

CONTRIBUTIONS TO THE FLORA OF MYANMAR III: NEW RECORDS OF 10 WOODY SPECIES FROM THE MERGUI ARCHIPELAGO OF SOUTHERN MYANMAR

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ABSTRACT

Ten woody species of angiosperms representing 10 genera and nine families are newly added to the flora of Myanmar: *Semecarpus curtisii* (Anacardiaceae), *Anaxagorea javanica* (Annonaceae), *Loeseneriella pauciflora* (Celastraceae), *Atuna racemosa* subsp. *racemosa* (Chrysobalanaceae), *Vatica stapfiana* (Dipterocarpaceae), *Diospyros longipilosa* (Ebenaceae), *Koilodepas longifolium*, *Trigonostemon capillipes* (Euphorbiaceae), *Dalbergia rostrata* (Fabaceae) and *Reinwardtiodendron humile* (Meliaceae), among which four genera, *Loeseneriella*, *Atuna*, *Koilodepas* and *Reinwardtiodendron*, are new to Myanmar. For each taxon, voucher specimens, the general distribution and photographs, together with taxonomic notes, are provided. For *Atuna racemosa* subsp. *racemosa*, and *Vatica stapfiana*, DNA barcoding region of the partial genes of *rbcl* and *matK* were registered with the DNA database.

Keywords: angiosperms, flora, Lampi Marine National Park, new records, Tanintharyi Region

INTRODUCTION

The Mergui (Myeik) Archipelago, located in the Tanintharyi Region, southern Myanmar, comprises more than 800 islands distributed along 60 km off the western shore of the Malay Peninsula in the Andaman Sea. In addition to the coastal vegetation including seagrass beds, beach vegetation, dune forest and mangroves, evergreen forest characterized by the canopy of some species of Dipterocarpaceae is also found on large islands (KRESS *ET AL.*, 2003; NEW NEW YI, 2008; TINT TUN & BARRY, 2011; BEFFASTI *ET AL.*, 2016). NEW NEW YI (2008) surveyed the coastal area of the Myeik Archipelago and reported a total of 305 species belonging to 241 genera of 91 families. However, studies of the terrestrial flora are very limited and further exploration of the flora is required for developing conservation planning.

As part of the botanical inventory of Myanmar, a project under an agreement between the National Museum of Nature and Science, Japan, and the Forest Department, Ministry of

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Natural Resources and Environmental Conservation, Myanmar (TANAKA ET AL., 2018; TAGANE ET AL., 2018), we carried out floristic surveys of Lampi Marine National Park and its surrounding islands during 16–23 May 2017 and 6–12 February 2018 (Fig. 1), and collected a total of 1,459 specimens of vascular plant species. Among them, ten woody species, *Semecarpus curtisii* King (Anacardiaceae), *Anaxagorea javanica* Blume (Annonaceae), *Loeseneriella pauciflora* (DC.) A.C. Sm. (Celastraceae), *Atuna racemosa* Raf. (Chrysobalanaceae), *Vatica stapfiana* (King) Slooten (Dipterocarpaceae), *Diospyros longipilosa* Phengklai (Ebenaceae), *Koilodepas longifolium* Hook.f., *Trigonostemon capillipes* (Hook.f.) Airy Shaw (Euphorbiaceae), *Dalbergia rostrata* Grah. ex Prain (Fabaceae), and *Reinwardtiodendron humile* (Hassk.) Mabb. (Meliaceae), are reported as new to the flora of Myanmar. Four genera, *Loeseneriella*, *Atuna*, *Koilodepas* and *Reinwardtiodendron*, are recorded in Myanmar for the first time.

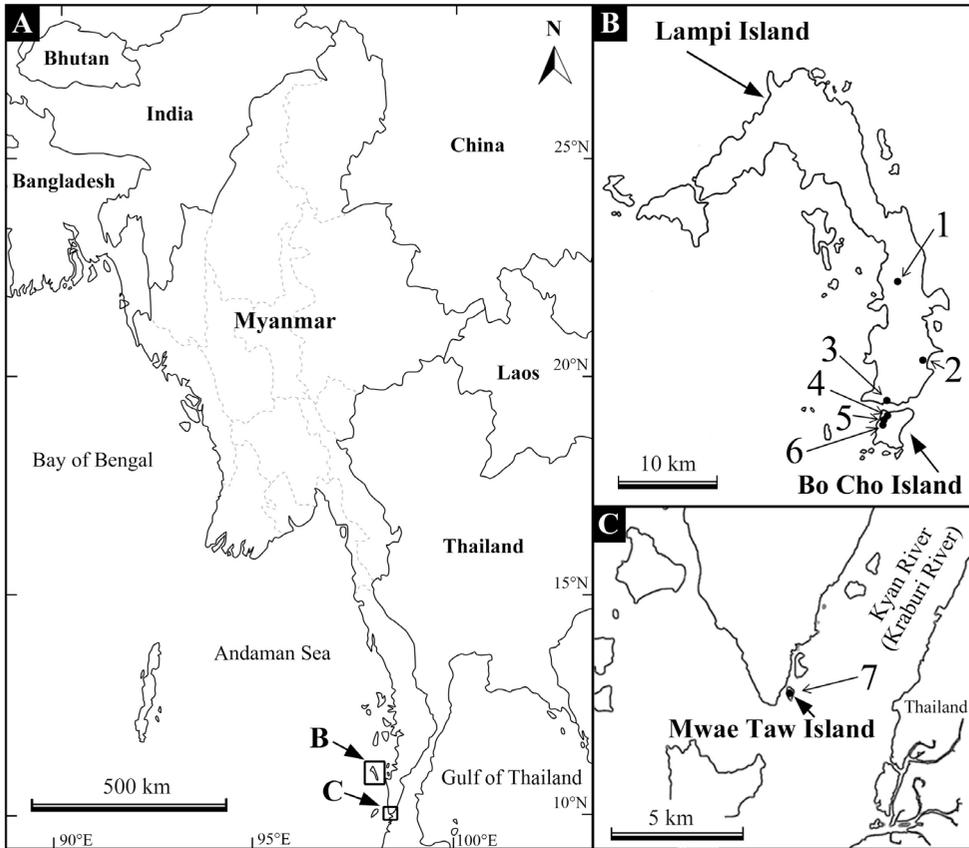


Figure 1. Maps of the three main islands surveyed in this study. A, surveyed sites in Myanmar, broken lines within Myanmar indicate boundaries of regions and states. B, Lampi Island and Bo Cho Island in Andaman Sea. C, Mwaë Taw Island located at the mouth of the Kyan River. Collection sites: 1, *Vatica stapfiana*; 2, *Diospyros longipilosa*, *Reinwardtiodendron humile* and *Trigonostemon capillipes*; 3, *Loeseneriella pauciflora*; 4 and 5, *Anaxagorea javanica* var. *javanica*; 6, *Atuna racemosa* subsp. *racemosa*, *Diospyros longipilosa*, *Koilodepas longifolium* and *Trigonostemon capillipes*; 7, *Dalbergia rostrata* and *Semecarpus curtisii*.

In addition to morphological examination, DNA sequences are extremely helpful for delimiting and identifying species (HEBERT & GREGORY, 2005; DICK & WEBB, 2012). We sequenced two DNA barcode regions, *rbcL* and *matK*, following the recommendation of the CBOL PLANT WORKING GROUP (2009) for the two samples (specimen nos. MY2210 and MY2525) that could not be identified by morphology in the field, and their DNA barcodes are provided in this study.

MATERIALS AND METHODS

Species identification and records in Myanmar are based on herbarium specimens at the Forest Herbarium, Bangkok (BKF), Herbarium of Faculty of Forestry, National University of Laos, Vientiane (FOF), Herbarium of Kyushu University, Fukuoka (FU), Kyoto University Museum, Kyoto (KYO), Herbarium of the Forest Research Institute, Nay Pyi Taw (RAF), Sarawak Herbarium, Kuching (SAR) and National Museum of Nature and Science, Tsukuba (TNS). We also examined specimen images on the web (e.g. JSTOR Global Plant, <https://plants.jstor.org/>), a checklist of Myanmar (KRESS *ET AL.*, 2003), as well as the taxonomic literature on particular groups and regional floras including the Flora of Thailand (SMITINAND & LARSEN *ET AL.*, 1970–present). Voucher specimens were deposited at the herbaria of RAF, TNS and KYO.

DNA amplification and sequencing of portions of the chloroplast genes *rbcL* and *matK* followed established protocols (KRESS *ET AL.*, 2009; DUNNING & SAVOLAINEN, 2010) as in TOYAMA *ET AL.* (2015).

SPECIES NEWLY RECORDED IN MYANMAR

Semecarpus curtisii King [Anacardiaceae]—Fig. 2A–C.

J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 65(3): 509 (1896).

We found this species at the edge of the evergreen forest along the border with a temple on Mwae Taw Island, on the opposite shore of Kawthaung Town. *Semecarpus curtisii* is similar to *S. albescens* Kurz but distinguished by its hypocarp enclosing 1/3–1/2 of the nut (vs. enclosing ca. 2/3 or more) (CHAYAMARIT, 2010; GARDNER *ET AL.*, 2016).

Specimen examined: MYANMAR. Tanintharyi Region: Mwae Taw Island, Kawthaung Township, 9°58'41"N, 98°33'26"E, 17 May 2017, *Tagane et al. MY1938* [fr.] (KYO, RAF, TNS).

Distribution: Malaysia (Peninsula: Langkawi, Perlis, Kedah, Pahang, Selangor, Negeri Sembilan, Johor), Myanmar (Mergui Archipelago), Singapore, and Thailand (Peninsular).

Anaxagorea javanica Blume [Annonaceae]—Fig. 2D–G.

Fl. Javae, Anon.: 66 (1830).

var. *javanica*

This is a small shrub, 1.5 m tall, locally common in the understory of evergreen forest. Only one species of *Anaxagorea*, *A. luzonensis* A. Gray, has been known from Myanmar (MAAS & WESTRA, 1984; KRESS *ET AL.*, 2003), but *A. javanica* is easily distinguished from *A.*

luzonensis by its larger and thicker petals, more stamens (ca. 45 or more in *A. javanica* vs. up to ca. 30 in *A. luzonensis*), more carpels (7 or more vs. up to 5) and the short beak of the monocarps up to 1 mm long (vs. 1.5 mm long or more) (MAAS & WESTRA, 1984).

Specimens examined: MYANMAR. Tanintharyi Region: Bo Cho Island, 10°40'20.63"N, 98°14'44.37"E, 75 m msl (above mean sea level), 18 May 2017, *Tagane et al. MY1969* [fl. & fr.] (KYO, RAF, TNS); Hlaing Gyi Aw Trail, Bo Cho Island, Kawthaung Township, 10°40'38.2"N, 98°14'58.6"E, 7 Feb. 2018, *Tanaka et al. MY3053* [fr.] and *MY 3054* [fl.] (RAF, TNS).

Distribution: Indonesia (Java, Sumatra), Malaysia (Borneo, Peninsula), Myanmar (Mergui Archipelago), Singapore, and Thailand (Peninsular, Southeast).

***Loeseneriella pauciflora* (DC.) A. C. Sm. [Celastraceae]—Fig. 2H–J.**

Amer. J. Bot. 28: 440 (1941).

This is a woody climber, occasional at the edge of the evergreen forest on Bacho Island. On the island, *Salacia verrucosa* Wight, another woody climber of Celastraceae, is common and apparently similar to this species, but *L. pauciflora* differs from *S. verrucosa* in having flowers in axillary cymes, terminal thyrses or panicles, with distinct peduncles (vs. flowers in axillary fascicles) and capsular (vs. drupaceous) fruits (HOU ET AL., 2010).

Specimen examined: MYANMAR. Tanintharyi Region: Bo Cho Island, Kawthaung Township, 10°41'35.64"N, 98°14'57.66"E, 26 m msl, 21 May 2017, *Tagane et al. MY2384* [fl.] (KYO, RAF, TNS).

Distribution: Cambodia (Mt. Bokor), Indonesia (Java, Lesser Sunda Islands, Moluccas, Sulawesi, Sumatra), Malaysia (Borneo, Peninsula [Kelantan, Pahang, Penang, Perak, Perlis, Selangor, Trengganu]), Myanmar (Mergui Archipelago), Papua New Guinea, Philippines, Thailand, and Vietnam.

***Atuna racemosa* Raf. [Chrysobalanaceae]—Fig. 3A–B.**

Sylva Tellur.: 153 (1838).

subsp. *racemosa*

We collected a sapling of this species in the evergreen forest on Lampi Island. The species is recognized by its flexuose (zigzagged) branching, relatively large and subsistent lanceolate stipules, and chartaceous and oblong leaves with long acuminate apex. *Atuna racemosa* subsp. *racemosa* is widely distributed from southern Thailand to the Pacific Islands (PRANCE, 1989, 1995), and the new locality is in the western limit of the distribution range of this species. The *matK* sequence of our material differs 3 bp of the total 818 bp from the other material of *Atuna racemosa* (GenBank accession no. KX180052).

Specimen examined: MYANMAR. Tanintharyi Region: Bo Cho Island, Kawthaung Township, 10°40'13.41"N, 98°14'37.61"E, 52 m msl, 19 May 2017, *Tagane et al. MY2210* [leafy branch only] (KYO, RAF, TNS).

Distribution: Brunei, Fiji, Indonesia (Sulawesi, Sumatra), Malaysia (Borneo, Peninsula [Perak]), Myanmar (Mergui Archipelago), Papua New Guinea, Philippines, Samoa, Singapore, Solomon Islands, Thailand (Peninsular), and Tonga.

GenBank accession no.: LC415115 (rbcL), LC415116 (matK); we sequenced *Tagane et al. MY2210*.

Vatica stapfiana (King) Slooten [Dipterocarpaceae]—Fig. 3C–E.

Bull. Jard. Bot. Buitenzorg ser. III, 9: 129 (1927).

We collected this species by a stream in the evergreen forest of Lampi Island. Among the species of *Vatica* in Myanmar, *Vatica stapfiana* is easily distinguished by its large and thick leaves, large fruits (more than 3 cm long), and not wing-like fruiting calyx lobes which are connate and fused into a nut (GARDNER *ET AL.*, 2015; POOMA *ET AL.*, 2017). *Vatica stapfiana* is listed as Vulnerable (VU) in the IUCN Red List (IUCN 2017), threatened by habitat loss and deforestation. It would be prudent to estimate overall population size in the new locality in Myanmar, which represents the northernmost and westernmost population. Its distribution in Cambodia is uncertain.

Specimen examined: MYANMAR. Tanintharyi Region: Lampi Island, Bokpyin Township, 10°47'52"N, 98°15'23"E, 47 m msl, 22 May 2017, *Tagane et al. MY2525* [fr.] (KYO, RAF, TNS).

Distribution: Cambodia?, Indonesia (Sumatra), Malaysia (Peninsula: widespread), Myanmar (Mergui Archipelago), Thailand (Peninsular).

GenBank accession no.: LC415117 (rbcL), LC415118 (matK); we sequenced *Tagane et al. MY2525*.

Diospyros longipilosa Phengklai [Ebenaceae]—Fig. 3F–H.

Nat. Hist. Bull. Siam Soc. 26: 342 (1977).

This is a small tree to 5 m, scattered in the evergreen forest on both Bo Cho Island and Lampi Island. *Diospyros longipilosa* is easily recognized from the other species of the genus in the region in having young twigs and petiole densely covered with long soft white to light brown hairs, oblong to oblong-lanceolate, chartaceous leaves with rounded to subcordate leaf base (PHENGLAI 1981, GARDNER *ET AL.*, 2015). In Thailand, it is known to grow in scrub and the understory of lowland evergreen forest, often close to the sea (GARDNER *ET AL.*, 2015).

Specimens examined: MYANMAR. Tanintharyi Region: Bo Cho Island, Kawthaung Township, 10°40'13.41"N, 98°14'37.61"E, 52 m msl, 20 May 2017, *Tagane et al. MY2282* [ster.] (KYO, RAF, TNS); Lampi Island, Bokpyin Township, 10°43'16.14"N, 98°16'44.80"E, alt. 65 m, 21 May 2017, *Tagane et al. MY2455* [fl.] (KYO, RAF, TNS).

Distribution: Myanmar (Mergui Archipelago), Thailand (Peninsular).

Koilodepas longifolium Hook.f. [Euphorbiaceae]—Fig. 4A–B.

Fl. Brit. India 5: 420 (1887).

This specimen, unfortunately sterile, is very similar to *Koilopedas bantamense* Hassk. and *K. longifolium* Hook.f. According to the revision of Asian *Koilopedas* by WELZEN (2010), those two species are different in morphology of the gland at the marginal teeth of the leaf blades. Our specimen possesses small and narrow glands on the marginal teeth of the leaf blades, and is identifiable as *K. longifolium*. The genus *Koilodepas* is recorded for the first time in Myanmar.

Specimen examined: MYANMAR. Tanintharyi Region: Bo Cho Island, Kawthaung Township, 10°40'13.41"N, 98°14'37.61"E, 52 m msl, 19 May 2017, *Tagane et al. MY2129* [ster.] (KYO, RAF, TNS).

Distribution: Indonesia (Sumatra), Malaysia (Borneo, Peninsula), Myanmar (Mergui Archipelago), Singapore, and Thailand (Peninsular: Yala).

Trigonostemon capillipes (Hook.f.) Airy Shaw [Euphorbiaceae]—Fig. 4C–G.

Kew Bull. 20: 413 (1967).

This species was occasional in the shady understory of the evergreen forest on both Bo Cho and Lampi Islands. The species is characterized by its dark purple petals, usually cauliflorous male inflorescence, few-flowered pistillate inflorescences with scale-like bracts, and an enlarged calyx when fruiting (CHANTARANOTHAI, 2005; GARDNER ET AL., 2016; YU & WELZEN, 2018).

Specimens examined: MYANMAR. Tanintharyi Region: Bo Cho Island, Kawthaung Township, 10°40'13.41"N, 98°14'37.61"E, 52 m amsl, 20 May 2017, *Tagane et al. MY2297* [fl. & fr.] (KYO, RAF, TNS); Lampi Island, Bokpyin Township, 10°43'16.14"N, 98°16'44.80"E, 65 m msl, 21 May 2017, *Tagane et al. MY2455* [fl.] (KYO, RAF, TNS).

Distribution: Malaysia (Borneo, Peninsular), Myanmar (Mergui Archipelago), Singapore, and Thailand (Peninsular, Southeast, Southwest).

Dalbergia rostrata Grah. ex Prain [Fabaceae]—Fig. 4H–J.

J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 70(1): 45. (1901).

We encountered this species along the edge of the evergreen forest on Mwae Taw Island. The species has been recorded widely from India and Sri Lanka in the west to western New Guinea in the east, but not in Myanmar (ADEMA ET AL., 2016; GARDNER ET AL., 2016). Our collection from Myanmar thus fills a gap in its distribution.

Specimen examined: MYANMAR. Tanintharyi Region: Mwae Taw Island, Kawthaung Township, 9°58'41"N, 98°33'26"E, 33 m msl, 17 May 2017, *Tagane et al. MY1946* [young fr.] (KYO, RAF, TNS).

Distribution: India, Indonesia (Java, Sumatra, western New Guinea), Malaysia (Borneo, Peninsula), Moluccas, Myanmar (Mergui Archipelago), Philippines, Singapore, Sri Lanka, and Thailand.

Reinwardtiidendron humile (Hassk.) Mabb. [Meliaceae]—Fig. 5A–B.

Malaysian Forester 45: 452 (1982).

We collected saplings of this species in evergreen forest. Although the specimens we collected were in the vegetative state, this species is easily recognized by its odd-pinnate leaves with 3 or 5 leaflets, glossy and almost glabrous leaves on both surfaces (with only very sparse hairs on the abaxial surface of the midrib), 10–20 pairs of secondary veins, and finely reticulated and prominent tertiary veins on both surfaces (RUEANGRUEA ET AL., 2015; GARDNER ET AL., 2016).

Specimen examined: MYANMAR. Tanintharyi Region: Lampi Island, Bokpyin Township, 10°43'16.14"N, 98°16'44.80"E, 65 m msl, 21 May 2017, *Tagane et al. MY2424* [fl.] (KYO, RAF, TNS).

Distribution: Cambodia, China (Hainan), Indonesia (Java, Kalimantan, Sulawesi, Sumatra), Laos, Malaysia (Borneo, Peninsula [Kelantan, Terengganu]), Myanmar (Mergui Archipelago), Philippines, Thailand (Peninsular, Southwest), and Vietnam.

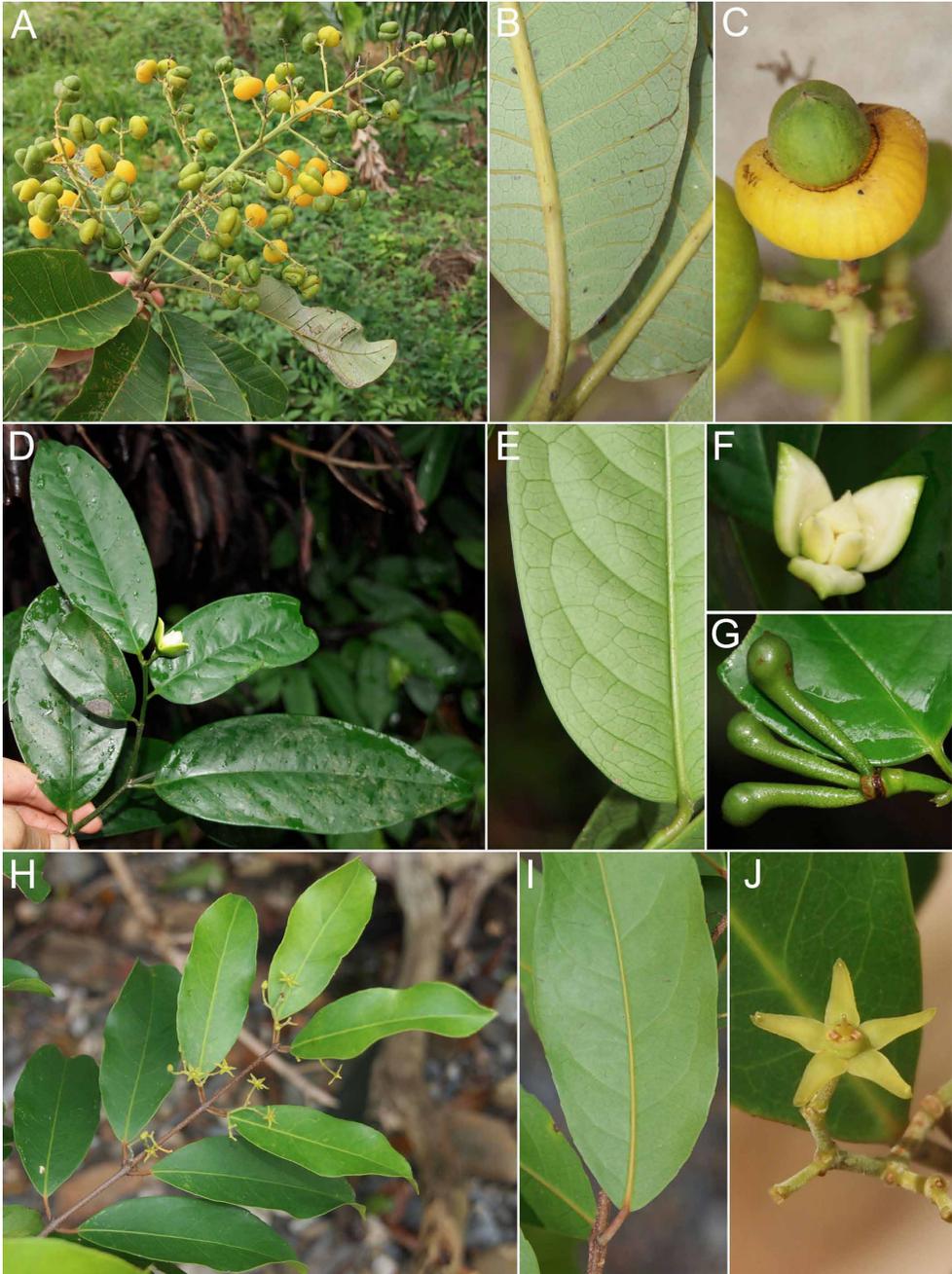


Figure 2. (A–C) *Semecarpus curtisii* King: A, fruiting twig; B, portion of lower leaf surface; C, fruit. (D–G) *Anaxagorea javanica* Blume var. *javanica*: D, flowering twig; E, portion of lower leaf surface; F, flower; G, young fruits. (H–J) *Loeseneriella pauciflora* (DC.) A. C. Sm.: H, flowering twig; I, portion of lower leaf surface; J, flower. Photographs by Shuichiro Tagane.

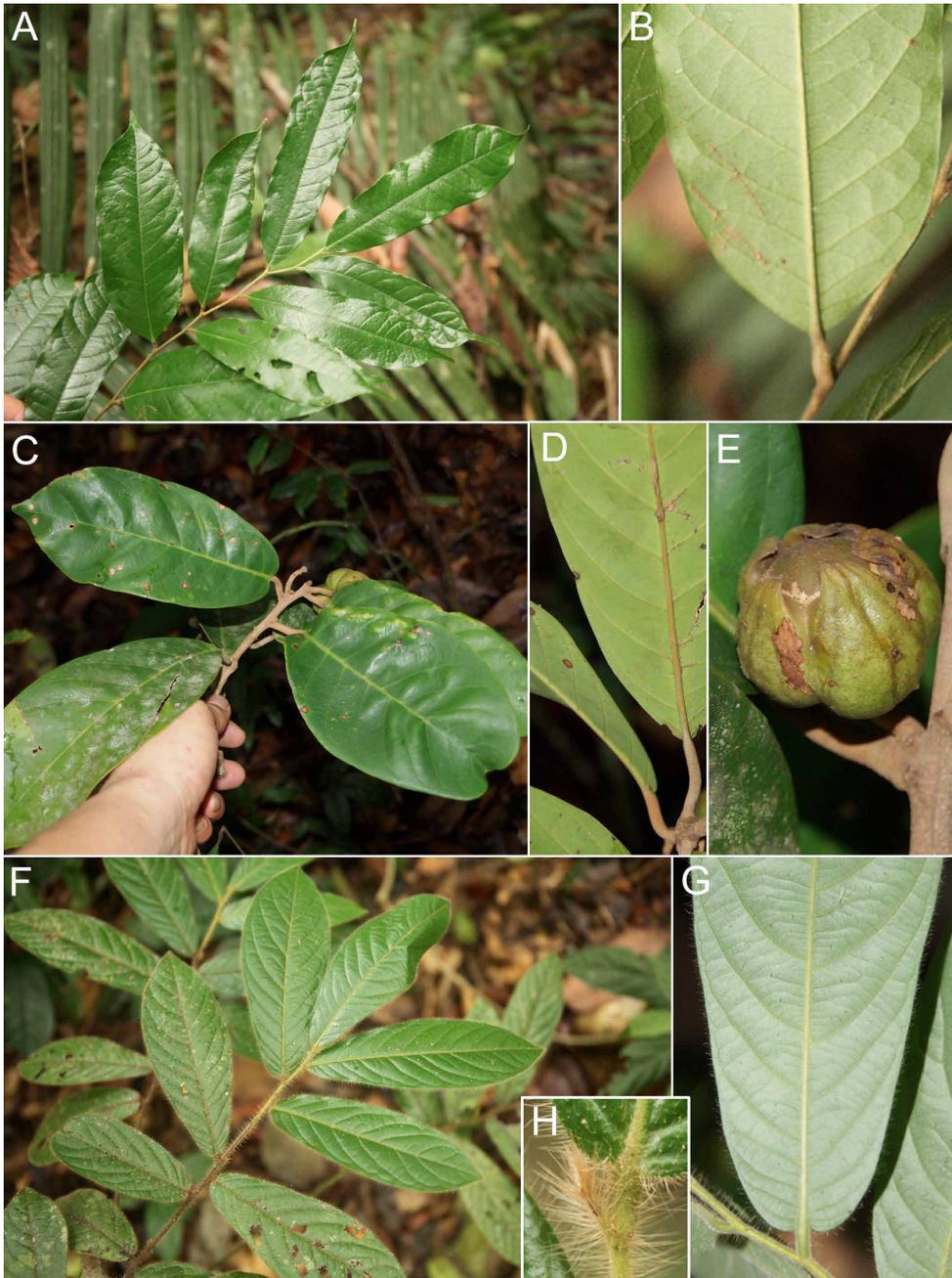


Figure 3. (A and B) *Atuna racemosa* Raf. subsp. *racemosa*: A, leafy twig; B, portion of lower leaf surface. (C–E) *Vatica stapfiana* (King) Slooten: C, fruiting twig; D, portion of lower leaf surface; E, fruit. (F–H) *Diospyros longipilosa* Phengklai: F, leafy twig; G, portion of lower leaf surface; H, base of petiole showing long soft hairs. Photographs by Hironori Toyama (A, B, F and H) and Shuichiro Tagane (C, D, E and G).

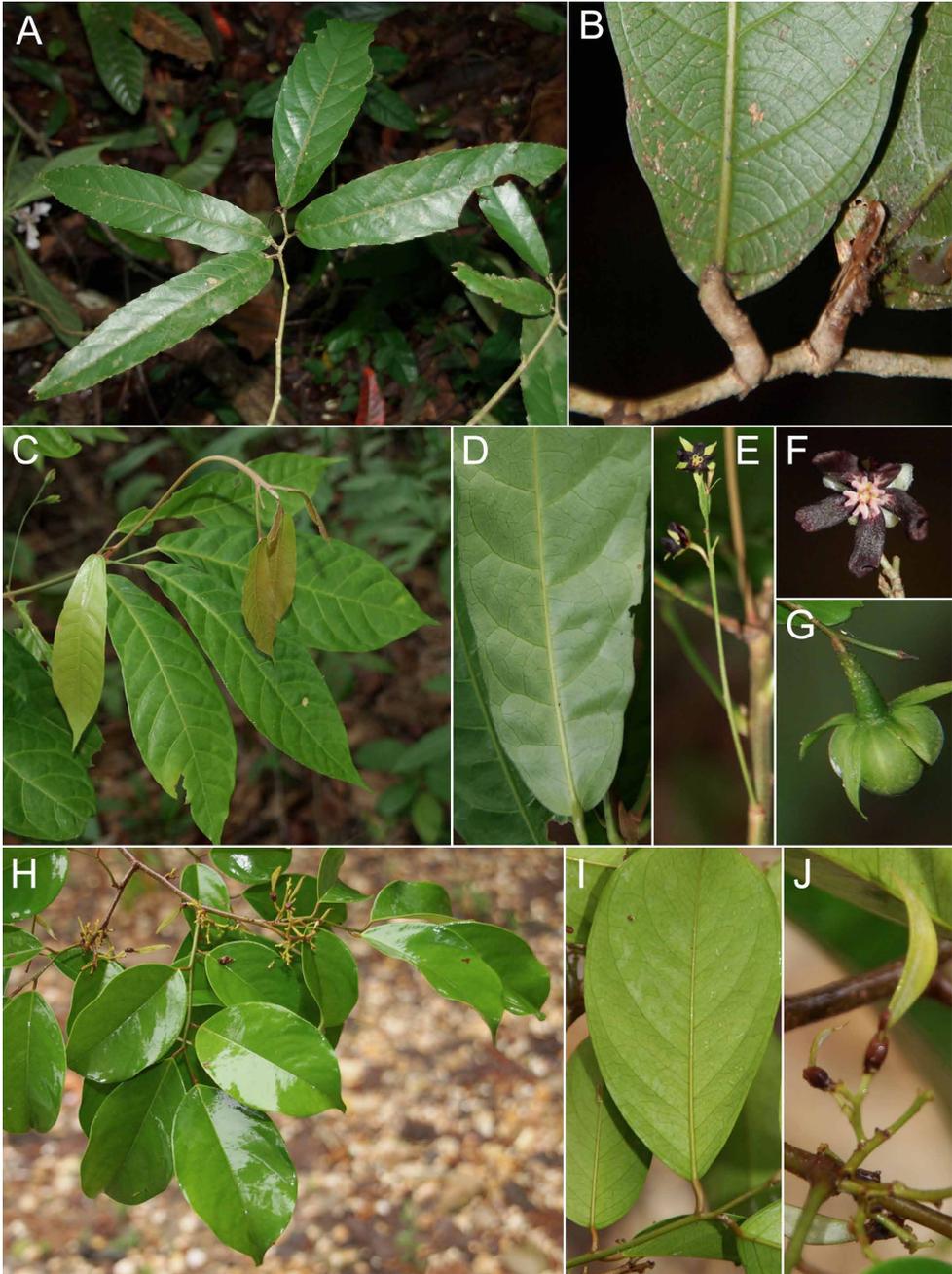


Figure 4. (A–C) *Koilodepas longifolium* Hook.f.: A, leafy twig; B, portion of lower leaf surface. (C–G) *Trigonostemon capillipes* (Hook.f.) Airy Shaw.: C, twig with pistillate inflorescence; D, portion of lower leaf surface; E, pistillate inflorescence; F, staminate flower; G, fruit. (H–J) *Dalbergia rostrata* Grah. ex Prain.: H, twig with young fruit; I, portion of lower leaf surface; J, young fruits. Photographs by Shuichiro Tagane.

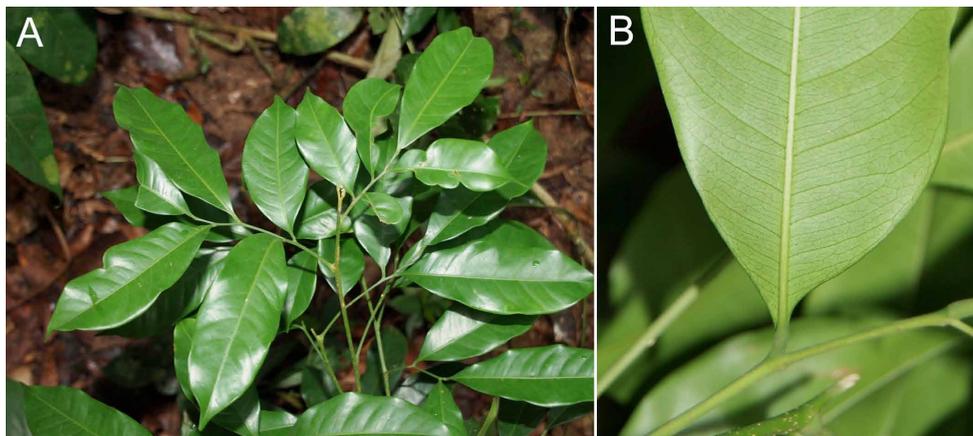


Figure 5. *Reinwardtiidendron humile* (Hassk.) Mabb.: A, leafy twig; B, portion of lower leaf surface. Photographs by Shuichiro Tagane.

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