New rare and threatened species of Peponidium and Pyrostria (Rubiaceae, Vanguerieae) from the drylands of Madagascar

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New rare and threatened species of Peponidium and Pyrostria (Rubiaceae, Vanguerieae) from the drylands of Madagascar

Jens Klackenberg & Sylvain G. Razafimandimbison

Abstract

KLACKENBERG J. & S.G. RAZAFIMANDIMBISON (2024). New rare and threatened species of Peponidium and Pyrostria (Rubiaceae, Vanguerieae) from the drylands of Madagascar. *Candollea* 79: 53–62. In English, English and French abstracts. DOI: http://dx.doi.org/10.15553/c2024v791a3

Four new species of the tribe *Vanguerieae* (*Rubiaceae*) from southern, southwestern and western Madagascar are described and illustrated. Two species belong to the genus *Pyrostria* Comm. ex Juss.: *P. costata* Klack. & Razafim. with small leaves and distinctly ribbed pollen presenters and fruits, and *P. macrocarpa* Klack. & Razafim. characterized by its large, obconical, 5–6-lobed fruits. The other two species belong to the Malagasy subendemic genus *Peponidium* Arènes: *P. leroyi* Klack. & Razafim., characterized by hairy leaves with ciliate margins, sparsely pubescent flowers and ribbed pollen presenters, and *P. sessile* Klack. & Razafim., distinct by its cordate almost sessile leaves and double-tipped corolla lobes. Risk of extinction assessments for all four species are presented, as well as the respective distribution maps.

Résumé

KLACKENBERG J. & S.G. RAZAFIMANDIMBISON (2024). Nouvelles espèces rares et menacées dans les genres Peponidium et Pyrostria (Rubiaceae, Vanguerieae) des zones arides de Madagascar. *Candollea* 79: 53–62. En anglais, résumés anglais et français. DOI: http://dx.doi.org/10.15553/c2024v791a3

Quatre nouvelles espèces de la tribu des *Vanguerieae* (*Rubiaceae*) du sud, du sud-ouest et de l'ouest de Madagascar sont décrites et illustrées. Deux espèces appartiennent au genre *Pyrostria* Comm. ex Juss., à savoir *P. costata* Klack. & Razafim. avec de petites feuilles et des présentateurs de pollen ainsi que des fruits nettement côtelés, et *P. macrocarpa* Klack. & Razafim., caractérisée par ses gros fruits obconiques à 5–6 lobes. Les deux autres espèces du genre sous-endémique malgache *Peponidium* Arènes: *P. leroyi* Klack. & Razafim., caractérisée par des feuilles poilues à bords ciliés, des fleurs peu pubescentes et des présentateurs de pollen côtelés, et *P. sessile* Klack. & Razafim., se distinguant par ses feuilles cordées presque sessiles et ses lobes de corolle à double pointe. Les évaluations du risque d'extinction des quatre espèces sont présentées, ainsi que les cartes de répartition respectives.

Keywords

RUBIACEAE – *Vanguerieae* – *Peponidium* – *Pyrostria* – Madagascar – New species

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Introduction

Vanguerieae as defined by Lantz & Bremer (2004) is one of the five Paleotropical tribes of the coffee family (*Rubiaceae*), encompassing c. 650 arborescent and lianescent species currently classified in 29 genera. The tribe is centered in Africa and Madagascar with c. 400 and c. 150 species, respectively. In Madagascar, the members of *Vanguerieae* are classified in six genera, *Bullockia* (Bridson) Razafim. et al., *Peponidium* (Baill.) Arènes sensu Razafimandimbison et al. (2009) (including all Western Indian Ocean *Canthium* Lam. species), *Pyrostria* Comm. ex Juss. sensu Razafimandimbison et al., 2009 (incl. *Dinocanthium* Bremek., *Leroyia* Cavaco, *Neoleroya* Cavaco, *Pseudopeponidium* Homolle ex Arènes, and *Scyphochlamys* Balf. f.), *Psydrax* Gaertn., *Rytigynia* Blume and *Vangueria* Juss. (De Block & Razafimandimbison, 2022). *Pyrostria* and *Peponidium* are the most species rich genera with c. 90 species (Atalahy, 2022) and c. 50 species (Razafimandimbison et al., 2007), respectively. The tribe is present in all five bioclimate zones of Madagascar (humid, subhumid, montane, dry and sub-arid climates) and from sea level to the highest altitudes (Razafimandimbison et al., 2009; De Block & Razafimandimbison, 2022). *Vanguerieae* is a monophyletic group that can be characterized by its paired axillary inflorescences, valvate corolla aestivation and a unique type of pollen presenter on the apex of the style (Lantz & Bremer, 2004).

Our knowledge of the phylogeny and classifications of the tribe *Vanguerieae* has tremenduously improved as a result of many molecular phylogenetic studies (e.g. Lantz & Bremer, 2004; Razafimandimbison et al., 2009) coupled with taxonomic studies (e.g. Bridson, 1987) conducted during the last four decades. In Madagascar, more new species of *Peponidium* and *Pyrostria* have been described. These genera belong to the dioecious group of *Vanguerieae* as delimited by Razafimandimbison et al. (2009). *Peponidium* is diagnosed by its deciduous, small cupular bracts located at the base of the peduncles and never enclose the young inflorescences. In contrast, *Pyrostria* is distinct in having persistent and basally connate, long acuminate paired bracts (Razafimandimbison et al., 2009). Lantz et al. (2007) published three new species: *Pyrostria serpentina* Lantz et al. from the southwestern domain, and both *P. pendula* Lantz et al. and *Peponidium crassifolium* Lantz et al. from the Marojejy mountains in northeastern Madagascar. More recently, Atalahy et al. (2021) described five new species of *Pyrostria*: *P. ambohitantelensis* Atalahy et al., *P. ambrensis* Atalahy et al., *P. betsomangensis* Atalahy et al., *P. coriacea* Atalahy et al. and *P. longicorollata* Atalahy et al. Despite these efforts, about 35 Malagasy species of *Pyrostria* remain to be described (Atalahy, 2022).

In this study, we formally describe four new *Vanguerieae* species, three from the dry south and southwest of Madagascar (*Pyrostria costata* Klack. & Razafim., *P. macrocarpa* Klack. & Razafim. and *Peponidium leroyi* Klack. & Razafim.) and one from the western limestone area east of Antsalova (*P. sessile* Klack. & Razafim.). Each new species is provided with line drawings, a risk of extinction assessement and a distribution map.

Materials and methods

The descriptions of the four new species were based on loans of herbarium specimens from P, with the exceptions of *Phillipson et al. 3105* at MO and *Davis et al. 1164* at K and BR. None of the specimens loaned from P for this study were found at BR, K, MO, TAN, TEF, S and UPS. The specimens of *Pyrostria costata* and *P. macrocarpa* examined in this study were not seen by Atalahy (2022) when he conducted a taxonomic revision of the Malagasy *Pyrostria* for his doctoral degree. All measurements were done using a stereomicroscope. The flowers and fruits were rehydrated before dissection. The preliminary conservation status of each species was assessed using the IUCN Red List Categories and Criteria (IUCN, 2012). Extent of occurrence [EOO] and area of occupancy [AOO] were estimated using GeoCAT (2024).

Taxonomic treatment

Pyrostria costata Klack. & Razafim., **sp. nov.** (Fig. 1).

Holotypus: Madagascar. Reg. Androy [Prov. Toliara]: env. N de Tsimilofo, Beloha, [24°59'S 45°10'E], 14.XI.1967, fr., *Service Forestier 27975* (P [P00518210]!).

Pyrostria costata Klack. & Razafim. differs from all other Malagasy congeners with ribbed fruits by the combination of small leaves clustered on brachyblasts, ribbed pollen presenter, and ± spherical and broadly ellipsoidal and 10-lobed fruits.

Shrub with stout, terete, glabrous branches. *Leaves* basically opposite but clustered on brachyblasts; petioles 0.5–1 mm long, with hairs around base; blade elliptic, 15–20 × 5–8 mm, cuneate at base, bluntly acute to rounded at apex, glabrous, herbaceous, with flat margin; venation pinnate, arched; midrib and 2–3 pairs of primary nerves visible when dry, only faintly so above, slightly raised on lower surface, flush with leaf surface above; domatia sometimes present as tufts of hairs in axils of main nerves; stipules broadly triangular, 2.2 × 1.8 mm, acuminate at apex, glabrous, soon dehiscent, with hairs present inside seen as small tufts on tip of brachyblasts. *Inflorescences* axillary on short (< 1 mm long) peduncles, umbel-shaped, c. 5 (male) to 1 (female)-flowered; peduncular bracts 2.5–3 mm long, paired, connate, navicular, acute, hairy inside, glabrous outside; pedicels 2.5–3.5 mm long at anthesis (male) and in fruit, glabrous but hairy around base. *Flowers* 5-merous, white. *Male flowers* with calyx glabrous; tube flat; limb tube 0.6 mm long with shallow lobes; corolla glabrous outside; tube ± cylindric

Fig. 1. – *Pyrostria costata* Klack. & Razafim. **A.** Habit, fruiting branch; **B.** Male inflorescences; **C.** Male flower; **D.** Male flower, part of dissected corolla from within; **E.** Close-up of hair from inside of corolla; **F.** Style in male flower; **G.** Immature fruit and peduncular bracts. [**A, G:** *Service Forestier 27975*, P; **B–F:** *Service Forestier 27974*, P] [Drawings: E. Hultén]

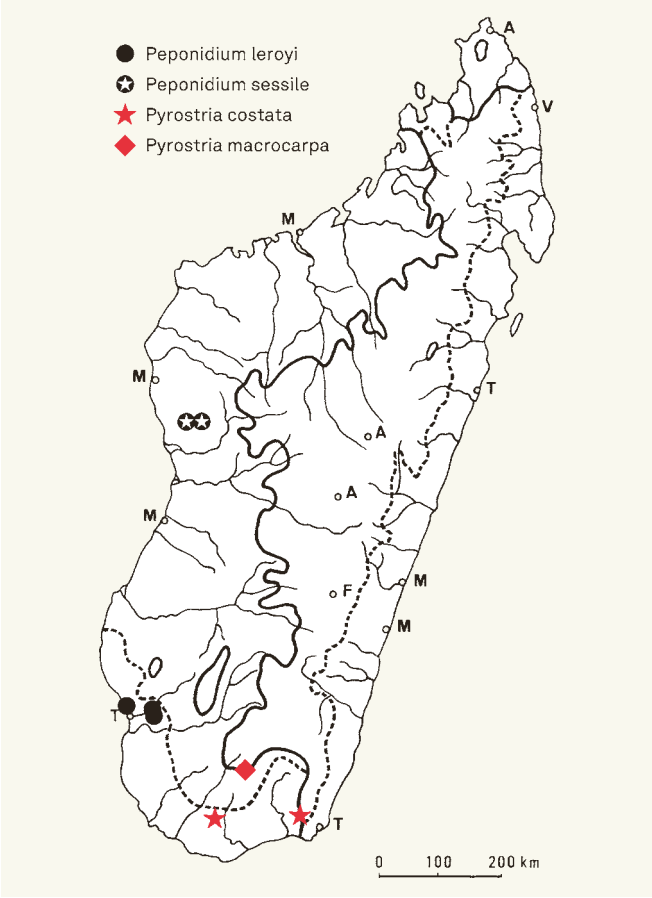

Fig. 2. – Distribution map of *Peponidium leroyi* Klack. & Razafim., *P. sessile* Klack. & Razafim., *Pyrostria costata* Klack. & Razafim. and *P. macrocarpa* Klack. & Razafim.

to somewhat barrel-shaped, 4.5–5.5 mm long, at mouth filled with 5 dense tufts of moniliform hairs between the stamens; lobes triangular to oblong, 3–3.4 × 2–2.3 mm, rotate to recurved? with reflexed tip, acute at apex, finely papillate on upper side; stamens attached to corolla tube at mouth; anthers ± sessile, ellipsoidal, 1–1.1 mm long, partly exserted, recurved after dehiscens; style including pollen presenter 6–7 mm long, shortly exserted; pollen presenter 1.2 mm long, ribbed; disc flat, glabrous. *Female flowers* not seen. *Fruit* (immature?) ± spherical to broadly ellipsoidal, 3.5–4 × 3.5–4 mm, topped by flat disc and calyx, with wrinkled distinct longitudinal ribs, glabrous, 2-locular.

Etymology. – The epithet *costata* refers to the ribbed fruits of the species.

Distribution and ecology. – *Pyrostria costata* is known from the drylands of southern Madagascar (Fig. 2). It has been collected in dry deciduous forest and dry spiny thicket.

Phenology. – Collected in both flower and fruit in November.

Conservation status. – *Pyrostria costata* has a restricted geographic range in the minimum AOO of 8 km². It is known from two localities, one of which is situated within the boundary of the Andohahela National Park. Forests within Parcelle II of the National Park are threatened by wild fires and demand of forest goods for the nearby coties (Goodman et al., 2018). Outside of the protected area, the species is threatened by forest clearing for agriculture and wild fire which would result in continuing decline of quality of habitat and number of mature individuals. *Pyrostria costata* is therefore assigned a preliminary conservation status of "Critically Endangered" [CR B2ab(i,ii,iii,iv,v)] in accordance with IUCN Red List Categories and Criteria (IUCN, 2012).

Notes. – Ribbed fruits are rare in the Malagasy *Pyrostria* (Leroy, 1972). *Pyrostria costata* and *P. verdcourtii* (Cavaco) Razafim. et al. are the only Malagasy *Pyrostria* species with ribbed, two-locular fruits (as opposed to the other species with ribbed, 5–8 locular fruits). The former species is distinct by its small (2.2 × 1.8 mm), broadly triangular stipules and ± spherical and broadly ellipsoidal and 10-locular fruits, while the latter species differs by its larger (c. 5 mm long), lanceolate stipules and obconical and 8-locular fruits. Furthermore, *P. costata* is restricted to the drylands of southern Madagascar, whereas *P. verdcoutii* is confined in the northwest and north of the island.

Additional specimens examined. – Madagascar. **Reg. Androy [Prov. Toliara]:** env. N de Tsimilofo, Beloha, [24°59'S 45°10'E], 14.XI.1967, fl., *Service Forestier 27974* (P [P00518210]); Andohahela RNI, parcelle 2, c. 50 km WNW of Taolagnaro (Fort Dauphin), forest 4.1 km due E of Ihazofotsy, [24°48'58"S 46°35'38"E], 150 m, 30.XI.1997, fr., *Davis et al. 1164* (K, BR [BR0000021253812]).

Pyrostria macrocarpa Klack. & Razafim., **sp. nov.** (Fig. 3).

Holotypus: Madagascar. Reg. Androy [Prov. Toliara]: à 20 km env. au S de Beraketa, [24°22'50"S 45°37'300"E], 18.XII.1968, fr., *Service Forestier 28513* (P [P00518215]!).

Pyrostria macrocarpa Klack. & Razafim. differs from the other Malagasy Pyrostria congeners by its large, 5–6-locular, obconical, non-ribbed fruits with a rather flat apex.

Shrub with branches often having short internodes, terete, younger parts covered by short erect hairs, glabrescent, with lenticels. *Leaves* opposite, covered on both sides with erect hairs, more densely so along the nerves below; petioles 1.5–2 mm long, hairy; blade elliptic, 4–5 × 1.5–2.5 cm, drying brown above and light green below, cuneate at base, acute to acuminate at apex, herbaceous, with flat margin; venation pinnate, arched; midrib and 5–7 pairs of primary nerves clearly

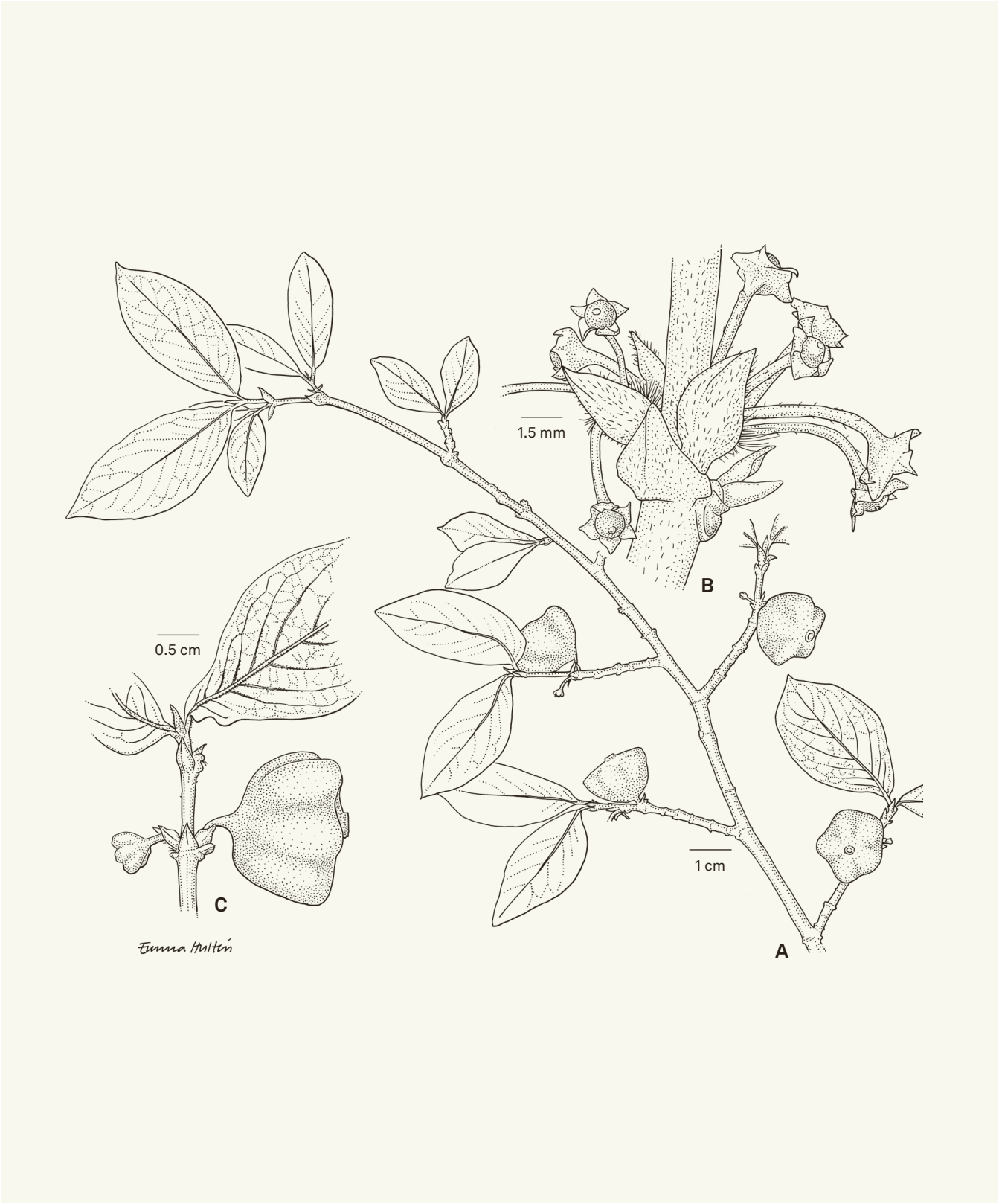

Fig. 3. – *Pyrostria macrocarpa* Klack. & Razafim. **A.** Habit, fruiting branch; **B.** Male inflorescence (overblown) and peduncular bracts; **C.** Fruit. [**A, C:** *Service Forestier 28513*, P; **B:** *Service Forestier 28512*, P] [Drawings: E. Hultén]

visible on both sides when dry, ± flush with leaf surface above, raised below; domatia not clearly separated from hairy veins; stipules narrowly ovate to triangular, 3–5.5 × 2–4 mm, acute to acuminate at apex, keeled, hairy, dehiscent. *Inflorescences* axillary on short (c. 0.5 mm long) peduncles to almost sessile, umbel-shaped, 1 (female) to 5–10 (male)-flowered; peduncular bracts large, 4–5 mm long, paired, navicular, acute, with a tuft of long hairs inside, shortly hairy outside; pedicels 2.5–5 mm long at anthesis (male) and in fruit, ± glabrous (male) to hairy, with longer hairs at the very base. *Male flowers* with calyx 5-merous, glabrous; tube flat, very short; limb tube c. 0.8 mm long with broadly triangular acute lobes; disc conical, glabrous; corolla, stamens and style not seen. *Female flowers* not seen. *Fruits* ± obconical and 5–6-lobed towards a rather flat apex, cuneate to rounded at base, up to 1.5 × 2 cm, glabrous.

Etymology. – The epithet *macrocarpa* refers to the large fruits of the species.

Distribution and ecology. – *Pyrostria macrocarpa* is known only from the type locality in the dry spiny thicket of south-western Madagascar (Fig. 2).

Phenology. – Overblown and fruiting specimens seen in December.

Conservation status. – *Pyrostria macrocarpa* has a restricted geographic range in the minimum of 4 km^2. It is known from a single locality outside of the protected area network. The dry spiny thicket is threatened by clearing for agriculture and wild fires, which would result in continuing decline of quality of habitat and number of mature individuals. The species has further not been observed since 1968. *Pyrostria macrocarpa* is therefore assigned a preliminary conservation status of "Critically Endangered" [CR B2ab(i,ii,iii,iv,v)] in accordance with IUCN Red List Categories and Criteria (IUCN, 2012).

Notes. – *Pyrostria verdcourtii* and *P. macrocarpa* are known to have obconical fruits but those of the former are 2-locular, deeply ribbed as opposed to 5–6-locular, non-ribbed in the latter. Furthermore, *P. verdcoutii* is confined in the northwest and north of Madagascar, while *P. macrocarpa* is confined to the south of the island.

Additional specimen examined. – **Madagascar. Reg. Androy [Prov. Toliara]:** à 20 km env. au S de Beraketa, [24°22'50"S 45°37'300"E], 18.XII.1968, old ♂ fl., *Services Forestier 28512* (P [P00518214]).

Peponidium leroyi Klack. & Razafim., **sp. nov.** (Fig. 4).

Holotypus: Madagascar. Reg. Atsimo-Andrefana [Prov. Toliara]: au N d'Andranohinaly, PK 45 de la route Tuléar-Sakaraha, [23°15'S 44°01'E], XII.1961, fl., *Service Forestier 20754* (P [P00518204]!).

Peponidium leroyi Klack. & Razafim. differs from the other congeners by the combination of hairy leaves with ciliate margins, sparsely pubescent flowers, and ribbed pollen presenters.

Shrub 2–3 m tall; branches somewhat compressed when young becoming terete, youngest branches densely hairy, glabrescent. *Leaves* at top of branches, opposite, hairy on both sides, more densely so along the nerves below; petioles 1–2 mm long, hairy; blade elliptic to obovate, 2.5–5.5 × 1–2 cm, cuneate at base, bluntly acute to rounded at apex, herbaceous, with flat, ciliate margin; venation pinnate with 7–12 pairs of primary veins ± parallel to slightly arched towards margin; midrib and primary veins clearly visible, distinctly raised on lower side when dry, ± flush with leaf surface above; tertiary nerves reticulate; domatia not seen; stipules first narrowly triangular becoming ovate, 4–5 × 0.5–3 mm, acuminate to subulate at apex, hairy, dehiscent. *Inflorescences* axillary, hairy; male flowers 5–7 in umbels on 2–4 mm long peduncles, female flowers 1–2 on very short peduncles (up to 2 mm in fruit) or peduncles missing; pedunculate inflorescences with small, free bracteoles; pedicels at anthesis 2–3 mm long (male flowers) or c. 1 mm long (female flowers) to 5 mm long in fruit, hairy. *Flowers* 5-merous, whitish. *Male flowers* with calyx glabrous or with few hairs; tube almost lacking crowned with shallow very broadly triangular to rounded lobes, c. 0.1 mm long; corolla hairy outside, at mouth filled with 5 tufts of somewhat moniliform up to 0.5 mm long hairs between the stamens; tube campanulate, c. 1.8 mm long; lobes triangular, bent outwards, acute at apex, c. 1.5 × 1.2 mm; stamens attached to corolla tube at mouth; anthers ± sessile, ellipsoidal, c. 1 mm long, partly exserted; style including pollen presenter c. 2.5 mm long, shortly exserted; pollen presenter c. 0.7 mm long, ribbed; disc annular, glabrous. *Female flowers* with hypanthium with calyx c. 2.2 mm, glabrous; limb tube 0.2 mm long; lobes insignificant; corolla with some hairs outside; tube ± cylindric, c. 1 mm long, with conspicuous tufts of moniliform hairs between the anthers; lobes, triangular, c. 2.5 × 1.1 mm, acute at apex, erect; stamens attached at mouth of corolla tube; anthers sessile, exserted, ovate in outline, c. 0.9 mm long; style with stigmatic head c. 1.8 mm long; stigmatic head c. 0.6 mm long, ridged; disc annular, short, glabrous; ovary 2-locular. *Fruit* bilobed, broadly obcordate with truncate base, c. 0.9 × 1 cm, sparsely hairy, topped by a short ring from persisting calyx.

Etymology. – The species is named in honour of Jean-François Leroy, who studied the Malagasy *Rubiaceae* for many years and identified several new species.

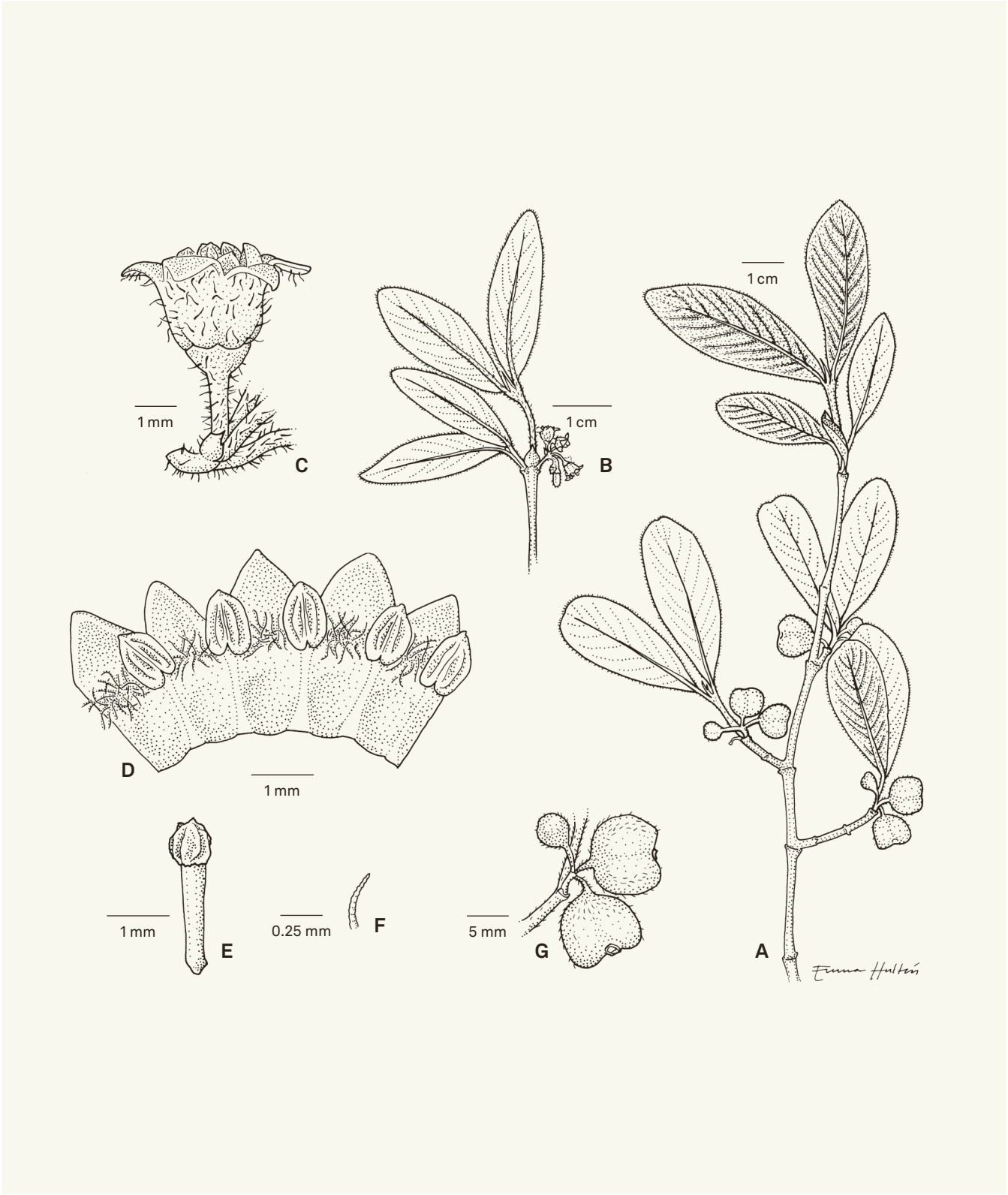

Fig. 4. – *Peponidium leroyi* Klack. & Razafim. **A.** Habit, fruiting branch; **B.** Male inflorescence; **C.** Male flower; **D.** Male flower, dissected corolla from within; **E.** Style in male flower; **F.** Close-up of hair from inside of corolla; **G.** Fruit. [**A, G:** *Phillipson & Rabesihanaka 3105*, P; **B–F:** *Service Forestier 20754*, P] [Drawings: E. Hultén]

Distribution and ecology. – *Peponidium leroyi* is known from dry deciduous forest and dry spiny thicket at lower altitudes in southwestern Madagascar, hitherto found only in Fiherenana valley northeast of Toliara (Fig. 2).

Phenology. – Collected in flower during November and December, in fruit known from January. Flowers seem to appear simultanously with leafing.

Conservation status. – *Peponidium leroyi* has an estimated EOO of 51 km² and a minimum AOO of 12 km². It is known from three localities, two of which are within the boundary of the Ranobe PK32 protected area. Changes in forest cover of the dry spiny thicket within the delimitation of the actual protected area between 1996 and 2016 have been as high as 35% loss (Goodman et al., 2018). Forest lost is associated with uncontrolled slash-and-burn shifting agriculture and human settlements (Goodman et al., 2018). These threats would result in continuing decline of quality of habitat and number of mature individuals. The new species is therefore assigned a preliminary conservation status of "Endangered" [EN B1ab(i,ii,iii,iv,v)+B2ab(i,ii,iii,iv,v)] in accordance with IUCN Red List Categories and Criteria (IUCN, 2012).

Notes. – Many Malagasy *Peponidium* species (including *P. leroyi*) have bilobed fruits. However, *P. leroyi* is distinct by its hairy leaves with ciliate margins, sparsely pubescent flowers, and ribbed pollen presenters.

Additional specimens examined. – **Madagascar. Reg. Atsimo-Andrefana [Prov. Toliara]:** valley of the Fiherenana, NE of Tulear, near Beantsy, 23°13'S 43°53'E, 50 m, 8.I.1989, fr., *Phillipson & Rabesihanaka 3105* (MO, P [P00518203]); sur la route de Manombo, au N du Fiherenana, [23°14'S 43°41'E], 8–12.XI.1967, fl., *Service Forestier 27919* (P [P00518207]).

Peponidium sessile Klack. & Razafim., **sp. nov.** (Fig. 5).

Holotypus: Madagascar. Reg. Melaky [Prov. Mahajanga]: forêt de l'Antsingy vers Ambodiriana, E d'Antsalova, [18°40'S 44°44'E], 100–150 m, 8.XII.1952, fl., *Leandri*, *Capuron & Razafindrakoto 2085* (P [P00518216]!).

Peponidium sessile Klack. & Razafim. differs from the other congeners by the combination of sessile, cordate leaves, glabrous calyx with distinct tuft of hairs at tips of lobes, and vaulted corolla lobes topped by horn-like outgrows.

Shrub 2–3 m high; branches terete, with younger parts hairy but soon bark becoming rough with outer layers peeling off. *Leaves* opposite along branches, ± sessile, mostly glabrous but basal part of midrib and petiole with erect hairs; petioles up to 0.5 mm long; blade ovate, 3–5.5 × 1.5–3.5 cm, cordate at base, subacute to rounded at apex, herbaceous, with flat margin; venation pinnate with 3–4 pairs of primary nerves, arched, hardly visible towards leaf margin; midrib distinct and raised on both sides when dry; primary nerves ± flush with leaf surface below, slightly raised above when dry; domatia sometimes present as tufts of hairs in axils of larger nerves; stipules towards apex distincly laterally compressed, 1.5–2.5 mm long, hairy mostly along margin, persistent 4–5 base pairs but eventually dehiscent. *Inflorescences* terminal, sessile (female) or on short < 0.5 mm long (male) peduncles, 1–2-flowered; peduncular bracts several, small and fused at base of inflorescence (male) or missing (female); pedicels 1–3 mm long at anthesis, up to 16 mm in fruit, glabrous to sparsely hairy. *Flowers* 4-merous, creamish white. *Male flowers* with calyx 0.5 mm with shallow lobes, glabrous except for a distinct tuft of hairs at tips of lobes; lobes very broadly triangular to rounded, 0.25 × 0.5 mm; corolla glabrous outside; tube 0.7 mm long; lobes standing together vaulted above stamens but towards apex separated from each other like four horns, elliptic, c. 1.6 mm long of which free horn-like tip c. 0.4 mm, c. 0.8 mm broad. *Female flowers* (mature but still closed flowers seen only) with hypanthium with calyx c. 2.2 mm, glabrous except for tips of calyx lobes; limb tube 0.3–0.35 mm long; lobes shallow, c. 0.3 × 1 mm, with a distinct tuft of hairs at tip; corolla glabrous outside; tube ± cylindric, c. 1.3 mm long, with conspicuous tufts of moniliform hairs between the anthers; lobes standing together vaulted above stamens and stigmatic head but towards apex separated from each other like four horns, narrowly triangular, c. 2.5 mm long of which free horn-like tip c. 1 mm, c. 0.8 mm broad; stamens attached at mouth of corolla tube; anthers sessile, oblong, c. 0.9 mm long, included in lower vaulted portion of corolla lobes; style with stigmatic head c. 1.8 mm long; stigmatic head c. 0.6 mm long, vaguely ridged; disc c. 0.6 mm high, glabrous. *Fruit* bilobed, broadly obcordate with truncate base, c. 0.8 × 1 cm, almost glabrous or with solitary hairs, reddish green, with calyx remaining on top.

Distribution and ecology. – *Peponidium sessile* is known from limestone rocks in the Tsingy of Bemaraha in western Madagascar (Fig. 2).

Phenology. – Collected in flower from October to December, and in fruit in October.

Conservation status. – *Peponidium sessile* has a restricted geographic range in the minimum AOO of 8 km². It is known from two localities, both of which are known within the boundary of the Tsingy de Bemaraha National Park. Fire density detected in the protected area or outside were among the highest in the country between 2006 and 2016 (Goodman et al., 2018). Forest is also threatened by illicit logging and new agricultural lands (Goodman et al., 2018). These threats would result in continuing decline of quality of habitat and

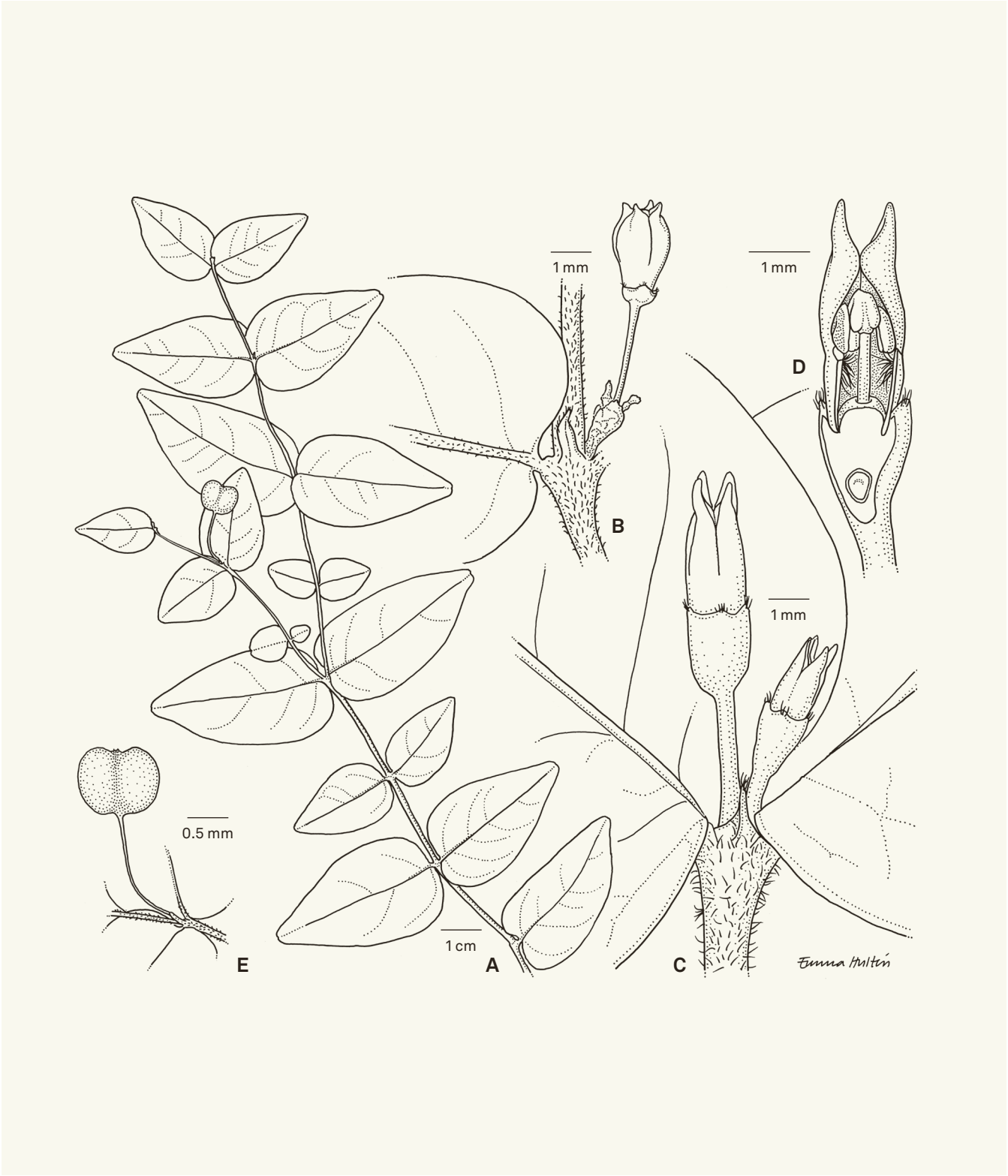

Fig. 5. – *Peponidium sessile* Klack. & Razafim. **A.** Habit, fruiting branch; **B.** Male inflorescence with small cupular bracts agglomerated at base and one mature and two aborted flowers; **C.** Female inflorescence; **D.** Female flower, two corolla lobes and corresponding part of tube removed, tangential longisection; **E.** Fruit.
[**A, E:** *Leandri 845*, P; **B:** *Leandri 812*, P; **C, D:** *Leandri et al. 2085*, P] [Drawings: E. Hultén]

number of mature individuals. The species has further not been observed since 1952. *Peponidium sessile* is therefore assigned a preliminary conservation status of "Critically Endangered" [CR B2ab(i,ii,iii,iv,v)] in accordance with IUCN Red List Categories and Criteria (IUCN, 2012).

Notes. – This species is characterized by its sessile, cordate leaves, glabrous calyx with distinct tuft of hairs at tips of lobes, vaulted corolla lobes that are topped by horn-like outgrows. The presence of distinct tuft hairs at the tips of lobes has also been reported in *Peponidium crassifolium* Lantz et al. (Lantz et al., 2007) but this latter has petiolate, obovate, and thick and slightly succulent leaves (vs. sessile, ovate, and non-succulent leaves in *P. sessile*). Further, *P. sessile* is known only from the Tsingy of Bemaraha in western Madagascar, while *P. crassifolium* is endemic to the Marojejy Massif in northeast of the island.

Additional specimens examined. – **Reg. Melaky [Prov. Mahajanga]:** Tsingy du Bemaraha (9e Réserve), à Tsiandro, [18°43'S 44°55'E], 10.II.1933, *Leandri 812* (P [P00524235]), *845* (P [P00518217]).

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References

Atalahy, A.M. (2022). *Révision taxonomique du genre Pyrostria Comm. ex Juss. (Rubiaceae) à Madagascar*. Thèse de doctorat, Université de Mahajanga, Madagascar.

Atalahy, A.M., F. Rakotonasolo, M. Rabarimanarivo, H.L.T. Ranarijaona & S.G. Razafimandimbison (2021). New species of the genus Pyrostria (Rubiaceae, Vanguerieae) from Madagascar. *Candollea* 76: 1–12.

Bridson D.M. (1987). Studies in African Rubiaceae-Vanguerieae: a new circumscription of Pyrostria and a new subgenus, Canthium subgen. Bullockia. *Kew Bull.* 42: 611–639.

De Block, P. & S.G. Razafimandimbison (2022). The Vanguerieae alliance (subfamily Ixoroideae). *In*: Goodman, S. (ed.), *The new Natural History of Madagascar*: 762–764. Princeton University Press.

GeoCAT (2024). *Geospatial Conservation Assessment Tool*. Royal Botanic Gardens, Kew. [http://geocat.kew.org]

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. IUCN Species Survival Commission, Gland and Cambridge.

Lantz, H. & B. Bremer (2004). Phylogeny inferred from morphology and DNA data: characterizing well-supported groups in Vanguerieae (Rubiaceae). *Bot. J. Linn. Soc.* 146: 257–283.

Lantz, H., J. Klackenberg, S.G. Razafimandimbison & A. Mouly (2007). Three new species of Vangueriae (Rubiaceae) from Madagascar. *Adansonia*, sér. 3, 29: 129–136.

Leroy, J.-F. (1972). La notion de genre et l'évolution: sur un cas remarquable de différenciation explosive chez les Rubiacées-Vangueriées à Madagascar. *Compt. Rend. Hebd. Séances Acad. Sci., Sér. D* 274: 1682–1685.

Razafimandimbison, S.G., H. Lantz & B. Bremer (2007). New combinations and names in Peponidium and Pyrostria (Rubiaceae, Vanguerieae). *Novon* 17: 516–521.

Razafimandimbison, S.G., H. Lantz, A. Mouly & B. Bremer (2009). Evolutionary trends, major lineages, and new generic limits in the dioecious group of the tribe Vanguerieae (Rubiaceae): insights into the evolution of functional dioecy. *Ann. Missouri Bot. Gard.* 96: 161–181.