Taxonomic studies of Diospyros (Ebenaceae) from the Malagasy region. V. Synoptic revision of the Bernieriana group in Madagascar and the Comoro Islands

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Abstract

SCHATZ, G.E., P.P. LOWRY II & P.B. PHILLIPSON (2020). Taxonomic studies of Diospyros (Ebenaceae) from the Malagasy region. V. Synoptic revision of the Bernieriana group in Madagascar and the Comoro Islands. Candollea 75: 203–218. In English, English and French abstracts. DOI: http://dx.doi.org/10.15553/c2020v752a5

A synoptic revision of the Bernieriana group of Diospyros L. (Ebenaceae) in Madagascar and the Comoro Islands is presented in which seven species are recognized, including four new species that are described and illustrated (Diospyros hongwae G.E. Schatz, Lowry & Phillipson, Diospyros ranirisonii G.E. Schatz, Lowry & Phillipson, Diospyros silicea G.E. Schatz, Lowry & Phillipson, and Diospyros suarezensis G.E. Schatz, Lowry & Phillipson). A key to the species is provided, along with a risk of extinction assessment for each species using the IUCN Red List criteria. Two species are assessed as “Endangered” (Diospyros hongwae and Diospyros silicea), one as “Vulnerable” (Diospyros ranirisonii), two as “Near Threatened” (Diospyros suarezensis and Diospyros torquata H. Perrier), and two as “Least Concern” (Diospyros bernieriana (Baill.) H. Perrier and Diospyros danguyana H. Perrier).

Résumé

SCHATZ, G.E., P.P. LOWRY II & P.B. PHILLIPSON (2020). Études taxonomiques du genre Diospyros (Ebenaceae) de la région malgache. V. Révision synoptique du groupe Bernieriana à Madagascar et aux Comores. Candollea 75: 203–218. En anglais, résumés anglais et français. DOI: http://dx.doi.org/10.15553/c2020v752a5

Une révision synoptique du groupe Bernieriana du genre Diospyros L. (Ebenaceae) à Madagascar et aux Comores est présentée. Sept espèces sont reconnues dont quatre nouvelles décrites et illustrées ici (Diospyros hongwae G.E. Schatz, Lowry & Phillipson, Diospyros ranirisonii G.E. Schatz, Lowry & Phillipson, Diospyros silicea G.E. Schatz, Lowry & Phillipson, et Diospyros suarezensis G.E. Schatz, Lowry & Phillipson). Une clé d’identification des espèces est fournie ainsi qu’une évaluation préliminaire du risque d’extinction de chaque espèce selon les critères de la Liste Rouge de l’UICN. Deux espèces sont considérées comme «En Danger» (Diospyros hongwae and Diospyros silicea), une «Vulnérable» (Diospyros ranirisonii), deux «Quasi-menacée» (Diospyros suarezensis and Diospyros torquata H. Perrier), et deux «Préoccupation mineure» (Diospyros bernieriana (Baill.) H. Perrier and Diospyros danguyana H. Perrier).

Keywords

EBENACEAE – Diospyros – Madagascar – New species – New synonyms

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Introduction

An ongoing revision of the Ebenaceae of Madagascar, undertaken to update the Flora of Madagascar and Comoros treatment by Perrier de la Bâthie (1952b), has revealed a large number of undescribed species in the genus Diospyros L. (Schatz & Lowry, 2011, 2018, 2020; Schatz et al., 2013; Madagascar Catalogue, 2020). Currently, of the c. 730 accepted species of Diospyros worldwide (Govaerts, 2020), 97 species are recognized in Madagascar, of which all three species are endemic, and an additional 154 endemic species have been tentatively identified as new to science (Madagascar Catalogue, 2020). Most Malagasy Diospyros species can easily be placed in one of about a dozen informal morphological groups recognized on the basis of vegetative and reproductive features. Such groups constitute hypotheses of monophyletic groups within Diospyros as revealed by analyses using molecular sequence data (Duangjai et al., 2006, 2009; Linan et al., 2019). One such group, comprising Diospyros bernieriana (Baill.) H. Perrier and its putative relatives, has been named the Bernieriana group. It is characterized by axillary, solitary female flowers with a cupuliform to cylindrical-tubular to obconical calyx with an entire, truncate or sometimes shallowly lobed apex, the calyx strongly accrescent in fruit such that the fruit is usually wholly included within the calyx (the exceptions being D. hongwae G.E. Schatz, Lowry & Phillipson and D. suarezensis G.E. Schatz, Lowry & Phillipson in which the apex of fruit is visible and slightly exerted above the calyx), and the fruit irregularly tearing and breaking off during fruit maturation.

Three currently recognized species conform to the Bernieriana group (D. bernieriana, D. danguyana H. Perrier, and D. torquata H. Perrier), to which an additional four new species are herein described, each accompanied by an illustration and an assessment of its conservation status according to the IUCN Red List Categories and Criteria (IUCN, 2012). Because three of the species treated in this revision can form sufficiently large trees to be potential sources of 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 (2020) has been restricted. Full specimen records and distribution maps are available for the remaining members of the group in the Catalogue of the Plants of Madagascar (Madagascar Catalogue, 2020), and can also be found in the Sonnerat (2020) database. Post-facto georeferencing of historical specimens is indicated by square brackets.

Key to the species of the Bernieriana group of Diospyros

1. Leaf margins distinctly undulate ........................................... 2
2. Apex of fruit exserted above the calyx; fruit ellipsoid; Zombitys, Tsihombé ........................................ 5. D. silicea
3. Leaf blade with margins flat or slightly revolute, abaxial surface not at all obscured ........................................... 4
4. Largest leaf blade 2–4(–5) cm long; apex of fruit enclosed within the calyx; free portion of calyx tubular; Behefaka, Irarona (S of Ambilobe) ..................... 3. D. torquata
5. Leaves elliptic to obovate, broadest blade less than 3 times longer than wide, glabrous or initially with white farinose indument on the abaxial surface, rarely glabrous; accrescent portion of fruiting calyx entire; Behefaka, Irarona (S of Ambilobe) ..................... 6. D. suarezensis
6. Female flowers narrowly ellipsoid, 11–15 mm long, at least 2 times longer than wide; mature fruit 12–16 × 7–10 mm, the lobes of the calyx 6–8 mm long; far N of Madagascar ...................... 4. D. ranirisonii
7. Female flowers ellipsoid to subspherical, 5–10 mm long, only slightly longer than wide; mature fruit 10–13 × 6 mm, the lobes of the calyx 3 mm long; central and southern Madagascar .......................... 2. D. danguyana

Clé d’identification des espèces de Diospyros du groupe Bernieriana

1. Marges des feuilles distinctement ondulées ................. 2
1a. Marges des feuilles planes ou révolutées, pas distinctement ondulées (légerement ondulées en matériel frais de D. hongwae) ........................................... 3
2. Apex du fruit complètement entouré par le calice; fruit sphérique; N et NE de Madagascar et des Îles Comores
(Anjouan, Grande Comore, Mayotte et Mohéli) ..............

1. **Diospyros bernieriana**

2a. Apex du fruit prolongé au-delà du calice; fruit ellipsoïde; Zombitsy, Tsihombe ........................................ 5. **D. silica**

3. Limbe foliaire plane ou à marges légèrement revolutées, surface abaxiale visible ............................................ 4

3a. Limbe foliaire fortement revoluté, cachant beaucoup de la surface abaxiale sur au moins certaines feuilles ...... 5

4. Limbe de la feuille la plus grande mesurant 2 – 4(– 5) cm de long; apex du fruit entouré par le calice; partie libre du calice tubulaire; forêts occidentales, Bongolava à Kirindy .......................................................... 7. **D. torquata**

4a. Limbe de la feuille la plus grande mesurant 11 – 12 cm de long; apex du fruit dépassant le calice; partie libre du calice cupuliforme; Behefaka, Irarona (au S d’Ambilobe) .......................................................... 3. **D. hongwae**

5. Feuilles elliptiques à obovales, limbe le plus large moins de 3 fois plus long que large, surface abaxiale glabre ou initialement portant un indument farineux, glabrescent; partie accrescente du calice en fruit étière; région d’Antsiranana jusqu’à Daraina ............. 6. **D. suarezensis**

5a. Feuilles étroitement elliptiques ou étroitement oblongues à linéaires, parfois étroitement obovales, limbe le plus large au moins (3–)4– 8 fois plus long que large, surface abaxiale portant un indument roux-farineux, parfois également sur la surface adaxiale, rarement glabre; partie accrescente du calice en fruit nettement lobée ............. 6

6. Fleurs femelles étroitement elliptiques ou étroitement oblongues à linéaires, parfois étroitement obovales, limbe le plus large au moins (3–)4– 8 fois plus long que large, surface abaxiale portant un indument roux-farineux, parfois également sur la surface adaxiale, rarement glabre; partie accrescente du calice en fruit nettement lobée ............. 6

6a. Fleurs femelles elliptoïdes à subsphériques, 5–10 mm de long, à peine plus longues que larges; fruit mature 10–13 × 6 mm, lobes du calice 3 mm de long; parties centrale et sud de Madagascar .................. 2. **D. danguyana**

**Systematics**

1. **Diospyros bernieriana** (Baill.) H. Perrier in Mém. Inst. Sci. Madagascar, Sér. B, Biol. Vég. 4: 154. 1952.

   = **Olax bernieriana** Baill. in Adansonia 3: 121. 1862.

**Holotypy**: MADAGASCAR. Reg. DIANA [Prov. Antsiranana]: “Vavatobé”, II.1880, fr., Hildebrandt 3319 [P [P00573728]]; islecto-: G [G00341339, G00341340], JE [JE00000257, JE00000258] image seen, M [M0105326] image seen, P [P00573729]; US [US00113447] image seen, W [W-18890089177] image seen.

**Vernacular names.** — “Jobamapotra” (Leopold 142); “Kirandrambiavy” (Be et al 100, 125; Service Forestier 6274); “Kirandrambiavy vavy” (Christian et al. 71); “Luangati mainty” (Barthelat et al. 331); “Mampingo” (Andriamihajiarivo et al. 1067); “Mapingo” (Service Forestier 5581); “Tantam hazou” (Barthelat et al. 331); “Tongozo lolo” (Pascal 943).

**Distribution and ecology.** — **Diospyros bernieriana** is known from dry to subhumid forest on both sand and calcareous substrates from Oronjia south to Vohemar along the east coast of Madagascar and Mahajanga along the west coast, as well as from Mayotte, Mwali and Grande Comore (MADAGASCAR CATALOGUE, 2020), at an elevation of 0–432 m.

**Conservation status.** — **Diospyros bernieriana** has a geographic range in the form of an Extent of Occurrence (EOO) of 188,912 km² and a minimum Area of Occupancy (AOO) of 148 km². It is present in the Andrafiamaena Andavakoera, Ankara, Antrema, Loky Manambato, Montagne des Français, and Oranjia protected areas. Outside of protected areas, it is threatened by fire, forest clearing for agriculture, grazing, and exploitation for firewood and house construction material. With respect to the principal threat of forest clearing for agriculture, it exists at 35 locations. Therefore, **D. bernieriana** can be assessed for its risk of extinction as “Least Concern” [LC].

**Notes.** — **Diospyros bernieriana** is one of only three Malagasy members of the genus that are not endemic to the island (MADAGASCAR CATALOGUE, 2020). It is characterized by leaves with distinctly undulate margins and a calyx in fruit that completely encloses the fruit (Fig. 1A).

Two sheets of **Bernier 259** are deposited in the Paris herbarium, one of which is annotated “Olax bernieriana Bn.” in Baillon’s hand, which we take to be the holotype. A second sheet of **Bernier 259** with the original label is a mixture, comprising a small branch of **D. bernieriana** and a second branch that is clearly assignable to **D. hildebrandtii** Boivin ex Hiern. This sheet has an annotation label prepared by Perrier de la Bâthie indicating that he assigned it to **D. hildebrandtii var. hildebrandtii**, and indeed he cited **Bernier 259** under that name. In order to avoid any possible confusion, we have therefore annotated the material belonging to **D. bernieriana** as **Bernier 259 ‘A’** and that to **D. hildebrandtii** as **Bernier 259 ‘B’**. The holotype of **D. hildebrandtii** at B was destroyed. We have therefore selected the best preserved of the two sheets at P as the lectotype.
**Diospyros danguyana** is known from subarid thicket and forest on sand, sandstone, and lateritic substrates from Ambatofinandrahana in the east and Ankiliko in the west, south to Tolagnaro and north of Cap Sainte Marie (Madagascar Catalogue, 2020), at an elevation of 20–1800 m.

**Distribution and ecology.** – Diospyros danguyana has a geographic range in the form of an EOO of 125,261 km² and a minimum AOO of 128 km². It is present in the Analavonina, Andohahela, Isalo, and Makay protected areas. Outside of protected areas, it is threatened by fire and grazing. With respect to the principal threat of grazing, it exists at 29 locations. Therefore, D. danguyana can be assessed for its risk of extinction as “Least Concern” [LC].

**Notes.** – *Maba enveris* H. Perrier. (= *Diospyros enveris* (H. Perrier) G.E. Schatz & Lowry) is here placed into synonymy under *D. danguyana*. Described from the southwestern portion of the overall range of *D. danguyana*, and thus from the transition from subarid to dry bioclimates, *M. enveris* exhibits leaves that are somewhat less strongly revolute upon drying, but are otherwise identical to *D. danguyana* in shape and size, with identical fruit completely enclosed within the cylindrical-tubular accrescent calyx. *Diospyros danguyana* can be distinguished from other members of the Bernieriana group by its linear leaves 4–8 times longer than wide, its elliptic to subspherical female flowers only slightly longer than wide, and its distinctly lobed accrescent calyx enclosing the fruit, the lobes 3 mm long.

**Additional material examined.** – **MADAGASCAR. Reg. Amoron'i Mania** [Prov. Fianarantsosa]: Ambatofinandrahana, PK 2, 38, 30.6°S 45°48'E, 2000 m, C. Dembeni. 19.III.1996, fr., *Diospyros danguyana* (K, M, MO, P;). 2. **Diospyros danguyana** H. Perrier in Mém. Inst. Sci. Madagascar, Sér. B, Biol. Vég. 4: 117. 1952.

**Lectotypus** (designated by Schatz & Lowry, 2011: 274): Madagascar. Reg. Anosy [Prov. Toliarahina]: bassin supérieur du Mandrare (SE); Bois Ambamahy, près d’Esira, [24°15'S 46°39'E], 1000–1150 m, 25.IX.1928, frs. & fl., Humbert 6826 (P [P00573529]; isolecto-: BRI, G [G00191501], K, MO-6128543, MO-6128571, NY, P [P00573530], PTE, PRE, TAN).
l’Androy), [24°28’00”S 45°30’00”E], [450 m], 23.X.1931, buds, Decary 9370
(MO, P [2 sheets]); env. d’Ampandrandava (entre Bekily et Tsiory), [24°05’S
45°42’E], 1945, buds, Seyrig 779 (P); ibid. loco, 1945, buds, Seyrig 779B (P);
Maroakoho, colline gneissique, rive droite de la Menarandra, près de Tra-
noroa, [24°42’S 45°04’E], 14.XI.1967, ♀ fl., Service Forestier 27966 (MO,
NY, P [2 sheets], TEF, WAG); Marovato, E sur la rte de Tsihombe au Cap
Sainte-Marie, [25°35’S 45°09’E], 17.XII.1968, ♀ fl., Service Forestier 28532
(P [2 sheets]); rte from de Cap Sainte Marie to Tsihombe, c. 20 km from
Cap Sainte Marie, 25°28’04”S 45°21’01”E, 28 m, 4.IV.2010, fr., De Block et al.
2434 (BR, MO, P); village d’Ankorakosy, au SSE de Tsihombe, [25°18’00”S
45°29’00”E], [20–50 m], 17.XII.1968, buds, Service Forestier 28523 (K, MO,
P [2 sheets], TEF). Reg. Anosy [Prov. Toliara]: Analapatsy, fokontany
Ambaribe, 25°10’23”S 46°39’19”E, 253 m, 17.II.2019, stec., Bernard et al. 2670
(DBEV, MO, P, TAN); Andohahela PN, Ambatoabo, Imonty-Evasia, en bas
d’Apiky, 24°47’11”S 46°43’26”E, 680 m, 17.XII.2004, fr., Andriasimbjarivo
489 (MO, P, TAN, TEF); ibid. loco, Parcel 2, [24°53’S 46°35’E], [120–1000
m], 20.X.1990, ♀ fl., Dumetz 1338 (MO, P); ibid. loco, Parcel 3, 25°01’06”S
46°38’13”E, 200–600 m, 17.XI.1990, ♀ fl., Dumetz 1418 (MO, P); ibid. loco,
25°01’12”S 45°38’18”E, 100–300 m, 8.IV.1993, fr., Randriamampionona 279
(MO, P); ibid. loco, au bord de la RN 13, 25°01’01”S 46°38’E, 100 m, 29.IV.1995,
fr., Ebahazo 1011 (MO, P); Mont Apiky au-dessus de Mahamavo, bassin de
la Mananara, [24°47’S 46°44’E], 1.1.1934, fr., Humbert 13853 (K, MO, P [2
sheets], TAN); Mont Morahariva (Mahamena), vallée de la Manambolo,
rive droite (bassin du Mandrare) aux env. d’Isomono (confluent de la Sak-
mailo), [24°32′06″S 45°37′48″E], 1000–1400 m. XI.1933, stes., Humbert 132726(P); Mont Vohiopolaka, au N de Betroka, [23°08′S 45°05′E], XI.1933, stes., Humbert 11667(P); Mont Vohiopolaka, vallée moyenne du Mandrare, près d’Anabadolava, [24°15′56″S 45°43′E], [800–850 m]. XII.1933, fr., Service Forestier MO, P [2 sheets]; PK 40 on RN 13 from Fort Dauphin to Ambovombe, 25°00′45″S 46°36′04″E, 28.III.2010, fr., De Block et al. 2378(MO); rte Ambovombe-Ft. Dauphin, env. de Belevy, [25°00′30″S 46°36′00″E], 100 m. 23.IX.1953, buds, Service Forêts 8944(TF); ibd. loco. S of Belevy village, 25°01′S 46°36′E, 100 m. 27.III.1953, fr., Randrianarisoa 203(MO, TAN); ibd. loco, c. 60 road-km W of Tolagnaro, 24°59′S 45°33′E, 70 m. 24.V.1991, fr., Zarouchi et al. 7484 (MO, P); Vinambe, [25°03′33″S 45°56′28″E], [100 m]. 17.X.1990, fl., Dumetz 1320(MO, P).

Reg. Atsimo-Andrefana [Prov. Toliara]: Beroroha, 4 km avant Antsoa, sur côte, 21°15′33″S 45°09′52″E, 492 m. 4.XII.2010, buds, Andrianitiana et al. 1024(MO, P, TAN); ibd. loco, forêt d’Anosilamy, 21°20′30″S 45°10′53″E, 448 m. 13.I.2010, fr., Mary Dasi, plateau au W of Lake Anosilany, 21°20′17″S 45°10′42″E, 607 m. 27.XI.2010, fl., Phillipson et al. 6262 (G, K, MO, P, TAN); massif d’Anavelona, bassin de la Mananadabo, [22°37′18″S 44°10′41″E], 1000–1300 m. 13.XII.1962, stes., Service Forêts 22196 (P).

Reg. Ihorombe [Prov. Fianarantsoa]: entre Tametsoa et Sahanafa, au N de Hisalo, [22°18′5′′S 45°05′20′′E], [700–1100 m]. 30.I.1955, fr., Cours 5048(P [2 sheets]); Kritanga, entre Ambaratara et Ivandrika, 20 km au NE d’Ihosy, [22°17′30″S 45°10′20″E], 13.1.2010, fr., Razakamalala et al. 7030(MO, P, TAN); Makay Massif, plateau au W of Lake Alonilaby, 21°20′17″S 45°10′42″E, 607 m. 27.XI.2010, fl., Phillipson et al. 6262 (G, K, MO, P, TAN); massif d’Anavelona, bassin de la Mananadabo, [22°37′18″S 44°10′41″E], 1000–1300 m. 13.XII.1962, stes., Service Forêts 22196 (P).

Diospyros hongwae G.E. Schatz, Lowry & Phillipson can be assessed initially sparsely to moderately densely covered with appressed, very short (< 0.1 mm) gray trichomes, glabrescent. Male flowers not seen. Female flowers solitary in the axils of leaves and fallen leaves; pedicel 2–3 mm long, 2–3 mm diam., bearing several bracts (based upon bract scars), densely covered with very short, erect, light golden to gray trichomes; flowers ellipsoid at anthesis, calyx fully fused, adnate to the receptacle, the apex entire, 7–8 mm long, 6 mm in diam., glabrous outside, densely covered with very short, erect light golden to gray trichomes inside; calyx rapidly expanding post anthesis, extending an additional 4 mm, cupuliform; corolla tubular, 15 mm long, 4 mm in diam., lobes 4, ovate, 5 × 4 mm, apex acute, adaxially concave, densely covered with very short, appressed trichomes outside, glabrous inside; staminodia c. 18, inserted at base of corolla tube, filaments 3 mm, the distal 1 mm free, antherodes 1.5 mm, ovary subperipheral, crowned by conical style, the stigma 4-lobed, lobes 1.5 mm long. Pedicel in fruit expanding to 4–5 mm in diam., with a distinct apical rim to 6 mm in diam., the apex convex. Receptacle in fruit to 3 mm thick at base. Fruit subperipheral, the apex slightly exserted above the prolonged cupuliform calyx, i.e., visible, c. 10–12 mm in diam., densely covered with short (c. 0.5 mm), appressed, light golden trichomes, crowned by the style/stigma remnant, cone-shaped, 2–4 mm tall, 2 mm in diam. at base, densely covered with shorter (c. 0.2 mm) semi-appressed darker golden trichomes.

Etymology. – The species epithet honors our colleague and good friend Cynthia Hong-Wa, who brought order to the large and complex genus Noronhia Stadtm. ex Thouars (Oleaceae).

Vernacular name. – “Ambavy” (Hong-Wa 317).
Fig. 2. – *Diospyros hongwae* G.E. Schatz, Lowry & Phillipson. **A.** Fruiting branch; **B.** Detail of leaf venation (adaxial surface); **C.** Fruit; **D.** Female flower prior to anthesis; **E.** Schematic drawing of female flower with a portion of the calyx removed.

[A–E: Hong-Wo 317, P] [Drawing: Alain Jouy]
Notes. – The collections Humbert & Capuron 25932 and Service Forestier 3075 represent a single gathering divided between two separate collection series. Diospyros hongwae can be distinguished from other members of the Bernieriana group by its large leaves with flat margins (weakly undulate in fresh material) and its subspherical fruit, the apex of which is slightly exserted above the prolonged cupuliform calyx and thus visible.

Paratypi. – Madagascar. Reg. DIANA [Prov. Antsiranana]: Ambakirano, Behefaka, Anjahana, 17°20′55″S 49°10′45″E, 236 m, 7.VI.2005, fr., Hong-Wa 317 (MO, P); ibid. loc., 13.XII.2018, fr., Randrianaivo et al. 3298 (MO, P, TAN); vallée de l’Ifasy, en aval d’Anaborano, grès et alluvions, [13°24′S 48°55′E], 50–200 m, 31.III.1951, f., Humbert & Capuron 25932 (G, MO, P [2 sheets]).

4. Diospyros ranirisonii G.E. Schatz, Lowry & Phillipson, sp. nov. (Fig. 3).

Holoty whole: Madagascar. Reg. DIANA [Prov. Antsiranana]: forêt de Sahafary 20.II.1962, fr., Service Forestier 20972 (P [P03974996]); iso-: MO-6956009!, G [G00341734]!, K!, P [P00722703]!, TEF [TEF000892]!, W!).

Diospyros ranirisonii G.E. Schatz, Lowry & Phillipson can be distinguished from other members of the Bernieriana group by its linear to narrowly oblong leaves with strongly revolute margins, the abaxial surface of the lamina obscured on many leaves, its female flowers narrowly ellipsoid, 11–15 mm long, at least 2 times longer than wide, with the apex of the calyx lobed, and its mature fruit 12–16 × 7–10 mm, the lobes of the calyx 6–8 mm long.

Tree 5–10 m tall, to 30 cm DBH. Young stems initially densely covered with erect, very short (< 0.1 mm) gray trichomes and rufous, farinose trichomes, glabrescent. Leaves 0.9–4.4 × 0.3–0.8 cm, narrowly elliptic to linear, occasionally narrowly obovate, initially densely covered above and below with rufous farinose trichomes with a gray stellate/lepidote base, glabrescent, glossy above, base acute to cuneate, margin strongly revolute, the underside of the leaf often completely obscured, apex acute with the tip rounded, midrib slightly impressed above, raised below, covered with gray farinose trichomes, venation absent; petiole 2–4 mm, 0.8 mm diam., canaliculate, initially densely covered with rufous farinose trichomes and very short (< 0.1 mm), semi-appressed white trichomes, glabrescent. Male flowers solitary in the axils of leaves and fallen leaves; pedicel 2–3 mm long, 2 mm diam., with 4 minute distichous bracteoles, densely covered with rufous farinose trichomes and very short (< 0.1 mm), erect, light golden to gray trichomes; flowers narrowly ellipsoid at anthesis, 10–11 mm long, 4–5 mm in diam., adnate to receptacle, 8–10 mm tall, the apex with (3–)4 lobes, 2 × 2–3 mm, slightly reflexed, densely covered outside with rufous farinose trichomes and sparse semi-appressed light golden trichomes 0.5 mm long; calyx lobes rapidly expanding post anthesis, to 6–8 × 5–6 mm, succulent; corolla tubular, 10 mm long, tube 8 mm long, lobes 4 × 2–mm, broadly triangular, densely covered with semi-appressed light golden trichomes; stamens 9, filaments 1.2 mm, anther 0.8 mm; ovary 3 mm long, 2 mm in diam., ellipsoid, basal third glabrous, upper ½ densely covered with short appressed light golden trichomes, stylar column narrowly conical, 3 mm. Pedicel in fruit expanding to 4–5 mm in diam. Fruit 12–16 mm long, 7–10 mm in diam., ellipsoid, initially enclosed within the prolonged calyx until it breaks off, glabrous to densely covered toward the apex with short (< 0.1 mm), appressed, light golden trichomes, crowned by the style/stigma remnant, cone-shaped, 2 mm tall, 1 mm in diam. at base.

Etymology. – The species epithet honors Patrick Ranirison, who made many important collections from the Loky Manambato protected area while pursuing his doctoral studies and played a leading role in the establishment of the new Ampasindava and Galoko-Kalobinono protected areas.

Vernacular name and uses. – “Mapingo” (Andriambolona & Bernard 275). Wood is used for the manufacture of furniture (Andriambolona & Bernard 275).

Distribution and ecology. – Diospyros ranirisonii is known from dry forest on sand in the far north in DIANA and SAVA regions from the Sahafary forest south to the Bobankora forest (Madagascar Catalogue, 2020), at an elevation of 50–230 m.

Conservation status. – Diospyros ranirisonii has a geographic range in the form of an EOO of 760 km² and a minimum AOO of 32 km². It is present in the Loky-Manambato protected area. At other localities, it is threatened by fire, forest clearing for agriculture, grazing, and exploitation for firewood and construction material, all of which are projected to result in continuing decline. With respect to the principal threat of forest clearing for agriculture, it exists at seven locations.
Fig. 3. – Diospyros ranirisonii G.E. Schatz, Lowry & Phillipson. A. Flowering branch; B–C. Leaves (abaxial surface); D. Detail of female flower; E. Nearly mature fruit.

[A, D: Service Forestier 24523, P; B–C, E: Service Forestier 20972, P] [Drawing: Alain Jouy]
Diospyros ranirisonii can therefore be assessed for its risk of extinction as “Vulnerable” [VU B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v)].

Notes. – Diospyros ranirisonii can be distinguished from other members of the Bernieriana group by its narrowly elliptic to linear leaves with strongly revolute margins, initially densely covered with rufous farinose indumentum, narrowly ellipsoid female flowers at least 2 times longer than wide, and lobed calyx enclosing the fruit, the lobes 6–8 mm long in fruit.

Paratypes. – Madagascar. Reg. DIANA [Prov. Antsiranana]: forêt d’Anafoandrony, 26.II.1964, fr., Service Forestier 23322 (FHO, G, K, MO, P [2 sheets], TAN, TEF, US, W); ibid. loco, 7.II.1966, 2 fl., Service Forestier 24522 (G, MO, P, TAN, TEF); ibid. loco, 7.II.1966, 8 fl., Service Forestier 24523 (G, MO, P [2 sheets], TAN, TEF, W). Reg. SAVA [Prov. Antsiranana]: Ampandra, 3.X.2013, fr., Rakarijiana et al. 326 (K, MO, P, TAN); Loky Manambato AP, 27.IX.2013, stet., Andriambolondena & Bernard 275 (MO, TAN); ibid. loco, 16.IV.2004, fr., Ranirison 668 (G, MO, P); ibid. loco, 14.IX.2013, fr., Onjalalaina et al. 21 (BR, K, MO, P, TAN); ibid. loco, 11.II.2004, fr., Ranirison & N'Gashamer 417 (G, MO); ibid. loco, 6.III.2003, fr., Gautier et al. 4241 (G, MO, P); ibid. loco, 9.III.2004, fr., Gautier et al. 4506 (G, MO, P).

5. Diospyros silicea G.E. Schatz, Lowry & Phillipson, sp. nov. (Fig. 4).

Holotypus: Madagascar. Region Atsimo-Andrefana [Prov. Toliara]: forêt de Zombitsy (= Zombite-Vohibasia) (Sakaraha), [22°52′52″S 44°41′22″E], 600–850 m, 26–29.III.1955, fr., Humbert, Bégué & Capuron 29598 (P [P03974999]!; iso-: G [G00341735]!, MO-6956010!, P [P00722704]!), TAN!, W!).

Diospyros silicea G.E. Schatz, Lowry & Phillipson can be distinguished from other members of the Bernieriana group by its leaves with distinctly undulate margins and its ellipsoid fruit with the apex exerted above the calyx.

Tree 5–10 m tall. Young stems initially covered with erect, very short (< 0.1 mm) gray trichomes, glabrescent. Leaves 2.4–7.8 × 1.2–2.7 cm, elliptic, glabrous above and below, base cuneate, margin distinctly undulate and somewhat revolute, apex acute to acuminate with the tip rounded, midrib slightly impressed above, raised below, venation weakly brochidodromous with 6 secondary veins per side, slightly raised and faintly visible above, completely obscure below; petiole 3–7 mm, 0.7 mm diam., canaliculate, initially covered with very short (< 0.1 mm) semi-erect white trichomes, glabrescent. Male flowers in fascicles of 3 or 4 in axils of leaves, ellipsoid, 4–5 mm long, 2.5–3 mm in diam. in bud; pedicels 1 mm long, 0.5 mm in diam, covered with very short (< 0.1 mm) erect, white trichomes, bearing several caducous bracts; calyx tubular, 4–5 mm long, 2–3 mm in diam., the apex with irregular shallow lobes, densely covered very short (< 0.1 mm) semi-appressed, white trichomes and the surface papillate outside, glabrous inside; corolla tubular, 7.5 mm long, 2.2 mm in diam., basal half glabrous, distal half densely covered with very short (0.1 mm) appressed trichomes, lobes 5.3 × 1.5 mm, narrowly ovate, imbricate, adaxially concave, densely covered with white, appressed trichomes c. 0.1 long outside, glabrous inside; stamens 10, adnate to corolla at the base, filaments 0.5–0.8 mm, anthers 2–2.2 mm. Female flowers not seen. Pedicel in fruit 2–3 mm long, to 4–5 mm in diam., covered with very short (< 0.1 mm) semi-appressed white trichomes; calyx extending 5–6 mm above fruit, apex with shallow irregular lobes, not completely enclosing the fruit, i.e., the apex of the fruit visible before the calyx lobes break off, glabrous outside, densely covered with very short (< 0.1 mm) erect, white trichomes inside. Fruit 15–18 mm long, 9–14 mm in diam., ellipsoid, the apex exerted above the calyx, glabrous to densely covered toward the apex with short (< 0.1 mm), appressed, light golden trichomes, crowned by the style/stigma remnant, cone-shaped, 2 mm tall, 1 mm in diam. at base.

Etymology. – The species epithet refers to the weathered siliceous sand substrate where the new species occurs.

Distribution and ecology. – Diospyros silicea is known from only two gatherings in subarid forest and thicket on siliceous sand from Zombitse-Vohibasia National Park south to Tsıombe (Madagascar Catalogue, 2020), at an elevation of 250–850 m.

Conservation status. – Diospyros silicea has a restricted geographic range in the form of an AOO of 8 km2. It is present from the Zombitse-Vohibasia National Park. At its other known locality, east of Tsıombe, it is threatened by grazing, fire, and exploitation for firewood and construction material, all of which are projected to result in continuing decline. With respect to the principal threat of grazing, it exists at two locations. Therefore, D. silicea can be assessed for its risk of extinction as “Endangered” [EN B1ab(iii)].

Notes. – The two collections Humbert et al. 29598 and Service Forestier 11918 represent a single gathering divided between two separate collection series. Diospyros silicea can be distinguished from other members of the Bernieriana group by its leaves with distinctly undulate margins, and its ellipsoid fruit exerted above the calyx with shallow irregular lobes.

Paratypes. – Madagascar. Reg. Androy [Prov. Toliara]: env. E de Tsıombe, [25°18′45″S 45°30′15″E], 70 m, 14.XI.1967, buds, Service Forestier 27981 (MO, P, TEF). Reg. Atsimo-Andrefana [Prov. Toliara]: forêt de Zombitsy, à l’Est de Sakaraha, [22°52′52″S 44°41′22″E], 600–850 m, III.1955, fr., Service Forestier 11918 (G, MO, NY, P [2 sheets], TEF, US).
Fig. 4. – Diospyros silicea G.E. Schatz, Lowry & Phillipson. A. Flowering branch; B. Fruiting branch; C. Fruit; D. Detail of leaf venation (adaxial surface).
[A: Service Forestier 27981, P; B–D: Service Forestier 11918, P] [Drawing: Alain Jouy]
6. *Diospyros suarezensis* G.E. Schatz, Lowry & Phillipson, sp. nov. (Fig. 5, 6A–B).

**Holotypos:** Madagaskar. Reg. DIANA [Prov. Antsiranana]: Forêt d’Orangea [Orangea], along the dirt track near the remains of the French fort on hill above Ramena, 12°15'01"S 49°21'39"E, 50 m, 20.1.2003, fr., Miller et al. 10724 (MO-H883922; iso-: P [P01031025]), G [G00341891], TAN!, W).

*Diospyros suarezensis* G.E. Schatz, Lowry & Phillipson can be distinguished from other members of the Bernierana group by its small (0.8–2.7 × 0.3–1.6 cm) elliptic to obovate leaves with revolute margins, the broadest blade less than 3 times longer than wide, the adaxial surface of the lamina glossy, the abaxial surface glabrous or initially with white farinose indument and then glabrescent, its female flowers obconical, with the apex of the calyx entire, the calyx strongly accrescent in fruit to 8–9 mm long.

Shrub to tree 1.5–5 m tall. **Young stems** densely covered with erect, very short (< 0.1 mm) gray trichomes. **Leaves** 0.8–2.7 × 0.3–1.6 cm, elliptic to obovate, glabrous and glossy above, glabrous or initially with white farinose indument and then glabrescent below, base acute to obtuse, margin revolute to strongly revolute and then obscuring much of the abaxial lamina surface, apex obtuse to rounded, the very tip rounded, midrib flat to slightly impressed above, slightly raised below, venation weakly brochidodromous with 3–4 secondary veins per side, flat to slightly raised above, only faintly visible above and below, tertiary venation indistinct; petiole 1–3 mm, 0.8 mm diam., canaliculate, densely covered with erect, very short (< 0.1 mm) gray trichomes. **Male flowers** not seen. **Female flowers** solitary in the axils of leaves and fallen leaves; pedicel 0.5–1 mm long, 0.7 mm diam., bearing several bracts densely covered with very short, appressed, light golden to gray trichomes; flowers obconical at anthesis, calyx fully fused, obconical, 4–5 mm long, 2 mm diam. at base to 3–3.5 mm in diam. at apex, the apex entire, densely covered with rufous farinose trichomes and very short, appressed golden to gray trichomes outside, very densely covered with very short semi-appressed light golden trichomes inside, glabrescent outside; calyx rapidly expanding post anthesis, extending an additional 4–9 mm, with visible venation, the apex entire; corolla tubular to slightly obconical, 5 mm long, 2 mm in diam. at base to 2.5 mm diam. at apex, glabrous for basal ¾, densely covered with very short appressed trichomes for apical ¼, lobes 3 or 4, broadly ovate, 2.5 × 2 mm, apex obtuse, densely covered with very short, appressed trichomes outside, glabrous inside; staminodia 4, inserted toward the apex of corolla tube, filaments adnate to corolla, 3 mm, the, the antherodes 1 mm, ovary obovoid to subspherical, 2 mm tall, 2 mm in diam., densely covered with short appressed trichomes, crowned by the cylindrical style, 2 mm tall, 0.5 mm diam., densely covered with short appressed trichomes. **Peduncle** in fruit expanding to 2 mm long, 3–5 mm in diam. **Fruit** 9–12 mm in diam., subspherical, initially enclosed within the prolonged calyx until it breaks off, densely covered with short (c. 0.5 mm), appressed, light golden trichomes toward the apex, crowned by the style/stigma remnant, narrowly cone-shaped, 2 mm tall, 0.8 mm in diam. at base.

**Vernacular names.** – “Beando beravina” (Christian et al. 67); “Jaobiampototra” (Razaftisalama 593); “Kirandrambiavy madiniky” (Be et al. 126); “Sarimina” (Ratovoison 2105).

**Distribution and ecology.** – *Diospyros suarezensis* is known from dry forest on sand in the DIANA region from Orongia south to Irodo (Madagascar Catalogue, 2020), at an elevation of 0–280 m.

**Conservation status.** – *Diospyros suarezensis* has a restricted geographic range in the form of an EOO of 439 km² and a minimum AOO of 68 km². It is present in the Ambodiva-hibe Marine Reserve and Orongia protected areas. Outside of protected areas, it is threatened by grazing, fire, and exploitation for firewood and construction material, all of which are projected to result in continuing decline. With respect to the principal threat of fire, it exists at 16 locations. Therefore, *D. suarezensis* can be assessed for its risk of extinction as “Near Threatened” [NT], as it nearly qualifies as “Vulnerable” under Criteria B1 and B2 (IUCN, 2012).

**Notes.** – *Diospyros suarezensis* can be distinguished from other members of the Bernierana group by its small elliptic to obovate leaves with revolute margins, and its subspherical fruit enclosed within the accrescent calyx lacking lobes.

**Paratypes.** – Madagascar. Reg. DIANA [Prov. Antsiranana]: Ambaranarana, 12°16'47"S 49°22'37"E, 72 m, 12.XII.2015, buds, Ratovoison 2105 (MO, P, TAN [+ 2 sheets]); ibid. loco, 12°16'36"S 49°22'07"E, 60 m, 13.II.2005, fl., Schatz 4234 (CNARP, MO, P, TAN); Ambodivahibe, forêt littorale d’Ambovobe, 12°23'4"S 49°26'23"E, 10 m, 19.V.2005, fr., Ramanantahary et al. 309 (MO, P, TAN); Andrafaibe, 3 km au NW d’Ambolobozokely, 12°25'59"S 49°30'07"E, 34 m, 16.VI.2005, fr., Be et al. 126 (MO, P, TAN); ibid. loco, 12°26'00"S 49°30'08"E, 16 m, 28.XII.2008, fr., Christian et al. 67 (CNARP, MO, TAN); ibid. loco, 4 km au N d’Ambolobozoko, 12°29'00"S 49°31'25"E, 10, 8.II.2005, fr., Ratovoison et al. 929 (G, MO, P, TAN); ibid. loco, 2 km au NW du village, 12°26'15"S 49°29'15"E, 11.XII.2007, fl., Rakotovasao 767 (K, TAN); Andrafakely, Ambolobozokely, Ampasina, à 2 km au NW du village, 12°26'15"S 49°29'39"E, 11.XII.2007, fr., Rakotondranahatra 1264 (MO, P, TAN); Ankaranana (Korangana), Irodo, Analafondro forest, 12°37'47"S 49°31'15"E, 55 m, 24.II.2006, stér., Birkinshaw et al. 169 (MO, P, TAN); ibid. loco, 12°17'59"S 49°21'23"E, 5 m, 11.V.2005, fr., Ratovoison et al. 978 (G, MO, P, TAN); ibid. loco, 12°17'18"S 49°21'22"E, 0 m, 16.II.2005, fl., Schatz et al. 4337 (CNARP, MO, P, TAN); à l’île d’Antsiranana, 12°16'49"E, 22.II.1962, fr., Service Forêts et Forestier 2094 (MO, P, TEF); ibid. loco, 12°16'00"S 49°22'00"E, 25.II.1964, fr., Service Forêts et Forestier 23259 (MO, P [2 sheets], TEF); Baie des Dunes, 12°14'27"S 49°22'26"E, 10 m, 17.V.2004, fr., Razaftisalama et al. 593 (MO, P, TAN); forêt d’Analafondro, à la base du plateau de Sahafary
Fig. 5. – Diospyros suarezensis G.E. Schatz, Lowry & Phillipson. A. Fruiting branch; B. Mature fruit; C. Outline of leaves, showing revolute margins (abaxial surface); D. Detail of leaf venation (adaxial surface).
[A–B, D: Miller et al. 10724, P; C: Ratovoson 978, P] [Drawing: Alain Jouy]
catalogue, 2020), at an elevation of 0 – 242 m. To the Kirindy forest north of Morondava (Madagascar). cited in dry deciduous forest on sand from Boriziny south of Ambany, 12°35’05"S 49°27’22"E, 205 m, 5.XII.2006, fr., (G, MO, P, TAN); Sahafary, Sadjoavato, Saharenana W); Ramena (2 km à l’E du village), 12°15’05"S 49°22’01"E, 12.I.2005, fr., P, TEF); d’Ivovona, [12°19’S 49°23’E], 15.XII.1963, ster., (MO, P, TAN); Pres, ibid. loco (G, MO, P [2 sheets], TEF); ibid. loco (au S), prés ibid. loco (G, MO, P [2 sheets], TEF); Service Forestier 22727 al. 526 (BR, K, MO, P, TAN); Oronjia, 12°14’11"S 49°21’51"E, 41 m, 27.I.2014, fr., Rabarijaona et al. 227; “Hazomintina” (IBTS, MO, P, TAN); Tanneverse, PK 10, rte de Ramena, 12°17’58"S 49°21’20"E, 18.X.2013, fr., Rakotarisoa & Andriamahay 3288 (K, MO, P, TAN, TEF).
Fig. 6. – *Diospyros suarezensis* G.E. Schatz, Lowry & Phillipson: A–B. Nearly mature fruit with expanded calyx. *D. torquata* H. Perrier: C. Immature fruit with developing calyx.
[A–B: Randrianaivo et al. 2499; C: Phillipson et al. 6146] [Photos: A–B: R. Randrianaivo; C: P.B. Phillipson]
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