

# Some distinctive new species of *Psychotria* (Rubiaceae, Psychotrieae) from Madagascar

Charlotte M. Taylor, Roy E. Gereau & Heidi H. Schmidt

## Abstract

TAYLOR, C.M., R.E. GEREAU & H.H. SCHMIDT (2020). Some distinctive new species of *Psychotria* (Rubiaceae, Psychotrieae) from Madagascar. *Candollea* 75: 159–182. In English, English and French abstracts. DOI: <http://dx.doi.org/10.15553/c2020v752a1>

*Psychotria* L. (Rubiaceae, Psychotrieae) is an unusually species-rich genus in Madagascar. Recent botanical explorations here have found a number of undescribed species, and some unusual morphological structures for this genus. Here ten new *Psychotria* species from Madagascar are formally described: *Psychotria ambatovensis* C.M. Taylor, *Psychotria antilahimenae* C.M. Taylor, *Psychotria birkinshawiana* C.M. Taylor, *Psychotria davisiana* C.M. Taylor, *Psychotria eumachioides* C.M. Taylor, *Psychotria hamifera* C.M. Taylor, *Psychotria mutabilis* C.M. Taylor, *Psychotria notopleuroides* C.M. Taylor, *Psychotria palifera* C.M. Taylor, and *Psychotria razafimandimbisonii* C.M. Taylor. Unusual morphological features of some of these species include a prostrate habit, deeply retuse leaves, and enlarged, persistent, funnelform stipules. Assessment of the conservation status of these using IUCN Red List categories finds four of them “Vulnerable” and six “Endangered”.

## Résumé

TAYLOR, C.M., R.E. GEREAU & H.H. SCHMIDT (2020). Quelques nouvelles espèces remarquables du genre *Psychotria* (Rubiaceae, Psychotrieae) à Madagascar. *Candollea* 75: 159–182. En anglais, résumés anglais et français. DOI: <http://dx.doi.org/10.15553/c2020v752a1>

*Psychotria* L. (Rubiaceae, Psychotrieae) est un genre exceptionnellement riche en espèces à Madagascar. Des explorations botaniques récentes y ont trouvé un certain nombre d'espèces non décrites et des structures morphologiques inhabituelles pour ce genre. Dix nouvelles espèces de *Psychotria* de Madagascar sont formellement décrites: *Psychotria ambatovensis* C.M. Taylor, *Psychotria antilahimenae* C.M. Taylor, *Psychotria birkinshawiana* C.M. Taylor, *Psychotria davisiana* C.M. Taylor, *Psychotria eumachioides* C.M. Taylor, *Psychotria hamifera* C.M. Taylor, *Psychotria mutabilis* C.M. Taylor, *Psychotria notopleuroides* C.M. Taylor, *Psychotria palifera* C.M. Taylor et *Psychotria razafimandimbisonii* C.M. Taylor. Les caractéristiques morphologiques inhabituelles de certaines de ces espèces comprennent un port prostré, des feuilles profondément rétuses et des stipules en forme d'entonnoir agrandies et persistantes. L'évaluation du statut de conservation de ces espèces en utilisant les catégories de la Liste Rouge de l'UICN montre que quatre espèces sont «Vulnérables» et six «En danger».

## Keywords

RUBIACEAE – Psychotrieae – *Psychotria* – Madagascar – New species

---

Address of the authors:

Missouri Botanical Garden, 4344 Shaw Blvd., St. Louis MO 63116, USA. E-mail: [charlotte.taylor@mobot.org](mailto:charlotte.taylor@mobot.org)

Submitted on May 19, 2019. Accepted on August 20, 2020.

First published online on October 29, 2020.

ISSN: 0373-2967 – Online ISSN: 2235-3658 – *Candollea* 75(2): 159–182 (2020)

© CONSERVATOIRE ET JARDIN BOTANIQUES DE GENÈVE 2020

## Introduction

*Psychotria* L. is one of the most species-rich genera in Madagascar (G. Schatz, pers. comm.). The genus was recently reviewed taxonomically and morphologically there by TAYLOR (2020), who gave an overview of pertinent taxonomic and molecular study of this genus and its tribe. She also noted that recent botanical exploration has found additional species that are new to science. Several of these have morphological features that are uncommon in *Psychotria* and/or Madagascar, as discussed in more detail there. Several of these new species are described here, and additional new species will be described later (Taylor, in prep.).

*Psychotria* (Rubiaceae, *Psychotrieae*; i.e., *Psychotria* s.s.; ANDERSSON, 2002) is a pantropical genus that comprises 1500+ species of shrubs and small trees found in seasonal to wet tropical vegetation of the Americas, Africa, Madagascar, Asia, Australia, and Pacific Islands (RAZAFIMANDIMBISON et al., 2014). Study of *Psychotria* in recent years shows that this unusually large genus is systematically complicated and morphologically diverse (TAYLOR, 1996; NEPOKROEFF et al., 1999; ANDERSSON & ROVA, 1999; ANDERSSON, 2002; RAZAFIMANDIMBISON et al., 2014; BARRABÉ et al., 2014). *Psychotria* is characterized by its perennial, nearly always woody habit; tissues with raphides; usually deciduous, often bilobed stipules; basically terminal, cymose inflorescences; four-merous or usually five-merous distylous flowers; corollas with valvate aestivation; usually bilocular ovaries with a single basal ovule in each locule; and drupaceous fruits with usually two pyrenes that have an alcohol-soluble pigment in their wall and lack preformed germination slits (PGS's). Additionally, the stem nodes usually have a ring of persistent colleters that are visible after the stipules have fallen, and dried specimens of *Psychotria* usually have a distinctive reddish-brown or gray tinge (though they also often dry green; TAYLOR, 2020).

Ten distinctive new *Psychotria* species from Madagascar are described here, to document the morphological variation found in this group on this single island. The content provided here for these each species presents formal nomenclatural and morphological descriptions, diagnostic line drawings, data corresponding to the specimens studied of these species, conservation assessments using the IUCN Red List format based on the specimens studied, an overview of habitat and phenology, an explanation of the basis for first author's personal choice for the epithet, notes on distinctive and peculiar morphological characters and ecology, the putative placement of the species in BREMEKAMP's (1963) classification of this group, an outline of similar species that can easily be confused, and selected photographs of some species.

## Methods

This work is based on standard herbarium techniques. Additional information is available online in the RUBIACEAE

PROJECT (2020), including specimen data and maps, high-resolution specimen scans, and notes on ecology and identification. The new species are presented in alphabetical order because the species groups that BREMEKAMP (1963) distinguished in Western Indian Ocean *Psychotria* are not clearly distinct (TAYLOR, 2020), but the putative group assignment in his classification is indicated because his treatment is often useful for identification. Some of these new species are most similar to other *Psychotria* species that do not, however, fall in the same group of Bremekamp; these similar species are noted and contrasted in the discussion because of their similarity, and because Bremekamp's groups are probably not natural and those similar species may actually be closely related. Duplicate specimens that are reportedly deposited at institutions other than MO are cited here based on collection management records, but those have not seen in this study and are not confirmed to be conspecific with the duplicates that have been studied.

Morphological terminology follows LAWRENCE (1951) for general features, TAYLOR (2006, 2012) for characteristic features of *Psychotria*, and ROBBRECHT (1988) with regard to the contracted inflorescence form of *Psychotria* being subcapitate rather than genuinely capitate. As with most *Rubiaceae*, the flowers here have bilocular ovaries and the "merosity" noted applies to the calyx, corolla, and anthers. Measurements describe length unless otherwise specified, and those of particular structures are given in the same units consistently to facilitate comparison. Some terminology that has varied among authors is defined the first time it is used. The fruit measurements presented here are based on dried specimens so these basically describe the size of the pyrenes that the fruits contain, unless otherwise stated.

The descriptions here mostly follow those of BREMEKAMP (1963) to facilitate comparison with that work. Some of his structures are re-ordered here, however, to follow modern format (e.g., base of the leaf blade is described before apex), but others continue to follow his sequence (i.e., stipules follow the other parts of the leaf, as in many *Rubiaceae* treatments of the last 60 years; e.g., TAYLOR, 2012). Some additional characters are also included in the descriptions here because they have been taxonomically useful in other, more recent studies of *Psychotria* (e.g., order of inflorescence branching, detailed arrangement of the flowers, the hypanthium as a separate structure from the calyx limb, shape of the overall corolla and of its lobes; TAYLOR, 2012). Several other characters described by Bremekamp are not detailed here. Some are omitted because they are generally variable within *Psychotria* species and not reliable to characterize or separate them: for example, length and diameter of the stem internodes depend in large part on the developmental stage and environmental conditions, and color of the dried leaves varies at least in part with how the specimen was prepared and conserved. Bremekamp also described the pollen for the species he studied, but detailed documentation of this is beyond the scope of this present study, and generalized pollen

descriptions at the level he presented are of limited taxonomic significance. *Psychotria* pollen is generally similar across most of the genus, with little taxonomic or systematic diversity so far documented (PETIT, 1964; PLESSCHAERT, 2001); pollen size often varies in size and ornamentation within species, and even within the same anther (JOHANSSON, 1992). Notes about similar species and their separation are provided to aid the identification of these species because there is no current comprehensive treatment of *Psychotria* in Madagascar.

The conservation assessments here are authored by REG and HHS. Synoptic assessments are presented here with the protected areas all grouped together in one class as “PA”; full assessments that identify protected areas by category, to relate them to IUCN protected area management categories (DUDLEY, 2008; SHADIE et al., 2013) and other published information on protected areas in Madagascar (GOODMAN et al., 2018), are available in the supplemental materials in the RUBIACEAE PROJECT (2020).

## Taxonomy

*Psychotria ambatovens* C.M. Taylor, **sp. nov.** (Fig. 1A–F).

**Holotypus:** MADAGASCAR. **Reg. Alaotra-Mangoro [Prov. Toamasina]:** Moramanga, Ambohibary, Ampitambe, 18°50'17"S 48°15'44"E, 975 m, 24.II.2009, *Andriamiarinoro et al.* 164 (MO-6416482!; iso-: P, TAN).

*Psychotria ambatovens* C.M. Taylor is distinguished from *P. macrochlamys* (Bremek.) A.P. Davis & Govaerts by its smaller leaves, subsessile subcapitate inflorescences, and calyx limbs that are pubescent externally (i.e., abaxially).

*Shrubs* and small *trees*, collected in flower at 2–6 m tall, branched; stems flattened, smooth or with shallow medial channel, densely hirtellous with trichomes 0.3–1.2 mm. *Leaves* opposite; *petiole* 0.3–1.8 cm, densely hirtellous with trichomes 0.3–1.2 mm; *blade* obovate to elliptic, 1.5–6.5 × 0.8–5 cm, at base acute to obtuse or rounded, at apex obtuse to rounded, truncate, or shallowly retuse, drying chartaceous to subcoriaceous, adaxially weakly bullulate to plane, shiny, and glabrous, abaxially densely hirtellous with trichomes 0.3–1.2 mm; secondary veins 4 to 10 pairs, looping to interconnect near margins, apparently without domatia, without intersecondary veins or sometimes with 1 short vein arising from costa between a pair of secondary veins, adaxially costa and secondary veins impressed, tertiary venation plane to impressed or thinly prominulous, and remaining venation not visible, abaxially costa and secondary veins prominent and loosely reticulated tertiary and quaternary venation prominulous. *Stipules* calyptrate, caducous, in bud fully fused into a conical or ovoid cap, 6–18 mm, acute at top, splitting along 1 or 2 sides then separating from stem at base, abaxially (i.e.,

externally) densely hirtellous with trichomes 0.3–1.2 mm, adaxially (i.e., internally) densely to sparsely hirtellous with trichomes 0.5–1.5 mm. *Inflorescences* terminal, subcapitate, subsessile, subglobose, 3- to 7-flowered, initially enclosed by a calyptrate, caducous stipule 10–18 mm; bracts 2 or 4, stipuliform, 4–6 mm. *Flowers* all subsessile, at base surrounded by dense ring of pilose or strigose trichomes 1–2 mm, 4-, 5-, or 6-merous; hypanthium cylindrical to ellipsoid, 1–1.5 mm, densely strigose to hirtellous with trichomes 0.5–1.5 mm; *calyx* limb c. 2 mm, externally hirtellous to strigose with trichomes 1–1.5 mm, internally glabrous, lobed for  $\frac{1}{4}$ – $\frac{1}{2}$  of its length, lobes narrowly triangular to linear; *corolla* funnellform, yellow, externally glabrous or moderately to densely strigose on top part of tube and base of lobes with trichomes 0.5–1 mm, tube 4.5–5 mm, c. 1.5 mm diam. near middle, internally glabrous except densely tomentulose with trichomes 0.3–0.5 mm at top of tube (i.e., in throat), lobes narrowly triangular, 2–2.5 mm, acute, adaxially shortly galeate, abaxially with rounded thickening near apex; *stamens* with filaments c. 1 mm, inserted in uppermost part of tube, anthers oblong, c. 0.8 mm, exerted; *style* and *stigma* not seen. *Infructescences* similar to inflorescences. Young *fruits* ellipsoid, c. 6 × 5 mm, densely strigose to hirtellous with trichomes 1–1.5 mm, with calyx often enlarging, to 4 mm, when mature not seen but reportedly orange to red; *pyrenes* hemispherical, adaxially plane, abaxially apparently smooth; *endosperm* deeply and densely ruminate on all sides.

*Habitat, distribution, and phenology.* – *Psychotria ambatovens* has been collected in humid evergreen forest at 974–1180 m in east-central Madagascar (Toamasina), with flowers in February and March, and with fruits in July.

*Conservation status.* – *Psychotria ambatovens* is known from five specimen collections representing five unique occurrences in humid evergreen forest. Two occurrences are within the mine footprint of the Ambatovy nickel-mining project, and have been removed from the dataset for the calculation of assessment parameters. The Extent of Occurrence (EOO) of the species is 18 km<sup>2</sup>, within the limits for “Critically Endangered” under IUCN Red List Criterion B1; and the Area of Occupancy (AOO) is 12 km<sup>2</sup>, within the limits for “Endangered” under Criterion B2 (IUCN, 2012). One occurrence is within the well-protected Mantadia Protected Area (PA), and the other four occurrences are in areas to the west of the Park: three in Analamay Forest (with one label indicating “conservation zone”), and one in a “degraded forest patch” at Ankoditrazo. Forested areas without formal protection in the vicinity of Mantadia PA are subject to degradation by small-scale slash and burn agriculture (GOODMAN et al., 2018). Two of the sites within Analamay Forest are within the mine footprint of the Ambatovy nickel-mining project, while the third is within the adjacent conservation zone. After removal of the two collection

sites on the mine footprint, which have already been destroyed, three locations (sensu IUCN, 2012; see also IUCN, 2019) can be defined relative to the known threats: the degraded site at Ankoditrazo; the one protected site within the Ambatovy conservation zone; and the one protected site within Mantadia PA. With three locations, given general habitat degradation in unprotected sites with the westernmost location at Ankoditrazo likely to disappear in the near future, causing a decline in EOO, AOO, number of locations, and number of mature individuals, the Red List status of *P. ambatovens* is assessed as “Endangered” [EN B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v)].

**Notes.** – *Psychotria ambatovens* is characterized by the combination of its dense hirtellous to hirsute pubescence on both vegetative and reproductive structures; relatively small obovate leaf blades that are obtuse to truncate at the tip; caducous calyptrate stipules; subsessile, subcapitate, few-flowered inflorescences; lobed, rather well developed calyx limbs; rather small yellow corollas; rather small fruits; and endosperm that is ruminant on both surfaces. The plants dry with a dark brown or reddish brown color, with the dried trichomes deeply reddish brown to brown. The leaves are often weakly bullulate. This species apparently lacks acarodomatia on the leaves, although the dense pubescence of the abaxial vein axils may have this function. The flowers seen have variously four to six lobes and anthers, with the number apparently consistent on an individual plant. The few flowers seen agree with the short-styled form of distylous *Psychotria* species, but whether this species is distylous is not yet known. The fruits seen appear to be young, and the smooth young pyrenes of some species develop ridges as they mature (TAYLOR, 2020) and this is a possibility here. The characters of *P. ambatovens* place this in BREMEKAMP (1963)’s *Mapouria* Group VI. Its calyptrate stipules are supposedly anomalous in his group but were actually overlooked in several of its species, including *P. macrochlamys* (Bremek.) A.P. Davis & Govaerts (TAYLOR, 2020).

*Psychotria ambatovens* is similar to *P. macrochlamys*, which differs in its larger leaf blades 8–22 × 4.5–17 cm, fasciculate to pedunculate, branched inflorescences, and calyx limbs that are glabrous externally. *Psychotria ambatovens* is also similar in aspect to *P. reducta* Baker, which differs in its glabrous to sparsely hirtellous stems and leaves, leaf blades with regularly developed acarodomatia, interpetiolar, bilobed, shorter stipules 3–5 mm long, and pedunculate branched inflorescences.

**Paratypes.** – MADAGASCAR. **Reg. Alaotra-Mangoro [Prov. Toamasina]:** Moramanga, Andasibe, Ambatovy, forêt d’Analamay, 18°49’21”S 48°20’07”E, 3–5.II.2005, *Andriatsiferana et al.* 2531 (MO, P, TAN); *ibid. loco*, 18°48’38”S 48°20’41”E, 1151 m, 27.VI.2008, *Antilahimena et al.* 6408 (MO, P, TAN); *ibid. loco*, 18°49’13”S 48°20’06”E, 1180 m, 2.II.2005, *Razafindraibe & Antilahimena* 7 (MO, P, TAN); Mantadia National Park, 18°49’03”S 48°26’03”E, 1080 m, 1.III.2011, *Razafimandimbison et al.* 1095 (MO, S).

***Psychotria antilahimena* C.M. Taylor, sp. nov.** (Fig. 2A–E).

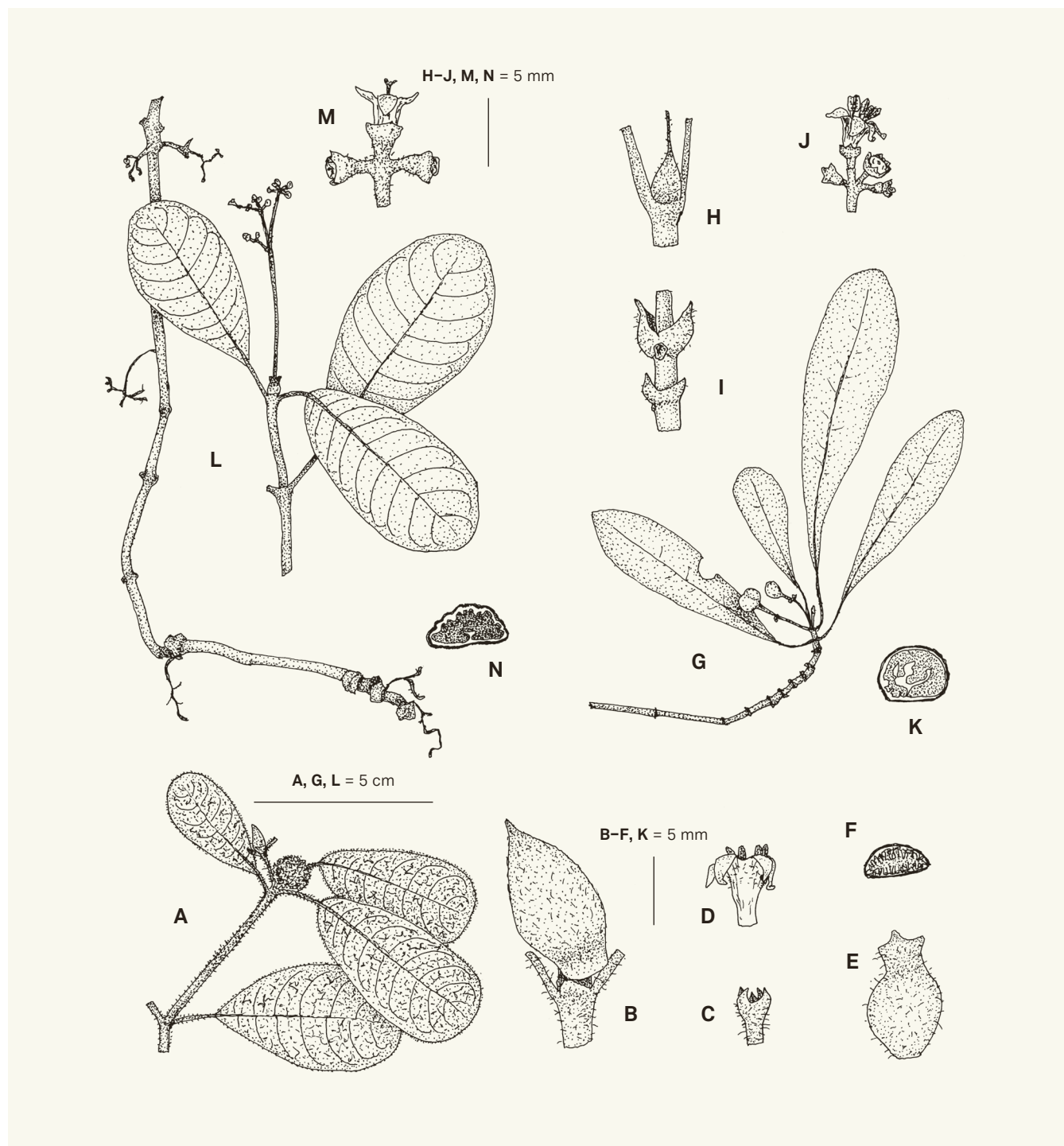
**Holotypus:** MADAGASCAR. **Reg. Analanjirofo [Prov. Toamasina]:** Nosy Mangabe, 15°50’S 49°46’E, 0–330 m, 10.X.1987, *Schatz 1619* (MO-3586737!; iso-: K, P, TAN).

*Psychotria antilahimena* C.M. Taylor is distinguished from *P. simianensis* A.P. Davis & Govaerts by its 5-merous flowers, longer calyx, and white corollas.

*Shrubs*, collected in flower and fruit variously at 0.3–1.5 m tall, unbranched (i.e., monopodial), sometimes accumulating detritus along stem inside leaf bases; stems flattened to subterete, smooth, glabrous. *Leaves* opposite; *petiole* 0.2–1 cm, glabrous or puberulous with trichomes 0.1–0.2 mm; *blade* obovate to oblanceolate, 18–35 × 4–14.5 cm, at base tapered then acute to obtuse, at apex obtuse to rounded then shortly abruptly acuminate with tip 3–10 mm, drying papery to chartaceous, adaxially glabrous, abaxially glabrous or occasionally densely puberulous on costa with trichomes up to 0.1 mm; secondary veins 14 to 20 pairs, looping to interconnect near margins, without domatia, on both surfaces costa prominent, secondary veins prominulous, and remaining venation plane and not evident or sometimes one intersecondary vein evident between pairs of secondary veins and infrequently some tertiary venation evident and prominulous. *Stipules* interpetiolar, caducous, triangular, c. 25 mm, acute, abaxially glabrous and costate, adaxially glabrous. *Inflorescences* terminal, subcapitate to congested-cymose, pedunculate, glabrous; peduncle 1–5 cm; flower-bearing portion hemispherical to irregularly subglobose, 1–3 × 1.5–3 cm, unbranched or shortly branched to 1 order, 20- to 140-flowered; bracts reduced or few, ovate, 0.5–1 mm; pedicels 1–2 mm. *Flowers* all pedicellate in cymes of 3- to 7, 5-merous; hypanthium narrowly ellipsoid, c. 1 mm, glabrous; *calyx* limb 1–1.2 mm, glabrous, denticulate or lobed for up to 1/3 of its length, lobes narrowly triangular, acute; *corolla* tubular, white, externally glabrous, tube c. 3 mm, c. 1.2 mm diam. near middle, internally glabrous except pilose in throat with white trichomes 1–1.5 mm, lobes narrowly triangular, c. 2.5 mm, acute, adaxially plane to shortly galeate, abaxially smooth; *stamens* with filaments c. 1 mm, inserted near top of corolla tube, anthers narrowly oblong, 1–1.2 mm, exserted; *style* c. 2 mm, *stigmas* c. 0.8 mm, included. *Infructescences* similar to inflorescences or becoming laxer, to 4 × 4 cm. *Fruits* ellipsoid to subglobose, 8–9 × 7–8 mm, glabrous, red, with calyx often enlarging, to 2 mm; *pyrenes* hemispherical, adaxially plane, abaxially with c. 6 well developed, rounded, longitudinal ridges; *endosperm* sparsely ruminant to a moderate depth on all sides.

**Etymology.** – This distinguished, handsome species has been documented by Mr. Patrice Antilahimena, an exceptionally productive explorer of Madagascar’s flora who has collected more than 11,000 high-quality specimens, and the species epithet honors him.





**Fig. 1.** – *Psychotria ambatovensensis* C.M. Taylor: **A.** Flowering branch; **B.** Stem apex with bases of two petioles and stipules in process of dehiscence; **C.** Hypanthium and calyx limb of flower; **D.** Corolla at anthesis; **E.** Fruit; **F.** Cross-section of pyrene and seed.

*Psychotria eumachioides* C.M. Taylor: **G.** Fruiting branch; **H.** Stem apex with stipule and basal part of two petioles; **I.** Portion of stem below leaves with two nodes, stipules (upper node), and stipule scar (lower node); **J.** Portion of inflorescence with three flowers from which corollas have fallen and one flower at anthesis; **K.** Cross-section of pyrene and seed.

*Psychotria notopleuroides* C.M. Taylor: **L.** Flowering stem and part of basal prostrate stem; **M.** Portion of inflorescence with two flower buds and one flower at anthesis; **N.** Cross-section of pyrene and seed.

[**A–D:** Andriamiarinoro 164; **E–F:** Antilahimena 6408; **G, K:** Rabehevitra 1059; **H–J:** De Block 1172; **L:** Schatz et al. 3666; **M:** Labat & Andrianjafy 3377; **N:** Zjhra & Hutcheon 378]

**Habitat, distribution and phenology.** – *Psychotria antilahimenae* has been collected in perhumid evergreen forest at 0–600 m on the Masoala Peninsula in northeastern Madagascar (Antsiranana, Toamasina), with flowers in February, October, and November and with fruits in April through July.

**Conservation status.** – *Psychotria antilahimenae* is known from 11 specimen collections representing nine unique occurrences in perhumid evergreen forest. The EOO of the species is 2,407 km<sup>2</sup>, within the limits for “Endangered” under IUCN Red List Criterion B1; and the AOO is 32 km<sup>2</sup>, also within the limits for “Endangered” under Criterion B2 (IUCN, 2012). One occurrence is within the well-protected Masoala PA, two occurrences are within Nosy Mangabe PA, and the other six occurrences are in unprotected areas adjoining but distinctly outside Masoala PA and Makira PA. Forested areas without formal protection in the vicinity of Masoala PA and Makira PA are subject to degradation by small-scale slash and burn agriculture and mineral exploitation (GOODMAN et al., 2018). Six locations (sensu IUCN, 2012) can be defined relative to the known threats: the one collection site within Masoala PA; the two collection sites within Nosy Mangabe PA; the three collection sites near Ambanizana just west of Masoala PA; and one location for each of the collection sites to the northeast and northwest of Masoala PA and near the east edge of Makira PA. With six locations, given general habitat degradation in unprotected sites and with no reason to assume that any of the unprotected sites is more likely to disappear than the others, the Red List status of *P. antilahimenae* is assessed as “Vulnerable” [VU B1ab(iii)+2ab(iii)].

**Notes.** – *Psychotria antilahimenae* is characterized by its unbranched or little-branched habit with well developed, subsessile to shortly petiolate, obovate leaves; pedunculate, subcapitate to shortly cymose inflorescences; five-merous flowers; somewhat short, subtruncate to dentate calyx limbs; short white corollas; red fruits; abaxially ridged pyrenes; and endosperm that is ruminant on all surfaces. The habit of this species is found in only a small percentage of *Psychotria* species worldwide, and has sometimes been called a “trash bucket” habit due to the detritus that is accumulated along the stems by the closely set leaves. No adventitious roots were seen along the stems in the specimens studied here, but these are sometimes found growing into the accumulated detritus in other “trash bucket” species. The inflorescences and infructescences are terminal on all the specimens studied, but one well developed axillary bud subtends the infructescence of one collection (*Zjhra* & *Hutcheon* 318): the unbranched stem may at least sometimes continue its growth from this position, so the plants may be able to flower and fruit more than once. In contrast, another specimen (*Zjhra* & *Hutcheon* 174) bears two peduncles from the stem apex, so some plants may have determinate stems, or

be able to branch. The flowers are described on one collection (Lowry et al. 4243) as having an “unpleasant odor suggesting fly pollination”; however, the flowers have showy (though small), bright white corollas with barbate throats and exerted anthers that are not usually suggested to be correlated with fly-pollination. The few flowers seen agree with the short-styled form of distylous *Psychotria* species, but whether this species is distylous is not yet known. The flowers are pedicellate at anthesis but usually borne in short congested groups, then later the inflorescence axes develop and the fruits become separated from each other as they mature. *Psychotria antilahimenae* agrees with BREMEKAMP (1963)’s *Mapouria* Group VI.

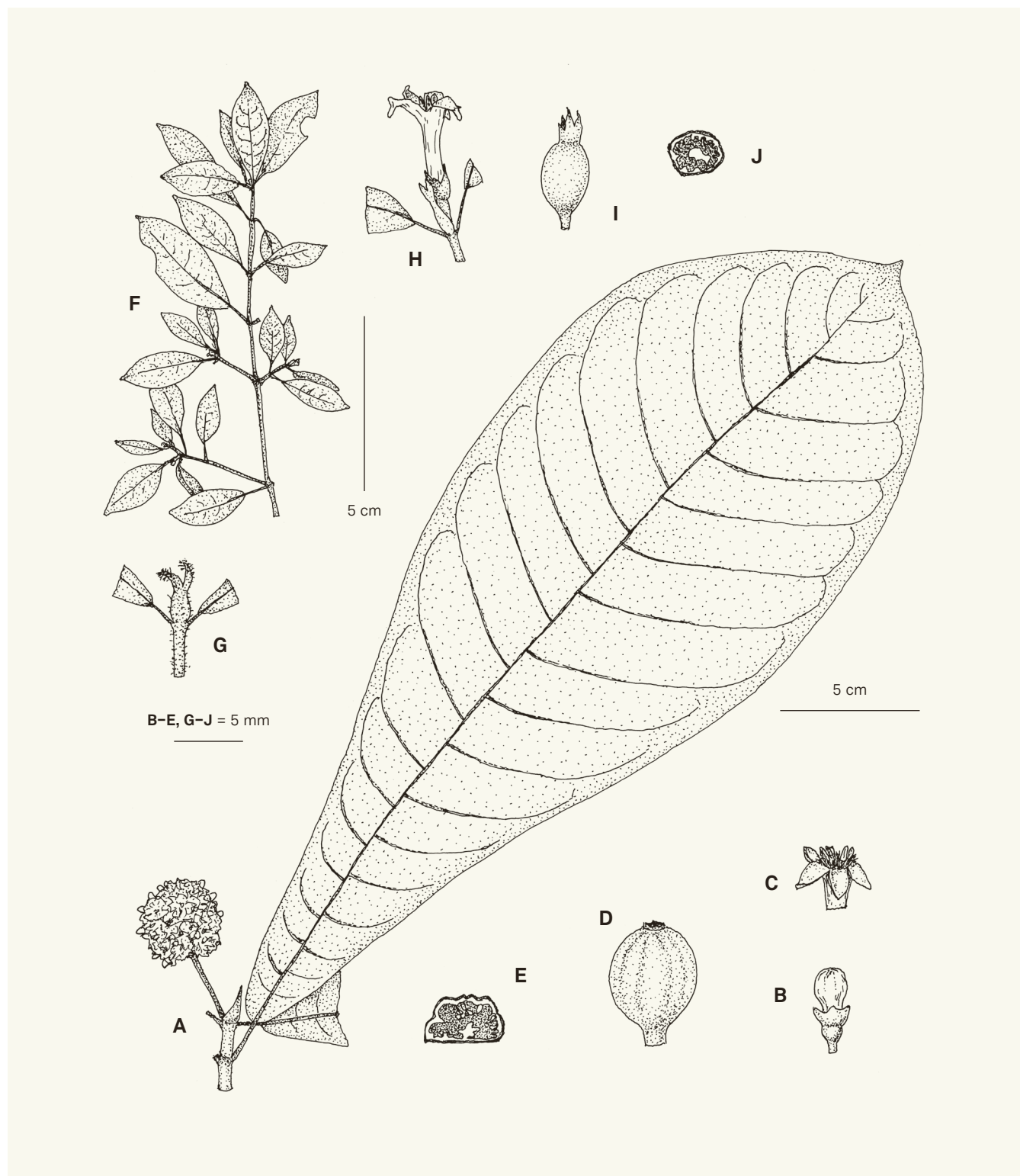
*Psychotria antilahimenae* is similar to *P. simianensis*, the only other *Psychotria* species known so far from Madagascar with a monopodial, “trash-bucket” habit. *Psychotria simianensis* can be separated by its dried leaves with regularly reticulated tertiary and quaternary venation that is prominulous on both leaf surfaces, 6- or 7-merous flowers, shorter calyx limbs c. 0.5 mm long, and yellow corollas. In the classification used here, *P. simianensis* includes only plants that agree with these particular characteristics, and is now only documented from the area of Mananara on Madagascar’s mainland. This circumscription of *P. simianensis* includes plants that match the type of that species, but excludes additional specimens that have been subsequently identified as this species but do not match it (Taylor, in prep.).

**Paratypes.** – **MADAGASCAR. Reg. Analanjirofo [Prov. Toamasina]:** Maroantsetra, Anjahana, Ambanizana, 15°38'03"S 49°58'47"E, 7.V.2002, *Antilahimena* 1049 (BR, K, MO, P, TAN); Andranobe, env. 8 km S of Ambanizana, 15°39'32"S 49°57'31"E, 10 m, 18.I.2006, *Raharimampionona* 115 (MO, NY, P, TEF); Ambanizana, trail A behind MBG House, 15°39'30"S 49°57'30"E, 600 m, V.1993, *Zjhra* & *Hutcheon* 318 (K, MO); Antsirabe Sahatany, Anjahely, 15°24'16"S 49°30'41"E, 393 m, 27.V.2004, *Antilahimena* 2583 (MO, P, TAN); hills E of village of Sahavary, up Andranofotsy riv. from Maroantsetra, [15°19'S 49°52'E], 300 m, 24.X.1986, Lowry et al. 4243 (K, MO); Masoala Peninsula, W of Ambohitralanana, forest near Sahafary, 15°16'S 50°22'E, 75 m, 19.VI.1997, *McPherson* 17105 (MO); *ibid. loco*, Antalavia, following coastal path leading S, 15°46'S 50°01'E, 25 m, 17.IV.1987, *Nicoll et al.* 563 (K, MO); RS Nosy Mangabe, 15°30'S 49°47'E, 215 m, 22.IV.1987, *Nicoll* & *Schatz* 597 (K, MO); *ibid. loco*, 15°30'S 49°46'E, 0–330 m, 6–8.V.1998, *Schatz et al.* 2374 (K, MO). **Reg. SAVA [Prov. Antsiranana]:** Masoala Peninsula, forest surrounding research station at Andranobe on W coast, 15°39'30"S 49°57'30"E, 0–600 m, 19.II.1992, *Zjhra* & *Hutcheon* 174 (MO).

***Psychotria birkinshawiana* C.M. Taylor, sp. nov.** (Fig. 3A–E).

**Holotypus:** **MADAGASCAR. Reg. Analanjirofo [Prov. Toamasina]:** Maroantsetra, hills E of village of Sahavary, up Andranofotsy River from Maroantsetra, along trail toward headwaters of Sahafotra River (Ravim Bé swamp), [15°19'S 49°52'E], 300 m, 24.X.1986, Lowry et al. 4248 (MO-3436895!; iso-: K, P, TAN).

*Psychotria birkinshawiana* differs from *P. nossibensis* A.P. Davis & Govaerts and *P. humblotii* (Bremek.) A.P. Davis & Govaerts by its shorter calyx limbs, smaller corollas, and smaller fruits.



**Fig. 2.** – *Psychotria antilahimena* C.M. Taylor: **A.** Flowering branch; **B.** Flower bud; **C.** Corolla at anthesis; **D.** Fruit; **E.** Cross-section of pyrene and seed.

*Psychotria davisiana* C.M. Taylor: **F.** Flowering branch; **G.** Stem apex with bases of two leaves and a stipule;

**H.** Stem apex with bases of two petioles, one stipule, and one flower at anthesis; **I.** Fruit; **J.** Cross-section of pyrene and seed.

[**A–C:** Schatz 1619; **D–E:** Schatz et al. 2374; **F–G:** Randrianasolo et al. 511 (isotype); **H:** Randrianaivo et al. 511 (holotype); **I–J:** Miandramana 398]

Small *trees*, collected in flower and fruit variously at 4–9 m tall, branched; stems flattened when young quickly becoming subterete, smooth, glabrous, at apex sometimes with shiny exudate on stipules and young leaves. *Leaves* opposite; *petiole* 0.5–2.5 cm, glabrous; *blade* obovate to oblanceolate or narrowly elliptic, 4.5–15 × 1.8–7.5 cm, at base acute to cuneate, at apex obtuse to rounded or truncate, drying chartaceous, on both surfaces glabrous; secondary veins 8 to 28 pairs, looping to interconnect near margins, without domatia, on both surfaces costa thickened and remaining venation plane and not evident. *Stipules* interpetiolar or shortly fused around stem, caducous, ovate to broadly triangular, 4–12 mm, obtuse to rounded, abaxially glabrous, adaxially densely sericeous to strigose with silky trichomes 1–2 mm. *Inflorescences* terminal, cymose, subsessile (i.e., apparently fasciculate), glabrous or with patches of sericeous trichomes 1–2 mm at nodes; peduncle reduced, represented by a leafless node with reduced stipule borne immediately above distalmost leaf-bearing node of stem; flower-bearing portion corymbiform, 2–3 × 2–4 cm, branched to 1- or 2 orders, c. 25- to 70-flowered; bracts triangular, 0.2–0.5 mm, adaxially sericeous with trichomes 1–2 mm. *Flowers* all subsessile in clusters of 5 to 7, subtended by sericeous trichomes 1–2.5 mm, 5-merous; hypanthium obconic, 1.2–1.5 mm, glabrous; *calyx* limb 1.5–2.2 mm, glabrous, truncate to irregularly subtruncate; *corolla* salverform, yellow, externally glabrous, tube cylindrical to weakly funnel-form, 2.5–3 mm, 1–1.2 mm diam. near middle, internally densely tomentulose-pilous with white trichomes 0.5–1 mm in a zone just above middle of tube but not extending into throat, lobes narrowly triangular, c. 2 mm, acute, fleshy, adaxially shortly galeate, abaxially with rounded to conical low thickening near tip; *stamens* with filaments c. 1 mm, inserted below top of corolla tube, anthers narrowly oblong, c. 1 mm, positioned with tips in corolla throat; *style* c. 3.5 mm, *stigmas* c. 1 mm, included. *Infructescences* similar to inflorescences or becoming laxer, to 4 × 8 cm. *Fruits* subglobose, 10–15 mm diam., glabrous, yellowish orange; *pyrenes* hemispherical, adaxially plane, abaxially smooth; *endosperm* densely and deeply ruminant on all sides.

*Etymology.* – The epithet of this very tall, apparently mammal-dispersed new species honors Dr. Christopher R. Birkinshaw, a lemur biologist who has contributed extensively to conservation in Madagascar.

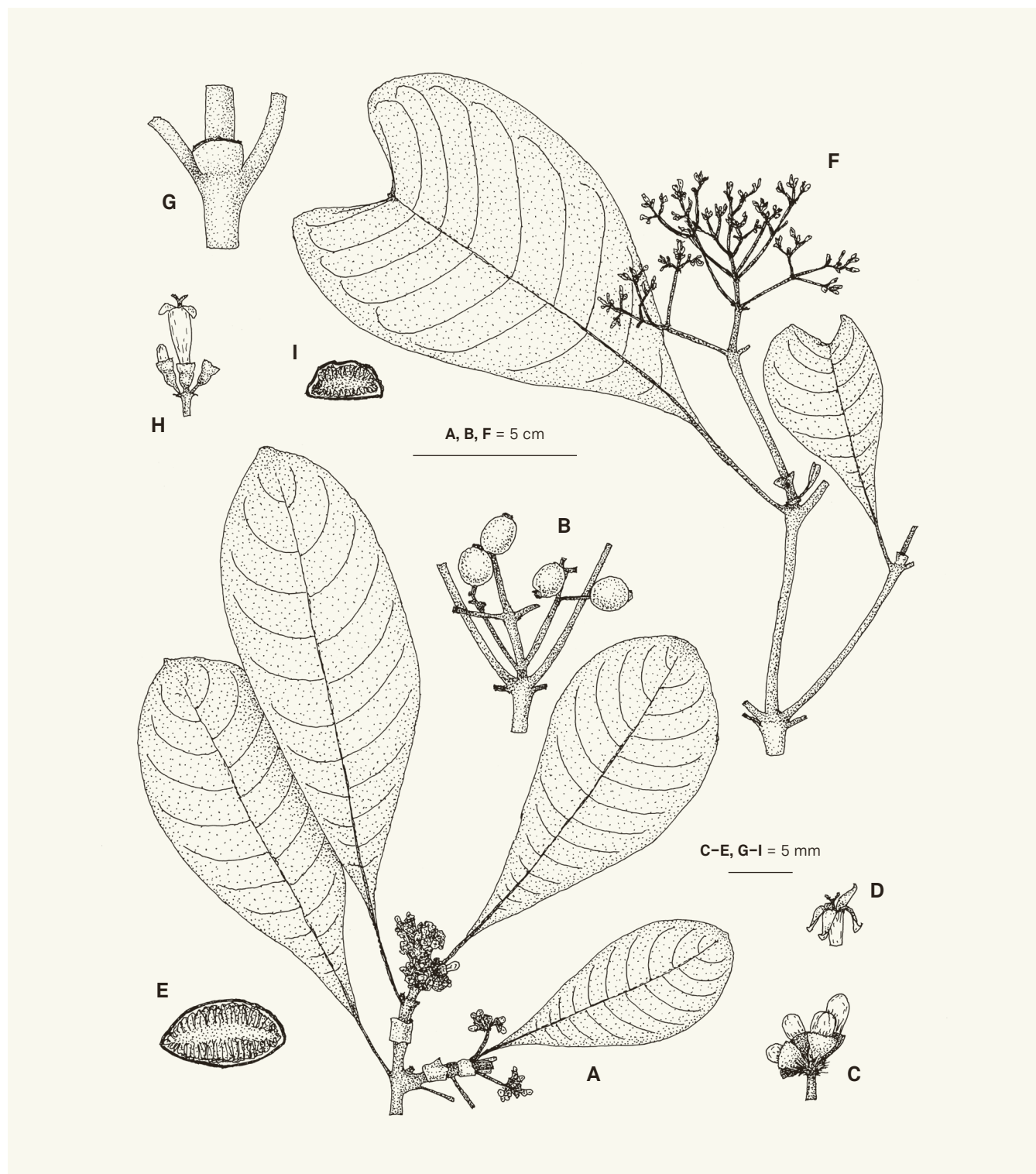
*Habitat, distribution and phenology.* – *Psychotria birkinshawiana* has been collected in perhumid evergreen forest at 0–400 m, sometimes on sandy soils, on the Masoala Peninsula (Antsiranana, Toamasina), with flowers in October and with well-developed fruits in February, April–August, October, and November.

*Conservation status.* – *Psychotria birkinshawiana* is known from 23 specimen collections representing 19 unique

occurrences in perhumid evergreen forest at 0–400 m elevation. The EOO of the species is 7,290 km<sup>2</sup>, within the limits for “Vulnerable” under IUCN Red List Criterion B1; and the AOO is 68 km<sup>2</sup>, within the limits for “Endangered” under Criterion B2 (IUCN, 2012). Four of the 19 occurrences are within the well-protected Masoala PA. The remaining fifteen occurrences are in unprotected areas. Two of the collection sites have degraded or disturbed forest habitats. Forested areas without formal protection in the vicinity of Masoala PA are subject to degradation by small-scale slash and burn agriculture and resource exploitation, including logging, hunting and mining (GOODMAN et al., 2018). Five collection sites indicate watershed/headwaters/river basin drainages as habitat; two sites have coastal habitat. The four occurrences within Masoala PA can be counted as one protected location (sensu IUCN, 2012, 2019), and the remaining, unprotected occurrences can be grouped into nine additional locations based on geographic clustering relative to the scale of threats, some of them at high risk for further disturbance and exploitation due to their water resources. With ten locations and given general habitat degradation in unprotected sites, the sensitive nature of watershed areas, and no reason to assume that any of the unprotected sites is more likely to disappear than the others, the Red List status of *P. birkinshawiana* is assessed as “Vulnerable” [VU B1ab(iii)+2ab(iii)].

*Notes.* – *Psychotria birkinshawiana* can be recognized by the combination of its robust habit; medium-sized, glabrous, obovate leaf blades that are obtuse to rounded at the apex; triangular, broadly angled stipules; rather short, cymose, terminal inflorescences with patches or tufts of dense sericeous pubescence along the axes and adaxially on the bracts; subsessile flowers with truncate calyx limbs; short yellow corollas; relatively well developed, yellow to orange fruits; and seeds with the endosperm densely ruminant on all sides. This species is notable in Malagasy *Psychotria* for its robust size. The leaves appear to be fleshy or rather succulent in life. The few flowers seen agree with the short-styled form of distylous *Psychotria* species, but whether this species is distylous is not yet known. The fruits are relatively large for *Psychotria* and appear on dried material to be fleshy rather than juicy, and their form suggests they may be eaten by lemurs (C. Birkinshaw, pers. comm.); whether these could be bird-dispersed has not been investigated. No ecological documentation is available for *P. birkinshawiana*, so its dispersers are only postulated here. *Psychotria birkinshawiana* agrees with BREMEKAMP (1963)’s *Mapouria* Group III, which comprises species with a similar general aspect and relatively large fleshy fruits. The fruits of *P. birkinshawiana* range to a smaller size than Bremekamp gave for that group, which he diagnosed as having fruits 15–20 mm in diameter, but its largest fruits and other features agree with that group.





**Fig. 3.** – *Psychotria birkinshawiana* C.M. Taylor: **A.** Flowering branch; **B.** Infrutescences with bases of two lateral stems; **C.** Portion of inflorescence with four flower buds; **D.** Corolla at anthesis; **E.** Cross-section of pyrene and seed. *Psychotria razafimandimbisonii* C.M. Taylor: **F.** Flowering branch; **G.** Stem node with bases of two petioles and one stipule; **H.** Portion of inflorescence with one flower from which corolla has fallen, one flower bud, and one flower at anthesis; **I.** Cross-section of pyrene and seed. [A: Lowry et al. 4248; B, E: Ralimanana 1209; C–D: Bernard 1675; F: Rakotovao & Randriantafika 1011; G: Rakotovao 957; H: Daniel 9098; I: Overdorff 39]

*Psychotria birkinshawiana* is similar to *P. megalocarpa* (Bremek.) A.P. Davis & Govaerts and *P. humblotii*, both of which are also found in eastern Madagascar. These others are only known from south of the range of *P. birkinshawiana*, however, and differ in their larger calyx limbs, 3–5 mm long; larger corollas, with the tube c. 8 mm long and lobes 4–5 mm long; and generally larger fruits, 15–20 mm in diameter, that may be green at maturity. *Psychotria birkinshawiana* is also similar to *P. nossibensis* A.P. Davis & Govaerts, which is found in northwestern Madagascar and has flowers and fruits that are similar in size and color to those of *P. megalocarpa*. *Psychotria birkinshawiana* is also similar to *P. mangorensis* (Bremek.) A.P. Davis & Govaerts, which is found in scattered localities along the east coast of Madagascar, south of the range of *P. birkinshawiana*, and possibly only on white sand soils. *Psychotria mangorensis* can be separated from all of these other species by its generally smaller fruits, 6–9 mm in diameter, that turn white as they mature then blue at maturity and its endosperm that is only ruminant on the adaxial side.

**Paratypes.** – MADAGASCAR. **Reg. Analanjirofo** [Prov. Toamasina]: Maroantsetra, Anjahana, Ambanizana, 15°38'12"S 49°58'15"E, 120 m, 10.VI.2002, *Antilabimena* & *Arida* 1073 (MO, TAN); Andranofotsy, 15°25'10"S 49°49'06"E, 140 m, 14.VII.2002, *Antilabimena* et al. 1150 (MO, TAN); Farankaraina forest, 15°26'30"S 49°51'00"E, 21.VI.2003, *Antilabimena* 1966 (MO, TAN); Anjahana, Ambatoledama forest on way to Antalaha, 15°17'00"S 50°00'00"E, VI.2003, *Antilabimena* 1997 (MO, TAN); *ibid. loco*, *Antilabimena* 2024 (MO, P, TAN); Bezavona forest, 2 km E of Sahavary village, 15°19'20"S 49°50'48"E, 244 m, 29.VIII.2009, *H. Ralimanana* et al. 1209 (BR, G, K, MO, TAN); PN Masoala, Ambanizana, 15°37'S 49°58'E, 0–400 m, 2.IV.1996, *Aridy* 225 (MO, P, TEF); Andranobe, 15°40'S 49°57'E, 200–300 m, 17.IV.1996, *Aridy* et al. 262 (MO, P, TEF); 2–3 km W of Amebromanitra, near Ranomena riv., 16°51'25"S 49°15'39"E, 450 m, 11.XI.1999, *Davis* & *Rakotonasolo* 2271 (K, MO, TAN); S of Ambanizana, 15°41'S 49°58'E, 50–100 m, 12.II.1999, *McPherson* et al. 17567 (K, MO, TAN); Tampolo, 15°43'S 49°57'E, 0–5 m, 31.X.1992, *Schatz* et al. 3376 (MO); Andranobe, vicinity of Peregrine Fund site, [15°40'50"S 49°57'50"E], 270 m, 5.VII.2003, *Sweeney* et al. 1381 (MO); S of Ambanizana in Andranobe riv. watershed, 15°40'24"S 49°57'51"E, 110–260 m, 25.X.1994, *Vasey* & *Behasy* 46 (MO); *ibid. loco*, *Vasey* & *Velo* 346 (K, MO, P, TAN); *ibid. loco*, *Vasey* & *Velo* 349 (MO); Ambanizana, 15°39'30"S 49°57'30"E, 600 m, VI.1993, *Zjhra* & *Hutcheson* 322 (K, MO); Andranobe, Camp Be-dinta, 15°39'30"S 49°57'30"E, 550–600 m, VII.1993, *Zjhra* & *Hutcheon* 509 (K, MO). **Reg. SAVA** [Prov. Antsiranana]: Masoala PN, à 22 km de la ville d'Ampanavoana, sur la route d'Ifasina, 15°41'S 50°15'E, 0–200 m, 1.II.1996, *Aridy* & *Rahajaso* 102 (MO, P, TEF); Antalaha, à 21 km du village de Sahamalaza sur la route de Vakoanina, Vinanivao, 15°48'S 50°18'E, 0–113 m, 15–16.II.1996, *Aridy* & *Moïse* 138 (MO, P, TEF); c. 10 km au S de Sahafary, à 3 km W du ruisseau de Sahalampona, 15°23'S 50°22'E, 100–200 m, 5.V.1995, *Bernard* 108 (MO, P, TAN); Ampanavoana, Antalaha, Sanaenjika, 15°41'33"S 50°13'30"E, 12–100 m, 2.II.1996, *Bernard* et al. 150 (MO, P, TAN); Ankavia, Mantazanina, Ambalavy, 15°20'10"S 50°14'07"E, 76 m, 20.X.2010, *Bernard* & *Ndrano* 1675 (K, MO, P, TAN).

*Psychotria davisiana* C.M. Taylor, **sp. nov.** (Fig. 2F–J, 4).

**Holotypus:** MADAGASCAR. **Reg. Analamanga** [Prov. Antananarivo]: Anjozorobe, Betatao, forêt de Vohitralongo, rte Anjozorobe–Ambatondrazaka, à 30 km au NE de Betatao, 18°04'07"S 47°58'41"E, 950–1093 m,

8.III.2000, *Randrianaivo* et al. 511 (MO-6071774!; iso-: BR, G [G00341940]!, K, MO-6146891!, P, TAN).

*Psychotria davisiana* C.M. Taylor is distinguished from *P. haplantha* Bremek. by its larger leaf blades with acarodomatia, often shortly pedicellate flowers, longer calyx limbs, longer corollas, and endosperm that is at least shallowly ruminant on both abaxial and adaxial surfaces.

*Shrubs* and small *trees*, collected in flower and fruit variously at 1–4 m tall, much-branched, with well developed main stems bearing numerous branched lateral stems; stems weakly flattened when young becoming subterete, densely hirtellous to hispidulous with trichomes 0.2–0.5 mm, pubescence deciduous with age. *Leaves* opposite; *petiole* 0.1–0.5 cm, glabrous; *blade* oblanceolate to elliptic, 0.6–4.5 × 0.5–2 cm, at base cuneate to acute, at apex obtuse to acute or weakly acuminate with tip to 2 mm, drying papyraceous to chartaceous, on both surfaces glabrous; secondary veins 4 to 10 pairs, looping to interconnect near margins, usually with regularly developed small domatia comprising a pit and/or a tuft of strigose trichomes 0.1–0.3 mm, usually with 1 intersecondary vein present between pairs of secondary veins, adaxially costa thickened to prominent, secondary veins plane to thickened, and remaining venation plane, abaxially costa prominent, secondary and tertiary veins plane to prominulous, and remaining venation not visible. *Stipules* interpetiolar, caducous, abaxially and marginally densely hispidulous to hirtellous with trichomes 0.2–0.5 mm, adaxially glabrous in upper part and densely strigillose in lower part with trichomes 0.1–0.2 mm, oblong to pandurate in outline, 1.2–7 mm, lobed for ¼–½ their length, basal portion (i.e., below lobes) ligulate to triangular or ovate, lobes lanceolate to narrowly triangular or linear, acute, erect when young then spreading laterally with age. *Inflorescences* terminal, reduced from a cyme to 1-flowered or shortly cymose and 2- or 3-flowered, enclosed by 1 pair of persistent stipules; bracts apparently reduced; pedicels 0.1–1 mm. *Flowers* variously subsessile to pedicellate, 5-merous, distylous; hypanthium obconic to cylindrical, c. 1 mm, glabrous to densely hirtellous with trichomes 0.3–0.5 mm; *calyx* limb abaxially and adaxially glabrous, tubular portion 1–2 mm, lobes narrowly ligulate to narrowly triangular, 1–2.5 mm, acute to obtuse or rounded, marginally ciliate; *corolla* salverform, yellow, externally glabrous, tube cylindrical, 5–8 mm, 1.2–1.5 mm diam. near middle, internally glabrous except densely pilosulous at stamen insertion in upper part of tube, lobes triangular, 2–2.5 mm, acute, adaxially plane (i.e., not galeate), abaxially with conical thickening 0.5–1 mm near tip; *stamens* in short-styled form with filaments 2–2.5 mm, inserted in upper part of corolla tube, anthers c. 1.2 mm, exserted, in long-styled form not seen; *style* in short-styled form c. 3 mm with *stigmas* c. 1 mm, included, in long-styled form c. 7.5 mm with stigmas c. 1 mm, exserted. *Infructescences* similar to inflorescences. *Fruits* subglobose, c. 5 mm diam., sparsely hirtellous to glabrous, red, apparently





**Fig. 4.** – *Psychotria davisiana* C.M. Taylor.  
[Antilahimena 6011] [Photo: A.P. Antilahimena]

juicy; pyrenes 2, hemispherical, adaxially plane, abaxially smooth to weakly irregularly ridged or wrinkled; endosperm adaxially sparsely but deeply ruminant, abaxially sparsely shallowly ruminant.

**Etymology.** – The epithet of this species honors Dr. Aaron Davis, a *Rubiaceae* specialist who has documented and studied Malagasy *Psychotria* (DAVIS et al., 2007).

**Habitat, distribution and phenology.** – *Psychotria davisiana* has been collected in humid, usually dense evergreen forest at 950–1342 m in central eastern Madagascar, and reportedly is often locally common. It has been collected with flowers in February, March, May, and June, and with ripe fruits in July and October.

**Conservation status.** – *Psychotria davisiana* is known from 19 specimen collections representing 19 unique occurrences in humid, usually dense evergreen forest at 950–1342 m elevation. The EOO of the species is 2,705 km<sup>2</sup>, within the limits for “Endangered” under IUCN Red List Criterion B1; and the AOO is 44 km<sup>2</sup>, also within the limits for “Endangered”

under Criterion B2 (IUCN, 2012). One occurrence is within the protected Anjozorobe Angavo forest corridor, one of the last vestiges of natural forests in Madagascar central highlands. The other 18 occurrences are in unprotected areas, one to the north and 17 to the south of the protected area. Forested areas without formal protection in the vicinity of Anjozorobe Angavo are subject to degradation by small-scale slash and burn agriculture and fire to create habitat for cattle farming (GOODMAN et al., 2018). The one occurrence to the north of Anjozorobe Angavo (at Vohitralongo Forest) constitutes one location (sensu IUCN, 2012) with respect to the known threats; the one within the protected area is a second location; the two isolated occurrences to the south constitute one location each; and the 15 collection sites from the Moramanga area, the site of a long-standing nickel mining operation, are a fifth location. Given the nature of three of the locations with general habitat degradation in unprotected sites and the remaining location in close proximity to on-going mining operations, causing a decline in AOO and number of mature individuals, the Red List status of *P. davisiana* is assessed as “Endangered” [EN B1ab(ii,iii,v)+2ab(ii,iii,v)].

**Notes.** – *Psychotria davisiana* is characterized by its stems with smooth internodes and hirtellous pubescence; relatively small, obovate, abaxially glabrous leaves with small crypt-type domatia; hirtellous, rather small, caducous stipules that are bilobed for  $\frac{1}{3}$ – $\frac{1}{2}$  of their length; terminal, subsessile to shortly pedunculate, solitary to three flowers subtended by a pair of persistent stipules; rather well developed, deeply lobed calyx limbs; medium-sized yellow corollas with the lobes abaxially bearing a conical projection; medium-sized red fruits; pyrenes that are smooth abaxially; and endosperm that is ruminant both abaxially and adaxially. The specimens seen dried brownish green or dark brown, with the dried trichomes dark reddish brown. *Psychotria davisiana* has a distinctive branching arrangement, with leafless principal stems bearing smaller, ascending, branched stems that do bear leaves. The acarodomatia are relatively small, and only one or two are developed on some leaves so these can be overlooked. On flowering branches, most of the stems bear inflorescences but few flowers are open at any time. Few long-styled flowers have been seen, and these were not dissected in order to preserve them. The style length is presented here following BREMEKAMP (1963)’s format and based on one flower, but it probably varies with corolla size to position the stigmas just above the top of the corolla tube. This is one of several *Psychotria* species with relatively small leaves and the flowers borne singly or in small groups at the stem apices; only five such species were treated by Bremekamp, but this habit and flower presentation are now known from more species of *Psychotria* as well as some very similar species of *Gaertnera* Lam. (MALCOMBER & TAYLOR, 2009). *Psychotria davisiana* agrees with Bremekamp’s *Mapouria*

Group VII, which is diagnosed in part by endosperm that is ruminant both adaxially and abaxially; the adaxial ruminations in *P. davisiana* are well developed, while the abaxial ones seen are small and can be overlooked.

*Psychotria davisiana* is similar to *P. haplantha* Bremek., which can be separated by its branching pattern, with well-developed leafless stems bearing regularly spaced, short, unbranched, leaf-bearing stems; usually smaller leaf blades, 0.6–1.4 × 0.4–0.7 cm, without domatia; subsessile flowers; shorter calyx limbs, 0.8–1 mm long; shorter corollas, with the tube 1.8–3 mm long; and endosperm that is entire or ruminant only adaxially. The fruits of *P. haplantha* were not seen by BREMEKAMP (1963), but are now documented: these are red at maturity, ellipsoid to subglobose, and c. 5.5 mm in diameter, with two pyrenes that are smooth to weakly longitudinally ridged abaxially and endosperm weakly ruminant on the adaxial face (*Kotozafy 1006*, MO) (Bremekamp included *P. haplantha* in his *Psychotria* Group I, but he did not know the fruits are red so it does not agree with the characters of that group.) *Psychotria davisiana* keys to Bremekamp's *Mapouria* Group VII, or if the abaxial seed ruminations are not noted to his *Mapouria* Group V; all of the species in both of those groups differ from *P. davisiana* in their branched inflorescences with more than three flowers.

**Paratypes.** – MADAGASCAR. **Reg. Analamanga [Prov. Antananarivo]:** piste de Tsiazompaniry à Andapa, Andramasina, [19°16'00"S 47°59'00"E], VI.1961, *Service Forestier 20291* (MO, P). **Reg. Alaotra-Mangoro [Prov. Toamasina]:** Moramanga, Andasibe, Berano, Ambatovy forest, 18°51'52"S 48°17'50"E, 1018 m, 3.III.2005, *Antilabimena et al. 3569* (MO, P, TAN n.v.); Ambatovy, Sahaviana forest, 18°51'37"S 48°17'10"E, 976 m, 14.II.2007, *Antilabimena et al. 5345* (MO, TAN); Ambatovy, Andranovory forest, 18°52'04"S 48°18'27"E, 22.X.2007, *Antilabimena 5886* (MO, P, TAN); *ibid. loco*, 18°51'55"S 48°18'35"E, 993 m, 10.II.2008, *Antilabimena 6011* (MO, P, TAN); *ibid. loco*, 18°52'12"S 48°18'34"E, 1003 m, 15.II.2008, *Antilabimena 6055* (MO, P, TAN); Ambatovy, côté SE de Berano, 18°49'18"S 48°17'04"E, 1046 m, 13.X.2008, *Miandrimanana 389* (MO, TAN); Ambatovy, côté Ampitambe, 18°49'17"S 48°17'09"E, 1011 m, 13.X.2008, *Miandrimanana 398* (MO, P, TAN); *ibid. loco*, 18°51'49"S 48°18'39"E, 988 m, 10.II.2008, *Rakotondrafara et al. 542* (MO, TAN); *ibid. loco*, 18°51'53"S 48°18'36"E, 14.II.2008, *Rakotondrafara et al. 622* (MO, P, TAN); *ibid. loco*, 18°50'47"S 48°17'18"E, 1020 m, 4.III.2005, *Rakotovoao et al. 1486* (MO, P, TAN); *ibid. loco*, 18°49'34"S 48°17'14"E, 1058 m, 25.X.2011, *Rasoazanany et al. 29* (AVY, MO, P, TAN); *ibid. loco*, 18°51'05"S 48°18'13"E, 1080 m, 15.X.2005, *Razanatoa et al. 530* (K, MO, P, TAN); Phelps-Dodge project site, c. 15 air-km NE of Moramanga, c. 11 km E of Antanambao, 18°50'16"S 48°21'14"E, 950 m, 4.III.1997, *Rakotomalaza et al. 1231* (MO, P, TEF); Ambongabe, Sahamorandro, 18°39'30"S 47°57'59"E, 1342 m, 8.IV.2005, *Rakotonirina et al. 240* (MO, P, TAN); Ambatovy, Ankosy, 18°48'41"S 48°17'45"E, 1071 m, 31.VII.2012, *Ramahenina et al. 85* (MO, P, TAN); Andasibe, Berano, Ampa-nadiofanantsy forest, 18°51'46"S 48°16'31"E, 983 m, 27.X.2008, *Randrianasolo et al. 983* (MO, TAN); massif de l'Ifody, rive droite du Mangoro, [18°55'S 48°03'E], 29.V.1966, *Service Forestier 24803* (MO, P).

*Psychotria eumachioides* C.M. Taylor, **sp. nov.** (Fig. 1G–K).

**Holotypus:** MADAGASCAR. **Reg. SAVA [Prov. Antsiranana]:** Vohémar, Tsarabaria, Manakana, forêt

d'Ambondrobe, 13°42'46"S 50°05'25"E, 18.V.2004, *Rabehevitra et al. 1059* (MO-5899412!; iso-: TAN).

*Psychotria eumachioides* C.M. Taylor differs from *P. rubropedicellata* (Bremek.) Razafim. & B. Bremer by its stems that become yellowed and indurated with age, narrower oblanceolate leaves that lack domatia, and shorter inflorescences.

*Shrubs*, at least sometimes apparently deciduous, collected in flower and fruit variously at 1.5–2 m tall, branched with lateral stems usually comprising 5 to 10 nodes separated by reduced internodes; stems glabrous, weakly flattened becoming subterete, with bark often becoming yellowed or brown and thickened with age. *Leaves* opposite; *petiole* 4–28 mm, glabrous or moderately to densely puberulous or pilosulous with trichomes 0.1–0.3 mm; *blade* oblanceolate, 2.8–9 × 0.5–3.2 cm, at base tapered and acute, at apex broadly obtuse to rounded, drying papery, on both surfaces glabrous or moderately puberulous to pilosulous with trichomes 0.1–0.3 mm; secondary veins 7 to 12 pairs, weakly looping to interconnect or reticulating near margins, without domatia, without intersecondary veins, adaxially venation plane or costa thinly impressed, secondary veins thickened, and remaining venation not evident, abaxially costa prominent, secondary veins plane to thickened, and remaining venation not evident. *Stipules* interpetiolar or shortly fused around stem, deciduous leaving thickened scar, ovate to triangular, 3–5 mm, abaxially glabrous or moderately pilosulous with trichomes 0.1–0.3 mm, adaxially sparsely pilosulous with trichomes 0.1–0.3 mm, acute to acuminate, at tip sometimes glandular or bifid with lobes 0.2–0.5 mm. *Inflorescences* terminal, cymose, pedunculate, sparsely to moderately pilosulous with trichomes 0.1–0.3 mm; peduncle 0.5–1 cm; flower-bearing portion rounded-corymbiform, 1–1.5 × 1–2 cm, branched to 1 or 2 orders, c. 10- to 25-flowered; bracts reduced or usually triangular, 0.1–0.5 mm, acute; pedicels 1–1.5 mm. *Flowers* all pedicellate in umbelliform groups of 5 to 7, 5-merous; hypanthium cylindrical to ellipsoid, c. 0.8 mm, moderately pilosulous with trichomes 0.1–0.3 mm; *calyx* limb c. 0.8 mm, externally moderately to sparsely pilosulous with trichomes 0.1–0.3 mm, lobed for 1/3–1/2 of its length, lobes ovate, acute to shortly acuminate; *corolla* funnelform, yellow, externally sparsely pilosulous with trichomes 0.1–0.3 mm, tube c. 3 mm, c. 1.2 mm diam. near middle, internally glabrous except densely hirtellous in upper part of tube, lobes narrowly triangular, c. 2 mm, adaxially galeate, abaxially with rounded thickening near tip; *stamens* with filaments c. 1.5 mm, inserted in upper part of corolla tube, anthers c. 1.2 mm, exserted; *style* c. 2 mm, *stigmas* c. 0.8 mm, included and positioned above pubescent internal ring of corolla tube. *Infructescences* similar to inflorescences except sometimes displaced to pseudoaxillary by subsequent stem growth from an axillary bud, and with axes elongating and deciduous as fruits fail to develop or fall off; pedicels elongating, to 6 mm,



becoming fleshy. *Fruits* didymous, c.  $5 \times 8$  mm, glabrous, juicy, orange to red; *pyrenes* subglobose, abaxially smooth, adaxially plane; *endosperm* abaxially entire (i.e., not ruminant), adaxially with a few deep ruminations.

**Etymology.** – The species epithet refers to the similarity of this new species to some species of *Eumachia*, as discussed below. *Eumachia* has been commonly confused with *Psychotria* but these are not closely related (TAYLOR et al., 2017). *Eumachia* differs from *Psychotria* in its stipules that are generally persistent and have one or two gland-tipped lobes, a lack of persistent colleters at the stipule insertion, and molecular sequences that indicate its relationships are in another tribe, *Palicoureae*.

**Habitat, distribution and phenology.** – *Psychotria eumachioides* has been collected in gallery forest in subhumid or dry bioclimate zones (CORNET, 1974), from near sea level to c. 40 m in northwestern Madagascar (Antsiranana), variously in littoral forest and on lakeshores and river banks. It has been collected with flowers in January, and with fruits in February and May.

**Conservation status.** – *Psychotria eumachioides* is known from four specimen collections representing four unique occurrences in gallery forest in subhumid or dry bioclimatic zones at 0–40 m elevation. The EOO of the species is 896 km<sup>2</sup>, within the limits for “Endangered” under IUCN Red List Criterion B1; and the AOO is 12 km<sup>2</sup>, also within the limits for “Endangered” under Criterion B2 (IUCN, 2012). Two occurrences are within the generally well-protected Loky-Manambato PA, though there are reports of some artisanal gold mining within the protected area (C. Birkinshaw, pers. comm.). A third occurrence is near the northern boundary of, but distinctly outside, Analamerana PA, and the remaining occurrence is not in a formally recognized protected area, although the label indicates “forêt d’Ambondrobe”. Forested areas without formal protection in the vicinity of Loky-Manambato PA are subject to degradation by small-scale slash and burn agriculture and resource exploitation including logging, hunting and mining (GOODMAN et al., 2018). The northernmost collection site outside Analamerana PA is stated to be in dry, semi-deciduous, very degraded forest, and it constitutes one “location” (sensu IUCN, 2012) with respect to the known threats. This is the northernmost location and its disappearance would significantly reduce both EOO and AOO. The two occurrences within Loky-Manambato constitute a second location, and the single occurrence at Ambondrobe Forest is a third location. With only three locations, documented degradation at the northernmost location, and general habitat degradation in unprotected sites, the Red List status of *P. eumachioides* is assessed as “Endangered” [EN B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v)].

**Notes.** – *Psychotria eumachioides* is characterized by its stems with shortened internodes and an epidermis that often becomes yellowed and indurated with age; medium-sized oblanceolate leaves that are obtuse to rounded at the apex and lack domatia; triangular to ovate, acute, medium-sized stipules that are deciduous and leave a thickened scar; corymbiform several-flowered inflorescences that are overtopped by the leaves; flowers that are pedicellate in umbelliform cymes; developed calyx limbs; somewhat small yellow corollas; orange to red fruits borne on thickened pedicels; smooth subglobose pyrenes; and endosperm with several adaxial ruminations. The plants dry with a generally green color. The dried trichomes are mostly white, though some trichomes on old stipules turned brown. The stems do have developed internodes but these are quite short, so the growth pattern can almost be considered a brachyblast and its arrangement is accentuated by thickened petiole and stipule scars. This growth pattern may be related to the habitat of this species, which lives in relatively dry areas and is apparently deciduous. *Psychotria eumachioides* appears to produce flowers and new leaves together, then the fruit and stem development proceed concurrently. The few flowers seen resemble the short-styled form of distylous *Psychotria* species, but whether this species is distylous is not yet known. A fruiting specimen is chosen as the type because most of characters that diagnose this new species are in the fruits and seeds. *Psychotria eumachioides* agrees with BREMEKAMP (1963)’s *Mapouria*, and keys there to either Group VI or Group V but does not fully agree with either. It agrees with Group IV in its lack of domatia, but differs in its fruits that are not blue or white at maturity; it agrees with Group V in its yellow to red fruits, but differs in its lack of domatia and entire stipules.

*Psychotria eumachioides* is similar to *P. rubropedicellata*, which has stems with regularly developed, elongated internodes, larger leaf blades  $6.5\text{--}16 \times 2\text{--}10$  cm with pilosulous domatia and tips that are sharply obtuse to acute, stipules with two linear lobes, often larger inflorescences 2–7 cm long, and usually longer fruiting pedicels, 5–12 mm long, that become fleshy and red.

**Paratype.** – MADAGASCAR. **Reg. Sava [Prov. Antsiranana]:** Analamera, bank of Irodo riv., side of Irodo village,  $12^{\circ}40'25''\text{S } 49^{\circ}32'40''\text{E}$ , 41 m, 10.I.2002, De Block et al. 1172 (BR, MO, P, TAN); Nosy Be, au bord du lac Sahaka, forêt d’Analabe,  $13^{\circ}04'14''\text{S } 49^{\circ}53'40''\text{E}$ , 2.II.2003, Rabevobitra et al. 4463 (MO, TEF); *ibid. loco*,  $13^{\circ}04'43''\text{S } 49^{\circ}54'04''\text{E}$ , 13.V.2003, Razakamalala et al. 1272 (MO, P, TEF).

***Psychotria hamifera* C.M. Taylor, sp. nov.** (Fig. 5A–E).

**Holotypus:** MADAGASCAR. **Reg. Analanjanjiffo [Prov. Toamasina]:** Maroantsetra, Ambinanitelo, Marovovonana, nearest village Ambatofotsy, Mangabe forest,  $15^{\circ}17'40''\text{S } 49^{\circ}29'15''\text{E}$ , 690 m, 30.VIII.2004, Antilahimena 2657 (MO-6877030!; iso-: G [G00341935]!, P, TAN).

*Psychotria hamifera* C.M. Taylor is distinguished from other *Psychotria* species in Madagascar by its the combination of the cupuliform shape and length, 20–25 mm long, of the stipules.

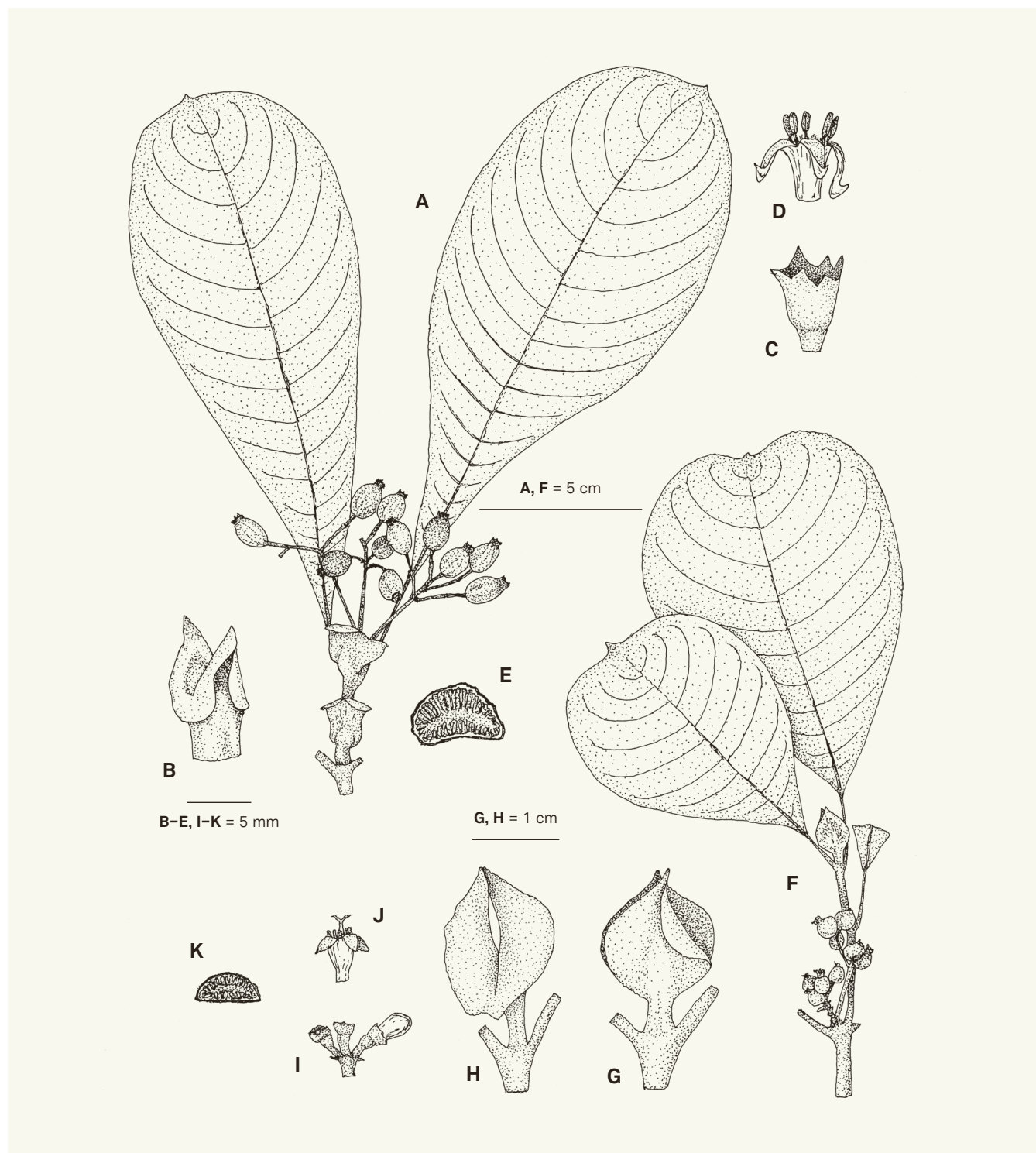
*Shrubs* and small *trees*, collected in flower and fruit variously at 2.5–6 m tall, branched; stems stout, weakly flattened becoming subterete, glabrous. *Leaves* opposite; *petiole* 2.5–5 cm, glabrous; *blade* obovate, 12.5–30 × 5–15 cm, at base tapered and acute, at apex obtuse to rounded or truncate and shortly acuminate with deltate tip 2–5 mm, drying papery, on both surfaces glabrous; secondary veins 11 to 19 pairs, reticulating near margins with higher-order venation or sometimes weakly looping to interconnect, without domatia, with 1 well developed intersecondary vein between pairs of secondary veins, on both surfaces costa and secondary veins prominent, intersecondary veins prominent to plane, and loosely reticulated tertiary venation plane to thinly prominulous. *Stipules* united around stem into a tube, in bud with top portions pressed together with their margins reflexed, at maturity funnellform, persistent with the leaves or tardily deciduous, falling off as a tube around stem, 15–30 mm, on each interpetiolar side with the basal  $\frac{1}{3}$ – $\frac{1}{2}$  of their length triangular and smooth, at top truncate to undulate, glabrous abaxially, adaxially glabrous except densely pubescent on basal smooth portion with trichomes 1–3 mm, with upper portions of tube densely longitudinally venose or fibrous and this visible on one or both sides depending on age and preservation of the stipule. *Inflorescences* terminal, branched, glabrous, subsessile to shortly pedunculate; peduncle to 0.5 cm; branched portion rounded-corymbiform, c. 6 × 6 cm, branched to 2 or 3 orders, c. 35- to 50-flowered; bracts triangular and 0.1–0.5 mm or reduced and represented by a tuft of hirtellous trichomes 0.2–0.5 mm; pedicels 2–5 mm. *Flowers* all pedicellate in umbelliform cymes of 5 to 7, 5- or 6-merous; hypanthium obconic, c. 2 mm, glabrous; *calyx* limb 5–7 mm, glabrous, fleshy, lobed for c.  $\frac{1}{2}$  of its length, lobes narrowly triangular, acute; *corolla* salverform, orange, fleshy, externally glabrous, tube 5–6 mm, cylindrical, c. 3 mm diam. near middle, internally glabrous except densely pilose in throat with trichomes 2–3 mm, lobes narrowly ligulate to triangular, 3–4 mm, obtuse, adaxially shortly galeate, abaxially with conical thickening c. 1 mm; *stamens* with filaments c. 1 mm, inserted in upper part of corolla tube, anthers c. 1.5 mm, exserted; *style* c. 2 mm, *stigmas* c. 1.5 mm, included and positioned below ring of corolla pubescence. *Infructescences* similar to inflorescences or becoming laxer, with pedicels to 8 mm. *Fruits* ellipsoid, 12–15 × 7–10 mm, glabrous, orange, texture unknown; *pyrenes* hemispherical, abaxially with 5 or 6 low, rounded to angled ridges, adaxially glabrous; *endosperm* densely ruminant on all surfaces.

*Etymology*. – The stipules of this new species resemble buckets or pails, and its species epithet refers to this feature.

*Habitat, distribution and phenology*. – *Psychotria hamifera* has been collected in perhumid evergreen forest at 383–861 m on the Masoala Peninsula and nearby eastern escarpment of Madagascar (Antsiranana, Toamasina), with flowers in December and with well-developed fruits in January, February, May, July, and August.

*Conservation status*. – *Psychotria hamifera* is known from six specimen collections representing six unique occurrences in perhumid evergreen forest at 383–861 m elevation. The EOO of the species is 889 km<sup>2</sup>, within the limits for “Endangered” under IUCN Red List Criterion B1; and the AOO is 24 km<sup>2</sup>, also within the limits for “Endangered” under Criterion B2 (IUCN, 2012). Three occurrences are within the generally well-protected Makira PA, and one occurrence is within Masoala PA. The coordinates of its remaining two collection sites map outside Makira PA, but one of them (Davis *et al.* 4534) has label data indicating that it is inside Makira PA in an area with “minimal disturbance”. The interiors of the reserves are well protected but parts close to villages are seriously impacted by exploitation of timber and, to a lesser extent, shifting cultivation (C. Birkinshaw, pers. comm.). Forested areas without formal protection in the vicinity of Masoala PA and Makira PA are subject to degradation by small-scale slash and burn agriculture and mineral exploitation (GOODMAN *et al.*, 2018). The one occurrence definitely outside Makira PA constitutes one location (*sensu* IUCN, 2012) with respect to the known threats; and the occurrences within each protected area constitute a location each for a total of three locations. With one location subject to general habitat degradation and the remaining two locations in protected areas, the Red List status of *P. hamifera* is assessed as “Endangered” [EN B1ab(iii)+2ab(iii)].

*Notes*. – *Psychotria hamifera* is characterized by its robust leaves with obovate blades that are obtuse to rounded or truncate and shortly acuminate at the tip; unusual, large, persistent, tubular stipules; cymose, subsessile to shortly pedunculate inflorescences with pedicellate flowers; well developed truncate calyx limbs; orange, somewhat large corollas; well developed fruits that become orange; and endosperm that is densely ruminant on all sides. The dried specimens seen have a strong reddish brown color. The stipules are distinctive in *Psychotria* in the combination of their tubular, funnel- or skirt-shaped form, persistence, and relatively large size; among the previously known species of *Psychotria*, they are similar only to those of *P. retusa* (Bremek.) A.P. Davis & Govaerts, another endemic Malagasy species. These stipules are also similar to those of *P. palifera*, which is newly described below. The inflorescences have relatively short axes and flowers that are rather closely grouped at anthesis, but the axes and pedicels elongate as the fruits develop so the infructescences are quite lax. The calyx limbs are apparently fleshy, and enclose the corollas



**Fig. 5.** – *Psychotria hamifera* C.M. Taylor: **A**. Fruiting branch; **B**. Stipule at stem apex; **C**. Hypanthium and calyx limb of flower; **D**. Corolla at anthesis; **E**. Cross-section of pyrene and seed.

*Psychotria palifera* C.M. Taylor: **F**. Fruiting branch; **G**. Stem apex with bases of two petioles and young stipules; **H**. Stem apex with bases of two petioles and older stipules; **I**. Portion of inflorescence with two flowers from which corollas have fallen and one flower bud; **J**. Corolla at anthesis; **K**. Cross-section of pyrene and seed.

[**A**: Antilahimena 1778; **B–D**: Antilahimena 1594; **E**: Antilahimena 2657; **F**, **K**: Andrianjafy 368; **G**: Rasoandriana 169; **H**: Andrianjafy 371; **I–J**: Croat 32639]



from young to quite mature buds and mostly cover the fully developed corolla tubes. The few flowers seen are similar to the short-styled form of distylous *Psychotria* species, but whether *P. hamifera* is distylous cannot yet be determined. The fruits are relatively large for *Psychotria*, but similar in size to some other Malagasy *Psychotria* that are hypothesized to possibly be dispersed by lemurs though without any actual documentation of their fruit dispersal. Data for the collection Davis 4535 describe the fruits as “7 cm in diameter” but this appears to be a typographical error for 7 mm. *Psychotria hamifera* agrees with Bremekamp's *Mapouria* Group VI, although the fruits are sometimes larger than Bremekamp documented for this group.

*Psychotria hamifera* is similar to *P. retusa*, which differs in its leaf blades with retuse tips, caducous smaller stipules 9–10 mm long, shorter calyx limbs c. 0.5 mm long, and smaller fruits c. 5 mm in diameter. The mature corollas of *P. retusa* have not been documented; Bremekamp reported the corolla tubes in bud as c. 2.5 mm long and the lobes in bud as c. 1.2 mm long in bud, but the age of those buds was not noted.

*Paratypes*. – MADAGASCAR. Reg. SAVA [Prov. Antisanana]: Antalaha-CR Vinanivao, CAP Masoala Grand, vallée d'Anaovanandrano, 15°44'S 50°10'E, 49 m, 16.IX.2003, Wohlhauser et al. 525 (G, MO, NEU). Reg. Analanjirofo [Prov. Toamasina]: Anjahely, Vohitaly forest, 15°26'28"S 49°32'01"E, 540 m, 23.XII.2002, Antilabimena et al. 1594 (MO, TAN); Sahantaha, 15°13'39"S 49°31'52"E, 600 m, 23.I.2003, Antilabimena 1778 (MO, TAN); Anjahely, 15°24'16"S 49°30'41"E, 393 m, 27.VI.2004, Antilabimena 2587 (MO, TAN); Makira PA, c. 15 km due W of Ambinanitelo, 15°25'11"S 49°29'19"E, 400 m, 17.V.2007, Davis 4534 (K, MO, TAN).

*Psychotria mutabilis* C.M. Taylor, *sp. nov.* (Fig. 6).

**Holotypus:** MADAGASCAR. Reg. Atsinanana [Prov. Toamasina]: Vatomandry, Ambalabe, Ambinanindrano II, Vohibe forest, mountain ridge NW of MBG Camp, 19°08'35"S 48°34'29"E, 720 m, 23.XI.2013, Randrianasolo et al. 1506 (MO-6877034!; iso-: G [G00341932]!, P, TAN).

*Psychotria mutabilis* C.M. Taylor is distinguished from *P. rufovillosa* (Bremek.) A.P. Davis & Govaerts by its proportionally broader leaf blades, inflorescences that are initially subsessile and subcapitate then expand tardily, six-merous flowers, corollas with longer lobes, 3 mm long, and larger fruits.

*Shrubs* and small *trees*, collected in flower and fruit variously at 2–6 m tall, branched; stems weakly flattened to subquadrangular, becoming terete with age, densely hirtellous to hirsute with trichomes 1–2 mm. *Leaves* opposite; *petiole* 10–80 mm, densely hirtellous to hirsute with trichomes 1–2 mm; *blade* obovate to elliptic or broadly elliptic, 6–20.5 × 2.5–12.2 cm, at base cuneate to obtuse, at apex obtuse to broadly rounded and shortly acuminate with tip 1–5 mm, drying chartaceous, adaxially glabrous, abaxially moderately to densely hirtellous, pilosulous, or hirsute on veins and lamina with trichomes 1–2 mm; secondary veins 9 to 14 pairs, reticulating sparsely to extensively

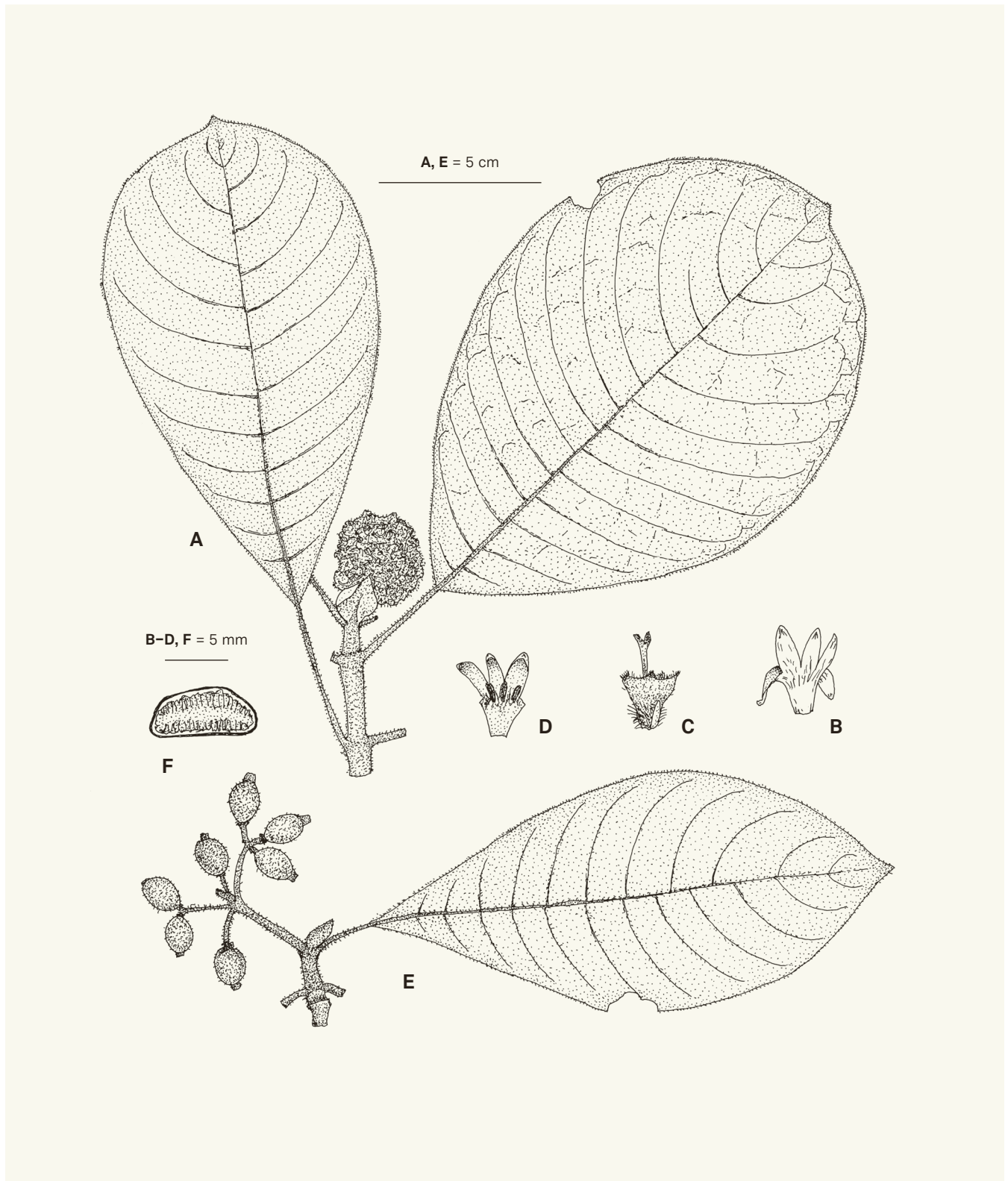
near margins or sometimes looping weakly to interconnect near margins, without intersecondary veins or more often with 1 weak intersecondary vein present between pairs of secondary veins, sometimes with a distinct dense tuft of pubescence in abaxial axils of secondary veins, adaxially venation plane or costa thickened, abaxially costa and secondary veins prominent, intersecondary and loosely reticulated tertiary and quaternary venation plane to prominent, and remaining venation plane. *Stipules* interpetiolar, caducous, on both surfaces moderately to densely pilosulous or hirtellous with trichomes c. 1 mm, ovate, 12–21 mm, abaxially with triangular central portion bounded by low rounded ridges, 2-lobed, lobes linear to ligulate, 2–4 mm, acute, adaxially with dense row of persistent pilose trichomes 1–1.5 mm borne on stem at base of stipule. *Inflorescences* terminal, subcapitate, subsessile; flowering head subglobose, 2–3 cm diam., c. 45- to 60-flowered; bracts narrowly triangular, 1–3 mm, acute. *Flowers* all subsessile in glomerules of 3 to 7, surrounded at base by sericeous to pilose trichomes 1–2 mm, 5- or 6-merous; hypanthium obconic, c. 2 mm, densely pilose to hirtellous with trichomes 1–2 mm; *calyx* limb 2–3 mm, glabrous or sparsely hirtellous with trichomes c. 0.5 mm, truncate to shallowly broadly lobed, lobes up to 0.5 mm, marginally densely pilosulous with trichomes 0.5–0.8 mm; *corolla* tubular-funnelform, yellow, externally sparsely strigillose with trichomes 0.1–0.3 mm, tube cylindrical to funnelform, 2.5–3.5 mm, 2–2.5 mm diam. near middle, internally glabrous except with densely pilosulous ring c. 1 mm wide in upper part, lobes ligulate, 2.5–3 mm, fleshy, adaxially shortly galeate, abaxially with rounded thickening 0.5–1 mm; *stamens* inserted in upper part of corolla tube, filaments c. 0.3 mm, anthers c. 0.8 mm, included; *style* 5–6 mm, *stigmas* 0.5–0.8 mm, exserted. *Infrutescences* becoming lax, cymose, pedunculate; peduncle 1–4.5 cm; branched portion broadly pyramidal to corymbiform, 1.5–2 × 4.5–7 cm, branched to 1 to 3 orders. *Fruits* sessile or with stipe up to 2 mm, subglobose to ellipsoid, 10–11 mm diam., sparsely to moderately pubescent with pilose to hirtellous trichomes c. 1 mm, dark green becoming orange or red, fleshy; *pyrenes* 2, hemispherical, adaxially plane, abaxially smooth; *endosperm* densely and deeply ruminant on both surfaces.

*Etymology*. – The specific epithet refers to the extensive morphological change from the inflorescence to the infrutescence.

*Habitat, distribution and phenology*. – *Psychotria mutabilis* has been collected in perhumid evergreen forest at 640–1100 m in east-central Madagascar (Fianarantsoa, Toamasina), with flowers in November and with well-developed fruits in April, May, and November.

*Conservation status*. – *Psychotria mutabilis* is known from 12 specimen collections representing 12 unique occurrences in





**Fig. 6.** – *Psychotria mutabilis* C.M. Taylor. **A.** Flowering stem; **B.** Corolla, external view; **C.** Basal portion of flower: hypanthium, calyx, subtending bract, style, stigma; **D.** Corolla dissected, interior view; **E.** Fruiting branch; **F.** Cross-section of pyrene and seed. [A–D: Randrianasolo et al. 1506; E–F: McPherson & van der Werff 16468]

perhumid evergreen forest at 640–1100 m elevation. The EOO of the species is 19,610 km<sup>2</sup>, within the limits for “Vulnerable” under IUCN Red List Criterion B1; and the AOO is 40 km<sup>2</sup>, within the limits for “Endangered” under Criterion B2 (IUCN, 2012). Six of the collection sites are within five protected areas: Analamazoatra PA and Mantadia PA, both with a good level of protection; Makira PA and Ankeniheny-Zahamena Corridor PA (two occurrences), both with the interior of reserve well protected but parts close to villages seriously impacted by exploitation of timber and, to a lesser extent, shifting cultivation; and Ranomafana PA, with a good level of protection. The other six collection sites are in unprotected areas adjacent to but outside Analamazoatra, Ankeniheny-Zahamena, and Ranomafana. Forested areas without formal protection in the vicinity of these protected areas are subject to degradation by small-scale slash and burn agriculture and fire to create habitat for cattle farming as well as resource exploitation including logging, hunting and mining (GOODMAN et al., 2018). The five protected areas with one or more collection sites constitute one “location” (sensu IUCN, 2012) each. The remaining six collection sites can be considered as four distinct locations, based on geographic clustering with respect to the scale of the known threats, giving a total of nine locations. Four collection sites in or near Mantadia PA are in close proximity to an active graphite mine and a reduction in habitat, locations, and mature individuals can be inferred. The four unprotected locations are subject to general habitat degradation and at least one of the protected areas is in close proximity to on-going mining operation, causing a decline in AOO, extent and/or quality of habitat, and number of mature individuals. Thus, the Red List status of *P. mutabilis* is assessed as “Vulnerable” [VU B1ab(ii,iii,iv,v)+2ab(ii,iii,iv,v)].

**Notes.** – *Psychotria mutabilis* is characterized by its dense hirtellous pubescence on both vegetative and reproductive structures; medium-sized leaf blades that are mostly obtuse at the tip; well developed interpetiolar stipules with two acute lobes; inflorescences that are initially subsessile, subcapitate, and globose then expand markedly in fruit; subsessile six-merous flowers; rather well developed tubular calyx limbs with rounded, short, densely pubescent lobes; medium-sized yellow corollas; lax, branched inflorescences with well developed peduncles and axes; somewhat large red fruits; and endosperm that is ruminate on both surfaces. The plants dry with a brown or reddish brown color, and the dried trichomes are dark reddish brown or reddened. The upper surfaces of the leaf blades seen are unusual in being completely glabrous, rather than having sparse pubescence at least on the principal veins as in other *Psychotria* species with dense pubescence. This species apparently lacks crypt-type domatia, but the dense pubescence of the abaxial vein axils may function as acarodomatia. The few flowers seen agree with the long-styled form of distylous *Psychotria* species,

but whether this species is distylous cannot be confirmed. The change in form between the subcapitate, subsessile inflorescence and the lax infructescences is notable, but both of these structures are borne on the same stem of *McPherson & van der Werff* 16495 so they clearly belong to the same species. This species agrees with BREMEKAMP (1963)’s *Mapouria* Group VI.

*Psychotria mutabilis* is similar to *P. rufovillosa*, which differs in its elliptic to narrowly elliptic leaf blades 3.5–7 cm wide, inflorescences that are branched before flowering commences and borne on developed peduncles, five-merous flowers, corollas with shorter lobes c. 2 mm long, and smaller fruits 5–6 mm in diameter.

**Paratypes.** – MADAGASCAR. **Reg. Vatovavy-Fitovinany [Prov. Fianarantsoa]:** Ifadenia, PN Ranomafana, 21°15'31"S 47°25'16"E, 974 m, 11.VI.1996, *Birkinshaw* 264 (MO, TAN); *ibid. loco*, 21°18'00"S 47°38'30"E, 29.V.2004, *Rakotonasolo & Zachary* 805 (K, MO, TAN). **Reg. Alaotra-Mangoro [Prov. Toamasina]:** PN Mantadia, 18°47'58"S 48°25'43"E, 19.IV.2010, *De Block et al.* 2528 (BR, K, MO, TAN); *ibid loco*, 18°47'47"S 48°25'32"E, 1100 m, 7.IV.2004, *Maurin* 145 (K, MO, TAN); *ibid. loco*, 18°55'S 48°25'E, 900 m, 2.XI.1994, *McPherson & van der Werff* 16468 (K, MO); *ibid. loco*, 18°48'03"S 48°25'41"E, 965 m, 26.V.2011, *Razakamalala* 6574 (MO, S, TAN); Bekalakody, corridor forestier Analamay Mantadia, 18°45'37"S 48°25'37"E, 943 m, 28.IV.2012, *Razafindrabaja & Antilabimena* 242 (MO, P, TAN); Atsinanana, Didy à Brickaville, [18°29'S 48°48'E], 1954, *Cours* 4904 (MO, P); Makira PA, 15°23'53"S 49°27'05"E, 750 m, 14.V.2007, *Davis* 4505 (K, MO, TAN); NW of Foara Habitation, 19°08'58"S 48°35'39"E, 640 m, 14.III.2005, *Randrianasolo et al.* 1007 (MO, TAN); Périnet-Analamazaotra, [18°56'S 48°26'E], 22.I.1968, *Service Forestier* 28141 (MO, P).

***Psychotria notopleuroides* C.M. Taylor, sp. nov.** (Fig. 1L–N).

**Holotypus:** MADAGASCAR. **Reg. SAVA [Prov. Antsiranana]:** Masoala Peninsula, 3 km SW of “Tamany Fred”, watershed of Anaovandrano riv., 15°45'30"S 50°11'45"E, 50 m, 15.X.1996, *Schatz et al.* 3666 (MO-4848658!; iso-: TAN).

*Psychotria notopleuroides* C.M. Taylor differs from other species of this genus in Madagascar by the combination of its prostrate habit, elliptic leaves that are apically obtuse to truncate and dark green adaxially, shortly cymose inflorescences with well developed peduncles, four-merous flowers, fruits that are red at maturity, and seeds with the endosperm entire except for a T-shaped adaxial intrusion.

**Subshrubs** or fleshy **herbs**, little-branched, with main stems prostrate and rooting, producing ascending, leaf-bearing, erect stems up to 0.3 m tall; stems glabrous or when young densely hirtellous or pilosulous with trichomes 0.2–0.5 mm, flattened becoming subterete. **Leaves** opposite; **petiole** 6–31 mm, densely tomentulose to pilosulous or hirtellous with trichomes 0.2–0.5 mm; **blade** elliptic to obovate, 5–12 × 2.3–6.6 cm, drying papyraceous to chartaceous, adaxially glabrous, abaxially densely hirtellous on veins and sparsely hirtellous on lamina with trichomes 0.1–0.5 mm; secondary veins 5 to 12 pairs, looping broadly to interconnect near margins, without

intersecondary veins, without domatia, adaxially venation plane or costa prominulous, abaxially costa and secondary veins prominent and remaining venation not visible. *Stipules* interpetiolar or shortly united around stem, caducous, abaxially hirtellous with trichomes 0.2–0.5 mm, ovate, 3–6 mm, adaxially glabrous, bilobed, lobes linear, 1–2 mm, glandular at tip. *Inflorescence* terminal, shortly cymose, pedunculate, sparsely to densely hirtellous with trichomes 0.3–1 mm, green; peduncle 3–5.5 cm; branched portion corymbiform, 0.6–2 × 1–2 cm, 10- to 30-flowered, branched to 1 or 2 orders; bracts narrowly triangular, 0.5–2 mm, acute, at tip glandular; pedicels 0.1–1.5 mm. *Flowers* subsessile to pedicellate with both arrangements mixed in cymose to umbelliform groups of 3 to 9, 4-merous; hypanthium obconic to cylindrical, c. 1 mm, glabrous or puberulous with trichomes 0.2–0.3 mm; *calyx* limb 1–1.2 mm, externally glabrous, shallowly lobed, lobes broadly triangular, obtuse, marginally with 2 or 3 glands on each lobe; *corolla* tubular to funnellform, white, externally glabrous, tube c. 3 mm, 1.2–2 mm diam. near middle, internally in upper part and throat with dense ring c. 1 mm wide of pilosulous trichomes 0.3–0.5 mm, lobes ligulate, 1.2–1.5 mm, obtuse to rounded, adaxially plane or with minute galeate projection, abaxially smooth; *stamens* inserted in upper part of corolla tube, filaments c. 0.5 mm, anthers c. 0.8 mm, included or partially exserted; *style* c. 3.5 mm, *stigmas* c. 0.3 mm, exserted. *Infructescences* similar to inflorescences, except becoming displaced to pseudaxillary by stem growth from one axillary bud. *Fruits* ellipsoid, c. 6 × 5 mm, glabrous, red, apparently fleshy; *pyrenes* 2, hemispherical, adaxially plane, abaxially with 4–5 rounded longitudinal ridges; *endosperm* entire abaxially, adaxially with 1 medial, longitudinal, T-shaped intrusion.

*Etymology.* – This new species resembles several species of the neotropical genus *Notopleura* (Benth.) Bremek., and the species epithet refers to this similarity. *Notopleura* has been commonly confused with Neotropical species of *Psychotria* but these genera are not closely related (RAZAFIMANDIMBISON et al., 2014). Terrestrial species of *Notopleura* differ from *Psychotria* in their consistently pseudoaxillary inflorescences, stipules with well developed glands on the margins and/or a medial appendage, lack of persistent colleters at the stipule insertion, and molecular sequences that indicate their relationships are in another tribe, *Palicoureeae*.

*Habitat, distribution and phenology.* – *Psychotria notopleuroides* has been collected in perhumid evergreen forest at 0–200 m on the Masoala Peninsula in eastern Madagascar (Antsiranana, Toamasina), with flowers in October and November and with fruits in June and September.

*Conservation status.* – *Psychotria notopleuroides* is known from four specimen collections representing four unique

occurrences in perhumid evergreen forest at 0–200 m elevation. The EOO of the species is 69 km<sup>2</sup>, within the limits for “Critically Endangered” under IUCN Red List Criterion B1; and the AOO is 16 km<sup>2</sup>, within the limits for “Endangered” under Criterion B2 (IUCN, 2012). Three occurrences are within the Masoala PA. Two of these occurrences are in the Anaovandrano river watershed and may be particularly sensitive to disturbances. The interior of Masoala PA is well protected but parts close to villages are impacted by exploitation of timber and, to a lesser extent, shifting cultivation (C. Birkinshaw, pers. comm.). A fourth occurrence is the westernmost point, at Ambanizana, and is approximately 800 m outside Masoala PA. Forested areas without formal protection in the vicinity of Masoala PA are subject to degradation by small-scale slash and burn agriculture and resource exploitation including logging, hunting and mining (GOODMAN et al., 2018). The westernmost collection site is along the Androka River and it constitutes one location (sensu IUCN, 2012) with respect to the known threats. This location’s disappearance would reduce EOO, AOO, the number of locations, and the number of mature individuals. The two easternmost occurrences, within the Anaovandrano River watershed, constitute a second location with regard to known threats, and the remaining occurrence, within Masoala PA, south of the unprotected occurrence, is a third location. With three locations, the sensitive nature of watershed habitats at two of the locations, and given general habitat degradation in unprotected sites, the Red List status of *P. notopleuroides* is assessed as “Endangered” [EN B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v)].

*Notes.* – *Psychotria notopleuroides* is characterized by its unusual prostrate habit, triangular caducous stipules, medium-sized to rather small leaves that are obtuse to usually rounded or truncate at the apex, shortly cymose inflorescences that are initially terminal but quickly displaced to pseudoaxillary by subsequent growth from an axillary bud, somewhat small four-merous corollas, medium-sized red fruits, pyrenes that are shallowly ridged abaxially, and endosperm that lacks rumination except for a well developed, medial, T-shaped intrusion on the adaxial face. The specimens dry with a brown or reddish brown color, and the dried trichomes are dark reddish brown. The prostrate stems root along their length, and produce new stems sympodially. The leaves appear to be similar to those of some other *Rubiaceae* found in dark humid understory, with the epidermis composed of relatively large cells, the upper surface dark velvety green in life, and the lower surface light-colored and perhaps silvery. The collection data of one specimen (Zjhra & Hutcheon 378) note that the leaves are brittle. Most of the leaves on the dried specimens have revolute margins, but it is not clear if this is a character found in life or an artifact of drying. The corolla lobes of *P. notopleuroides* are distinctive in being rounded at the tips, similarly to the leaves, rather than acute as in most species of this genus. Two flowering collections



have been seen, and both agree with the long-styled form of distylous *Psychotria* species; whether this new species is distylous cannot yet be determined. This new species is not similar to any other *Psychotria* known from Madagascar.

The pyrenes of *Psychotria notopleuroides* have the form BREMEKAMP (1963) used to diagnose *Apomuria*. All the Malagasy species of that group, however, differ from this new species in their erect shrub habit and five- or six-merous flowers. At first glance *Psychotria notopleuroides* is similar in aspect to the *Rubiaceae* genera *Geophila* D. Don and *Puffia* Razafim. & B. Bremer, but both of those differ in their cordiform leaves, subcapitate inflorescences, and seeds with endosperm that lacks any rumination or intrusions. *Psychotria notopleuroides* is also similar to *P. decumbens* (Bremek.) A.P. Davis & Govaerts, which is not well known but can be separated by its hirtellous bilobed stipules and oblanceolate leaves with acute to deltate tips that appear, based on herbarium specimens, to be similarly colored on both surfaces. The number of *P. decumbens*'s corolla lobes was not described and cannot be discerned from the on-line type images. Bremekamp classified *P. decumbens* in *Mapouria*, which was diagnosed by its seed with the endosperm ruminate to some degree, but he did not actually see its seeds so this character has also not been confirmed.

*Paratypes*. – MADAGASCAR. **Reg. Sava [Prov. Antsiranana]**: Antalaha-CR Vinanivao, CAP Masoala Grand Parc, 15°44'S 50°10'E, 50 m, 15.IX.2003, Wohlhauser et al. 503 (G, MO, NEU). **Reg. Analanjirofo [Prov. Toamasina]**: Masoala Peninsula, Tampolo, 15°41'52"S 49°57'56"E, 22.X.2001, Labat & Andrianjafy 3377 (BR, G, K, MO, TAN, TEF); Ambanizana, along Androka River south of MBG house, 15°39'30"S 49°57'30"E, 0 m, VI.1993, Zjhra & Hutcheon 378 (MO).

***Psychotria palifera* C.M. Taylor, sp. nov.** (Fig. 5F–K, 7).

**Holotypus:** MADAGASCAR. **Reg. Analanjirofo [Prov. Toamasina]**: Ambatondrazaka, Réserve Naturelle Intégrale de Zahamena, 15–20 km au SE d'Ambarifotsy, Rivière d'Ihofika, 17°39'46"S 48°59'05"E, 560–630 m, 27.V.2003, Andrianjafy et al. 368 (MO-5789365!; iso-: TAN).

*Psychotria palifera* C.M. Taylor is distinguished from its congeners by its relatively large stipules with a distinctive shape in bud, along with the combination of its obovate, domatiate leaf blades that are subtruncate to shallowly retuse at the apex, relatively short, fasciculate, rounded inflorescences that often become overtopped by stem growth from both axils, and well developed lobed calyx limbs; the stipules of this new species are fused around the stem in the basal part into a tubular sheath and in the upper portion free, obovate, acute to acuminate or bidenticulate, and with dense longitudinal veins or fibers.

*Shrubs* and small *trees*, collected in flower variously at 6–12 m tall, branched; stems weakly flattened becoming terete, glabrous. *Leaves* opposite; *petiole* 5–30 mm, glabrous; *blade*

obovate, 5–18 × 2.8–11.5 cm, at base cuneate to obtuse, at apex subtruncate to shallowly retuse then abruptly acuminate with tip 1–3 mm, drying papyraceous to chartaceous, on both surfaces glabrous and weakly shiny; secondary veins 6 to 12 pairs, looping to interconnect near margins at least in apical part of blade, without intersecondary veins or usually with 1 intersecondary vein present between pairs of secondary veins, with regularly developed crypt domatia, adaxially venation plane or costa and sometimes secondary veins prominulous, abaxially costa and secondary veins prominent and remaining venation plane. *Stipules* fused around stem, caducous, glabrous on both surfaces, sheath portion cylindrical, 3–12 mm, free upper portion ovate, 5–15 mm, with dense longitudinal fibers or veins, acute to acuminate or bidenticulate. *Inflorescences* terminal, cymose, with cymes borne on fasciculate axes, the group of axes sessile to subsessile, glabrous to densely pilosulous with trichomes 0.1–0.2 mm; flowering-bearing portion rounded-corymbiform, 3–6 × 4–8 cm, branched to 2 or 3 orders, c. 30- to 60-flowered; bracts reduced or broadly triangular, 0.1–0.5 mm, acute; pedicels 0.5–1 mm. *Flowers* all pedicellate in dichasial cymes of 5 to 9, 5-merous; hypanthium obconic, c. 0.8 mm, glabrous; *calyx* limb 1–1.2 mm, glabrous, denticulate or lobed to 1/3 of its length, lobes triangular, acute to obtuse; *corolla* funnellform, yellow, externally glabrous, tube c. 3.5 mm, c. 1.5 mm in diam. near middle, internally densely pilose in upper part with trichomes c. 1 mm, lobes ligulate to triangular, c. 2 mm, obtuse, adaxially shortly galeate, abaxially smooth; *stamens* inserted in upper part of corolla tube, filaments not seen, anthers c. 0.8 mm, included or partially exerted, positioned with tips at top of corolla tube; *style* c. 4 mm, stigmas c. 1 mm. *Infructescences* similar to inflorescences or often markedly overtopped by growth from subtending axils. *Fruits* subglobose, c. 5 mm diam., glabrous, red, with calyx limb 1.5–4 mm, lobed for 1/4–1/2 of its length; *pyrenes* 2, hemispherical, adaxially plane, abaxially smooth; *endosperm* densely deeply ruminate on both surfaces.

*Etymology*. – The profile shape of the stipules in bud resembles a spade, and the specific epithet refers to that implement.

*Habitat, distribution and phenology*. – *Psychotria palifera* has been collected in humid evergreen forest at 560–1100 m in central eastern Madagascar (Toamasina), with flowers in March and with fruits in May and June.

*Conservation status*. – *Psychotria palifera* is known from ten specimen collections representing nine unique occurrences in humid evergreen forest at 560–1100 m elevation. The EOO of the species is 2,716 km<sup>2</sup>, within the limits for “Endangered” under IUCN Red List Criterion B1; and the AOO is 36 km<sup>2</sup>, also within the limits for “Endangered” under Criterion B2 (IUCN, 2012). Six of the collection sites are within two protected areas: Zahamena PA (two sites), with a good protection





Fig. 7. – *Psychotria palifera* C.M. Taylor.  
[Rasoanindriana et al. 169] [Photo: S.E. Rakotoarisoa]

level; and Ankeniheny-Zahamena Corridor PA (4 sites), with the interior of the reserve well protected but parts close to villages seriously impacted by exploitation of timber and, to a lesser extent, shifting cultivation (C. Birkinshaw, pers. comm.). The remaining three collection sites are in unprotected areas: one to the east of Ankeniheny-Zahamena Corridor PA and c. 4 km west of Betampona PA (forêt secondaire de Sondrimaro); one c. 200 m outside Ankeniheny-Zahamena Corridor in secondary forest (Ambodivoromborogna Forest); and the third c. 11 km east of the southernmost parcels of Ankeniheny-Zahamena Corridor PA. This distant collection is from 1975 in an area with no protection, near a major roadway; it very likely that the population no longer exists at this collection site. The

loss of this site would significantly decrease the EOO for this species as well as the AOO. Forested areas without formal protection in the vicinity of these protected areas are subject to degradation by small-scale slash and burn agriculture and fire to create habitat for cattle farming as well as resource exploitation including logging, hunting and mining (GOODMAN et al., 2018). All three of the unprotected collecting sites would be subject to such threats. The northernmost two collections are within Zahamena PA, and constitute a single “location” (sensu IUCN, 2012, 2019). Three collections are from the northernmost parcel of Ankeniheny-Zahamena Corridor adjacent to Zahamena PA, and constitute a second location. One collection is from forêt d’Ambatoaragnana, Ankeniheny-Zahamena Corridor PA and constitutes a third location. Each of the three widely separated unprotected sites constitutes a separate location, giving a total of six locations. Three locations are in generally well-protected areas, but the other three are in vulnerable areas, one of which may already be lost, causing a decline in EOO and AOO, extent and/or quality of habitat, number of locations and number of mature individuals. Thus, the Red List status of *P. palifera* is assessed as “Vulnerable” [VU B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v)].

*Notes.* – *Psychotria palifera* is characterized by the combination of its relatively robust habit for its genus; glabrous vegetative structures; medium-sized obovate leaf blades with small domatia in the abaxial axils and the apices truncate to shallowly retuse; distinctive large stipules; relatively short, fasciculate, corymbiform inflorescences that often become overtopped by growth from both subtending axils; well-developed lobed calyx limbs; medium-sized fruits; pyrenes that are smooth abaxially; and endosperm that is reticulate on both surfaces. The specimens dry with a dark brown color, which is also seen in the sapwood of cut stems. The stipules of *P. palifera* are unusually well developed and distinctive in form: these are fused in their basal portions into a cylindrical sheath, then the upper parts are ovate, venose or fibrose, and initially pressed flat together with their margins rolling back. These stipules also vary markedly in size, from smaller ones on terminal buds of stems with young leaves to those that are mature and dehiscing. These stipules are similar in form to those of *P. hamifera*, newly described above. Only one fully developed flower has been seen, and was not dissected in order to preserve it; it agrees with the long-styled form of distylous *Psychotria* species, but whether *P. palifera* is distylous cannot be determined. The infructescences are relatively short and have a characteristic form that is commonly seen in *Psychotria*, with the flowers borne in groups on several axes, and these axes then arising from a node that either bears developed leaves, or bears an internode that is hardly developed (1–2 mm long) and then another node that bears bracts and the axes. This arrangement was analyzed in detail by TAYLOR (2020), who

noted that it is part of continuous variation in inflorescence form in this genus, and its interpretation as pedunculate vs. subsessile or fasciculate depends on the degree of development of the leaf-like structures borne from the subtending node: if these are small they are considered bracts and the inflorescence pedunculate, while if they are enlarged and green they are considered leaves and the inflorescence sessile to subsessile and fasciculate. In *P. palifera* the inflorescences seen are subtended by developed leaves, and are also overtopped or enclosed by leafy stems that develop from one or usually both of the axils of the subtending leaves. The development of a reduced internode just above the leaves that subtend the inflorescence is variable in *P. palifera*, so it is sometimes evident and sometimes apparently did not develop. The calyx limb appears to enlarge as the fruit develops, to almost twice its size at anthesis, but the flowers are not well enough documented to confirm this. This species agrees with BREMEKAMP (1963)'s *Mapouria* Group VII. A fruiting specimen is chosen as the type because most of the characters that contrast it with the similar species Bremekamp treated are in the fruits and seeds.

*Psychotria palifera* is similar to *P. imerinensis* (Bremek.) A.P. Davis & Govaerts and *P. manampamihensis* (Bremek.) A.P. Davis & Govaerts, which both can be separated by their shorter ligulate to ovate stipules, 2–5 mm long, and their shorter, truncate to denticulate calyx limbs, 0.5–1 mm long, and they also often differ by their narrower leaf blades, 1.2–6 cm wide.

**Paratypes.** – MADAGASCAR. **Reg. Analanjirofo [Toamasina]:** Ambatondrazaka, RN Zahamena, 17°39'46"S 48°59'05"E, 560–360 m, 27.V.2003, *Andrianjafy et al.* 371 (CNARP, MO, P, TEF); Vavatenina, à 10 km au N d'Anamborano, 17°42'04"S 49°00'48"E–17°42'04"S 49°00'48"E, 620 m, 12.VI.2004, *Andrianjafy et al.* 436 (CNARP, MO, P, TEF); PN Zahamena, 17°33'30"S 48°53'35"E, 800 m, 5.V.2003, *Rakotonandrasana* 688 (CNARP, MO, TEF); *sine loco*, 17°41'27"S 48°59'52"E, 13.VI.2001, *Randrianjanaka et al.* 611 (CNARP, MO, P, TEF); Miarinarivo–Anamborano, Ambinanisavaharina, 17°41'15"S 49°00'02"E, 580–620 m, 14.VI.2001, *Ratovoson et al.* 492 (CNARP, MO, P, TEF); Atsinanana, along rte #2, 41 km E of Perinet, [18°55'00"S 48°37'00"E], 600 m, 1.III.1975, *Croat* 32639 (MO); Toamasina II, Sahambala, Sahavongo, forêt d'Ambodivoromborogna, 18°01'41"S 49°05'37"E, 608 m, 20.V.2017, *Ralaijaona & Syde* 159 (K, MO, P, TAN); forêt d'Ambatoaragnana, 18°01'31"S 49°04'59"E, 675 m, 21.V.2017, *Rasoanindriana et al.* 169 (K, MO, P, TAN); Ambodirafia, proche Lohanifotsy, 17°52'54"S 49°09'56"E, 452 m, 20.VI.2017, *Rasoanindriana et al.* 201 (BR, K, MO, P, TAN).

***Psychotria razafimandimbisonii* C.M. Taylor, sp. nov.** (Fig. 3F–I).

**Holotypus:** MADAGASCAR. **Reg. Haute Matsiatra [Prov. Fianarantsoa]:** 2 km W de la gare Andrambovato, côté riv. Tatamaly, 21°30'07"S 47°24'06"E, 1075 m, 13.X.2000, *Rakotovoao & Randiantafika* 1011 (MO-04804424; iso-: TAN).

*Psychotria razafimandimbisonii* C.M. Taylor is distinguished from *P. retusa* (Bremek.) A.P. Davis & Govaerts by its markedly retuse leaf blades without acarodomatia, shorter stipules,

abaxially weakly ridged pyrenes, and endosperm that is ruminant on both surfaces.

*Shrubs* and small *trees*, collected in flower and fruit variously at 3–7 m tall, branched; stems glabrous, weakly flattened becoming subterete. *Leaves* opposite; *petiole* 4–42 mm, glabrous; *blade* obovate, 4–7 × 3–11 cm, at base acute to obtuse, at apex retuse for 1/5–1/4 of its length with sinus broadly rounded and sometimes costa terminating in an apiculate tip to 1 mm, drying papery to chartaceous, glabrous on both surfaces; secondary veins 8 to 11 pairs, weakly looping to interconnect, without intersecondary veins or with reticulated tertiary veins extending between some pairs of secondary veins, without domatia, adaxially costa prominulous and remaining venation plane or secondary veins sometimes thickened, abaxially costa and secondary veins prominent, loosely reticulated tertiary venation plane to prominulous, and remaining venation plane and not visible. *Stipules* fused around the stem for their entire length, caducous, externally glabrous, 2–4.5 mm, interpetiolarly truncate or rounded to obtusely angled, adaxially pilosulous with trichomes 0.8–1 mm, entire to bidenticulate. *Inflorescences* terminal, cymose, pedunculate, glabrous to moderately pilosulous with trichomes 0.1–0.3 mm, subtended by 1 reduced internode to 1 cm, at top with truncate to rounded stipules 1.5–3 mm, without leaves or with foliaceous bracts up to 2 cm; peduncles 0.6–4.5 cm; branched portion rounded-corymbiform, 2–5.5 × 4–9 cm, branched to 2 or 3 orders, c. 35- to 70-flowered; bracts triangular to rounded, 0.2–1 mm, aristate to bilobed or fimbriate; pedicels 0.5–2.5 mm. *Flowers* all pedicellate in dichasial cymes of 5 to 7, 5-merous, distylous; hypanthium ellipsoid to obconic, c. 1 mm, glabrous to puberulous; *calyx* limb 1–1.2 mm, glabrous, truncate to denticulate; *corolla* funnelform, yellow, externally glabrous, tube 4.5–5 mm, 1.2–1.5 mm diam. near middle, internally in upper part with densely pilosulous ring c. 1 mm wide with trichomes c. 0.3 mm, lobes triangular to narrowly triangular, 1.5–2 mm, at tip acute, adaxially galeate, abaxially with rounded thickening; *stamens* in short-styled form inserted in upper part of corolla tube, filaments c. 1 mm, anthers c. 1.5 mm, partly to fully exerted, in long-styled form filaments c. 0.3 mm, anthers c. 1 mm, included with tips positioned at top of corolla tube; *style* in short-styled form 2–3 mm, *stigmas* 0.5–1 mm and included, in long-styled form style 5.5–6 mm, stigmas 0.8–1 mm and exerted. *Infrutescences* similar to inflorescences. *Fruits* ellipsoid to subglobose, 5–6 mm diam., glabrous, red; *pyrenes* 2, hemispherical, adaxially with 3–4 weak rounded longitudinal ribs; *endosperm* densely deeply ruminant on both surfaces.

**Etymology.** – This elegant, tall, distinctive new species named for one of its collectors, Dr. Sylvain Razafimandimbison, a leading specialist in Malagasy *Rubiaceae* and a native of Madagascar.

*Habitat, distribution and phenology.* – *Psychotria razafimandimbisonii* has been collected in humid evergreen forest at 400–1100 m in central eastern Madagascar (Fianarantsoa), with flowers in August through November and with fruits in April and October. This species is unusual for *Psychotria* in being represented by more flowering than fruiting specimens.

*Conservation status.* – *Psychotria razafimandimbisonii* is known from 13 specimen collections representing 12 unique occurrences in humid evergreen forest at 400–1100 m elevation. The EOO of the species is 322 km<sup>2</sup>, within the limits for “Endangered” under IUCN Red List Criterion B1; and the AOO is 32 km<sup>2</sup>, also within the limits for “Endangered” under Criterion B2 (IUCN, 2012). Eleven of the collection sites are within two protected areas: Fandrina Vondrozo Forest Corridor Reserve, whose interior is well protected but parts close to villages seriously impacted by exploitation of timber and shifting cultivation (C. Birkinshaw, pers. comm.); and the well-protected Ranomafana PA. One collection is on the eastern boundary of Ranomafana PA and label information indicates the habitat is infested with invasive *Psidium* L.; this constitutes a single location (sensu IUCN, 2012) based on the unique threats known to occur. It is likely that the border edges of the protected area are subject to degradation by small-scale slash and burn agriculture and resource exploitation including logging, hunting and mining (GOODMAN et al., 2018) and this location may have loss of suitable habitat. The northernmost collection is within Fandrina Vondrozo Forest Corridor Reserve, and constitutes a second location. The southernmost collection is also within Fandrina Vondrozo, along the Tatamaly River, a possible sensitive habitat due to the water resources and in a separate parcel of the Reserve, and is considered a third location. The remaining collection sites are all in the interior of Ranomafana PA and thus not subject to the threats at the first location. These constitute another location for a total of four locations with respect to known threats. Three locations are in generally well-protected areas but the fourth can be considered vulnerable for loss of habitat quality, thus the Red List status of *P. razafimandimbisonii* is assessed as “Endangered” [EN B1ab(iii)+2ab(iii)].

*Notes.* – *Psychotria razafimandimbisonii* is characterized by the combination of its glabrous vegetative structures; medium-sized leaves that are markedly retuse at the top and lack domatia; relatively small, broadly rounded to truncate stipules; pedunculate corymbiform inflorescences with the flowers pedicellate in dichasial groups and the peduncle borne on a reduced internode topped by a leafless node; truncate to denticulate, medium-sized calyx limbs; slender, yellow, medium-sized corollas; medium-sized ellipsoid fruits; pyrenes that are weakly ridged abaxially; and endosperm that is ruminant on both surfaces. The specimens characteristically

dry brown or yellowish brown. The markedly retuse leaves are distinctive, and unusual in *Rubiaceae*. These are easily mistaken at first glance for leaves that are damaged by insect or physical tearing, but the complete leaves consistently have this form. The sinus is usually edged for part or all of its length by the distalmost pair of secondary veins, with no blade tissue extending out from them on the distal side. The secondary leaf veins are not markedly more closely set near the apex, so the retuse shape appears to be due to additional growth of the lamina and marginal tissue rather than to a foreshortened central portion and costa. The margins of most of the leaf blades are thinly revolute, but this may be an artifact of drying rather than a character of the living plants. The adaxial trichomes of the stipules are a little longer than the sheath, so these extend past it and can appear to be marginal cilia; whether these trichomes are covered by the stipule in life then the stipule shrinks in drying is not known. The inflorescences are distinctive in the reduced stem segment at the base of the peduncle, which is leafless but has two truncate stipules. The inflorescences are described on some labels as whitened. This new species agrees with BREMEKAMP (1963)’s *Mapouria* Group VI.

*Psychotria razafimandimbisonii* is similar to *P. retusa* (Bremek.) A.P. Davis & Govaerts, which can be separated by its leaves that are only shallowly retuse at the apex and have regularly developed domatia in the abaxial vein axils, larger stipules 9–25 mm long, abaxially smooth pyrenes, and endosperm that is ruminant only on the abaxial side. *Psychotria razafimandimbisonii* is also similar to *P. manampamihensis* (Bremek.) A.P. Davis & Govaerts, which can be separated by its generally smaller, obovate leaf blades, 5–12 × 3–6 cm, that have regularly developed domatia and are obtuse to truncate at the apex with acuminate tips 1–8 mm long, stipules that are slenderly acuminate at the top, and flowers that are subsessile or borne on shorter pedicels, up to 0.5 mm long.

*Paratypes.* – MADAGASCAR. Reg. Vatovavy-Fitovinany [Prov. Fianarantsoa]: distr. Ifadenia, Ranomafana PN, 21°15'25"S 47°25'30"E, 918 m, 24.IV.2005, Acevedo-Rodríguez & Razafindralaibe 14457 (MO, US); 21°02'00"S 47°18'00"E–21°25'00"S 47°37'00"E, 400–1375 m, 14.VIII.1988, Kremen 88-1 (MO); 21°15'36"S 47°25'12"E, 854–915 m, 1.XI.1998, Almeda 7932 (CAS, MO, TAN); 21°16'S 47°25'E, 900–1100 m, 31.X.1998, Daniel 9011 (CAS, MO, TAN); 21°16'S 47°26'E, 1000–1100 m, 4.XI.1998, Daniel 9098 (CAS, MO, TAN); 21°15'S 47°25'E, 1100 m, 3.XI.1997, Davis et al. 1045 (K, MO, TAN); 21°15'S 47°27'E, 800–1000 m, 3–8.IX.1993, Kotozafy et al. 212 (MO); *ibid. loco*, 900 m, 19–21.X.1993, Kotozafy & Randriamanantena 335 (MO); 21°15'S 47°28'E, 950 m, 3.X.1986, Nicoll 116 (MO); 7 km W of Ranomafana, Duke University Primate Center, 21°16'S 47°25'E, 1000 m, 27.X.1987, Overdorff 39 (MO); 21°15'50"S 47°25'17"E, 998 m, 14.IV.2016, Razafimandimbison et al. 1381 (MO, S, TAN); Vatoharanana, 40 km S Ranomafana (ville), 21°17'04"S 47°26'00"E, 1025 m, 2.X.2000, Rakotovoao & Randriantafika 957 (MO, P, TAN).



## Acknowledgments

Many thanks are due to Laurent Gautier, Aaron Davis, Sylvain Razafimandimbison, Sylvie Andriambololonerana, Noro Ravololomanana, Armand Randrianasolo, Laure Barrabé, Peter Phillipson, Zach Rogers, Petra De Block, Chris Davidson, Frederic Piesschaert, Richard Abbott, and especially Chris Birkinshaw for information, collegial conversations, and general help. For detailed information about conservation threats and protected areas, we thank Sylvie Andriambololonerana, Chris Birkinshaw, Laurent Gautier, Marina Rabarimanarivo, and Armand Randrianasolo, for help with analytic maps we thank Burgund Bassüner and for the field photographs, we thank Patrice Antilahimena and Solofo Rakotoarisoa. Useful commentary was provided by two anonymous reviewers, and Martin Callmänder and his colleagues at Candollea provided exceptional editorial help. The first author thanks Sharon Christoph, Chris Davidson, and the Conservatoire et Jardin botaniques de Genève for support for travel, and James S. Miller for general support for this project.

## References

- ANDERSSON, L. (2002). Relationships and generic circumscriptions in the *Psychotria* complex (Rubiaceae, Psychotrieae). *Syst. Geogr. Pl.* 72: 167–202.
- ANDERSSON, L. & J.H.E. ROVA (1999). The rps16 intron and the phylogeny of the Rubioideae (Rubiaceae). *Pl. Syst. Evol.* 214: 161–186.
- BARRABÉ, L., L. MAGGIA, Y. PILLON, F. RIGALT, A. MOULY, A.P. DAVIS & S. BUERKI (2014). New Caledonian lineages of *Psychotria* (Rubiaceae) reveal different evolutionary histories and the largest documented plant radiation from the archipelago. *Mol. Phylogenet. Evol.* 71: 15–35.
- BREMEKAMP, C.E.B. (1963). Sur quelques genres de Psychotriées (Rubiaceae) et sur leurs représentants malgaches et comoriens. *Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Tweede Sect.* 54(5).
- CORNET, A. (1974). Essai de cartographie bioclimatique à Madagascar. *Notic. Explic. ORSTOM* 55.
- DAVIS, A.P., R.H.A. GOVAERTS & M. BRIGGS (2007). Indian Ocean Mapouria species transferred to *Psychotria* (Rubiaceae-Psychotrieae). *Blumea* 52: 245–262.
- DUDLEY, N. (ed.) (2008). *Guidelines for applying protected area management categories*. IUCN, Gland.
- GOODMAN, S.M., M.J. RAHERILALAO & S. WOHLHAUSER (ed.) (2018). *Les aires protégées terrestres de Madagascar: leur histoire, description et biote / The terrestrial protected areas of Madagascar: their history, description, and biota*. 3 vol. Association Vahatra, Antananarivo.
- IUCN (2012). *IUCN Red List Categories and Criteria. Version 3.1*. Ed. 2. Gland & Cambridge.
- IUCN [STANDARDS AND PETITIONS COMMITTEE] (2019). *Guidelines for Using the IUCN Red List Categories and Criteria. Version 14*. Prepared by the Standards and Petitions Committee.
- JOHANSSON, J.T. (1992). Pollen morphology in *Psychotria* (Rubiaceae, Rubioideae, Psychotrieae) and its taxonomic significance. A preliminary survey. *Opera Bot.* 115.
- LAWRENCE, G.H.M. (1951). *Taxonomy of Vascular Plants*. The Macmillan Company, New York.
- MALCOMBER, S.T. & C.M. TAYLOR (2009). A systematic revision of Gaertnera (Rubiaceae, Gaertnereae). *Ann. Missouri Bot. Gard.* 96: 575–671.
- NEPOKROEFF, M., B. BREMER & K.J. SYTSMA (1999). Reorganization of the genus *Psychotria* and tribe Psychotrieae (Rubiaceae) inferred from ITS and rbcL sequence data. *Syst. Bot.* 24: 5–27.
- PETIT, E.M.A. (1964). Les espèces africaines du genre *Psychotria* L. (Rubiaceae) I. *Bull. Jard. Bot. État Bruxelles* 34.
- PIESSCHAERT, F. (2001). *Carpology and pollen morphology of the Psychotrieae (Rubiaceae-Rubioideae)*. Ph.D. Dissertation, Catholic University of Leuven, Belgium.
- RAZAFIMANDIMBISON, S.G., C.M. TAYLOR, N. WIKSTROM, T. PAILLER, A. KHODABANDEH & B. BREMER (2014). Phylogeny and generic limits in the sister tribes Psychotrieae and Palicoureeae (Rubiaceae): evolution of schizocarps in *Psychotria* and origins of bacterial leaf nodules in the Malagasy species. *Amer. J. Bot.* 101: 1102–1126.
- ROBBRECHT, R. (1988). Tropical woody Rubiaceae. *Opera Bot. Belg.* 1.
- RUBIACEAE PROJECT (2020). Missouri Botanical Garden, St. Louis. [<http://www.tropicos.org/Project/Rubiaceae>]
- SHADIE, P., N. DUDLEY & S. STOLTON (2013). *IUCN WCPA best practice guidance on recognizing protected areas and assigning management categories and governance types*. Best Practice Protected Area Guidelines Series 21. IUCN, Gland.
- TAYLOR, C.M. (1996). Overview of the Psychotrieae (Rubiaceae) in the Neotropics. *Opera Bot. Belg.* 7: 261–270.
- TAYLOR, C.M. (2006). Rubiacearum americanarum magna hama pars XVIII: new species of *Psychotria* subg. *Psychotria* from Central America and western South America. *Novon* 16: 142–154.
- TAYLOR, C.M. (2012). *Psychotria*. In: DAVIDSE, G. et al. (ed.), *Fl. Mesoamericana* 4(2): 192–241.
- TAYLOR, C.M. (2020). Overview of *Psychotria* in Madagascar (Rubiaceae, Psychotrieae), and of Bremekamp's foundation study of this group. *Candollea* 75: 51–70.
- TAYLOR, C.M., S.G. RAZAFIMANDIMBISON, L. BARRABÉ, J.G. JARDIM & M.R.V. BARBOSA (2017). *Eumachia* expanded, a pantropical genus distinct from *Psychotria* (Rubiaceae, Palicoureeae). *Candollea* 72: 289–318.