

# A new record and emended description of a rare Amazonian white-sand species: *Schoepfia clarkii* (Schoepfiaceae)

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**Abstract.** *Schoepfia clarkii* is a rare species of Schoepfiaceae that to date has been known only from the single flowering specimen used in the original description from white-sand vegetation in Venezuela. Here we report new records for this species collected from the lower Negro River basin in Brazil, ca. 900 km from the type locality, but also from white-sand vegetation. We provide a more detailed description of the species, including the first observations of fruit characters, as well as illustrations, photographs, a distribution map, and discussion of its conservation status. We also provide a key for the identification of the South American species of *Schoepfia*.

**Keywords:** Brazilian Amazon, hemiparasite, Santalales, Campinaranas, white-sand vegetation.

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Schoepfiaceae is a recently accepted family that has been segregated from the presumably non-monophyletic Olacaceae (Sleumer, 1984). It is actually more closely related to the hemiparasitic families Santalaceae and Misodendraceae (Malécot & Nickrent, 2008; APG IV, 2016). Molecular studies have shown that Schoepfiaceae comprises three genera: *Arjona* Cav. (6 spp., Andean region), *Quinchamalium* Molina (33 spp., Andean region) and *Schoepfia* (Der & Nickrent, 2008).

*Schoepfia* Schreb. comprises 24 species, 20 of which are Neotropical, the other four being disjunct in Southeast Asia (Sleumer, 1984; BFG, 2015). Root-parasitism has been reported in only one species of *Schoepfia* (Werth et al. 1979), but it may be expected in other species (Reed, 1955). In Brazil, *Schoepfia* is represented by three species, one of which is endemic, and occurs in different forest biomes including Amazonia, the Atlantic Forest, and the Caatinga (Sleumer, 1984; BFG, 2015).

*Schoepfia clarkii* Steyerf. was first described from the white-sand vegetation of Venezuela based on a single flowering specimen, and until recently it was known only from the type

collection (Steyermark, 1988). Here, we report the re-discovery of the species 30 years later in the lower drainage of the Negro River. We emend the description to include a complete description of fruit morphology, and provide new data on geographic distribution, ecology and conservation status, as well as a key to the species of *Schoepfia* that occur in South America.

## Material and methods

We conducted expeditions in 2018 to WSV in the Negro River Sustainable Development Reserve (Negro River SDR), Amazonas State, Brazil. The digital image of the type material of *Schoepfia clarkii* available on the Missouri Botanical Garden website (Tropicos, 2017) was essential for confirming the new occurrence of this species in Brazil. Specimens were analyzed with a dissecting stereomicroscope, and measured with a digital caliper. Morphological terms of vegetative and reproductive characters follow Sleumer (1984) and Steyermark (1988). We generated a distribution map for *S. clarkii* using R environment (R

Core Team 2017) with packages *prettymap* (Dunnington, 2017), and *rgdal* (Bivand et al., 2018). In order to determine the conservation status of *S. clarkii* according to IUCN categories and criteria (2012), we calculated the extent of occurrence (EOO) and area of occupancy (AOO) using R package *red* (Cardoso, 2017).

### Taxonomic treatment

***Schoepfia clarkii*** Steyerl. Ann. Missouri Bot. Garden 75: 1061–1062. 1988. Type: Venezuela. Amazonas: Mari's bana (low Amazon caatinga), 16 August 1987, H. L. Clark 8111 (holotype: MO barcode MO-204912). (Figs. 1 and 2)

*Shrub or tree* 2–7 m tall. *Leaf* blades narrowly lanceolate-elliptic, acute or subacute at apex, cuneate or acute at base,  $4.5\text{--}8.6 \times 1.2\text{--}2.8$  cm, glabrous, entire, costal secondary veins, 3–4 each side, petioles 2–4.5 mm, olive-green and dull when dry, drying black when preserved in alcohol. *Inflorescence* axillary, spiciform, solitary or geminate, simple, up to 7-flowered, 3–10 mm long; peduncle 2–3 mm long. *Flowers* sessile. Bract and bracteoles (epicalyx) more than half-way connate, forming a 3-lobed involucre,  $1.5\text{--}1.8 \times 1.5\text{--}1.6$  mm, narrowing to 0.9 mm wide at base, outside densely puberulent; 1 larger lobe broadly triangular-ovate, abruptly acute at apex,  $0.8 \times 0.9$  mm at the base; 2 smaller lobes narrower, broadly triangular, slenderly acuminate-attenuate,  $0.5 \times 0.4$  mm, tube of the epicalyx shallowly campanulate, 1 mm long, 1 mm broad at the apex, 0.6 mm broad at base. Corolla greenish yellow, cylindrical, the tube  $1.8\text{--}2 \times 1.6\text{--}1.8$  mm, glabrous on both surfaces except for a minute tuft of villous white hairs at the point of staminal insertion in the adaxial surface; lobes 4, distally reflexed, squarrose, broadly triangular-ovate, obtusely acute or subacute at the apex,  $1.2 \times 1.2$  mm. Stamens 4, subsessile, anthers

suborbicular,  $0.2 \times 0.3$  mm; filaments 0.2 mm long. Disk depressed-sub-globose, glabrous, annular,  $0.7 \times 1$  mm. Ovary inferior,  $0.8 \times 1.3$  mm at the truncate apex, narrowed at base to 0.3 mm wide. Style 1.8 mm long; stigma capitate,  $0.4 \times 0.7$  mm. Drupe ellipsoid, greenish fresh, drying black,  $7.5\text{--}8.5 \times 5.5\text{--}6.5$  mm.

*Distribution and habitat*.—*Schoepfia clarkii* was known only from the type collection from WSV (locally called “bana”) in the Upper Negro/Casiquire Rivers in Venezuela (Steyerl, 1988), but now it is also known to occur in WSV (locally called “campina”) in the Lower Negro River basin in Brazil. The habitat varies from open to low canopy (Figs. 3 and 4 A–B), where the common woody species are *Acmanthera minima*, *Aspidosperma verruculosum* Müll. Arg., *Pagamea coriacea* Spruce ex Benth., *Neea obovata* Spruce ex Heimerl and *Myrcia clusiifolia* (Kunth) DC. *Schoepfia clarkii* appears to be endemic to WSV from the Negro River basin in Venezuela (Steyerl, 1988; Funk et al., 2007; Berry et al., 2003) and Brazil.

*Phenology*.—The flowering type material was collected in August; the Brazilian specimens, including both flowering and fruiting material, were collected from April to June.

*Conservation status*.—*Schoepfia clarkii* is known in Venezuela only from the type collection and was reported as rare (Steyerl, 1988; MacDougal, 2003). It should be regarded as Critically Endangered [CR, B2ab(ii)] in Brazil, due to its AOO being  $<10$  km<sup>2</sup> (IUCN, 2017) and the continuous decline in the species' habitat by deforestation and white-sand mineral extraction (Anderson, 1981; Adeney et al., 2016). Although all Brazilian specimens were collected in the Negro River SDR, which is part of the Mosaic of Lower Negro River Protected Areas, the WSV in this conservation unit is currently under great anthropogenic pressure. (Fig. 4-C)

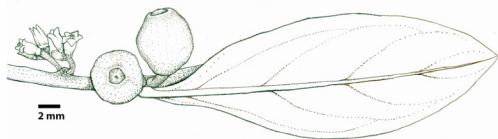
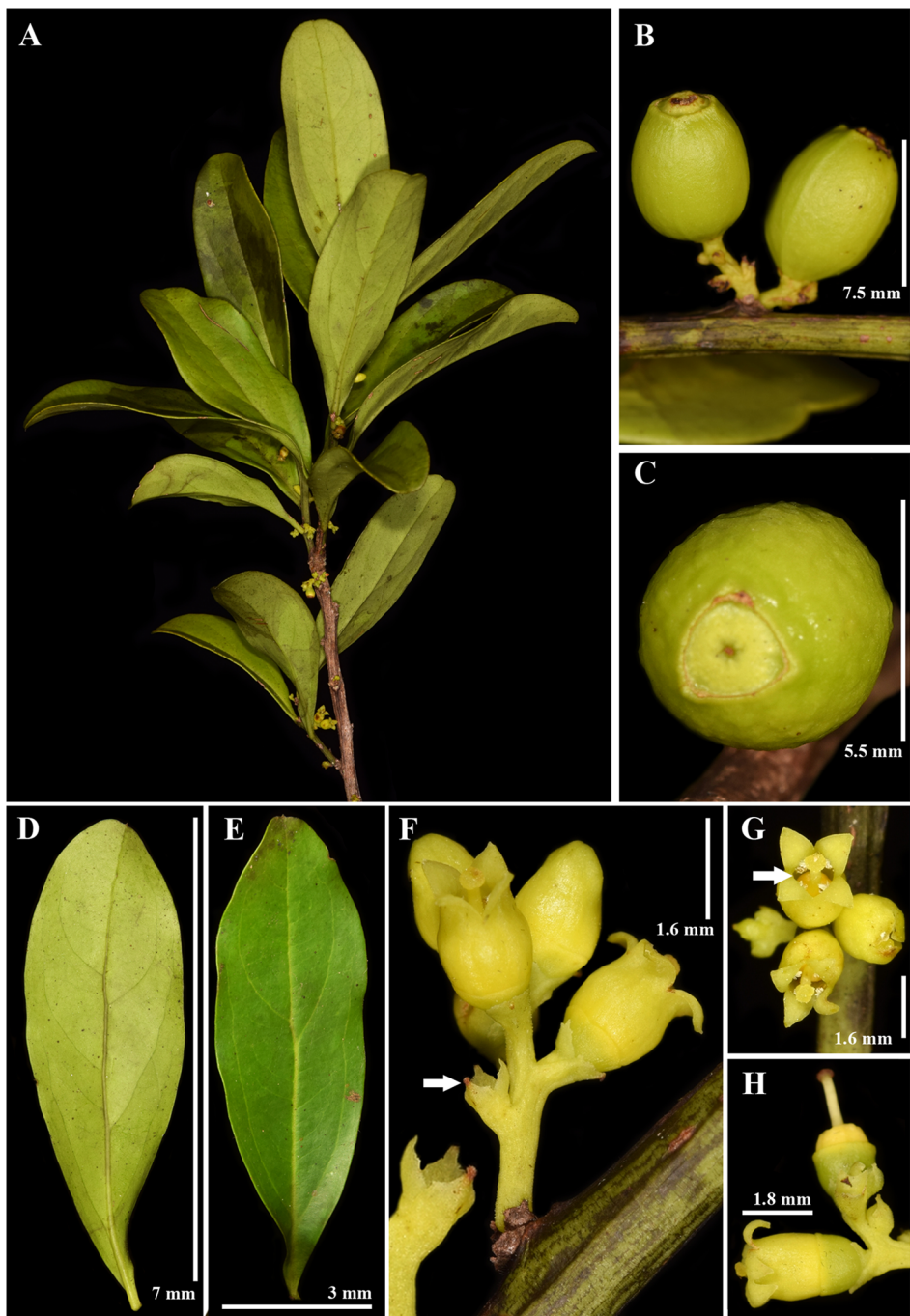


FIG. 1. Fertile branch of *Schoepfia clarkii*. (Based on Farroñay et al. 1002; drawing by Laura C. C. Leite.)

### Additional specimens examined. BRAZIL. Amazonas:

Mun. Iranduba, Negro River SDR,  $3^{\circ}2'44''\text{S}$ ,  $60^{\circ}43'41''\text{W}$ , 63 m, Apr 2018 [fl, fr] *F. Farroñay 1000* (INPA, RB, NY);  $3^{\circ}3'1''\text{S}$ ,  $60^{\circ}43'43''\text{W}$ , 65 m, Apr 2018 [fl, fr], *F. Farroñay 1001* (INPA, RB);  $3^{\circ}3'14''\text{S}$ ,  $60^{\circ}43'42''\text{W}$ , 62 m, May 2018 [fl, fr], *F. Farroñay et al. 1002* (INPA);  $3^{\circ}3'38''\text{S}$ ,  $60^{\circ}45'11''\text{W}$ , 60 m, June 2018 [sterile], *F. Farroñay et al. 1003* (INPA);



**FIG 2.** Field photographs of *Schoepfia clarkii*. **A.** Fertile branch. **B.** Lateral view of fruit. **C.** Frontal view of fruit. **D.** Leaf surface abaxial. **E.** Leaf surface adaxial. **F.** Inflorescence, showing the epicalyx (by the arrow) and the enlargement of this (left). **G.** Frontal view of flowers, showing minute puberulence on corolla tube (by the arrow). **H.** Detail of style and stigma (by the arrow). (From *F. Farroñay 1000*.)

3°3'41"S, 60°45'3"W, 65 m, May 2018 [fl], *F. Farroñay et al.* 1004 (INPA).

The genus *Schoepfia* in South America occurs in open forest or shrub vegetation at high and low

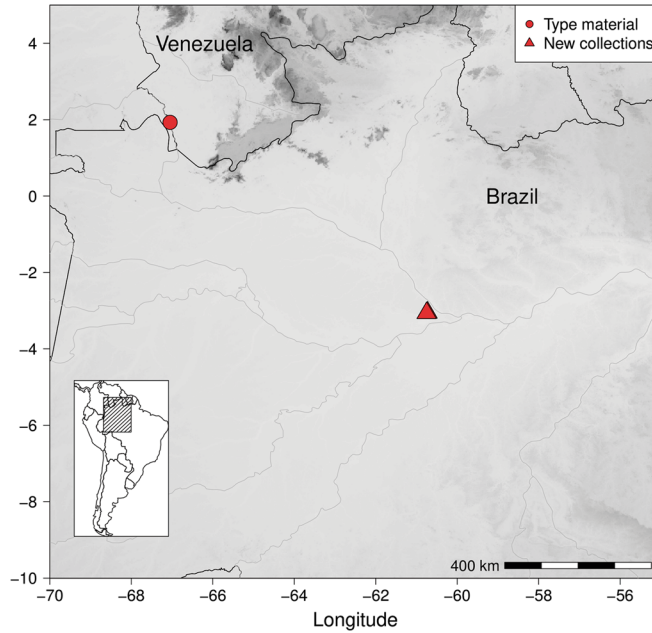


FIG. 3. Distribution map of *Schoepfia clarkii*

elevations; also, this lineage occurs in vegetation that develops on oligotrophic soils like the genus *Pagamea* Aubl. (Vicentini, 2016) and *Potalia* Aubl. (Frasier et al., 2008). *Schoepfia clarkii* is characterized by having small corollas with a short tube 1.8–2 mm long, bracts and bracteoles of the epicalyx connate to more than half of their lengths, and the leaf lamina narrowly elliptic. It is morphologically similar to *S. lucida* Pulle, but the latter has bracts and bracteoles of the epicalyx free

almost to the base, corolla 4–5 mm long, and fruits 12–15 × 9–10 mm. *Schoepfia clarkii* was not included in the list of vascular plant species that are WSV specialists (García-Villacorta et al., 2016); and its apparently disjunct distribution may be related to the long-distance dispersal capacity characteristic of many WSV plant species (Macedo, 1977; Macedo & Prance, 1978).

On other hand, the density of collections in the Amazon Basin is still very low (Hopkins, 2007),

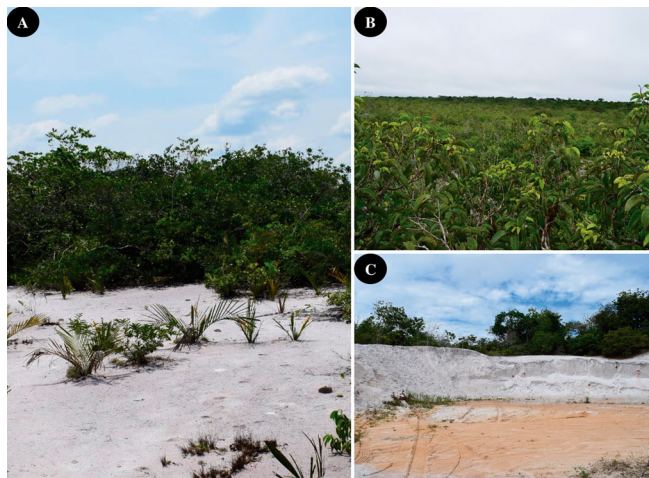


FIG. 4. Habitat of *Schoepfia clarkii*. A. Vegetation growing in white sandy soils. B. View of canopy WSV in the Negro River SDR. C. Mineral extraction of white sand near the Negro River SDR



and several plant species are represented only by the type material, as well as described from only one reproductive structure (bud, flower or fruit) (Nelson, 1990), which limits the delimitation of species and therefore the understanding of distribution patterns of species in WSV (Vicentini, 2004). This first record of *Schoepfia clarkii* for the Brazilian flora in the Lower Negro River, in

addition to expanding its geographical distribution, shows the importance of continuing with floristic studies in areas of Amazonian WSV. Finally, WSV is an important, unique and fragile component of Amazonian biodiversity that deserves special consideration in conservation efforts (Adeney et al., 2016; Fine & Bruna, 2016).

### Key to the species of *Schoepfia* in South America

1. Top of ovary and disk usually puberulous . . . . . *S. schreberi* J.F. Gmel.
1. Top of ovary and disk glabrous . . . . . 2
  2. Leaves persistently shortly-pubescent abaxially . . . . . *S. velutina* Sandwith
  2. Leaves glabrous on both sides . . . . . 3
    3. Inflorescence spicate, 5–8-flowered, with flowers scattered in groups of 2 or 3 along rachis, 5–15 mm long from base of peduncle to end of rachis . . . . . 4
      4. Flowers 1.8–2 mm long . . . . . *S. clarkii* Steyererm.
      4. Flowers > 3 mm long . . . . . 5
        5. Corolla 4–5 mm long; drupe 12–15 mm long . . . . . *S. lucida* Pulle
        5. Corolla 6–8 mm long; drupe 10–11 mm long . . . . . *S. flexuosa* (Ruiz & Pav.) Schult.
    3. Inflorescences with only of 2 or 3 flowers at or near apex of short (2–10 mm long) peduncle . . . . . 6
      6. Leaf venation prominulous on both sides of the lamina . . . . . *S. tepuiensis* Steyererm.
      6. Leaf venation inconspicuous on both sides of the lamina . . . . . 7
        7. Corolla 4–5 mm long . . . . . *S. tetramera* Herzog
        7. Corolla 6 mm long . . . . . *S. brasiliensis* A. DC.

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