Phytotaxa 48: 39–60 (2012)
www.mapress.com/phytotaxa/

Article

ISSN 1179-3155 (print edition)
PHYTOTAXA
ISSN 1179-3163 (online edition)

Studies of Malagasy *Eugenia* (Myrtaceae)—III: Seven new species of high conservation concern from the eastern littoral forests

NEIL SNOW[1,5], JOHNY RABENANTOANDRO[2], FALY RANDRIATAFIKA[2], DAVID RABEHEVITRA[2], N. DARIE RAZAFIMAMONJY[3] & STUART CABLE[4]

[1]*Herbarium Pacificum, B.P. Bishop Museum, 1525 Bernice Street, Honolulu, Hawaii 96825, USA*
[2]*Rio Tinto/QIT Madagascar Minerals S.A., Villa 3H Lot J, 169 Antananarivo, 101, MADAGASCAR;*
E-mails:johny.rabenantoandro@riotinto.com;
david.rabehevitra@riotinto.com; faly.randriatafika@riotinto.com
[3]*Department of Botany, University of Antananarivo, MADAGASCAR; E-mail: dariejosmail@yahoo.com*
[4]*Royal Botanic Gardens, Kew, Richmond, Surrey, UNITED KINGDOM; E-mail: s.cable@kew.org*
[5]*Corresponding author and current address: Montana Natural Heritage Program, 1515 East Sixth Ave., Helena, Montana, 59620-1800, USA; E-mail: nsnow2@mt.gov*

Abstract

Seven species of *Eugenia* from eastern littoral forests in Madagascar are newly proposed. Six occur in or near the forests of Petriky, Mandena, or Sainte Luce near Tolagnaro in the southeast, including *Eugenia guajavoides*, *Eugenia manonae*, *Eugenia petrikensis*, *Eugenia stictophylla*, *Eugenia roseopetiolata* and *Eugenia stibephylla*. The seventh, *Eugenia vanwykiana*, occurs in the Analabe littoral forest near Lac Sahaka in the northeast. Descriptions and diagnostic field characters are provided for each species. Conservation threat analyses based on IUCN Red List Categories and Criteria suggest the status of Endangered for *Eugenia guajavoides*, *E. petrikensis*, *E. stictophylla*, *E. roseopetiolata*, and *E. vanwykiana*, and Vulnerable for *E. manonae* and *E. stibephylla*. A provisional key to species of *Eugenia* from the Tolagnaro region is provided.

Résumé

Sept nouvelles espèces dans le genre *Eugenia* des forêts littorales de l'est de Madagascar sont nouvellement proposées. Six de ces espèces poussent près de Tolagnaro au Sud-Est de l'île, incluant *Eugenia guajavoides*, *Eugenia manonae*, *Eugenia petrikensis*, *Eugenia punctiphylla*, *Eugenia rosapetiolata* et *Eugenia stibephylla*. La septième, *Eugenia vanwykiana*, pousse dans la forêt littorale d'Analabe près du Lac Sahaka au Nord-Est. Des descriptions et des caractères diagnostiques de terrain sont proposés pour chaque espèce. L'évaluation du statut de conservation de chaque espèce suivant les Catégories et les Critères de l'UICN montre que *Eugenia guajavoides*, *E. petrikensis*, *E. stictophylla*, *E. roseopetiolata*, et *E. vanwykiana* sont En Danger alors que *E. manonae* et *E. stibephylla* sont Vulnérables. Une clé provisoire des espèces d'Eugenia de la région de Tolagnaro est proposée.

Kew words: Aleyrodidae, *Eugenia*, IUCN Red List, littoral forests, Madagascar, Myrtaceae, new species, vernacular names, white flies

Introduction

The Myrtle family (Myrtaceae) in Madagascar is represented by two native genera, *Eugenia* L. and *Syzygium* Gaertn. Taxonomic studies in both genera lagged for many years following the work of Perrier de la Bâthie (1953a, b) six decades ago. Recent progress has advanced our knowledge of both genera (Miller 2000; Labat

Accepted by Eve Lucas: 6 Mar. 2012; published online in PDF: 15 Mar. 2012

& Schatz 2002; Snow 2008, 2010, 2011), but much additional work remains to describe and adequately document the Malagasy taxa of Myrtaceae.

Madagascar has long been recognized as a hotspot of biodiversity (Myers *et al.* 2000). Its littoral forests are critically imperiled and harbor many species of high conservation concern (Consiglio *et al.* 2006; Lowry *et al.* 2008; Vincelette *et al.* 2008; Callmander *et al.* 2007). The new species of *Eugenia* from littoral forests proposed in this paper from a small area reflect how taxonomically rich yet incompletely known the littoral forests continue to be.

This purpose of this paper is to propose seven new species of *Eugenia*, mostly from the region surrounding Tolagnaro, and to provide conservation threat assessments following IUCN (2001) Red List Categories and Criteria.

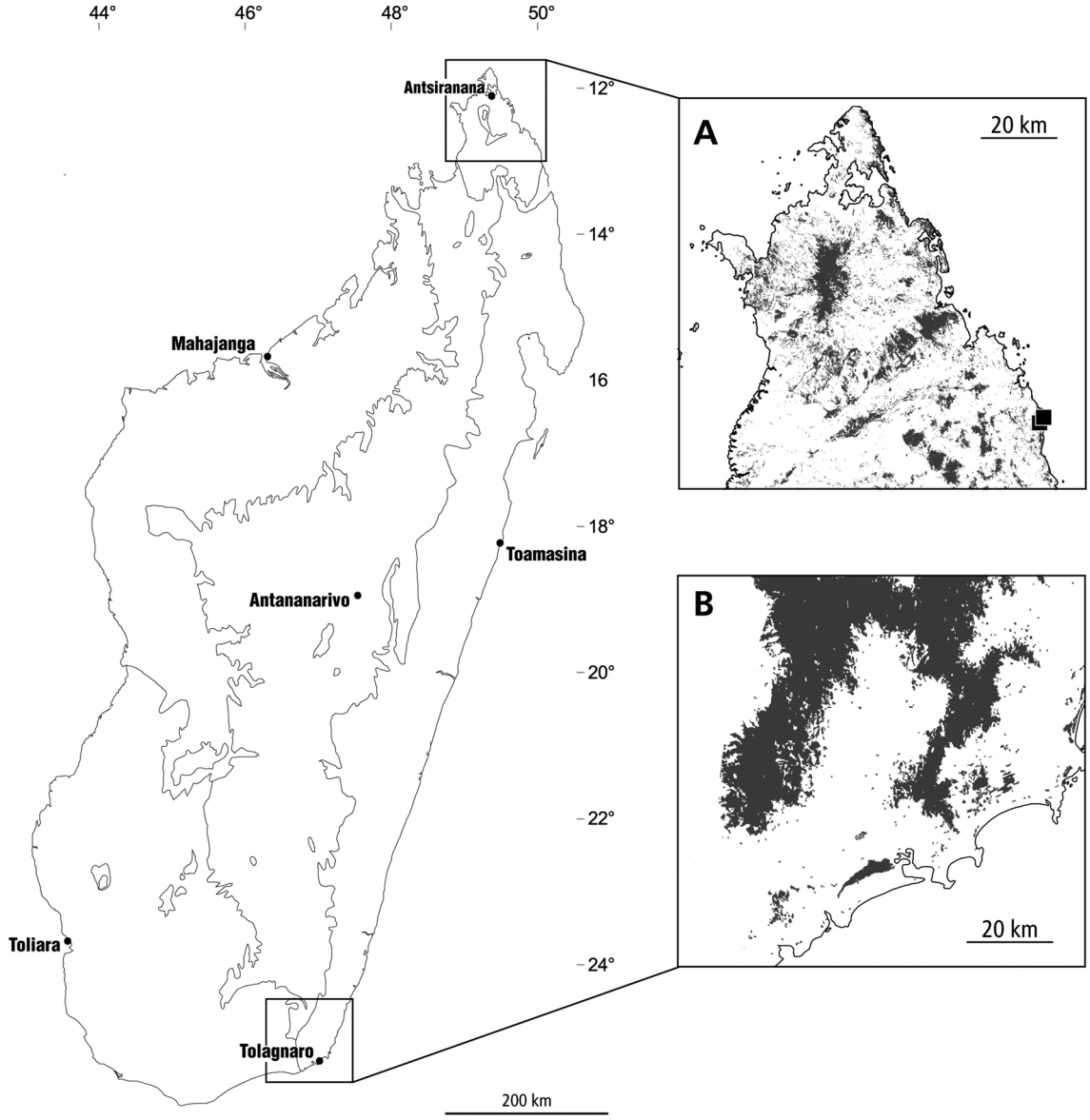

FIGURE 1. Madagascar. A: Location of *Eugenia vanwykiana* (■) in the northeast. B. The southeast region of Madagascar in vicinity of Tolagnaro (detailed in Fig. 2). Currently forested areas are shaded in gray.

Materials and methods

The first author viewed type specimens of *Eugenia* from Madagascar housed at P and MO (acronyms following Thiers [2011]) and examined all indetermined material of Malagasy Myrtaceae at MO in May of 2010. Comparisons were also made to all material at MO of *Eugenia* from Africa and insular areas near Madagascar. Living material cultivated at Royal Botanic Gardens, Kew, was used for the basis of color descriptions (e.g., *E. roseopetiolata*) as were images captured in the field.Where possible, we use color descriptions suggested by Beentje (2010). Apart from the one species proposed herein from the northeastern littoral forests (*Eugenia vanwykiana*), one or more of the Malagasy authors of this paper (i.e., all but NS and SC) recently have studied the species in the field. The final author organized digital images, helped coordinate communication among authors, clarified issues regarding type specimens and identifications, and assembled information from cultivated material (e.g., *E. roseopetiolata*).

Species descriptions are not strictly in parallel but include all information that could be observed and reported with confidence. The species concept and terminology follow similar studies by the first author (Snow 1997; Snow *et al*. 2003). The collection number for each specimen follows the senior collector in accordance with most database systems now in use, although its placement on specimens varies. We have minimized the use of specialized terms for Myrtaceae but included (as needed) the terms anthopodium, metaxyphyll, brachyblast, bracteole, monad, and triad (see Briggs and Johnson 1979).

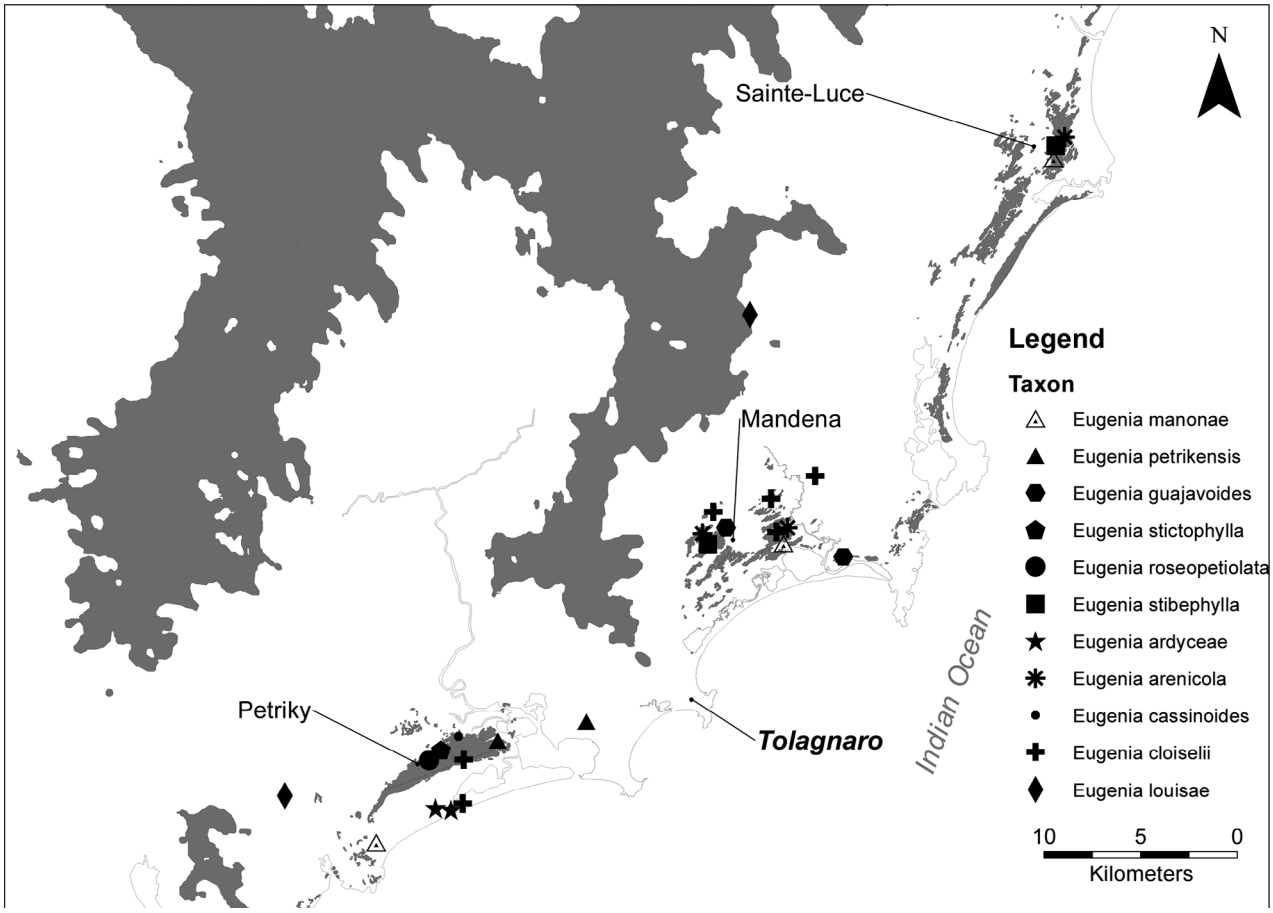

FIGURE 2. Distribution of species and selected specimens of *Eugenia* in southeastern Madagascar based on vouchered herbarium specimens and recently captured (but non-vouchered) digital images. Remaining forested areas (Petriky, Mandena, Sainte-Luce) along the coast are indicated in gray. In cases where the icons largely or completely overlapped based on geo-coordinates they have been separated slightly for easier viewing (e.g., *E. ardyceae*, *E. stictophylla* and *E. cloiselii* along the coast west of Tolagnaro). Many additional specimens of *Eugenia* from the region await identification or description and cannot be mapped confidently at the present time.

We use the name Tolagnaro (= Tôlaňaro) for the municipal area also commonly known as Fort-Dauphin (Fig. 2). Descriptions were derived exclusively from herbarium material for *Eugenia vanwykiana*, but all

others include recent observations of living material. The numerous digital images of living material taken by the Malagasy coauthors and their comparison to dried herbarium material highlighted the degree to which colors of herbarium specimens in *Eugenia* can change from fresh material. Flowers of each species were rehydrated in water before dissecting.

The conservation status of each species was assessed following IUCN (2001) using the Red List Categories and Criteria. The calculations of area of occupancy (AOO), extent of occurrence (EOO) and number of subpopulations are based on methods presented in Callmander *et al*. (2007). The grid cell size used to calculate AOO is 3 x 3 km. Threat assessments for all but *E. vanwykiana* include recent observations in the field by the Malagasy authors of this paper.

Eugenia guajavoides N. Snow & F. Randria., *sp. nov.* (Figs. 2, 3).

A congeneribis madagascariensibus combinatione characterum sequentium distinguitur: arbores usque ad 8 m altae; pedicelli magentei crassi; hypanthium et calycis lobi flavovirentes; petala subrosea; filamenta et styli albidi; antherae eburneae.

Type:—MADAGASCAR. Prov. Toliara: Region of Tolagnaro; on QIT concession, Mandena site; 24°57'S, 47°00'E, 25 m, 17 October 1989, *G. McPherson 14145, N. Dumetz, & R. Rabevohitra* (holotype MO! [sheet no. 3771530]; isotypes BISH! [2 sheets, nos. 747509 and 747510], P).

Trees 2–8 meters. Indumentum (where present) moderately to densely short-sericeous; trichomes dibrachiate, whitish-brown. *Branchlets* laterally compressed, emerald green when young becoming brownish (grayish dried), smooth, densely short sericeous on emergence but becoming glabrous; oil glands absent; internodes 1–3 cm long. *Leaves* thickly coriaceous, evenly distributed along branchlets, emerald green and glossy above, matte and lighter green below (strongly discolorous and brown when dry); venation brochidodromous. Stipules absent. *Petioles* 5–10 mm, slightly sulcate above, emerging sericeous but becoming glabrous, eglandular, rugose-wrinkled. *Leaf blades* 4.4–9.0 x (2.0–)3.0–4.5 cm, elliptic to obovate and often slightly falcate, base cuneate, apex obtuse and sometimes slightly asymmetrically conduplicate at tip, margin drying slightly revolute, blade flat to slightly bullate between secondary veins; adaxial surface emerging sericeous but becoming glabrous, oil glands absent, midvein mostly flush or slightly sulcate proximally; abaxial surface glabrous, oil glands absent, secondary veins indistinct, not or only slightly looping at connection to intramarginal vein, intramarginal vein faint, 1–2 mm from margin at laminar midpoint. *Inflorescence* only partially known, evidently a few-flowered cyme, ramiflorous, solitary or paired (possibly fascicled but not confirmed), pedicels stiff, 8–9 mm long, terete, sericeous, often pink, oil glands absent. *Bracteoles* 1.0–1.2 mm long, ca. 0.8 mm wide, broadly ovate, stiff, sparsely sericeous below, often persisting in fruit. *Calyx lobes* 4, 3.0–4.5 mm long, rounded, apex obtuse, sericeous above, sericeous below (especially proximally). *Petals* 4, pinkish throughout or nearly white on margins. *Stamens* numerous (100+, estimated), filaments whitish, anther sacs globose, cream or ivory-colored. *Style* white. *Fruit* 12–17 mm long, 12–18 mm wide, globose, base rounded, sericeous, greenish-brown to maroon, crowned by persistent calyx lobes. *Seeds* globular to subglobular, 1 per fruit, 9–12 mm long, whitish (fresh) drying nearly black, partially encircled by flattened, belt-like hypocotyl (see e.g., Snow 2011, Fig. 6e).

Field characters:—Trees 2 to 8 meters tall. Leaf blades emerald green and glossy above, slightly asymmetrical to falcate, the apex sometimes slightly (and asymmetrically) conduplicate. Petals white or pinkish; filaments and styles whitish, anthers ivory to tawny.

Distribution:—*Eugenia guajavoides* occurs in southeastern Madagascar about 10 km northeast of Tolagnaro. The eastern collection (paratype) is in or very near the conservation parcel M3 of Mandena Forest. It is uncertain whether the western collection (type gathering) is in, or only adjacent to, the conservation zone M16 of Mandena Forest (Fig. 2; see also Lowry *et al.* 2008).

Habitat and ecology: Littoral forest.

FIGURE 3. *Eugenia guajavoides*. (No voucher; photo by J. Rabenantoandro).

Phenology:—Flowering confirmed only for late December but assuredly occurring well into January. Fruiting confirmed for October but probably beginning much earlier.

Additional specimen examined (paratype):—MADAGASCAR. Prov. Toliara: Mandromodromotra, Parcelle M2, Fokontany Lokaro, Firaisana Mandromodromata, Fort-Dauphin, 24°57'44", 47°03'56"E, 3 October 2000, *R. Rabevohitra 3727 et al.* (MO).

Etymology:—Derived from the specific epithet of the common guava, *Psidium guajava* L. given the similarities of the fruits. The local vernacular name, *sarigoavy*, indicates that it resembles a guava fruit.

Conservation status:—*Eugenia guajavoides* is known from a single subpopulation. The relatively imprecise coordinates of the type specimen were added after the collection was made (Z. Rogers, pers. comm. 2010) so it is uncertain whether it and the paratype gathering occur within a Protected Area (Fig. 2). With an AOO of 18 km^2, one subpopulation, only two collections from a relatively well-collected region, and an estimated number of individuals of less than 250, *Eugenia guajavoides* is assigned a prelminary status of "Endangered" (EN: D).

Discussion:—Flowers are unknown from herbarium material; measurements and information were taken from fruiting material and digital images.

Eugenia manonae N. Snow & Rabenant., *sp. nov.*, (Figs. 2, 4).

A congeneribis madagascariensibus combinatione characterum sequentium distinguitur: cortex brunneus; rami glabri; flores solitarii terminales ex pedicellis glabris crassis orientes; calyx albidus sed marginibus magenteis; petala pallide rosea; styli et filamenta pallida; antherae luteae.

Type:—MADAGASCAR. Prov. Toliara: Tolagnaro region, SW of town in forest called Petriky, along coastline near S end of the most SW lake, 22 January 1990, *G. McPherson 14855, N. Dumetz & R. Rabevohitra* (holotype MO! [sheet no. 3771521); isotypes P, TAN).

Trees or shrubs 1–12 meters; bark somewhat flaky, mottled in patches of various sizes in gray, light brown, orange or green. Plants glabrous except where noted. *Branchlets* terete, greenish (drying light brown to light gray), smooth; oil glands common, distinct, of uniform size; internodes (1.0–)1.5–3.0 cm long, the younger ones sparsely and shortly sericeous above base of petiole (use magnification). *Leaves* coriaceous, evenly distributed along branchlets, emerald green above and below, slightly glossy above and matte below (drying brownish and slightly discolorous); venation brochidodromous. Stipular hairs few but obscure with younger leaves. *Petioles* 3.5–6(–9.5) mm long, sulcate at least proximally. *Leaf blades* (2.5–)4.0–6.5 x 2.5–4.0 cm, elliptic (mostly) to occasionally broadly elliptic or obovate, base cuneate, margin slightly revolute, laminar surface mildly wavy, apex obtuse, tip obtuse or occasionally abruptly narrowed and acute; adaxial surface oil glands dense but faint, midvein impressed more or less throughout or at least proximally; abaxial surface oil glands common to dense but faint, secondary veins 6–11 per side, protruding slightly (dry), marginal vein faint, 1.5–2.0 mm from laminar margin at midpoint, arching only slightly between tips of secondary veins. *Inflorescence* terminal, consisting of 1–2 solitary flowers per axil. *Peduncles* 9–15 mm long, stiff, terete, ascending, glandular, light green. *Bracteoles* inferred from scars but otherwise unknown. *Hypanthium* obconic, terete, glabrous, yellowish-green. *Calyx lobes* 4, 6.6–7.5 mm (as measured on mature fruit), dimorphic (outer ones shorter and narrower), broadly ovate to semi-circular or oblate, glabrous, whitish but with a distinct, narrow marginal band colored magenta that fades to some degree during anthesis, imbricate in bud, persistent in fruit. *Petals* light pinkish-white to light pink, length and width unknown, oil glands common. *Stamens* numerous (100+); filaments white; anthers globose, length not measured, ivory to stramineous. *Style* whitish, slightly longer than longest filaments, gradually tapering in diameter towards apex; stigma very narrow, terete. *Fruits* 1.8–2.5 x 1.2–2.1 cm, globular, terete, greenish becoming orange to yellowish; exocarp relatively thin, soft, ca. 0.7 mm thick, densely glandular (glands of varying sizes), heavily vascularized with numerous vertical strands of varying thickness (easily seen in dry or rehydrated material). *Seeds* 1–2 per fruit, ca. 18.0 x 11.5 mm, compressed oblate; testa leathery, ca. 0.3 mm thick, densely glandular; hypocotyl elongate, fused into and flush with cotyledons.

FIGURE 4. *Eugenia manonae*. Upper left: main bole. Upper right: branchlet. Lower left: terminal buds. Lower right: flower with evidently six petals. (No voucher; photos by D. Rabehevitra).

Field characters:—Shrubs or trees up to 12 meters, outer bark thin and peeling irregularly, brownish with shades of orange and green. Plants glabrous apart from the sparse covering of hairs at base of internode above younger petioles. Flowers terminal, arising from stout pedicels. Hypanthium light yellowish-green. Calyx lobes whitish but margins strongly magenta in bud, persistent and crowing mature fruit. Petals light pink. Filaments and style white; anthers cream-colored. Fruits globular, greenish-yellow to yellowish-orange.

Distribution:—Southeastern Madagascar, from west of Tolagnaro to Sainte Luce, from three collections scattered across approximately 50 km. The type gathering southwest of Petriky Forest is not in a conservation area (Fig. 2). The northernmost paratype gathering (Fig. 2) is evidently located in the conservation zone (S9) in Sainte Luce (see also Lowry *et al.* 2008).

Habitat and ecology:—In dense shrubby vegetation and littoral forests over sand.

Phenology:—Flowering in October, November and possibly into December. Fruiting in January.

Additional specimens examined (paratypes):—MADAGASCAR: Prov. Toliara: Sainte Luce, QMM Forestry Station, parcel S9 [not "59", as written on label], 1–2 km from QMM Forestry trailhead, 24°46'05"S, 47°10'16"E, 23 January 2006, *Z. S. Rogers 968, R. Ranaivojoana, C. Davidson, & S. R. Christoph* (BISH! [sheet no. 744885]; MO, P, TAN); Jardin Botanique de Manena, 24°57'10.08"S, 47°00'10.39"E (see note below regarding geocoordinates), 25-26 October 1989, *R. Rabevohitra 2075* (K!, MO!; P, TAN).

Epynomy:—The species honors Manon Vincelette (b. 1959), a long-term resident of Madagascar who has contributed significantly to its conservation programs and who implemented the forest restoration program at Fort Dauphin of Rio Tinto QMM (e.g., Vincelette *et al.* 2008).

Conservation status:—The written description associated with the type gathering allows us to infer with reasonable confidence its position at about 25°05'50"S, 46°50'25"E somewhat southwest of Petriky forest, near the coast. The type locality is evidently a narrow band of littoral forest that varies from ca. 50–200 meters wide in that area. The paratype of *Rogers et al.* from Sainte Luce was georeferenced at the time of its collection and is approximately 2.7 km west of the coast and directly west of Sainte Luce in a relatively large and mostly undisturbed forest remnant, possibly located within conservation zone S9 of Sainte Luce (see Lowry *et al.* 2008). The collection label of *Rabevohitra 2075* indicates "Jardin Botanique de Mandena" as the locality. A string of recent communications with workers from Missouri Botanical Garden and colleagues in Madagascar, including Rabevohitra, suggest that the "botanical garden" locality is in a conservation zone in Mandena. Based on recent satellite imagery, the coordinates cited above as being most likely to reflect the collection locality are in an area that appears to be mostly altered by mining activities. We are thus unable to determine precisely the origin of that specimen.

In light of its distribution at three general areas, which includes a relatively undisturbed area west of Sainte Luce, and the likelihood of additional individuals occurring between the three locations, we assign a preliminary status of Vulnerable (VU: A1c,B2a,b(ii)).

Discussion:—The description of *E. manonae* is based on three herbarium specimens and several unvouchered digital images, which we are confident match the herbarium material. The absence of flowering material among herbarium specimens prevented inclusion of some descriptive information (e.g., width and length of petals, filaments, and style). Notes on the label of the type specimen indicated that the magenta margin of the calyx lobes can persist with mature fruits. The number of petals is uncertain; Fig. 4 (lower right) shows five of evidently six pinkish petals rather than the typical number of four, although it is uncertain whether this is an aberration.

Approximately fifteen larvae of an undetermined white fly (Class Homoptera; family Aleyrodidae), probably representing the first instar, were located on the abaxial leaf surface of the holotype specimen (vouchers at Bishop Museum).

Eugenia petrikensis N. Snow & Randriat., *sp. nov.* (Figs. 2, 5).

A congeneribis madagascariensibus combinatione characterum sequentium distinguitur: frutex 0.3–2 m altus; petioli

3.5–4.5 mm longi; folia 16.5–30 mm longa, 10–17.5 mm lata, elliptica, basi cuneata vel rotundata, apice obtuso; petala magentea ad marginem hyalina; stamina 20–30.

Type:—MADAGASCAR. Prov. Toliara: District Tolagnaro; forêt de Petriky, 25°05'S, 46°52'E, 26 October 1989, *N. Dumetz 812, G. McPherson & R. Rabevohitra* (holotype MO! [sheet no. 3778658]).

Shrubs 0.3–2 meters at flowering. *Branchlets* moderately to densely sericeous on emergence but becoming sparsely so to nearly glabrous (trichomes dibrachiate, dense, clear to ferrugineous that become whitish brown); oil glands not visible or only faint (becoming more prominent in age), occasional; internodes ca. 1.0–1.2 cm long. *Leaves* coriaceous, evenly distributed along branchlets, slightly discolorous, emerald green and slightly glossy above, citrine and matte below; venation brochidodromous. Stipules absent. *Petioles* 3.0–4.5 mm, slightly sulcate above, eglandular but rugose-wrinkled throughout, glabrous, yellowish-green. *Leaf blades* 1.6–3.0 x 1.0–1.7 cm, elliptic, base cuneate to rounded, margin somewhat revolute except near apex, laminar surface flat, apex and tip obtuse; adaxial surface sparsely sericeous towards base, oil glands absent, midvein slightly sulcate proximally but becoming flush distally; abaxial surface glabrous, oil glands absent, secondary veins invisible or faint with 4–5 veins arising on each side of midvein, sometimes slightly raised (dried material), intramarginal vein faint, 0.2–0.5 mm from margin at laminar midpoint. *Inflorescence* axillary or ramiflorous, consisting of monads or 3–flowered cymes, solitary, paired or generally in fascicles (sometimes densely so). *Peduncles* (or pedicels, if flowers solitary) 2–5 mm long, stiff, terete to compressed, medium green, glabrous or with a few scattered hairs. Anthopodia absent; metaxphylls mostly absent (present on one flower). *Bracteoles* 0.5–0.7 mm long, ca. 0.3 mm wide at base, narrowly triangular to triangular, scale-like, spreading, stiff, sparsely hairy, persistent in flower. *Hypanthium* 1.0–1.5 mm long, 1.3–1.5 mm wide at apex at base of calyx lobes, obconic, glabrous, whitish to ivory or stramineous, oil glands common but small and inconspicuous, surface smooth, apex of ovary glabrous at base of style but villous towards staminal ring. *Calyx lobes* 4, 1.4–1.8 mm long, rounded to oblong, apex broadly rounded, glabrous, upper surface often magenta or cerise during anthesis and hyaline along margin, lower surface greenish. *Petals* 4, 3.0–4.1 x 2.1–2.2 mm, ovate, oil glands sparse, magenta but hyaline on margins. Staminal ring villous, diameter 1.5–1.8 mm. *Stamens* 20–30, in 1 or 2 series; filaments ca. 2–3 mm long, whitish; anther sacs 0.7–0.9 mm long, globose to cylindrical, dorsifixed, bearing a single apical gland, cream colored. *Style* ca. 3 mm long, whitish, glabrous; stigma punctiform (scarcely if at all capitate). Locules 2; placentation axile, capitate, ovules 5–7 per placenta and radiating irregularly from placenta. *Fruit* (dimensions not measured) globose, glabrous, yellow at maturity, apex crowned by persistent calyx lobes.

Field characters:—Shrubs up to 2 meters tall; flowers often ramiflorous in clusters and relatively small; hypanthium glabrous; calyx lobes sometimes with three relatively prominent veins; petals magenta; stamens relatively 30 or less. (Fig. 5).

Distribution:—Known only from the eastern part of Petriky Forest (Fig. 2) and Ambinanibe Forest in Toliara Province in southeastern Madagascar. Ambinanibe Forest (not labeled in Fig. 2), only infrequently indicated on maps and from digital sources, is the highly fragmented area west of Tolagnaro, north of Lac Andriambe, an area of active mining operations.

Habitat and ecology:—Growing in full sun (or more rarely in shade) in low forest on littoral sands from 0–10 meters elevation.

Phenology:—Flowering late October to February; fruiting from December to March.

Etymology:—The specific epithet is based on Petriky Forest (Fig. 5).

Vernacular name:—*Ropasy lahiny. Ropasy* is a contraction of *rotry* and *fasiky*, the former of which is a generic vernacular name used for species of *Eugenia* and *Syzygium* around Tolagnaro. *Fasiky* refers to sand; thus *ropasy* means "*Eugenia* that grows on sand". When more than one species of a genus occurs locally a second name often is added for distinction, such as *lahiny* (male) or *vaviny* (female). The name *ropasy* is also used in Mandena (north of Tolagnaro) for *Eugenia arenicola* H. Perrier, another species from littoral forests in the general region.

FIGURE 5. *Eugenia petrikensis*. Upper left: bark of main bole. Upper right: sessile to subsessile inflorescences. Lower left: emerging leaves with whitish indumentum. Lower right: mature leaves; abaxial (upper) and adaxial (lower) surfaces. (No voucher; photos by D. Rabehevitra).

Conservation status:—The type gathering is in or near the eastern part of conservation zone P1 in Petriky Forest (Fig. 2; see also Lowry *et al.* 2008). The paratype (Fig. 5) was from a non-protected and highly disturbed area. Although herbarium material of *Eugenia petrikensis* currently is known only from the type gathering, the species has been observed and photographed recently at Ambinanibe Forest (25°02'35'S, 46°56'04"E) growing in full sun or rarely in shade. With an AOO of 18 km^2, and 2 subpopulations, one in a protected area (Petriky), *E. petrikensis* is assigned a preliminary status of "Endangered" (EN: B2ab[iii]).

Discussion:— *Eugenia petrikensis* may be more common than suggested by the known number of herbarium specimens. Its vegetative and floral morphologies most closely resemble those of *E. ardyceae* N. Snow (Snow 2011), which also occurs in the Tolagnaro region (Fig. 2). However, the pedicillate flowers with glabrous hypanthia of *R. petrikensis* contrast with the sessile to subsessile flowers with sericeous-villous hypanthia of *E. ardyceae*. The dibrachiate trichomes of *E. ardyceae* on younger leaves are highly asymmetrical (i.e., arms of differing lengths [Snow 2011]), which contrast with the more symmetrical trichomes in the emerging foliage of *E. petrikensis*. The calyx lobes on the type specimen of *E. petrikensis* have 3 straight and equally-spaced vascular bundles that converge apically slightly inside of the margin (magnification required), but it is uncertain if this trait occurs in all specimens.The leaves, inflorescences, and flowers of *E. urschaiana* H. Perr. var. *urschiana* also somewhat resemble those of *E. petrikensis* (e.g., *M. Ursch 17*, holo: P! [image seen]). However, *E. urschaiana* var. *urschiana* occurs ca. 1300 km north of Tolagnaro at ca. 250 m. elevation in forests at or near Analamazaotra (Perrier 1953a, b) ("Analamazoatra" on herbarium label).

More detailed field surveys are urgently needed for this species.

Eugenia stictophylla N. Snow & Razafim., *sp. nov.* (Figs. 2, 6).

A congeneribis madagascariensibus combinatione characterum sequentium distinguitur: arbor 4–7 m alta; petioli 3.5-5.5 mm longi, sulcati; folia 20–50 mm longa, 7–12(–15) mm lata, anguste elliptica, basi cuneata, apice obtuso, lamina dense glandulosa; petala alba; stamina 35–70.

Type:—MADAGASCAR. Prov. Toliara: District Tolagnaro; forêt de Petriky. 25°05'S, 46°52'E, 5 December 1990, *N. Dumetz 1106 & G. McPherson* (holotype MO! [sheet no. 3778655]; isotypes BISH! [sheet no. 747508], MO, P, TAN).

Trees 4–7 meters. Indumentum (where present) shortly sericeous, trichomes dibrachiate and ferrugineous. *Branchlets* laterally compressed and maroon or pinkish on emergence, becoming terete and grayish (dried), smooth, sericeous below the base of (often supra-axillary) pedicels but glabrous or only sparsely sericeous elsewhere; oil glands sparse, indistinct; internodes 1.0–2.2 cm long. Stipules of short, setose hairs (type A: Snow *et al.* 2003:7). *Leaves* thinly coriaceous, mostly evenly spaced on branchlets, secondary veins faintly protruding above (dried material), slightly discolorous, somewhat glossy above, matte below; venation (obscurely) brochidodromous. *Petioles* 3.5–5.5 mm long, deeply sulcate adaxially, prominently glabrescent along apex of sulcus, abaxially verrucose. *Leaf blades* 2.0–5.0 x 0.7–1.2(–1.5) cm, narrowly elliptic, base strongly cuneate, margin flat or drying slightly revolute, obtuse; adaxial surface glabrescent, secondary nerves indistinct and somewhat protruding (dried material), oil glands small but dense (use magnification), midvein sulcate proximally but becoming flush distally; abaxial surface glabrous, oil glands much less prominent than above, secondary veins obscure (sometimes scarcely visible), of 10–14 pairs, intramarginal vein indistinct, closely paralleling margin, ca. 0.5 mm from margin at midpoint of blade. *Inflorescence* a solitary flower, axillary or (mostly) supra-axillary. *Peduncles* 7–12(–15) mm long, laterally compressed (dried), mostly ascending, somewhat flexuous, sericeous near base but more sparsely distally, oil glands faint, moderately common. *Bracteoles* 2, 0.5–1.0 mm long x $\leq$ 0.5 mm, ovate to broadly ovate, scale-like, stiffly erect to ascending, stiff, sparsely sericeous, persisting in flower. *Hypanthium* 1.5–2.0 mm long (dried), ca. 1.3–2.4 mm wide below base of calyx lobes, obconic, terete, sparsely sericeous (especially above base of bracteoles towards calyx lobes), oil glands small but dense. Ovary apex sparsely short-villous along outer edges (i.e., in region adjacent to inner margin of staminal ring). *Calyx lobes* 4, 1.5–3.0 mm long, distinct and dimorphic in bud (the inner 2 somewhat longer than the outer 2), orbicular to shortly to broadly ovate, ciliate and sparsely sericeous, densely glandular (glands larger and more protruding than those of hypanthium), persistence in fruit unknown. *Petals* 4, 5–7 mm long, (2.5–)3.5–4.0 mm wide, obovate or widely obovate, white, glabrous, oil glands common and of similar size to those of calyx lobes. *Stamens* 35–70, in several whorls; filaments

FIGURE 6. Isotype of *Eugenia stictophylla* (*Dumetz 1106 & McPherson* [BISH]).

3–6 mm long; anthers 0.5–0.8 mm long, globose to subcylindrical, sub-basifixed, with a single prominent apical gland. *Style* 4.5–5 mm long, glabrous, tapering to a narrow punctiform stigma. Locules 2; placentation parietal, placenta capitate from middle of locule; ovules 8–13 per ovary, radiating from placenta. *Fruit* ca. 2–3 x 2–3 cm, yellowish-brown.

Field characters:—Trees 4–7 meters. Petioles deeply sulcate above; leaves densely glandular on upper surface, narrowly elliptic, apically obtuse. Petals white.

Distribution:—Known only from Petriky and Ambinanibe forests west of Tolagnaro.

Habitat and ecology:—Littoral forests on sand; elevation to about 15 m.

Phenology:—Flowering December and January; fruits not known.

Etymology:—The specific epithet is derived from the Greek elements *stict* and *phyll* in reference to the densely glandular leaves.

Additional specimen examined (paratype):—MADAGASCAR. Prov. Toliara: Tolagnaro region; SW of town in forest called Petriky, along QIT road, 25°05'S, 46°52'E, 12 January 1990, *G. McPherson 14774 et al.* (G, K!, MO!, P, TAN).

Conservation status:—The imprecise geo-coordinates preclude knowing whether the two specimens occur(ed) in conservation zone P1 of Petriky Forest (Fig. 2; see also Lowry *et al*. 2008). With just two collections from a restricted forest, an AOO of 9 km^2, and a single subpopulation constituting a single location with an estimated number of less than 250 individuals, near or within a protected area (Petriky), *E. stictophylla* is assigned a preliminary status of "Endangered" (EN: D).

Discussion:—Our reports of fruiting material are taken from the field and from information provided by people locally who know the species. Among other species of *Eugenia* in the vicinity of Petriky Forest, *Eugenia stictophylla* most closely resembles *Eugenia cassinoides* Lam. However, *E. stictophylla* has a more deeply sulcate petiole, more narrowly elliptic leaf blades, denser and much darker laminar oil glands (living and dried material), and more flexible pedicles. The leaf blades of the new species tend to dry significantly greener than those of *E. cassinoides*, the latter of which typically dry darkish brown adaxially, although the dried color may be an artifact of drying temperatures and duration.

The paratype specimen of *E. stictophylla* may be slightly introgressed with the much more common *E. cassinoides*, although genetic studies would be necessary to test this hypothesis. Differences of the paratype from the type gathering include fewer stamens (ca. 35–45 v. 60–70), subglobular (v. cylindrical) anther sacs, and fewer (8–9 v. 11–13) ovules per locule.

Eugenia roseopetiolata N. Snow & S. Cable, *sp. nov.* (Figs. 2, 7).

A congeneribis madagascariensibus combinatione characterum sequentium distinguitur: petioli rubri glandulis prominentibus flavidis; bracteolae breves et appressae; filamenta et petala albida.

Type:—MADAGASCAR. Prov. Toliara: SW of Ft. Dauphin in Petriky Forest, W side of forest tract N of Lake Andrato lohorano, block P-1 of QIT-FER, 25°04'S, 46°49'E, 15 m, 19 November 1990, *D. Faber-Langendoen 3557* (holotype MO! [sheet no. 4029290]).

Tree to 4 meters. Indumentum on vegetative and reproductive parts shortly sericeous-villous (trichomes dibrachiate and mostly somewhat ferrugineous). *Branchlets* laterally compressed, smooth to slightly irregular, moderately sericeous, light brown; oil glands not visible; internodes ca. 1–2 cm long. *Leaves* thinly coriaceous, concentrated near branchlet tips, glossy emerald green above but dull (matte) citrine below (fresh; brownish when dry); venation brochidodromous. Stipules absent. *Petioles* 4.0–6.5 mm long, deeply sulcate above, bright magenta to maroon (the pigment often extending into base of midrib and proximal region of laminar margin), oil glands prominent and distinctly yellowish in younger material, sericeous above (especially on emergence). *Leaf blades* (2.8–)4.0–4.7 x 1.8–2.3 cm, mostly elliptic (rarely obovate), base cuneate, apex and tip obtuse, margin slightly revolute, surface flat; adaxial surface sparsely sericeous

FIGURE 7. *Eugenia roseopetiolata* (from cultivated material at Kew). Top left: bark. Top right: petiole of freshly harvested material taken through dissecting scope. Middle left: flowering branchlet. Middle right: flowers. Bottom left: flower, post-anthesis, with petals and stamens removed. Bottom right: adaxial (top) and abaxial (bottom leaf surfaces).

(proximally) on emergence but becoming glabrate, oil glands indistinct but numerous (especially visible near base and along proximal margins), midvein slightly sulcate (proximally, becoming flush distally); abaxial

surface sparsely sericeous-villous (becoming glabrate), oil glands moderate to common, faint (fresh of dried), secondary veins visible but not prominent; intramarginal vein 1.0–1.5 mm from laminar margin at midpoint. *Inflorescence* a solitary axillary flower, or arising from a short brachyblast; pedicel 4–8. 5 mm long, terete, shortly sericeous-villous (trichomes dibrachiate), stiff but sometimes slightly curved, light green (fresh), often with minute triangular bract at base (bract with numerous oil glands of various sizes; apex of bract greenish or light brown). *Bracteoles* 0.5–0.8 mm long, ovate, scale-like, erect and stiffly appressed (in flower) against base of hypanthium (apex of pedicel slightly swollen underneath base of each bracteole), moderately sericeous. *Hypanthium* 2.0–2.4 mm long, ca. 2.0 mm wide at base of calyx lobes, obconic, terete and light green (fresh), moderately sericeous-villous, ovary apex glabrous. Buds light green, densely but faintly yellowish-glandular, sparsely sericeous (trichomes dibrachiate, often brownish). *Calyx lobes* 4, 1.5–2.3 mm long, dimorphic (2 longer, 2 shorter), light yellow-green (when fresh), rounded, sparsely dibrachiate-sericeous above and below, oil glands below of distinctly different sizes, prominent and slightly protruding. *Petals* 4, 5.0–5.7 mm long, widely ovate, glabrous above and below, white, sparsely and faintly glandular, relatively thick. Staminal ring densely short-villous, ca. 2.5 mm wide. *Stamens* ca. 90–110; filaments 2.5–5.5 mm, white; anther sacs ca. 0.7 mm long, subcylindrical, sub-basifixed, cream colored, apical gland on connective faint. *Style* ca. 6 mm long (material scant), glabrous, white; stigma terete but scarcely if at all capitate. Ovary bilocular; placentation axile; ovules arising from center of placenta. *Fruit* unknown.

Field characters:—Petioles bright magenta to maroon, sulcate and slightly sericeous above; leaf blades 4-4.7 cm long; petals, filaments and style white.

Distribution:— Petriky Forest (Fig. 2).

Habitat and ecology:—White sand littoral forest.

Phenology:—Flowering in November. Fruits unknown.

Additional specimen examined (paratype):—MADAGASCAR. Prov. Toliara: Petriky (Vohibary), 25°3’6.68”S, 46°53’45.24”E, 21 February 2007, *E. Landry P165* (K! [seed source for Millenium Seed Bank], TAN).

Etymology:—A Latinization that refers to the bright reddish petiole in living material.

Conservation status:—The species is known from Petriky forest. With just two collections (Fig. 7) from a restricted forest, an AOO of 9 km^2, and a single subpopulation constituting a single location with an estimated number of less than 250 individuals, encompassed within or near a protected area (Mandena), *E. rosapetiolata* is assigned a preliminary status of “Endangered” (EN: D).

Although field studies have not attempted to count the number of individuals, substantial collecting in Petriky since the 1980s likely would found additional specimens if *E. roseopetiolata* were more common. Also, given that *Eugenia arenicola*, *E. cassinoides*, and *E. cloiselii* have been collected in the same general area in greater numbers, we tentatively estimate the total population of *E. rosapetiolata* to be less then 250 individuals.

Discussion:—*Eugenia roseopetiolata* most closely resembles *E. cassinoides*, but several aspects of the former appear to be distinct from the latter, including: the reddish color of the petioles that extends into the lower leaf margins and somewhat into the midvein of the laminar surface, and prominent yellowish oil glands on the petiole (Fig. 7). Additional study of fresh material of *E. roseopetiolata*, *E. cassinodies*, and related material will be necessary to better understand variation between these taxa.

Eugenia stibephylla N. Snow & Rabeh., *sp. nov.* (Figs. 2, 8).

A congeneribis madagascariensibus combinatione characterum sequentium distinguitur: petioli longi et indumentum floccosum in foliis ramulsique iuvenibus.

Type:—MADAGASCAR. Prov. Toliara: Tolagnaro region; W of town in forest called Mandena; trail through Botanical Garden, 24°57’S, 047°00’E, 25 m, 6 December 1989, *G. McPherson 14647 & N. Dumetz* (holotype MO! [sheet no. 04805046]; isotypes MO! [sheet no. 3771517], P, TAN).

Trees to 8 meters; bark light to medium brown, irregularly fissured vertically, flaking irregularly in rectangular polygons. Indumentum of young branchlets and leaves whitish, hoary (frost-like) or floccose; indumentum of reproductive parts sericeous (trichomes dibrachiate, reddish-brown, especially on dry material). *Branchlets* laterally compressed, medium green to light brown (fresh) or light greenish brown (dried), smooth, somewhat pruinose, glabrous; oil glands sparse and indistinct; internodes 0.9–1.7 cm long. *Leaves* coriaceous, evenly distributed along branchlets, concolorous and medium green (fresh), strongly discolorous (dry), glossy above, matte below; venation brochidodromous. Stipules absent. *Petioles* 7–14 mm long, deeply and narrowly sulcate above, floccose when young, smooth, eglandular. *Leaf blades* (3.5–)5.0–7.0 x 2.3–3.6 cm, mostly elliptic (a few obovate), base cuneate, apex obtuse (rarely acute), tip obtuse, margin slightly revolute (fresh and dried), surface flat or slightly irregular; adaxial surface floccose when young but becoming sparsely and minutely sericeous in age (trichomes dibrachiate), oil glands not visible, midvein flush or slightly sulcate at base; abaxial surface hoary but becoming sparsely and minutely sericeous along base of midvein (trichomes whitish), oil glands common, prominent (less so on dried material, but see younger leaves), secondary veins faint (fresh) but prominent when dried, intramarginal vein indistinct, 1.5–2.0 mm from laminar margin at midpoint. *Inflorescence* a 3–9-flowered cyme (central flowers typically sessile or subsessile), solitary to paired or fascicled in the axils, sometimes on brachyblasts (bracteate short shoots); central axis ascending to erect, stiff, laterally compressed, moderately to densely sericeous (trichomes dibrachiate, brownish). *Bracteoles* ca. 1 x 1 mm, broadly elliptic to broadly ovate, scale-like, densely sericeous below but more or less glabrous above, ascending to erect, stiff, persistent or not in flower, yellowish or light brown to maroon (fresh). *Hypanthium* 1.8–2.1 mm long, 1.6–1.8 mm wide at base of calyx lobes, obconic, terete (fresh) but becoming slightly rugose when dried, densely sericeous; ovary apex glabrous. *Calyx lobes* 4, 2.0–2.7 mm long, semi-circular, glabrous above, densely sericeous proximally but less so apically, light green drying brownish. *Petals* 4, 5.5–7.6 mm, very widely elliptic or very widely ovate to widely obovate, sparsely to moderately short ciliate (glabrous otherwise), white (tinged with pink in bud and sometimes towards base during anthesis), oil glands common. Staminal ring glabrous, 2.5–3.0 mm wide. *Stamens* ca. 105–125; filaments 5–6 mm; anther sacs 0.8–1.1 mm long, globose to subcylindrical, basifixed, with a prominent apical gland on connective. *Style* 5.0–8.5 mm, glabrous; stigma terete and scarcely if at all capitate. Locules 2; placenta axile, capitate, arising from middle of locular wall; ovules 8–10 per placenta, radiating from placenta. *Fruit* unknown.

Field characters:—Trees to 8 meters tall; bark light to medium brown, vertically fissured; young leaves and branchlets bearing floccose (frost-like) indumentum; petioles relatively long; upper leaf surface glossy; leaves concolorous or nearly so when fresh; petals and filaments white (petals pinkish tinged in bud and near base during anthesis), anther sacs cream colored, style light green.

Distribution:— *Eugenia stibephylla* is presently known from the type gathering the Mandena conservation area and from the digital image (Fig. 8) in a block of forest in Sainte Luce (Fig. 2).

Habitat and ecology:—Occurring only in coastal littoral forests in sandy soils.

Phenology:—Flowering in December. Fruits not known; presumably by late December and at least into January.

Etymology:—From the Greek words *stibe*, in reference to the irregularly floccose, hoary young leaves and branchlets, and *phyllum* for leaf.

Conservation status:—Recent observations in the field suggest that that the species is represented by fewer than 500 individuals. With one collection known from a restricted protected forest (Mandena), an AOO of 9 km^2, and a single subpopulation constituting a single location with an estimated number of less than 500 individuals, encompassed within a protected area (Petriky), *E.stibephylla* is assigned a preliminary status of "Vulnerable" (VU: D1, 2).

Discussion:—The species is unmistakable among Malagasy *Eugenia* by virtue of its long petioles and the floccose, hoary indumentum of the emerging branchlets and leaves. The vertically fissured, medium brown bark is unlike other species of *Eugenia* in the Petriky Forest region.

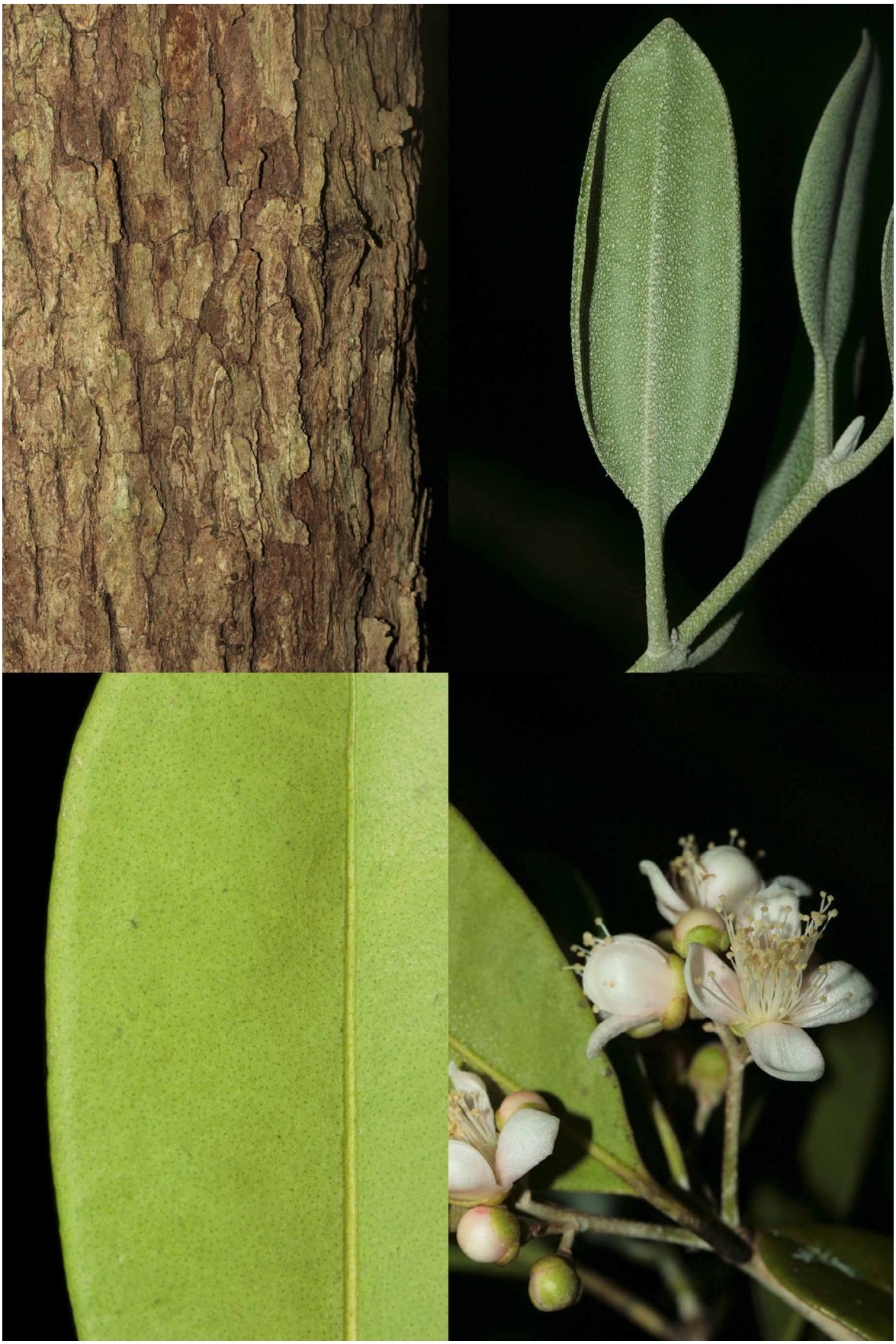

FIGURE 8. *Eugenia stibephylla*. Upper left: bark of main bole. Upper right: emerging leaves showing hoary indumentum. Lower left: Adaxial surface of mature leaf showing oil glands. Lower right: flowers. (No voucher; photos by D. Rabehevitra).

Eugenia vanwykiana N. Snow *sp. nov.* (Figs. 1, 9).

A congeneribis madagascariensibus combinatione characterum sequentium distinguitur: arbor mediocris; ramuli juniores et hypanthium dense tomentosum, pilis dibrachiatis aliquantum ferrugineis; ramuli complanati vel teretes; folia obovata vel elliptica, (20–)30–47 x (10–)15–39 mm, nervo medio supra sulcato; hypanthium valde costata.

Type:—MADAGASCAR. Prov. Antsiranana: Vohémar, Nosibe, Anjiabe. Village le plus proche: Anaborana près du lac Sahaka, 13°04’43’’S, 49°54’04’’E, 10 m, 23 Février 2003, *J. Rabenantoandro 1319, R. Rabevohitra, R. Razakamalala & S. Mathieu* (holotype MO! [sheet no. 6038327]; isotypes BISH! [sheet no. 731731], P, TAN).

Trees 10–12 meters; bark unknown. Indumentum on young branchlets and hypanthium dense (trichomes dibrachiate and somewhat ferrugineous). *Branchlets* laterally compressed becoming rounded, brownish-gray, becoming slightly scaly or fissured, densely sericeous; internodes 1.2–3.0 cm long. *Leaves* coriaceous, evenly distributed along branchlets, discolorous (fresh color unknown), matte above and below; venation brochidodromous. Stipules absent. *Petioles* 4.2–10.5 mm long, deeply sulcate above, densely hairy, becoming glabrous and somewhat rugose-wrinkled. *Leaf blades* (2.0–)3.0–5.5 x (1.0–)1.5–3.9 cm, narrowly elliptic or elliptic to narrowly obovate or obovate, base cuneate, margin flat to slightly revolute, laminar surface flat to mildly wavy, apex obtuse, tip acute (or less frequently acute); adaxial surface sparsely hairy along midvein and proximally but becoming glabrous, oil glands faint or not visible, midvein sulcate proximally becoming flush distally; abaxial surface sparsely hairy becoming glabrous, oil glands relatively occasional to common, flush, faint and of uniform size, midvein protruding and striate but becoming flush distally, secondary veins relatively few and not particularly distinct, the distal ends of secondary veins connected by a somewhat arching intramarginal vein less than 1.5–5.5 mm from laminar margin at midpoint. *Inflorescence* axillary or terminal, in fascicles of monads, triads (3-flowered cymes) or few-flowered panicles. *Peduncles* 2–15 mm long, terete to laterally compressed, stiff. Pedicels 3–4 mm long, densely hairy, anthopodia and metaxyphylls absent. *Bracteoles* 0.7–1.3 x < 0.5 mm, narrowly triangular to broadly ovate or oblate, scale-like, mostly densely hairy. *Hypanthium* 3–4 mm long, 4–5 mm wide at base of calyx lobes, obconic, prominently ribbed in flower, densely hairy, oil glands (if present) completely obscured by hairs. *Calyx lobes* 4, 3–4 mm long, ovate to broadly ovate, hairy below especially near margins and center, yellowish. *Petals* 4, 7.5–9.5 x 7–8 mm, broadly obovate to very broadly obovate, glabrous, yellowish, oil glands absent or sparse. Staminal ring densely hairy, 3.0–3.2 mm wide. *Stamens* ca. 75–100; filaments 6–10 mm; anther sacs 0.8–1.0 mm long, globose to subcylindrical, dorsifixed, eglandular. *Style* 10.5–11.5 mm, glabrous, sparsely glandular; stigma terete and scarcely if at all capitate. Locules 2; placentation axile; ovules 15–17 per placenta, apically (i.e., opposite point of attachment) broad with well-defined angular sides but narrowing towards base, radiating from centrally positioned, rounded placenta. *Fruit* evidently green (not confirmed).

Field characters:—Tree to 12 m tall; leaves elliptic to obovate, upper midvein impressed above in lower half of blade; hypanthium conspicuously ribbed in flower and densely hairy; calyx green, petals yellow, fruits green.

Distribution:—*Eugenia vanwykiana* is known from two collections from the Analabe littoral forest near Lac Sahaka, located east of Anaborano and about 2.8 km west of the coastline (Fig. 1). This general area is approximately 33 km northwest of Vohémar and about equidistant from the coastal outlets of the Manambato and Manankolana rivers.

Habitat and ecology:—In littoral forest over sand.

Phenology:—Flowering February through May. Fruiting indicated from both known gatherings (February and May) but none seen by the first author.

Additional specimen examined (paratypes):—MADAGASCAR: Antsiranana: Fivondronana: Vohémar, Firaisana: Nosy Be (Nossi-be), Fokontany: Anjiabe, 13°04’43’’S, 49°54’04’’E, 13 May 2004, *R. Razakamalala 1324 et al.* (BISH! [sheet nos. 731742, 731743], MO!, P, TEF).

Eponomy:—The specific epithet honors Dr. Abraham van Wyk (1952–) of the University of Pretoria, Gauteng Province, South Africa, whose studies provided important insights into the the anatomical and morphological variability of the South African species of *Eugenia*.

FIGURE 9. Isotype of *Eugenia vanwykiana* (*Rabenantoandro 1319 et al.* [BISH]).

Conservation status:—Recent satellite imagery suggests that the Analabe littoral forest near Lac Sahaka remains relatively undisturbed and relatively free of roads. However, Consiglio *et al*. (2006) estimated only ca. 2200 hectares of remaining littoral forests in this region. Unlike the other species proposed herewith, recent field observations are unavailable for *Eugenia vanwykiana* and no attempt was made to estimate its population size at Analabe.With just two collections, an AOO of 9 km^2, and a single subpopulation constituting a single location not encompassed within a protected area, *E. vanwykiana* is assigned a preliminary status of "Endangered" (EN: B2ab(i, iii)) because of the relatively undisturbed area where the species is growing.

Discussion:—The label on the type specimen indicates the fruits are greenish but we have seen no fruits on herbarium material, and green typically applies only to immature fruits in *Eugenia*.

Discussion

Bebber *et al.* (2010) recently documented that herbaria collectively harbor thousands of plant species still unknown to science, and that a large majority of new taxa remain undescribed for many years after their first collection.In accordance with their general findings, most of the species proposed herein also were first collected many years ago.

The littoral forests of eastern Madagascar are highly diverse, heavily fragmented, and severely endangered throughout their range (Consiglio *et al.* 2006, Rabenantoandro *et al.* 2007; Callmander *et al.* 2007; Vincelette *et al.* 2008). Although fewer collections have been made during the past decade, the region around Tolagnaro has been relatively well collected in part because of ilmenite mining operations (Consiglio *et al*. 2006; Rabenantoandro *et al*. 2007; Vincelette *et al*. 2008) and due to the extensive restoration efforts by Rio Tinto QMM to eventually reclaim the mining area using native plant species (Lowry *et al.* 2008).The Tolagnaro region, from somewhat west of Petriky to Sainte Luce (Fig. 2), harbors at least twelve species of *Eugenia* (see provisional key below). We wish to stress three important points. One, since the range of variation provided for characters are based on one or only a few specimens for each taxon, undue emphasis on any one character should be avoided when trying to identify unknown material. Two, many specimens of *Eugenia* from the region have not been mapped. Three, additional species are known to exist in the region but need further study before they can be adequately described.

Recent fieldwork by the Malagasy authors of this paper (JR, DR, FR, and NDR), combined with recent examination of all known herbarium specimens, suggest that *Eugenia cassinoides* Lam., *E. cloiselii* H. Perrier, and *E. arenicola* H. Perrier are the most common members of the genus in the Tolagnaro region.It is not known which species of *Eugenia* are most common in the region around Lac Sahaka in the general vicinity of *E. vanwykiana*. The species newly described here and others recently described from the same region (Snow 2011) have been confirmed thus far mostly from only two collections or localities: *Eugenia ardyceae*, *E. guajavoides*, *E. louisae* N. Snow, *E. mandonae*, *E. petrikensis*, *E. stictophylla* and *E. stibephylla*. An undescribed species (*Eugenia* sp. nov. "ehoala"; see key below) has not been collected but has been photographed in sufficient detail and compared to all known species regionally and across Madagascar that we are reasonably confident of its eventual recognition. Another possibly undescribed species that somewhat resembles *E. cloiselii* also is inadequately known and thus is excluded from the provisional key and Fig. 2.

Including those newly proposed here and others described recently (Snow 2008, 2011), the confirmed number of species of *Eugenia* for Madagascar stands at approximately fifty. All Malagasy species of *Eugenia* as presently understood are endemic, apart from the horticultural species *E. uniflora* L. Unpublished studies by the first author suggest that at least 10–15 additional species of *Eugenia* await description from Madagascar. Additional field work is urgently needed to better document rare or infrequently collected species to enhance our knowledge of their geographical distributions and habitats, and to more comprehensively understand the threats to their continued survival.

An illustrated field guide to tree species from the littoral forests of the Tolagnaro region will be available

soon (Rabehevitra *et al*. in press). Until then, the following key should help to identify many species of *Eugenia* occurring in littoral forests from Petriky to Sainte Luce.

Provisional key to species of *Eugenia* in the littoral forests of southeastern Madagascar

1. Leaves thickly coriaceous, ≤ 2.5 cm long; petals white ..... *E.* "ehoala" sp. nov. ined.
- Leaves coriaceous, > 2 cm long; petals white, pink, or magenta 2

2. Flowers sessile or subsessile (pedicels mostly 2–5 mm long) 3
- Flowers pedicellate (sometimes shortly so) 4

3. Hypanthium glabrous; indumentum of emerging leaves whitish ..... *E. petrikensis*
- Hypanthium hairy; indumentum of emerging leaves ferrugineous ..... *E. ardyceae*

4. Inflorescence axis, peduncle, or hypanthium with ferrugineous, dibrachiate trichomes (sparsely so in *E. stictophylla*) 5
- Inflorescence axis, peduncle, or hypanthium glabrous or with whitish hairs 9

5. Lower leaf surface with reddish trichomes; leaves obovate ..... *E. arenicola*
- Lower leaf surface more or less glabrous; leaves obovate or elliptic 6

6. Leaves narrowly elliptic ..... *E. stictophylla*
- Leaves obovate to elliptic 7

7. Leaves obovate, margin wavy ..... *E. louisae*
- Leaves obovate or elliptic, margin not wavy 8

8. Inflorescence a solitary flower, solitary, paired, or in fascicles, axillary or terminal or sometimes ramiflorous ..... *E. cassinoides*
- Inflorescence 3-several flowered cyme, usually paired or in fascicles, almost always ramiflorous ..... *E. cloiselii*

9. Branchlets hairy; indumentum floccose or frost-like ..... *E. stibephylla*
- Branchlets glabrous 10

10. Flowers hairy (whitish fresh, turning ferrugineous dried); leaf surface wavy ..... *E. louisae*
- Flowers glabrous; leaf surface flat 11

11. Petiole bright magenta to maroon ..... *E. roseopetiolata*
- Petiole yellowish-green, green or light pink 12

12. Flowers terminal; pedicel greenish; calyx lobes white or pinkish white, margin of lobes with distinct magenta band ..... *E. manonae*
- Flowers axillary or ramiflorous; pedicel magenta; calyx lobes (including margin) yellowish green … *E. guajavoides*

Acknowledgements

We thank Missouri Botanical Garden for several loans of specimens to the first author, and Zachary Rogers, Porter P. Lowry II, Armand Randrianasolo, and Jim Solomon for assistance in various capacities. Many thanks to Martin W. Callmander (MO), Dominique Andriambahiny (QIT Madagascar Minerals) for producing Figures 1 and 2 (respectively), and to Bryon Steinwand (University of Montana-Helena) for finalizing images. Arnold Hori at Bishop Museum captured digital images of several herbarium specimens with support from NSF MRI-082868. At the Royal Botanic Gardens, Kew, Sven Landrein dissected flowers and captured images of *E. roseopetiolata* from material cultivated by James Beatie and Nick Johnson. Peter Wilson kindly

provided the Latin description for *E. vanwykiana*. Al Samuelson of the Bishop Museum identified the white fly larvae on *Eugenia manonae*. The comments of M. Callmander and an annonymous reviewer improved the manuscript.

References

Bebber, D.P., Carine, M.A., Wood, J.R.I., Wortley, A.H., Harris, D.J., Prance, G.T., Davidse, G., Paige, J., Pennington, T.D., Robson, N.K.B. & Scotland, R.W. (2010) Herbaria are a major frontier for species discovery. *Proceedings ofthe National Academy of Sciences (USA)* 107: 22169–22171.

Beentje, H. (2010) *The Kew plant glossary: An illustrated dictionary of plant terms*. Kew: Royal Botanic Gardens.

Briggs, B.S., & Johnson, L.A.S. (1979) Evolution in the Myrtaceae–evidence from inflorescence structure.*Proceedings of the Linnean Society of New South Wales* 102: 157–256.

Callmander, M. W., Schatz, G. E., Lowry, P. P. II, Laivao, M. O., Raharimampionona, J., Andriambololonera, S., Raminosoa, T., & Consiglio, T. K. (2007) Application of the IUCN Red List criteria and assessment of priority areas for plant conservation in Madagascar: rare and threatened Pandanaceae indicate new sites in need of protection. *Oryx* 41: 168–176.

Consiglio, T., Schatz, G. E., McPherson, G., Lowry, P. P., II, Rabenantoandro, J., Rogers, Z. S., Rabevohitra, R. & Rabehevitra, D. (2006) Deforestation and plant diversity of Madagascar's littoral forests. *Conservation Biology* 20: 1799–1803.

IUCN (2001) IUCN Red List Categories and Criteria: Version 3.1. IUCN Species Survival Commission, IUCN, Gland, Switzerland; Cambridge, United-Kingdom, 33 pp.

Labat, J.-N. & Schatz, G. E. (2002) New combinations and a new name in *Syzygium* (Myrtaceae) from Madagascar and the Comoro Islands. *Novon* 12: 201–205.

Lowry, P.P. II, Randriatafika, F., & Rabenantoandro, J. (2008) Conservation status of vascular plant species from the QMM/Rio Tinto mining area at Mandena, Tolagnaro (Fort Dauphin) region, southeast Madagascar. *Madagascar Conservation and Development* 3: 55–63.

Miller, J. S. (2000) New taxa and nomenclatural notes on the flora of the Marojejy Massif, Madagascar. IV. Myrtaceae: New species of *Eugenia* L. *Adansonia, sér.* 3, 22: 111–116.

Myers, N., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B. & Kent, J. (2000) Biodiversity hotspots for conservation priorities. *Nature* 403: 853–858.

Perrier de la Bâthie, H. (1953a) Les Myrtaceés de Madagascar et des Comores, révision, diagnoses et biologie. *Mémoires de L' Institut Scientifiique de Madagascar, B*, 4(2): 161–202.

Perrier de la Bâthie, H. (1953b) Myrtaceae: 1–80, *Flore de Madagascar et des Comores*, fam. 152. Muséum national d'Histoire naturelle, Paris.

Rabenantoandro, J., Randriatafika, F. & Lowry, P. P., II (2007) Floristic and structural characteristics of remnant littoral forest sites in the Tolagnaro area. Pp. 65–93 in *Biodiversity, ecology and conservation of littoral ecosystems in southeastern Madagascar, Tolagnaro (Fort Dauphin)*, J. U. Ganzhorn, S. M. Goodman, and M. Vincelette (eds). SI/MAB Series #11. Washington, DC: Smithsonian Institution.

Rabehevitra, D., Rabenantodandro, J., Randriatafika, F., Channeliere, S. & Cable, S. (In press) *Field guide to the littoral forest trees of south east Madagascar*. Kew: Royal Botanic Gardens.

Snow, N. (1997) Application of the phylogenetic species concept: a botanical monographic perspective. *Austrobaileya* 5: 1–8.

Snow, N. (2008) Studies of Malagasy *Eugenia* (Myrtaceae) – I: Two new species from the Masoala Peninsula and generic transfers from *Monimiastrum*. *Systematic Botany* 33: 343–348.

Snow, N. (2010) Studies of Malagasy *Syzygium* (Myrtadeae) – Two new species with small leaves and winged branchlets. *Harvard Papers in Botany* 15: 85–91.

Snow, N. (2011) Studies of Malagasy *Eugenia* (Myrtaceae) – II: Four new species, including one eaten by black lemurs on Nosy Be. *Systematic Botany* 36(3): 677–689.

Snow, N., Guymer, G. P. & Sawvel, G. (2003) Systematics of *Austromyrtus, Lenwebbia*, and the Australian species of *Gossia* (Myrtaceae). *Systematic Botany Monographs* 65: 1–95.

Thiers, B.M. (2011) Index Herbariorum: A global directory of public herbaria and associated staff. http://sciweb.nybg.org/science2/IndexHerbariorum.asp

TROPICOS®. (2012) http://www.tropicos.org/.Accessed January 2012.

Vincelette, M., Théberge, M. & Randrihasipara, L. (2008) Evaluations of forest cover at regional and local levels in the Tolagnaro region since 1950. Pp. 49–58 in *Biodiversity, ecology and conservation of littoral ecosystems in southeastern Madagascar, Tolagnaro (Fort Dauphin)*, J. U. Ganzhorn, S. M. Goodman, and M. Vincelette (eds). SI/MAB Series #11. Washington, DC: Smithsonian Institution.