
TAXONOMIC STUDIES OF
DIOSPYROS (EBENACEAE) FROM
THE MALAGASY REGION. VII.
REVISION OF *DIOSPYROS*
SECT. *FORBESIA* IN
MADAGASCAR AND THE
COMORO ISLANDS¹

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ABSTRACT

A recent molecular phylogenetic study revealed that *Diospyros* L. sect. *Forbesia* F. White, originally circumscribed to encompass two species from Africa and several from the Mascarene Islands (White, 1980), also includes a group of species endemic to Madagascar. The taxonomy of the Malagasy members of the section has not been examined since Perrier de la Bâthie's 1952 treatment in the *Flore de Madagascar et des Comores*, and in the intervening seven decades, numerous specimens have been collected that cannot be identified based on the key provided. This revision presents a significantly updated taxonomy of *Diospyros* sect. *Forbesia* in the Malagasy region in which 18 species are recognized, 14 of which are newly described and illustrated, including one new species restricted to Mayotte Island in the Comoro archipelago. An identification key is provided as well as IUCN risk of extinction assessments, which indicate that two species are Critically Endangered, four are Endangered, and seven are Vulnerable, while one is Near Threatened and four are Least Concern. A full description is provided for each species, along with color photos; each of the new species is also illustrated with a line drawing.

Key words: Ebony, IUCN Red List, lectotypifications, Madagascar, Mayotte, new species, revision.

The genus *Diospyros* L. (Ebenaceae) is a pantropical group of chiefly woody plants, with 747 currently recognized species (Schatz & Lowry, 2020; Schatz et al., 2020; Govaerts, 2021). One of its centers of diversity is located in the islands of the western Indian Ocean, and especially Madagascar, which harbors 101 described species and ca. 150 new species that remain to be described, bringing the estimated total on Madagascar to ca. 250 species (Madagascar Catalogue, 2021). All but three of these species are endemic to this island, viz. two that also occur in the adjacent Comoro Islands (*D. bernieriana* (Baill.) H. Perrier and *D. comorensis*

Hiern) and one that extends from coastal East Africa to Sri Lanka and perhaps farther east (*D. ferrea* (Willd.) Bakh.). The Mascarene Islands, located to the east of Madagascar, harbor an additional 14 species, all endemic to the archipelago (Richardson, 1980).

A recent phylogeographic study that sought to elucidate the biogeographic origins of Mascarene *Diospyros* (Linan et al., 2019) included comprehensive coverage of the species from these islands as well as broad sampling from throughout the genus, with an emphasis on Madagascar, including representatives from a number of informal, morphologically coherent groups that have

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recently been recognized there (see Schatz & Lowry, 2020; Schatz et al., 2020). The chloroplast phylogenies of Linan et al. (2019) provided strong support for a clade that comprised two well-supported subclades: (a) one containing all but one of the extant Mascarene species (the exception being *D. tessellaria* Poir.); and (b) another that included four members of the informal Mappingo group from Madagascar as well as the East African species *D. consolatae* Chiov.

The phylogenetic relationships among species from the Mascarenes and East Africa revealed by Linan et al. (2019) were consistent with the delimitation of *Diospyros* sect. *Forbesia* F. White, which had been described to include a morphologically coherent group comprising *D. consolatae* and *D. rotundifolia* Hiern from Africa, along with six unnamed Mascarene species (White, 1980). Frank White was not familiar with Malagasy *Diospyros*, which may explain why none of them were included in his initial delimitation of the section. In any case, the results of Linan et al. (2019) suggest that, in order for *Diospyros* sect. *Forbesia* to be monophyletic, it should be expanded to include all of the Mascarene species (except *D. tessellaria*) as well as all members of the Malagasy Mappingo group. The informally recognized Mappingo group includes four described species from Madagascar (*D. analamerensis* H. Perrier, *D. cupulifera* H. Perrier, *D. mappingo* H. Perrier, and *D. platycalyx* Hiern) along with several morphologically well-delimited new species that remain to be described, including one from the Comoro Islands.

As part of an ongoing effort to clarify the delimitation of species recognized by Perrier de la Bâthie (1952) in his treatment of Ebenaceae for the *Flore de Madagascar et de Comores* (Schatz & Lowry, 2011; Schatz et al., 2013; Madagascar Catalogue, 2021) and to describe the many new species that have been recognized over the last decade (Schatz & Lowry, 2018, 2020; Schatz et al., 2020, 2021a, 2021b; Mas et al., in press), we provide here a revision of the members of *Diospyros* sect. *Forbesia* that occur in Madagascar and the Comoro Islands. Species belonging to the section are characterized by fruit with an apex that is usually depressed, a cupuliform calyx that nearly always has distinct lobes with decurrent margins (i.e., whose margins extend below the sinus onto the calyx cup; see Fig. 1E) and are elaborately pleated or folded in some species, leaves that are generally coriaceous and often have revolute margins, and male flowers whose calyx is truncate to shallowly lobed at anthesis. In Madagascar and the Comoros, *Diospyros* sect. *Forbesia* is represented by 18 species, including 14 new species that are described below. The group has undergone a remarkable radiation in northern Madagascar, where 11 of the 17 Malagasy species occur. A full description is provided for each species, including those previously published,

whose original descriptions were very brief. The conservation status of each species is assessed according to the IUCN Red List criteria (IUCN, 2012), and each of the new species is illustrated.

MATERIALS AND METHODS

Measurements of vegetative and reproductive structures were taken from 212 herbarium specimens, including material deposited at MO and borrowed from G and P (acronyms according to Thiers, 2021). Species hypotheses were formulated on the basis of unique combinations of morphological characters, primarily of the leaves and the fruiting calyx, as well as eco-geography. Measurements and descriptions were made on organ tissues unless otherwise stated. Measurements of fine-scale reproductive structures (style, ovary, anthers, etc.) were made using stereomicroscope images with ImageJ v.1.52a (Schneider et al., 2012). The terminology used for leaf shape and most vegetative and reproductive structures follows Beentje (2016), while that concerning leaf venation follows Ash et al. (1999).

Maps were generated using ArcGIS v.10.6 from shapefiles downloaded from <www.diva-gis.org> and elevation raster datasets from NASA laser topography mission at 30 arc-second resolution (Van Zyl, 2001). Geo-coordinates for specimens estimated post facto are given in square brackets, and bioclimatic zones used for mapping were derived from Cornet (1974; as simplified by Schatz, 2000). Risk of extinction assessments were performed according to the IUCN Red List Categories and Criteria (IUCN, 2012), for which the area parameters of extent of occurrence (EOO) and area of occupancy (AOO) were calculated using GeoCAT (GeoCAT, 2021). Because seven of the species treated in this revision can form large enough trees to be potential sources of commercially valuable ebony wood, which is under significant pressure in Madagascar from illegal, unsustainable exploitation (Mason et al., 2016), geo-coordinates and detailed locality data have been withheld for them, and public access to this information through the Madagascar Catalogue (2021) has been restricted.

TAXONOMIC TREATMENT

Diospyros sect. *Forbesia*, as treated here, is expanded significantly beyond White's original treatment of two species from East Africa and six from the Mascarene Islands (White, 1980), to include six additional species from the Mascarenes, 17 from Madagascar, and one from the Comoros. The revision presented here treats the Malagasy and Comorian members of the section, which include four previously described species and 14 new species. A taxonomic revision of Mascarene

Diospyros, including those identified by Linan et al. (2019) as belonging to *Diospyros* sect. *Forbesia*, was published by Richardson (1980), and White (1980) listed the African species belonging to the group.

KEY TO SPECIES OF *DIOSPYROS* SECT. *FORBESIA* IN MADAGASCAR AND THE COMORO ISLANDS

- 1a. Petiole ≥ 10 mm long 2
- 2a. Lamina of the largest leaf > 11 cm long; subhumid evergreen forest
D. manongarivensis A. G. Linan, G. E. Schatz & Lowry
- 2b. Lamina of the largest leaf < 9 cm long; dry, semi-deciduous forest 3
- 3a. Fruiting calyx with a reflexed flange, with an irregularly lacerate margin, lacking lobes
D. chitoniophora Capuron ex A. G. Linan, G. E. Schatz & Lowry
- 3b. Fruiting calyx with 5 acute lobes often extending just beyond the fruit apex, the margins flat along their entire length, lacking a flange *D. mapingo* H. Perrier
- 1b. Petiole < 10 mm long 4
- 4a. Secondary veins of leaves emerging at a 25° – 30° angle to midvein, the inter-secondaries as prominent as the secondaries 5
- 5a. Young stems and leaves often densely pubescent; base of fruiting calyx lobes not overlapping with those of the adjacent lobes; fruit often with 4 rounded protuberances situated opposite the sinuses of the calyx lobes *D. pubiramulis* A. G. Linan, G. E. Schatz & Lowry
- 5b. Young stems and leaves almost always glabrous; base of fruiting calyx lobes overlapping with those of the adjacent lobes; fruit lacking protuberances *D. analamerensis* H. Perrier
- 4b. Secondary veins of leaves emerging at $> 30^{\circ}$ angle to midvein, inter-secondaries absent or less prominent than the secondaries 6
- 6a. Fruiting calyx proximally flanged, resembling an epicalyx, with lacerate margins *D. cupulifera* H. Perrier
- 6b. Fruiting calyx without a flange 7
- 7a. Lamina of leaf distinctly shiny in dried material, apex typically emarginate (rarely rounded)
D. nitidifolia A. G. Linan, G. E. Schatz & Lowry
- 7b. Lamina \pm matte in dried material, apex typically rounded (rarely emarginate) 8
- 8a. Leaves distinctly coriaceous 9
- 9a. Lamina width 4–8.2 cm; fruit $\geq 2 \times 3$ cm *D. crassifolia* A. G. Linan, G. E. Schatz & Lowry
- 9b. Lamina width 1.3–4.5 cm; fruit $\leq 1.6 \times 2.5$ cm 10
- 10a. Petiole ≥ 4 mm long; secondary veins 7 or more per side; margins of calyx lobes in fruit irregularly plicate-undulate along their entire length; eastern littoral forests
D. orientalis A. G. Linan, G. E. Schatz & Lowry
- 10b. Petiole ≤ 3.5 mm long; secondary veins 6 or fewer per side; margins of calyx lobes in fruit \pm flat; inland dry deciduous forests 11
- 11a. Young leaves glabrous, petiole > 2 mm diam., margins of fruiting calyx lobes extending slightly below sinuses *D. olivieri* A. G. Linan, G. E. Schatz & Lowry
- 11b. Young leaves pubescent on lower surface, petiole ≤ 1.5 mm diam., margins of fruiting calyx lobes extending well below sinuses to the base of the calyx cup, forming evident wings 12
- 12a. Leaf margins often very revolute both in vivo and in sicco, lamina < 2 cm wide; calyx lobes in flower unfolded-plane, covered with short, fine, blonde trichomes; fruit oblate-globose
D. obscurinerva A. G. Linan, G. E. Schatz & Lowry
- 12b. Leaf margins slightly revolute, lamina ≥ 2 cm wide; calyx lobes in flower folded in half longitudinally, covered with long, coarse, black trichomes; fruit ovoid *D. montisgallicarum* A. G. Linan, G. E. Schatz & Lowry
- 8b. Leaves chartaceous to sometimes subcoriaceous 13
- 13a. Petiole ≤ 2 mm long; midvein raised on upper surface; Comoro Islands
D. pascalii A. G. Linan, G. E. Schatz & Lowry
- 13b. Petiole ≥ 3 mm long; midvein flat to slightly impressed on upper surface; Madagascar 14
- 14a. Lamina obovate; calyx of mature fruit always glabrous 15
- 15a. Secondary veins > 8 per side; fruit 4-locular, ovoid, ≤ 1.6 cm diam., margins of the calyx lobes entire *D. courierensis* A. G. Linan, G. E. Schatz & Lowry
- 15b. Secondary veins < 7 per side; fruit 8-locular, \pm globose, ≥ 2 cm diam., margins of the calyx lobes lacerate toward the base *D. platycalyx* Hiern
- 14b. Lamina elliptic, oblong, or ovate; calyx of mature fruit usually pubescent, rarely glabrous 16
- 16a. Apex of leaf lamina rounded to obtuse; secondary veins ≥ 12 per side
D. arenicola A. G. Linan, G. E. Schatz & Lowry
- 16b. Apex of leaf lamina acute or acuminate; secondary veins ≤ 12 per side 17
- 17a. Fruit ovoid to pyriform; calyx lobes strongly and irregularly plicate-undulate along their whole margin, their apex acute
D. plicatocalyx A. G. Linan, G. E. Schatz & Lowry
- 17b. Fruit oblate-globose; calyx lobes flat, their apex rounded to obtuse
D. beankensis A. G. Linan, G. E. Schatz & Lowry

1. *Diospyros analamerensis* H. Perrier, Mém. Inst. Sci. Madagascar, Sér. B, Biol. Vég. 4(1): 124, f. IX: 1–2. 1952. TYPE: Madagascar. DIANA Region [Antsiranana Prov.], collines et plateaux calcaires de l'Analamera, Jan. 1938 (fr.), *H. Humbert 19121* (lectotype, designated here, P[barcode] P00541735!; isolectotypes, P [bc] P00541736!, P00541734!). Figure 1.

Tree to 20 m tall and 40 cm DBH. Young stems glabrous or rarely with semi-appressed, short, fine, blonde trichomes, glabrescent, mature stems beige. Leaves 4–10.6 × 1.2–4.4 cm, elliptic to narrowly elliptic or narrowly oblong, coriaceous, the lower surface initially often with semi-appressed, short, fine, blonde trichomes, glabrescent, base acute to ± rounded, margins flat to slightly undulate, weakly revolute, apex acute to rounded, very rarely acuminate, midvein slightly impressed above, raised below, venation reticulate, evident above and below, 11 or 12 secondaries per side, inserted at a 25°–30° angle to the midvein, inter-secondaries as prominent as the secondaries; petiole 4–8 mm, 1–2 mm diam., nearly terete, slightly flattened above, glabrous or with semi-appressed, short, fine, blonde trichomes, glabrescent. Male flowers solitary, axillary, sessile, borne either among the terminal tuft of leaves or just below them; calyx cup 5–6 × 5–6 mm, abruptly tapering at the base, covered densely throughout with long, appressed, blonde and black trichomes, lobes 4 or 5, shallow, 3–4 × 3 mm; corolla tube urceolate, 5 × 5–6 mm, glabrous, lobes 4 or 5, 5–6 × 4–5 mm, ± oblong, with long, appressed, blonde and black trichomes; stamens 65 to 110, inserted at the base of corolla tube, filaments 3 × 0.1 mm, flattened, anthers 2 × 0.2 mm; pistillode present, highly reduced, with sparse to dense indument of short, blonde trichomes. Female flowers not seen. Fruit solitary, axillary, sessile, borne either in leaf axils or at nodes of fallen leaves, 8- to 10-locular, 1.4–1.6 × 1.8–1.9 cm at maturity, obovate-globose, with moderately dense indument of short, semi-erect, fine, blonde trichomes, glabrescent, green in vivo when young, color at maturity unknown, brown in sicco, apex flat to slightly depressed; calyx with semi-appressed, short, fine, blonde trichomes throughout, glabrescent, calyx cup ca. 1 × 2 cm, calyx lobes (4 or)5, 1.2 × 1.5 cm, spreading at maturity, ± orbicular, adjacent bases overlapping, margins flat, entire, apex rounded-obtuse. Seeds 9.5–10 × 5.5–6 mm, spherical wedge-shaped.

Distribution, ecology, and phenology. *Diospyros analamerensis* occurs mostly in and surrounding the Ankarana and Analamera reserves, in dry forests at elevations of 50–150 m, likely on calcareous substrate. Flowers have been recorded from September through November, and fruits in November and December.

Vernacular name. Mapingo (*Andriamihajarivo et al. 1403*).

Conservation status. *Diospyros analamerensis* has a geographic range in the form of an EOO of 2764 km² and a minimum AOO of 368 km². It is present in the Analamera and Ankarana protected areas. Elsewhere it is threatened by fire, forest clearing for agriculture, grazing, and exploitation for firewood and house construction material, all of which will result in continuing decline. With respect to the most serious plausible threat of forest clearing for agriculture, *D. analamerensis* is known to occur at eight locations. It was recently assessed for its risk of extinction as Endangered under criteria B1 and B2 (Lowry & Schatz, 2021a), but recent collections from several new locations result in an assessment of Vulnerable [VU B1ab (i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v)].

Notes. Among the three duplicates of *Humbert 19121* at P, we have selected one of them ([bc] P00541735) as the lectotype because it possesses the most fruiting material.

By virtue of reaching 20 m in height and 40 cm DBH, *Diospyros analamerensis* is considered to be a large enough tree to be potentially exploited for its hardwood, and thus precise coordinates have been withheld.

Additional specimens examined. Madagascar. **DIANA Region [Antsiranana Prov.]**: Masorolava, Mahagaga, 23 Sep. 2007 (fl.), *Andriamihajarivo et al. 1403* (MO, P, TAN); massif de l'Ankarana, 2 Nov. 1990 (fl.), *Bardot-Vaucoulon 194* (P); same locality, 3 Nov. 1990 (fr.), *Bardot-Vaucoulon 220* (P); same locality, 11 May 2007 (fl.), *Bardot-Vaucoulon 1785* (MO, P); same locality, 17 Jan. 2014 (st.), *Randrianaivo et al. 2404* (BR, G, MO, P); same locality, 17 Jan. 2014 (st.), *Randrianaivo et al. 2408* (BR, G, MO, P); same locality, 19 Jan. 2014 (st.), *Randrianaivo et al. 2425* (BR, G, MO, P); same locality, 8 Dec. 2018 (fr.), *Randrianaivo 3262* (DBEV, G, MO, P, TAN); same locality, 124 m, 8 Dec. 2018 (fr.), *Randrianaivo 3266* (DBEV, G, MO, P, TAN); same locality, 133 m, 8 Dec. 2018 (fr.), *Randrianaivo 3267* (DBEV, G, MO, P, TAN); same locality, 103 m, 11 Dec. 2018 (fr.), *Randrianaivo 3288* (DBEV, G, MO, P, TAN); same locality, 107 m, 11 Dec. 2018 (fr.), *Randrianaivo 3289* (DBEV, G, MO, P, TAN); same locality, 103 m, 11 Dec. 2018 (st.), *Randrianaivo 3287* (DBEV, MO, P); Mosorolava, Ampombiantambo, 23 Sep. 2007 (♂ fl.), *Ratovoson 1328* (CNARP, MO, P, TAN).

2. *Diospyros arenicola* A. G. Linan, G. E. Schatz & Lowry, sp. nov. TYPE: Madagascar. DIANA Region [Antsiranana Prov.]: Antsiranana II, Ramena, Orangea, Mamelon vert, 12°15'45"S, 49°22'56"E, 100 m, 18 Dec. 2008, *C. Christian, A. Razanakolona & J. M. Elyse 40* (fr.) (holotype, MO-6577618!; isotypes, CNARP not seen, P [bc] P01066401!, TAN!). Figures 1, 2.

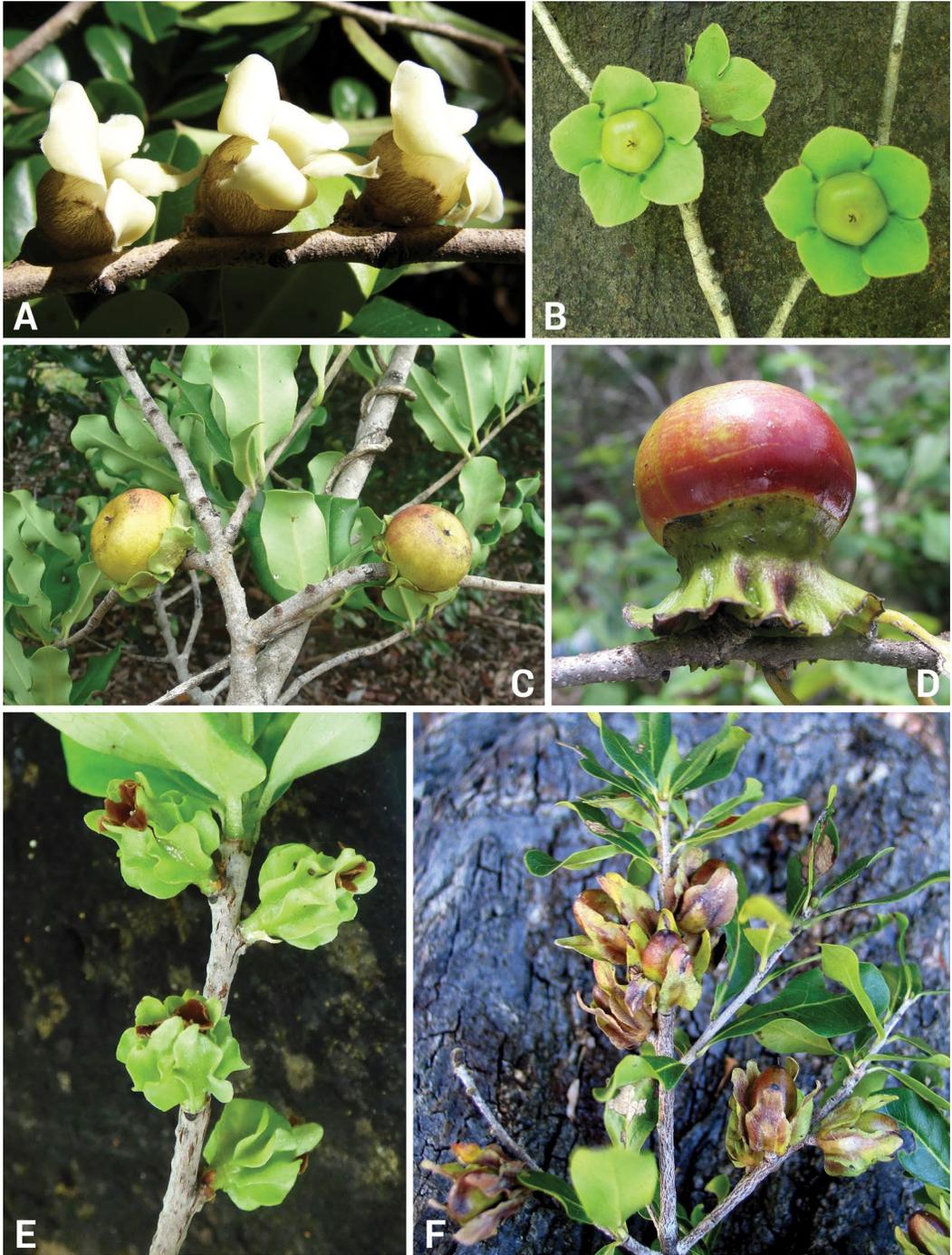


Figure 1. Photos of *Diospyros* species. A, B. *Diospyros analamerensis* H. Perrier. —A. Male flowers (Ratovoson 1328). —B. Immature fruits (Randrianaivo 3262). —C. *Diospyros arenicola* A. G. Linan, G. E. Schatz & Lowry, branch with mature fruits (Randrianaivo 2434). —D. *Diospyros chitoniophora* A. G. Linan, G. E. Schatz & Lowry, mature fruit (Randrianaivo 1350). E, F. *Diospyros courierensis* A. G. Linan, G. E. Schatz & Lowry. —E. Female flowers (Randrianaivo 3302). —F. Branch with mature fruits (Ramananjahary & Ratovoso 298). Photos: A, F, F. Ratovoson; B–E, R. Randrianaivo.

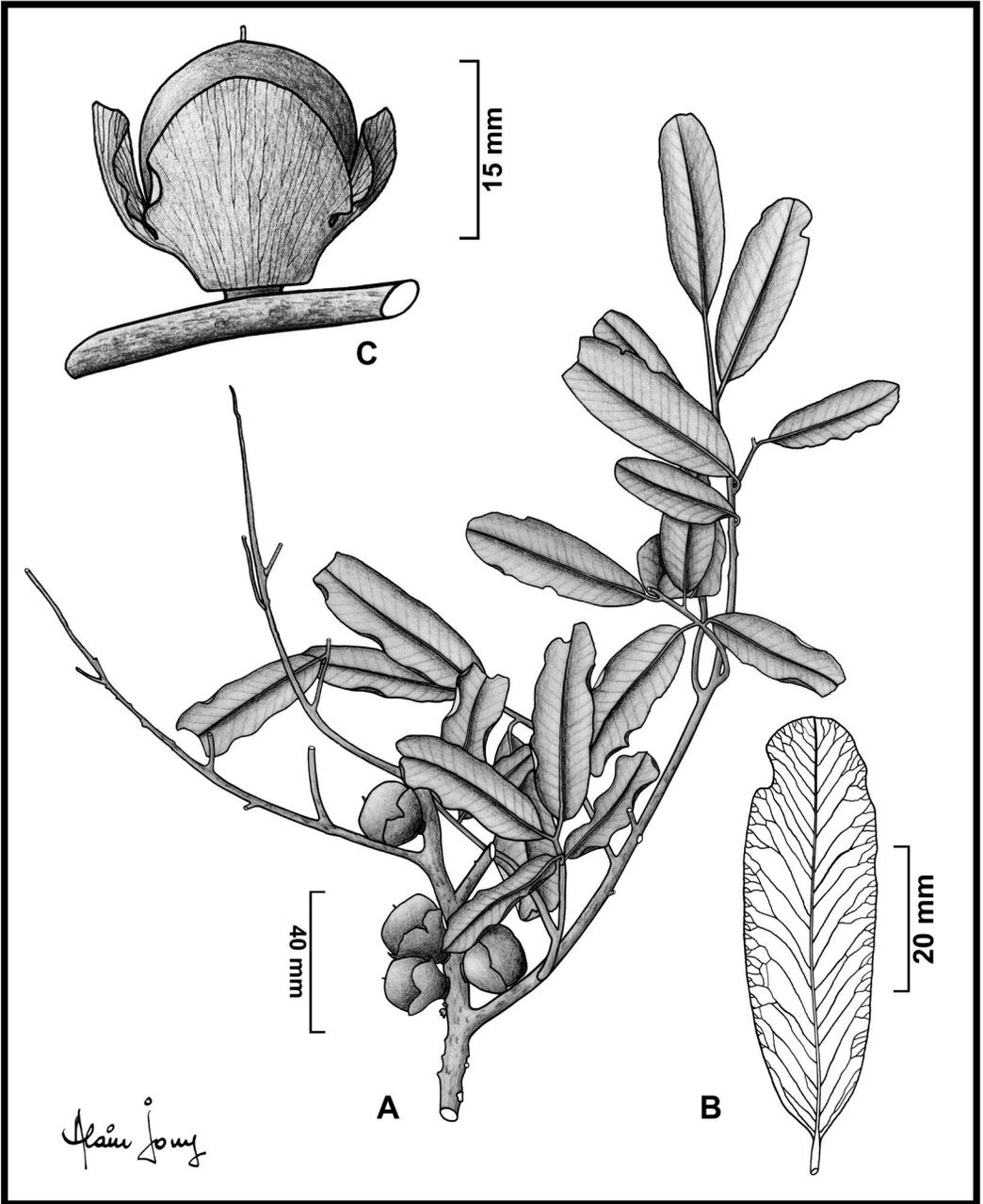


Figure 2. *Diospyros arenicola* A. G. Linan, G. E. Schatz & Lowry. —A. Branch with fruits. —B. Detail of leaf venation (adaxial surface). —C. Fruit. (A–C, *Service Forestier* 28749.) Drawing by A. Jouy.

Diagnosis. *Diospyros arenicola* A. G. Linan, G. E. Schatz & Lowry can be distinguished from the species it most closely resembles vegetatively, *D. analamerensis* H. Perrier, by its leaves with weakly brochidodromous venation (vs. reticulate in *D. analamerensis*) and often strongly undulate margins (vs. flat to weakly undulate), and the truncate to rounded lobes of its calyx in fruit (vs. obtuse-rounded) bearing per-

sistent, coarse, black trichomes (vs. fine, blonde trichomes and glabrescent).

Shrub to small tree to 10 m tall and 15 cm DBH. Young stems nearly always glabrous, very rarely with moderately dense indument of short, appressed, fine,

blonde trichomes, glabrescent, mature stems beige. Leaves 6–10 × 1.25–2 cm, narrowly elliptic to narrowly oblong, coriaceous, generally glabrous on both surfaces, rarely with moderately dense indument of short, appressed, fine, blonde trichomes, base obtuse to rounded, occasionally acute, margins generally undulate, occasionally flat or revolute, apex rounded, rarely obtuse or emarginate, midvein slightly impressed above, raised below, glabrous, venation weakly brochidodromous, evident above, often obscure below, 12 to 18 secondaries per side, inserted at a 40°–45° angle to midvein, inter-secondaries obscure or absent; petiole 5–6 mm, ca. 1 mm diam., terete, slightly flattened above, glabrous. Male and female flowers not seen. Fruit solitary, axillary, sessile, borne at nodes of fallen leaves, 8-locular, 1.5–1.7 × 1.6–1.8 cm, oblate-globose, glabrous, green in vivo when young, maturing to variegated yellow tinged with red, brown in sicco, apex depressed; calyx cup shallow, 4–5 × 15–16 mm, with moderately dense indument of appressed, coarse, black trichomes mixed with finer blonde trichomes, transitioning to nearly glabrous toward the base of the lobes, calyx lobes 5(or 6), not spreading, appressed to fruit surface, ca. 6 × 10 mm, broadly trullate, ± glabrous, margins entire, deflected away from the fruit at the base, extending slightly below the sinuses onto the calyx cup, margins appressed toward the truncate to rounded apex. Seeds 9–11 × 4–5 mm, spherical wedge-shaped.

Distribution, ecology, and phenology. *Diospyros arenicola* is restricted to the east coast of the very northern tip of Madagascar, from Oronjia south to the lower Irodo River valley (Fig. 3), where it occurs in dry deciduous forests on sand or limestone at elevations of 10–116 m. It has not been recorded in flower, but fruits have been collected from December to February.

Vernacular names. Mappingo (*Guittou* 352), Jaob-ampototy (*Ratovoson* 784).

Conservation status. *Diospyros arenicola* has a geographic range in the form of an EOO of 784 km² and a minimum AOO of 40 km². It is present in the Montagne de Français and Oronjia protected areas (Fig. 3). Outside of these protected areas (and possibly also within them), it is threatened by fire, forest clearing for agriculture, grazing, and exploitation for firewood and house construction material, all of which will result in continuing decline. With respect to the most serious plausible threat of forest clearing for agriculture, it is known to occur at 10 locations. Therefore, *D. arenicola* can be assessed for its risk of extinction as Vulnerable [VU B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v)].

Additional specimens examined. Madagascar. **DIANA Region** [Antsiranana Prov.]: Analabolona, 3 km à l'Ouest

d'Irodo, 12°37'21"S, 49°30'01"E, 102 m, 20 June 2004 (bud), *Be* 13 (CNARP, MO, P, TAN); Orangea, [12°14'S, 49°22'E], 22 Jan. 1960 (fr.), *Cours* 5406 (P); Andavakoera, forêt d'Andranonankomba, 12°21'02"S, 49°21'37"E, 116 m, 20 Feb. 2007 (fr.), *Guittou* 352 (CNARP, MO, P, TAN); Forêt d'Oronjia, 12°15'07"S, 49°22'51"E, 16 m, 21 Jan. 2014 (st.), *Randrianaivo et al.* 2434 (BR, G, MO, P); Montagne des Français, forêt de Fozamalandy, 12°20'25"S, 49°21'40"E, 75 m, 23 Jan. 2014 (fr.), *Randrianaivo et al.* 2444 (BR, G, MO, P); same locality, 74 m, 24 Jan. 2014 (st.), *Randrianaivo et al.* 2445 (BR, G, MO, P); Ambodimadiro, forêt de Beantely, 3 km N d'Antsahampano, 12°16'33"S, 49°10'32"E, 55 m, 28 Jan. 2005 (fr.), *Ratovoson* 784 (CNARP, G, MO, P, TAN); Andrafiabe, presqu'île entre Ambolobozobe et Ambolobozokely, 12°29'39"S, 49°34'04"E, 10 m, 9 Feb. 2005 (fr.), *Ratovoson* 957 (CNARP, G, MO, P, TAN); Oronjia, 12°16'41"S, 49°23'30"E, 9 m, 14 Jan. 2011 (fr.), *Schatz* 4340 (MO); same locality, [12°15'S, 49°23'E], 25 Feb. 1964 (fr.), *Service Forestier* 23264 (MO, P, TEF); same locality, sables, [12°15'S, 49°22'E], 118 m, 16 Dec. 1963 (fl.), *Service Forestier* 22977 (MO, P); Forêt de Sahafary, [12°34'S, 49°26'E], 100–300 m, 7 Feb. 1966 (fr.), *Service Forestier (Capuron)* 24531 (P, TEF); Forêt d'Orangea, [12°15'S, 49°23'E], 1 Feb. 1969 (fr.), *Service Forestier (Capuron)* 28749 (MO, P, TEF).

3. *Diospyros beankensis* A. G. Linan, G. E. Schatz & Lowry, sp. nov. TYPE: Madagascar. Melaky Region [Mahajanga Prov.]: Beanka, S de la Kimanambolo, 18°07'19"S, 44°33'33"E, 320 m, 1 Dec. 2012, (fr.), *L. Gautier, P. Ranirison, R. M. Hanitrarivo & I. Luino* 5896 (holotype, G [bc] G00377870!; isotypes, MO-6612771!; P [bc] P01060276!). Figure 4.

Diagnosis. *Diospyros beankensis* A. G. Linan, G. E. Schatz & Lowry can be distinguished from the species it most closely resembles vegetatively, *D. plicatocalyx* A. G. Linan, G. E. Schatz & Lowry, by its oblate-globose fruit (vs. ovoid to rarely pyriform in *D. plicatocalyx*) and its calyx lobes with flat margins (vs. irregularly plicate-undulate) perpendicular to the fruit surface, extending below the sinuses to the base of the calyx cup, forming lacerate wings (vs. irregularly plicate-undulate and entire).

Tree to 16 m tall and 12 cm DBH. Young stems with moderately dense indument of short, erect to semi-appressed, blonde trichomes, glabrescent, mature stems beige. Leaves 4–5 × 1.1–1.3 cm, narrowly elliptic to narrowly ovate, coriaceous, glabrous on both surfaces, base cuneate to rounded, margins slightly revolute, apex acuminate, midvein slightly impressed above, raised below, glabrous, venation weakly brochidodromous, somewhat obscure above, more evident below, 10 to 12 secondaries per side, inserted at a 40°–45° angle to the midvein, inter-secondaries weakly evident; petiole ca. 3 mm, ca. 0.6–0.7 mm diam., terete, slightly flattened above, initially with moderately dense indument of short, erect to semi-appressed, blonde trichomes, glabrescent. Male and female flowers not seen. Fruit (known only from immature material) solitary, axillary, sessile, borne at nodes of fallen leaves, number of locules unknown, 6–8 × 1.1–1.3 cm, oblate-globose, gla-

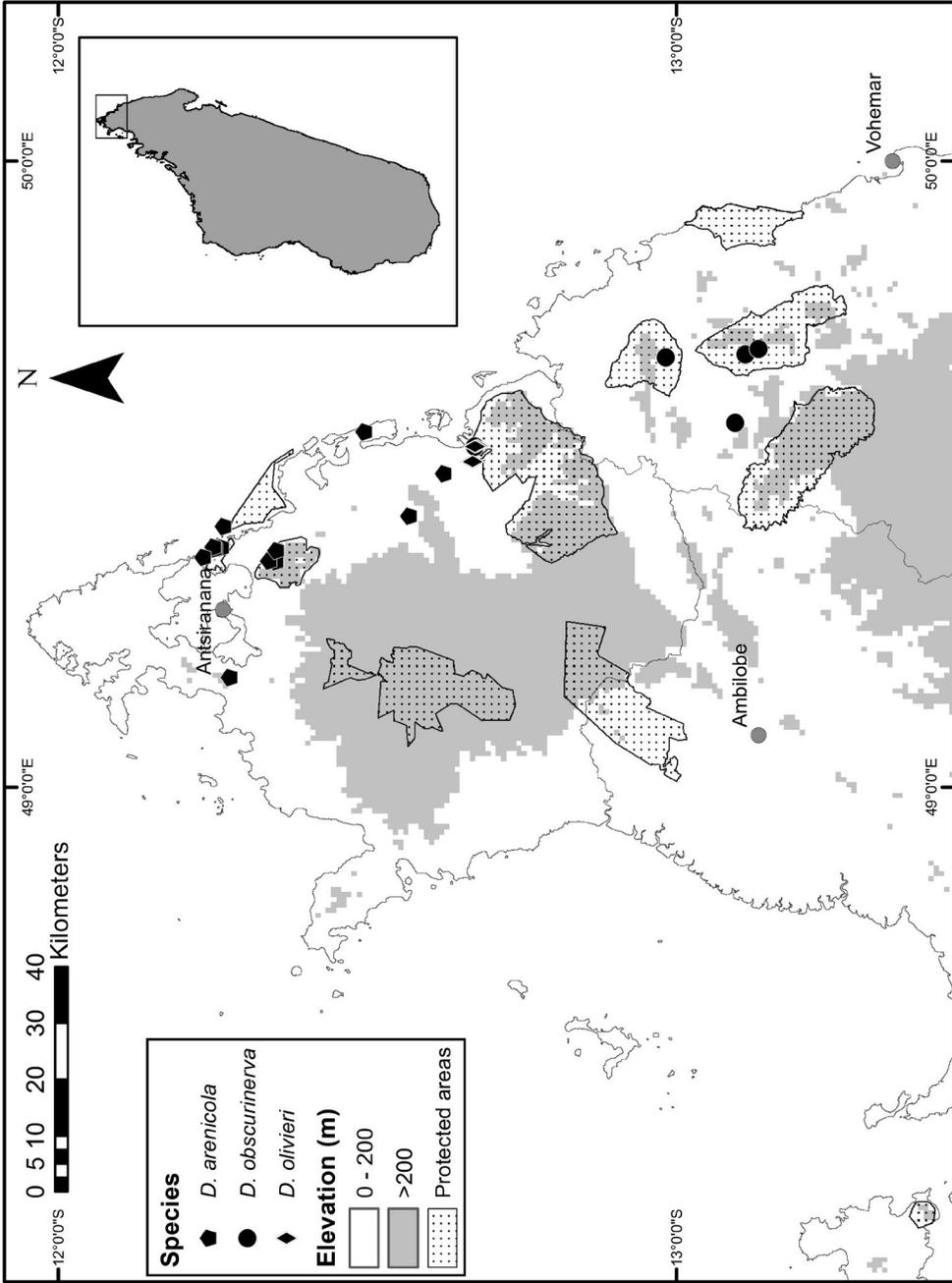


Figure 3. Distribution map of *Diospyros* L. species in northern Madagascar: *D. arenicola* A. G. Linan, G. E. Schatz & Lowry, *D. obscurinerva* A. G. Linan, G. E. Schatz & Lowry, and *D. olivieri* A. G. Linan, G. E. Schatz & Lowry.

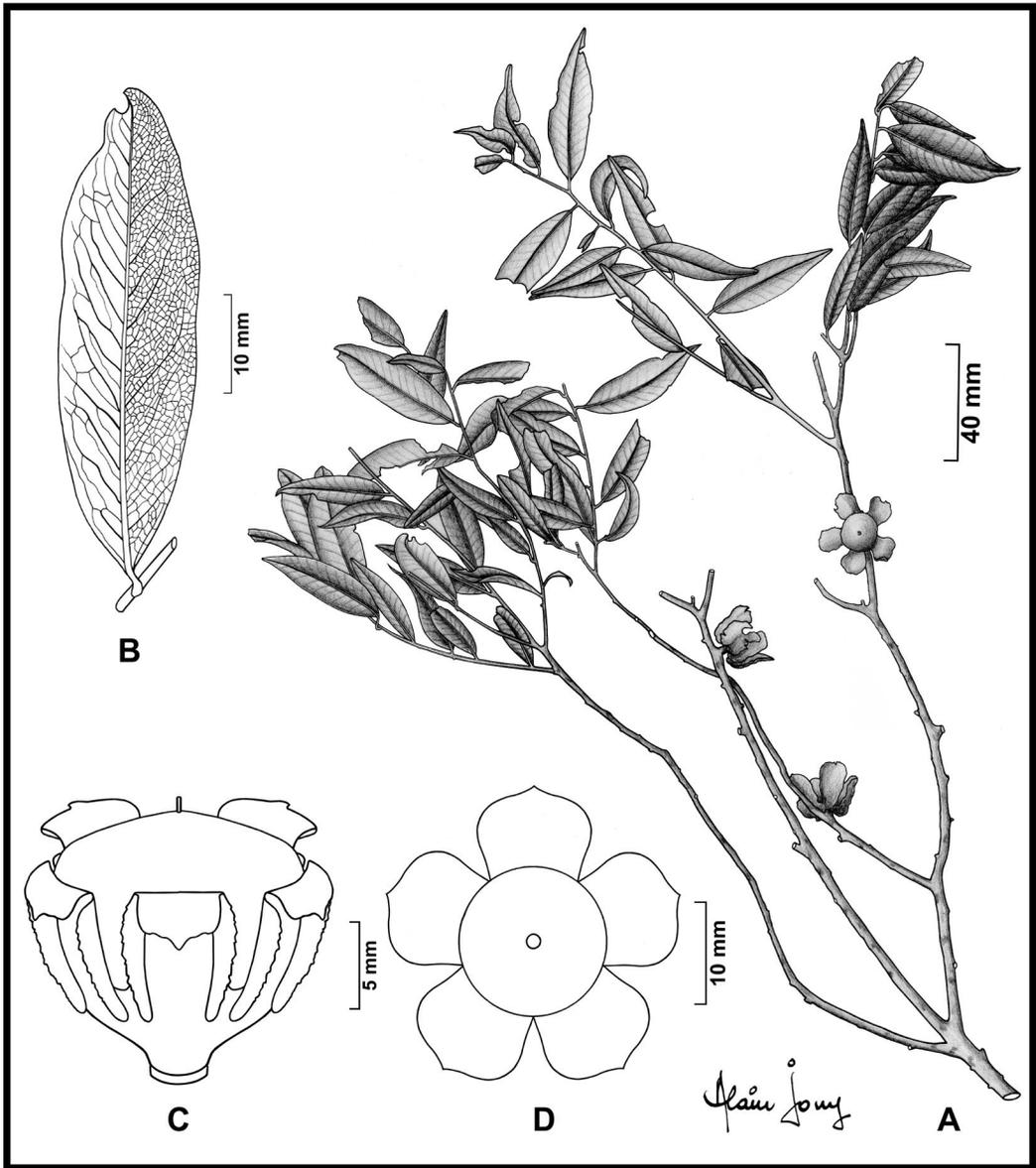


Figure 4. *Diospyros beankensis* A. G. Linan, G. E. Schatz & Lowry. —A. Branch with fruits. —B. Detail of leaf venation (adaxial surface). —C. Schematic drawing of fruit (side view). —D. Schematic drawing of fruit (top view). (A–D, Gautier *et al.* 5896.) Drawing by A. Jouy.

brous, green in vivo when young, brown in sicco, apex flattened to slightly depressed; calyx with sparsely to moderately dense indument of semi-appressed, short, coarse, black trichomes, concentrated toward the base of the lobes, calyx cup 7–8 × 14 mm, calyx lobes 5, spreading to slightly recurved, 7–8 × 10–14 mm, obovate, the margins perpendicular to the fruit surface at the base, extending below the sinuses to the base of the

calyx cup, forming evident irregularly lacerate wings, transitioning to flat and entire toward the apex.

Distribution, ecology, and phenology. *Diospyros beankensis* is known only from the type gathering made at Beanka protected area (Fig. 5), where it was collected in dry forest on coarse limestone at an elevation of ca. 320 m. It has been collected in fruit in December.

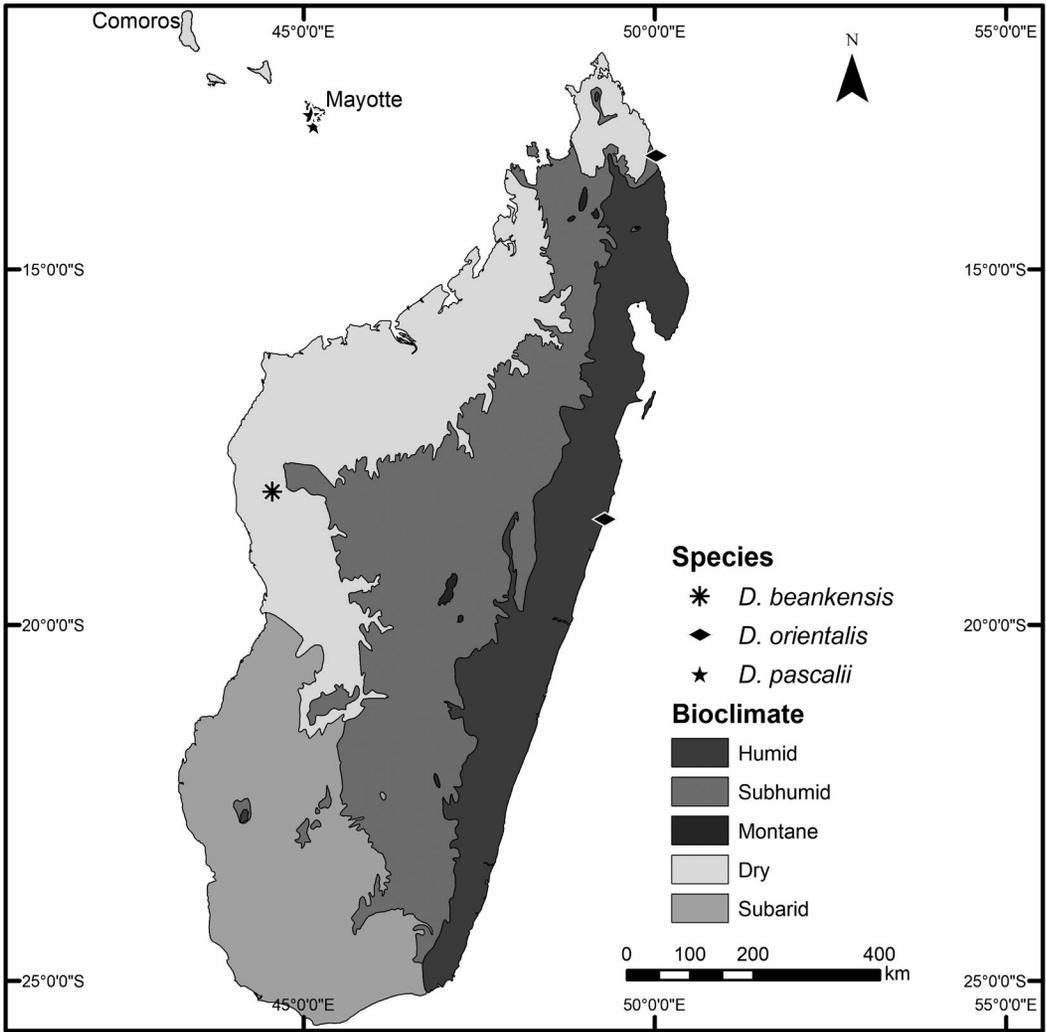


Figure 5. Distribution map of *Diospyros* L. species in Madagascar and the Comoro Islands, mapped on the bioclimatic zones of Madagascar (after Cornet, 1974; see Schatz, 2000): *D. beankensis* A. G. Linan, G. E. Schatz & Lowry, *D. orientalis* A. G. Linan, G. E. Schatz & Lowry, and *D. pascalii* A. G. Linan, G. E. Schatz & Lowry.

Conservation status. *Diospyros beankensis* has a geographic range in the form of an AOO of 4 km². It is known only from the Beanka protected area (Fig. 5). Lacking any known threats, *D. beankensis* can therefore be assessed for its risk of extinction as Least Concern [LC], a status that is, however, contingent upon the continuing effective management of the Beanka protected area.

4. *Diospyros chitoniophora* Capuron ex A. G. Linan, G. E. Schatz & Lowry, sp. nov. TYPE: Madagascar. DIANA Region [Antsiranana Prov.]: Parc National d'Ankarana, 118 m, 6 Dec. 2018 (fr.),

R. Randrianaivo, A. N. Sandratriniaina & G. Randrianandrasana 3242 (holotype, MO-6956001!; isotypes, DBEV not seen, G [bc] G00341887!, P [bc] P00722712!, TAN not seen). Figures 1D, 6.

Diagnosis. *Diospyros chitoniophora* Capuron ex A. G. Linan, G. E. Schatz & Lowry can be distinguished from the species it most closely resembles vegetatively, *D. mapingo* H. Perrier, by its oblong-elliptic leaves (vs. oblong-ovate in *D. mapingo*) with long petioles (10–15 mm vs. ca. 10 mm) and 10 to 12 secondary veins per side (vs. 11 to 13). In fruit, *D. chitoniophora* can be easily distinguished from all other species in *Diospyros* sect. *Forbesia* F. White by its distinctly flanged, skirtlike calyx with margins that are irregularly lacinate but lack calyx lobes.

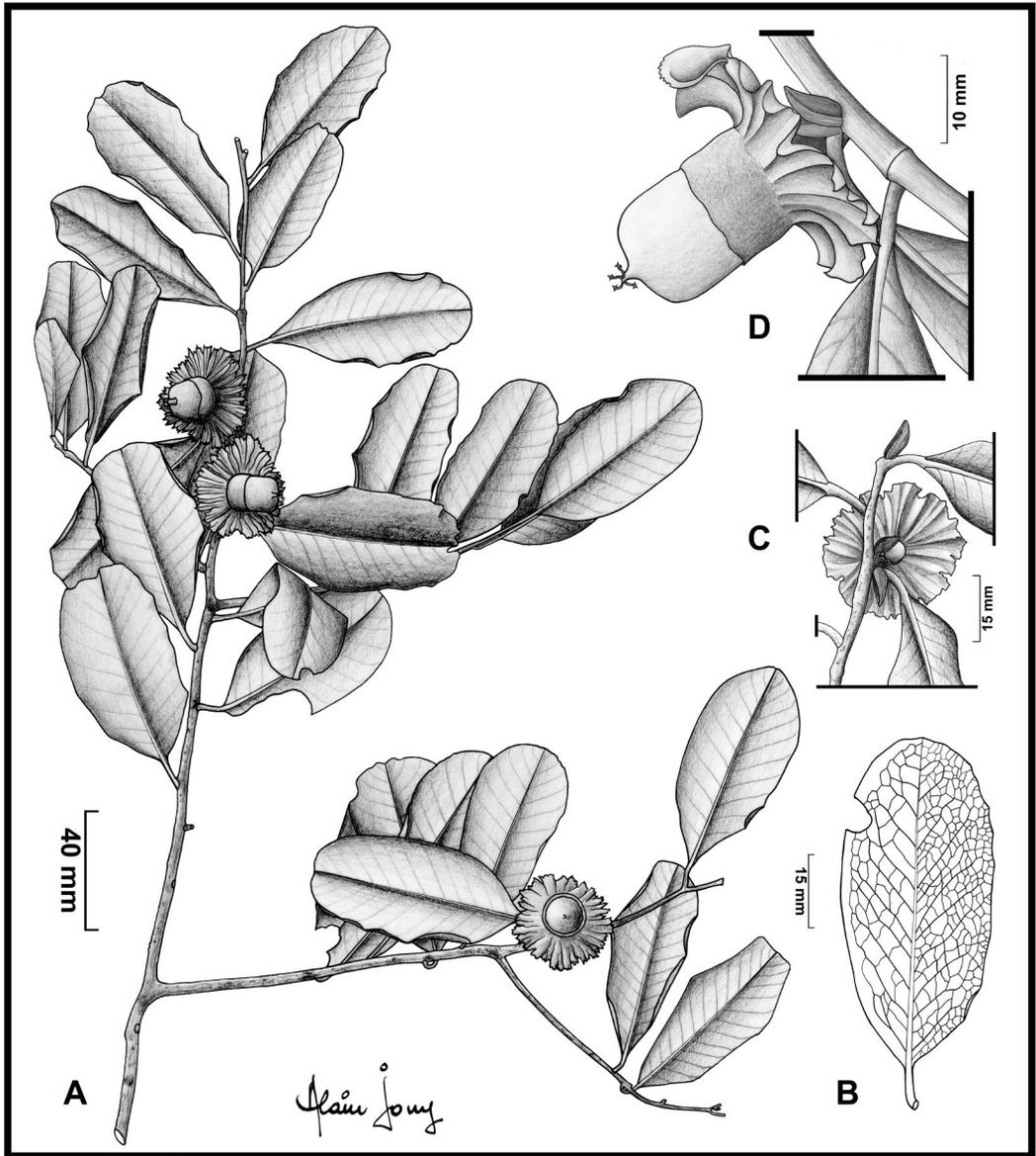


Figure 6. *Diospyros chitoniphora* A. G. Linan, G. E. Schatz & Lowry. —A. Branch with fruits. —B. Detail of leaf venation (adaxial surface). —C. Fruiting calyx (from below). —D. Fruit. (A–D, *Randrianaivo et al.* 3242.) Drawing by A. Jouy.

Tree to 12 m tall and 25 cm DBH. Young stems glabrous, mature stems grayish, glabrous. Leaves 4–9 × 2.5–3.5 cm, oblong-elliptic, coriaceous, glabrous on both surfaces, base cuneate, margins undulate, apex obtuse to round, midvein slightly impressed above, raised below, venation weakly brochidodromous, evident on both surfaces, 10 to 12 secondaries per side, inserted at ca. 45° angle to midvein, inter-secondaries weakly evident; petiole 10–15 mm, 1–1.5 mm diam., terete, slightly flattened above, glabrous. Male flowers

borne in axillary fascicles of 3 or 4 flowers, ± glabrous throughout, pedicels 3.5 mm; calyx ± salverform, ca. 3 × 10 mm, with obscure, very shallow lobes, margins flat, corolla tube urceolate, ca. 5 × 7 mm, lobes 5, 9 × 6 mm, obovate; stamens ~70, inserted at the base of corolla tube, filaments 0.7 × 0.2 mm; flattened, anthers 2–2.5 × 0.3–0.4 mm; pistillode, very highly reduced, densely covered with short, fine, erect, blonde trichomes. Female flowers solitary, axillary, ± sessile borne either among the terminal tuft of leaves or just below them,

glabrous throughout, calyx cup ca. 3 mm high, 4 mm diam., with a proximal, flat, skirtlike flange, 26–27 mm diam., the margin irregularly lacerate, lacking lobes; corolla tube 5–6 × 5–6 mm, urceolate, lobes 5, 10–11 × 6–7 mm, obovate; staminodes 30 to 35, 4–5 mm; ovary ca. 4 × 5 mm, ca. 10-locular, globose, glabrous, styles ca. 5, ca. 3 mm. Fruit solitary, axillary, sessile, borne either in leaf axils or at nodes of fallen leaves, ca. 10-locular, 1.8 × 2 cm, globose, glabrous, green in vivo when young, maturing to variegated yellow tinged with red, dark brown in sicco, apex slightly depressed; calyx accrescent, glabrous throughout, calyx cup 5–10 cm high, 16–18 cm diam., appressed to fruit, with a proximal, reflexed, skirtlike flange, 9–10 mm high, 25–30 mm diam., the margin irregularly lacerate, lacking lobes. Seeds not seen.

Distribution, ecology, and phenology. *Diospyros chitoniophora* occurs in a limited area in and around Ankarana Special Reserve, in deciduous dry forest at elevations of 85–550 m, and has been observed growing on limestone. Flowers and immature fruits have been recorded in November through December, and mature fruit in January.

Etymology. The specific epithet refers to the appearance of the fruit and persistent calyx, which are reminiscent of a group of marine mollusks belonging to the class Polyplacophora, commonly known as chitons. René Capuron recognized that this was a new species and wrote the name “*Diospyros chitoniophora*” on several herbarium specimens, but it was never published.

Vernacular names. Mapingo (*Service Forestier* 9732; *Service Forestier* 12053).

Conservation status. *Diospyros chitoniophora* has a geographic range in the form of an EOO of 246 km² and a minimum AOO of 28 km². It is present in the Ankarana protected area. Elsewhere it is threatened by fire, forest clearing for agriculture, grazing, and exploitation for firewood and house construction material, all of which will result in continuing decline. With respect to the most serious plausible threat of forest clearing for agriculture, it is known to occur at six locations. Therefore, *D. chitoniophora* can be assessed for its risk of extinction as Vulnerable [VU B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v)].

Notes. The characteristic flanged calyx that is so distinctive of *Diospyros chitoniophora* appears to be similar and possibly homologous to that of the much-reduced calyx flange in *D. cupulifera*, and these two species may be closely related to one another.

By virtue of reaching 25 cm DBH, *Diospyros chitoniophora* is considered to be a large enough tree to be potentially exploited for its hardwood, and thus precise coordinates have been withheld.

Additional specimens examined. Madagascar. **DIANA Region** [Antsiranana Prov.]: Massif de l’Ankarana, 26 Nov. 2019 (fr.), *Barberá et al.* 2827 (G, MO, P, TAN, W); same locality, 18 Nov. 1990 (fl., fr.), *Bardot-Vaucoulon et al.* 308 (P); Montagne des Français, 8 Nov. 1944 (♂ fl.), *Homolle* 257 (P); forêts aux alentours d’Anjahankely, 25 Dec. 2010 (fr.), *Burivalova* 118 (G, P); Ambilomagodro, 10 Feb. 2006 (fr.), *Randrianaivo* 1350 (CNARP, MO, P, TAN); Parc National d’Ankarana, 17 Jan. 2014 (st.), *Randrianaivo et al.* 2403 (BR, G, MO, P); same locality, 19 Jan. 2014 (fr.), *Randrianaivo et al.* 2429 (BR, G, MO, P); same locality, 5 Dec. 2018 (fr.), *Randrianaivo* 3221 (DBEV, G, MO, P, TAN); same locality, 5 Dec. 2018 (st.), *Randrianaivo* 3222 (DBEV, MO, P); same locality, 5 Dec. 2018 (fr.), *Randrianaivo* 3223 (DBEV, G, MO, P, TAN); same locality, 5 Dec. 2018 (st.), *Randrianaivo* 3224 (DBEV, MO, P); same locality, 5 Dec. 2018 (fr.), *Randrianaivo* 3227 (DBEV, G, MO, P, TAN); same locality, 6 Dec. 2018 (st.), *Randrianaivo* 3241 (DBEV, MO, P); same locality, 26 Nov. 1952 (bud), *Service Forestier* 6621 (P); same locality, 13 Apr. 1954 (bud), *Service Forestier* 9732 (P); same locality, 18 Nov. 1954 (fr.), *Service Forestier* 12053 (P); same locality, 15 Nov. 1958 (fr.), *Service Forestier* 18979 (P); same locality, 24 Dec. 1963 (♂ fl.), *Service Forestier* 23151 (P, MO); same locality, 24 Dec. 1963 (♀ fl.), *Service Forestier* 23152 (P, MO).

5. *Diospyros courrierensis* A. G. Linan, G. E. Schatz & Lowry, sp. nov. TYPE: Madagascar. DIANA Region [Antsiranana Prov.]: Andramaimbo, Baie de Courier, 12°12’45”S, 49°08’38”E, 9 m, 14 May 2005 (fr.), *R. H. Ramananjanahary & F. Ratoivoson* 298 (holotype, MO-6443092!; isotypes, CNARP not seen, P [bc] P03975084!, TAN!). Figures 1E, 7.

Diagnosis. *Diospyros courrierensis* A. G. Linan, G. E. Schatz & Lowry can be distinguished from the species that it most closely resembles vegetatively, *D. platycalyx* Hiern, by its ± flat leaf margins (vs. undulate in *D. platycalyx*), short lamina (3–6 cm vs. 5–8 cm), and 9 to 11 secondary veins per side (vs. 6 to 8). Its fruit can be distinguished from those of *D. nitidifolia* A. G. Linan, G. E. Schatz & Lowry, which they most closely resemble, by the presence of 4 locules (vs. 8 in *D. nitidifolia*) and calyx lobes whose margins are deflected away at the base and transition to flat toward the apex (vs. ± perpendicular to the fruit surface along the whole length of the lobe).

Small tree up to 8 m tall and 12 cm DBH. Young stems glabrous, mature stems gray-beige. Leaves 3–6 × 2.5–5 cm, obovate, coriaceous, often shiny above, glabrous on both surfaces, base cuneate, margins ± flat to slightly undulate, apex rounded, midvein flat to slightly impressed above, raised below, venation weakly brochidodromous, strongly evident on both surfaces, 9 to 11 secondaries per side, inserted at ca. 45° angle to the midvein, inter-secondaries strongly evident; petiole 4–4.5 mm, ca. 1 mm diam., ± terete, slightly flattened

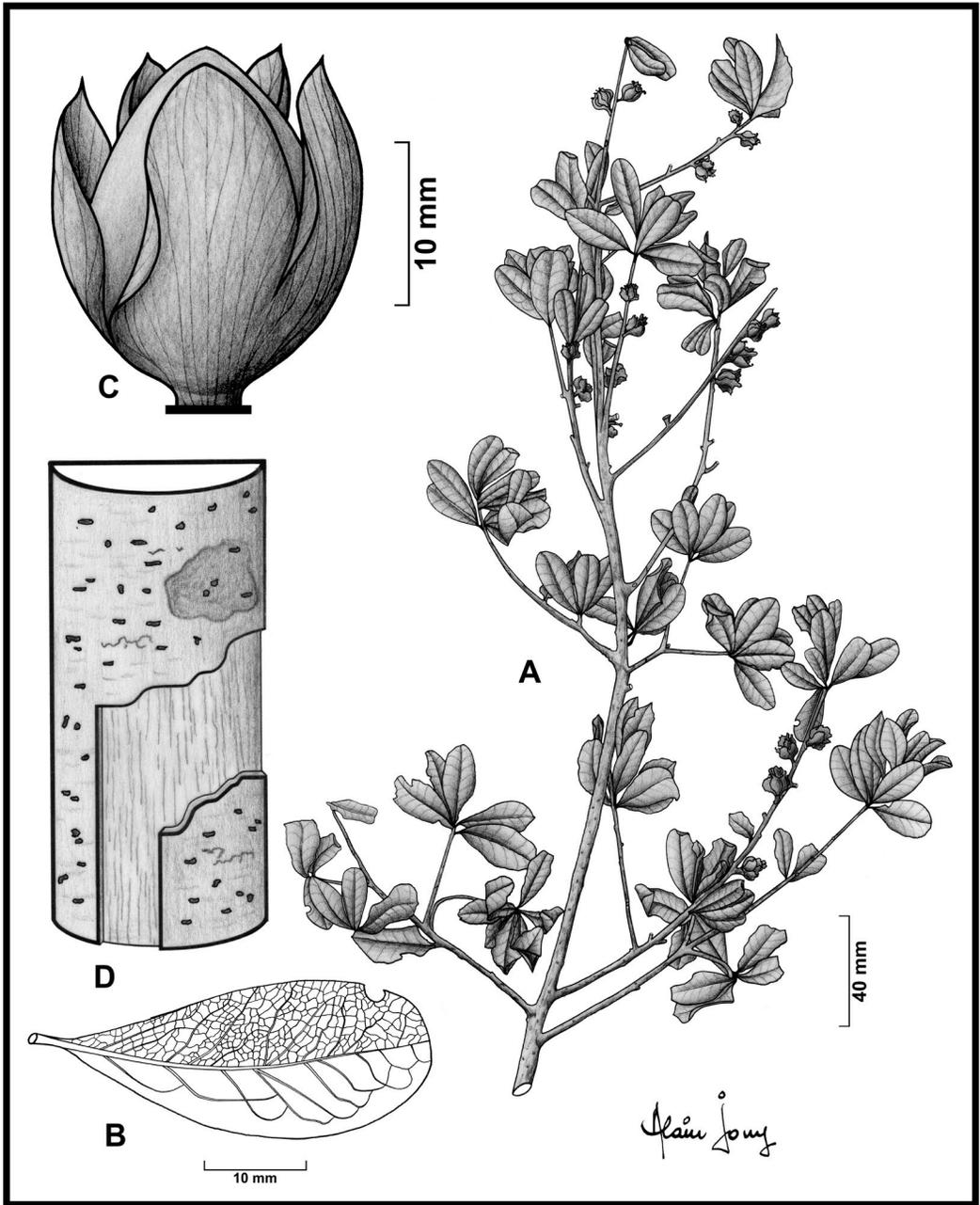


Figure 7. *Diospyros courierensis* A. G. Linan, G. E. Schatz & Lowry. —A. Branch with fruit. —B. Detail of leaf venation (abaxial surface). —C. Fruit. —D. Branch with bark. (A, *Randrianaivo* 3302; B–D, *Ramananjahary & Ratovoso* 298.) Drawing by A. Jouy.

above, glabrous. Male flowers not seen. Female flowers solitary, axillary, \pm sessile, borne at nodes of fallen leaves, glabrous throughout, subtended by small bracts, ca. 2×1 mm; calyx cup \pm conical, ca. 5×4 mm, lobes 5, ca. 10×7 mm, the margins entire, perpendicular to

the ovary surface and weakly undulating at the base, extending below the sinuses to the base of the calyx cup, forming evident wings, becoming \pm flat toward the acute apex; corolla tube \pm conical, 4×2 mm diam., lobes 5, ca. 5×5 mm, obovate; staminodes ca. 15, in-

served at the base of corolla tube, 4–4.5 × 0.5 mm; ovary ca. 2 × 3 mm, 4-locular, ovoid, glabrous, style 2-branched, ca. 4 mm. Fruit solitary, axillary, sessile, borne either in leaf axils or at nodes of fallen leaves, 4-locular, ca. 1.5 × 1–1.5 cm, ovoid-ellipsoid, glabrous, green in vivo when young, maturing to variegated green-yellow with red tinge, brown in sicco, apex acute to rounded; calyx glabrous, accrescent, calyx cup ca. 7 × 10 mm, calyx lobes 5, ca. 1 × 1 cm, not spreading, ± appressed to fruit surface, triangular-trullate, the margins entire, deflected away from the fruit surface and weakly undulating at the base, extending below the sinuses to the base of the calyx cup, forming evident wings, transitioning to ± flat toward the acute apex. Seeds 12 × 4 mm, ellipsoid-wedge shaped.

Distribution, ecology, and phenology. *Diospyros courierensis* is known only from a restricted area around the Baie de Courrier in far northern Madagascar (Fig. 8), where it occurs in dry littoral forests at 9–50 m elevation. Flowers have been recorded in December, and fruits in May.

Conservation status. *Diospyros courierensis* has a geographic range in the form of an EOO of 0.007 km² and an AOO of 0.007 km². It is not present in any protected areas (Fig. 8), and is threatened by fire and grazing, which will result in continuing decline. With respect to the most serious plausible threat of fire, it is known to occur at one location. Therefore, *D. courierensis* can be assessed for its risk of extinction as Critically Endangered [CR B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v)].

Additional specimens examined. Madagascar. **DIANA Region [Antsiranana Prov.]:** Baie de Courrier, Formation II, 12°12'45"S, 49°08'51"E, 36 m, 15 Dec. 2018 (♀ fl.), *Randrianaivo 3300* (DBEV, G, MO, P, TAN); same locality, 38 m, 15 Dec. 2018 (♀ fl.), *Randrianaivo 3302* (DBEV, G, MO, P, TAN); same locality, 50 m, 15 Dec. 2018 (st.), *Randrianaivo 3307* (DBEV, G, MO, P, TAN); same locality, 43 m, 15 Dec. 2018 (♀ fl.), *Randrianaivo 3308* (DBEV, G, MO, P, TAN).

6. *Diospyros crassifolia* A. G. Linan, G. E. Schatz & Lowry, sp. nov. TYPE: Madagascar. DIANA Region [Antsiranana Prov.]: piste Benavony, Ankarana AP, 12°57'11"S, 49°07'46"E, 113 m, 7 Dec. 2018 (fr.), *R. Randrianaivo*, *A. N. Sandratrinina* & *G. Randrianandrasana 3247* (holotype, MO-6956002!; isotypes, DBEV not seen, G [bc] G00341888!, K!, P [bc] P00722713!, TAN not seen, W!). Figures 9A, 10.

Diagnosis. *Diospyros crassifolia* A. G. Linan, G. E. Schatz & Lowry can be distinguished from the species it most closely

resembles vegetatively, *D. olivieri* A. G. Linan, G. E. Schatz & Lowry and *D. orientalis* A. G. Linan, G. E. Schatz & Lowry, by its broadly elliptic leaves (vs. obovate to oblong in *D. orientalis* and *D. olivieri*) with a slightly asymmetric base (vs. cuneate) and 14 to 16 secondary veins per side (vs. 5 to 6 and 7 to 8 in the two other species, respectively). The fruits of *D. crassifolia* can be distinguished from those of *D. manongarivensis* A. G. Linan, G. E. Schatz & Lowry and *D. mapingo* H. Perrier, which they most closely resemble, by their depressed apex (vs. slightly acute in *D. manongarivensis*, but depressed in *D. mapingo*) and glabrous calyx (vs. with evident indument in *D. manongarivensis* and *D. mapingo*).

Shrub to small tree to 7 m tall and 15 cm DBH. Bark smooth, grayish. Young stems glabrous; mature stems grayish. Leaves 7–13 × 4–8.2 cm, broadly elliptic, very coriaceous, shiny above, glabrous on both surfaces, base slightly asymmetric, margins revolute, apex round to truncate, midvein slightly impressed above, raised below, yellow in vivo, venation reticulodromous, obscure above and less so below, 14 to 16 secondaries per side, inserted at 45°–50° angle from midvein, intersecondaries evident; petiole 3–5 mm, 2.5–3 mm diam., ± terete, flattened above, with slightly winged margins, glabrous. Male flowers borne in axillary fascicles of 1 to 3 flowers, peduncle 1–2 mm, conical, subtended by ± elliptic bracts ca. 12 × 9 mm, pedicels ca. 1 mm, articulated, glabrous, the proximal portion lighter than the distal portion; calyx cup ca. 2 × 3–4 mm, glabrous, with 5 shallow calyx lobes 2.5 × 3 mm, triangular, apex acute-acuminate, with very sparse indument of short, appressed, fine, blonde trichomes, increasing in density toward the apex; corolla glabrous throughout, corolla tube urceolate, ca. 5 × 10 mm, lobes 5, ca. 10 × 7 mm, obovate; stamens ~70, inserted at the base of corolla tube, filaments 1 × 0.2 mm, flattened, anthers 3–3.5 × 0.6 mm; pistillode present, highly reduced, densely covered with short, fine, erect, blonde trichomes. Female flowers not seen. Fruit solitary, axillary, sessile, borne either in leaf axils or at nodes of fallen leaves, 10-locular, ca. 2 × 3 cm, oblate-globose, glabrous, green in vivo when young, maturing to variegated yellow tinged with red, brown in sicco, apex slightly depressed; calyx cup ± conical, 2–2.5 × 3.5 cm, glabrous, calyx lobes 5, to ca. 20 × 15 mm, very slightly spreading at maturity, triangular, margins entire, the basal portion ± deflected away from the fruit surface, extending slightly below the sinuses, apex acute. Seeds 13–14 × 8–9 mm, spherical wedge-shaped.

Distribution, ecology, and phenology. *Diospyros crassifolia* is known only from sites in and around the Ankarana Special Reserve (Fig. 8), where it occurs in deciduous dry forest on limestone at elevations of 82–227 m, with most collections from around 100 m elevation. Flowers have been recorded in December, and fruits from December through February.

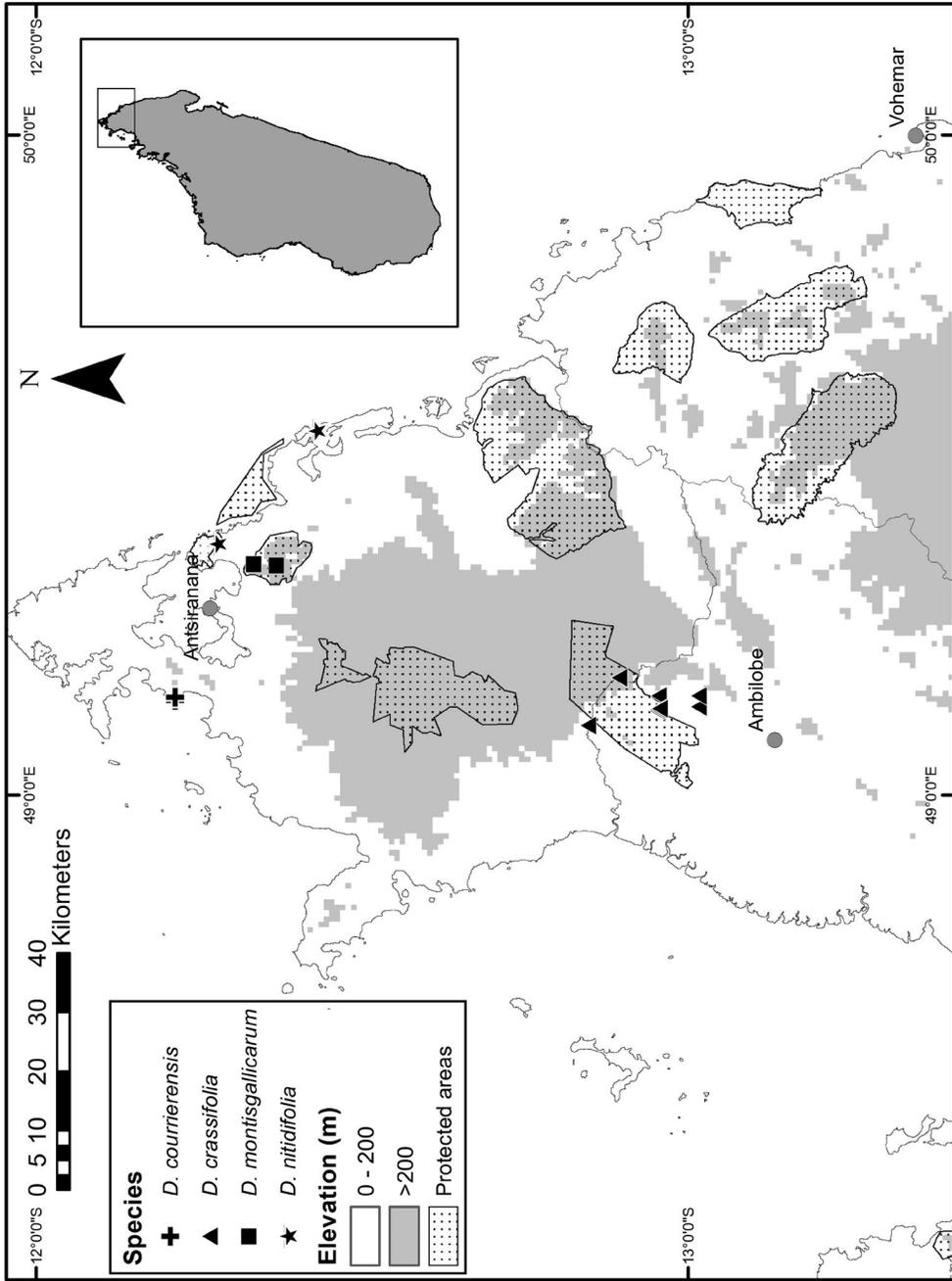


Figure 8. Distribution map of *Diospyros* L. species in northern Madagascar: *D. courrierensis* A. G. Linan, G. E. Schatz & Lowry, *D. crassifolia* A. G. Linan, G. E. Schatz & Lowry, *D. montisgallicarum* A. G. Linan, G. E. Schatz & Lowry, and *D. nitidifolia* A. G. Linan, G. E. Schatz & Lowry.

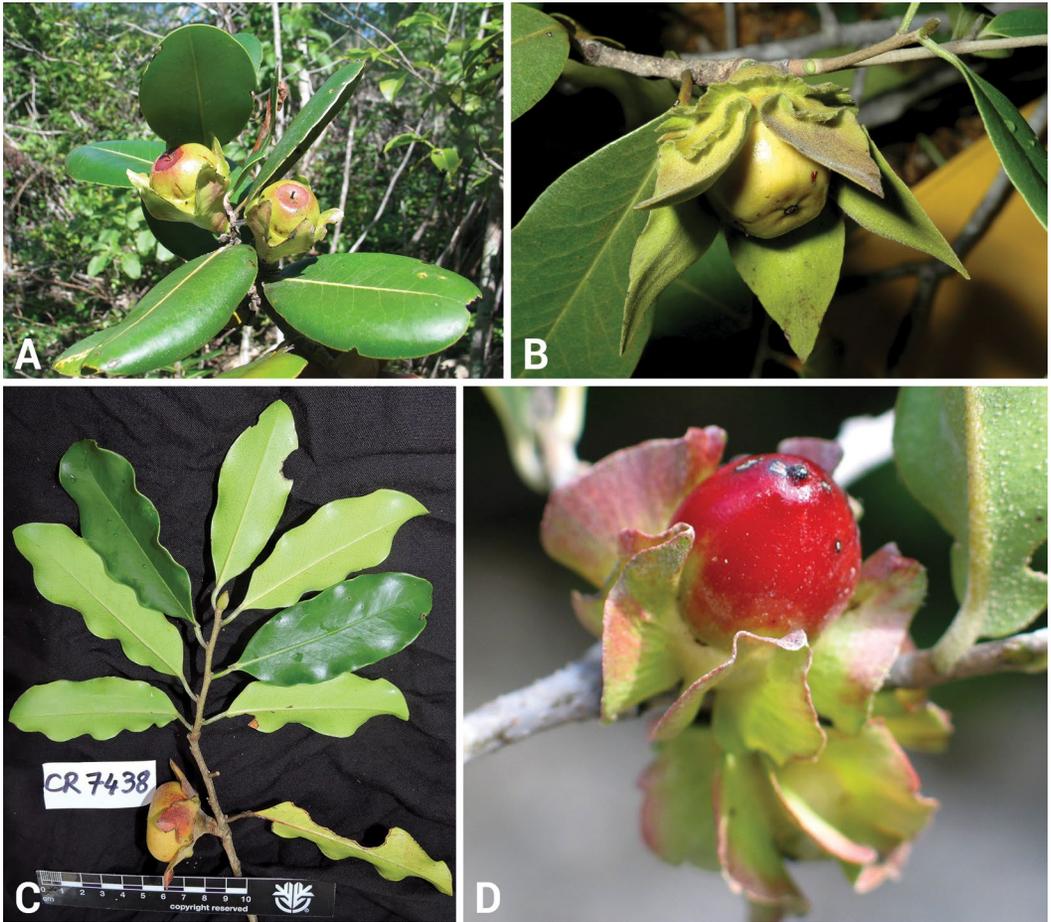


Figure 9. Photos of *Diospyros* L. species. —A. *Diospyros crassifolia* A. G. Linan, G. E. Schatz & Lowry, branch with mature fruits (Rakotonandrasana 1012). —B. *Diospyros cupulifera* H. Perrier, immature fruit (Lowry et al. 6906). —C. *Diospyros mapingo* H. Perrier, branch with mature fruit (Rakotovo & Randrianaivo 7438). —D. *Diospyros nitidifolia* A. G. Linan, G. E. Schatz & Lowry, mature fruit (Razafusalama 947). Photos: A, R. Randrianaivo; B, P. Lowry; C, C. Rakotovo; D, F. Ratovoson.

Conservation status. *Diospyros crassifolia* has a geographic range in the form of an EOO of 79 km² and a minimum AOO of 28 km². It is present in the Ankarana protected area (Fig. 8). Elsewhere it is threatened by fire, forest clearing for agriculture, grazing, and exploitation for firewood and house construction material, all of which will result in continuing decline. With respect to the most serious plausible threat of forest clearing for agriculture, it is known to occur at six locations. Therefore, *D. crassifolia* can be assessed for its risk of extinction as Vulnerable [VU B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v)].

Additional specimens examined. Madagascar. **DIANA Region [Antsiranana Prov.]**: Mahamasina, massif de l'Ankarana, bord et lit de la rivière Ambodimadiro, 12°57'19"S, 49°09'00"E, 120 m, 25 Jan. 2003 (fr.). *Bardot-Vaucoulon et al. 1314* (MO, P, TAN); Ankarana, tsingy ca. 3 km NE of Ma-

hamasina, not part of Ankarana NP, on right side of rd. (when walking toward Antsiranana) at the second bridge from Mahamasina, 12°50'47"S, 49°06'18"E, 82 m, 16 Jan. 2002 (fr.). *De Block et al. 1259* (BR, K, MO, P, TAN); collines et plateaux calcaires de l'Ankarana, forêt tropophile près d'Ambodimagodro, [13°01'S, 49°08'E], 150–200 m, Dec. 1937–Jan. 1938 (st.). *Humbert 19027bis* (P); Ambilobe, Marivorahona, Ambilomagodro, Ampondrabe, à 7 km à l'ESE de Mahamasina, 12°53'41"S, 49°10'40"E, 227 m, 11 Feb. 2007 (fr.). *Rakotonandrasana 1012* (CNARP, MO, P, TAN); Tanambao Marivorahona, Betsimiranjana, Ankarana AP, côte E Mahamasina, piste campement de Prince vers Tsingy Rary, 12°57'13"S, 49°07'36"E, 112 m, 6 Dec. 2006 (♂ fl.). *Ranaivojaona et al. 1655* (CNARP, MO, P, TAN); Parc National d'Ankarana, 12°57'09"S, 49°07'44"E, 116 m, 17 Jan. 2014 (st.). *Randrianaivo 2411* (BR, G, MO, P); piste Benavony, Ankarana AP, 12°57'11"S, 49°07'46"E, 109 m, 7 Dec. 2018 (fl.). *Randrianaivo 3246* (DBEV, MO, P); same locality, 114 m, 7 Dec. 2018 (fr.). *Randrianaivo 3250* (DBEV, G, MO, P, TAN); same locality, 97 m, 7 Dec. 2018 (fr.). *Randrianaivo 3252* (DBEV, G, MO, P, TAN); same locality, 108 m, 7 Dec.

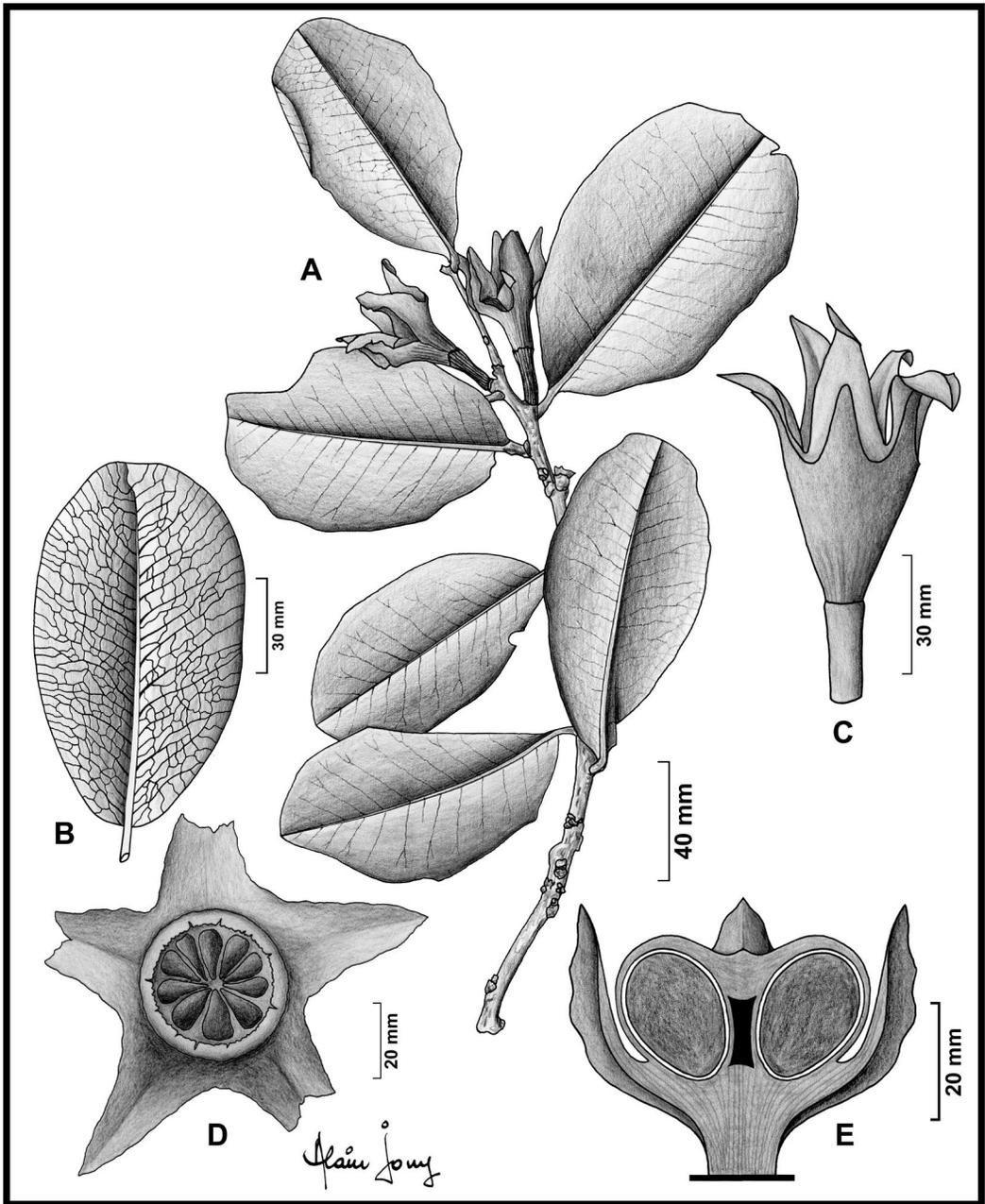


Figure 10. *Diospyros crassifolia* A. G. Linan, G. E. Schatz & Lowry. —A. Branch with immature fruit. —B. Detail of leaf venation (adaxial surface). —C. Immature fruit. —D. Mature fruit (cross section, from above). —E. Mature fruit (transverse section, from side). (A–C, *Razafitsalama* 947; D–E, *Randrianaivo et al.* 1369.) Drawing by A. Jouy.

2018 (fr.), *Randrianaivo* 3254 (DBEV, G, MO, P, TAN); rivière Ampondrabe, Ankarana AP, 12°57'22"S, 49°07'52"E, 110 m, 11 Dec. 2018 (fr.), *Randrianaivo* 3285 (DBEV, G, MO, P, TAN); same locality, 113 m, 11 Dec. 2018 (fr.), *Randrianaivo* 3286 (DBEV, G, MO, P, TAN); Ankarana Special Reserve, [13°01'S, 49°09'E], 11–14 Jan. 2002 (fr.), *Razafimandimbi-son* & *Andrianatoanina* 460 (MO).

7. *Diospyros cupulifera* H. Perrier, Mém. Inst. Sci. Madagascar, Sér. B, Biol. Vég. 4(1): 146–147, f. XII: 5–6. 1952. TYPE: Madagascar. Anosy Region [Toliara Prov.]: vallée moyenne du Mandrare, Dec. 1933 (fr.), *H. Humbert* 12356 (lectotype, designated by Schatz & Lowry [2011: 274], P [bc])

P00491893!; isoelectotypes, MO-6128545!, TEF not seen). Figure 9B.

Shrub to tree to 12 m tall and 40 cm DBH. Young stems glabrous to moderately covered with short, fine, semi-appressed to erect, blonde trichomes, often glabrescent, mature stems beige to grayish. Leaves 4–7.2 × 1.4–3.5 cm, oblong-elliptic, coriaceous, glabrous above, ± glabrous but rarely initially sparsely covered on both surfaces with short, fine, semi-appressed to erect, blonde trichomes, glabrescent, base cuneate to acute, margins slightly revolute and slightly undulate, apex round to obtuse, midvein slightly impressed above, raised below, venation weakly brochidodromous, evident above and more so below, 7 to 10 secondaries per side, inserted at 45°–50° angle to the midvein, intersecondaries weakly evident; petiole 5–9 mm, ca. 1 mm diam., terete, slightly flattened above. Male flowers borne in axillary fascicles of 1 to 3 flowers, subtended by pubescent bracts, pedicels ca. 1 mm, with short, fine, semi-appressed to erect, blonde trichomes; calyx covered throughout with dense indument of fine, short, semi-appressed, blonde trichomes on outside, glabrous inside, calyx cup 3–4 × 2 mm, cylindrical, abruptly tapering at the base, the apex shallowly 5-lobed, the lobes triangular, ca. 1 × 1 mm; corolla with sparse, long, fine, appressed, blonde trichomes, concentrated on the lobes outside, glabrous inside, corolla tube ca. 4 × 4 mm, ± urceolate, lobes 5, ca. 2 × 2 mm, obovate, margins flat, apex obtuse-rounded; stamens ca. 60, inserted at the base of corolla tube, filaments 1–1.8 × 0.2 mm, flattened, anthers 2–2.3 × 0.5–0.7 mm; pistillode present, highly reduced, densely covered with short, fine, erect, blonde trichomes. Female flowers solitary, sessile, borne in leaf axils; calyx with sparse to moderately dense indument of ± appressed, long, fine, blonde trichomes, calyx cup shallow, ca. 6 × 15 mm, almost always with a proximal flange, resembling an epicalyx, ca. 1.5 mm diam., its margins flat and irregularly lacerate, calyx lobes 5, ca. 20 × 10 mm, slightly spreading, narrowly ovate-elliptic, margins lacerate, deflected away from the ovary at the base such that they are united to form a crest, transitioning to flat and entire toward the acute to obtuse apex; corolla with short, fine, appressed, blonde trichomes outside, concentrated along the median of the lobes, glabrous inside, corolla tube 5–6 × 5–6 mm, cylindrical, lobes 5, 6–7 × 3–4 mm, ± trullate; staminodes ca. 45, inserted at the base of the corolla tube, 4–5 mm tall; ovary ca. 5 × 6.5 mm, broadly ovoid to globose, glabrous, style 5-branched, ca. 4 mm. Fruit solitary, axillary, sessile, borne at nodes of fallen leaves, 8- to 10-locular, to 1–1.5 × 3 cm, obovate-globose, glabrous, green when young in vivo, maturing to variegated yellow tinged with red, brown in sicco, apex flattened to slightly depressed; calyx accrescent,

with sparse to moderately dense indument of ± appressed, long, fine, blonde, persistent trichomes throughout, calyx cup shallow, 12–14 × 16–18 mm, almost always with a proximal flange, resembling an epicalyx, 15–35 mm diam., its margins flat and lacerate, calyx lobes 5, spreading, ca. 2 × 1.5 cm, narrowly triangular, margins lacerate, deflected away from the fruit surface at the base such that they are united to form a crest, transitioning to flat and entire toward the acute to obtuse apex. Seeds 9 × 9 mm, spherical wedge-shaped.

Distribution, ecology, and phenology. *Diospyros cupulifera* is widely distributed across southern and southwestern Madagascar, from west of Tolagnaro to north of Morondava, and has also been collected a few times as far north as Andronomavo in Namoroka National Park. It occurs in dry forests, on limestone or alluvium, commonly found near rivers and streams, mostly at elevations of 30–400 m but rarely in subhumid forests up to 1100 m. Flowers have been recorded from October through November, and fruits from December through March.

Vernacular names. Porofoky (*Laha* 208), Forofoky (*Randriatsivery* 294; *Randrianarivony* 519), Forofoka (*Reserves Naturelles* 10768), Vatraha (*Andriamihajirivo* 491), Revaky (*Reserves Naturelles* 5614), Maintifototra (*Service Forestier* 13045).

Conservation status. *Diospyros cupulifera* has a geographic range in the form of an EOO of 126,321 km² and a minimum AOO of 120 km². It is present in the Andohahela and Namoroka protected areas. Elsewhere it is threatened by fire, forest clearing for agriculture, grazing, and exploitation for firewood and house construction material, all of which will result in continuing decline. With respect to the most serious plausible threat of forest clearing for agriculture, *D. cupulifera* is known to occur at 26 locations, and it was recently assessed for its risk of extinction as Least Concern [LC] (Faranirina et al., 2019).

Notes. Specimens of *Diospyros cupulifera* collected in the far north of its range at Tsingy de Namoroka National Park have mature leaves that are more reddish in color and less coriaceous compared to material from farther south, and that are sparsely covered in semi-erect, short, fine, blonde trichomes on both surfaces, rather than glabrous. Despite these differences, however, the collections from Namoroka exhibit the highly distinctive fruiting calyx morphology typical of *D. cupulifera*. The flanged calyx appears in many ways to be analogous to that of *D. chitoniophora*, and these two species are probably closely related to one another.

By virtue of reaching 40 cm DBH, *Diospyros cupulifera* is considered to be a large enough tree to be potentially exploited for its hardwood, and thus precise coordinates have been withheld.

Additional specimens examined. Madagascar. **Anosy Region [Toliara Prov.]**: Parc National d'Andohahela, 17 Dec. 2004 (♂ fl.), *Andriamihajarivo 491* (MO, P, TAN, TEF); Amboasary Sud, 10 Nov. 2008 (fr.), *Andriamihajarivo et al. 1542* (MO, P, TAN); Andohahela Réserve, 16 Mar. 1994 (fr.), *Andrianarisata 100* (MO, P, TAN); same locality, 100–138 m, 2 Nov. 1994 (♂ fl.), *Eboroke 923* (MO, P); vallée de la Manambolo, July 1933 (fr.), *Humbert 12816* (P); Andrahomana (Cap Andavaka), 25 Feb. 1955 (fr.), *Humbert 29123* (P); Andohahela Réserve, 23 July 1996 (st.), *Laha 208* (MO, TAN); Andohahela National Park, parcel 1, 21 Jan. 2008 (fr.), *Lowry et al. 6906* (MO, P); same locality, parcel 2, 28 Feb. 2009 (fr.), *Randrianaivo et al. 1769* (MO, P, TAN); Ambatoabo, 18 Jan. 2011 (fr.), *Randrianaivo 1791* (MO, P, TAN); same locality, 18 Jan. 2011 (fr.), *Randrianaivo & Fiadana 1956* (MO, P, TAN); Amboasary Sud, 11 Feb. 2013 (fr.), *Randrianarivony 519* (MO, TAN); same locality, 1 Nov. 2007 (♂ fl.), *Randriatsivery 294* (MO, P, TAN); Ambatoabo, 17 Nov. 2009 (♂ fl.), *Ratovoson 1497* (MO, P, TAN); Kelibona, 29 Feb. 1960 (fr.), *Réserves Naturelles 10768* (P, TEF); Andohahela, parcel 2, 15 Feb. 1990 (fr.), *Schatz 2965* (MO, P); entre Ambatoabo et Behara, 28 Sep. 1953 (♂ fl.), *Service Forestier 8526* (MO, P, TEF); entre Imonty et Ankoba, 9 May 1954 (fr.), *Service Forestier 22434* (MO, TEF). **Atsimo-Andrefana Region [Toliara Prov.]**: Forêt d'Analavelona, 17 Dec. 2017 (fr.), *Andriamihajarivo 2163* (MO, P, TAN); basse vallée du Fiherenana, Nov. 1933 (fr.), *Humbert 11543* (MO, P); Beza Mahafaly Reserve, 26 Oct. 1987 (♂ fl.), *Phillipson 2465* (MO, P); same locality, 180 m, 26 Oct. 1987 (♀ fl.), *Phillipson 2466* (MO, P); S de Sakaraha, 5 Feb. 2007 (fr.), *Rakotoarisoa 492* (MO, P); forêt d'Analavelona, 14 Dec. 2017 (fr.), *Rakotoarivelo 942* (MO, P, TAN); Ankasy forest, 22 Feb. 2011 (bud), *Randrianasolo et al. 1443* (MO, P, TAN); Antsoa, 9 Jan. 2011 (fr.), *Razakamalala 5917* (MO, P, TAN); rte. Sakaraha–Toliary, 10 Nov. 1952 (fr.), *Service Forestier (Capuron) 5935* (MO, P, TEF); vallée de l'Onilahy, Mar. 1953 (fr.), *Service Forestier (Capuron) 6952* (MO, P, TEF); entre Ihazofotsy et Ambatoabo, Mar. 1955 (st.), *Service Forestier (Capuron) 11853* (MO, P); Beando, 31 Dec. 1954 (fr.), *Service Forestier 13045* (P, TEF); rte. Sakaraha–Toliary, July 1961–Jan. 1962 (fr.), *Service Forestier (Capuron) 20734* (MO, TEF); W d'Andranovory, 26 Feb. 1970 (fr.), *Service Forestier (Capuron) 29095* (MO, P, TEF). **Boeny Region [Mahajanga Prov.]**: RN 8 (Soalala), 23 July 1953 (♀ fl.), *Réserves Naturelles 5614* (P); same locality, 10 Apr. 1959 (fr.), *Réserves Naturelles 11607* (P).

8. *Diospyros manongarivensis* A. G. Linan, G. E. Schatz & Lowry, sp. nov. TYPE: Madagascar. Diana Region [Antsiranana Prov.]: Réserve Spéciale de Manongarivo, 7–12 Dec. (fr.), *S. T. Malcomber, A. Leeuwenberg, M. van Bergen, J. Andriatiana & B. Randriamampionona 1945* (holotype, MO-6923934!; isotypes, CAS!, G [bc] G00341889!, K!, P [bc] P03975095!, W!). Figure 11.

Diagnosis. *Diospyros manongarivensis* A. G. Linan, G. E. Schatz & Lowry can be distinguished vegetatively from other members of *Diospyros* L. sect. *Forbesia* F. White by its large (9–24.5 × 2.5–7.5 cm), elliptic leaves with obscure venation

on the upper surface. Furthermore, the fruits of *D. manongarivensis* can be distinguished from those of *D. crassifolia* A. G. Linan, G. E. Schatz & Lowry and *D. mapingo* H. Perrier, which they most closely resemble, by their slightly acute apex (vs. depressed in *D. crassifolia* and *D. mapingo*) and shallow fruiting calyx cup ca. 1 cm tall (vs. 2–2.5 cm in *D. crassifolia* and 1.5–1.7 cm in *D. mapingo*).

Tree up 12 m tall, DBH unknown. Young stems glabrous, mature stems beige. Leaves 9–24.5 × 2.5–7.5 cm, elliptic, very coriaceous, glabrous on both surfaces, base cuneate, margins slightly revolute, apex obtuse, midvein impressed above, raised below, venation obscure or absent on both surfaces, 10 to 15 secondaries per side, inserted at 45°–50° angle to the midvein, inter-secondaries obscure or absent; petiole 10–20 mm, 1.5–3.5 mm diam., ± terete, slightly flattened above, glabrous. Male flowers solitary, sessile, borne in leaf axils subtended by 3 or 4 scaly bracts; calyx cup 5–6 × 6–7 mm, densely covered with coarse, short, black trichomes outside, glabrous inside, lobes 5, 4 × 3 mm, triangular; corolla with sparse, short, appressed, coarse, black to rust-colored trichomes, glabrous inside, corolla tube 4–5 × 5–6 mm, short cylindrical, lobes 5, 10 × 4 mm, elliptic; stamens ca. 65, inserted at the base of corolla tube, filaments 2 × 0.1 mm, flattened, anthers 3 × 0.2 mm, pistillode present, highly reduced, densely covered with coarse, short, black trichomes. Female flowers not seen. Fruit (from nearly mature material) solitary, axillary, sessile, borne at nodes of fallen leaves, 10-locular, 1.5–1.8 × 1.8–2 cm, broadly ovoid to globose, glabrous, mature fruit orange-brown in vivo, brown in sicco, apex slightly acute; calyx cup 1 × 2 cm, with dense indument of semi-appressed, coarse, black trichomes, calyx lobes 5, 1.5 × 1.2 cm, spreading slightly at maturity, triangular, margins entire, deflected away from the fruit surface at the base and sinuses, transitioning to flat toward the obtuse-rounded apex, densely covered with appressed, coarse, black trichomes, transitioning to glabrous toward the apex. Seeds 7–8 × 4–5 mm, spherical wedge-shaped.

Distribution, ecology, and phenology. *Diospyros manongarivensis* is restricted to sites in and around the Manongarivo Special Reserve in northeastern Madagascar. It occurs in wet, often riparian forest at 500–1000 m elevation. Flowers have been recorded in September, and fruits in December.

Conservation status. *Diospyros manongarivensis* has a geographic range in the form of an AOO of 8 km². It is known only from the Manongarivo protected area. Lacking any known threats, *D. manongarivensis* can be assessed for its risk of extinction as Least Concern [LC], a status that is, however, contingent upon the continuing effective management of the Manongarivo protected area.

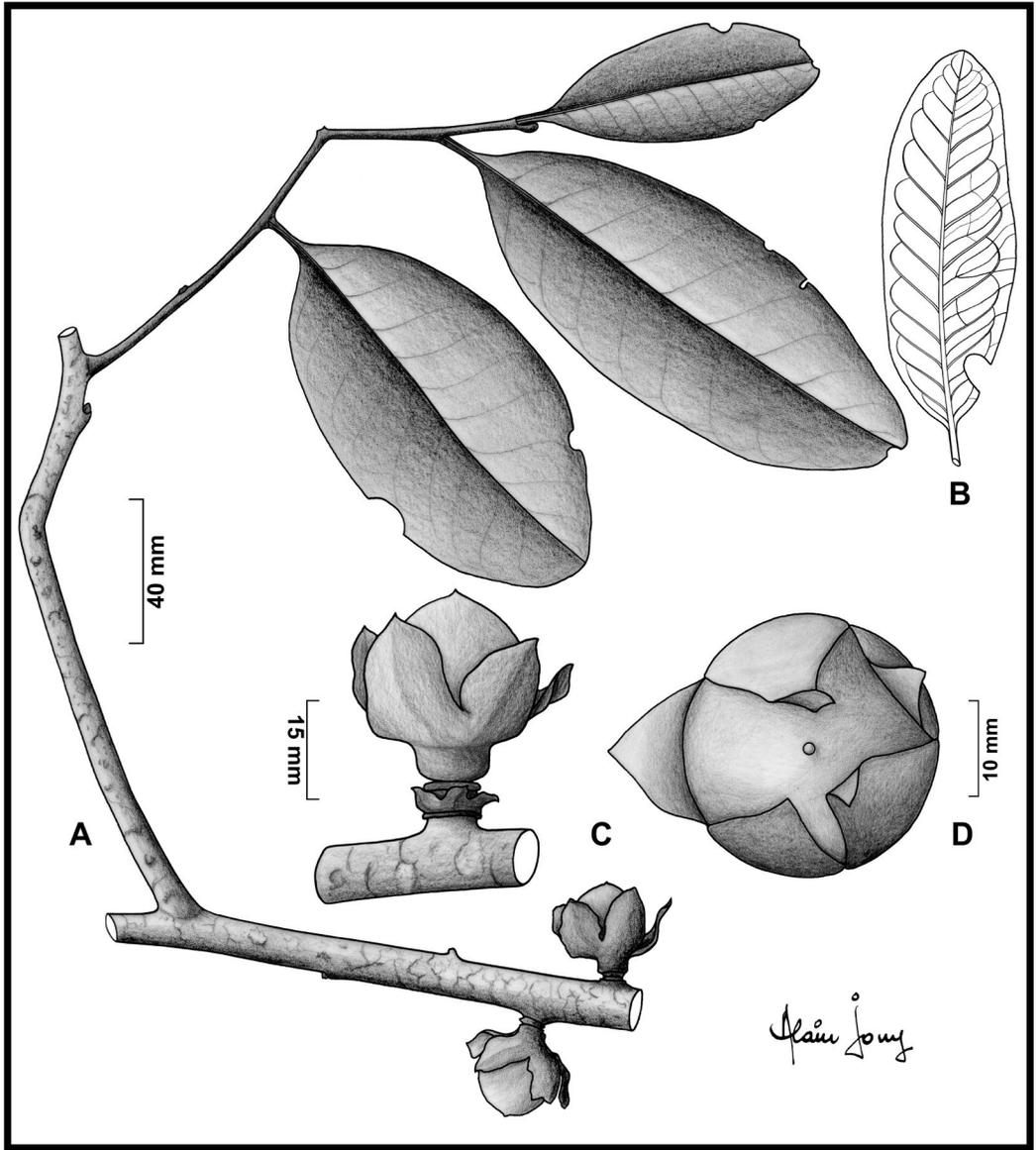


Figure 11. *Diospyros manongarivensis* A. G. Linan, G. E. Schatz & Lowry. —A. Branch with mature fruits. —B. Detail of leaf venation (adaxial surface). —C. Mature fruit (from above). —D. Mature fruit (from side). (A, C, D, *Malcomber et al.* 1945; B, *Malcomber et al.* 1987.) Drawing by A. Jouy.

Additional specimens examined. Madagascar. **Diana Region** [Antsiranana Prov.]: Réserve Spéciale de Manongarivo, 7–12 Dec. 1992 (fr.), *Malcomber et al.* 1987 (MO, P); Besinkara, 17 Sep. 1996 (♂ fl.), *Gautier 3067* (G, MO, P, TAN, WAG).

9. *Diospyros mapingo* H. Perrier, *Mém. Inst. Sci. Madagascar*, Sér. B, Biol. Vég. 4(1): 145, f. IX: 6–9. 1952. TYPE: Madagascar. Boeny Region [Mahajanga Prov.]: près de Bezovo, Oct. 1908 (♀

fl., fr.), *H. Perrier de la Bâthie 8791* (lectotype, designated here, P [bc] P00541791!; isolectotype, P [bc] P00541792!). Figure 9C.

Tree (rarely shrub) to 25 m tall and 35 cm DBH. Bark blackish. Young stems moderately covered with appressed, short, fine, blonde trichomes, glabrescent, mature stems beige. Leaves 7–11 × 2.5–4 cm, oblong-ovate, chartaceous, with appressed, short, fine, blonde trichomes on both surfaces, glabrescent, base round-

cuneate, margins slightly revolute and slightly undulate, apex round-obtuse, midvein slightly impressed above, raised below, venation weakly brochidodromous, somewhat obscure above, less so below, 11 to 13 secondaries per side, inserted at a 45°–50° angle to the midvein, inter-secondaries evident; petiole ca. 10 mm, 2 mm diam., terete, flattened above. Male flowers borne in axillary fascicles of 2 or 3? flowers, subtended by bracts ca. 9 × 5 mm, densely covered with semi-erect, short, fine, blonde trichomes, pedicels ca. 1 mm, densely covered with semi-erect, short, fine, blonde trichomes; calyx likewise with the same dense indument outside, glabrous inside; calyx cup ca. 8 × 5 mm, lobes 6, ca. 1 × 1 mm, triangular, apex acute; corolla moderately covered with semi-erect, short, fine, blonde trichomes, concentrated along the median of the lobes, glabrous inside, corolla tube ca. 7 × 5 mm, conical-urceolate, lobes 6, ca. 6 × 5 mm, ± obovate; stamens, ca. 55, inserted at the base of corolla tube, filaments 1.5 × 0.2 mm, flattened, anthers 2–2.5 × 0.6–0.7 mm; pistillode present, highly reduced, densely covered with semi-erect, short, fine, blonde trichomes. Female flowers solitary, sessile, borne in leaf axils, subtended by large bracts 1.5 × 1 cm; calyx accrescent, conical, densely covered throughout outside with semi-erect, short, fine, blonde trichomes, indument more sparse inside, calyx cup ca. 1.3 × 1.1 cm, lobes 5, ca. 1.5 × 0.9 mm, narrowly triangular, margins entire, apex acute; corolla moderately to sparsely covered with semi-erect, short, fine, blonde trichomes, concentrated on the lobes, corolla tube ca. 6 × 6 mm, cylindrical, lobes 5, ca. 1.1 × 0.8 mm, obovate; staminodes ca. 15, inserted at the base of the corolla tube, ca. 4 × 0.5 mm; ovary ca. 6 × 5 mm, ± globose, densely pubescent, style ca. 3 mm. Fruit solitary, sessile, borne at leafless nodes, 10-locular, 2 × 3–3.3 cm, oblate-globose, glabrous, green in vivo when young, maturing to variegated yellow with a red tinge, brown in sicco, apex depressed; calyx accrescent, densely covered with semi-erect, short, fine, blonde trichomes, becoming sparse with age, calyx cup 1.5–1.8 × 2.7–3 cm, ± conical, calyx lobes 5, 3–3.5 × 2–2.3 cm, spreading, triangular-trullate, margins entire, deflected away from the fruit surface at the base and sinuses, transitioning to flat toward the acute apex. Seeds 15–17 × 10–11 mm, spherical wedge-shaped.

Distribution, ecology, and phenology. *Diospyros mapingo* occurs in western and northwestern Madagascar, from north of Morondava to northeast of Mahajanga, extending to the far north to the Ampasindava Peninsula and Marotolana. It is found in dry to sub-humid forests including on limestone, at elevations of 50–418 m, rarely to 1199 m. Flowers have been recorded from September through December, and fruits from November through February.

Vernacular names. Hazojôby (*Madiomanana 109*), Lopingo (*Service Forestier 12003*), Mappingo (*Perrier de la Bâthie 8791*).

Conservation status. *Diospyros mapingo* has a geographic range in the form of an EOO of 89,220 km² and a minimum AOO of 120 km². It is present in the Ampasindava, Ankarafantsika, Beanka, Bemaraha, Menabe Antimamenaena, and Tsaratanana protected areas. Elsewhere it is threatened by fire, forest clearing for agriculture, grazing, and exploitation for firewood and house construction material, all of which will result in continuing decline. With respect to the most serious plausible threat of forest clearing for agriculture, *D. mapingo* is known to occur at 21 locations, and it was recently assessed for its risk of extinction as Least Concern [LC] (Schatz & Lowry, 2021a).

Notes. The calyx lobes of developing fruit of *Diospyros mapingo* occasionally break off in dried specimens. Interestingly, the ovary in flower is densely covered with trichomes that must wear off shortly after anthesis because even immature fruits are glabrous. Two sheets of the type collection (*Perrier de la Bâthie 8791*) are deposited in the Paris herbarium. We have chosen one of them ([bc] P00541791) as the lectotype because it is the only one that bears both flowering and fruiting material.

By virtue of reaching 25 m in height and 35 cm DBH, *Diospyros mapingo* is considered to be a large enough tree to be potentially exploited for its hardwood, and thus precise coordinates have been withheld.

Additional specimens examined. Madagascar. **DIANA Region:** [Antsiranana Prov.]: Tsarabanja, 14 Nov. 2008 (fr.), *Bernard 1206* (G, MO, P, TAN); Ampasindava, 2 Dec. 2013 (♂ fl.), *Gautier 6070* (G, K, MO, P, TAN); same locality, 11 Nov. 2008 (fr.), *Madiomanana et al. 109* (G, K, MO, P, TEF, WAG); same locality, 29 Nov. 2007 (fr.), *Nusbaumer 2644* (G, TEF); Marotolana, 30 Nov. 2000 (♀ fl.), *Ratovoson 364* (MO, P). **Boeny Region [Mahajanga Prov.]:** Réserve Nationale Intégrale de Namoroka, 1903 (♂ fl.), *Perrier de la Bâthie 1650* (P); Ankarafantsika, Oct. 1910 (♀ fl.), *Perrier de la Bâthie 8770* (P); Namoroka, Oct. 1926 (♂ fl.), *Perrier de la Bâthie 17816* (P); Ankarafantsika, 26 Feb. 2019 (fr.), *Rakotoao & Randrianaivo 7438* (DBEV, G, MO, P, TAN); same locality, 25 Feb. 2019 (st.), *Randrianaivo 3346* (DBEV, G, MO, P, TAN); same locality, 21 Nov. 1951 (fr.), *Réserves Naturelles 3330* (P); same locality, 21 Nov. 1951 (fr.), *Service Forestier 4696* (P); N de Majunga-Ampazony, 17 Nov. 1957 (♀ fl.), *Service Forestier 18445* (P); plateau de Berivotra, 22 Nov. 1957 (♀ fl.), *Service Forestier (Capuron) 18455* (P); Antsanovato, 20 Jan. 1959 (fr.), *Service Forestier (Capuron) 19259* (P). **Melaky Region [Mahajanga Prov.]:** Beanka, 25 Jan. 2012 (fr.), *Bolliger 124* (G, MO, P); same locality, 23 Nov. 2011 (fr.), *Gautier 5713* (G, MO, P); same locality, 30 Nov. 2012 (fr.), *Gautier 5890* (G, MO, P); same locality, 8 Feb. 2012 (fr.), *Hanitrarivo 154* (G, MO, P); same locality, 10 Feb. 2012 (fr.), *Hanitrarivo 162* (G, MO, P); Bemaraha, 27 Nov. 1996 (fr.), *Jongkind 3249* (MO, WAG); same locality, 50 m,

11 Dec. 1996 (fr.), *Jongkind 3509* (MO, WAG); same locality, 4 Dec. 1992 (fr.), *Labat & Deroin 2307* (MO, P, TAN); same locality, Feb. 1933 (fr.), *Leandri 1010* (MO, P); Beanka, 24 Feb. 2013 (fr.), *Luino & Rakotozafy 51* (G, MO, P); Beanka, 13 Nov. 2012 (fr.), *Rakotoavao 6225* (MO, P, TAN); Antsalova, [18°12'S, 44°35'E], 150–750 m, 20 Oct. 1954 (fl.), *Service Forestier 12003* (P).

10. *Diospyros montisgallicarum* A. G. Linan, G. E. Schatz & Lowry, sp. nov. TYPE: Madagascar. DIANA Region [Antsiranana Prov.]: Massif de la Montagne des Français, piste des manguiers, vallée d'Andavakoera, [12°20'S, 49°21'E], 0–100 m, 23 Feb. 1962 (fr.), *Service Forestier (Capuron) 20930* (holotype, P [bc] P03975078!; isotypes, G [bc] G00341890!, MO-6956003!, P [bc] P00722714!, W!). Figure 12.

Diagnosis. *Diospyros montisgallicarum* A. G. Linan, G. E. Schatz & Lowry can be distinguished from the species it most closely resembles vegetatively, *D. obscurinerva* A. G. Linan, G. E. Schatz & Lowry, by its wider leaves (2–2.5 cm vs. 1.3–1.9 cm in *D. obscurinerva*), ovoid fruit (vs. obovate-globose), and more shallow fruiting calyx cup (0.5–0.7 cm vs. ca. 1.5 cm).

Small tree to 5 m tall and 10 cm DBH. Young stems with dense indument of appressed, short, fine, blonde trichomes, glabrescent, mature stems beige-gray. Leaves 3.1–3.7 × 2–2.5 cm, obovate, coriaceous, upper surface glabrous and somewhat shiny, lower surface with sparse to moderately dense indument of appressed, fine, black, trichomes, persistent, base cuneate, margins slightly revolute, apex rounded, midvein slightly impressed above, raised below, venation weakly brochidodromous, somewhat obscure above and below, 6 or 7 secondaries per side, inserted at a 40°–45° angle to the midvein, inter-secondaries obscure or absent; petiole ca. 3 mm, 1–1.5 mm diam., ± terete, slightly flattened above, glabrous. Male flowers not seen. Female flowers solitary, sessile, borne in leaf axils, subtended by small pubescent bracts, with dense indument of appressed, short, fine, blonde trichomes, ca. 3.5 × 2.5 mm; calyx cup 7–8 × 4–5 mm, conical, with the same sparse indument on the outside, glabrous inside, calyx lobes 5, 14–15 × 5–6 mm, spreading, narrowly elliptic, margins entire and folded in half abaxially along the median, extending below the sinuses to the base of the calyx cup forming evident wings, apex acute-rounded; corolla with dense indument of appressed, short, fine, blonde trichomes, concentrated toward the median and base of the lobes, corolla tube ca. 5 × 3 mm, cylindrical, lobes 5, 6–7 × 3 mm, oblong; staminodes ca. 15, inserted on the base of the corolla tube, 3.5–4 × 0.5 mm; ovary ca. 3 × 3.5 mm, 4-locular, pyriform, with rounded protuberances, glabrous, styles 2 or 3, ca. 4 mm. Fruit 1.7–2 × 1–1.2 cm, solitary, axillary, sessile, borne either in leaf axils or at nodes of fallen leaves,

4-locular, ovoid, glabrous and sticky, color in vivo unknown, brown in sicco, apex acute; calyx accrescent, with sparse to moderately dense indument of appressed, fine, black trichomes, concentrated along the median of the lobes, calyx cup 5–7 × ca. 10 mm, calyx lobes 5, 18–20 × ca. 7 mm, not spreading, ± appressed to fruit surface, trullate-triangular, the margins perpendicular to the fruit surface, extending below the sinuses to the base of the calyx cup, forming evident wings, irregularly lacerate toward the base, transitioning to entire toward the ± acute apex. Seeds 14 × 5 mm, ellipsoid-wedge shaped.

Distribution, ecology, and phenology. *Diospyros montisgallicarum* is restricted to the Montagne des Français (Fig. 8), where it occurs in dry forest on calcareous substrate (tsingy, the Malagasy word for a characteristic form of karstic limestone), from 0 to 200 m elevation. Flowers have been recorded in December, and fruits in February.

Etymology. The species epithet refers to the Montagne des Français in far northern Madagascar, where *Diospyros montisgallicarum* appears to be endemic.

Vernacular names. Jobiampototra (*Be et al. 316*).

Conservation status. *Diospyros montisgallicarum* has a geographic range in the form of an AOO of 8 km². It is known only from the Montagne des Français protected area (Fig. 8), where it is threatened by fire, habitat degradation and land clearing for agriculture and charcoal production, all of which will result in continuing decline. With respect to the most serious plausible threat of land clearing for agriculture, it is known to occur at two locations. This species can therefore be assessed for its risk of extinction as Endangered [EN B2ab(i,ii,iii,iv,v)].

Additional specimens examined. Madagascar. DIANA Region [Antsiranana Prov.]: Antsiranana II, Mahavanona, Andranomanitra, Montagne des Français, Antalolanaomby, Ambatosariolo, 7 km au N d'Andranomanitra, 12°22'07"S, 49°20'54"E, 195 m, 14 Dec. 2006 (♀ fl.), *Be et al. 316* (MO, P, TAN).

11. *Diospyros nitidifolia* A. G. Linan, G. E. Schatz & Lowry, sp. nov. TYPE: Madagascar. DIANA Region [Antsiranana Prov.]: Antsiranana II, Andrafiabe, Ambolobozokely, forêt de Nosy Voanio, à 4 km à l'Est d'Ambolobozokely, 12°25'59"S, 49°33'05"E, 15m, 15 Feb. 2006 (fr.), *R. Randrianaivo, R. Rakotonandrajaona, S. Rakotonandrasana, R. Guittou, V. Benjara, C. Claude, A. Razanakolona & Michel 1369* (holotype, MO-6418985!;

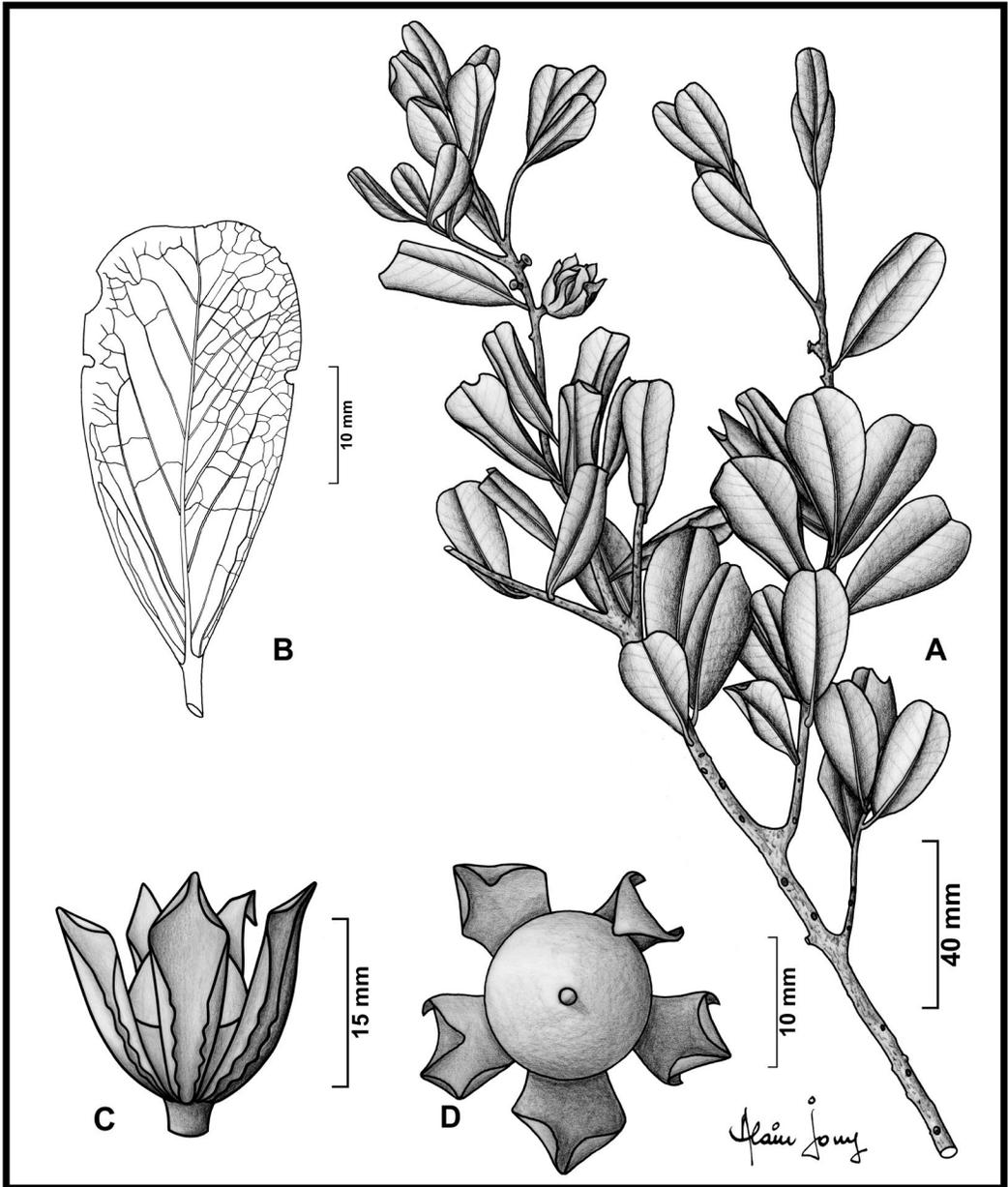


Figure 12. *Diospyros montisgallicarum* A. G. Linan, G. E. Schatz & Lowry. —A. Branch with mature fruit. —B. Detail of leaf venation (abaxial surface). —C. Mature fruit (from side). —D. Mature fruit (from above). (A–D, *Service Forestier* 20930.) Drawing by A. Jouy.

isotypes, CNARP not seen, P [bc] P04611069!, TAN not seen). Figures 9D, 13.

Diagnosis. *Diospyros nitidifolia* A. G. Linan, G. E. Schatz & Lowry can be distinguished vegetatively from other members of *Diospyros* L. sect. *Forbesia* F. White by its distinctly shiny, glabrous mature leaves, usually with an emarginate to rounded apex. Its fruits can be distinguished from those of *D. courierensis* A. G. Linan, G. E. Schatz & Lowry, with

which they are most similar, by the presence of 8 locules in ovary (vs. 4 in *D. courierensis*) and calyx lobes whose margins are \pm perpendicular to the fruit surface along their whole length (vs. margins deflected away at the base and transitioning to flat toward the apex).

Small tree to 4 m tall and 7 cm DBH. Young stems glabrous, mature stems beige-gray. Leaves 3–6 \times 2.5–5 cm, obovate-orbicular, coriaceous, glabrous and dis-

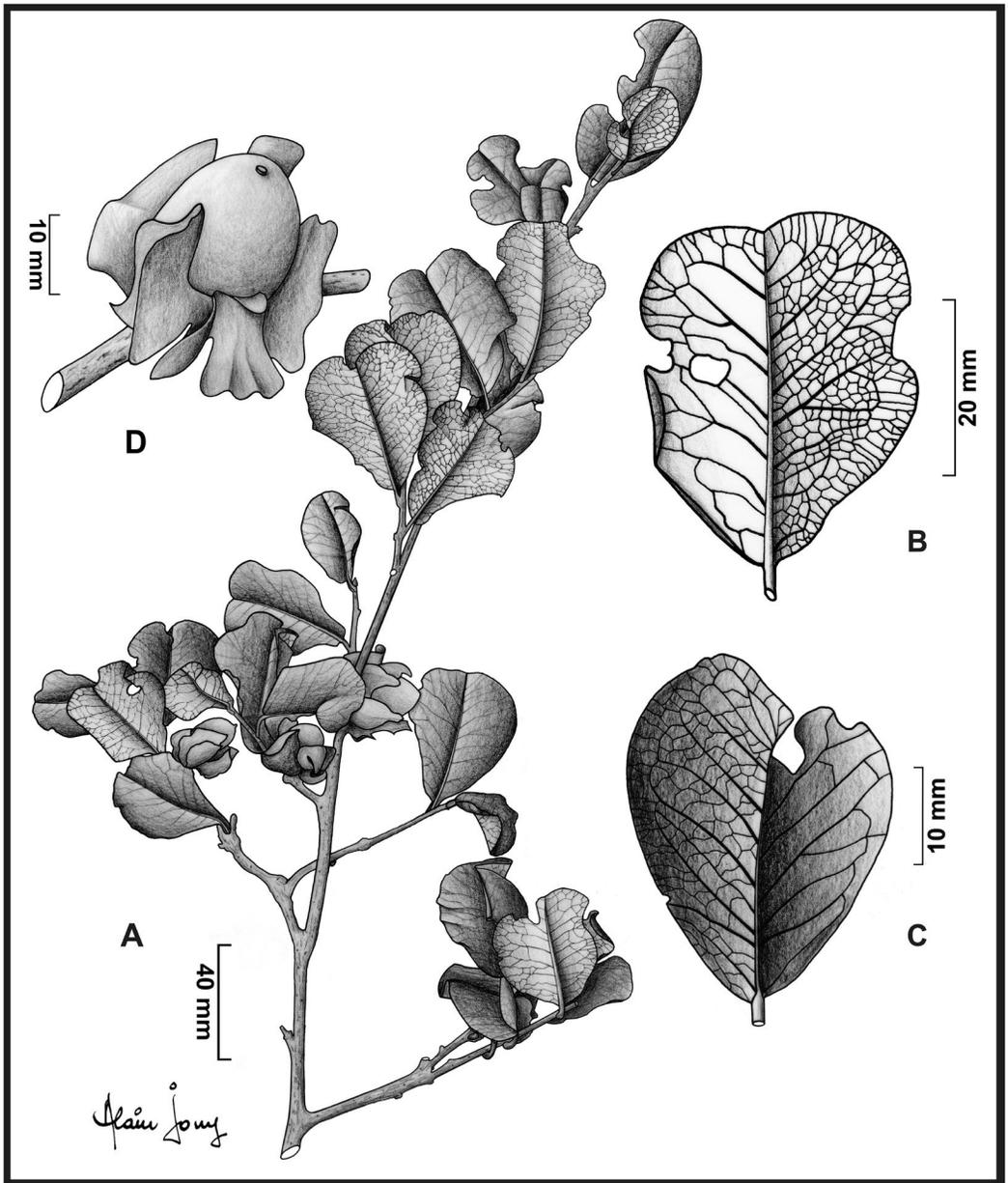


Figure 13. *Diospyros nitidifolia* A. G. Linan, G. E. Schatz & Lowry. —A. Branch with mature fruits. —B. Detail of leaf venation (abaxial surface). —C. Leaf (adaxial surface). —D. Mature fruit. (A–C, *Razafitsalama* 947; D, *Randrianaivo et al.* 1369.) Drawing by A. Jouy.

tinctly shiny above, initially moderately covered with very short, fine, blonde trichomes below, glabrescent, base cuneate, margins weakly undulate, apex emarginate to retuse to rounded; midvein slightly impressed above, raised below, venation weakly brochidodromous, very evident on both surfaces, 6 to 9 secondaries per side, inserted at a 40°–45° angle to the midvein, inter-

secondaries very weakly evident; petiole ca. 3.5 mm, 1–1.5 mm diam., ± terete, slightly flattened-caniculate above, glabrous. Male and female flowers not seen. Fruit (known only from slightly immature material) 19–22 × 11–13 mm, solitary, axillary, sessile, borne at nodes of fallen leaves, ca. 8-locular, ovoid to globose, glabrous, green in vivo when young, maturing to variegated yellow

with a red tinge, brown in sicco, apex slightly acute; calyx glabrous, calyx cup ca. 1×1.5 cm, calyx lobes 5, ca. 20×9 – 10 mm, slightly spreading, trullate-triangular, margins entire, \pm perpendicular to the fruit surface along their whole length, slightly undulate, extending below the sinuses to the base of the calyx cup, forming evident wings, apex \pm acute. Seeds 11 – 13×4 – 5 mm, ellipsoid-wedge shaped.

Distribution, ecology, and phenology. *Diospyros nitidifolia* is restricted to the east coast of the very northern tip of Madagascar (Fig. 8), where it occurs in littoral forest on sand and/or limestone, at elevations of 0–50 m. Fruits have been recorded from November through March.

Etymology. The species epithet refers to the shiny upper leaf surface characteristic of *Diospyros nitidifolia*.

Conservation status. *Diospyros nitidifolia* has a geographic range in the form of an EOO of 3.73 km² and a minimum AOO of 3.73 km². It is present in the Oranjia protected area (Fig. 8). Elsewhere it is threatened by fire, forest clearing for agriculture, and grazing, all of which will result in continuing decline. With respect to the most serious plausible threat of forest clearing for agriculture, it is known to occur at two locations. Therefore, *D. nitidifolia* can be assessed for its risk of extinction as Endangered [EN B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v)].

Additional specimens examined. Madagascar. **DIANA Region [Antsiranana Prov.]**: Baie de Sakalava, piste entre Baie de Sakalava et Orangea, $12^{\circ}16'39''S$, $49^{\circ}22'49''E$, 21 m, 5 Nov. 2006 (fr.), *Ranaivojaona et al.* 1507 (MO, P, TAN); Andrafiabe, Ambolobozokely (Ambolobozikely), Nosy Voanio, ca. 2 km à l'Est d'Ambolobozokely, (Baie de Rigny), $12^{\circ}25'46''S$, $49^{\circ}33'05''E$, 9 m, 18 Mar. 2006 (fr.), *Razafit-salama* 947 (CNARP, MO, P, TAN).

12. *Diospyros obscurinerva* A. G. Linan, G. E. Schatz & Lowry, sp. nov. TYPE: Madagascar. SAVA Region [Antsiranana Prov.]: Vohemar, Mantamena, part of Bekaroaka Range, 7 km NE of Daraina, [$13^{\circ}08'S$, $49^{\circ}42'E$], 112–330 m, 29 Mar. 1990 (fr.), *D. M. Meyers & F. Boltz* 82 (holotype, MO-6857402!; isotypes, P [bc] P03975086!, TAN not seen). Figures 14A, B, 15.

Diagnosis. *Diospyros obscurinerva* A. G. Linan, G. E. Schatz & Lowry can be distinguished from the species it most closely resembles vegetatively, *D. montisgallicarum* A. G. Linan, G. E. Schatz & Lowry, by its narrower leaves (1.3 – 1.9 cm wide vs. 2 – 2.5 cm wide in *D. montisgallicarum*), and oblate-globose fruit (vs. ovoid) with taller margins of calyx cup (1.3 – 1.9 cm vs. 0.5 – 0.7 cm).

Small tree to 8 m tall and 18 cm DBH. Young stems glabrous, mature stems beige. Leaves 3 – 8.7×1.3 – 1.9 cm, narrowly obovate to obovate, very coriaceous, glabrous above, initially with sparse appressed, short, fine, blonde trichomes below, glabrescent, base cuneate to attenuate, margins slightly revolute, apex round to emarginate, midvein slightly impressed above, raised below, venation very obscure, secondaries weakly visible, 4 to 6 per side, inserted at ca. 25° – 30° angle to the midvein, inter-secondaries obscure or absent; petiole 3 – 3.5 mm, ca. 1.5 mm diam., \pm terete, slightly flattened above, glabrous. Male flowers borne in axillary fascicles of 1 to 3? flowers, peduncle ca. 4×2 mm, subtended by glabrous bracts, pedicels ca. 1 mm, moderately covered with sparse, appressed, short, fine, blonde trichomes; calyx cup 3.5×3 mm, moderately covered with appressed, short, fine, blonde trichomes, cylindrical, abruptly tapering at the base, the apex shallowly 5-lobed, calyx lobes ca. 1×1 mm, triangular; corolla with very sparse, appressed, long, fine, blonde trichomes outside, glabrous inside, corolla tube ca. 2×1.5 mm, \pm cylindrical, lobes 4 or 5, ca. 3×3 mm, narrowly triangular-trullate; stamens 28 to 32, inserted at the base of corolla tube, filaments ca. 1×0.2 mm, flattened, anthers ca. 2×0.4 mm; pistillode present, highly reduced, densely covered with appressed, short, fine, blonde trichomes. Female flowers solitary, axillary, sessile, borne at nodes of fallen leaves, subtended by small glabrous bracts 4×2 mm; calyx sparsely covered with appressed, short, fine, blonde trichomes outside, glabrous inside, calyx cup conical, 7 – 8×4 – 5 mm, calyx lobes 5, ca. 11×6 mm, enclosing the flower, narrowly trullate to narrowly elliptic, margins entire, \pm perpendicular to the ovary toward the base and sinuses, extending below the sinuses to the base of the calyx cup, forming evident wings, transitioning to flat toward the obtuse-rounded apex; corolla with sparse, appressed, short, fine, blonde trichomes, concentrated toward the median of the lobes, glabrous inside, corolla tube ca. 5×4 mm, cylindrical, lobes 4 or 5, 5 – 6×3 mm, \pm oblong; staminodes ca. 20, inserted on the base of the corolla tube, ca. 3×0.5 mm; ovary ca. 2×4 mm, 10-locular, oblate-globose, glabrous, style 5-branched, 4 mm. Fruit solitary, sessile, borne in leaf axils, 8- to 10-locular, 1.3 – 1.6×2 – 2.5 cm, oblate-globose, glabrous, green in vivo when young, color at maturity unknown, brown in sicco, apex depressed; calyx accrescent, glabrous throughout, calyx cup 1.5×1.5 cm, calyx lobes 5, ca. 2×1.2 mm, spreading slightly, \pm narrowly triangular, margins entire, \pm perpendicular to the fruit surface toward the base and sinuses, extending below the sinuses to the base of the calyx cup, forming evident wings, transitioning to flat toward the acute apex. Seeds 10 – 11×7 – 8 mm, spherical wedge-shaped.

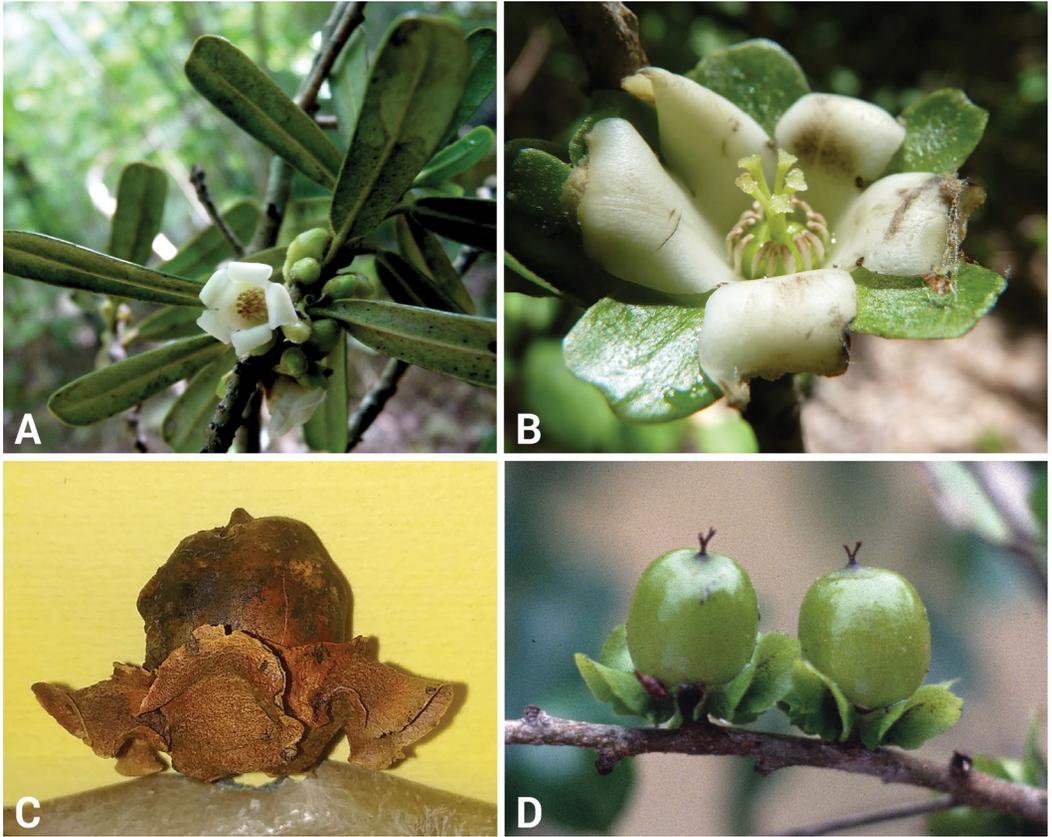


Figure 14. Photos of *Diospyros* L. species. A, B. *Diospyros obscurinerva* A. G. Linan, G. E. Schatz & Lowry. —A. Branch with male flower (Karatra et al. 31). —B. Female flower (Karatra et al. 32). —C. *Diospyros orientalis* A. G. Linan, G. E. Schatz & Lowry, mature fruit (Service Forestier 18084). —D. *Diospyros pascalii* A. G. Linan, G. E. Schatz & Lowry, branch with nearly mature fruits (Pascal 881). Photos: A, B, M. Ramamonjhasina; C, A. Linan; D, O. Pascal.

Distribution, ecology, and phenology. *Diospyros obscurinerva* is restricted to the far north of Madagascar, where it is known from Analamerana Special Reserve and the Daraina area (Fig. 3). It occurs in dry deciduous forests on limestone and/or sand, at elevations of 50–350 m. Label data from Meyers 82 and Meyers 262 indicate that its fruits are eaten by a locally endemic lemur species, *Propithecus tattersalli* Simons. Flowers have been recorded from December through February, and fruits from February through March, with a single specimen reportedly fruiting in October.

Etymology. The species epithet refers to the obscure leaf venation characteristic of *Diospyros obscurinerva* (Figs. 14A, B and 15).

Vernacular names. Mappingo (Meyers 262; Andri-anantoanina et al. 753).

Conservation status. *Diospyros obscurinerva* has a geographic range in the form of an EOO of 405 km² and a minimum AOO of 20 km². It is present in the Analamerana and Loky Manambato protected areas (Fig. 3). Elsewhere it is threatened by fire, forest clearing for agriculture, grazing, and exploitation for firewood and house construction material, all of which will result in continuing decline. With respect to the most serious plausible threat of forest clearing for agriculture, it is known to occur at six locations. Therefore, *D. obscurinerva* can be assessed for its risk of extinction as Vulnerable [VU B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,v,v)].

Additional specimens examined. Madagascar. **DIANA Region** [Antsiranana Prov.]: Analamera, bank of Irodo River, 12°40'25"S, 49°32'40"E, 41 m, 9 Jan. 2002 (♂ fl.), De Block et al. 1163 (BR, G, MO, TAN, WAG). **SAVA Region** [Antsiranana Prov.]: Daraina, forêt d'Ambararatabe, en bas ver-

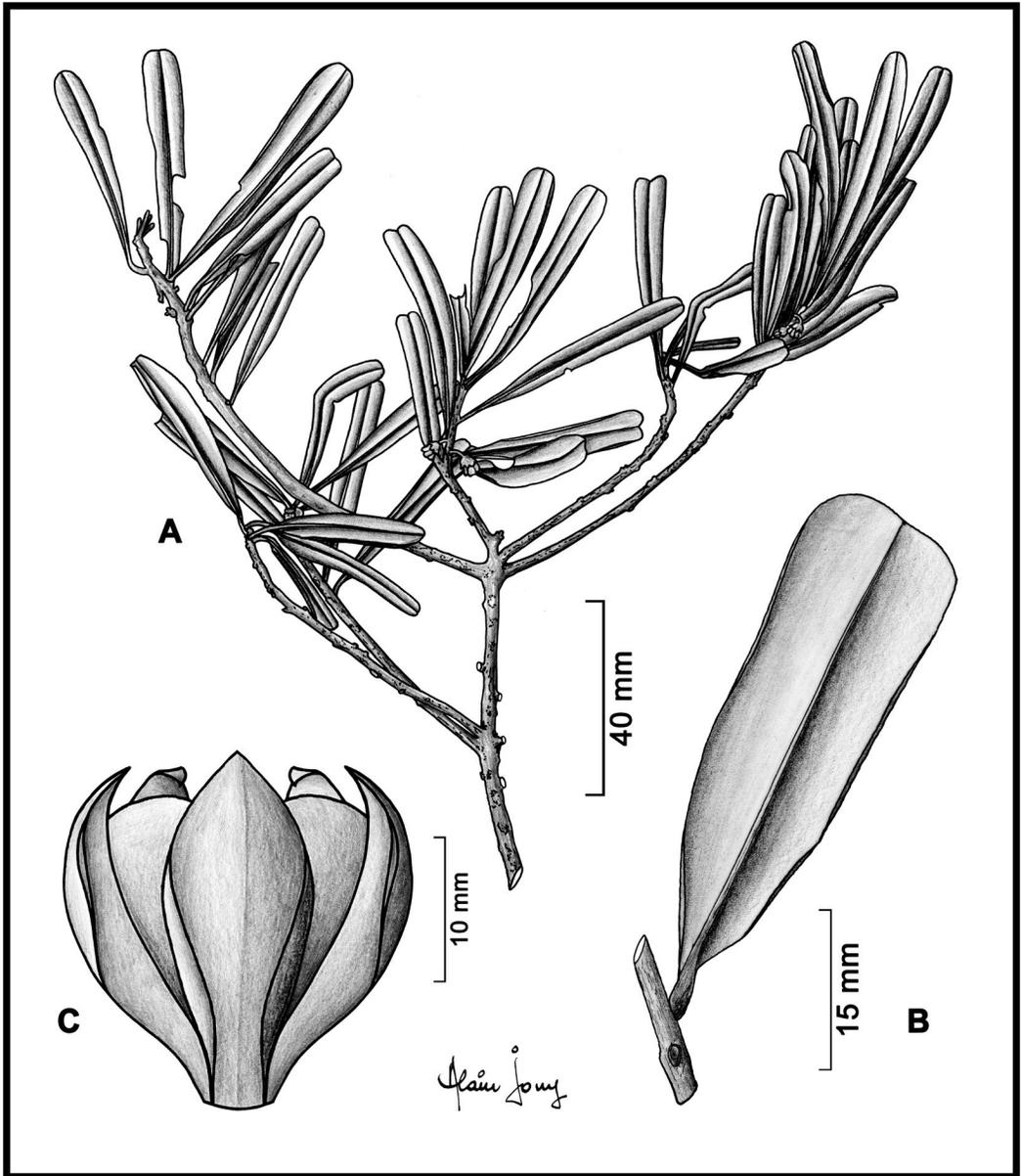


Figure 15. *Diospyros obscurinerva* A. G. Linan, G. E. Schatz & Lowry. —A. Branch. —B. Detail of leaf (abaxial surface). —C. Mature fruit. (A, *De Block et al. 1163*; B, *Randrianaivo et al. 1438*; C, *Meyers 262*.) Drawing by A. Jouy.

sant, 13°07'33"S, 49°42'37"E, 183 m, 4 Oct. 2013 (fr.), *Andriamiarinoro et al. 391*, (G, MO, P, TAN); forêt du Mont Ambararata Nord, sur crête, 13°06'43"S, 49°41'31"E, 344 m, 5 Oct. 2013 (fr.), *Andriamiarinoro et al. 396*, (G, MO, P, TAN); Daraina, forêt d'Ampondrabe, 12°58'57"S, 49°41'11"E, 95 m, 8 Feb. 2019 (♂ fl.), *Karatra et al. 31* (DBEV, MO, P, TAN); same locality, 96 m, 8 Feb. 2019 (♀ fl.), *Karatra et al. 32* (DBEV, G, MO, P, TAN); same locality, 94 m, 8 Feb. 2019 (fl.), *Karatra et al. 33* (DBEV, P); same locality, 91 m, 8 Feb. 2019 (♀ fl.), *Karatra et al. 34* (DBEV, G, MO, P, TAN); same local-

ity, 90 m, 8 Feb. 2019 (bud), *Karatra et al. 35* (DBEV, P); same locality, 96 m, 8 Feb. 2019 (bud), *Karatra et al. 37* (DBEV, G, MO, P, TAN); same locality, 20 m, 8 Feb. 2019 (bud), *Karatra et al. 38* (DBEV, P); same locality, 94 m, 8 Feb. 2019 (bud), *Karatra et al. 39* (DBEV, G, MO, P, TAN); Bekaroaka Range, 7 km NE of Daraina, [13°08'S, 49°42'E], 112–330 m, 6 Apr. 1991 (fr.), *Meyers & Boltz 262* (MO); Befarafara, forêt de Solanampilana, à 35 km au N de Daraina, 13°05'42"S, 49°34'57"E, 137 m, 9 Dec. 2006 (♂ fl.), *Randrianaivo et al. 1438* (CNARP, MO, P, TAN).

13. *Diospyros olivieri* A. G. Linan, G. E. Schatz & Lowry, sp. nov. TYPE: DIANA Region [Antsiranana Prov.]: Environs de la Réserve Spéciale d'Analamera, à 25 km à l'Est de Sadjoavato par route, à 2 km à l'Est du village d'Antafiamantsina, campement près de la rivière d'Ampondrakely, 12°40'40"S, 49°32'43"E, 127 m, 17–22 Jan. 1995, O. Andrianantoanina, M. Zjhra, J. Hutcheon & R. Bezara 753 (fr.) (holotype, MO-04903238!; isotypes, P [bc] P03975082!, TAN not seen). Figure 16.

Diagnosis. *Diospyros olivieri* A. G. Linan, G. E. Schatz & Lowry can be distinguished from the species it most closely resembles vegetatively, *D. crassifolia* A. G. Linan, G. E. Schatz & Lowry and *D. orientalis* A. G. Linan, G. E. Schatz & Lowry, by its leaves with 5 to 6 secondary veins per side (vs. 14 to 16 in *D. crassifolia* and 7 to 8 in *D. orientalis*), and generally shorter petiole (2.5–3.5 mm vs. 3–5 cm in *D. crassifolia* and 4–9 cm in *D. orientalis*). Its fruits can be distinguished from those of *D. obscurinerva* A. G. Linan, G. E. Schatz & Lowry, which they most closely resemble, by their less-woody calyx (vs. distinctly woody in *D. obscurinerva*) whose lobes have margins that extend slightly below the sinuses and are irregularly lacerate at the base and the sinuses, transitioning to entire toward the apex (vs. lobe margins entire and extending below the sinuses to the base of the calyx cup in *D. obscurinerva*).

Shrub or small tree to 7 m tall and 5 cm DBH. Young stems glabrous, mature stems gray to beige. Leaves 4–7.5 × 2–3 cm, obovate to oblong, very coriaceous, glabrous on both surfaces, base cuneate, margins slightly revolute, apex round, midvein slightly impressed above, yellow in vivo, raised below, venation weakly brochidodromous, ± obscure on both surfaces, 5 or 6 secondaries per side, inserted at ca. 45° angle to the midvein, inter-secondaries obscure or absent; petiole 2.5–3.5 mm, ca. 2.5 mm diam., ± terete, flattened above, margins slightly winged. Male flowers borne in axillary fascicles of 1 to 3? flowers, peduncle subtended by tiny pubescent bracts ca. 4 × 2 mm, pedicels ca. 1 mm, with moderately dense indument of short, fine, blonde, semi-appressed trichomes; calyx cup 3.5 × 3 mm, cylindrical, abruptly tapering at the base, covered with moderately dense indument of short, fine, blonde, semi-appressed trichomes throughout, the lobes 5, ca. 1 × 1 mm, triangular; corolla glabrous on both surfaces, corolla tube ca. 4 × 3 mm, ± urceolate, lobes 4 or 5, 6–7 × 2 mm, obovate-elliptic; stamens ca. 30, inserted at the base of corolla tube, filaments 1.3 × 0.2 mm, flattened, anthers ca. 3 × 0.4 mm; pistillode present, highly reduced, densely covered with moderately dense indument of short, fine, blonde, semi-appressed trichomes. Female flowers not seen. Fruit ca. 1.5 × 2.5 cm, solitary, sessile, borne in leaf axils, oblate-globose to ± ovoid, glabrous, ca. 8-locular, green in vivo when young, color at maturity unknown, brown in sicco, apex depressed; calyx accrescent, sparsely covered prior to maturity

with moderately dense indument of short, fine, blonde, semi-appressed trichomes, concentrated in the median of the lobes, glabrescent, calyx cup 1.5 × 1.3 cm, calyx lobes 5, ca. 1.5 × 1.6 cm, spreading at maturity, narrowly triangular, margins lacerate, ± perpendicular to the fruit surface toward the base, extending slightly below the sinuses onto the calyx cup, transitioning to entire and ± flat toward the acute apex. Seeds not seen.

Distribution, ecology, and phenology. *Diospyros olivieri* is restricted to the far north of Madagascar, from around the Analamerana Special Reserve (Fig. 3), where it occurs in dry semi-deciduous forests on limestone, at elevations of 50–150 m. Flowers and fruits have been recorded in January.

Etymology. This species is named in honor of Olivier Andrianantoanina, who made nearly 1000 excellent collections in northern Madagascar while working for the Missouri Botanical Garden between 1993 and 1996.

Conservation status. *Diospyros olivieri* has a geographic range in the form of an AOO of 4 km². It occurs just outside the Analamerana protected area (Fig. 3), where it is threatened by grazing and exploitation for firewood and house construction material, which will result in continuing decline. With respect to the most serious plausible threat of forest clearing for agriculture, it is known to occur at one location. Therefore, *D. olivieri* can be assessed for its risk of extinction as Critically Endangered [CR B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v)].

Additional specimens examined. Madagascar. **DIANA Region [Antsiranana Prov.]**: Analamera, along Ambatabe River, 12°40'25"S, 49°32'43"E, 41 m, 8 Jan. 2002 (fr.), *De Block et al. 1116* (BR, G, MO, P, TAN); same locality, 41 m, 8 Jan. 2002 (♂ fl.), *De Block et al. 1118* (BR, MO, TAN); same locality, 6–10 Jan. 2002 (♂ fl.), *Razafimandimbison et al. 414* (MO, UPS); same locality and date (fr.), *Razafimandimbison et al. 420* (MO, UPS).

14. *Diospyros orientalis* A. G. Linan, G. E. Schatz & Lowry, sp. nov. TYPE: Madagascar. Antsinana Region [Toamasina Prov.]: forêt sublittorale, sur sables, à Vohibola, à l'ouest de Tampina, [18°31'S, 49°17'E], 0–50 m, 12–14 Aug. 1957 (fr.), *Service Forestier (Capuron) 18084* (holotype, P [bc] P03974926!). Figures 14C, 17.

Diagnosis. *Diospyros orientalis* A. G. Linan, G. E. Schatz & Lowry can be distinguished from the species it most closely resembles vegetatively, *D. crassifolia* A. G. Linan, G. E. Schatz & Lowry and *D. olivieri* A. G. Linan, G. E. Schatz & Lowry, by its leaves with slightly longer petioles (4–8 mm vs. 3–5 mm in *D. crassifolia* and 2.5–3.5 mm in *D. olivieri*) and 7 or 8 secondary veins per side (vs. 14 to 16 in *D. crassifolia* and 5 or 6 in *D. olivieri*).

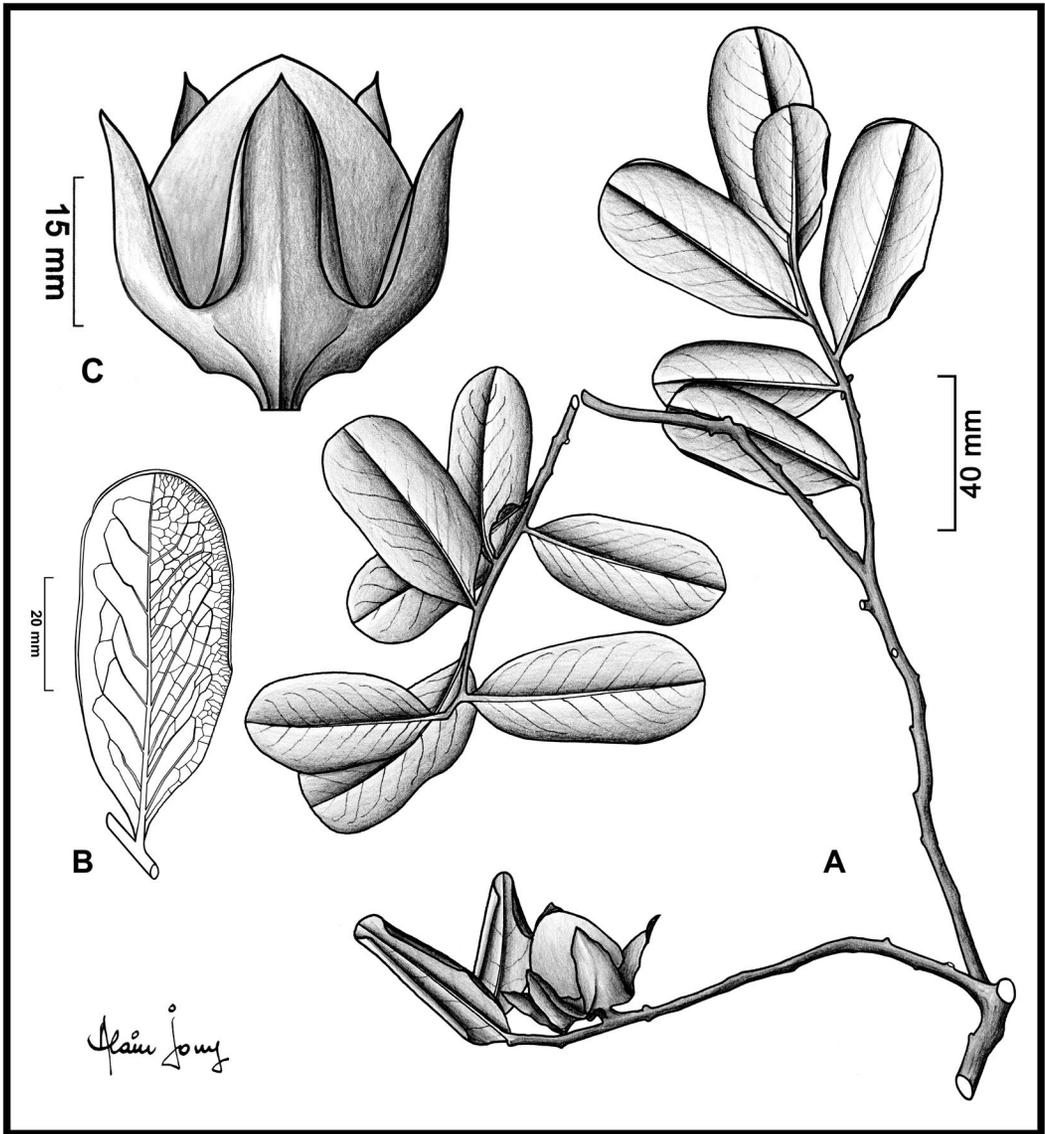


Figure 16. *Diospyros olivieri* A. G. Linan, G. E. Schatz & Lowry. —A. Branch with fruit. —B. Detail of leaf venation (abaxial surface). —C. Fruit. (A–C, *Andrianantoanina et al.* 753.) Drawing by A. Jouy.

Tree to 10 m tall, DBH unknown. Young stems and young leaves unknown, stems glabrous and beige. Leaves 5.5–11 × 2.5–4.5 cm, obovate, very coriaceous, glabrous on both surfaces, base cuneate, margins revolute, apex round to rarely emarginate, midvein impressed above, raised below, venation weakly brochidodromous, ± obscure on both surfaces, 7 or 8 secondaries per side, inserted at ca. 45° angle from the midvein, inter-secondaries evident; petiole 4–9 mm, 1.5–3 mm diam., ± terete, flattened above, with slightly winged margins, glabrous. Male flowers solitary, axil-

lary, sessile, borne either in leaf axils or at nodes of fallen leaves, subtended by bracts 3 × 2 mm, densely covered with semi-erect to erect, short, coarse, black trichomes; calyx cup 5 × 3–4 mm, cylindrical, abruptly tapering at the base, apex shallowly 5-lobed, the lobes 3 × 3 mm, triangular, with dense indument of semi-erect to erect, short, coarse, black trichomes outside, glabrous inside, apex acute; corolla with very sparse, appressed, long, fine, blonde trichomes outside, concentrated along the median of the lobes, glabrous inside, corolla tube 3 × 5 mm, urceolate, lobes 5, ca. 5 ×

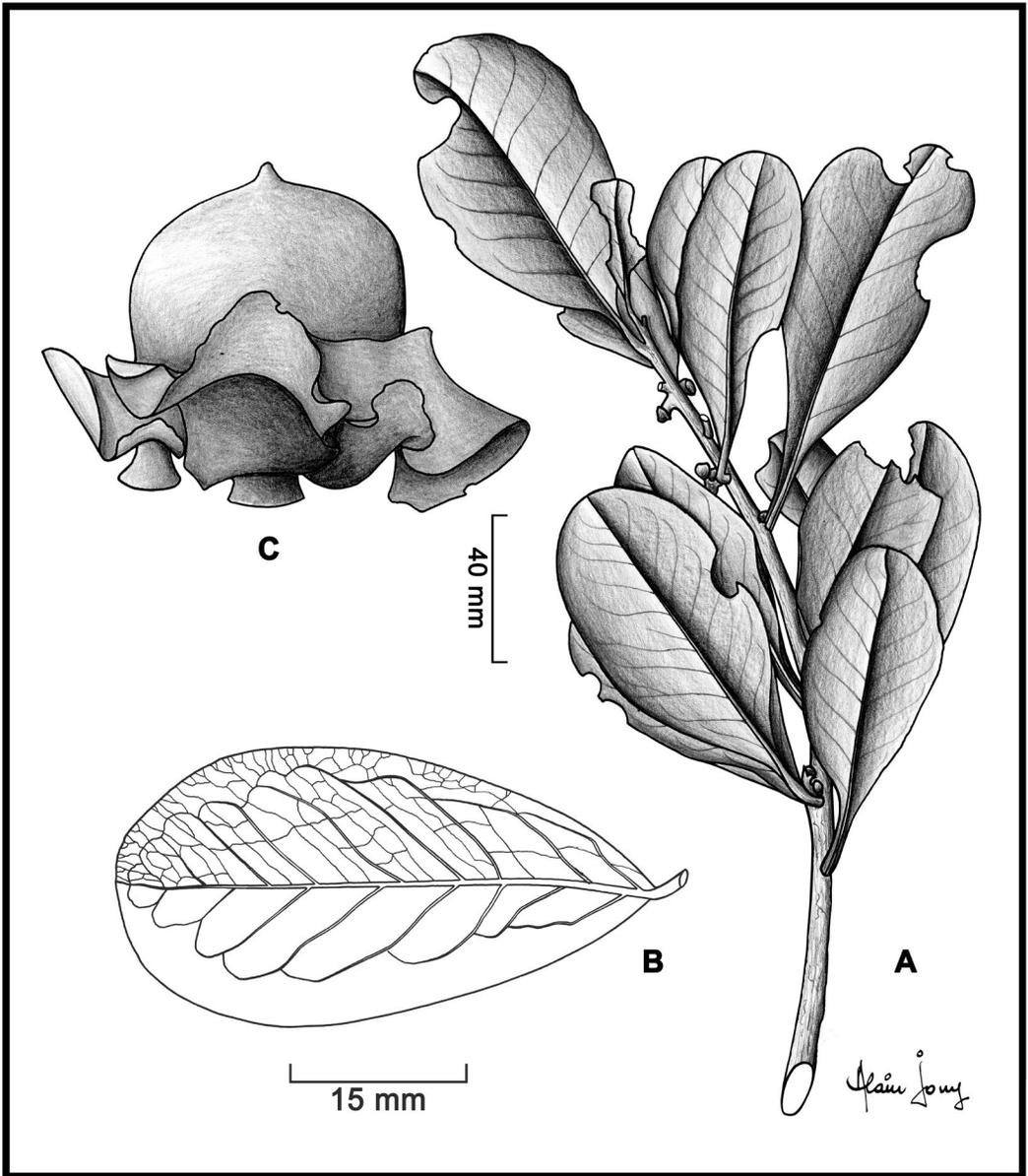


Figure 17. *Diospyros orientalis* A. G. Linan, G. E. Schatz & Lowry. —A. Branch with fruiting pedicels (fruit fallen). —B. Detail of leaf venation (abaxial surface). —C. Fruit. (A–C, *Service Forestier 18084*.) Drawing by A. Jouy.

4 mm; stamens 25 to 55, inserted at the base of corolla tube, filaments 1.3×0.2 mm, flattened, anthers 2.5×0.4 mm; pistillode present, very reduced, densely covered with short, blonde trichomes. Female flowers not seen. Fruit 1.2–1.4 \times 1.4–1.6 cm, solitary, axillary, pedicels 5–10 mm, borne at nodes of fallen leaves, globose to ovoid, glabrous, number of locules unknown, fruit color unknown in vivo, brown in sicco, apex depressed; calyx glabrous throughout, calyx cup shallow,

ca. 10×15 –19 mm, calyx lobes 5, 7–8 \times 10–12 mm, spreading, triangular-trullate, margins entire, strongly undulate along the length of the lobe, apex acute. Seeds 9–10 \times 4–5 mm, spherical wedge-shaped.

Distribution, ecology, and phenology. *Diospyros orientalis*, the only member of *Diospyros* sect. *Forbesia* known from along the east coast of Madagascar, has been recorded at just two sites separated from one an-

other by about 550 km (Fig. 5). It occurs in littoral and sub-littoral forest at elevations of 0–50 m. Flowers have been recorded in August, and fruit in December.

Etymology. The specific epithet refers to the distribution of the species, which is the only member of *Diospyros* sect. *Forbesia* restricted to the eastern coast of Madagascar.

Conservation status. *Diospyros orientalis* has a geographic range in the form of an AOO of 8 km². It is not present in any protected areas (Fig. 5) and is threatened by fire, forest clearing for agriculture, grazing, and exploitation for firewood and house construction material, all of which will result in continuing decline. With respect to the most serious plausible threat of forest clearing for agriculture, it is known to occur at two locations. Therefore, *D. orientalis* can be assessed for its risk of extinction as Endangered [EN B2ab(i,ii,iii,iv,v)].

Additional specimen examined. Madagascar. **SAVA Region [Antsiranana Prov.]:** forêt littorale au S de Vohémar, [13°24'05"S, 50°00'52"E], 11–19 Dec. 1966 (♂ fl.), *Service Forestier 27296* (MO, P).

15. *Diospyros pascalii* A. G. Linan, G. E. Schatz & Lowry, sp. nov. TYPE: Mayotte Island, Sohoa, 12°49'16"S, 45°06'32"E, 200 m, 5 Feb. 1997 (fr.), *O. Pascal 881* (holotype, P [bc] P00143103!; isotypes, G not seen, K not seen, MAO not see, MO-6921263!, WAG not seen). Figures 14D, 18.

Diagnosis. *Diospyros pascalii* A. G. Linan, G. E. Schatz & Lowry can be distinguished from the other members of *Diospyros* L. sect. *Forbesia* F. White by its leaves that are small (2.5–3.5 × 1–1.8 cm), chartaceous, and ovate, with an acute apex and a rounded acumen, and a raised midvein on the upper surface, as well as its small fruit (1.5–1.7 × 1.6–1.8 cm).

Tree to 25 m tall, DBH unknown. Young stems moderately to sparsely covered with short, erect, blonde trichomes, glabrescent, mature stems gray to rust-colored. Leaves 2.5–3.5 × 1–1.8 cm, ovate, chartaceous, glabrous on both surfaces, base rounded, margins flat to slightly revolute, apex acuminate, the acumen rounded, midvein raised on both surfaces, venation weakly brochidodromous, very obscure above, somewhat so below, 7 to 9 secondaries, inserted at 45°–50° angle to the midvein, inter-secondaries obscure or absent; petiole 1.5–2 mm, 0.5 mm diam., ± terete, slightly flattened above. Male flowers solitary, sessile, axillary, subtended by tiny bracts 2.5 × 2 mm; calyx cup ca. 3 × 3–4 mm, with dense indument of short, appressed, coarse, black trichomes outside, glabrous inside, the 5 shallow triangular lobes spreading, 0.3–0.5 × 0.3–0.5 mm, apex rounded to acute; corolla with sparse

indument of long, appressed, coarse, black trichomes outside, concentrated toward the median of the lobes, glabrous inside, corolla tube ca. 3 × 3 mm, urceolate, lobes 5, 2–3 × 2 mm, ± oblong; stamens 28 to 30, inserted at the base of corolla tube, filaments ca. 0.5 × 0.2 mm, anthers ca. 1.5 × 0.3 mm; pistillode absent. Female flowers solitary, axillary, sessile, borne at nodes of fallen leaves, subtended by tiny glabrous bracts ca. 3 × 2 mm; calyx ± cylindrical, very deeply lobed, the 5 lobes united at the base of the flower, ca. 4.5 × 3 mm, triangular-trullate, densely covered along the median with long, appressed, coarse, black trichomes, the margins entire, perpendicular to the ovary at the base of the lobes, very slightly undulate, transitioning to flat toward the acute apex; corolla brick red in vivo, with sparse indument of long, appressed, coarse, black trichomes, corolla tube ca. 3 × 3 mm, ± cylindrical, ± glabrous on both surfaces, lobes 5, ca. 3 × 2 mm, ± oblong; staminodes ca. 15, inserted on the base of the corolla tube, 2.5 × 2.5 mm; ovary 1.5 × 1.8 mm, ovoid-globose, glabrous, style 2-branched, ca. 2 mm. Fruit (known only from slightly immature material) solitary, axillary, sessile, borne at nodes of fallen leaves, 4?-locular, 7–9 × 7–9 mm, globose to ovoid, glabrous, fruit color green when young, maturing to yellow in vivo, brown in sicco, apex depressed; calyx accrescent, with long, appressed, coarse, black trichomes, concentrated along the median of the lobes, calyx cup shallow, ca. 3.5 × 6 mm, calyx lobes 5, ca. 10 × 9 mm, spreading, triangular-trullate, margins ± perpendicular to the fruit surface toward the base of the lobe such that the margins on either side of the lobe are nearly touching one another and extending below the sinuses to the base of the calyx cup, forming evident wings, ± irregularly lacerated toward the base, transitioning to entire and flat toward the ± acute apex. Seeds 5 × 3 mm, spherical wedge-shaped.

Distribution, ecology, and phenology. *Diospyros pascalii* is known only from the French department of Mayotte, an island situated in the Comoro archipelago (Fig. 5), where it occurs at low elevations (150–200 m). Flowers have been recorded from September through November, and fruits from December through February.

Etymology. This species is named in honor of the Franco-Swiss botanist Olivier Pascal, who skillfully and passionately piloted the planning and organization of numerous large biodiversity expeditions throughout the world (including in Corsica, French Guyana, Gabon, Madagascar, Mozambique, New Caledonia, Papua New Guinea, and Vanuatu) for Pro-Natura International and the Muséum National d'Histoire Naturelle in Paris, and who conducted extensive botanical fieldwork on Mayotte in the Comoros archipelago between 1995 and

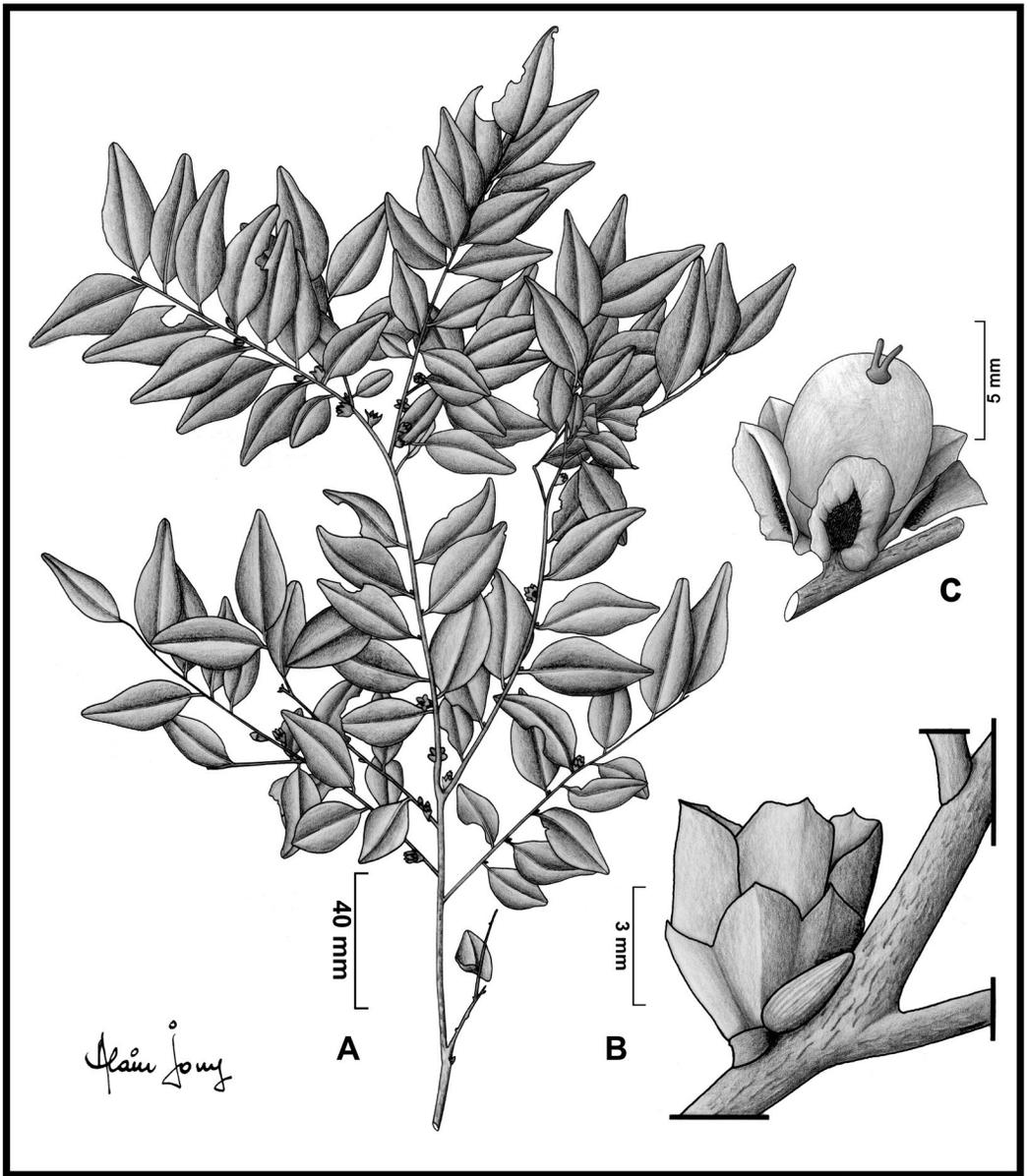


Figure 18. *Diospyros pascalii* A. G. Linan, G. E. Schatz & Lowry. —A. Branch with female flowers. —B. Female flower. —C. Nearly mature fruit. (A–C, *Pascal 980*.) Drawing by A. Jouy.

1997, during which he made several collections of *Diospyros pascalii*, including the type.

Vernacular names. Mri Moudrou Mena (*Pascal 881*), Mri Moudrou (*Pascal 692*).

Conservation status. *Diospyros pascalii* has a geographic range in the form of an AOO of 8 km². It is not

present in any protected areas, although one subpopulation is situated in an area that was previously classified as the Réserve Forestière des Crêtes du Sud. It is threatened by fire, forest clearing for agriculture, and exploitation for firewood and house construction material, all of which will result in continuing decline. With respect to the most serious plausible threat of forest clearing for agriculture, it is known to occur at two lo-

cations. Therefore, *D. pascalii* can be assessed for its risk of extinction as Endangered [EN B2ab(i,ii,iii,iv,v)].

Notes. Individuals of *Diospyros pascalii* have been recorded in the field to reach 25 m in height and were noted to be highly branched (O. Pascal, pers. comm.). A small color drawing of the fruit of *D. pascalii* was used in several places in Pascal (2002) to mark the end of various sections of the text, and also appears on the back cover. The calyx morphology of *D. pascalii* (shallow calyx cup with spreading lobes and margins nearly touching at the base; Figs. 14D and 18) appears to be similar to and possibly homologous with that of *D. platycalyx*, suggesting that these two species may be closely related to one another.

Additional specimens examined. Mayotte Island (Comoros archipelago), Grande Terre, Kani Keli, Charifou, 12°59'35"S, 45°08'49"E, 11 Nov. 2010 (♂ fl.), *Viscardi 358* (BR, G, HKM, K, MO, P); Sohoa, 12°49'16"S, 45°06'32"E, 150 m, 30 Sep. 1996 (♀ fl.), *Pascal 692* (B, BR, G, K, MA, MAO, MO, NY, P, PRE, WAG); Sohoa, 12°49'16"S, 45°06'32"E, 150 m, 1 Oct. 1997 (♂ fl.), *Pascal 980* (B, BR, G, K, MA, MAO, MO, NY, P, PRE, WAG).

16. *Diospyros platycalyx* Hiern, Trans. Cambridge Philos. Soc. 12: 218. 1873. TYPE: Madagascar. Melaky Region [Mahajanga Prov.]: Ambongo, 16 Feb. 1841 (fr.), *A. Pervillé 640* (lectotype, designated here, P [bc] P00573713!; isolectotypes, P [bc] P00573714!, P00573715!). Figure 19A, B.

Diospyros striicalyx H. Perrier, Mém. Inst. Sci. Madagascar, Sér. B, Biol. Vég. 4(1): 117, t. V. 1952, syn. nov. TYPE: Madagascar. Betsiboka Region [Mahajanga Prov.]: Le Berizoka [Beritsoka], à l'E de Maevatanana (Boina) au N de Tsarasanta, Oct. 1897 (♂ fl.), *Perrier de la Bâthie 354* (lectotype, designated here, P [bc] P00573617!; isolectotypes, P [bc] 00573618!, P00573619!).

Shrub or tree up to 12 m tall and 30 cm DBH. Young stems glabrous, mature stems gray to beige. Leaves 5–8 × 2–3 cm, obovate to nearly elliptic, somewhat chartaceous, glabrous on both surfaces, base cuneate, margins slightly revolute and undulate, apex round to obtuse, midvein ± flush with lamina surface above, raised below, venation weakly brochidodromous, ± obscure above, less so below, 6 to 8 secondaries per side, inserted at 45°–50° angle to the midvein, intersecondaries obscure or absent; petiole 4.5–6 mm, ca. 1 mm diam., ± terete, slightly flattened above. Male and female flowers not seen. Fruit solitary, axillary, sessile, borne most often at nodes of fallen leaves, rarely in leaf axils, 8-locular, 1.5–1.7 × 2–2.3 cm, globose, glabrous, green in vivo when young, maturing to variegated yellow with a red tinge, brown in sicco, apex depressed; calyx accrescent, glabrous, calyx cup shallow, 1.5–

1.7 × ca. 1.5 cm, calyx lobes 5 (rarely 6), ca. 2.2 × 2 cm, spreading at maturity, triangular-trullate, margins ± perpendicular to the fruit surface toward the base of the lobe such that the margins on either side of the lobe are touching one another or nearly so and extending below the sinus to form evident wings, transitioning to ± entire and flat toward the acute apex. Seeds 13–15 × 6–7 mm, spherical wedge-shaped.

Distribution, ecology, and phenology. *Diospyros platycalyx* ranges along the west coast of Madagascar, from near Morondava north to the area around Antsohihy (Madagascar Catalogue, 2021), where it primarily occurs in dry forest on sand and limestone, at elevations of 0–50 m. Fruits have been recorded from November through March, and rarely in May and August.

Vernacular names. Mapingo (*Randriatsivery 210*; *Service Forestier 19103*; *Service Forestier 15768*), Lopingo (*Rakotovao 6504*; *Service Forestier 6879*), Pingo (*Service Forestier 15914*), Rotral (*Service Forestier 10215*), Lopingo (*Service Forestier 19103*), Tsiolaboayo (*Service Forestier 10557*).

Conservation status. *Diospyros platycalyx* has a geographic range in the form of an EOO of 99,043 km² and a minimum AOO of 60 km². It is present in the Baie de Baly, Menabe Antimenaena, and Tsimembo Manambolomaty protected areas (Madagascar Catalogue, 2021). Elsewhere it is threatened by fire, forest clearing for agriculture, grazing, and exploitation for firewood and house construction material, all of which will result in continuing decline. With respect to the most serious plausible threat of forest clearing for agriculture, *D. platycalyx* is known to occur at 14 locations. It was recently assessed for its risk of extinction as Least Concern (Lowry & Schatz, 2021b), but based on the collections assigned here, it is assessed as Near Threatened [NT] because it nearly qualifies for Vulnerable under criterion B2.

Notes. The type collection of *Diospyros platycalyx* (*Pervillé 640*) is represented by three sheets at P. We have chosen one of them ([bc] P00573713) as the lectotype because it possesses the most fruiting material and has Pervillé's original label. The calyx morphology of *D. platycalyx* (shallow calyx cup with spreading lobes and margins nearly touching at the base; Fig. 19B) appears to be similar to and possibly homologous with that of *D. pascalii*, suggesting that these two species may be closely related to one another. It is rather surprising that *D. platycalyx* has never been collected in flower.

Among the three duplicates of *Perrier de la Bâthie 354* at P, we have selected one of them ([bc] P00573617)



Figure 19. Photos of *Diospyros* L. species. A, B. *Diospyros platycalyx* Hiern. —A. Branch with immature fruit (Rakotovoao 6504). —B. Mature fruits (Randriatsivery 210). —C. *Diospyros plicaticalyx* A. G. Linan, G. E. Schatz & Lowry, branch with immature fruits (Schatz et al. 4321). Photos: A, C. Rakotovoao; B, M. Randriatsivery; C, G. Schatz.

as the lectotype of *Diospyros striicalyx* because it comprises the most complete material.

By virtue of reaching 30 cm DBH, *Diospyros platycalyx* is considered to be a large enough tree to be potentially exploited for its hardwood, and thus precise coordinates have been withheld.

Additional specimens examined. Madagascar. **Boeny Region [Mahajanga Prov.]:** Baie de Baly, 6 June 1930 (fr.), Decary 7836 (P, TAN); Katsepy, 10 Nov. 2005 (fr.), Labat 3544 (MO, P); près Majunga, Feb. 1901 (fr.), Perrier de la Bâthie 1824 (P); Majunga, Jan. 1921 (fr.), Perrier de la Bâthie 13454 (P); Soalala, 24 Feb. 1956 (fr.), Service Forestier 15914 (P). **Melaky Region [Mahajanga Prov.]:** Antsalova, 27 Dec. 1952 (fr.), Service Forestier 6879 (MO, P); same locality, 11 Aug. 1954 (bud), Service Forestier 10557 (P); Ampasindoro, 19 May 1956 (fr.), Service Forestier 16312 (MO, P). **Menabe Region [Toliara Prov.]:** Kirindy Forest, 18–19 Mar. 1992 (fr.), Noyes et al. 1024 (MO, P, TAN); same locality, 17 Jan. 2014 (fr.), Rakotovoao 6504 (MO, P); Belo sur Tsirihina,

17 May 1954 (fr.), Service Forestier 10215 (P). **Sofia Region [Mahajanga Prov.]:** Antsohihy, Antonibe, 19 Aug. 2007 (fr.), Randriatsivery 210 (MO, P, TAN); Ambondro-Antoniobe, 21 Feb. 1956 (fr.), Service Forestier 15768 (P); Ambodimanary, 31 May 1958, Service Forestier 19103 (fr.) (TEF, P).

17. *Diospyros plicaticalyx* A. G. Linan, G. E. Schatz & Lowry, sp. nov. TYPE: Madagascar. DIANA Region [Antsiranana Prov.]: Sahafary, 210 m, 15 Feb. 2005 (fr.), G. E. Schatz, F. Ratovoson & R. Guittou 4321 (holotype, MO-6923923!; isotypes, CNARP not seen, P [bc] P00967733!, TAN not seen). Figures 19C, 20.

Diagnosis. *Diospyros plicaticalyx* A. G. Linan, G. E. Schatz & Lowry can be distinguished from the other members of *Diospyros* L. sect. *Forbesia* F. White by its chartaceous leaves and its fruiting calyx whose distinctive lobes have margins

that are deflected away from the fruit and irregularly plicate-undulate along nearly their entire length.

Tree (rarely shrub) to 20 m tall and 7 cm DBH. Young stems glabrous or with sparse indument of erect, fine, blonde trichomes. Leaves 4–8 × 1.5–2.8 cm, elliptic to narrowly elliptic, chartaceous, glabrous or with sparse indument of erect, fine, blonde trichomes, persistent on both surfaces, rarely shiny above, base cuneate, margins slightly undulate, apex acute to acuminate, midvein slightly impressed above, raised below, venation weakly brochidodromous, ± evident on both surfaces, 8 to 10 secondaries per side, inserted at ca. 45° angle to the midvein, inter-secondaries weakly evident; petiole 4–8 mm, 1 mm diam., nearly terete, slightly flattened above, either glabrous or with sparse indument of erect, fine, blonde trichomes. Male and female flowers not seen. Fruit solitary, axillary, sessile, borne at nodes of fallen leaves, 4-locular, 1.3–2 × 1.2 cm, ovoid to rarely pyriform, with sparse indument of erect, fine, blonde trichomes, sometimes nearly glabrous, fruit green in vivo when young, color at maturity unknown, brown in sicco, apex slightly depressed; calyx with sparse indument of erect, fine, blonde trichomes, calyx cup ca. 1 × 1 cm, calyx lobes 5 or 6, 20 × 7–10 mm, not spreading, ± appressed to fruit surface, narrowly triangular, margins entire, deflected away from the fruit and irregularly plicate-undulate along nearly the entire length of the lobe, extending below the sinuses to the base of the calyx cup, forming evident wings, transitioning to somewhat twisted at the acute apex. Seeds 9–10 × 5–6 mm, spherical wedge-shaped, reddish in vivo.

Distribution, ecology, and phenology. *Diospyros plicatocalyx* is found in northern Madagascar, where it occurs in dry forest, at elevations of 82–600 m. Label data from Meyers 62 indicate that its fruits are eaten by the locally endemic lemur species *Propithecus tattersalli* Simons. Fruits have been recorded from January through February, and rarely in May.

Etymology. The specific epithet is derived from the Latin word “plicat,” meaning folded, referring to the strongly and irregularly plicate-undulate margins of the calyx lobes in *Diospyros plicatocalyx* (Fig. 19C).

Conservation status. *Diospyros plicatocalyx* has a geographic range in the form of an EOO of 2744 km² and a minimum AOO of 24 km². It is present in the Ankarana and Loky Manambato protected areas. Elsewhere it is threatened by fire, forest clearing for agriculture, grazing, and exploitation for firewood and house construction material, all of which will result in continuing decline. With respect to the most serious

plausible threat of forest clearing for agriculture, *D. plicatocalyx* is known to occur at six locations. It was recently assessed for its risk of extinction as Endangered under criteria B1 and B2 (Schatz & Lowry, 2021b), but recent collections from several new locations result in an assessment of Vulnerable [VU B1ab (i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v)].

Notes. *Diospyros plicatocalyx* displays variation across its distribution, with specimens in the western part of its range possessing glabrous leaves, stems, calyx, and fruit, whereas these structures are pubescent in material from the east.

By virtue of reaching 20 m in height, *Diospyros plicatocalyx* is considered to be a large enough tree to be potentially exploited for its hardwood, and thus precise coordinates have been withheld.

Additional specimens examined. Madagascar. **DIANA Region [Antsiranana Prov.]:** Ankarana, 26 Jan. 2003 (fr.), Bardot-Vaucoulon & Andrianantoanina 1333 (K, MO, TAN); NE of Mahasima, 16 Jan. 2002 (fr.), De Block 1257 (BR, K, MO, P, TAN); Ankarana, 11–14 Jan. 2002 (fr.), Razafimandimbison & Andrianantoanina 459 (MO). **SAVA Region [Antsiranana Prov.]:** Binara Range, 200–1180 m, 23 Feb. 1990 (fr.), Meyers 35 (MO, P, TAN); Bobankora Range, 8 May 1990 (fr.), Meyers & Boltz 125 (MO, P, TAN); same locality, 15 Mar. 1990 (fr.), Meyers 62 (MO, P, TAN); same locality, 11 Feb. 1991 (fr.), Meyers 265 (MO).

18. *Diospyros pubiramulis* A. G. Linan, G. E. Schatz & Lowry, sp. nov. TYPE: Madagascar. DIANA Region [Antsiranana Prov.]: Sahafary, 20 Feb. 1962 (fr.), Service Forestier (Capuron) 20982 (holotype, MO-6153657; isotypes, BR [bc] BR0000015394965 as image!, G [bc] G0042734!, K not seen, P [bc] P00541736!, TAN!, WAG [bc] WAG.1782809 as image!). Figure 21.

Diagnosis. *Diospyros pubiramulis* A. G. Linan, G. E. Schatz & Lowry can be distinguished from the species it most closely resembles vegetatively, *D. analamerensis* H. Perrier, by the often very dense pubescence on its young stems and the underside of its young leaves (vs. nearly always glabrous in *D. analamerensis*), its generally smaller leaves (2.5–6.7 × 0.7–2.4 cm vs. 4–10.6 × 1.2–4.4 cm), its fruits with non-overlapping bases of adjacent calyx lobe (vs. overlapping), the margins of the calyx lobes deflected away from the fruit surface at the sinuses (vs. flat), and the presence of 4 rounded protuberances on the fruit opposite the sinus of each calyx lobe (vs. lacking protuberances).

Tree to 15 m tall and 22 cm DBH. Young stems often with dense indument of short, fine, brown to rust-colored trichomes, glabrescent, mature stems beige to rust-colored. Leaves 2.5–6.7 × 0.7–2.4 cm, narrowly elliptic to narrowly oblong, coriaceous, often with dense indument of short, fine, brown to rust-colored trichomes on both surfaces, glabrescent, occasionally glabrous, base cuneate to ± rounded, margins slightly revolute,

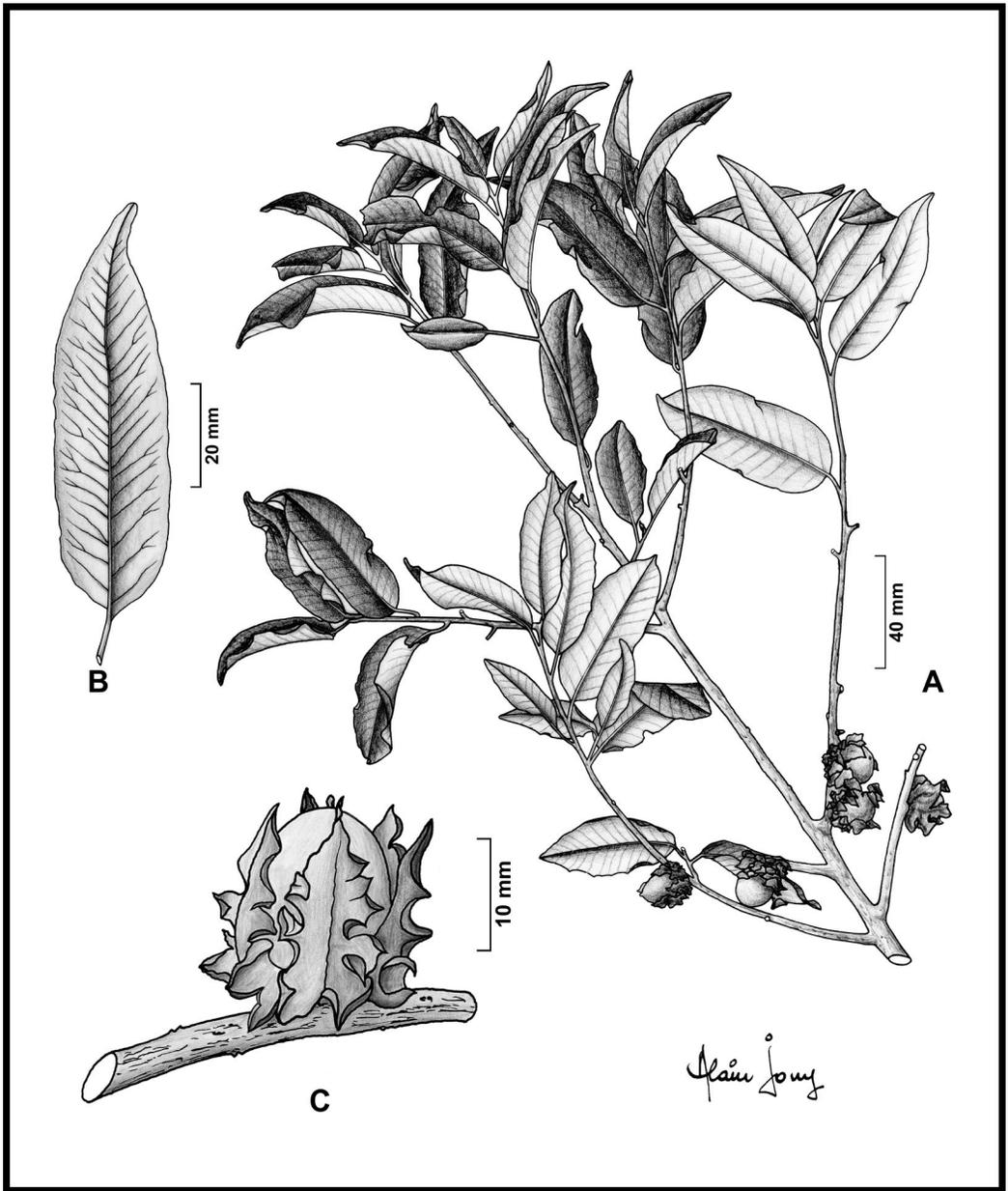


Figure 20. *Diospyros plicicalyx* A. G. Linan, G. E. Schatz & Lowry. —A. Branch with fruits. —B. Detail of leaf (abaxial surface). —C. Mature fruit. (A, B, Schatz et al. 4321.) Drawing by A. Jouy.

apex rounded to rarely emarginate, midvein slightly impressed above, raised below, venation craspedodromous, evident on both surfaces, 4 to 15 secondaries per side, inserted at 25°–30° angle to midvein, intersecondaries evident; petiole 2.5–7 mm, 1–1.5 mm diam., nearly terete, slightly flattened above, glabrous to covered with semi-erect, fine, blonde trichomes. Male flowers solitary, axillary, sessile, borne either in leaf

axils or at nodes of fallen leaves; calyx cup ca. 3.5 × 3–4 mm, abruptly tapering at the base, completely covered with a mixture of long, blonde and black, appressed trichomes, with 4 or 5 shallow, indeterminate lobes; corolla with mixture of fine blonde and coarse black, moderately dense indument of appressed, short trichomes outside, concentrated along the median of the lobes, glabrous inside, corolla tube 2.5–3 × 4 mm,

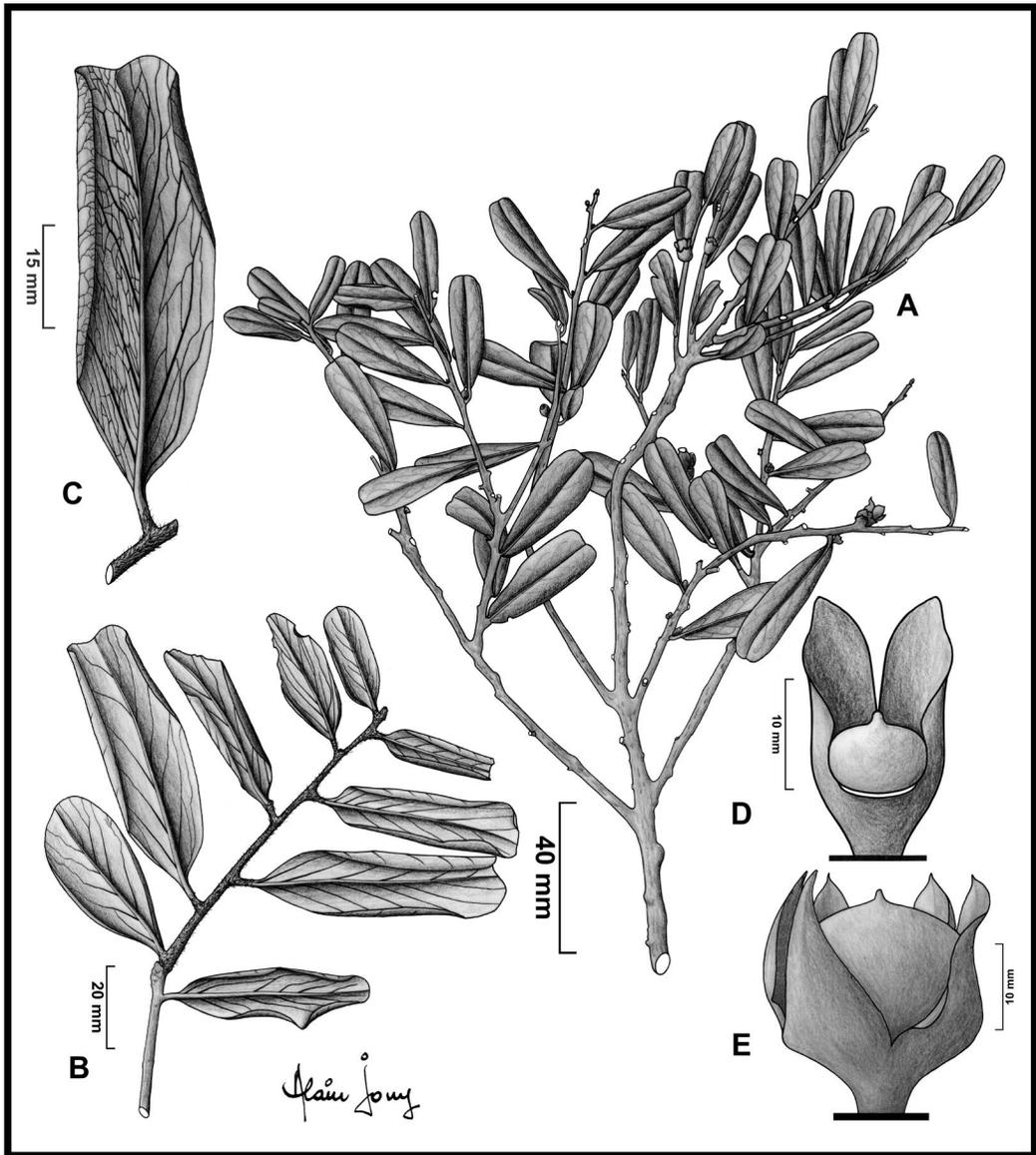


Figure 21. *Diospyros pubiramulis* A. G. Linan, G. E. Schatz & Lowry. —A. Branch. —B. Detail of branch. —C. Detail of leaf (abaxial surface). —D. Immature fruit (three calyx lobes removed). —E. Mature fruit. (A, *Ranirison & Nusbaumer 1150*; B, C, *Service Forestier 20982*; D, *Ramandimbimananana & Randimbiarison 315*; E, *Meyers 155*.) Drawing by A. Jouy.

urceolate, lobes 5, 2.5–3 × 2.5 mm, oblong; stamens ca. 45, inserted at the base of corolla tube, filaments ca. 1 × 0.1–0.2 mm, flattened, anthers 2.5–3 × 0.3–0.4 mm; pistillode present, highly reduced, sparsely to moderately covered with short blonde trichomes. Female flowers not seen. Fruit (known only from slightly immature material) solitary, axillary, sessile, borne either in leaf axils or at nodes of fallen leaves, 4- or 8-locular, 1.1–1.3 × 1.3 cm, oblate-globose, with short, semi-erect, fine, blonde trichomes becoming more sparse

with age, green in vivo when young, color unknown at maturity, brown in sicco, apex depressed, often with 4 rounded protuberances opposite each sinus of the calyx lobes; calyx densely covered with short, semi-erect, fine, blonde trichomes on both surfaces, calyx cup 6–7 × 1.4 cm, calyx lobes 3 to 5, 1.7–2 × 1.5 cm, not spreading, appressed to fruit surface and often completely enclosing the fruit, narrowly triangular to narrowly trullate, margins entire, deflected away from the fruit surface at the sinuses, extending slightly below

the sinuses onto the calyx cup, otherwise flat along the length of the lobe, apex obtuse-acute. Seeds 9.5–10 × 4 mm, spherical wedge-shaped.

Distribution, ecology, and phenology. *Diospyros pubiramulis* is found in the far north of Madagascar, where it occurs in dry to rarely subhumid evergreen forest, mostly at elevations of 150–1100 m, and very rarely as low as 50 m. Flowers have been recorded from November through February, and fruits from January through February, rarely in May.

Conservation status. *Diospyros pubiramulis* has a geographic range in the form of an EOO of 3138 km² and a minimum AOO of 48 km². It is present in the Loky Manambato, Montagne d'Ambre, and Montagne de Français protected areas. Elsewhere it is threatened by fire, forest clearing for agriculture, grazing, and exploitation for firewood and house construction material. With respect to the most serious plausible threat of forest clearing for agriculture, *D. pubiramulis* is known to occur at 10 locations, and was recently assessed for its risk of extinction as Vulnerable [VU B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v)] (Schatz & Lowry, 2021c).

Notes. Collections of *Diospyros pubiramulis* from sites at lower elevations (50–200 m) tend to have less pubescence on their young stems and leaves than material from high-elevation sites, and their secondary veins are denser and more numerous (12 to 15 per side at lower elevations vs. four to six at higher elevation sites), which gives them an appearance that resembles the leaves of *D. analamerensis* (which has 11 or 12 secondaries per side). These individuals may represent hybrids between *D. analamerensis* and *D. pubiramulis*, but because of their small leaf size and the morphology of their calyx in fruit, they have been assigned here to *D. pubiramulis*.

By virtue of reaching 22 cm DBH, *Diospyros pubiramulis* is considered to be a large enough tree to be potentially exploited for its hardwood, and thus precise coordinates have been withheld.

Additional specimens examined. Madagascar. **DIANA Region [Antsiranana Prov.]:** Montagne d'Ambre, 16 Nov. 2007 (fl.), *Gautier 5243* (G, P, TEF); same locality, 22 Jan. 2012 (fr.), *Ramandimbimanana & Randimbiarison 276* (MO, P); same locality, 24 Jan. 2012 (fr.), *Ramandimbimanana & Randimbiarison 315* (MO, P); Andavakoera, 7 Dec. 2019 (st.), *Ramanitrinzaka 128* (DBEV, MO, P, TAN); same locality, 23 Jan. 2014 (st.), *Randrianaivo et al. 2442* (BR, G, MO, P); same locality, 11 Feb. 2005 (fr.), *Randrianarivelo et al. 240* (MO, P, TAN, WAG). **SAVA Region [Antsiranana Prov.]:** Loky-Manambato AP, 27 Sep. 2013, (st.), *Andriambololonea & Bernard 276* (MO, P); Bekaraoka Sud, 18 Feb. 2019 (st.), *Karatra et al. 56* (DBEV, MO, P); same locality, 129 m, 19 Feb. 2019 (st.), *Karatra et al. 61* (DBEV, MO, P); Binara

Range, 16 May 1990 (fr.), *Meyers & Boltz 155* (G, MO, P); Bekaraoka, 11 Feb. 2004 (fl.), *Nusbaumer & Ranirison 1150* (G); Ambohitsondroina, 7 Jan. 2006 (♂ fl.), *Nusbaumer & Ranirison 1870* (MO, P); Bobankora, 25 Jan. 2005 (fr.), *Ranirison & Nusbaumer 909* (G, P); Antsaharaingy, 28 Feb. 2005 (fr.), *Ranirison & Nusbaumer 948* (G, MO, P); Solaniampilana-Maroadabo, 4 Feb. 2006 (fl.), *Ranirison & Nusbaumer 1150* (MO, P); same locality, 7 Feb. 2006 (fr.), *Ranirison & Nusbaumer 1156* (MO, P).

Literature Cited

- Ash, A., B. Ellis, L. Hickey, K. Johnson, P. Wilf & S. Wing. 1999. Manual of Leaf Architecture: Morphological Description and Categorization of Dicotyledonous and Net-Veined Monocotyledonous Angiosperms. Smithsonian Institution, Washington D.C.
- Beentje, H. 2016. Plant Glossary, an Illustrated Dictionary of Plant Terms, 2nd ed. Royal Botanic Gardens, Kew.
- Cornet, A. 1974. Essai de Cartographie Bioclimatique à Madagascar. Notice Explicative No. 55. ORSTOM, Paris.
- Faranirina, L., G. E. Schatz & N. Rakotonirina. 2019. *Diospyros cupulifera*. The IUCN Red List of Threatened Species 2019: e.T173894A1403639. <http://dx.doi.org/10.2305/IUCN.UK.2019-1.RLTS.T173894A1403639.en>.
- GeoCAT. 2021. Geospatial Conservation Assessment Tool. Royal Botanic Gardens, Kew, U.K. <<http://geocat.kew.org/>>, accessed 28 January 2021.
- Govaerts, R. 2021. World checklist of Ebenaceae. Facilitated by the Royal Botanic Gardens, Kew. <<http://wesp.science.kew.org/>>, accessed 28 January 2021.
- IUCN. 2012. IUCN Red List Categories and Criteria: Version 3.1. Second edition. Prepared by the IUCN Species Survival Commission. IUCN, Gland, Switzerland; Cambridge, United Kingdom.
- Linan, A. G., G. E. Schatz, P. P. Lowry, A. J. Miller & C. E. Edwards. 2019. Evolutionary relationships in the ebony and persimmon genus (*Diospyros*) across islands of the western Indian Ocean. *Bot. J. Linn. Soc.* 190: 359–373. <https://doi.org/10.1093/botlinnean/boz034>.
- Lowry, P. P., II & G. E. Schatz. 2021a. *Diospyros analamerensis*. The IUCN Red List of Threatened Species 2021: e.T173667A1394325. <https://dx.doi.org/10.2305/IUCN.UK.2021-1.RLTS.T173667A1394325.en>.
- Lowry, P. P., II & G. E. Schatz. 2021b. *Diospyros platyca-lyx*. The IUCN Red List of Threatened Species 2021: e.T173992A1408594. <https://dx.doi.org/10.2305/IUCN.UK.2021-1.RLTS.T173992A1408594.en>.
- Madagascar Catalogue. 2021. Catalogue of the Plants of Madagascar. <<https://www.tropicos.org/Project/Madagascar/>>, accessed 28 January 2021.
- Mas, C., P. P. Lowry II & G. E. Schatz. In press. Révision taxonomique des *Diospyros* L. (Ebenaceae) de la région Malgache. IX. Le groupe Gracilipes. Boissiera (in press).
- Mason, J., M. Parker, L. Vary, P. P. Lowry II, S. Hassold & G. Ruta. 2016. Malagasy Precious Hardwoods: Scientific and Technical Assessment to Meet CITES Objectives. Report submitted by the World Resources Institute and the World Bank. <<https://www.scribd.com/document/318123493/WRI-WB-Malagasy-Precious-Woods-Assessment-1-pdf>>.
- Pascal, O. 2002. Plantes des forêts de Mayotte. Muséum national d'Histoire naturelle, Paris.
- Perrier de la Bâthie, H. 1952. Ebenacées. Pp. 1–129 in H. Humbert (editor), *Flora de Madagascar et des Comores*, 165. Muséum national d'Histoire naturelle, Paris.
- Richardson, I. B. K. 1980. Notes on *Diospyros* (Ebenaceae) in the Mascarene Islands. *Kew Bull.* 34: 723–735.

- Schatz, G. E. 2000. Endemism in the Malagasy Tree Flora. Pp. 1–9 in *Diversity and Endemism in Madagascar*. Mémoires de la Société de Biogéographie, Paris.
- Schatz, G. E. & P. P. Lowry II. 2011. Nomenclatural notes on Malagasy *Diospyros* L. (Ebenaceae). *Adansonia*, ser. 3, 33(2): 271–281. <https://doi.org/10.5252/a2011n2a12>.
- Schatz, G. E. & P. P. Lowry II. 2018. Taxonomic studies of *Diospyros* (Ebenaceae) from the Malagasy region. III. New species from the island of Nosy Mangabe in the Bay of Antongil. *Novon* 26(3): 272–286. <https://doi.org/10.3417/2018209>.
- Schatz, G. E. & P. P. Lowry II. 2020. Taxonomic studies of *Diospyros* L. (Ebenaceae) from the Malagasy region. IV. Synoptic revision of the Squamosa group in Madagascar and the Comoro Islands. *Adansonia*, ser. 3, 42: 201–218. <https://doi.org/10.5252/adansonia2020v42a10>.
- Schatz, G. E. & P. P. Lowry II. 2021a. *Diospyros mapingo*. The IUCN Red List of Threatened Species 2021: e.T174006A1409169. <https://dx.doi.org/10.2305/IUCN.UK.2021-1.RLTS.T174006A1409169.en>.
- Schatz, G. E. & P. P. Lowry II. 2021b. *Diospyros* sp. nov. '*plicativalyx*.' The IUCN Red List of Threatened Species 2021: e.T183634881A183634884. <https://dx.doi.org/10.2305/IUCN.UK.2021-1.RLTS.T183634881A183634884.en>.
- Schatz, G. E. & P. P. Lowry II. 2021c. *Diospyros* sp. nov. '*pubiramulis*.' The IUCN Red List of Threatened Species 2021: e.T183634939A183634949. <https://dx.doi.org/10.2305/IUCN.UK.2021-1.RLTS.T183634939A183634949.en>.
- Schatz, G. E., P. P. Lowry II, C. Mas & M. W. Callmander. 2013. Further nomenclatural notes on Malagasy *Diospyros* L. (Ebenaceae): Goudot types in the Geneva herbarium. *Candollea* 68(2): 307–309. <https://doi.org/10.15553/c2012v682a15>.
- Schatz, G. E., P. P. Lowry II & P. B. Phillipson. 2020. Taxonomic studies of *Diospyros* L. (Ebenaceae) from the Malagasy region. V. Synoptic revision of the Bernieriana group in Madagascar and the Comoro Islands. *Candollea* 75: 203–218. <http://dx.doi.org/10.15553/c2020v752a5>.
- Schatz, G. E., P. P. Lowry II & H. N. Rakouth. 2021a. Taxonomic studies of *Diospyros* L. (Ebenaceae) from the Malagasy region. VIII. New species from the humid littoral forests of eastern Madagascar. *Novon* 29 (in press).
- Schatz, G. E., P. P. Lowry II, H. N. Rakouth & R. Randrianaivo. 2021b. Taxonomic studies of *Diospyros* L. (Ebenaceae) from the Malagasy region. VI. New species of large trees from Madagascar. *Candollea* (in press).
- Schneider, C. A., W. S. Rasband & K. W. Eliceiri. 2012. NIH Image to ImageJ: 25 Years of Image Analysis. *Nature Methods* 9(7): 671.
- Thiers, B. 2021 [continuously updated]. Index Herbariorum: A global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. <<http://sweetgum.nybg.org/science/ih/>>, accessed May 2020.
- White, F. 1980. Notes on the Ebenaceae VIII. The African sections of *Diospyros*. *Bull. Jard. Bot. Nat. Belg.* 50(3): 445–460.
- Zyl, J. J. Van. 2001. The Shuttle Radar Topography Mission (SRTM): A breakthrough in remote sensing of topography. *Acta Astronautica* 48(5–12): 559–65.