

Endemic families of Madagascar. VI. A synoptic revision of *Rhodolaena* (Sarcolaenaceae)

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ABSTRACT

As part of the reevaluation of the taxonomic frameworks of the vascular plant families endemic to Madagascar and the Comoro Islands prior to an assessment of their conservation status, a synoptic revision is presented of *Rhodolaena* (Sarcolaenaceae). Recent molecular sequence data suggest that Sarcolaenaceae are sister to Dipterocarpaceae in an expanded Malvales. Within the family, *Rhodolaena* appears to be closest to *Schizolaena*, with which it shares flowers usually borne in pairs subtended by an involucre that is indistinct or collar-like at anthesis but then expands very late to become somewhat fleshy and surround the woody, capsular fruit. *Rhodolaena* differs from *Schizolaena* by its solitary inflorescences with long, pendulous peduncles and flowers with 5 sepals versus branched inflorescences and flowers with 3 sepals in *Schizolaena*. Seven species are recognized, three of which are described as new (*R. coriacea*, *R. lerozana*, and *R. macrocarpa*). A key to the species is provided in English and French.

KEY WORDS

Sarcolaenaceae,
Rhodolaena,
Madagascar,
endemism.

RÉSUMÉ

Familles endémiques de Madagascar. VI. Révision synoptique du genre Rhodolaena (Sarcolaenaceae).

Dans le cadre de l'évaluation, pour la conservation, des familles de plantes vasculaires endémiques de Madagascar et des Comores, la révision synoptique

MOTS CLÉS

Sarco-laenaceae,
Rhodolaena,
Madagascar,
endémisme.

du genre *Rhodolaena* (Sarco-laenaceae) est présentée. Des données moléculaires récentes suggèrent que les Sarco-laenaceae constituent le groupe frère des Dipterocarpaceae, au sein des Malvales élargies. À l'intérieur de la famille, *Rhodolaena* semble être proche de *Schizolaena* ; ils partagent plusieurs caractères dont la présence de fleurs groupées généralement par deux, avec un involucre indistinct ou formant un collet à l'anthèse, puis s'allongeant tardivement pour devenir assez charnu et entourer le fruit capsulaire ligneux. Les *Rhodolaena* avec leurs inflorescences solitaires à longs pédoncules pendants et leurs fleurs à 5 sépales diffèrent des *Schizolaena* dont les inflorescences sont ramifiées et les fleurs à 3 sépales. Sept espèces sont reconnues, dont trois décrites comme nouvelles (*R. coriacea*, *R. leroyana* et *R. macrocarpa*). Une clé à l'espèce est établie en anglais et en français.

INTRODUCTION

This is the sixth in our series of synoptic revisions of genera in Madagascar's endemic plant families (cf. LOWRY et al. 1999, 2000; SCHATZ et al. 1998, 1999a,b), which we are publishing to provide an updated taxonomic framework for assessing the ca. 100 species concerned using the IUCN Red List threat categories (SCHATZ et al. 2000), with the ultimate goal of compiling a Red Data Book detailing the conservation status of each species. For the present paper we have examined all the available material of *Rhodolaena* Thouars at the major herbaria with important holdings of Malagasy plants (K, MO, P, TAN and TEF), and have reviewed the circumscription of the species recognized by CAVACO (1952a,b).

In the treatment of Chlaenaceae (= Sarco-laenaceae) for the Flore de Madagascar, CAVACO (1952b; see also CAVACO 1952a) recognized four species of *Rhodolaena*. During the next 15 years, René CAPURON and other workers collected material of *Rhodolaena* on numerous occasions during extensive botanical exploration conducted throughout Madagascar in the 1950s and 60s. However, despite CAPURON's keen interest in the family (see for example CAPURON 1970), he does not appear to have considered any of the material he saw to represent new species. For most other genera of Sarco-laenaceae, CAPURON placed provisional names on specimens in P and TEF, but perhaps somewhat surprisingly he did not do so for *Rhodolaena* despite the fact he collected specimens of two of the three new species described

herein, and saw material of the third new species. Indeed, based upon annotations and his published observations (CAPURON 1970), it would seem that he was inclined to recognize fewer species, suggesting for example that *R. bakeriana* was merely a form of *R. altivola*.

Several recent phylogenetic analyses utilizing molecular sequence data strongly suggest that Sarco-laenaceae and Dipterocarpaceae are sister taxa within an expanded Malvales (ALVERSON et al. 1998; BAYER et al. 1999). A number of fossil pollen types from the Miocene of South Africa clearly belonging to Sarco-laenaceae indicate that the endemic status of the family in Madagascar is a result of extinction elsewhere (COETZEE & MULLER 1984). Within Sarco-laenaceae, *Rhodolaena* appears to be most closely related to *Schizolaena* (see LOWRY et al. 1999), with which it shares mostly paired flowers subtended by an involucre that is indistinct or collar-like in flower but expands very late to become somewhat fleshy and surround the woody, septicidally dehiscent fruit. *Rhodolaena* differs from *Schizolaena* by its solitary inflorescences with long, pendulous peduncles and flowers with 5 sepals (2 small outer ones and 3 larger inner ones) versus branched inflorescences and flowers with 3 sepals in *Schizolaena*.

As noted by CAPURON (1970), involucre expansion occurs very late in fruit development, perhaps only several days prior to fruit dehiscence. Fully expanded involucre completely (or nearly) surrounding the fruit are known in *R. bakeriana*, *R. coriacea*, *R. leroyana* and *R. macrocarpa*. In the

three remaining species, the most mature fruits (already dehisced, but perhaps only as a function of the drying process) are subtended by somewhat accrescent, persistent sepals, but with no evidence (yet?) of involucre expansion. As in *Schizolaena*, the evolutionary adaptive significance of a woody, dehiscent fruit surrounded by a fleshy involucre is perplexing, and requires field observations to glean further insight.

As in the previous papers in this series, we have re-assessed species circumscriptions by examining morphological characters in combination with eco-geographic parameters, evaluating each taxon with regard to its distribution within Madagascar's biogeographic zones (CORNET 1974; SCHATZ 2000; see also LOWRY et al. 1997, 1998) and the substrates on which it occurs (DU PUY & MOAT 1996). This has been facilitated by several fine new collections made by Malagasy students conducting field work for their DEA studies at the Université d'Antananarivo as part of the Endemic Plant Families of Madagascar Project (SCHATZ et al. 2000).

Comparative study of the available material of *Rhodolaena* has thus enabled us to propose the following revised taxonomy, in which seven species are recognized, three of which are described as new. For the "Material examined"

cited below under each species, abbreviations are as follows: PN = Parc National; RNI = Réserve Naturelle Intégrale; RS = Réserve Spéciale; STF = Station Forestière. A full listing of exsiccatae for each species, with complete localities and latitude/longitude coordinates, has been compiled for the Madagascar Conspectus Project (SCHATZ et al. 1996), and is available on the World Wide Web through W3 TROPICOS (<http://mobot.mobot.org/W3T/Search/vast.html>). Images of selected taxa are also available on the Web at (<http://mobot.mobot.org/MOBOT/Madagascar/sarco.html>). Specimen data can also be accessed through the SONNERAT database at (<http://www.mnhn.fr/baselsonnerat.html>). Geographic coordinates indicated in square brackets were assigned *post facto* using available information on Malagasy place names and topographic maps, compiled as a gazetteer of botanical collecting localities in Madagascar (<http://www.mobot.org/mobot/research/madagascar/gazetteer.html>).

RHODOLAENA Thouars

Hist. Vég. Iles Austr. Afr. 47, pl. 13 (1805).

TYPE. — *Rhodolaena altivola* Thouars.

Key to the species of *Rhodolaena*

1. Young branches and midrib of blade below usually with dense golden indument, the trichomes ca. 0.5 mm long; stipules linear to narrowly triangular, persistent 5. **R. humblotii**
- 1'. Young branches and midrib of blade below glabrous, or twigs with dense brownish indument, the trichomes less than 0.1 mm long; stipules triangular, caducous 2
2. Leaves with a rounded apex (rarely acute) and usually emarginate, sometimes also with a tiny mucro 3
- 2'. Leaves with an acute to acuminate apex 4
3. Twigs usually glabrescent, and often glaucescent; leaves strongly coriaceous, the largest blade usually greater than 7 cm long (rarely less); inner sepals coriaceous, (2-)2.5-3.5 cm long 4. **R. coriacea**
- 3'. Twigs with dense brownish indument; leaves chartaceous, the largest blade usually less than 6 cm long (rarely to 7 cm); inner sepals chartaceous, not exceeding 1.8 cm long 3. **R. bakeriana**
4. Leaves with secondary veins nearly perpendicular to the midvein (> 80°); involucre a distinct collar at anthesis; ovary densely golden tomentose; seeds with dense white indument 6. **R. leroyana**
- 4'. Leaves with secondary veins ascending (< 70°); involucre mostly indistinct at anthesis; ovary subglabrous, or white puberulent to tomentose; seeds glabrous 5
5. Leaves drying olive green, with evident secondary veins on the glossy upper surface strongly ascending (< 45° to the midvein), tertiary veins forming an open reticulated network; twigs lacking conspicuous raised lenticels; flowers solitary; fruit large, the valves 2-3.3 × 2-2.5 cm 7. **R. macrocarpa**
- 5'. Leaves drying maroon-brownish, the secondary veins usually obscure on the dull upper surface, ascending at a 60-70° angle to the midvein, tertiary veins forming a dense reticulated network; twigs often with distinctly raised rusty brown lenticels; flowers paired 6

6. Leaves narrowly elliptic to slightly ovate, broadest near the middle, largest blades not exceeding 3(-3.6) cm wide, leaf base acute; sepals covered with dense, short, appressed trichomes on the portion covered by the adjacent sepal in bud; fruit dark green to black (in dry material), densely short tomentose, the trichomes ca. 0.2-0.3 mm long 1. **R. acutifolia**
- 6'. Leaves ovate, broadest below the middle, largest blades at least (4-)4.5 cm wide, leaf base more or less rounded; sepals glabrous, shiny; fruit chocolate brown (in dry material), sparsely puberulent, the trichomes less than 0.1 mm long 2. **R. altivola**

Clé des espèces de *Rhodolaena*

1. Jeunes branches et nervure médiane de la face inférieure du limbe habituellement densément couvertes de poils dorés mesurant environ 0,5 mm de long ; stipules linéaires à étroitement triangulaires, persistantes 5. **R. humblotii**
- 1'. Jeunes branches et nervure médiane de la face inférieure du limbe glabres, ou rameaux densément couverts de poils brunâtres mesurant moins de 0,1 mm de long ; stipules triangulaires, caduques 2
2. Feuilles à apex arrondi (rarement aigu) et généralement émarginé, parfois portant aussi un petit mucron 3
- 2'. Feuilles à apex aigu à acuminé 4
3. Rameaux généralement glabres, et souvent glaucescents ; feuilles fortement coriaces, limbes les plus grands mesurant habituellement plus de 7 cm de long (rarement moins) ; sépales internes coriaces, (2-)2,5-3,5 cm de long 4. **R. coriacea**
- 3'. Rameaux densément couverts de poils brunâtres ; feuilles cartacées, limbes les plus grands mesurant habituellement moins de 6 cm de long (rarement 7 cm) ; sépales internes cartacés, ne dépassant pas 1,8 cm de long 3. **R. bakeriana**
4. Feuilles à nervures secondaires presque perpendiculaires à la nervure médiane (> 80°) ; involucre sous forme d'un collet distinct à l'anthèse ; ovaire densément tomenteux, doré ; graines couvertes de poils blancs et denses 6. **R. leroyana**
- 4'. Feuilles à nervures secondaires ascendantes (< 70°) ; involucre plus ou moins indistinct à l'anthèse ; ovaire subglabre, ou pubérulent et blanc à tomenteux ; graines glabres 5
5. Feuilles sèches vert olive, à nervures secondaires apparentes sur la face supérieure brillante, fortement ascendantes (< 45° par rapport à la nervure médiane), nervures tertiaires formant un réseau ouvert et réticulé ; rameaux sans lenticelles apparentes ; fleurs solitaires ; fruit gros, à valves mesurant 2-3,3 × 2-2,5 cm 7. **R. macrocarpa**
- 5'. Feuilles sèches marron-brunâtres, à nervures secondaires indistinctes sur la face supérieure terne, ascendantes avec un angle de 60-70° par rapport à la nervure médiane, nervures tertiaires formant un réseau densément réticulé ; rameaux couverts souvent des lenticelles rousses en relief ; fleurs par paires 6
6. Feuilles étroitement elliptiques à légèrement ovales, plus larges vers le milieu du limbe, les plus grandes n'excédant pas 3(-3,6) cm de large, à base aiguë ; sépales couverts, sur la partie cachée dans le bouton par le sépale adjacent, de poils denses, courts et apprimés ; fruit vert foncé à noir (sur le matériel sec), densément couvert de courts poils tomenteux, environ 0,2-0,3 mm de long 1. **R. acutifolia**
- 6'. Feuilles ovales, plus larges en dessous du milieu du limbe, les plus grandes mesurant au moins (4-)4,5 cm de large, à base plus ou moins arrondie ; sépales glabres, brillants ; fruit brun chocolat (sur le matériel sec), faiblement pubérulent, à poils de moins de 0,1 mm de long 2. **R. altivola**

1. *Rhodolaena acutifolia* Baker

J. Linn. Soc., Bot., 21 : 322-323 (1884).

TYPE. — *Baron 2427*, Madagascar, without precise locality (holo-, K!).

Rhodolaena acutifolia occurs in mid-elevation humid to subhumid forest from Zahamena RNI and the Maningory River valley (Fig. 1). It is distinguished by it relatively small, subcoriaceous,

elliptic leaves, with an acuminate apex and acute base, and its sepals with dense, short, appressed indument on the portion covered by the adjacent overlapping sepal in bud. The leaves of *R. acutifolia* dry maroon-brownish, the secondary veins are usually obscure on the dull upper surface, and the tertiary veins form a dense reticulated network on the lower surface (characters shared with *R. altivola* – see below). This species has recently been collected at Zahamena RNI.

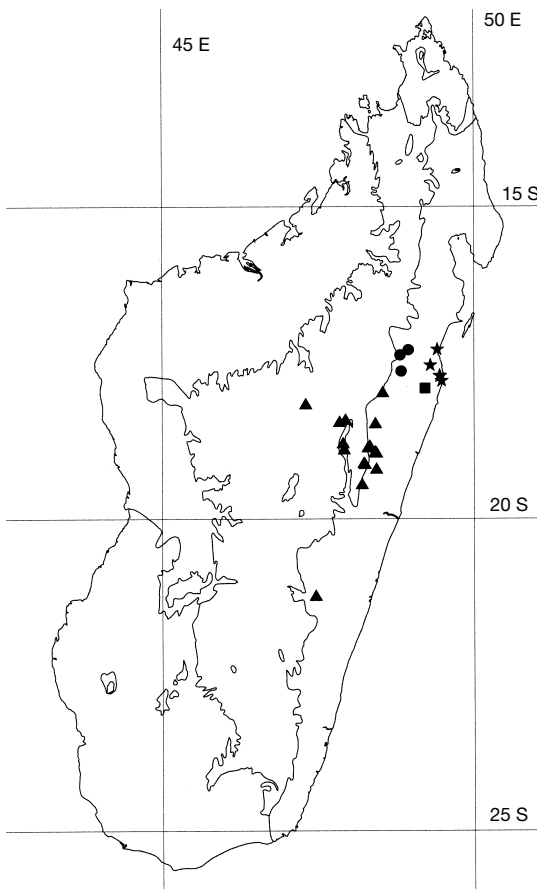


Fig. 1. — Distributions of *Rhodolaena*, mapped on the bioclimatic zones of Madagascar (after CORNET 1974; see SCHATZ 2000). *R. acutifolia* (●), *R. altivola* (★), *R. bakeriana* (▲), *R. leroyana* (■).

VERNACULAR NAMES. — Anjananjana, Tsimahamasakatsokina.

MATERIAL EXAMINED. — *Baron* 2427, 6086, without precise locality; *Cours* 1553, Tsonsona; *Herb. Inst. Sci. Madag.* 4454, Zahamena RNI; *Malcomber* 2513A, Zahamena RNI; *Perrier de la Bâthie* 2224, Maningory; *Réserves Naturelles* 3163, 10487, Zahamena RNI; *Service Forestier* 26090, Zahamena RNI.

2. *Rhodolaena altivola* Thouars

Hist. Vég. Iles Austr. Afr. 47, pl. 13 (1805).

TYPE. — *Thouars s.n.*, Madagascar, without precise locality (holo-, P!).

Rhodolaena altivola is a small tree occurring in low to mid-elevation humid forest along the north-central part of the east coast (Fig. 1). A single specimen with locality data indicating “Didy”, situated farther inland, was probably in fact collected much nearer to the coast. This species is distinguished by large, ovate, coriaceous leaves with an acuminate apex and more or less rounded base (closely resembling those of *Schizolaena laurina* Baill.), and glabrous, shiny sepals. As in *R. acutifolia*, the leaves dry maroon-brownish, the secondary veins are usually obscure on the dull upper surface, and the tertiary veins form a dense reticulated network on the lower surface. *Rhodolaena altivola* has recently been collected at Analalava west of Foulpointe, and at Tampolo STF.

MATERIAL EXAMINED. — *Catat* 1726, Didy; *d’Alleizette* 539, Baie d’Antongil; *Andrianjafy* 85, Analalava; *Humblot* 215, without precise locality; *Raholivelo* 22, Tampolo STF; *Rakotozafy* 1438, 1438bis, Analabe; *Service Forestier* 28891, Antetezana, 33539, Analalava; *Thouars s.n.*, without precise locality.

3. *Rhodolaena bakeriana* Baill.

Bull. Mens. Soc. Linn. Paris 1: 566 (1886). — Lectotype (here designated): *Baron* 1980, Madagascar, without precise locality (P!; iso-, K!, P!).

Rhodolaena bakeriana is a medium-sized tree that occurs in mid-elevation subhumid forest from Ranomafana PN to Ambohitantely RS, and east to Anjozorobe, Ambatovy and Analamazaotra-Périnet RS (Fig. 1). It can be recognized by its densely brownish pubescent twigs, and chartaceous leaves usually with an emarginate apex and the margins often folded under in dried material. Several recent collections have been made of this species.

BAILLON (1886a) recognized that the material referred to by BAKER (1883) as *Rhodolaena altivola* Thouars in fact represented a new species, for which he proposed the name *R. bakeriana*, referring to BAKER’s description (see also BAILLON 1886b). BAILLON’s new species was based on several collections (*Baron* 1980 and 2173; *Hildebrandt* 3823), which represent syntypes, although the last one was not cited by BAKER

(1883; but see BAKER 1886). The first syntype (*Baron 1980*) comprises material in full flower, whereas the second number is not (or is no longer) represented in the Paris herbarium, although two unnumbered sheets clearly belonging to *R. bakeriana* may well be attributable to this number. We have therefore selected *Baron 1980* as the lectotype.

VERNACULAR NAMES. — Anjananjana, Arina, Fontona, Fotana, Fotoana, Fotona, Tavaratra.

MATERIAL EXAMINED. — *Andrianjafy 23*, Analamazaotra-Périnet RS; *Andriatsiferana 2094*, Ambatovy; *Baron s.n., 1980, 3649*, without precise locality; *Cours 4069* (= *Herb. St. Agric. Alaotra 4069*), Ambatoharanana; *d'Alleizette 710*, Ampasakely (Mandraka); *Descoings 33*, Sandrangato; *Dorr 4493*, Analamazaotra-Périnet RS, 4575, Sandrangato; *Gentry 52559, 52648*, Analamazaotra-Périnet RS; *Herb. Forest. Madag. 66*, without precise locality; *Herb. Inst. Sci. Madag. 4654*, Analama; *Hildebrandt 3823*, without precise locality; *Labat 3081*, Analamazaotra-Périnet RS; *Leandri 710*, Analama; *Mabberley 812*, Analamazaotra-Périnet RS; *Miller 3747*, Analamazaotra-Périnet RS; *Perrier de la Bâthie 5335*, Analamazaotra-Périnet RS; *Rakotomalaza 1076*, Ambatovy, 1319, Analamay; *Rakotozafy 2685*, Anjozorobe; *Réserves Naturelles 35, 44, 1299*, Analamazaotra-Périnet RS; *Schatz 3640*, Anjozorobe, 3988, Analamazaotra-Périnet RS; *Schedl 64*, Analamazaotra-Périnet RS; *Service Forestier 1170*, Analamazaotra-Périnet RS, 2196, Anosibe-Moramanga, 2922, 4654, Analamazaotra-Périnet RS, 5811, Lakato, 8342, 8357, Analamazaotra-Périnet RS, 8371, Ambohitantly RS, 12432, 15004, 15686, Analamazaotra-Périnet RS, 15868, Antsahambavy, 17930, 18047, Analamazaotra-Périnet RS, 23214, Ranomafana PN, 24418, Sandrangato, 25322, 25715, 25716, 25717, 25760, 25763, 26022, 26023, 26188, 28137, Analamazaotra-Périnet RS, 28781bis, Fierenana (Moramanga), 30642, 31085, 34083, Analamazaotra-Périnet RS, 17-B-R-172, 76-R-211, 131-R-172, 169-R-172, Analamazaotra-Périnet RS, 420-R-212, without precise locality; *Thouvenot 44*, Analamazaotra-Périnet RS; *Ursch 10, 83*, Analamazaotra-Périnet RS.

4. *Rhodolaena coriacea* G.E. Schatz, Lowry & A.-E. Wolf, sp. nov.

Haec species foliorum apice rotundato plerumque emarginato R. bakerianae similis, sed ab ea ramulis plerumque glabrescentibus glaucescentibus, foliis longioribus plus coriaceis majore fere semper in longitudine

7 cm excedente (versus 6 cm non excedens in R. bakeriana) atque florum majorum sepalis (2-)2.5-3.5 cm longis (versus 1.8 cm non excedens) distinguitur.

TYPUS. — *Service Forestier 25521*, Madagascar, Lendava, Ampasimadinika II, canton et district d'Anosibe An'Ala, [19°30'S, 48°12'E], 15 Feb. 1965, fl. (holo-, P!; iso-, MO!, P!, TEF!).

Small to large tree, 5-25 m tall, twigs often initially with very fine, dense, short indument, usually eventually glabrescent and sometimes glaucescent. Leaves with petiole 0.7-1.3 cm long, lamina strongly coriaceous, glabrous, elliptic, (4-)6.2-14.5 × 3.3-7.3 cm, base acute to rounded, apex rounded to emarginate, venation weakly brochidodromous with 9-12 secondary veins per side, midvein usually deeply sunken above, prominently raised below, venation usually obscure on the upper surface or sometimes the secondary veins evident, tertiary venation densely reticulate and slightly raised below, margin sometimes slightly revolute. Inflorescence solitary, axillary, 2-flowered, peduncle 2-5 cm long, glabrous except sparsely golden pubescent at apex just below involucre, involucre slightly lobed at anthesis, with dense tufts of trichomes; pedicel 0.3-0.5 cm long, 0.2 cm in diam.; outer 2 sepals elliptic, 0.4-0.5 × 0.2-0.3 cm; inner 3 sepals asymmetrically ovate, (2-)2.5-3.5 × 1-3.8 cm, glabrous and shiny, coriaceous, persistent and becoming somewhat woody in young fruit; petals elliptic, 5-6.5 × 1.8-2.8 cm, thin membranous drying hyaline with evident venation, glabrous, base cuneate and abruptly truncate, apex obtuse to rounded; stamens ca. 30, inserted above disc at base of ovary, filaments 3-4 cm long, anthers versatile, 0.8-1 × 0.5 mm; style 3.7-4.2 cm long, stigma capitate, papillate-tuberculate. Fruit 3-valved, valves broadly ovate, 1.6-1.9 cm long, 1.3-1.4 cm broad, surrounded by the accrescent, fleshy, shallowly 3-lobed involucre. — Fig. 2.

Rhodolaena coriacea is a small to large tree that occurs in humid to subhumid forest from sea level to 1700 m elevation from Kianjavato to Anjanaharibe-Sud RS (Fig. 3). This species can be difficult to distinguish from *R. bakeriana*, with which it shares leaves with a rounded and emarginate apex, but differs by its generally larger

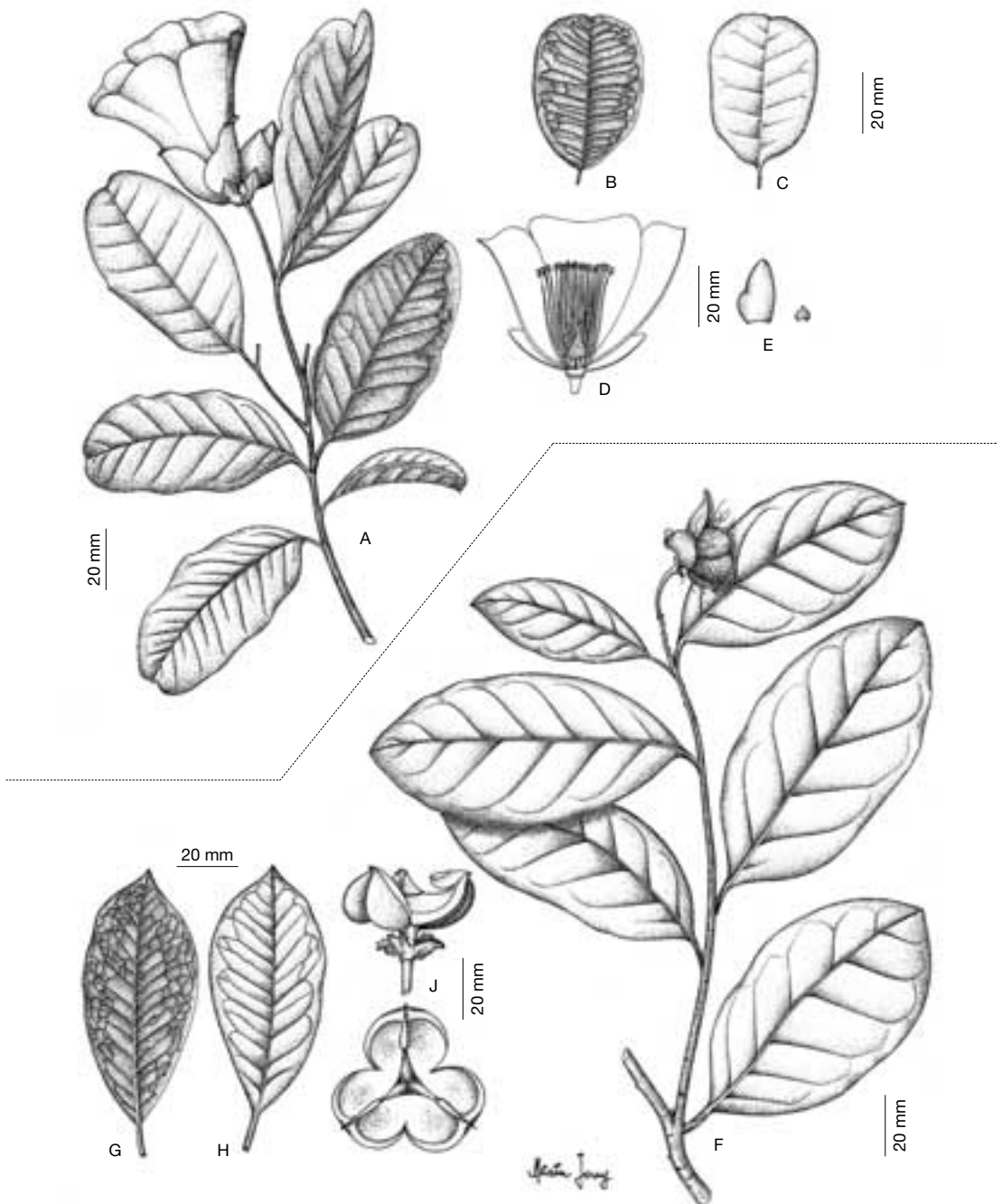


Fig. 2. — *Rhodolaena coriacea*: A, flowering branch; B, leaf (adaxial surface); C, leaf (abaxial surface); D, flower (schematic view); E, sepals (inner, outer). — *Rhodolaena macrocarpa*: F, fruiting branch; G, leaf (adaxial surface); H, leaf (abaxial surface); J, dehiscent fruit with involucre (A, Service Forestier 8893; B-E, Service Forestier 8864; F, Andrianjafy et al. 61; G-J, Service Forestier 27200).

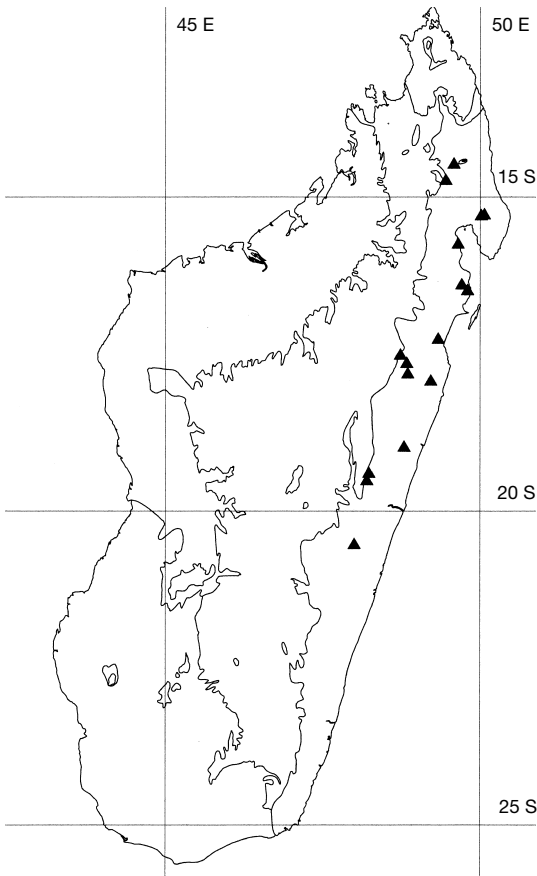


Fig. 3. — Distribution of *Rhodolaena coriacea*, mapped on the bioclimatic zones of Madagascar (after CORNET 1974; see SCHATZ 2000).

leaves, the largest blade on a specimen usually at least 7 cm long versus in *R. bakeriana* rarely exceeding 6 cm. Flowers of *R. coriacea* are also larger, with sepals (2-)2.5-3.5 cm long versus sepals that do not exceed 1.8 cm long in *R. bakeriana*. *Rhodolaena coriacea* has recently been collected at both Betampona RNI and Zahamena PN/RNI.

VERNACULAR NAMES. — Arina, Harinavavy, Pikazana, Tamanampotsy, Tsimahamasatsokina, Tsimamasasokina, Vazanomby.

PARATYPES. — MADAGASCAR, *Prov. Antsiranana: Rasoavimbahoaka 674*, Marojejy PN, 14°27'30"S, 49°34'54"E, 920-1040 m, 15-29 May 1995, fl. (K,

MO, P, TAN); *Ravelonarivo 608*, Anjanaharibe-Sud RS, 14°43'10"S, 49°27'12"E, 1700 m, 14 Feb. 1995, fl. (K, MO, P, TAN). *Prov. Fianarantsoa: Bosser 18885*, Kianjavato, route de Mananjary, [21°22'S, 47°52'E], Jan. 1964, ster. (TAN); *Service Forestier 14735*, Sahakorihina, Ambodilafa, Nosy-Varika, [20°31'S, 48°00'E, 450 m], 12 Jul. 1954, fl. (P, TEF). *Prov. Toamasina: Andrianjafy 88, 89*, Betampona RNI, 17°55'50"S, 49°12'12"E, 550 m, 19 July 2000, fr. (K, P, MO, TAN, TEF); *Carlson 419*, Betampona RNI, 17°53'S, 49°13'30"E, 520 m, 22 Aug. 1990, ster. (MO, TAN); *Cours 2422 (= Herb. Inst. Sci. Madag. 2422)*, Dist. Tamatave, de Sahalampy à Ampitamano, [17°48'S, 48°51'E], 1200 m, 18 Jan. 1945, fl. (P, TAN), *2812*, Zahamena RNI, [17°30'S, 48°38'E], 8 Mar. 1951, ster. (TEF); *Raharimalala 241*, Mananara Biosphere Reserve, Mahavoha, [16°23'S, 49°43'30"E], 12 Feb. 1990, fl. (P), *370*, Mananara-Nord PN, forêt d'Ambodihazovola, [16°29'S, 49°48'30"E], 26 Feb. 1990, ster. (P); *Ratovoson 257*, Zahamena PN, 17°30'15"S, 48°43'56"E, 996-1250 m, 18 July 2000, fl. (MO, P, TAN, TEF); *Réserves Naturelles 2812*, Zahamena RNI, [17°38'S, 48°50'E], 8 Mar. 1951, fl. (P); *Service Forestier 8800*, entre col d'Ambatondradama et le Beanjada, [15°16'S, 50°04'E, 700-800 m], Dec. 1953, bud, fl. (P, TEF), *8864*, crête au N du col d'Ambatondradama, [15°17'S, 50°01'E], 800 m, Jan. 1954, fl. (P, TEF), *8893*, entre Rantabe et Tenina, [15°44'S, 49°39'E, 10 m], Jan. 1954, fl. (P, TEF), *9099*, bassin de la Manonga (affluent rive gauche de la Rantabe) aux environs de Sahajinja, [15°38'S, 49°25'E], 800 m, 4 Mar. 1954, fl. (P), *10763*, Sahamamy, Anivorano, Brickaville, [18°33'S, 48°58'E, 200 m], 29 Sep. 1954, fl. (P), *18174*, Forêt d'Analatsara, à l'Ouest de Rantolava (NW de Tampolo-Fénériver), [17°15'S, 49°20'E], 1 Sep. 1957, fl. (P, TEF), *26073*, Vadivohitra, près de Foravohitra, canton d'Anosibe, [19°23'S, 48°14'E], 900 m, 27 Mar. 1966, ster. (TEF).

5. *Rhodolaena humblotii* Baill.

Bull. Mens. Soc. Linn. Paris 1: 566 (1886). — Lectotype (here designated): *Humblot 474*, Madagascar, Antsianaka (P!; iso-, K!, P!)

Rhodolaena humblotii is a medium-sized tree that occurs in low to mid-elevation humid to subhumid forest from Ifanadiana to Fampanambo NW of Maroantsetra (Fig. 4). It can usually be recognized easily by its twigs with dense, long, golden indument, and generally persistent, linear to narrowly triangular stipules. *Rhodolaena humblotii* has recently been collected at several localities, including Betampona RNI, Zahamena PN/RNI, the upper Rantabe water-

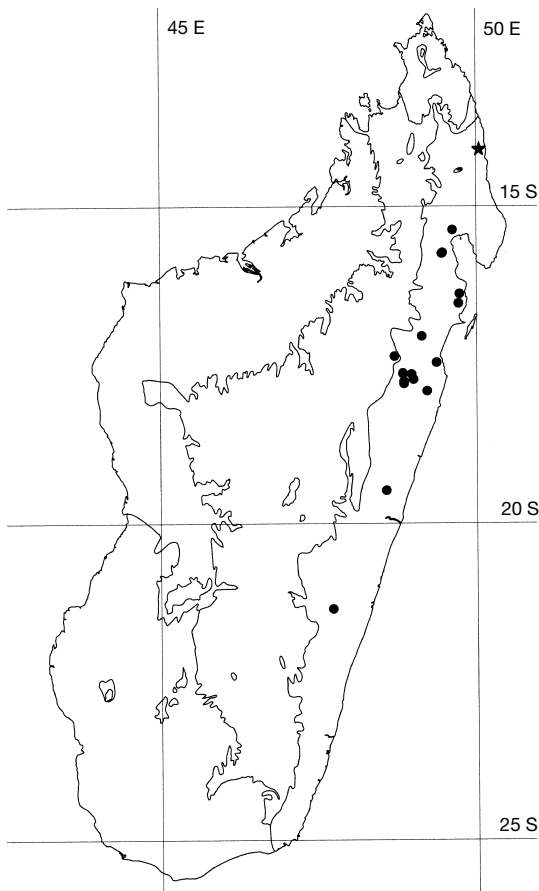


Fig. 4. — Distributions of *Rhodolaena*, mapped on the bioclimatic zones of Madagascar (after CORNET 1974; see SCHATZ 2000). *R. humblotii* (●), *R. macrocarpa* (★).

shed in the Bay of Antongil area, and at Fampanambo near Maroantsetra.

When BAILLON (1886a) described *R. humblotii*, he cited two collections (*Humblot* 428 and 474), the latter of which is in better condition and has therefore been selected as the lectotype.

VERNACULAR NAMES. — Arinala, Hazomafana, Fotona, Malemisisika, Vandrozana, Voandrozana.

MATERIAL EXAMINED. — *Andrianjafy* 68, Beanana, 88, Betampona RNI, 102, Zahamena RNI; *Cours* 1844 (= *Herb. Inst. Sci. Madag.* 1844), Ambodivoangy, 2392, Sahalampy, 2429 (= *Herb. Inst. Sci. Madag.* 2429 and *Herb. St. Agric. Alaotra* 2429), Sahalampy à Ampitanonoka; *Guillaumet* 2420,

Antanambao-Manampotsy; *Herb. Inst. Sci. Madag.* 3723, Zahamena RNI; *Homolle* 1844, without precise locality; *Humblot s.n.*, without precise locality, 428, 474, Antsianaka; *Iambana* 146, Betampona RNI; *Jacquemin* 226, Fotsialanana à Mitanonoka; *Malcomber* 2513, Zahamena RNI; *Nicoll* 501, Manambato; *Pierre s.n.*, without precise locality; *Rakotozafy* 677, Fotsialanana-Ampitanonoka; *Ratovoson* 92, Fampanambo; *Réserves Naturelles* 3723, Zahamena RNI, 7414, Betampona RNI, 7834, Zahamena RNI, 8749, Betampona RNI, 10508, 12442, Zahamena RNI; *Service Forestier* 4484, Sahamazaka, 9060, Beanana, 9109, Sahajinja-Sahamalaza, 17558, Betampona RNI, 21420, Tsinjoarivo, 23229, Ifanadiana, 31934, Verezantsoro, Mananara-Nord PN.

6. *Rhodolaena leroyana* G.E. Schatz, Lowry & A.-E. Wolf, sp. nov.

Haec species a congeneris foliorum apicibus acutis acuminatisve munitis venatione secundaria rectangulari, ab omnibus involucre maturitate profunde laciniato atque seminibus indumento albo longo densoque obtectis distinguitur.

TYPUS. — *Réserves Naturelles* 124, Madagascar, Prov. Toamasina, Canton Ambodiriana, Anjiro à la RN1 [Betampona], sommet, [17°55'S, 49°13'E], 19 Mar. 1954, fl. (holo-, P!; iso-, K!, MO!, P!, TEF!).

Shrub to tree to 8 m tall, branches glabrous. Leaves with petiole 0.4-0.7 cm long, lamina membranous to subcoriaceous, glabrous, elliptic to slightly obovate, 3.6-12 × 1.3-4.7 cm, base acute to cuneate, apex acuminate to cuspidate, acumen 0.3-1.3 cm long, venation weakly brochidodromous with 5-6 (-11) secondary veins per side nearly perpendicular to the midvein, midvein slightly sunken above, prominently raised below. Inflorescence solitary, axillary, 2-flowered, peduncle slender, 3.5-8 cm long, involucre 5-lobed, with dense golden simple and stellate indument, pedicel 0.7 cm long; outer 2 sepals narrowly elliptic, 0.2-0.7 × 0.2 cm, base attenuate and abruptly truncate, apex acute, the lower half strongly reflexed and then the upper half abruptly bent upwards, the margins revolute for the lower half and then involute for the upper half, densely stellate pubescent outside, glabrous inside; inner 3 sepals ovate, 1.7-2.5 × 1.2-1.4 cm, strongly concave, base truncate, apex obtuse to acute, densely stellate pubescent outside, glabrous

inside; petals elliptic, 3.8-4 × 1.7 cm, base cuneate and abruptly truncate, apex obtuse to rounded; disc annular, 0.4 mm in diam., 0.2 mm high; stamens ca. 40, inserted above disc at base of ovary, 3.5 cm long, anthers basifixed and resupinate, 1 × 1 mm; ovary subglobose, 4 mm high, 4 mm in diam., tomentose, style to 5 cm long, exerted, stigma crateriform. Fruit 3-valved, ultimately completely surrounded by the somewhat fleshy, accrescent involucre with deeply lacinate margins, valves broadly ovate, 1.3 cm long, 1.5-1.7 cm broad, densely golden pubescent outside; seeds depressed globose, 1.2 mm in diam., 0.5 mm thick, with dense white wooly indument. — Fig. 5.

Rhodolaena leroyana is a shrub to small tree in low elevation humid forest, and is known only from the Betampona RNI, where it was collected earlier this year (Fig. 1). It is easily distinguished by its leaves with an acuminate apex and 2° veins nearly perpendicular to the midvein (> 80°), as well as its densely golden tomentose ovary and fruit, and seeds covered with a dense, long, white indument.

ETYMOLOGY. — The species epithet honors the late Jean-François LEROY.

VERNACULAR NAMES. — Manasavelona, Tsipatika, Tsipatikala.

PARATYPES. — MADAGASCAR, *Prov. Toamasina: Andrianarisata 127*, Betampona RNI, 17°55'S, 49°13'E, 24 Apr. 1994, y.fr. (MO, P, TEF), *171*, Betampona RNI, 17°55'S, 49°13'E, 29 Apr. 1994, y.fr. (MO, P, TEF), *224*, Betampona RNI, 17°55'S, 49°13'E, 5 Oct. 1994, fr. (MO!, P, TEF); *Andrianjafy 86*, Betampona RNI, 17°55'50"S, 49°12'12"E, 550 m, 17 July 2000, fr. (K, MO, P, TAN, TEF); *Service Forestier 3573*, Betampona RNI, [17°55'S, 49°13'E], 12 June 1951, fr. (P, TEF).

7. *Rhodolaena macrocarpa* G.E. Schatz, Lowry & A.-E. Wolf, **sp. nov.**

Haec species a congeneris foliorum venatione secundaria divergente, floribus solitariis atque fructum magni valvis 2-3.3 × 2-2.5 cm distinguitur.

TYPUS. — *Andrianjafy, Rabenantoandro, Razafindrakoto, Birkinshaw & Lowry 61*, Madagascar,

Prov. Antsiranana, massif de Tsihomanaomby, ca. 35 km au Nord de Sambava, W d'Ambavala, forêt dense sur pente, sur sable quartzite, 14°06'03"S, 50°02'52"E, 150 m, 7 May 2000, fr. (holo-, MO!; iso-, K!, P!, TAN!, TEF!).

Tree to 10 m tall, branches glabrous. Leaves with petiole 0.7-1.6 cm long, canaliculate, glabrous; lamina stiff coriaceous, drying olive green, glossy, narrowly elliptic to elliptic to slightly obovate-elliptic, 3.2-11.2 × 2-6.8 cm, base acute to cuneate and slightly asymmetrical, apex abruptly short acuminate, occasionally rounded, margin weakly to strongly revolute, venation brochidodromous with 9-11 secondary veins per side strongly ascending at 45° angle or less, the secondary veins only slightly raised on upper surface; flowers known only at post-anthesis; peduncles in fruit 4.5-7.5 cm long, 2 mm in diam.; involucre entire, shallowly 3-lobed, lobes 3 mm long, 5 mm broad, densely light olive-tan stellate pubescent; pedicel post-anthesis 3-4 mm long, 2-3 mm in diam., expanding in fruit to 5-7 mm long, 4 mm in diam.; outer 2 sepals triangular to ovate, 1-2 × 0.6-2 mm, inner 3 sepals broadly elliptic, 2.2-2.7 × 1.3-1.8 cm; stamens ca. 60, filament 4.5-6 cm long, anther 0.7 mm long; style 6.5 cm long, stigma capitate with 3 triangular lobes; fruits globose, 1.5-1.7 cm in diam., weakly 3-sided in cross section, valves of dehisced fruits ovate, 2-3.3 cm long, 2-2.5 cm broad, densely stellate-strigose, with the central trichome branch much longer than the others. — Fig. 2.

Rhodolaena macrocarpa is a medium-sized tree that occurs in low elevation humid forest, and is known only from the type locality N of Sambava (Fig. 4). It is distinguished by its stiff coriaceous leaves drying glossy olive green with secondary veins strongly ascending at a 45° angle or less to the midvein, and its large fruit, exceeding those of all other members of the genus. Based on the available material, *R. macrocarpa* appears to be the only member of the genus with flowers borne singly above the involucre, whereas in the other species they consistently occur in pairs, one of which develops into fruit and the other aborts, leaving a more or less evident scar.

VERNACULAR NAME. — Voandrozana.

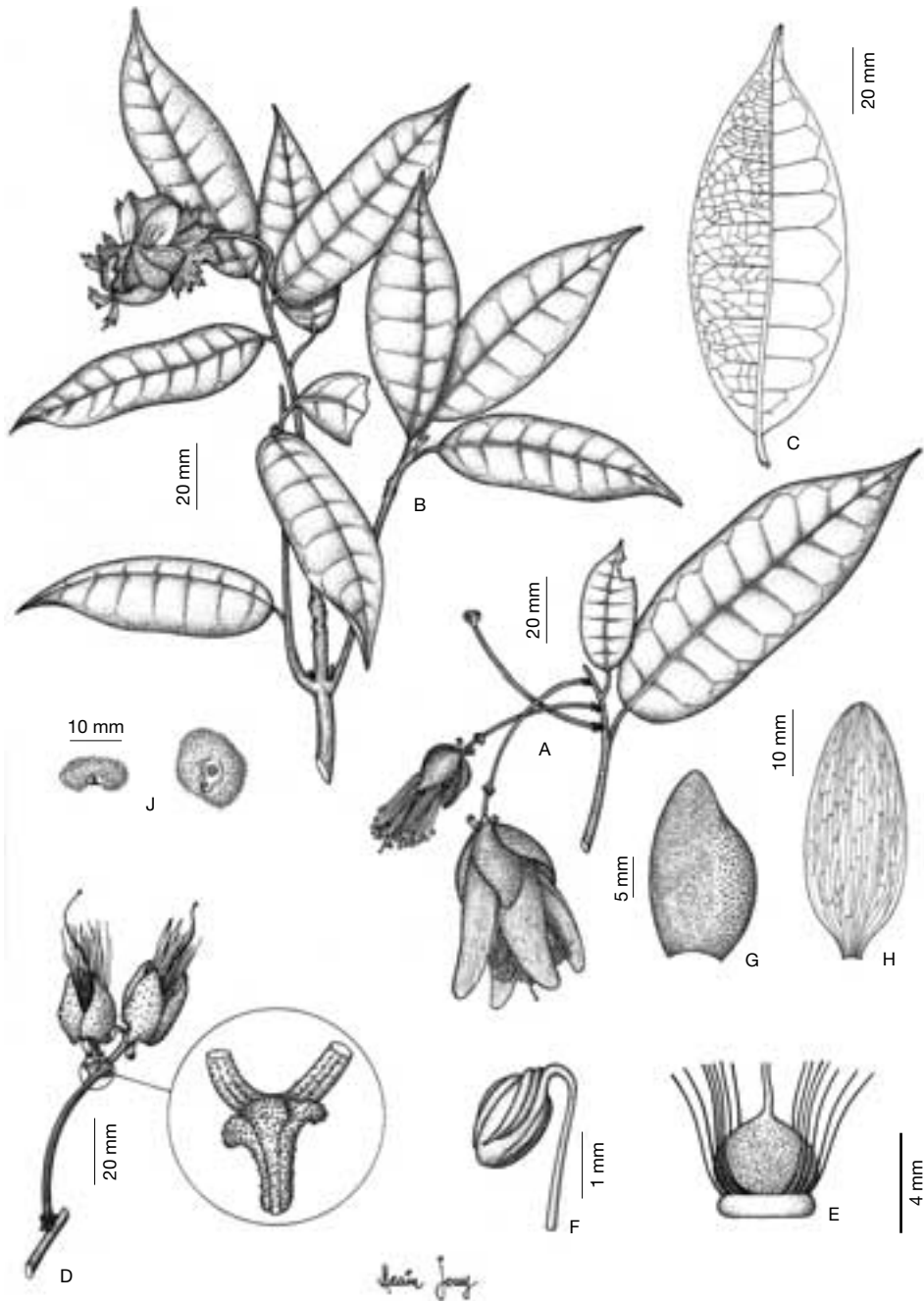


Fig. 5. — *Rhodolaena leroyana*: **A**, flowering branch; **B**, fruiting branch; **C**, leaf (abaxial surface); **D**, inflorescence (post-anthesis); **E**, ovary; **F**, anther; **G**, sepal; **H**, petal; **J**, seed. (A, C-H, *Service Forestier* 3573; B, J, *Andrianarisata* 224).

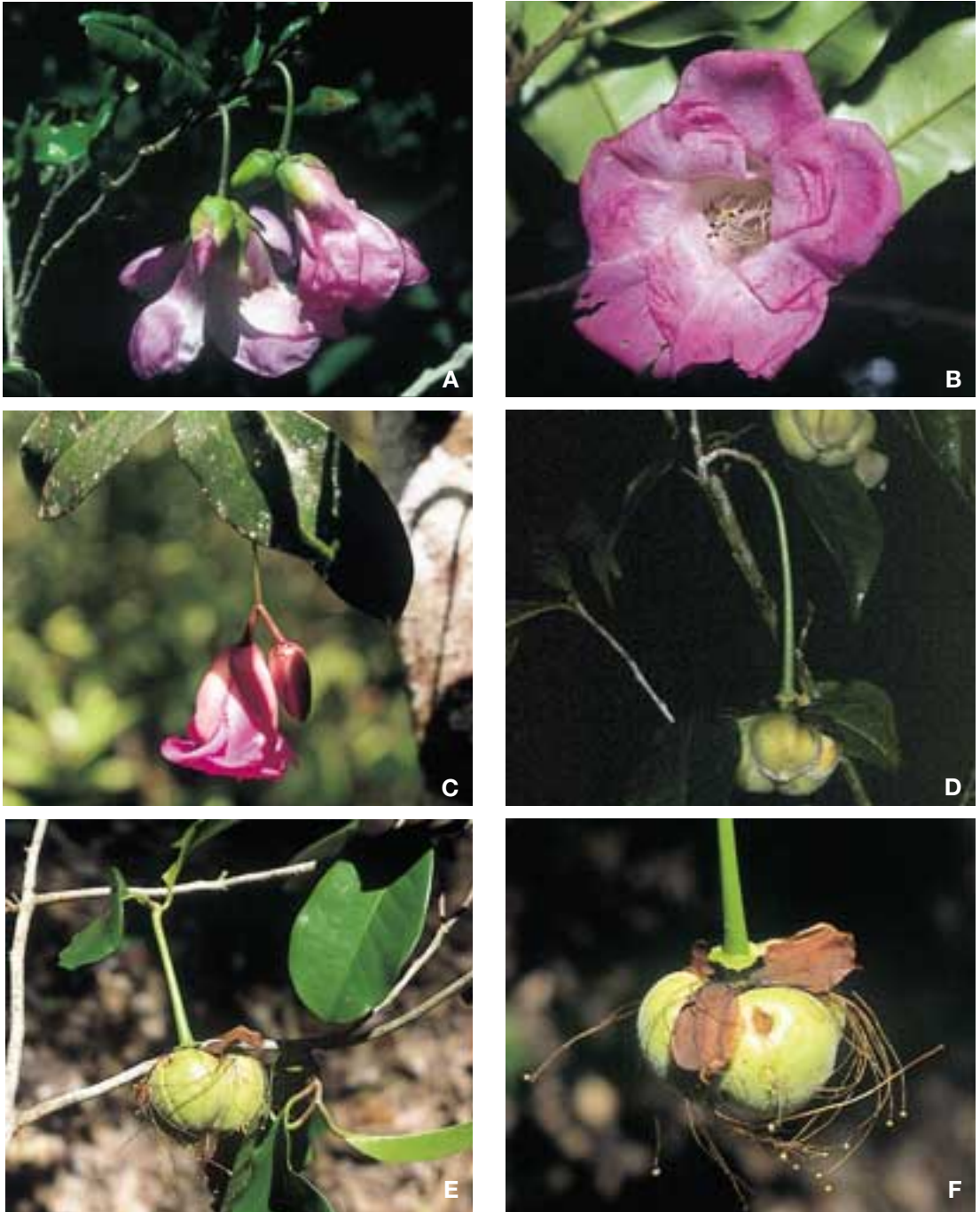


Fig. 6. — Photographs of *Rhodolaena*. — *R. bakeriana*: **A**, flowering branch; **B**, flower. — *R. acutifolia*: **C**, flowering branch. — *R. leroyana*: **D**, immature fruit. — *R. macrocarpa*: **E**, fruiting branch; **F**, immature fruit (Photos — A, G.E. SCHATZ; B, J.-N. LABAT; C, S. MALCOMBER; D, M. ANDRIANJAFY ; E-F, P.P. LOWRY).

PARATYPES. — MADAGASCAR, *Prov. Antsiranana: Service Forestier (Capuron) 27200*, Madagascar, Prov. Antsiranana, entre Andrangana et la rivière Anjambazamba (route de Sambava à Antsirabe-Nord), [14°05'S, 50°03'E], 2-7 Dec. 1966, fr. (K, MO, P, TEF).

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REFERENCES

- ALVERSON W.S., KAROL K.G., BAUM D.A., CHASE M.W., SWENSEN S.M., MCCOURT R. & SYTSMA K.J. 1998. — Circumscription of the Malvales and relationships to other Rosidae: evidence from *rbcL* sequence data. *Amer. J. Bot.* 85: 876-877.
- BAILLON H. 1886a. — Liste des plantes de Madagascar (suite). *Bull. Mens. Soc. Linn. Paris* 1: 562-568.
- BAILLON H. 1886b. — Nouvelles observations sur les Chlénacées. *Bull. Mens. Soc. Linn. Paris* 1: 570-572.
- BAKER J.G. 1883. — Contributions to the flora of Madagascar. Part I. Polypetalae. *J. Linn. Soc. Bot.* 20: 87-158.
- BAKER J.G. 1886. — Further contributions to the flora of Madagascar. *J. Linn. Soc. Bot.* 22: 441-537.
- BAYER C., FAY M.F., DE BRUIJN A.Y., SAVOLAINEN V., MORTON C.M., KUBITZKI K., ALVERSON W.S. & CHASE M.W. 1999. — Support for an expanded family concept of Malvaceae within a circumscribed order Malvales: a combined analysis of plastid *atpB* and *rbcL* DNA sequences. *Bot. J. Linn. Soc.* 129: 267-303.
- CAPURON R. 1970. — Observations sur les Sarcolaenacées. *Adansonia*, sér. 2, 10: 247-265.
- CAVACO A. 1952a. — Recherches sur les Chlénacées, famille endémique de Madagascar. *Mém. Inst. Sci. Madagascar, sér. B, Biol. Vég.* 4: 59-92.
- CAVACO A. 1952b. — Chlénacées. *Fl. Madagascar* 126: 1-37.
- COETZEE J.A. & MULLER J. 1984. — The phytogeographic significance of some extinct Gondwanan pollen types from the Tertiary of the southwestern Cape (South Africa). *Ann. Missouri Bot. Gard.* 71: 1088-1099.
- CORNET A. 1974. — Essai de cartographie bioclimatique à Madagascar. *Notic. Explic. ORSTOM* No. 55.
- DU PUY D.J. & MOAT J. 1996. — A refined classification of the vegetation types of Madagascar, and their current distribution: 205-218, in LOURENÇO W.R. (ed.), *Biogéographie de Madagascar*. Editions de l'ORSTOM, Paris.
- LOWRY II P.P., SCHATZ G.E. & PHILLIPSON P.B. 1997. — The classification of natural and anthropogenic vegetation in Madagascar: 93-123, in GOODMAN S.M. & PATTERSON B.D. (eds.), *Natural change and human impact in Madagascar*. Smithsonian Inst. Press, Washington & London.
- LOWRY II P.P., SCHATZ G.E. & PHILLIPSON P.B. 1998. — Classification de la végétation naturelle et anthropique de Madagascar. *Bull. Acad. Natl. Madagascar*, n.s., 73: 219-233.
- LOWRY II P.P., SCHATZ G.E., LEROY J.-F. & WOLF A.-E. 1999. — Endemic families of Madagascar. III. A synoptic revision of *Schizolaena* (Sarco-laenaceae). *Adansonia*, sér. 3, 21: 183-212.
- LOWRY II P.P., HAEVERMANS T., LABAT J.-N., SCHATZ G.E., LEROY J.-F. & WOLF A.-E. 2000. — Endemic families of Madagascar. V. A synoptic revision of *Eremolaena*, *Pentachlaena*, and *Perrierodendron* (Sarco-laenaceae). *Adansonia*, sér. 3, 22: 11-31.
- SCHATZ G.E. 2000. — Endemism in the Malagasy tree flora: 1-9, in LOURENÇO W.R. & GOODMAN S.M. (eds.), *Diversity and Endemism in Madagascar*. Mém. Soc. Biogéogr., Paris.
- SCHATZ G.E., BIRKINSHAW, C.R., LOWRY II P.P., RANDRIANTAFIKA F. & RATOVOSON F. 2000. — The endemic plant families of Madagascar project: integrating taxonomy and conservation: 11-24, in LOURENÇO W.R. & GOODMAN S.M. (eds.), *Diversity and Endemism in Madagascar*. Mém. Soc. Biogéogr., Paris.
- SCHATZ G.E., LOWRY II P.P., LESCOT M., WOLF A.-E., ANDRIAMBOLOLONERA S., RAHARIMALALA V. & RAHARIMAMPIONONA J. 1996. — Conspectus of the vascular plants of Madagascar: a taxonomic and conservation electronic database: 10-17, in VAN DER

- MAESEN L.J.G., VAN DER BURGT X.M. & VAN MEDENBACH DE ROOY J.M. (eds.), *The Biodiversity of African Plants*. Proc. XIV AETFAT Congress. Kluwer Academic Publishers, Wageningen, The Netherlands.
- SCHATZ G.E., LOWRY II P.P. & WOLF A.-E. 1998. — Endemic families of Madagascar. I. A synoptic revision of *Melanophylla* (Melanophyllaceae). *Adansonia*, sér. 3, 20: 233-242.
- SCHATZ G.E., LOWRY II P.P. & WOLF A.-E. 1999a. — Endemic families of Madagascar. II. A synoptic revision of Sphaerosepalaceae. *Adansonia*, sér. 3, 21: 107-123.
- SCHATZ G.E., LOWRY II P.P. & WOLF A.-E. 1999b. — Endemic families of Madagascar. IV. A synoptic revision of *Asteropeia* (Asteropeiaceae). *Adansonia*, sér. 3, 21: 255-268.

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