



Calophyllum honbaense (Clusiaceae), A new species from Hon Ba Nature Reserve, Southern Vietnam

Van-Son DANG^{1,*}, Hironori TOYAMA², Shuichiro TAGANE³, Nghia-Son HOANG¹ and Akiyo NAIKI²

1. Institute of Tropical Biology, Vietnam Academy of Science and Technology, 85 Tran Quoc Toan Street, District 3, Ho Chi Minh City, Vietnam.

2. Iriomote Station, Tropical Biosphere Research Center, University of the Ryukyus, 870 Uehara, Taketomi-cho, Yaeyama-gun, Okinawa, 907-1541, Japan.

3. The Kagoshima University Museum, Kagoshima University, 1-21-30, Korimoto, Kagoshima, 890-0065, Japan.

*Corresponding author's email: dvsonitb@gmail.com

(Manuscript received 4 September 2018; accepted 31 January 2019; online published 28 February 2019)

ABSTRACT: The new species of Clusiaceae, *Calophyllum honbaense* V.S. Dang, H. Toyama & Tagane, sp. nov., was discovered in the Hon Ba Nature Reserve of southern Vietnam and is here described and illustrated.

KEY WORDS: *Calophyllum honbaense*; *Calophyllum rugosum*; New species; Clusiaceae; Taxonomy; Vietnam.

INTRODUCTION

The genus *Calophyllum* L. includes about 187 species distributed in tropical regions, mainly in Asia, and also in East Africa, tropical America, Madagascar, the Mascarenes and Australia (Li *et al.* 2007). This genus can be readily recognized by its opposite leaves with closely and regularly parallel veins that alternate with latex canals, usually appear to be hermaphroditic flower, ovary with a single, basal, anatropous ovule, and drupelike fruit (Stevens, 1980).

The last monograph was provided by Stevens (1980), in which he classified 179 species using mainly vegetative characters such as venation density, venation prominence, scale scars at the base of the axillary innovations. In mainland Southeast Asia, 22 species have been recognized (Pitard 1910; Gagnepain 1943; Stevens 1980; Pham 2000; Li *et al.* 2007), but many of the species are poorly known (Stevens 1980). *Calophyllum rugosum* P.F. Stevens is one example having polymorphic features. Stevens (1980) noted that *Poilane 30918* (holotype, collected from Bidoup, P) had long internodes and relatively large leaf blades that were cuneate or rounded at the base. *Poilane 3494* (P) has short internodes and smaller leaf blades that are broadly rounded at the base. *Chevalier 38865* (P) has long internodes and rather large, sessile leaf blades that are cordate at the base. However, these three specimens (*Poilane 30918*, *Poilane 3494* and *Chevalier 38865*) are assigned to *C. rugosum* by Stevens based on the similarity of indumentum of terminal bud, leaf type and inflorescence position because of the insufficient materials.

In 2013–2017, we carried out field surveys to assess the plant diversity of Hon Ba Nature Reserve in southern Vietnam where *Chevalier 38865* was collected, and found a species of *Calophyllum* that could be identical to

it. In addition, we collected a species of *Calophyllum* that is identical to the holotype of *C. rugosum* from our surveys in Hon Giao area in Bidoup Nui Ba National Park. After a careful examination based on our new collections, we noted the former one identical with *Chevalier 38865* possess fewer flowers per inflorescence than those of *C. rugosum* and cordate leaf bases, which are clearly distinguishable from type of *C. rugosum*. Additionally, the collection of Hon Ba differs from all the species formerly reported from Indochina (Pitard, 1910; Gagnepain, 1943; Stevens, 1980; Pham, 2000) and China (Li *et al.*, 2007), and does not match any described species of the genus. Here, we describe it as a new species, *Calophyllum honbaense* V.S. Dang, H. Toyama & Tagane. Our conclusion is based on observations of specimens in the herbaria BKF, FOF, HN, KAG, P, RAF and VNM, and specimen images on the website of JSTOR Global Plants (<https://plants.jstor.org/>). We also provide DNA sequences of two DNA barcode regions; the partial genes for the large subunit ribulose-1,5-bisphosphate carboxylase oxygenase (*rbcL*) and maturase K (*matK*) (CBOL Plant Working Group, 2009); established protocols were used to determine the sequences of these regions (Kress *et al.*, 2009; Dunning and Savolainen, 2010).

TAXONOMIC TREATMENT

Calophyllum honbaense V.S. Dang, H. Toyama & Tagane, sp. nov. **Fig. 1**

Type: Vietnam, Khanh Hoa Province, Hon Ba Nature Reserve, 30 km west of Nha Trang City, slope direction N60°E, evergreen forest, alt. 1498 m, 12°07'86"N, 108°56'52"E, 18 July 2013, Tagane S., Yahara T. Nagamasu H., Fuse K., Toyama H., Tran H., Son V.D., Loi X.N., Thach N.D., Cuong Q.N., Hieu P.N.H., Thach K.N.

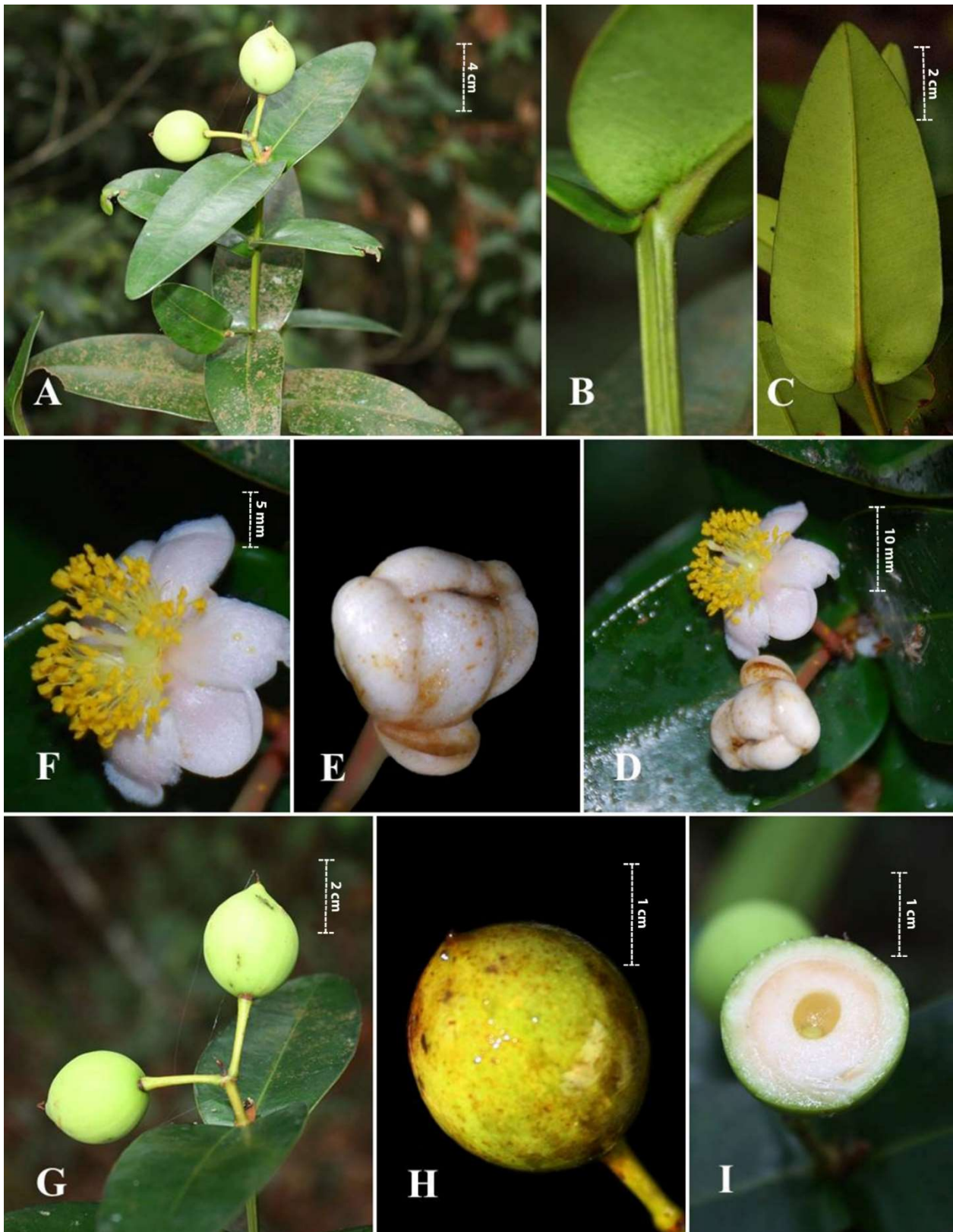


Fig. 1. *Calophyllum honbaense* V.S. Dang, H. Toyama & Tagane: **A.** Twig with immature fruit; **B.** Sessile petiole; **C.** Abaxial leaf surface; **D.** Inflorescence; **E** and **F.** Close-up of flowers; **G.** Immature fruits; **H.** Mature fruit; **I.** Transverse section of immature fruit. A–C & G for Tagane *et al.* V269; D–F & H–I for V.S. Dang 202.

**Table 1.** Morphological comparison between *Calophyllum honbaense* and *Calophyllum rugosum*

Characters	<i>Calophyllum honbaense</i>	<i>Calophyllum rugosum</i> ¹
Twig	slightly flattened, 4-angled	flattened, 2 or 4-angled
Terminal bud size	3.5–5.5 mm long	2.5–4.5 mm long
Petioles	sessile	3–10 mm long
Leaf blade	ovate to lanceolate, 4–8 by 2–4 cm	elliptic to broadly elliptic, rarely obovate, 1.2–10.5 by 1.1–5.4 cm
Leaf base	strongly cordate	cuneate to rounded
Inflorescence	(1–)2-flowered, the axis up to 4 cm long	5–9-flowered, the axis up to 5 cm long
Bracts length	5 mm long	5–10 mm long
Number of sepals	4	4
Number of petals	4	4(–6)
Fruit	ovoid, 2.5–3 by 1.5–2 cm	spherical to ellipsoid, 2–2.2 by 1.7–2 cm
Stone	ellipsoid to ovoid-ellipsoid, 1.5–2 by 1–1.2 cm	ellipsoid to spherical, 1.9 by 1.6–1.75 cm

¹ The measurements from Toyama *et al.* V1892 & V4187 (VNM), Tagane *et al.* V9691 (KAG) and Stevens (1980, for fruit and stone only).

V269 [fr.] (holotype, VNM!; isotypes, FU!, TAI!, VNM!, Station of Hon Ba Nature Reserve!).

Diagnosis: *Calophyllum honbaense* is similar to *C. rugosum* P.F. Stevens distributed in Vietnam, but it is distinct by its sessile leaves with a strongly cordate base (vs. cuneate to rounded in *C. rugosum*), fewer flowers per inflorescence (1–2 vs. 5–9), 4 petals (vs. 4–6) and ovoid fruits (vs. spherical to ellipsoid).

Tree 6–14 m tall, ca. 18 cm in d.b.h.; bark gray brown to dark brown, with longitudinal fissures, usually exuding pale yellow resins when wounded; twigs slightly flattened, 4-angled, pubescent, dark brown to blackish when dry; internodes 0.5–5 cm long; terminal bud, ca. 3.5–5.5 mm long, covered with brownish indumentum. **Leaves:** lamina coriaceous, ovate to lanceolate, 4–8 by 2–4 cm, apex rounded to shallowly retuse, base strongly cordate, margin entire, grayish olive above and fulvous below when dry, glabrous, midrib impressed adaxially, raised abaxially, slightly undulate curved to the margin, the venation obscure on both surfaces, ascending at an angle of ca. 70–80°, ca. 5–9 veins/5 mm; petioles sessile, glabrous. **Inflorescences:** terminal from foliate axils along stem, (1–)2-flowered, the axis up to 4 cm long, subtomentose to puberulent when young, 4-angled, lowest internode 1–1.5 cm long, pubescent; bracts ovate, ca. 5 mm long, pubescent, caducous; pedicels 1.5(–2) cm long, glabrous. **Flower:** scented, hermaphroditic; sepals 4, ovate to suborbicular, outer 2 smaller, ca. 6 mm long, inner 2, ca. 8 mm long, pubescent; petals 4, oblanceolate to broadly obovate, ca. 9–10 by 5–6 mm, concave, apex rounded, pinkish white; stamens 120–140, filaments 3–5 mm long, anthers oblong, ca. 1.5–2 mm long, retuse at apex, yellow in anthesis; ovary globose, ca. 1.6–2 mm in diam., pubescent, style 4–5 mm long, stigmas peltate, ca. 1 mm in diam. **Fruits:** ovoid, 2.5–3 by 1.5–2 cm, acute at apex, grayish brown when dry, puberulent when young, shallowly wrinkled when dry; outer layer detaching cleanly from stone, ca. 0.8 mm thick, compact; fruiting pedicels 1.5–2 cm long. Stone ellipsoid to ovoid-ellipsoid, 1.5–2 by 1–1.2 cm, obtuse at apex, the walls 0.2–0.6 mm thick, smooth, unmarked, fibrous; spongy layer thin.

Phenology: Flowers known in December – February, and fruits in March – July.

Distribution: Known only from Hon Ba Nature Reserve, Khanh Hoa Province, southern Vietnam.

Habitat and Ecology: In montane evergreen forest dominated by Fagaceae, at alt. 1498–1521 m.

Etymology: The specific epithet refers to Hon Ba Nature Reserve where this species was discovered.

Other specimens examined: Vietnam, Khanh Hoa Province, Hon Ba Nature Reserve, 30 km west of Nha Trang City: alt. 1500 m, 12°07'09"N, 108°56'58"E, 27 December 2017, Dang Van Son, V.S.Dang 202 [fl. & fr.] (VNM); alt. 1521 m, 12°07'06"N, 108°56'52"E, 19 July 2014, Tagane S, Kanemitsu H, Son V.D, Tran H with Loi X.N, Thach N.D, Dinh N & Hieu P.N.H, V1757 [fr.] (FU, VNM, the Station of Hon Ba Nature Reserve); alt. 1000–1500 m, 28–31 August 1918, Chevalier 38865 (P).

Notes: *Calophyllum honbaense* is morphologically similar to *C. rugosum* P.F. Stevens (Fig. 2) and has been considered within infraspecific variation of *C. rugosum*, but clearly differs from that species in several characters (see Table 1).

GenBank Accession No.: Toyama *et al.* V269, MK558199 (*rbcl*), MK558198 (*matK*).

ACKNOWLEDGEMENTS

The authors are grateful to staff of Hon Ba Nature Reserve and Bidoup Nui Ba for their helpful assistance in the field collection. We are grateful to the curators of herbaria BKF, FOF, HN, KAG, P, RAF and VNM for their help to access specimens for our studies, and to Professor Tetsukazu Yahara of the Kyushu University, Japan and Associate Professor Tran Hop of the University of Science Ho Chi Minh City, Vietnam for their help in the identification of the taxon and providing relevant literature.

LITERATURE CITED

- CBOL Plant Working Group.** 2009. A DNA barcode for land plants. *PNAS* **106**(31): 12794–12797.
- Dunning, L.T. and V. Savolainen.** 2010. Broad-scale amplification of *matK* for DNA barcoding plants, a technical note. *Bot. J. Linn. Soc.* **164**(1): 1–9.
- Gagnepain, F.** 1943. *Calophyllum*. In: Gagnepain, F. & H. Humbert (eds.), *Fl. Indo-Chine* [P.H. Lecomte *et al.*] Suppl.: 268–275. Masson, Paris.

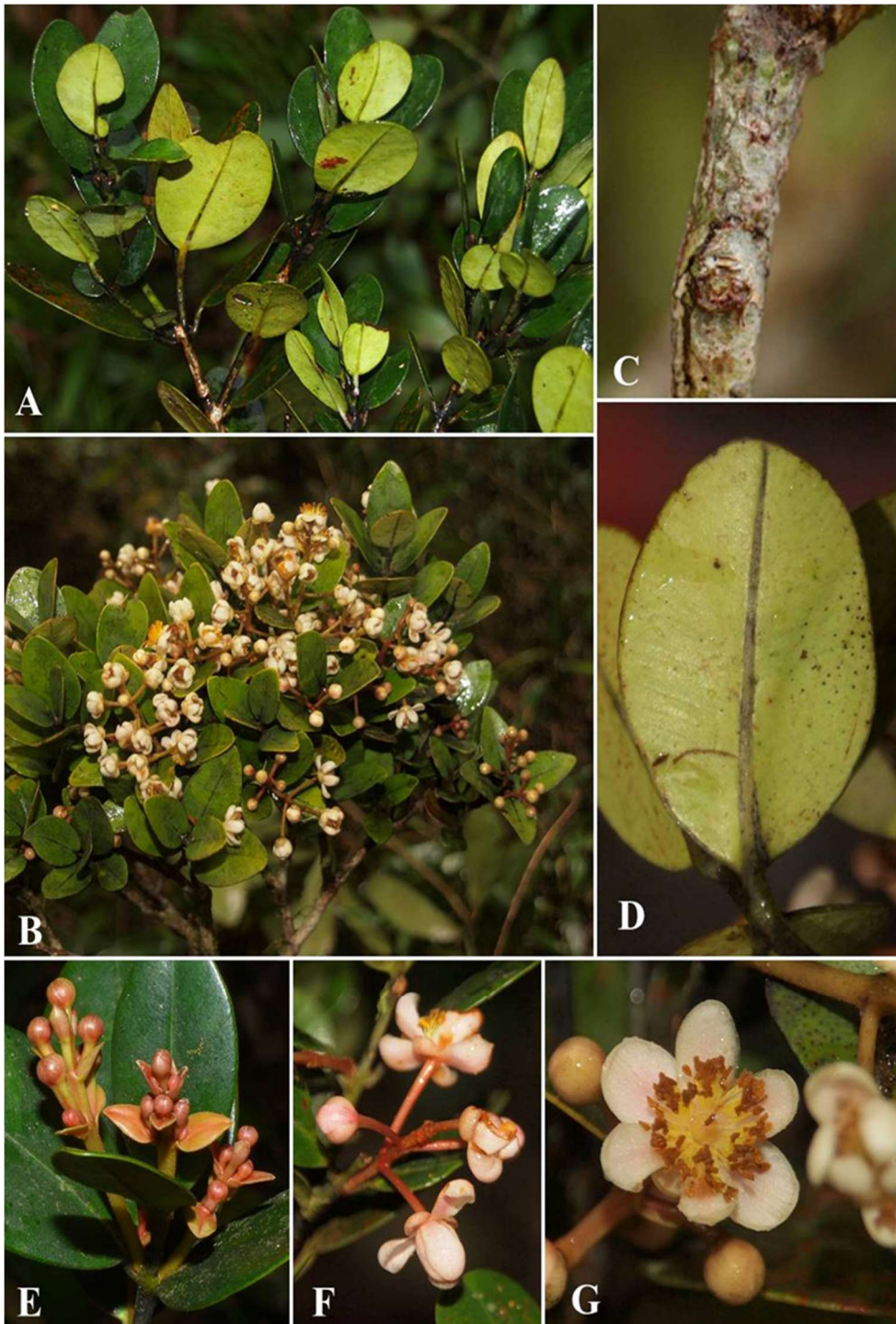


Fig. 2. *Calophyllum rugosum* P.F. Stevens: **A.** Leafy twig; **B.** Flowering twig; **C.** Twig; **D.** Abaxial leaf surface; **E.** Young inflorescence; **F:** inflorescence; **G:** Flower. A & C for Toyama *et al.* V1892; B, D, F & G for Tagane *et al.* V9691; E for Toyama *et al.* V4187.

Kress, W.J., D. L. Erickson, F. A. Jones, N. G. Swenson, R. Perez, O. Sanjur and E. Bermingham. 2009. Plant DNA barcodes and a community phylogeny of a tropical forest dynamics plot in Panama. *PNAS* **106(44)**: 18621-18626.

Li, X., J. Li and P. F. Stevens. 2007. *Calophyllum*. In: Wu, Z. Y., P. H. Raven & D. Y. Hong (eds.), *Fl. China* 13: 40-47. Science Press, Beijing.

Pham, H.H. 2000. An Illustrated Flora of Vietnam. Vol. 1, Young Publishing house, Ho Chi Minh, Vietnam, Pp. 449-457.

Pitard, C.J. 1910. *Calophyllum*. In: Lecomte, P.H. & F. Gagnepain (eds.), *Fl. Indo-Chine* [P.H. Lecomte *et al.*] 1: 316-325. Masson, Paris.

Stevens, P.F. 1980. The revision of the Old World species of *Calophyllum* (Guttiferae). *J. Arnold Arbor.* **61**: 117-700.