

Two Distinctive New Species of Malagasy *Garcinia* (Clusiaceae)

ZACHARY S. ROGERS^{1,3} and PATRICK W. SWEENEY^{1,2,3}

¹Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63116-0299 U.S.A.

²University of Missouri-Saint Louis, One University Boulevard, St. Louis, Missouri 63121-4400 U.S.A.

³Authors for correspondence (zachary.rogers@mobot.org; patrick.sweeney@mobot.org)

Communicating Editor: Thomas A. Ranker

ABSTRACT. During a recent survey of Malagasy *Garcinia*, we uncovered several herbarium collections sharing the general floral morphology of *G. verrucosa*, the sole member of the Xanthochymus Group in Madagascar but differing in a number of leaf, flower and fruit characters. Further inspection of specimens deposited in herbaria particularly rich in Madagascar collections led us to conclude that these unassigned collections represent two new species of Malagasy *Garcinia*, which we describe here under the names, *G. capuronii* and *G. lowryi*. *Garcinia verrucosa* differs from both new species by having larger (≥ 8 vs. ≤ 5 mm long) flowers and fruits without ridges or lobes. *Garcinia capuronii* is easily distinguished from *G. lowryi* by its larger (26–41.4 vs. 1–10.5 cm long), bullate (vs. plane) leaf blades, and strongly 8-ridged (vs. shallowly (3)4-lobed) fruits. Based on IUCN criteria, the widespread *G. lowryi* should be considered a species of Least Concern (LC), whereas *G. capuronii*, a species known only from its type, is provisionally assigned to the Critically Endangered (CE) category.

KEYWORDS: Clusiaceae, *Garcinia*, Guttiferae, IUCN Red List, Madagascar, new species, taxonomy.

The dioecious genus *Garcinia* L. comprises over 250 species of mostly small to medium-sized trees, which are an important component of tropical forests world-wide. A recent molecular phylogenetic study of *Garcinia* (Sweeney, in prep.) utilizing two nuclear markers showed that a broad circumscription of the genus (sensu Jones 1980; Stevens 2006) is justified and further identified several strongly supported monophyletic groups within *Garcinia* that are each supported by synapomorphies, or are characterized by a unique combination of floral and vegetative characters. Four of these clades contain species that are native to Madagascar and the Comoros. Two of the clades that include Malagasy species consist of taxa formerly treated as *Rheedia* L. and *Ochrocarpos* Thouars in the *Flore de Madagascar et des Comores* by Perrier de la Bâthie (1951). Numerous authors consider these two segregate genera synonymous with *Garcinia* on morphological (e.g., Robson 1958; Adams 1970; Jones 1980; Kearns et al. 1998; Schatz 2001; Stevens 2006; Sweeney and Rogers, in press) and molecular grounds (Sweeney, in prep.). The two other clades contain species treated by Perrier de la Bâthie (1948, 1951) as *Garcinia*.

Sweeney and Rogers (in press) recognized 32 species in Madagascar and the Comoros, including the two new species described below, and each species was assigned to one of four Species Groups (Brindonia, Paragarcinia, Rheedia, Xanthochymus). These groups are recognized mainly on the basis of floral morphology and correspond to the clades recognized in the molecular analysis (Sweeney, in prep.); a key to each group is also available (Sweeney and Rogers, in press).

The Xanthochymus Group in Madagascar presently composed of a single currently described Malagasy endemic (*G. verrucosa* Jum. & H. Perrier), is distinguished by its staminate flowers lacking well-developed pistillodes and possessing androecia consisting of four antepetalous phalanges of incompletely fused stamens surrounding a fleshy central disk, and pistillate flowers with staminodial phalanges alternating with irregularly-shaped, antesealous lobes (Sweeney and Rogers, in press). Numerous herbarium specimens examined as part of our previous study were found to possess floral morphology of the Xanthochymus Group; yet in contrast to *G. verrucosa* and its invalidly published infraspecific taxa (see below), these specimens exhibited sizeable differences in several vegetative, floral, and fruit characters. To accommodate these morphologically distinct specimens, we describe two new species here under the names, *G. capuronii* Z. S. Rogers & P. Sweeney and *G. lowryi* Z. S. Rogers & P. Sweeney.

In regards to the taxonomy of *Garcinia verrucosa*, Perrier de la Bâthie (1948, 1951) recognized four invalid infraspecific taxa for the species (subspecies “*typica*” and “*orientalis*” and varieties “*apiculata*” and “*piriformis*”). While our observations of the collections cited by Perrier suggest that there is considerable morphological variation within this species, examination of herbarium material (particularly the ca. 100 additional collections made subsequent to Perrier’s work) reveals that the cited differences between his infraspecific taxa represent overlapping, continuous variation. Although the large amount of variation in *G. verrucosa* may indeed correspond to more than one taxon, we are unable at this time to recognize any clearly

diagnosable taxa within this complex. It should be noted that the invalid infraspecific names described within *G. verrucosa* in no way apply to either of the new species described below.

MATERIALS AND METHODS

Our results are based on a morphological examination of all available herbarium specimens of Malagasy and Comorian *Garcinia* deposited at BM, K, MO, P, TAN, and TEF (herbarium citation follows Holmgren et al. 1990). The criteria we use to distinguish between species, groups of morphologically similar organisms, are several differences in morphological characters showing discontinuous, non-overlapping variation. We consider these species to be tentative, testable hypotheses that may correspond with species recognized by concepts emphasizing other phenomena and/or other kinds of data (see Mayden 1997; de Queiroz 1998). By being explicit in how we define species, our species can be clearly compared to those that have been derived using other methods.

Descriptive terminology follows Stearn (1992). The term "puberulent" is used for surfaces possessing trichomes that

are straight, erect, and ≤ 1 mm long. Color information for flowers and fruits are taken from label data unless otherwise noted. Measurements are based on fertile specimens. Flower length measurements in the key exclude the pedicel and were taken from dried herbarium specimens. Dimensions of the floral organs reported in the descriptions were measured from rehydrated flowers. All specimen data and type photos and images of other representative specimens are databased on W³TROPICOS (<http://mobot.mobot.org/W3T/Search/vast.html>) and SONNERAT (<http://coldb.mnhn.fr/colweb/form.do?model=SONNERAT.wwwsonnerat.wwwsonnerat.wwwsonnerat>).

Post-facto geographic coordinates and elevations are enclosed in square brackets and were assigned, whenever possible, using the web-based *Gazetteer to Malagasy Botanical Collecting Localities* (Schatz and Lescot 2007). The distribution map provided here was generated using ArcGIS 9 software.

Conservation status of each species is provisionally assigned based on the *Red List Categories and Criteria, version 3.1* (IUCN 2001). The extent of occurrence (EOO) and area of occupancy (AOO) were calculated using several ArcView project scripts developed by J. Moat (see Willis et al. 2003 for methodology).

TAXONOMIC TREATMENT

A KEY TO THE MALAGASY SPECIES OF *GARCINIA* IN THE XANTHOCHYMUS GROUP (SENSU SWEENEY AND ROGERS, IN PRESS)

1. Leaf blades 26–41.4 cm long, obovate, bullate, secondary veins forming two well-defined intramarginal vein loops; fruits with 8 strongly-raised longitudinal ridges *G. capuronii*
1. Leaf blades 1–20 cm long and ovate to obovate (–28.5 cm long but then ovate to elliptic), plane, secondary veins forming a single intramarginal vein loop; fruits not ridged, unlobed or with (3)4 shallow lobes 2
2. Flowers 8–11 mm long (excluding pedicel); petioles 1.2–2.2 cm long; fruits unlobed *G. verrucosa*
2. Flowers 2.3–4(–4.8) mm long (excluding pedicel); petioles 0.3–1 cm long; fruits shallowly (3)4-lobed *G. lowryi*

Garcinia capuronii Z. S. Rogers & P. Sweeney, sp. nov.—TYPE: MADAGASCAR. Fianarantsoa: Kianjavato, entre Ifanadiana et Anosivolo, [21°22'S, 47°52'E], 6 Dec 1964, ♀ fl., fr., *Service Forestier (Capuron)* 23916 (holotype: P-030776!; isotypes: P-030774!, P-030775!, P-030777!, TEF!). Fig. 1.

Garcinia capuronii Z. S. Rogers & P. Sweeney ab affinibus *G. verrucosa* Jum. & H. Perrier et *G. lowryi* Z. S. Rogers & P. Sweeney in foliis longioribus (26–41.4, non 1–20(–28.5) cm longo), bullatis (non planis), venatio insolita (brochidodroma biseriata, non uniseriata), et fructu longitudinaliter 8-porcato (non sine lobato vel tri- ad quadrilobo), rostro longiore (≥ 3 cm, non ≤ 1 cm longo), differt.

Diocious, evergreen tree; exudate not seen; branchlets distinctly 4-sided, 6–8 mm wide at the middle of distal internode, puberulent. **Leaves** opposite; petioles 1.3–1.7 cm long, 4.5–6.5 mm wide, transversely rugose and with longitudinal ridges, puberulent, base adaxially ligulate; blades obovate, 26–41.4 cm long, 8.4–17.2 cm wide, bullate, coriaceous, glabrous adaxially, puberulent

abaxially, base subcordate to cordate and decurrent, margin revolute and crenate, apex acuminate to apiculate, or rarely rounded, acumen up to 9 mm long; midribs raised above and below, more so abaxially, glabrous adaxially, puberulent abaxially; venation brochidodromous; secondary veins distinct from intersecondaries, 11–15 pairs per side, raised on both surfaces, more so abaxially, angle of divergence with midrib 65–75°, forming the first vein loop ca. 1–1.5 cm from the margin and then forming the intramarginal vein loop 1–4 mm from the margin; higher order venation conspicuous and densely reticulate; exudate-containing canals inconspicuous on both surfaces. **Inflorescences** supra-axillary, up to 3 mm above subtending leaf axil, cymose, densely congested, up to 7-flowered; peduncles 5–8 mm long, flattened, puberulent; pedicels (in bud) 1.8–3.5 mm long, ca. 1.2 mm wide, puberulent; inflorescence bracts paired, triangular, keeled, glabrous adaxially, puberulent abaxially, more so near margin and along apex, bracts at apex of peduncle 3–4 mm long, 1–1.5 mm wide, bracts within branched portion of the inflorescence 1–2 mm long, 1–1.5 mm wide. **Staminate flowers**

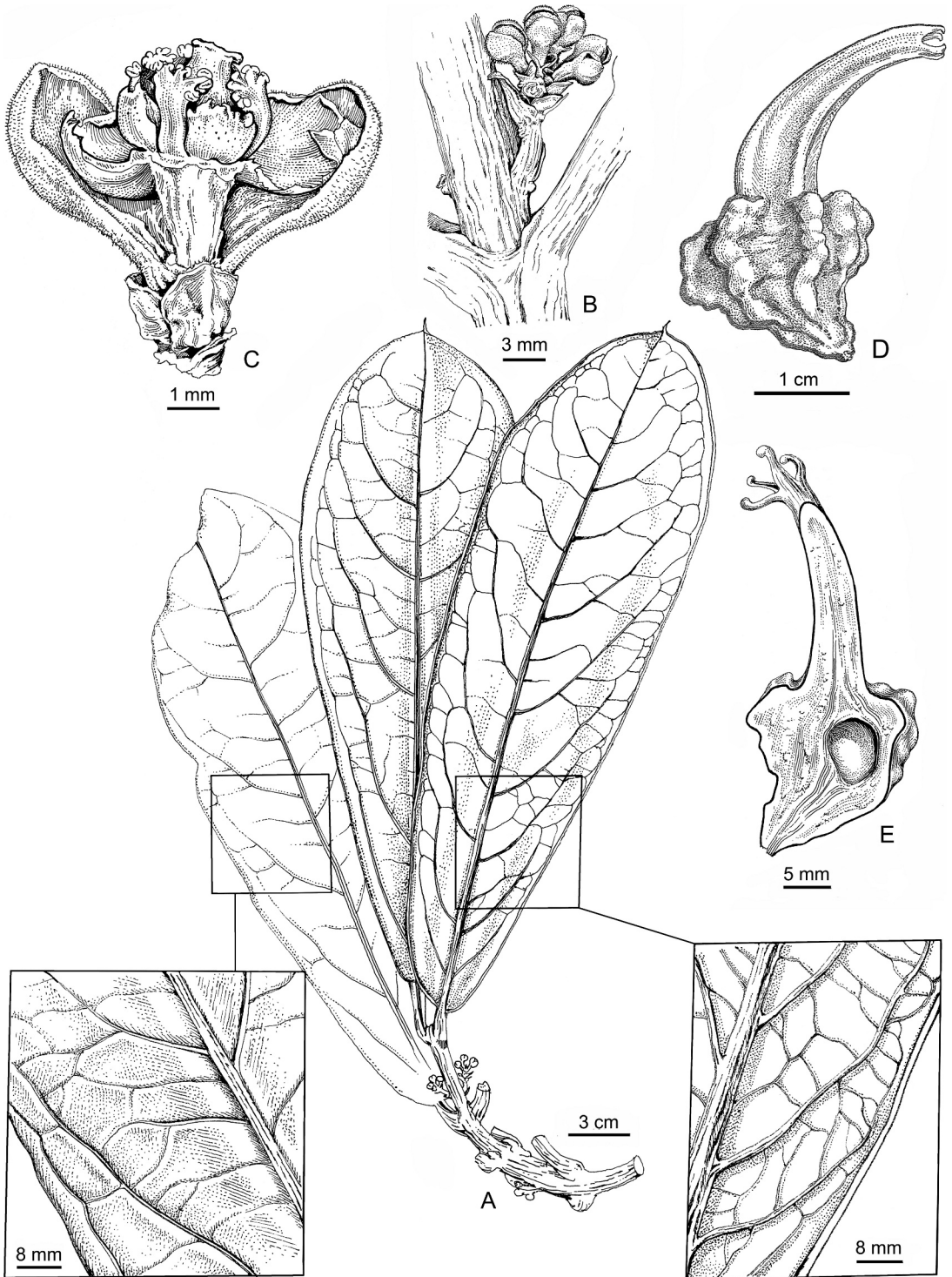


FIG. 1. *Garcinia capuronii*. A. Habit showing both leaf surfaces under magnification. B. Pistillate inflorescence. C. Dissected pistillate flower bud. D. Mature fruit. E. Longitudinal section of fruit. All illustrations based on type, *Service Forestier* 23916 (P, TEF). D drawn from a pickled fruit at TEF. E drawn from dried material at P.

not seen. **Pistillate flowers** (in bud) 4-merous, 4–5 mm long, ca. 5 mm wide; sepals free, imbricate, orbicular, convex and keeled, 2.8–3.8 mm long, 2.8–4.2 mm wide (inner pair slightly smaller), coriaceous, drying red-brown, glabrous adaxially, puberulent abaxially, margin subcoriaceous and ciliate; petals free, imbricate, orbicular-ovate, 3–3.5 mm long, 3–4 mm wide, white, glabrous; sterile androecium 4-phalangiata, glabrous; phalanges antepetalous, strap-shaped, distally inflexed, ca. 2 mm long, ca. 0.4 mm wide, apically branched into individual filaments for ca. 1/3 of the length of the phalange; antherodes 12 per phalange, introrse, suborbicular, ca. 0.3 mm long, ca. 0.2 mm wide; disk composed of fleshy and irregular lobes protruding between staminodial phalanges; gynoecium 4-locular and 4-lobed, glabrous; ovary ovoid, 1.6–2 mm long, 1.5–2 mm wide, sessile; locules 4, uniovulate; style 4-armed; united basal portion < 0.1 mm long; stylar arms up to 1 mm long, 0.7–1.2 mm wide, spreading. **Fruits** baccate, beaked, obovoid-globose, subtruncate where the main fruit body meets the fruit beak, up to 4.6–5.1 cm long, 2–2.4 cm wide, with 8 longitudinal ridges (two on the outer wall of each locule), sepals and staminodial phalanges persistent; beak 3–3.5 cm long (reaching up to ca. 2/3 of the total length of the fruit), ca. 1 cm wide at base; fruiting stylar arms 4, up to 8 mm long, with tips curved inward. **Seeds** not seen in good condition.

Distribution and Ecology. *Garcinia capuronii* (Fig. 2) occurs in humid forest in central eastern Madagascar near the town of Kianjavato (Fianarantsoa Province) at an estimated 500 m elevation. The species flowers and fruits in December.

Conservation Status. This species is known only from the type, which was collected in 1964 at an unprotected forest fragment northwest of Kianjavato [21°22'S, 47°52'E]. Some of the remaining vegetation in the area may still be suitable habitat for the species based on recent satellite imagery and an observation made from the nearby national route by a Missouri Botanical Garden conservation agent (C. Birkinshaw, pers. com.). With only a single distribution point, the extent of occurrence (EOO) for the species is not calculable, but the area of occupancy (AOO) is estimated at 10 km² given a grid cell of that same size. *Garcinia capuronii* is assigned a provisional conservation status of Critically Endangered (CE B1ab+B2ab) until other extant populations are found.

Etymology. We name this species in honor of famous French botanist René Capuron (1921–1971) because he was the first person to collect the species and was one of the most active botanists ever to have studied the forest flora of Madagascar.

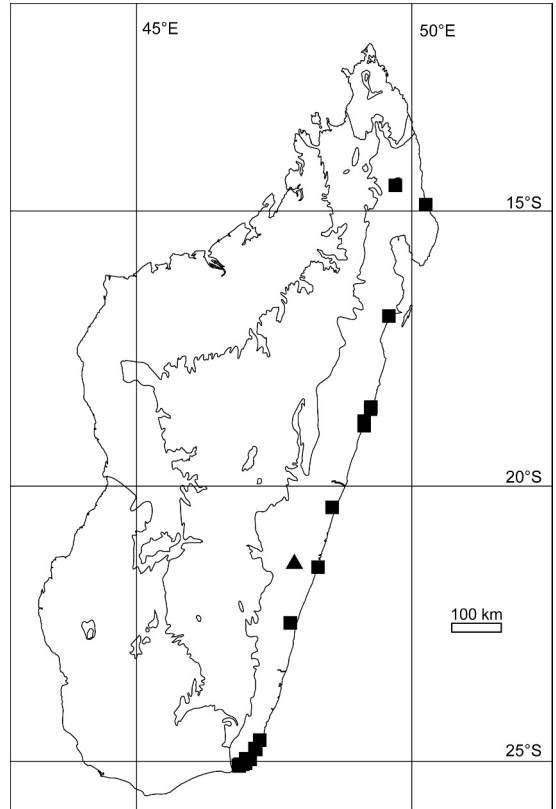


FIG. 2. Distribution of *Garcinia capuronii* (▲) and *G. lowryi* (■) mapped over the five simplified bioclimatic zones of Madagascar (Schatz 2000).

Observations. *Garcinia capuronii* is the most morphologically distinct member of the Xanthochymus Group in Madagascar differing from the other species by its bullate leaves (vs. plane) with two well-defined intramarginal vein loops (vs. one) and its remarkably distinctive fruits with eight longitudinal ridges (two on the outer wall of each locule). In addition, compared to the other species in the group, the leaf blades of *G. capuronii* are much larger (≥ 26 vs. ≤ 20 (–28.5) cm long) and the fruit beaks are at least three times longer (≥ 3 vs. ≤ 1 cm long).

***Garcinia lowryi* Z. S. Rogers & P. Sweeney, sp. nov.**—TYPE: MADAGASCAR. Toliara: Fort-Dauphin, W of town in forest called Mandena, trail through Botanical Garden, 10 m, [24°57'S, 47°00'E], 6 Dec 1989, ♂ fl., McPherson & Dumetz 14648 (holotype: MO!; isotypes: P!, TAN!, TEF!). Fig. 3.

Garcinia lowryi Z. S. Rogers & P. Sweeney a *G. verrucosa* Jum. & H. Perrier in floribus minoribus (3.3–4.8, non 8–11 mm longis), pedicellis minoribus (0.8–3, non 3–10 mm longis), petiolis minoribus (0.3–1, non 1.2–2.2 cm longis), et fructu tri- ad quadrilobo (non sine lobato), differt.

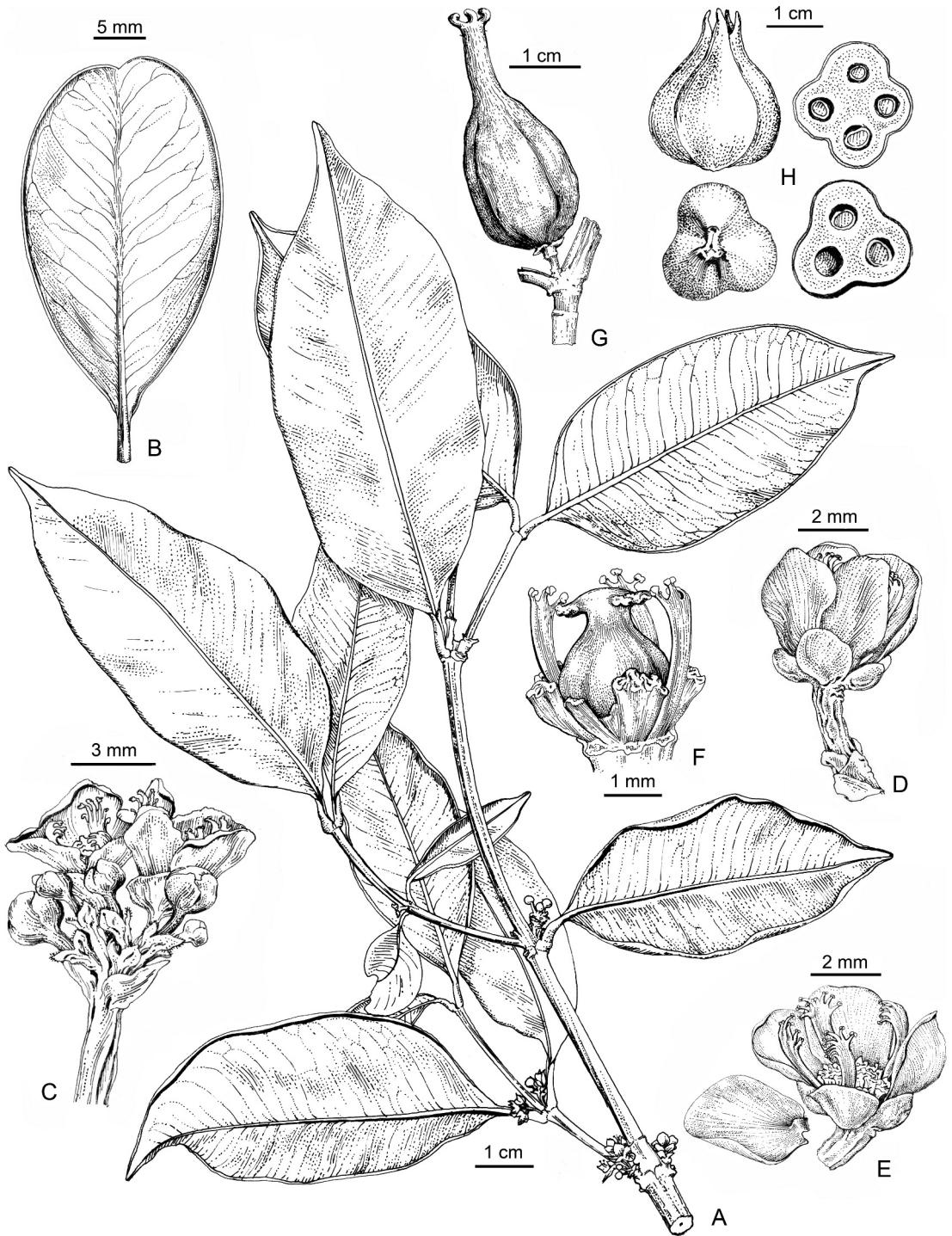


FIG. 3. *Garcinia lowryi*. A. Habit. B. Abaxial surface of emarginate obovate leaf. C. Staminate inflorescence. D, E. Staminate flowers. F. Pistillate flower without sepals and petals. G. Immature fruit. H. Fruits. A, C, D, E, drawn from isotype, *McPherson & Dumetz 14648* (TEF). B based on *Lowry et al. 6060* (TEF). F drawn from *Dumetz & McPherson 1156* (MO). G illustrated from *Randrianasolo 576* (MO). H drawn from *Service Forestier 28617* (TEF).

Dioecious, evergreen trees, up to 8 m tall; exudate white to yellow; branchlets distinctly 4-sided, 1–3 mm wide at the middle of distal internode, glabrescent to puberulent, indument usually much denser near tips. **Leaves** opposite; petioles 3–10 mm long, 1–2 mm wide, transversely rugulose, glabrescent to densely puberulent, base adaxially ligulate; blades elliptic to obovate, or less often ovate, 1–10.5 cm long, 0.5–4.6 cm wide, plane, chartaceous, glabrous adaxially, glabrescent to sparsely puberulent abaxially, often young leaves red-tinged abaxially, base cuneate to rounded and often decurrent, margin slightly revolute and occasionally faintly crenate, apex acuminate to acute, sometimes emarginate or rounded, acumen up to 1.9 cm long when acuminate; midribs similarly raised above and below, glabrous adaxially, glabrous to sparsely pubescent abaxially; venation brochidodromous; secondary veins not markedly distinct from intersecondaries, raised on both surfaces, sometimes not obviously visible abaxially, angle of divergence with midrib ca. 40–80°, forming an intramarginal vein loop ca. 0.5–1 mm from the margin; higher order venation inconspicuous; exudate-containing canals often visible abaxially especially on young leaves as sinuous dark lines, angle of divergence with midrib ca. 15–40°, intersecting or parallel to the secondaries. **Inflorescences** axillary or supra-axillary, cymose, densely congested, up to 15-flowered (or more) in staminate plants, generally fewer flowered in pistillate plants; peduncles up to 6 mm long, usually flattened, glabrescent to puberulent; pedicels 0.8–3 mm long, glabrescent to puberulent; inflorescence bracts paired, triangular or subtriangular, keeled, glabrous adaxially, glabrous to puberulent abaxially, bracts at apex of peduncle 1.2–5 mm long, 0.8–2.6 mm wide, bracts within branched portion of the inflorescence subtriangular or triangular-ovate, 0.7–1 mm long, 0.6–1 mm wide. **Staminate flowers** 4-merous, 2.3–4(–4.8) mm long, 2.7–5 mm wide; sepals free, imbricate, orbicular, convex and keeled, 1–2.5 mm long, 1–2.5 mm wide (inner pair ca. 1.5–2 times as large as the outer pair), coriaceous, drying red-brown, glabrous adaxially, sparsely puberulent abaxially, margin membranous and ciliate; petals free, erect, imbricate, ovate to obovate, 2–4 mm long, 2.5–3.5(–4.2) mm wide, membranous, white or off-white, glabrous; androecium 4-phalangiata, glabrous; phalanges antepetalous, strap-shaped, distally inflexed, 2–4 mm long, 0.2–0.5 mm wide, apically branched into individual filaments for ca. 1/5–1/10 of the length of the phalange, anthers 4–11 per phalange, introrse, globose, 0.1–0.2 mm long, ca. 0.1 mm wide; disk in the center of the

flower 2–3 mm wide, fleshy, irregularly lobed, lobes protruding between staminal phalanges; pistillode in the center of the disk, rudimentary, conical-attenuate or absent. **Pistillate flowers** with sepals, petals, sterile androecia, and disks similar to those found in the staminate flowers; gynoecium (3)4-locular and (3)4-lobed, glabrous; ovary ovoid to obovoid, 2–2.5 mm long, 1.5–1.8 mm wide, sessile; locules 4, uniovulate; style 4-armed; united basal portion 0.2–0.3 mm long; stylar arms 0.5–0.8 mm long, 0.5–0.7 mm wide, spreading. **Fruits** baccate, beaked, globose to ovoid-globose, rounded where the main fruit body meets the fruit beak, up to 3–3.9 cm long, 2–2.7 cm wide, shallowly (3)4-lobed, green, sepals and staminodial phalanges persistent; beak up to 1.4 cm long (reaching up to ca. 1/3 of the total length of the fruit), 5–6 mm wide at the base; fruiting stylar arms 4, up to 3.5 mm long, with tips usually curved inward. **Seeds** up to ca. 2 cm long.

Distribution and Ecology. *Garcinia lowryi* (Fig. 2) is predominantly distributed in Madagascar's eastern littoral forest on sand near sea level, roughly from Antalaha (north of the Masoala Peninsula) to Petriky (southwest of Fort-Dauphin). Two collections, *Razanatsima & Honoré 74* and *Cours 3389*, were made at much higher elevation, 627 m and 500–1,000 m elevation (estimated), respectively. The label of *Service Forestier 24637* specifically mentions lateritic soil and basaltic rock.

Garcinia lowryi flowers from October to April and fruits from December through March.

Vernacular Names. Bongo (*Service Forestier 2886*) – name commonly used in Madagascar for *Mammea* L. (Clusiaceae); Ditsaka (*Rabevohitra et al. 3734*) – the variant “Disaka” used for *Symphonia* L. f. (Clusiaceae) according to Schatz (2001: 116); Ditsaky (*Service Forestier 6089*); Ditsaka madinika (*Rabenantoandro et al. 387*); Vavongo, Vangolahy (*Service Forestier 32526*); Voaditsaka madini-dravina (*Razanatsima & Honoré 74*); Vongohely (*Service Forestier 2448*).

Conservation Status. *Garcinia lowryi* is mostly confined to the highly fragmented and severely threatened eastern coastal forest of Madagascar (Consiglio et al. 2006). The species occurs in a few protected sites within the littoral forest community (e.g., Ambila Lemaitso, Mandena, Petriky, Sainte Luce) and may also grow within the boundaries of the Marojejy protected area in the north of the island. Extent of occurrence (EOO) is estimated at 63,000 km². Given the relatively large EOO, the area of occupancy (AOO) is estimated to be 90,000 km² based on a grid cell size of 100 × 100 km. The species is provisionally assigned to the IUCN conservation category of Least Concern (LC).

Etymology. This species is named in honor of Dr. Porter P. Lowry II, a key collaborator and long-time participant in botanical exploration in Madagascar.

Observations. *Garcinia lowryi* can be distinguished from *G. capuronii* by its smaller (1–10.5 vs. 26–41.4 cm long), plane (vs. bullate) leaf blades, and by its shallowly (3)4-lobed (vs. strongly 8-ridged) fruits. *Garcinia lowryi* differs from *G. verrucosa* in having smaller flowers (3.3–4.8 vs. 8–11 mm in long), shorter pedicels (1–3 vs. 3–10 mm long) and petioles (0.3–1 vs. 1.2–2.2 cm long), and (3)4-lobed (vs. un-lobed) fruits.

We found notable morphological variation in *Garcinia lowryi* with regards to leaf shape and indument density of the vegetative organs. A few specimens from within the central portion of the distribution (the sole collection from Vatoman-dry, and some but not all of the collections from Ambila-Lemaitso) have obovate leaves with emarginate or rounded (vs. elliptic and acute to acuminate) apices (Fig. 3B) and densely puberulent (vs. glabrous to less often puberulent) twigs, petioles, and inflorescences. There are, however, intermediates and consequently we cannot find sufficient differences to recognize this subset of specimens as a distinct entity.

In addition, the largest and most mature fruit observed on the collection from Vatoman-dry (*Razanatsima & Honoré 74*) has an extremely short (ca. 1 mm long) fruit beak compared to those seen on other examined specimens of *G. lowryi*. Further collections from this area bearing mature fruit may provide additional taxonomically important characters.

Collections of *Garcinia lowryi* may be mistaken vegetatively for small-leaved members of the *Rheedia* Group (i.e. *G. aphanophlebia* Baker, *Rheedia arenicola* Jum. & H. Perrier, *R. thouvenotii* H. Perrier, *R. urschii* H. Perrier), but the staminate flowers of the *Rheedia* Group differ markedly in having free stamens arranged in a ring surrounding a disk, and pistillate flowers having a fleshy ring between the ovary and the free staminodes (Sweeney and Rogers, in press).

Paratypes. MADAGASCAR. Antsiranana: Forêt d'Ambatosoratra, [14°32'S, 49°42'E], 8 Jan 1949, ♂ fl., *Cours 3389* [=Herbier Institut Scientifique Madagascar 3389] (MO[2 sheets], P, TAN); Est (Nord): Forêt d'Andrakaraka, pres d'Antalaha, [14°53'S, 50°15'E], 18 Apr 1968, ♂ fl., *Service Forestier (Capuron) 24637* (MO, P[2 sheets], TEF). Fianarantsoa: Fivondronana Mananjary, Firaisana Ankatafana, Fokontany Marohita, forêt littorale d'Alimamba, 13 m, 21°28'04"S, 48°17'43"E, Oct 2004, imm. fr., *Razakamalala et al. 1644* (K, MO, P, TEF[2 sheets]); Forêt d'Amporoforo (entre Farafangana et Vohipeno), [22°29'S, 47°47'30"E], 9 Dec 1964, fr., *Service Forestier (Capuron) 23977* (MO, P, TEF); Toamasina: Ambila-Lemaitso, 10 km E of Brickaville, 1–2 km S of intersection to Hotel Everglades and Ambila-Lemaitso, along road to Andevoranto, approximately 6 km S of Ambila-

Lemaitso, 0–10 m, 18°54'S, 49°08'E, 26–27 Jan 1991, ♂ fl. buds, *Schatz & Armbruster 3142* (MO, P, TAN); Ambila-Lemaitso, N of railroad bridge at Ambila-Lemaitso and W of freshwater canal on exposed dunes, 0–10 m, 18°50'S, 49°08'E, 26–27 Jan 1991, imm. fr., *Schatz & Armbruster 3151* (MO, P, TAN); same locality, 9 Feb 1951, ♂ fl. buds, *Service Forestier (Augustin) 2886* (P, TAN, TEF); Andranokoditra, Akanin Nofy, [18°36'S, 49°15'E], 25 Nov 1983, fr., *Service Forestier 32526* (TEF); Mahanoro, Masomeloka, Fokontony Ambalavontaka, forêt littorale sur sable de Antaimby à 2.5 km au Sud du village, Ambalavontaka, 10 m, 20°22'58"S, 48°33'14"E, 13 Feb 2004, ♂ fl. buds, *Ludovic et al. 586* (K, MO[2 sheets], P, TEF[2 sheets]); Soanierana Ivongo, [16°54'30"S, 49°35'E], 27 Dec 1949, imm. fr., *Service Forestier 2448* (P); Vatoman-dry, Ambalabe, Ambinanindrano II, Nord Est de Toby Foara, 627 m, 19°09'35"S, 48°35'14"E, 19 Jan 2006, imm. fr., *Razanatsima & Honoré 74* (G, K, MO, P, TAN); Vohibola, forest N to NNW of village of Andranokoditra, N of Lac Ampitabe, littoral forest on sand along old forestry roads, moderately disturbed forest, 5 m, 18°33'34"S, 49°15'17"E, 12 Feb 2003, ♂ fl., *Lowry et al. 6060* (G, K, MO[2 sheets], P, TEF); same locality, no date, ♂ fl. buds, *Razakamalala 181* (TEF); same locality?, no date, imm. fr., *Razakamalala 196* (TEF). Toliara: Fort-Dauphin, [25°02'S, 46°59'E], ♂ fl., *Scott-Elliot 2846* (P); Iabokofo, forêt littorale sur sable, à Atsotso, 0–10 m, 24°36'46"S, 47°14'16"E, 18 Dec 2000, ♂ fl. buds, *Rabenantoandro et al. 387* (G, MO, P, TEF); Mandena, forêt littorale sur sable, 0–10 m, [24°57'S, 47°00'E], 17 Mar 1985, imm. fr., *Dorr et al. 4027* (MO, P, TAN); same locality, 17 Apr 1989, ♀ fl. buds, *Dumetz et al. 680* (MO, P, TAN); same locality, 25 Oct 1989, ♂ fl. buds, *Dumetz et al. 781* (MO, P, TAN, TEF); same locality, 31 Oct 1989, ♂ fl. buds, *Dumetz et al. 832* (MO); same locality, 6 Dec 1989, ♂ fl., *N. Dumetz & G. McPherson 1135* (MO, P, TAN, TEF); same locality, 15 m, 8 Oct 1990, ♀ fl. buds, *Faber-Langendoen & Randrianasolo 2153* (MO[2 sheets], TEF); same locality, 1 Apr 1947, imm. fr., *Humbert 20748* (MO, P); same locality, 25–26 Oct 1989, ♂ fl., *Rabevohitra 2069* (MO[2 sheets], P, TAN, TEF); same locality, 13 Jan 1990, imm. fr., *Rabevohitra 2138* (MO, P, TAN, TEF); same locality, Nov 1975, ♂ fl. buds, *Rakotozafy 1755bis* (MO, TAN); same locality, Jan 2006, fr., *Ranaivojaona & Rogers 1381* (MO, P, TAN); same locality, 20 Nov 1996, fr., *Randrianasolo 576* (G, K, MO, P); same locality, 4 Oct 1952, imm. fr., *Service Forestier 6089* (P, TEF); same locality, 9 Dec 1968, imm. fr., *Service Forestier (Capuron) 28635* (MO, P, TEF); same locality, 14 Dec 1969, ♂ fl., ♀ fl., *Service Forestier (Capuron) 29015* (P[2 sheets]); same locality, 17–20 Mar 1997, imm. fr., *Service Forestier 34926* [=Rabevohitra 3194] (TEF); same locality, 1–2 Dec 1997, fr., *Service Forestier 34972bis* [=Rabevohitra 3240] (TEF); same locality, 12 June 1991, imm. fr., *Zarucchi et al. 7600* (MO, P, TAN); Mandromodromotra, forêt littorale sur sable, 24°57'44"S, 47°03'56"E, 3 Oct 2000, imm. fr., *Rabevohitra et al. 3734* [=Service Forestier 35320] (TEF); Petriky forest, 0–10 m, 25°05'S, 46°52'E, 8 Dec 1989, ♀ fl., fr., *Dumetz & McPherson 1156* (MO, P, TAN, TEF); same locality, due N of NE corner of Lake Andranany and NW of large dune at end of road, in low forest on gray sand (ca. 11 km WSW of Fort-Dauphin), 0–10 m, 25°03'S, 46°53'E, 12 Apr 1989, imm. fr., *Gereau et al. 3357* (MO, TAN); same locality, 20 m, 25°03'08"S, 46°53'24"E, 17 Feb 2001, ♂ fl. buds, *OKTAN (Rakotonasolo et al.) 151* (K, TAN, TEF); same locality, 20–30 m, 20 Nov 1990, imm. fr., *Rabevohitra 2452* (MO[2 sheets], P, TAN); same locality, 14 Dec 1997, fr., *Service Forestier 35020* (TEF); Sainte Luce, forêt littorale au S de Sainte Luce, 0–10 m, 24°46'S, 47°09'E, 17–18 Jan 1990, imm. fr., *Rabevohitra 2177* (MO, P, TAN); same locality, 21 Oct 1989, ♂ fl. buds, *Dumetz et al. 765* (MO, P, TAN); Vinanibe, forêt sublittorale, sur sableux, à l'Ouest de Fort-Dauphin, 25°03'S, 46°56'E, 7 Dec 1968, imm. fr., *Service Forestier (Capuron) 28617* (MO, P, TEF).

ACKNOWLEDGMENTS. The authors thank Jean-Noël Labat and Sabine Comtet for providing loan material from the P herbarium, L. Roger Andriamiarisoa for illustrating both species, Gordon McPherson for translating the diagnoses into Latin, Justin Moat for supplying the ArcView script used in the conservation analyses, Fred Keusenkothen and Lucy Fisher for scanning and digitally editing the illustrations, and Peter Stevens and two anonymous reviewers for their helpful comments regarding the manuscript.

LITERATURE CITED

- ADAMS, C. D. 1970. Miscellaneous additions and revisions to the flowering plants of Jamaica. *Phytologia* 20: 309–314.
- CONSIGLIO, T., G. E. SCHATZ, G. MCPHERSON, P. P. LOWRY II, J. RABENANTOANDRO, Z. S. ROGERS, R. RABEVOHITRA, and D. RABEHIVITRA. 2006. Deforestation and plant diversity of Madagascar's Littoral Forests. *Conservation Biology* 20: 1799–1803.
- DE QUEIROZ, K. 1998. The general lineage concept of species, species criteria, and the process of speciation. Pp. 57–75 in *Endless forms: species and speciation*, eds. D. J. Howard and S. H. Berlocher. Oxford and New York: Oxford University Press.
- HOLMGREN, P. K., N. H. HOLMGREN, and L. C. BARNETT, eds. 1990. *Index herbariorum*. Ed. 8. New York: New York Botanical Garden.
- IUCN. 2001. *IUCN Red List categories and criteria: version 3.1*. Gland, Switzerland, and Cambridge: IUCN Species Survival Commission.
- JONES, S. 1980. *Morphology and major taxonomy of Garcinia (Guttiferae)*. Ph.D. dissertation. London: University of Leicester and British Museum.
- KEARNS, D. E., P. E. BERRY, P. F. STEVENS, N. L. CUELLO, J. J. PIPOLY III, N. K. B. ROBSON, B. K. HOLST, K. KUBITZKI, and A. L. WEITZMAN. 1998. Clusiaceae. Pp. 248–329 in *Flora of the Venezuelan Guayana* vol. 4, eds. P. E. Berry, B. K. Holst, and K. Yatskievych. St. Louis: Missouri Botanical Garden Press.
- MAYDEN, R. L. 1997. A hierarchy of species concepts: the denouement in the saga of the species problem. Pp. 381–424 in *Species: the units of biodiversity*, eds. M. F. Claridge, H. A. Dawah, and M. R. Wilson. London: Chapman and Hall.
- PERRIER DE LA BÂTHIE, H. 1948. Révision des Guttifères de Madagascar et des Comores. *Mémoires Muséum Naturelle Histoire Naturelle* 24: 75–110.
- . 1951. Guttifères. Pp. 1–186 in *Flore de Madagascar et des Comores (plantes vasculaires)*, ed. H. Humbert. Paris: Firmin-Didot.
- ROBSON, N. K. B. 1958. New and little known species from the Flora Zambesiaca area, VI. *Boletim da Sociedade Broteriana*, sér. 2, 32: 151–173.
- SCHATZ, G. E. 2000. Endemism in the Malagasy tree flora. Pp. 1–9 in *Diversity and Endemism in Madagascar*, eds. W. R. Lourenço and S. M. Goodman. Paris: Société de biogéographie.
- . 2001. *Generic tree flora of Madagascar*. Kew: Cromwell Press.
- and M. LESCOT. 2007. *Gazetteer to Malagasy botanical collecting localities*. Missouri Botanical Garden website (<http://www.mobot.org/MOBOT/Research/madagascar/gazetteer/>) [accessed 04/01/2007].
- STEARNS, W. T. 1992. *Botanical Latin*. Ed. 4. Portland: Timber Press.
- STEVENS, P. F. 2006. [2007]. Clusiaceae-Guttiferae. Pp. 48–66 in *The families and genera of vascular plants* vol. 9, ed. K. Kubitzki. Berlin: Springer Verlag.
- SWEENEY, P. W. and Z. S. ROGERS. In press. Notes on *Garcinia* (Clusiaceae) from Madagascar and the Comoros. *Novon*.
- WILLIS, F., J. MOAT, and A. PATON. 2003. Defining a role for herbarium data in Red List assessments: a case study of *Plectranthus* from Eastern and Southern Tropical Africa. *Biodiversity and Conservation* 12: 1537–1552.