 350 m.s.n.m., 04˚58'N 063˚24'W [4.966667, -63.400000], April 1988, *Ángel Fernández 4300* (PORT [accession 39226])

Smilax brevidpunculata has previously been confused with species that are documented in the Guiana Shield, including *S. jauaensis* Steyerm. & Maguire, *S. lasseriana*, *S. maypurensis* Humb. & Bonpl. ex Willd., *S. riedeliana* A. DC., and *S. siphilitica* Humb. & Bonpl. ex Willd. The species could be confused with the morphologically similar taxon, *S. magnifolia*, which is known from the Amazon of Peru. We focus our discussion on comparisons with *S. lasseriana* and *S. magnifolia*, which is also summarized in Table 1.

Smilax lasseriana has previously been treated as a morphologically variable taxon in herbaria. Gaskin and Berry (1998, 2005) included *S. lasseriana* as a heterotypic synonym of *S. staminea* Griseb. *Smilax staminea* is now accepted as a heterotypic synonym of *S. domingensis* Willd. (Ferrufino-Acosta, 2010). *Smilax lasseriana* is different from *S. domingensis* by the presence of two (vs. one) cataphylls at the base of lateral branches, verrucose-tuberculate (vs. smooth) stems, and shorter tepals (Murphy et al., in press). Additionally, phylogenetic relationships inferred from five plastid loci recover *S. domingensis* forming a clade with North American species, *S. laurifolia* Small and *S. smallii* Morong, and are distantly related to *S. lasseriana* and known close relatives (Murphy et al., in press). Considering the available morphological and molecular phylogenetic evidence, *S. lasseriana* should be recognized as a distinct species. *Smilax brevipedunculata* has been mistaken as *S. lasseriana*, probably due to the verrucose-tuberculate stems, coriaceous, lustrous leaves, and short peduncles. Taxonomic investigations are revealing that what has previously been determined as *Smilax lasseriana* represents multiple distinct species (Sipman, 1979; Murphy et al., in press). *Smilax lasseriana* has stems that possess verrucose-tuberculate projections that are conspicuously raised (vs. dense verrucose-tuberculate projections that are inconspicuously raised; Fig. 3A vs. 3B), leaves that are generally narrowly ovate to ovate with evenly tapered acute to obtuse apices (vs. short-acuminate to apiculate), leaves with tertiary veins conspicuously raised on the adaxial surface, forming a densely reticulate network (vs. with tertiary obscured and immersed, forming a lax reticulate network; Fig. 3D vs. 3E), receptacle shape ovoid (vs. reniform; Fig 3G vs. 3H), receptacle scales of stiff texture and apices acute (vs. papery texture and apices obtuse; Fig 3G vs. 3H), anthers that are of equal or almost equal length of filaments (vs. anthers of conspicuously shorter length than filaments; Fig. 3J vs. 3K).

Smilax brevipedunculata may also be confused with *S. magnifolia* because of its relatively short and wide peduncles, reniform receptacles (Fig 3G and 3I), and single basal cataphyll. *Smilax magnifolia* can be readily distinguished by multiple vegetative characters, including smooth stems (vs. lightly verrucose-tuberculate in *S. brevipedunculata*; Fig. 3A vs. 3C), leaves with tightly-spaced tertiary veins branching at a near-perpendicular to perpendicular angle from the midrib (vs. branching at distinctly acute angle in *S. brevipedunculata*; Fig. 3D vs. 3F), leaves with all vein orders conspicuous, and first lateral pair of secondary veins branching from the midrib above basal portion (vs. first lateral pair of secondary veins branching at the base of the midrib in *S. brevipedunculata*). The stems of *S. magnifolia* also differ in that they are subquandrangular, while stems of *S. brevipedunculata* are terete. Unfortunately, *S. magnifolia* flowers are not currently known, so we cannot make floral comparisons. The paucity of specimens with flowers is a recurring issue with neotropical *Smilax*, which would be ameliorated with further collecting efforts. *Smilax magnifolia* lacks a modern description, and appropriate circumscription of the species remains uncertain given the current lack of knowledge (T. Murphy, unpubl. data). *Smilax magnifolia* is known, with certainty, from the department of Loreto, Peru, mainly in the Maynas Province and one specimen examined from the Ucayali Province (*Valenzuela G. 35828* [MO]). Other specimens from Brazil, Peru, and Venezuela have been determined as *S. magnifolia* but may represent distinct but related species (T. Murphy, unpubl. data). Even when *S. magnifolia* and its allied segregates are considered for comparison with *S. brevipedunculata*, it remains morphologically diagnosable.

TABLE 1. Comparison of morphology, distribution, and habitat between *S. brevipedunculata* T. Murphy & S. M. Niño, *S. lasseriana* Steyerm., and *S. magnifolia* Macbr. sensu lato.

	SMILAX BREVIPEDUNCULATA	*SMILAX LASSERIANA*	*SMILAX MAGNIFOLIA*
Stem cross-section shape	Terete	Broadly quandrangular to quandrangular	Broadly quandrangular
Stem texture	Inconspicuously verrucose-tuberculate	Conspicuously verrucose-tuberculate	Smooth
Stem prickles[a]	Absent	Mostly absent, rarely present	Present
Number of cataphylls on axial side at base of branch	1	2	1
Leaf blade shape	Ovate to narrowly elliptic with short-acuminate to apiculate apex	Ovate to narrowly elliptic with rounded to acute apex	Narrowly oblong to narrowly elliptic with rounded to short-acuminate apex
Adaxial leaf surface	Higher order tertiary veins, reticulate, obscured, and immersed under blade surface	All veins conspicuously raised, forming a dense reticulate network	Higher order veins conspicuously raised, first-order tertiary veins branching from midrib at a near-perpendicular to perpendicular angle
Median (range in parentheses) number of first-order tertiary veins in middle 5 cm segment of leaf adaxial	4 (4–6)	3 (3–4)	10 (6–15)
Length between first-order tertiary veins on adaxial in middle	7.3–17.9 mm	12.2–28.0 mm	3.5–13.9 mm
Receptacle shape	Reniform, always wider than long	Broadly ovoid to globose	Reniform, always wider than long
Receptacle dimensions (length × width/length: width ratio)	2.2–6.2 mm × 4.0–10.8 mm/0.5–0.8	2.0–5.2 mm × 3.1–6.6 mm/0.5–1.1	8.0–13.0 mm × 13.0–17.0 mm/0.6–0.8
Receptacle scale texture and shape	Papery, rounded	Stiff, acute	Papery, rounded
Relative anther length	Shorter than filaments	Ca. as long as or longer than filaments	Unknown
Distribution/habitat	Guiana Shield/high, pluvial, and riverine forests	Guiana Shield/various but mainly lowland to upland forests associated with white sand	Amazon of Peru/lowland forest

[a] Stem prickles can be a problematic when comparing *Smilax* species because lower stems are often not well-collected or -documented (T. Murphy, pers. obs.), so what we describe here is based on limited data which is subject to change with additional fieldwork and documentation.

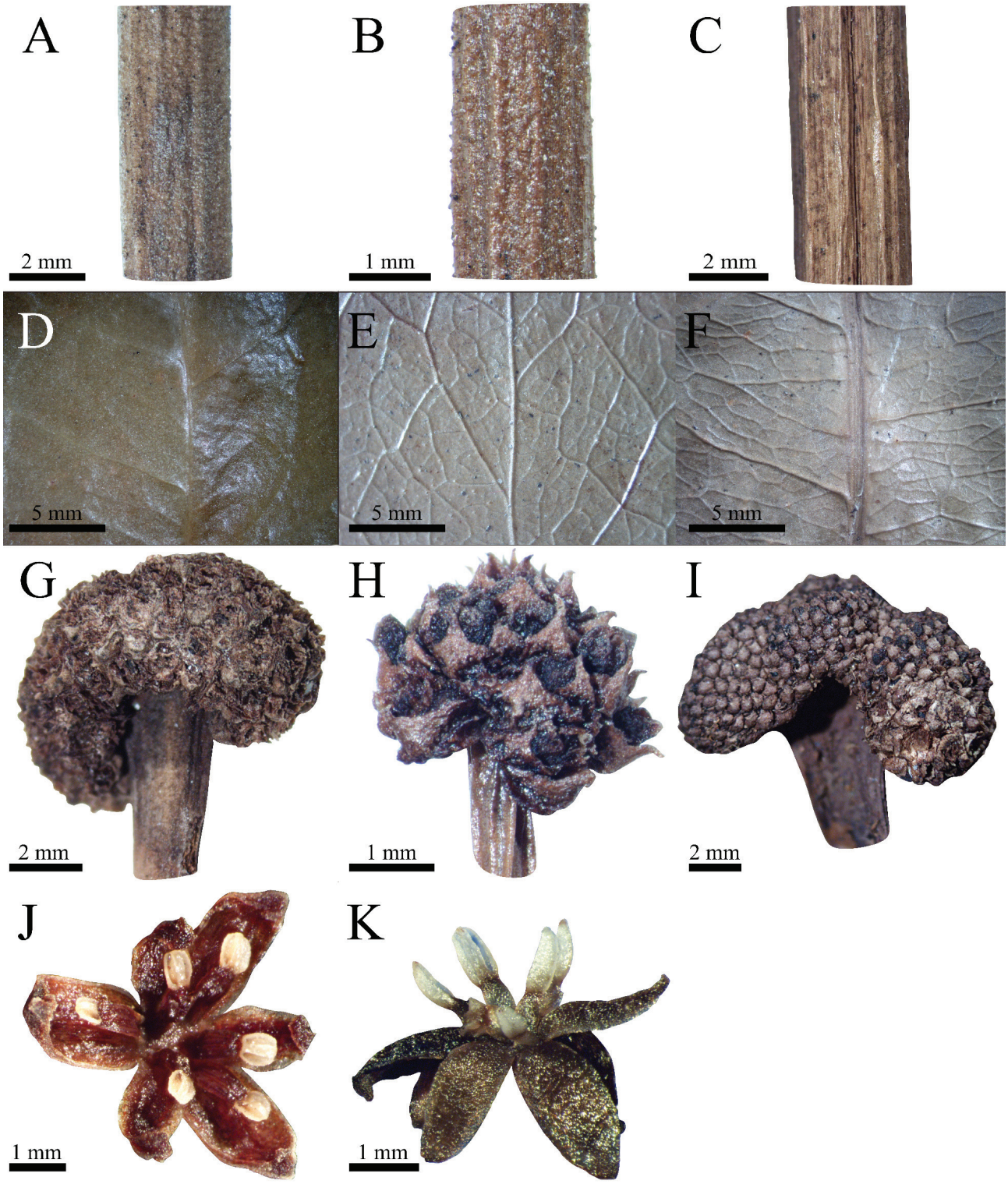

FIGURE 3. Comparison of key morphological features between *S. brevipedunculata* and morphologically similar species. Stems: **A–C**, leaf adaxial: **D–F**, receptacles: **G–I**, and staminate flowers: **J** and **K**. *Smilax brevipedunculata*: A, D, G, and J; *S. lasseriana* Steyerm.: B, E, H, and K; *S. magnifolia* Macbr.: C, F, and I. Note that photos of staminate flowers of *S. magnifolia* are not shown, because they are not known. A and G from *Bernardi s.n.* (NY); B from *Donselaar 2983* (MO); J from *Field No. F1453/ Record No. 4189* (NY); B and H from *Maas 3551* (NY); E from *Maas 3488* (NY); K from *Jansen-Jacobs 1029* (NY); C and I from *Ortiz 54* (MO); F from *Rimachi Y. 6503* (MO).

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