



## **Six New Species of Danais Vent. (Rubiaceae, Danaideae) from Madagascar**

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# Six new species of *Danais* Vent. (Rubiaceae, Danaideae) from Madagascar

Charlotte M. Taylor & Zachary S. Rogers

## Abstract

TAYLOR, C. M. & Z. S. ROGERS (2013). Six new species of *Danais* Vent. (Rubiaceae, Danaideae) from Madagascar. *Candollea* 68: 167-180. In English, English and French abstracts.

*Danais* Vent. (Rubiaceae, Danaideae) comprises about forty species of woody climbing plants, with most of them found in Madagascar. Recent exploration there has documented six new endemic species that are described, illustrated, and mapped here: *Danais antilahimena* C. M. Taylor, *Danais disticha* C. M. Taylor, *Danais laciniata* C. M. Taylor, *Danais masoalana* C. M. Taylor, *Danais rakotovaoui* C. M. Taylor, and *Danais randrianaivoi* C. M. Taylor. All six occur in humid vegetation and qualify as threatened based on preliminary IUCN conservation assessment (one “Critically Endangered”, four “Endangered”, one “Vulnerable”).

## Key-words

RUBIACEAE – *Danais* – Madagascar – IUCN Red List – New species – Taxonomy

## Résumé

TAYLOR, C. M. & Z. S. ROGERS (2013). Six nouvelles espèces de *Danais* Vent. (Rubiaceae, Danaideae) de Madagascar. *Candollea* 68: 167-180. En anglais, résumés anglais et français.

*Danais* Vent. (Rubiaceae, Danaideae) comprend environ quarante espèces de plantes ligneuses grimpantes, la plupart se trouvant à Madagascar. Des explorations récentes ont permis de documenter six nouvelles espèces endémiques qui sont décrites, illustrées et cartographiées ici: *Danais antilahimena* C. M. Taylor, *Danais disticha* C. M. Taylor, *Danais laciniata* C. M. Taylor, *Danais masoalana* C. M. Taylor, *Danais rakotovaoui* C. M. Taylor et *Danais randrianaivoi* C. M. Taylor. Les six espèces sont présentes dans la végétation humide et sont qualifiées de menacées selon une évaluation préliminaire du statut de conservation de l’UICN (une «En Danger Critique», quatre «En Danger», une «Vulnérable»).

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## Introduction

The paleotropical genus *Danais* Vent. (*Rubiaceae*, subfamily *Rubioideae*, tribe *Danaideae*) comprises about forty species of woody climbing plants found in moist vegetation at low to montane elevations in Madagascar, the Comoros Islands, the Mascarene Islands, and continental East Africa (BUCHNER & PUFF, 1993; PUFF & BUCHNER, 1994). *Danais* is characterized by a suite of morphological characters: a climbing habit; tissues with raphide crystals; opposite or sometimes verticillate leaf arrangement; interpetiolar, triangular, 2-lobed, or fimbriate, generally persistent stipules; terminal and/or axillary, bracteate, cymose inflorescences; bisexual, distylous, generally small flowers usually with five (but sometimes four or six) calyx lobes, corolla lobes, and stamens; funnelliform to salverform corollas with valvate-reduplicate lobes in bud and with the corolla tubes sometimes fenestrate at the base; two-lobed stigmas; two-locular ovaries with numerous ovules in each locule; capsular, loculicidal, subglobose, generally papery to somewhat woody fruits; and flattened winged seeds. The living plants sometimes have a foetid odor. The corollas are variously white, yellow, orange, red, violet, blue, purple, or nearly black, and often have remarkably slender tubes. The flowers of *Danais* were documented as distylous by BUCHNER & PUFF (1993), though only one floral form has been recorded for several poorly known species and the presence of distyly remains to be confirmed in these cases.

*Danais* is similar to *Payera* Baill. and *Schismatoclada* Baker in its flower and fruit characters, and these three genera comprise the tribe Danaideae as recognized by BREMER & MANEN (2000), BREMER & ERIKSSON (2009), RYDIN & al. (2009), and KRÜGER & al. (2012). BUCHNER & PUFF (1993) distinguished *Danais* from the other two genera of the tribe by its climbing habit, its inflorescences that are sometimes axillary, and its loculicidal capsules that are not beaked at the apex; vs. erect trees and shrubs with consistently terminal inflorescences and apically beaked fruits that are variously loculicidal or septicidal in the other two genera. However several species of *Danais* do sometimes have shortly beaked capsules, so this distinction does not completely separate these genera. KRÜGER & al. (2012) found *Danais* supported as monophyletic by molecular data, and sister to *Payera* plus *Schismatoclada*. The only distinguishing morphological feature they found for *Danais* is the climbing habit.

BUCHNER & PUFF (1993) detailed the morphology and anatomy of *Danais*, and PUFF & BUCHNER (1994) in a comprehensive revision recognized 26 species from Madagascar and adjacent islands, and treated three additional species that have been described in the genus as doubtful. PUFF & BUCHNER (1993) organized some of the species into groups, which they characterized but considered informal and did not name, and placed several species as intermediate between

groups; no formal infrageneric classification of *Danais* has ever been presented. Their species groups were not characterized in extensive detail, and they noted that one of their informal species groups was heterogeneous morphologically. KRÜGER & al. (2012) found three subclades were supported within *Danais* by molecular data from nuclear ITS plus four chloroplast sequences, with two of these partly corresponding to two of the informal species groups recognized by PUFF & BUCHNER (1994); no formal infrageneric classification of *Danais* was presented by KRÜGER & al. (2012) either. Some other genera of *Rubiaceae* that have undergone notable species radiations in Madagascar have been studied with detailed morphological and molecular data (e.g., *Gaertnera* Lam., MALCOMBER & TAYLOR, 2009; *Razafimandimbisonia* Kainul. & B. Bremer, KAINULAINEN & al., 2009; *Coffea* L., MAURIN & al., 2007), and those radiations appear to have been relatively recent with no infrageneric groups well enough supported for formal separation; *Danais* may have a similar evolutionary history.

Since PUFF & BUCHNER (1994)'s revision was published, extensive botanical exploration in Madagascar has documented *Danais* with numerous additional specimens from previously poorly known regions. Review of these new collections shows additional variation in taxonomically important characters, adds to our knowledge of several previously described species, and documents several species of *Danais* new to science. For further taxonomic notes and detailed specimen data for the *Danais* species of Madagascar see MADAGASCAR CATALOGUE (2013). The six new species described here bring the total number of indigenous *Danais* species known from Madagascar to 34 (including the species considered doubtful by PUFF & BUCHNER, 1994), with all but two of these endemic to the island.

## Methods

Morphological descriptions generally but not exactly follow the format of PUFF & BUCHNER (1994): some terminology instead follows LAWRENCE (1951); pollen and seed coat characters were not investigated here; and stem shape, leaf venation, and inflorescence arrangement are described in more detail here than done by PUFF & BUCHNER (1994). Some terminology is clarified in the first species description and the explanations are not repeated in subsequent descriptions. Measurements in the descriptions denote length unless otherwise indicated. Corolla measurements are based on rehydrated flowers taken from dried herbarium specimens. The species are treated in alphabetical order. Additional collection data for the specimens cited here and high-resolution digital images of the types are available in the TROPICOS database (TROPICOS, 2013), where they can be accessed by species name or by the first collector's last name plus the collection number.

Distribution maps were created in ArcView GIS 3.2 (ESRI, 1999) based on geographic coordinates of the specimens cited in this article. However extensive botanical exploration of Madagascar is ongoing, and readers are strongly encouraged to consult more detailed and regularly updated distributional data in the Madagascar Catalogue on TROPICOS (2013), where existing and future distributions can be mapped interactively and at higher resolution (MADAGASCAR CATALOGUE, 2013). Historical collections lacking precise locality data were georeferenced post-facto based on SCHATZ & LESCOT (2012). Species distributions are mapped over the outlines of the five simplified bioclimatic zones of Madagascar (SCHATZ, 2000; following CORNET, 1974).

Preliminary conservation assessments are provided here for the six newly described species using the IUCN Red List Categories and Criteria (IUCN, 2012). These conservation assessments are based on the study presented here, which is floristic. The statistics calculated for the quantitative criteria used to determine the conservation status were Extent of Occurrence (EOO), Area of Occupancy (AOO), and number of subpopulations (IUCN, 2013).

## Taxonomy

### 1. *Danais antilahimena* C. M. Taylor, *spec. nova* (Fig. 1A-C).

**Typus:** MADAGASCAR. **Prov. Toamasina:** Analanjirofo Region, Ambinanihely, Camp I, Befontsimanta, 15°29'53"S 49°22'56"E, 919 m, 21.XI.2003, fl., *Antilahimena* 2340 (holo-: MO-6306540!; iso-: K, P, SUNIV!, TAN).

*Haec species a congeneris stipulis bilobis grandibus marginibus plerumque serratis, foliis grandibus atque inflorescentia grandi axibus prolongatis spiciformibus distinguitur.*

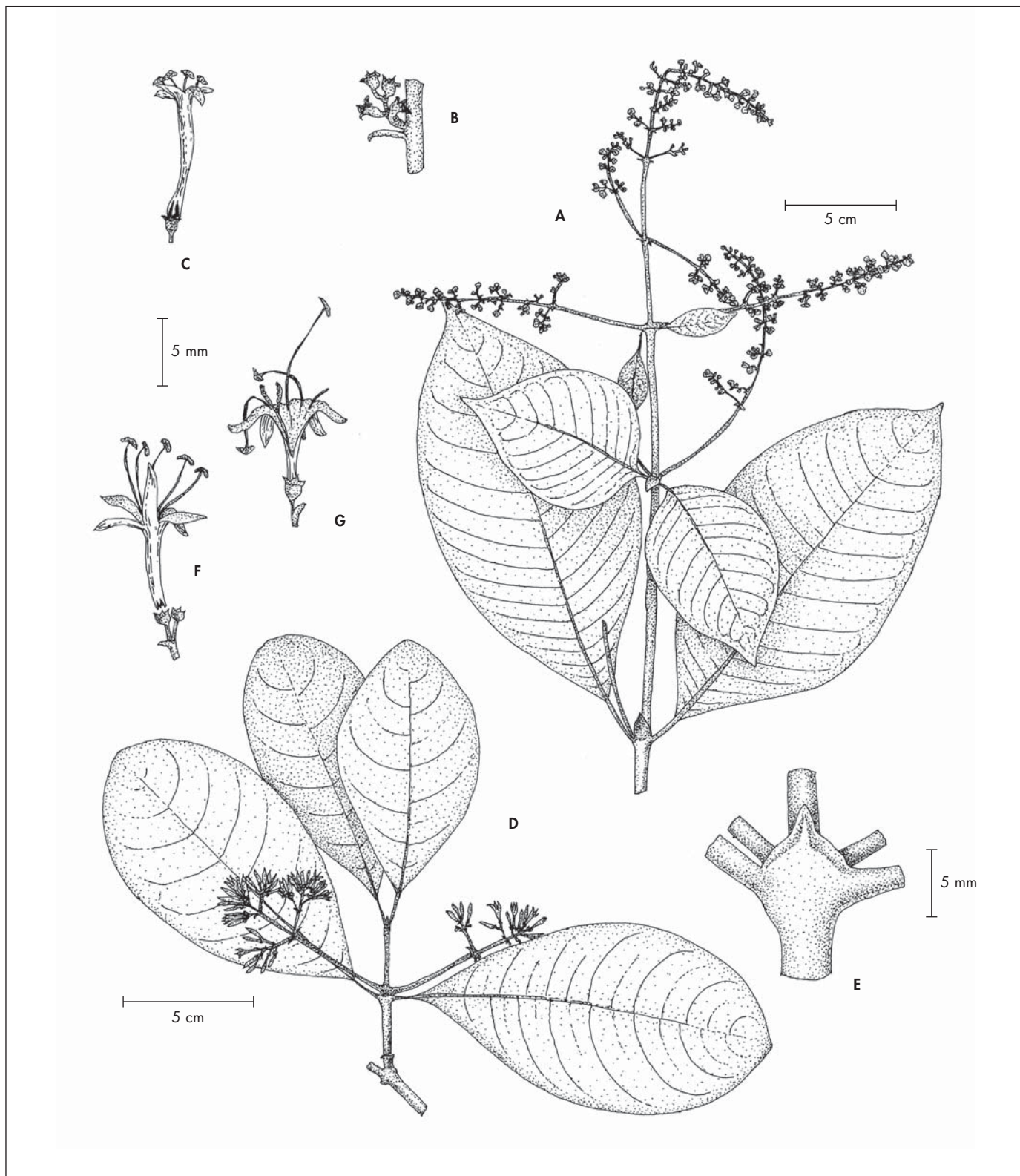
Woody *lianas* or climbing *shrubs*, climbing to 8 m high; stems puberulous, quadrangular. *Leaves* opposite; blades elliptic, ovate, or obovate, 12-24 × 6-9.5 cm, at base acute to cuneate, at apex acuminate with tips 3-10 mm, drying papery to chartaceous, adaxially glabrous, abaxially glabrous to puberulous on lamina and puberulous to strigillose or strigose on principal veins, with margins plane; secondary veins 12 to 18 pairs, looping to interconnect with each other near margins, adaxially costa and secondary veins plane to prominulous and tertiary venation prominulous and rather loosely reticulated, abaxially costa and secondary veins prominent and intersecondary and tertiary venation prominulous. *Petioles* 10-30 mm, puberulous to glabrescent. *Stipules* interpetiolar, persistent at least on distalmost 3 or 4 nodes, ovate to triangular or elliptic, 7-13 mm, abaxially puberulous to glabrescent, at apex obtuse to acute and shortly 2-lobed, margins entire to usually serrate or sparsely shortly lacinate. *Inflorescences* terminal and in

axils of uppermost leaves, paniculate, pyramidal in outline, 15-38 × 12-26 cm (including peduncles), multiflowered (ca. 60 to 200 flowers), branched to 2 to 3 orders, with principal axes spiciform, with axes puberulous, with basalmost secondary axes often subtended by ovate foliaceous bracts (or reduced leaves) 5.5-8.5 × 4-6.5 cm on stipes (or petioles) 0.3-1.5 cm; other bracts linear to triangular, 0.3-3 mm. *Flowers* in dichasial groups of 2 to 5 with terminal flower sessile and others subsessile to pedicellate on pedicels up to 1 mm, with floral biology (i.e., distyly vs. monomorphy) unknown; hypanthium (i.e., ovary portion) ellipsoid-obconic, ca. 0.8 mm, densely puberulous. *Calyx limb* divided nearly to base, densely puberulous, lobes 5, narrowly triangular, ca. 1 mm, acute. *Corolla* slenderly funnelform to salverform, purple, externally glabrous, internally sparsely pilose in throat and upper 2/3 of tube, tube 10-10.5 mm, ca. 1 mm diam. at base, ca. 1.5 mm diam. at throat, at base fenestrate with 5 slits, each slit 1.5-2 mm, lobes 5, narrowly triangular, ca. 3 mm, acute and shortly thickened at apex; stamens 5, inserted in throat, anthers 1.2-2 mm, purple, exserted on filaments ca. 4 mm. *Stigmas* 2, linear, ca. 2 mm, included and positioned above middle of corolla tube, style ca. 5 mm. *Capsules* subglobose to somewhat oblate, 3 × 3-3.2 mm, stiffly chartaceous, densely puberulous, dehiscent through flattened to broadly triangular beak portion (i.e., top part inside calyx limb), often also splitting from apex for 1/3-1/2 of body. *Seeds* irregular in shape but generally elliptic to rectangular, 0.3-0.8 mm, flattened, with circumferential wing shortly lacinate and usually elongated on one side.

*Names.* – The scientific name of this robust handsome species is created here to honor Mr. Patrice Antilahimena, collector of the type specimen and one of the Missouri Botanical Garden's resident field botanists. Mr. Antilahimena has extensively documented Madagascar's flora with excellent specimens collected during numerous explorations made throughout the island. No vernacular name has been noted in the information available.

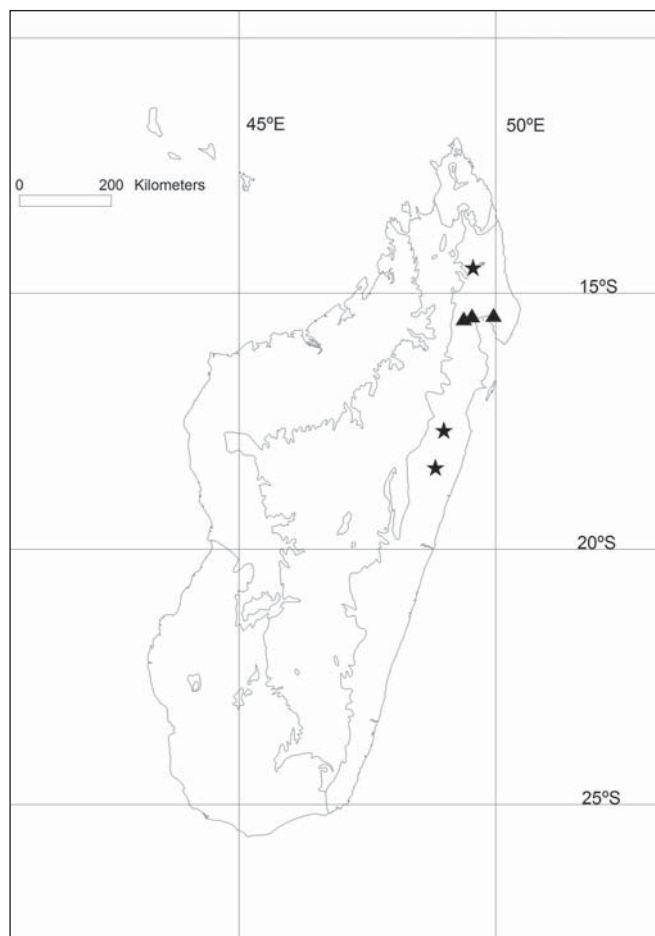
*Habitat and distribution.* – This species is documented from humid forests at 600-1125 m in eastern Madagascar, in northern Toamasina Province (Analanjirofo Region) in the area of the Masoala Peninsula and Baie d'Antongil (Fig. 2, humid bioclimatic zone). This species is known from a limited geographic distribution; see MADAGASCAR CATALOGUE (2013) for detailed distribution mapping.

*Conservation status.* – *Danais antilahimena* has an EOO of 134 km<sup>2</sup>, which meets the criterion for Endangered; an AOO <500 km<sup>2</sup>, which also meets the criterion for Endangered; and three subpopulations. The species is known from three localities, only one of which falls inside the boundaries of a currently protected area (Masoala National Park). The habitat of this species is already significantly fragmented and expected to diminish further in quality. *Danais*



**Fig. 1.** – *Danais antilahimena* C. M. Taylor. **A.** Flowering branch; **B.** Portion of inflorescence, with young fruits; **C.** Flower at anthesis. – *Danais masoalana* C. M. Taylor. **D.** Flowering branch; **E.** Stem node with stipule, bases of two petioles, and bases of two axillary peduncles; **F.** Flower at anthesis; **G.** Flower at anthesis, partially dissected.

[**A, B:** *Antilahimena* & al. 1627, MO; **C:** *Antilahimena* 2340, MO; **D-G:** based on *Hoffmann* & al. 36, MO] [Drawing: C. M. Taylor]



**Fig. 2.** – Distribution of *Danais antilahimena* C. M. Taylor (triangles) and *Danais rakotovaoui* C. M. Taylor (stars), mapped over the outlines of the five simplified bioclimatic zones of Madagascar of SCHATZ (2000, following CORNET, 1974).

*antilahimena* is assigned a preliminary conservation status of Endangered due to its limited distribution and threatened habitat [EN B1ab(i,ii,iii,iv)+2ab(i,ii,iii,iv)].

*Notes on morphology and similar species.* – This new species is characterized by its relatively large leaves (for *Danais*), its rather large stipules with shortly lacinate to usually serrate margins, its relatively very large inflorescences (for *Danais*) with the secondary axes prolonged and spiciform, its medium-sized flowers with purple corollas, and its small fruits. The stipules of this species are unusual in *Danais*, and similar only to those of *D. rakotovaoui*; see the discussion of that second species below for the distinctions between these. Only one flowering collection has been seen, with flowers that resemble the short-styled form of distylous species of *Danais*. The presence of the foliaceous bracts or reduced leaves at the base of the inflorescences is consistent in the specimens studied. The overall inflorescence arrangement of *D. antilahimena* (apart from the narrowly spiciform secondary axes)

and its small fruits are similar to the species that PUFF & BUCHNER (1994) included in their informal “*Danais microcarpa* group”. However the species included in that group are all characterized by white to yellow, shorter corollas, with the tubes 1-5.5 mm long, whereas the flowers of *D. antilahimena* are more similar to those of another Malagasy species, *D. nigra* Homolle, which has black to dark purple corollas and well developed corolla tubes. *Danais nigra* differs from *D. antilahimena* in its short (ca. 1 mm long) triangular stipules, its regularly cymose inflorescence axes, and its longer corollas (tubes 11-20 mm long).

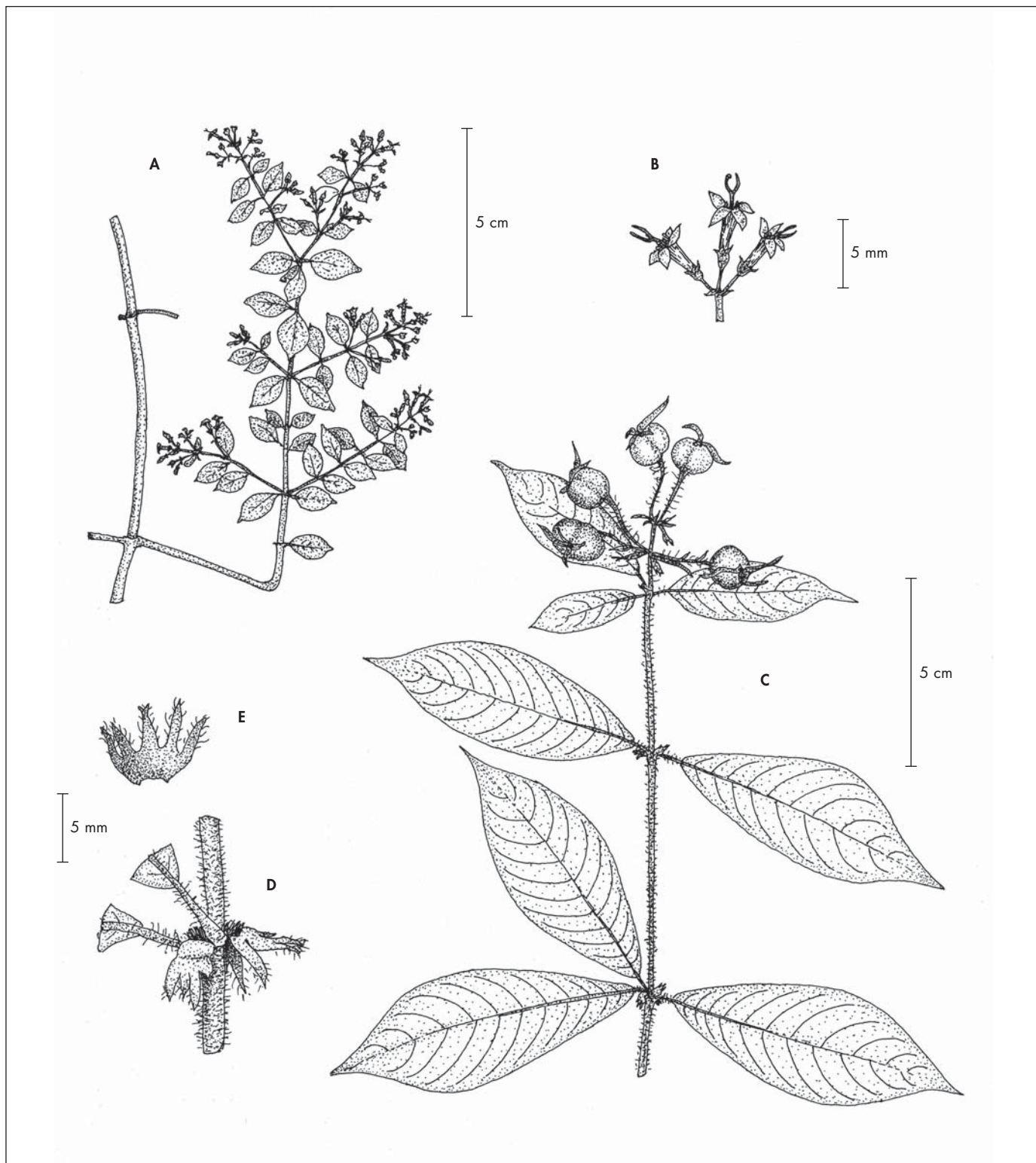
*Paratypi.* – MADAGASCAR. Prov. Toamasina: Analanjirofo, Maroantsetra, Antsirabesahatany, Anjahley, 15°26'30"S 49°32'19"E, 600 m, 27.XII.2002, fr., *Antilahimena*, Pascal & Ramaroson 1627 (MO!); Masoala National Park, E slope of Ambohitsitondroinan' Mahalevona, ESE of village of Mahalevona, 15°26'00"S 49°57'34"E, 1125 m, 23.II.2003, fr., *Lowry*, Schatz & Be 6097 (K, MO!, P, TAN).

## 2. *Danais disticha* C. M. Taylor, *spec. nova* (Fig. 3A-B).

**Typus:** MADAGASCAR. Prov. Fianarantsoa: Vatovavy-Fitovinany Region, E de Fianarantsoa, Parc National de Ranomafana, Parcelle III, Talatakely, 21°16'S 47°25'E, IV-V.1992, fl., *Rakoto 29* (holo-: MO-6087991!; iso-: G [G00369981]).

*Haec species a congeneris foliis parvis ut videtur disticha atque inflorescentia brevi pauciflora terminali distinguitur.*

Woody *lianas* or climbing *shrubs*, apparently rather extensively twining, climbing to at least 6 m high; stems densely puberulous, rounded, with principal stems elongated and mostly leafless, with leaves and flowers mostly borne on shorter lateral stems. *Leaves* opposite or rarely ternate; blades elliptic to broadly elliptic or ovate, 0.5-1.2 × 0.3-1 cm, at base cuneate to obtuse, at apex obtuse to acute or shortly acuminate with tips 1-1.5 mm, drying papery to chartaceous and often rather shiny, glabrous on both surfaces, with margins thinly revolute; secondary veins 3 or 4 pairs, free or sometimes weakly looping to interconnect with each other near margins, adaxially costa plane or prominulous and secondary veins and some tertiary veins thinly prominulous, abaxially costa prominent and secondary veins and some tertiary veins thinly prominulous. *Petioles* 0.5-1 mm, glabrous to puberulous. *Stipules* interpetiolar, deciduous below 5 to 8 distalmost nodes, triangular, ca. 1 mm, abaxially densely puberulous, acute. *Inflorescences* terminal and in axils of uppermost leaves, cymose, cylindrical to rounded in outline, 1-2.5 × 0.8-2.5 cm (including peduncles), few- to several-flowered (ca. 3 to 15), branched to 1 or 2 orders, with axes cymose, glabrous to puberulous; bracts narrowly triangular, 1-2 mm. *Flowers* in dichasial to umbelliform groups and all pedicellate on pedicels 1-3 mm, distylous; hypanthium oblate to ellipsoid, 0.3-0.8 mm, glabrous. *Calyx limb* divided nearly to base, glabrous, lobes 4 to 6, narrowly triangular to deltate or ligulate, 0.3-0.8 mm, acute



**Fig. 3.** – *Danais disticha* C. M. Taylor. **A.** Flowering branch; **B.** Portion of inflorescence with three flowers at anthesis. – *Danais laciniata* C. M. Taylor. **C.** Fruiting branch; **D.** Stem node with two reflexed stipules, and petioles and bases of two leaves; **E.** Stipule, abaxial face.

[**A-B:** Rakoto 29, MO; **C:** Antilahimena 2627, MO; **D-E:** Schatz & Antilahimena 4007, MO] [Drawing: C. M. Taylor]



**Fig. 4.** – Distribution of *Danais disticha* C. M. Taylor (crosses) and *Danais randrianaivoi* C. M. Taylor (squares), mapped over the outlines of the five simplified bioclimatic zones of Madagascar of SCHATZ (2000, following CORNET, 1974).

to rounded, with lobes generally equal or with 1 lobe slightly larger on some flowers. *Corolla* funnelliform to funnelliform-salverform, white becoming yellowed with age, externally glabrous, internally moderately to densely pilosulous in throat and upper 1/2 of tube, tube 3-3.5 mm, 1-1.2 mm diam. at base, 1-1.3 mm diam. at top, at base entire (i.e., not fenestrate), lobes 4 to 6, narrowly triangular, 1.5-2 mm, acute and smooth at apex. *Stamens* 4 to 5, inserted in corolla throat, anthers creamy white, in short-styled flowers ca. 0.8 mm and exserted on filaments 2.5-3 mm, in long-styled flowers ca. 0.8 mm, sessile, and partially exserted. *Stigmas* 2, linear, in short-styled flowers ca. 1 mm and included, with style ca. 2 mm, in long-styled flowers ca. 2 mm and exserted, with style ca. 5 mm. *Capsules* subglobose, 1.5-3 mm in diam., stiffly chartaceous to woody, glabrous, dehiscent from apex through top 1/3-1/2 of body, with beak portion flat to rounded. *Seeds* not seen.

*Names.* – The scientific name created here for this species refers to the apparently distichous leaf arrangement that is distinctive, as noted below. The vernacular name “Vahimavo” was noted on *Rakoto 29*, and is probably in the Betsileo dialect. Translated into English this means “yellow liana”.

*Habitat and distribution.* – This species is documented from humid forests at ca. 850-1300 m in east-central Madagascar, in the provinces of Fianarantsoa, in Ranomafana National Park (Vatovavy-Fitovinany Region), and Toamasina, in the Alaotra-Mangoro Region and in the region of Andasibe/Moramanga (Fig. 4, humid bioclimatic zone).

*Conservation status.* – *Danais disticha* has an EOO of 8609 km<sup>2</sup>, which meets the criterion for Vulnerable; an AOO of <500 km<sup>2</sup> which meets the criterion for Endangered; and three subpopulations. The species is known from four collections in three localities, and only one of those falls inside the boundaries of a currently protected area (Ranomafana National Park). The species was collected in a small forest remnant located about six kilometers outside of a second protected area (Analamazoatra Special Reserve) in 1997, so it is possible that extant populations occur within the adjacent Reserve or in the nearly contiguous Mantadia National Park. The habitat of this species is already significantly fragmented and expected to diminish further in quality. *Danais disticha* is assigned a preliminary conservation status of Vulnerable due to its limited distribution and threatened habitat [VUB1ab(i,ii,iii,iv)+2ab(i,ii,iii,iv)].

*Notes on morphology, biology and similar species.* – *Danais disticha* is characterized by its growth pattern, with prolonged and mostly leafless principal stems and shorter lateral stems bearing numerous regularly arranged small leaves; its short triangular stipules; its relatively small inflorescences that are terminal and sometimes also produced in the adjacent uppermost leaf axils; its pedicellate flowers; its calyx and corolla with a variable number of lobes (four to six); and its relatively small capsules. The regularly arranged leaves appear to be at least weakly distichous, even though the leaf arrangement in the genus is basically decussate. Such an arrangement requires twisting of the internodes to alter this decussate arrangement, and is found in some *Rubiaceae*. This apparent distichous arrangement may be only an artifact of specimen preparation, and field observations are needed to confirm the morphology of this species.

Only two flowering collections have been seen: one has short-styled flowers (*Turk & al. 454*) with variously four or five calyx and corolla lobes but consistently five stamens; the other has long-styled flowers (*Rakoto 29*) with variously four or five calyx and corolla lobes and consistently four stamens. Variation in calyx and corolla lobe number within *Danais* species was previously documented by PUFF & BUCHNER (1994). Only two apparently mature capsules have been



examined, and no mature seeds of this species were found; however all of the other characters, including the climbing habit, agree with *Danais* and this species is therefore included in this genus. Within *Danais*, this new species is similar to those included in PUFF & BUCHNER (1994)'s informal "*Danais microcarpa* group", in particular *D. microcarpa* Baker and *D. ligustrifolia* Baker. However this new species differs from these and other species of *Danais* in its consistently smaller leaves and characteristic branching arrangement.

*Paratypes*. – **MADAGASCAR. Prov. Fianarantsoa:** Vatovavy-Fitovinany, Ranomafana National Park, Parcelle 3, S of National Road 25 at 7 km W of Ranomafana, Talatakely trail system, 21°15'30"S 47°25'00"E, 950-1150 m, 7.V.1993, fl., *Turk & al.* 454 (MO!). **Prov. Toamasina:** Alaotra-Mangoro, along Route National no. 2 (Antananarivo to Tamatave [Toamasina]), 6 km due SE of Andasibe (Perinet), above the river near Anevoka, 18°56'S 48°27'E, 850 m, 24.XI.1997, y. fr., *Davis, Andriantiana, Gower & Malcomber* 1157 (G, K, MO!, TAN); Moramanga, Ambongabe, Ambodikija [Anjozorobe], 18°29'33"S 48°00'50"E, 1300 m, 4.IV.2005, y. fr., *Rabehevitra & al.* 1408 (MO!).

### 3. *Danais laciniata* C. M. Taylor, *spec. nova* (Fig. 3C-E).

**Typus:** **MADAGASCAR. Prov. Toamasina:** Analanjirofo Region, Ankirindro Massif, slopes above the village Ambo-divato, ca. 5 km NW of Ambinanitelo along the Vohimaro River, 15°19'13"S 49°33'29"E, 150 m, 20.XI.2002, fr., *Schatz & Antilahimena* 4007 (holo-: MO-5989728!; iso-: BR, K, P, TAN).

*Haec species a congeneris pubescentia hispida, foliis ternatis, stipulis reflexis laciniatis, inflorescentia terminali, pedicellis longis atque lobis calycinis longis linearibus distinguitur.*

Woody *lianas* or climbing *shrubs*, climbing to 7 m high; stems moderately to densely hispid or pilose, subterete. *Leaves* opposite or ternate with arrangement often variable on a single stem; blades obovate to oblanceolate or elliptic, 2.5-8.5 × 1-3 cm, at base acute to cuneate, at apex acute to acuminate with tips 3-10 mm, drying papery, adaxially moderately hispid to strigose throughout, abaxially moderately to densely hispid to strigose with pubescence denser on principal veins, with margins plane; secondary veins 7 to 11 pairs, not looping to interconnect with each other, adaxially costa and secondary veins prominulous and remaining venation plane, abaxially costa prominent, secondary veins prominulous, intersecondary veins inconspicuous or hardly developed, and tertiary venation loosely reticulated and plane to prominulous. *Petioles* 3-7 mm, densely hispid to pilose. *Stipules* interpetiolar, generally persistent with leaves and becoming reflexed, deeply laciniate, with unlobed basal portion truncate to triangular, 1-2.5 mm, with laciniae or lobes 3 to 6, narrowly triangular, 2-4 mm, acute to acuminate, entire to ciliate. *Inflorescences* and *flowers* not seen. *Infructescences* terminal and sometimes also axillary at distalmost 1 to

4 nodes, cymose, rounded in outline, 3-5 × 2-6 cm (including peduncles and fruits), several-flowered (2 to 5), with fruits umbellate or usually with primary axis developed and fruits produced at 2 nodes, with axes hispid to pilose; bracts narrowly elliptic to narrowly triangular or stipuliform, 5-13 mm. *Capsules* in umbelliform groups of 2 to 5 and all pedicellate on pedicels 15-26 mm, subglobose to oblate and laterally somewhat flattened, 8-12 × 10-12 mm, stiffly chartaceous to thinly woody, moderately to densely pilose to hispid, dehiscent from apex for 1/4-1/2 of body, beak portion flat to broadly conical, with persistent *calyx limb* divided nearly to base, hispid, lobes 5, narrowly triangular, 7-14 mm, subequal or unequal by up to 1/3 on an individual fruit, acute to acuminate. *Seeds* elliptic to suborbicular, 2-2.5 mm, flattened, with circumferential wing subtentire to weakly dentate and with 1 deep incision.

*Names*. – The scientific name created here for this species refers to the lacinate stipule form, which is unusual in the genus. The vernacular name "Vahidambo" was noted on *Antilahimena* 2627, and is probably in the northern Betsimisaraka dialect. This name translated into English means "pig liana" or "wild pig vine".

*Habitat and distribution*. – This species is documented from humid forests, at least sometimes in highly disturbed sites, at 150-298 m in eastern Madagascar, in Toamasina Province (Analanjirofo Region, Fig. 5, humid bioclimatic zone).

*Conservation status*. – An EOO cannot be calculated for *Danais laciniata* because the species is known only from two localities. Its AOO is very restricted, certainly <10 km<sup>2</sup>, which meets the criterion for Critically Endangered. The two localities where this species is known are ca. 4 km apart, and neither falls within Madagascar's current system of protected areas. Vegetation at one of the localities was highly fragmented and disturbed in 2002 according to the label information, and the other site is most likely similarly degraded. The habitat quality is certainly expected to worsen in the future, and *Danais laciniata* is assigned a preliminary conservation status of Critically Endangered due to its limited distribution and threatened habitat [CR B2ab(i,ii,iii,iv)].

*Notes on morphology, taxonomic identity and similar species*. – *Danais laciniata* can be recognized by its hispid or pilose pubescence, its leaves that are ternately arranged on at least some nodes and with the blades generally widest above the middle, its lacinate reflexed stipules, its rather lax umbelliform infructescences, its well developed persistent calyx lobes, and its relatively large fruits and seeds. Although the inflorescences and flowers of this species have not been seen, the fruit characters along with the climbing habit support its classification in *Danais* and the combination of the distinctive characters listed above distinguish *D. laciniata* from all other *Danais* species. The relatively long, perhaps flexuous pedicels also appear to be distinctive for this species, but in *Danais* the

fruiting pedicels are frequently much longer than flowering pedicels (e.g., *D. vestita* Baker), so details of the inflorescences cannot necessarily be inferred from the infructescences.

These plants may be the same as the fruiting specimen *J. S. Miller & al.* 3326 that was studied by PUFF & BUCHNER (1994: 44), but neither that collection nor duplicates have been located. PUFF & BUCHNER (1994) included that specimen provisionally in their circumscription of *Danais vestita* Baker but considered it anomalous due to its ternate leaves, sparser pubescence that dried whitish rather than rusty brown, fewer-flowered inflorescences, and more northern collection locality. Additional specimens of both *D. vestita* and this new species are now available and clarify that the distinctive features cited by PUFF & BUCHNER (1994) for each of these are consistent. *Danais vestita* differs from *D. laciniata* in its pubescence, which is densely pilosulous or hirtellous with shorter trichomes; its leaf blades that are widest below the middle and truncate to cordulate at the base; its stipules that are erect or sometimes weakly spreading; and its inflorescences that are mainly axillary with the bracts linear and generally 1-5 mm long. Specimens of *D. laciniata* will be identified by PUFF & BUCHNER (1994)'s key as *D. andribensis* Homolle, of central and southern Madagascar; however *D. andribensis* differs from *D. laciniata* in its pubescence, which is pilosulous to puberulous or entirely lacking, its opposite leaves with the blades widest below the middle and rounded to cordulate at the base, its consistently bilobed stipules, and its smaller capsules (4-8 mm in diam.).

*Paratypi.* – MADAGASCAR. Prov. Toamasina: Analanjirifo, Maroantsetra, Ambinanitelo, Marovovonana, 15°19'34"S 49°31'15"E, 298 m, 29.VIII.2004, fr., *Antilahimena* 2627 (MO!, P, TAN).

#### 4. *Danais masoalana* C. M. Taylor, *spec. nova* (Fig. 1D-G).

**Typus:** MADAGASCAR. Prov. Toamasina: Analanjirifo Region, Masoala Peninsula, S of Ambanizana, Andranobe, Piste A, 15°41'S 49°58'E, 50 m, 12.II.1999, fl., *Hoffmann, Robinson, McPherson & Harimalala* 36 (holo-: MO-5938276!; iso-: G [G00369979], K, TAN).

*Haec species a congeneris stipulis aristatis circum caulem breviter connatis, foliis satis grandibus, inflorescentia axillari atque floribus sicut fructibus papyraceis satis parvis pedicellis gracilibus insidentibus distinguitur.*

Woody *lianas* or climbing *shrubs*, climbing to 6 m high; stems glabrous, rounded or weakly laterally flattened. *Leaves* opposite; blades elliptic to obovate, 6.5-19 × 3-11 cm, at base cuneate to obtuse, at apex rounded to obtuse or acute and sometimes abruptly acuminate with tips 2-10 mm, drying chartaceous, glabrous on both surfaces, with margins plane; secondary veins 5 to 11 pairs, not looping to interconnect with each other, with intersecondary veins not, shortly, or occasionally well developed, adaxially costa prominulous, secondary veins plane, and laxly reticulated tertiary venation prominulous, abaxially costa and

secondary veins prominulous, laxly reticulated tertiary venation prominulous, and densely reticulated quaternary venation plane to thickened or prominulous. *Petioles* 15-28 mm, glabrous. *Stipules* shortly united around stem, rather quickly deciduous, triangular, 4-5 mm, abaxially puberulous to glabrous, acute to acuminate or weakly aristate, margins ciliolate to entire. *Inflorescences* axillary with leaves or sometimes borne in axillary arrangement at nodes below leaves, paniculiform, pyramidal in outline, 6-11 × 3-10 cm (including peduncles), multiflowered (ca. 35 to 60), branched to 2 or 3 orders, with axes cymose, puberulous to glabrous; bracts narrowly triangular to narrowly ligulate, 0.8-4 mm. *Flowers* in umbelliform groups of 5 to 9 and all pedicellate on pedicels 1-3 mm, with floral biology unknown; hypanthium subglobose to ellipsoid, ca. 1 mm, glabrous. *Calyx limb* divided nearly to base, lobes 5, triangular, 0.3-0.8 mm, acute. *Corolla* slenderly salverform, pale green on tube and bright orange on lobes, externally and internally glabrous, tube ca. 6 mm, ca. 0.5 mm diam. at bottom and at top, at base fenestrate with 5 slits, each slit 0.3-0.5 mm, lobes 5, ligulate to narrowly triangular, ca. 3 mm, acute and smooth at apex. *Stamens* 5, inserted in corolla throat, anthers black, ca. 2 mm and exerted, filaments ca. 8 mm. *Stigmas* 2, linear, 3-5 mm, positioned in upper part of corolla tube with tips exerted, style ca. 4.5 mm. *Capsules* ellipsoid to oblate and laterally flattened, 3-4 × 3.5-5 mm, woody to stiffly chartaceous, glabrous and sparsely to moderately granular, dehiscent from apex for 1/4-1/2 of body, beak broadly triangular to rounded. *Seeds* generally lenticular, 0.5-0.8 mm, flattened, with circumferential wing irregular (i.e., not entire and smooth) and often reduced.

*Names.* – This species is so far only known from the Masoala Peninsula, and the scientific name created here for it refers to this locality. No vernacular name is noted in the information available.

*Habitat and distribution.* – This species is documented from humid forests at 0-400 m in eastern Madagascar, on the Masoala Peninsula in Antsiranana Province (SAVA Region) and in Toamasina Province (Analanjirifo Region; Fig. 5, humid bioclimatic zone).

*Conservation status.* – *Danais masoalana* has an EOO of 159 km<sup>2</sup>, which meets the criterion for Endangered; an AOO of <500 km<sup>2</sup>, which also meets the criterion for Endangered; and three subpopulations. The species is known from four collections in two localities; one locality falls inside the boundaries of one protected area (Masoala National Park). The general habitat of this species is already significantly fragmented and expected to diminish further in quality. *Danais masoalana* is assigned a preliminary conservation status of Endangered due to its limited distribution and threatened habitat [EN B1ab(i,ii,iii,iv)+2ab(i,ii,iii,iv)].

*Notes on morphology, biology and similar species.* – *Danais masoalana* is characterized by its relatively large leaves (for *Danais*) with the quaternary venation closely

reticulated to form narrowly rectangular areoles on the abaxial surface; its stipules that are shortly united around the stem; its axillary multiflowered inflorescences; its medium-sized orange flowers with the anthers exerted on well developed filaments; and its relatively small fruits usually with a granular surface. Only one flowering collection has been seen, with flowers that resemble the short-styled form of distylous *Danais* species.

This new species is similar in general aspect to *D. rhamnifolia* Baker, which is found in the same region; however *D. rhamnifolia* differs in its usually smaller leaves, with the blades 2-11 × 1-5.5 cm and the petioles 2-17 mm long; its interpetiolar, shorter stipules, 1-2.5 mm long; its usually terminal inflorescences, although these may sometimes also be borne in the uppermost leaf axils; its smaller corollas, with the tube 2.5-5 mm long and the lobes 1.5-2.5 mm long; and its shorter filaments, 2-4.5 mm long. *Danais masolana* is also similar to *D. magna* Puff & R. Buchner, which is also found in the same region; however *D. magna* differs from this new species in its smaller leaves, 7-11 × 2.5-6 cm, with the densely reticulated tertiary and quaternary venation forming subcircular areoles on the lower surface; its shorter inflorescences, 1-3 cm long, with the flowers all sessile to subsessile and without developed secondary axes; its shorter filaments, 5-6 mm long; and its woody fruits with their bases or their short stipes or pedicels (to ca. 1 mm long) significantly thickened, so the fruits sometimes appear fused together. PUFF & BUCHNER (1994) did not see the fruits of *D. magna*, but these have been documented by recent collections (e.g., *Antilahimena* & al. 1147, MO!, see image at TROPICOS, 2013) and resemble those of *D. aurantiaca* Homolle. *Danais magna* is also notable for its habit, which was reported by PUFF & BUCHNER (1994) to be a liana climbing 18 m or more into the forest canopy; all the specimens seen of *D. masoalana* were gathered from much smaller plants.

*Paratypi*. – **MADAGASCAR. Prov. Antsiranana**: SAVA, Masoala Peninsula, W of Ambohitralanana, near Sahafary, 15°16'S 50°22'E, 100 m, fr., 20.VIII.1977, *McPherson 17126* (MO!). **Prov. Toamasina**: Analanjirifo, S of Ambanizana, Andranobe, Piste A, 15°41'S 49°58'E, 205 m, 16.II.1999, y. fr., *Hoffmann, Robinson, McPherson & Harimalala 54* (K, MO!, TAN); Parc National de Masoala, Ambanizana, 15°37'S 49°58'E, 0-400 m, 2.IV.1996, y. fr., *Aridy & Moïse 227* (MO!).

**5. *Danais rakotovaoui*** C. M. Taylor, **spec. nova** (Fig. 6D, E).

**Typus**: **MADAGASCAR. Prov. Antsiranana**: SAVA Region, Andapa, Doany, Andranomololo, forêt de moyenne altitude située à 10 km au Sud Ouest du village d'Andranomololo, Andramanalana, 14°29'55"S 49°33'43"E, 1098 m, IV.2006, fl., *Rakotovaoui & al. 3222* (holo-: MO-6082545!; iso-: P, TAN).

*Haec species a congeneris stipulis grandibus marginibus serratis usque breviter multifidis, inflorescentia axillari floribus in cymas densas rotundatas dispositis atque corolla violacea 9-10 mm longa distinguitur.*

Woody lianas or climbing shrubs; stems to 6 m long, densely strigillose to glabrous, rounded. Leaves opposite; blades obovate or oblanceolate to elliptic-oblong, 3.8-17.5 × 2-5.5 cm, at base acute to cuneate, at apex acute to acuminate with tips 3-5 mm, drying papery, adaxially and abaxially densely and rather uniformly puberulous or strigillose to glabrous throughout, with margins plane; secondary veins 10 to 11 pairs, weakly to strongly uniting with each other near margins at least in distal portion of blade, intersecondary veins not or shortly developed, adaxially costa prominent and remaining venation plane or sometimes secondary and loosely reticulated tertiary veins thickened, abaxially costa and secondary veins prominent, loosely reticulated tertiary venation thinly prominulous, and quaternary venation not visible or thickened and densely reticulated. Petioles 5-26 mm, glabrous to densely strigillose. Stipules interpetiolar, persistent at least on distalmost 3 to 5 nodes, ovate to triangular, 4-16 mm, abaxially glabrous to densely puberulous, at apex narrowly acute to acuminate, margins irregularly shortly serrate to shortly lacinate or multifid. Inflorescences axillary, cymose to paniculiform, rounded in outline, 2.5-8 × 2-6 cm (including peduncles), several- (ca. 30) to multiflowered (ca. 90), branched to 1 to 2 orders, with axes cymose, densely strigillose to glabrous, with basalmost secondary axes subtended by ovate foliaceous bracts (or reduced leaves) 0.7-1.6 × 0.8-1.3 cm on stipes (or petioles) 2-5 mm; other bracts stipuliform or narrowly triangular to linear, 0.8-5 mm. Flowers in congested cymes of 5 to 7 and sessile to subsessile or shortly pedicellate on pedicels to 1 mm, with floral biology unknown; hypanthium obconic to ellipsoid, ca. 1 mm, densely strigillose to glabrous. Calyx limb divided nearly to base, glabrous to densely strigillose, lobes 5, narrowly triangular, ca. 2 mm, acute and smooth at apex. Stamens 5, inserted below top of corolla tube, anthers ca. 1.2 mm, included and subsessile, color not noted. Stigmas 2, ca. 2 mm, exerted, style ca. 9.5 mm. Capsules and seeds not seen.

*Names*. – The scientific name created here for this species honors Mr. Charles Rakotovaoui, collector of the type specimen of this elegant species and one of the Missouri Botanical Garden's resident field botanists. Mr. Rakotovaoui has extensively documented Madagascar's flora with excellent specimens collected during numerous explorations made throughout the island. The vernacular name "Vahibivoraka" was noted on the specimen *Randriamanarivo & al. 39* and is in the Betsimisaraka dialect. The local name roughly translated into English

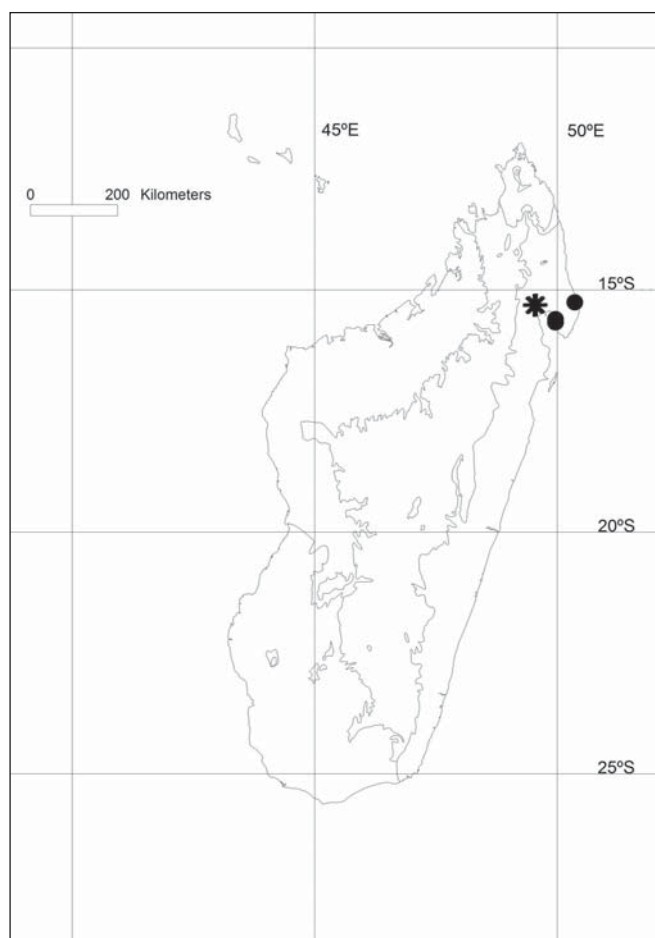


Fig. 5. – Distribution of *Danais laciniata* C. M. Taylor (asterisks) and *Danais masoalana* C. M. Taylor (circles), mapped over the outlines of the five simplified bioclimatic zones of Madagascar of SCHATZ (2000, following CORNET, 1974).

means “big liana with a soft consistency.” The reference to the soft quality of the plant may indicate that the stems can be compressed by squeezing between the fingers (A. Randrianasolo, pers. comm.).

**Habitat and distribution.** – This species is documented from humid forests at 720–1098 m in east-central to north-eastern Madagascar, in Antsiranana Province (SAVA Region) and Toamasina Province (Analanjiforo and Antsinanana Regions; Fig. 2, humid bioclimatic zone).

**Conservation status.** – *Danais rakotovaoui* has an EOO of 711 km<sup>2</sup>, which meets the criterion for Endangered; an AOO of <500 km<sup>2</sup>, which also meets the criterion for Endangered; and three subpopulations. The species is known from three widely separated collections. One of the localities apparently falls just inside the boundaries of a currently protected area (Zahamena National Park), and the northernmost collection was made approximately 3 km outside of the boundaries of a

second protected area (Marojejy National Park) and it is quite plausible that the species occurs inside that park as well. The habitat of this species is already significantly fragmented and expected to diminish further in quality. *Danais rakotovaoui* is assigned a preliminary conservation status of Endangered due to its limited distribution and threatened habitat [EN B1ab(i,ii,iii,iv)+2ab(i,ii,iii,iv)].

**Notes on morphology, classification and similar species.** – *Danais rakotovaoui* is characterized by its well developed stipules with shortly lacinate margins; its axillary, generally rounded inflorescences; its rather well developed narrow calyx lobes; and its medium-sized violet corollas. The fruits and seeds of this species have not been examined, but all other available features including the climbing habit support the classification of *D. rakotovaoui* in this genus.

The stipules of this new species are unusual in *Danais*, and similar only to those of *D. antilahimena*; however *D. antilahimena* can be separated from *D. rakotovaoui* by its much larger inflorescences with prolonged spiciform axes, its shorter calyx lobes, and its longer corollas. Only one flowering collection of *D. rakotovaoui* has been seen, which has flowers that are similar to the long-styled form of distylous species of *Danais*. This new species is unusual in *Danais* in the distribution of its leaf pubescence, which is generally uniform in density and trichome size throughout the blade, while in other species of the genus the leaf pubescence is usually denser and composed of longer trichomes on the veins than on the lamina. This new species appears also to be similar to the poorly known species *D. coerulea* Homolle ex Cavaco based on published descriptions. *Danais coerulea* is not well characterized but was described as having significantly larger corollas, 20–25 mm long in overall length (i.e., tube plus lobes), vs. ca. 9 mm in overall length in *D. rakotovaoui*.

**Paratype.** – MADAGASCAR. Prov. Toamasina: Analanjiforo, Vavatenina, Miarinarivo, Anamborano, Ambinanini, Sahavarina, à l’intérieur de l’AP à 1 km de la limite, 17°41’08”S 48°59’43”E, [no elevation], 16.VI.2001, fl., *Randriamanarivo* & al. 39 (MO!, TAN); Antsinanana, Brickaville, Maroseranana, Andeka, Amparamanambola, à 6 heures de marches au N d’Andeka, route vers Besaha, 18°24’47”S 48°49’42”E, 720 m, 29.X.2005, bud, *Andriamihajarivo* & al. 684 (MO!, TAN).

6. *Danais randrianaiivoi* C. M. Taylor, **spec. nova** (Fig. 6A–C).

**Typus:** MADAGASCAR. Prov. Toamasina: Analanjiforo Region, Tampolo (Masoala), Ambanizana, Anjahana, Maroantsetra, 15°44’12”S 49°57’24”E, 200–400 m, 12.X.2001, fl., *Randrianaivo* 664 (holo-: MO-6055804! iso-: G [G00369980]).

*Haec species a congeneris foliis grandibus late ellipticis, stipulis bilobis, lobis calycinis linearibus 1.5-4 mm longis atque corolla satis longa distinguitur.*

Woody *lianas*, climbing to 3 m high; stems glabrous, subterete, with internodes sometimes prolonged. *Leaves* opposite; blades elliptic to broadly elliptic or obovate, 9-18.5 × 4.4-13.5 cm, at base obtuse to rounded or truncate, at apex acute or rounded and rather abruptly acuminate with tips 2-20 mm, drying papery to chartaceous, on both surfaces glabrous and rather shiny, with margins plane to thinly revolute; secondary veins 6 to 8 pairs, free, reticulating, or sometimes looping to interconnect with each other in distal part of blade, adaxially costa prominent and secondary veins and rather densely reticulated tertiary and quaternary venation prominulous, abaxially costa prominent, secondary veins prominulous, and tertiary and quaternary venation plane to prominulous. *Petioles* 12-35 mm, glabrous. *Stipules* interpetiolar or shortly united around stem, deciduous after distalmost 1 to 3 nodes, ovate to broadly rounded, 4-6 mm, abaxially glabrous, shortly 2-dentate to 2-lobed for up to 1/2 of length, lobes narrowly to broadly triangular, acute to obtuse. *Inflorescences* pseudoaxillary (i.e., borne in only 1 axil of a node), produced below stem apex, cymose, rounded to broadly pyramidal in outline, 6-10 × 4-6 cm (including peduncles but not corollas), several- (ca. 15) to multi-flowered (ca. 40), branched to 1 to 2 orders, with axes cymose, densely puberulous to glabrous; bracts narrowly triangular to linear, 1-3 mm. *Flowers* in umbelliform to weakly dichotomous cymes of 3 to 7 and all pedicellate on pedicels 0.5-8 mm, distylous, fragrant; hypanthium ellipsoid to obovoid, 1-2 mm, densely puberulous to glabrous. *Calyx limb* divided nearly to base, densely puberulous to glabrous, lobes 5, narrowly triangular to linear, 1-2.5 mm and generally equal in length on an individual flower, acute. *Corolla* salverform, white to yellow, externally glabrous, internally glabrous except pilosulous in throat, tube 14-16 mm, 0.5-1 mm diam. at base, 0.8-1.2 mm diam. at top, at base fenestrate with 5 slits, each slit ca. 1 mm, lobes 5, narrowly triangular to narrowly ligulate, 7-7.5 mm, acute and smooth at apex. *Stamens* 5, inserted in corolla throat, anthers with color not noted, in long-styled flowers ca. 1.8 mm, partially exserted, and sessile, in short-styled flowers ca. 2 mm and exserted on filaments 3-4 mm. *Stigmas* 2, in long-styled flowers ca. 4.5 mm and exserted, with style ca. 16 mm, in short-styled flowers ca. 4 mm and included except tips exserted, with style ca. 10 mm. *Capsules* obovate, 4-5 × 5-7 mm, subcoriaceous to woody, glabrous, dehiscent for apical 1/3-1/2 of body, beak portion flat. *Seeds* irregular in shape but generally triangular, ca. 1 mm, with circumferential wing shortly lacinate.

*Names.* – The scientific name created here for this species honors Mr. Richard Randrianaivo, who collected the type of this handsome species and is one of the Missouri Botanical Garden's

resident field botanists. Mr. Randrianaivo has extensively documented Madagascar's flora with excellent specimens collected during numerous explorations made throughout the island. No vernacular name is noted in the information available.

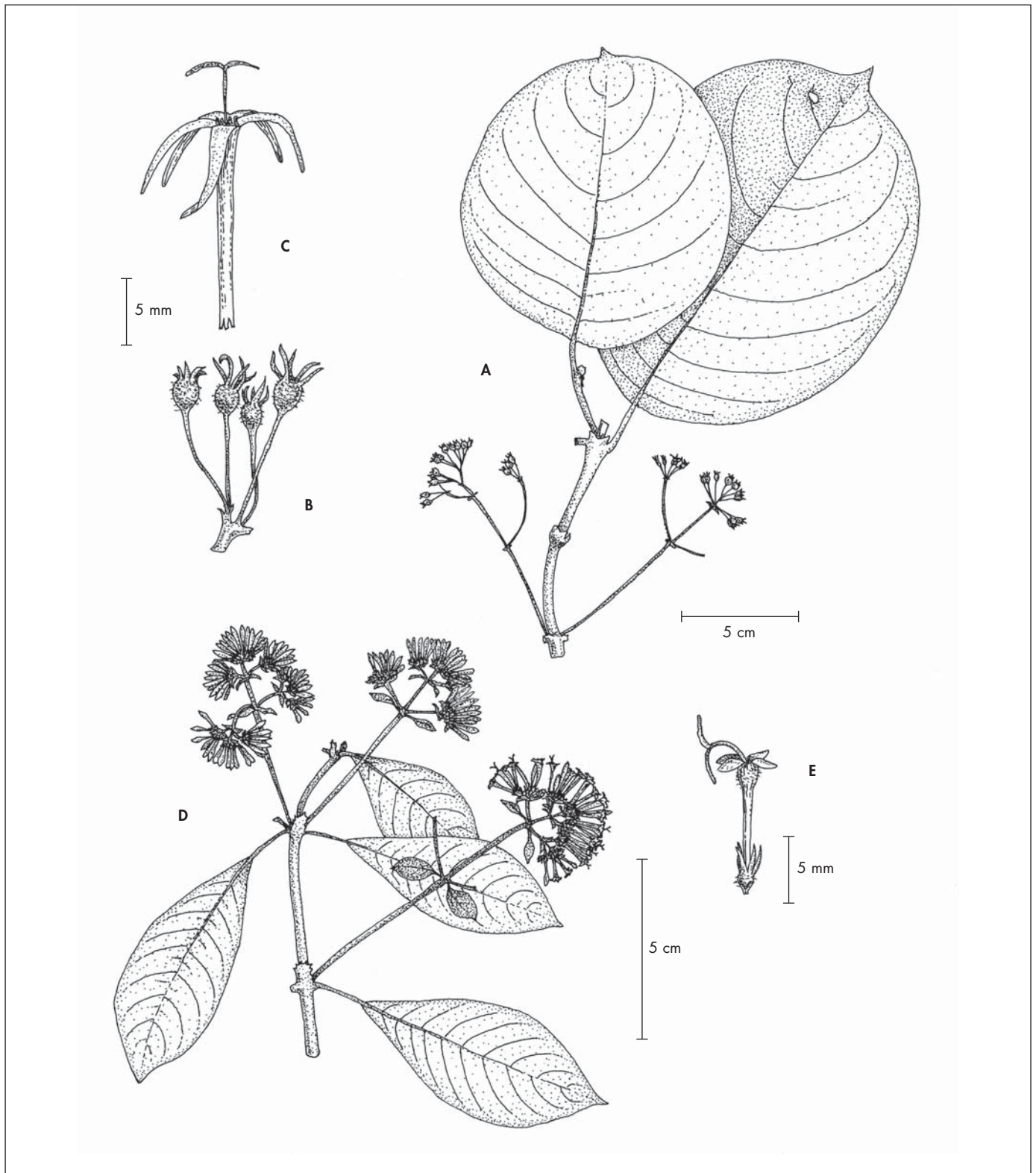
*Habitat and distribution.* – Humid forests at 200-400 m in northeastern Madagascar, on the Masoala Peninsula in Toamasina Province (Analanjirofo Region) (Fig. 4, humid bioclimatic zone).

*Conservation status.* – *Danais randrianaivoi* has an EOO of 230 km<sup>2</sup>, which meets the criterion for Endangered; an AOO of <500 km<sup>2</sup>, which also meets the criterion for Endangered; and one subpopulation. The species is known only from three localities, one of which is inside the boundaries of a currently protected area (Masoala National Park). The habitat of this species is already significantly fragmented and expected to diminish further in quality. Given the small EOO and its few localities, *D. randrianaivoi* is assigned a preliminary conservation status of Endangered due to its limited distribution and threatened habitat [EN B 1ab(i,ii,iii,iv)+2ab(i,ii,iii,iv)].

*Notes on morphology and similar species.* – *Danais randrianaivoi* is characterized by its woody rounded stems with generally elongated internodes; its relatively broad large leaves that are usually shiny on both surfaces; its bidentate stipules that are sometimes shortly united around the stem; its pseudoaxillary cymose inflorescences; its pedicellate flowers; its rather large, white to yellow corollas with very slender tubes and narrow lobes; and its obovate capsules.

The stipules of *D. randrianaivoi* are variably free to fused across the intrapetiolar portion, with two short, closely arranged, narrowly acute lobes on each interpetiolar side, or sometimes with two broadly triangular obtuse lobes or sometimes apparently entire. The stipules appear to widen markedly with age, as the stem thickens. PUFF & BUCHNER (1994) documented several *Danais* species with pseudoaxillary inflorescences that are first produced at the stem apex and then displaced or overtopped by subsequent growth from one of the axillary buds, so the flowers are borne at or near the stem apex but the infructescences are left behind as the vegetative part of the stem continues to grow. However in *D. randrianaivoi* the inflorescences appear to be produced initially in the pseudoaxillary position, well below the stem apex. This new species is similar to *D. longipedunculata* Homolle, but the latter differs by its elliptic to obovate leaves 3-7 cm wide and its shorter corollas (tubes 5.5-6 mm long and lobes 2-3 mm long).

*Paratypes.* – **MADAGASCAR. Prov. Toamasina:** Analanjirofo, Maroantsetra, Anjahana, Ambanizana, 15°42'35"S 49°58'13"E, 200 m, 20.X.2001, fl., *Randrianaivo* 719 (MO!); Tampolo (Masoala), 15°37'02"S 49°58'46"E, 200 m, 13.IX. 2002, fr., *Antilahimena* & *Aridy* 1385 (MO!).



**Fig. 6.** – *Danais randrianaivoi* C. M. Taylor. **A.** Flowering branch; **B.** Portion of inflorescence with four flowers from which the corollas have fallen; **C.** Corolla at anthesis, separated from rest of flower and showing the fenestrated base. – *Danais rakotovaai* C. M. Taylor. **D.** Flowering branch; **E.** Flower at anthesis.

[**A-C:** *Randrianaivo* 664, MO; **D-E:** *Rakotovao* & al. 3222, MO] [Drawing: C. M. Taylor]

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## References

- BREMER, B. & J.-F. MANEN (2000). Phylogeny and classification of the subfamily Rubioideae (Rubiaceae). *Pl. Syst. Evol.* 225: 43-72.
- BREMER, B. & T. ERIKSSON (2009). Time tree of Rubiaceae: Phylogeny and dating the family, subfamilies, and tribes. *Int. J. Pl. Sci.* 170: 766-793.
- BUCHNER, R. & C. PUFF (1993). The genus complex *Danais*-*Schismatoclada*-*Payera* (Rubiaceae). Character states, generic delimitation and taxonomic position. *Bull. Mus. Natl. Hist. Nat., sect. B, Adansonia* 15: 23-74.
- CORNET, A. (1974). *Essai de cartographie bioclimatique à Madagascar. Notice Explicative*. ORSTOM, No. 55.
- ESRI (1999). *ArcView GIS 3.2*. ESRI, Redlands, CA.
- IUCN (2012). *IUCN Red List Categories and Criteria, Version 3.1*. 2<sup>nd</sup> Edition. IUCN Species Survival Commission, IUCN Gland & Cambridge.
- IUCN [STANDARDS AND PETITIONS SUBCOMMITTEE] (2013). *Guidelines for Using the IUCN Red List Categories and Criteria, Version 10*. [[www.iucnredlist.org/documents/RedListGuidelines.pdf](http://www.iucnredlist.org/documents/RedListGuidelines.pdf)].
- KAINULAINEN, K., A. MOULY, A. KHODABANDEH & B. BREMER (2009). Molecular phylogenetic analysis of the tribe Alberteae (Rubiaceae), with description of a new genus, *Razafimandimbisonia*. *Taxon* 58: 757-768.
- KRÜGER, Å., S. G. RAZAFIMANDIMBISON & B. BREMER (2012). Molecular phylogeny of the tribe Danaideae (Rubiaceae, Rubioideae) - another example of out-of-Madagascar dispersals. *Taxon* 61: 629-636.
- LAWRENCE, G. H. M. (1951). *Taxonomy of Vascular Plants*. The MacMillan Company, New York.
- MADAGASCAR CATALOGUE (2013). Catalogue of the Vascular Plants of Madagascar. Missouri Botanical Garden, St. Louis [[www.efloras.org/madagascar](http://www.efloras.org/madagascar)].
- MALCOMBER, S. T. & C. M. TAYLOR (2009). A systematic revision of *Gaertnera* (Rubiaceae, Gaertnereae). *Ann. Missouri Bot. Gard.* 96: 575-671.
- MAURIN, O., A. P. DAVIS, M. CHESTER, E. F. MVUNGI, Y. JAUFERALLY-FAKIM & M. F. FAY (2007). Towards a phylogeny for *Coffea* (Rubiaceae): identifying well-supported lineages based on nuclear and plastid DNA sequences. *Ann. Bot.* 100: 1565-1583.
- PUFF, C. & R. BUCHNER (1994). Revision of *Danais* Vent. (Rubiaceae) in Madagascar and the Comores. *Bull. Mus. Natl. Hist. Nat., sect. B, Adansonia* 16: 11-64.
- RYDIN, C., K. KAINULAINEN, S. G. RAZAFIMANDIMBISON, J. E. E. SMEDMARK & B. BREMER (2009). Deep divergences in the coffee family and the systematic position of *Acranthera*. *Plant Syst. Evol.* 278: 101-123.
- SCHATZ, G. E. (2000). Endemism in the Malagasy tree flora. In: LOURENÇO, W. R. & S. M. GOODMAN (ed.), *Diversity and Endemism in Madagascar*: 1-9. Mémoire de la Société de Biogéographie, Paris.
- SCHATZ, G. E. & M. LESCOT (2012). *Gazetteer to Malagasy Botanical Collecting Localities*. Missouri Botanical Garden [[www.mobot.org/MOBOT/Research/madagascar/gazetteer/](http://www.mobot.org/MOBOT/Research/madagascar/gazetteer/)].
- TROPICOS (2013). Tropicos database. Missouri Botanical Garden, St. Louis [[www.tropicos.org](http://www.tropicos.org)].