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Two new species and 18 new records for the flora of Laos

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ABSTRACT

Six pteridophyte species of five families and 12 spermatophyte species of 10 families are reported from Bolaven Plateau, southern Laos, as new records to the flora of Laos. Moreover, two new species, *Sterculia bolavenensis* (Malvaceae) and *Wikstroemia bolavenensis* (Thymelaeaceae), are described. For each species, voucher specimens are cited, photographs are shown and additional information including geographical distribution, ecology and taxonomic notes are provided.

KEYWORDS: Bolaven Plateau, Dong Hua Sao National Protected Area, Indochina, flora, taxonomy.

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INTRODUCTION

Among Southeast Asian countries, collection density of plant specimens is the lowest in Laos (Middleton *et al.*, 2019), and more efforts to collect plant specimens are required to explore the vascular flora of Laos (Newman *et al.*, 2007; Middleton *et al.*, 2019). Since 2015, we have conducted eight field surveys to assess the Lao flora, and accumulated a total of 3,460 specimens collected from Nam Ha National Protected Area (NPA), Nam Kading NPA, Phou Khao Khuoay NPA, and Dong Hua Sao NPA. Using these materials, previously we reported 79 vascular plant species new to the flora of Laos including 18 new species in 11 families (Souladeth *et al.*, 2017, 2018, 2019, 2020, 2021a, b; Souvannakhoummane *et al.*, 2018; Suetsugu *et al.*, 2018; Tagane *et al.*, 2018a, b, c, 2020a, b, 2021; Tanaka *et al.*, 2020; Yang *et al.*, 2018; Nagahama e*t al.*, 2019).

Here, we report an additional 20 vascular plant species that have not been recorded from Laos, as a result from our most recent field survey in Bolaven Plateau from 16–22 December 2019 and subsequent efforts in identifying our previous collections.

MATERIALS AND METHODS

Study area

The Bolaven Plateau is located mostly in Champasak Province, and partly in Saravan, Sekong and Attapu Provinces in southern Laos (Fig. 1). The area of the Plateau is approximately 4,800 km^2, mostly ranging from 900–1,400 m in elevation and surrounded by lowland around 100–200 m in elevation with cliffs and steep escarpments, especially on the southern and eastern sides. The climate on the Plateau is moist and cool all year round: average annual temperature is 20.2°C and annual rainfall over 3,800 mm in Paksong Town at ca 1,290 m elevation (Climate-data.org http://climate-data.org/ Accessed 5 Mar. 2020). The area is protected mainly for biodiversity conservation at the national level (Dong Hua Sao NPA) and partly at the district level. Forest types are diverse along the altitudinal gradient, from

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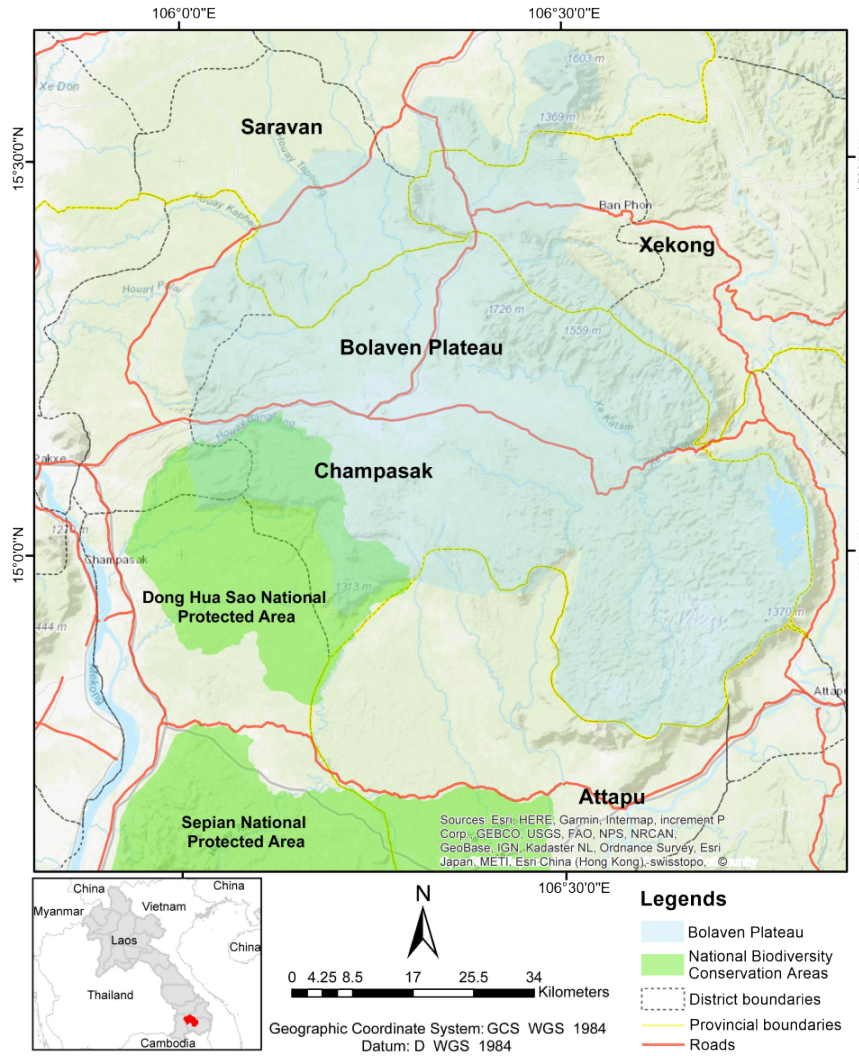

Figure 1. The location of the Bolaven Plateau in Laos.

dry evergreen forest at lowland to hill evergreen forest and dense montane conifer forest at high elevation, with open grassland and sparse pine forest (Rundel 1999; Tagane *et al.* 2020a).

Species identification

To identify species and confirm distribution records in Laos, we examined herbarium specimens at the Forest Herbarium, Bangkok (BKF), Herbarium of Faculty of Forest Science, National University of Laos, Vientiane (FOF), Kagoshima University Museum (KAG), Herbarium of Kyushu University, Fukuoka (FU), and National Herbarium of Laos (NHL); we also examined specimen images on the web (e.g., JSTOR Global Plant, https://plants.jstor.org/; Royal Botanic Garden Edinburgh (E), https://data.rbge.org.uk/search/herbarium/; Muséum national d'Histoire naturelle (P), https://science.mnhn.fr/institution/mnhn/item/search/form?lang=en_US; Naturalis (L), http://bioportal.naturalis.nl) and a checklist of the vascular plants of Lao PDR (Newman *et al.*, 2017 onwards; https://padme.rbge.org.uk/laos/list/), Ferns of Thailand, Laos and Cambodia (Lindsay & Middleton, 2012 onwards; http://rbg-web2.rbge.org.uk/thaiferns/) as well as the taxonomic literature on particular groups and regional Floras were also consulted, including Flore du Cambodge, du Laos et du Vietnam (Aubréville *et al.*, 1960–present),

Flora of Thailand (Smitinand & Larsen *et al.*, 1970–present) and Flora of China (Wu *et al.*, 1994–2013). Voucher specimens were deposited at the herbaria of FOF and KAG, and partly at BKF and the Kyoto University Museum (KYO).

SPECIES NEWLY RECORDED IN LAOS

Pteridophytes

Athyriaceae

Cornopteris opaca (D.Don) Tagawa, Acta Phytotax. Geobot. 8(2): 92. 1939.— *Hemionitis opaca* D.Don, Prodr. Fl. Nepal.: 13. 1825. Type: Nepal, *Wallich* (not seen). Fig. 2A–C.

Distribution.— India, Bhutan, Nepal, China, Japan, Thailand, Laos, Vietnam, Indonesia.

Ecology.— On wet ground in hill evergreen forest; alt. ca 1,100 m.

Note.— *Cornopteris opaca* is characterized by erect rhizome, 2- or 3-pinnate lamina ca 60 × 30 cm, grooved rachis, oblong or V-shaped sori located along dorsal side of veins, and absence of indusium.

Specimens examined.— Champasak Province [Paksong District, near Nong Luang Village, 15°04′13.49″N, 106°12′19.68″E, 1,108 m, 18 Dec. 2019, *Souladeth et al. L3446* (**FOF**, **KAG**).

Diplazium platychlamys C.Chr., Bull. Mus. Nation. Hist. Nat. (Paris) ser. 2, 6: 100. 1934. Type: Vietnam, Annam, Tourane, 13 Apr. 1927, *J. & M.S. Clemens 3562* (**P** [P00642881, digital image!]). Fig. 2D & E.

Distribution.— Laos, Vietnam.

Ecology.— In hill evergreen forest; alt. ca 1,150 m.

Note.— *Diplazium platychlamys* is a terrestrial fern. We found only a few individuals in Bolaven. While Vietnamese materials, including the type, have 11–12 pairs of pinnae (Christensen, 1934; Hô, 1999), our specimens have only 8 pairs of pinnae. However, we consider this difference to be infraspecific variation of this species.

Specimens examined.— Champasak Province [Paksong District, near Nong Luang Village, 15°04′22.14″N, 106°12′20.71″E, 1,167 m, 18 Dec. 2019, *Souladeth et al. L3453* (**BKF**, **FOF**, **KAG**)].

Aspleniaceae

Asplenium tenerum G.Forst., Fl. Ins. Austr.: 80. 1786. Type: *G. Forster s.n.* (lectotype **UPS** [T-24851], designated by Veldkamp & Wardani (2015), not seen). Fig. 2F & G.

Distribution.— India, Sri Lanka, Japan (Ogasawara), Korea, Laos, Myanmar, Vietnam, Cambodia, Malaysia, Indonesia, Philippines, Pacific islands.

Ecology.— On semi-shaded rocks and tree trunks in dense montane conifer forest; alt. ca 1,200 m.

Note.— This is a lithophytic or epiphytic species locally common in the dense montane conifer forest near Tad Sua Waterfall on Bolaven Plateau.

Specimens examined.— Champasak Province [Paksong District, near Nong Luang Village, 15°04′10.38″N, 106°12′30.37″E, 1,208 m, 17 Dec. 2019, *Souladeth et al. L3313* (**BKF**, **FOF**, **KAG**)].

Hymenasplenium cheilosorum (Kunze ex Mett.) Tagawa, Acta Phytotax. Geobot. 7(2): 84. 1938.— *Asplenium cheilosorum* Kunze ex Mett., Abh. Senckenberg. Naturf. Ges. 6: 177, t. 5, f. 12–13. 1859. Type: not located. Fig. 2H & I.

Distribution.— India, Bhutan, Nepal, Sri Lanka, China, Japan, Myanmar, Thailand, Laos, Vietnam, Malaysia, Indonesia, Philippines.

Ecology.— On wet ground in hill evergreen forest; alt. ca 1,100 m.

Note.— In Laos, the following two species of *Hymenasplenium* have been recorded: *H. apogamum* (N.Murak. & Hatan.) Nakaike and *H. excisum* (C.Presl) S.Linds. (Lindsay & Middleton, 2012 onwards). *Hymenasplenium cheilosorum* is easily distinguishable from these two by its deeply crenate to dentate margin on acroscopic side of pinnae (vs attenuate-cuneate in *H. apogamum* and serrate in *H. excisum*) and sori terminally located in its marginal teeth (vs medial in *H. apogamum* and *H. excisum*). In Bolaven, *H. excisum* was also collected near the collection site of *H. cheilosorum* (*Souladeth et al. L3449*, **BKF**, **FOF**, **KAG**).

Specimens examined.— Champasak Province [Paksong District, near Nong Luang Village, 15°04′13.49″N, 106°12′19.68″E, 1,108 m, 18 Dec. 2019, *Souladeth et al. L3442* (**BKF**, **FOF**, **KAG**)].

Plagiogyriaceae

Plagiogyria adnata (Blume) Bedd., Ferns Brit. India 1: t.51. 1865.— *Lomaria adnata* Blume, Enum. Pl. Javae 2: 205. 1828. Type: Indonesia, Java, *Blume s.n.* (**L** [L0051942], digital image!). Fig. 2J & K.

Distribution.— India, China, Japan, Myanmar, Thailand, Laos, Vietnam, Malaysia (Borneo, Peninsula), Indonesia (Java, Sumatra), Philippines (Luzon).

Ecology.— In primary dense montane conifer forest, near streams; alt. ca 1,200 m.

Phenology.— Young fertile fronds were collected in July.

Note.— *Plagiogyria adnata* is a terrestrial perennial ferns that was found near streams in the understory of the dense montane conifer forest. The species is widely distributed in East and Southeast Asia but had not been recorded from Lao and Cambodia (Zhang & Nooteboom, 1998, 2013a; Lindsay & Middleton, 2012 onwards).

Specimens examined.— Champasak Province [Bolaven Plateau, Paksong District, near Nong Luang Village, 15°03′54.16″N, 106°12′50.41″E, 1,218 m., 4 July 2019, *Souladeth et al. L2882* (**FOF**, **KAG**)].

Polypodiaceae

Leptochilus hemionitideus (Wall. ex C.Presl) Noot., Blumea 42(2): 285. 1997.— *Selliguea hemionitidea* Wall. ex C.Presl, Tent. Pterid.: 216. 1836. Type: Nepal, 1830, *Wallich 284* (**P** [P00626865, P00626866, P00626867, digital image!]). Fig. 2L & M.

Distribution.— India, Bhutan, Nepal, China, Japan, Thailand, Laos.

Ecology.— On wet ground in hill evergreen forest; alt. ca 1,100 m.

Note.— *Leptochilus hemionitideus* is characterized by its creeping rhizome, simple lamina which is narrowly ovate to narrowly obovate and 30–63 cm long, distinct veins forming areoles, and rounded to shortly elongate sori located in a discontinuous line between each pair of lateral veins (Lindsay & Middleton, 2012 onwards; Zhang & Nooteboom, 2013b).

Specimens examined.— Champasak Province [Paksong District, near Nong Luang Village, 15°04′13.49″N, 106°12′19.68″E, 1,108 m, 18 Dec. 2019, *Souladeth et al. L3444* (**BKF**, **FOF**, **KAG**)].

Spermatophyte

Orchidaceae

Cymbidium insigne Rofle, Gard. Chron. ser. 3, 35: 387. 1904. Type: Vietnam, Annam, 28 Sept. 1901, *Bronckart 43* (**K** [K000838835], digital image!]). Fig. 2N & O.

Distribution.— China (Hainan), Thailand, Laos, Vietnam.

Ecology.— In open grassland.

Phenology.— Flowering in December.

Note.— Only a few stocks (possibly a single genet) of this species were found on the plateau of Bolaven. We collected specimen with flower buds in December 2019 (Fig. 2N), and observed blooming in December 2018 (Fig. 2O). Although the place is inside the protected area, locality detail is not informed here to prevent illegal collecting.

Specimen examined.— Champasak Province [18 Dec. 2019, *Souladeth et al. L3467* [fl. bud] (**FOF**)].

Araliaceae

Dendropanax maingayi King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 67: 58. 1898. Type. Malaysia, Mt Ophir, Aug. 1867, *A.C. Maingay 2587* (lectotype **K** [K000810139, digital image!], designated by Esser and Jebb (2010). Fig. 2P–R.

Distribution.— Cambodia, Thailand, Laos, Vietnam, Malaysia (Peninsula), Indonesia (Sumatra).

Ecology.— In dense montane conifer forest; alt. 1,250–1,300 m.

Phenology.— Fruiting specimens were collected in December.

Note.— In Laos, only one species of *Dendropanax dentiger* (Harms) Merr. has been known (Newman *et al.*, 2017). *Dendropanax maingayi* is easily distinguished from *D. dentiger* by its chartaceous leaves (vs leathery in *D. dentiger*) and indistinct tertiary veins when dry (vs reticulate and prominent on both surfaces).

Specimens examined.— Champasak Province [Paksong District, near Nong Luang Village: 15°04′19.26″N, 106°12′38.67″E, 1,248 m, 10 Dec. 2018, *Tagane et al. L1962* [ster.] (**FOF**, **KAG**); 15°03′38.56″N, 106°12′28.68″E, 1,290 m, 17 Dec. 2019, *Souladeth et al. L3355* [fr.] (**BKF**, **FOF**, **KAG**)].

Figure 2. *Cornopteris opaca* (D.Don) Tagawa: A. habit, B. portion of lower pinna surface, C. rhizome; *Diplazium platychlamys* C.Chr.: D. habit, E. portion of lower pinna surface; *Asplenium tenerum* G.Forst.: F. habit, G. portion of lower frond surface; *Hymenasplenium cheilosorum* (Kunze ex Mett.) Tagawa: H. habit, I: portion of lower frond surface; *Plagiogyria adnata* (Blume) Bedd.: J. habit, K. portion of lower sterile frond surface; *Leptochilus hemionitideus* (C.Presl) Noot.: L. habit, M. portion of lower fertile frond surface; *Cymbidium insigne* Rofle: N. habit with flower bud, O. flowers; *Dendropanax maingayi* King: P. fruiting branch, Q. portion of lower leaf surface, R. young infructescence.

Begoniaceae

Begonia hemsleyana Hook.f., Bot. Mag. 125: t. 7685. 1899. Syntypes: China, Yunnan, Mengtze, *A. Henry 55* (**K** [K000035499, digital image!]), China, Yunnan, Mengtzi, *A. Henry 10379* (**K** [K000035497, K000035498, digital image!]), China, Szemeo, *A. Henry 12290* (**GH** [GH00135181], digital image!). Fig. 3A–D.

Distribution.— China, Laos, Vietnam.

Ecology.— In hill evergreen forest, near streams; alt. 1,100–1,250 m.

Phenology.— Flowering in December and fruiting in February and December.

Note.— *Begonia hemsleyana* is distinct from the other species of *Begonia* in Indochina by its evergreen habit, palmately compound cauline leaves consisted of 5–10 leaflets with distinct petiolules, and 3-winged dehiscent capsules.

Specimens examined.— Champasak Province [Paksong District, near Nong Luang Village: 15°04′26.35″N, 106°12′24.15″E, 1,210 m, 9 Dec. 2018, *Tagane et al. L1868* [fr.] (**FOF**, **KAG**); along a stream of Seua Waterfall, 15°04′02.6″N, 106°12′29.9″E, 1,147 m, 19 Feb. 2019, *Souladeth et al. L2494* [fl. & fr.] (**FOF**, **KAG**); ibid., 17 Dec. 2019, *Souladeth et al. L3326* [fl.] (**BKF**, **FOF**, **KAG**)].

Celastraceae

Microtropis crassifolia Craib, Bull. Misc. Inform. Kew 1926: 349. 1926. Type: Thailand, Chantaburi, Khao Soi Dao, 14 Dec. 1924, *A.F.G. Kerr 9665* (holotype **A** [A00049952, digital image!]; isotypes **BM** [BM000839119, digital image!], **K** [K000036657, digital image!], **UC** [UC354747, digital image!]). Fig. 3E–H.

Distribution.— Thailand, Laos.

Ecology.— In dense montane conifer forest; alt. 1,200–1,300 m.

Phenology.— Flowering and fruiting in December.

Note.— *Microtropis crassifolia* has been known from elevations of 1,000–1,562 m in Thailand (Ding Hou *et al.*, 2010), and the specimen found in Laos is within this range. It is distinguished from the other species of the genus in Indochina and Thailand in having leathery leaves with invisible secondary veins and a subsessile to shortly pedunculate inflorescence.

Specimens examined.— Champasak Province [Paksong District, near Nong Luang Village: 15°04′11.47″N, 106°12′31.24″E, 1,230 m, 17 Dec. 2019, *Souladeth et al. L3301* [female fl. & young fr.] (**BKF**, **FOF**, **KAG**)); 15°04′39.17″N, 106°12′22.33″E, 1,257 m, 18 Dec. 2019, *Souladeth et al. L3464* [male fl.] (**BKF**, **FOF**, **KAG**).

Fabaceae

Dunbaria rubella Span. ex Miq., Fl. Ned. Ind. 1(1): 178. 1855. Type: Indonesia, Java, *Spanoghe, Icon. Ined. Pl. jav. No. 10, c 1836* (holotype **L**, not seen). Fig. 3I & J.

Distribution: Thailand, Laos, Vietnam, Indonesia (Java).

Ecology.— At edge of dry evergreen forest, roadside; alt. ca 150 m.

Phenology.— Flowering in December.

Note.— This species is similar to *Dunbaria fusca* (Wall.) Kurz but distinguished by its much larger leaves, longer inflorescence 16–35 cm long with lateral branches ca 10 cm long (vs inflorescence shorter than 13 cm and without lateral branches) and yellow corolla (vs yellow and red to purple) (Van der Maesen, 1998).

Specimens examined.— Champasak Province [Pathouphone District, 14°53′31.97″N, 106°01′20.80″E, alt. 149 m, 14 Dec. 2019, *Tagane et al. L2386* [fl.] (**FOF**, **KAG**)].

Lauraceae

Actinodaphne henryi Gamble, Bull. Misc. Inform. Kew 1913(7): 265. 1913. Type: China, Szemao, *A. Henry 11799A* (**A** [A00041095, digital image!], **K** [K000778972, digital image!], **NY** [NY00354762, digital image!]). Fig. 3K–M.

Distribution.— China, Thailand, Laos.

Ecology.— In hill evergreen forest; alt. ca 950 m.

Phenology.— Flowering in December.

Note.— *Actinodaphne henryi* is distinguished from the other species of *Actinodaphne* in Laos by its paniculiform inflorescences (umbels arranged in raceme), branches densely covered with grayish appressed hairs, leaf blade pubescent along midrib and veins abaxially, and secondary veins 7–10 pairs (Huang & van der Wreff, 2008; Tanaros *et al.*, 2010).

Specimens examined.— Champasak Province [Paksong District, near Tad Fane Waterfall, 15°10′57.24″N, 106°07′36.82″E, alt. 959 m, 12 Dec. 2018, *Tagane et al. L2163* [fl.] (**FOF**, **KAG**)].

Loganiaceae

Gardneria ovata Wall., in Roxb. Fl. Ind. 1: 400. 1820. Type: Bangladesh, Sylhet, *M.R. Smith in Wallich Cat. 816* (lectotype **K** [K001111952, digital image!], designated by Leenhouts (1962a); isolecotypes **BM** [BM001014350, digital image!], **GDC** [G00132042, digital image!], **GH** [GH00076163, digital image!], **K** [K001111952, K001111953, digital image!], **M** [M0183868, digital image!], **NY** [NY00297345, digital image!], **P** [P00647638, P00647639, P00647640, digital image!]). Fig. 3N–Q.

Distribution.— India, Bangladesh, Sri Lanka, China, Myanmar, Thailand, Laos, Malaysia (Peninsula), Indonesia (Java, Sumatra).

Ecology.— In hill evergreen forest; alt. 1,100 m.

Phenology.— Flower buds in December.

Note.— *Gardneria ovata* is a glabrous woody climber. It is widely distributed from India to West Malesia (Leenhouts, 1962b; Griffin & Parnell, 1997;

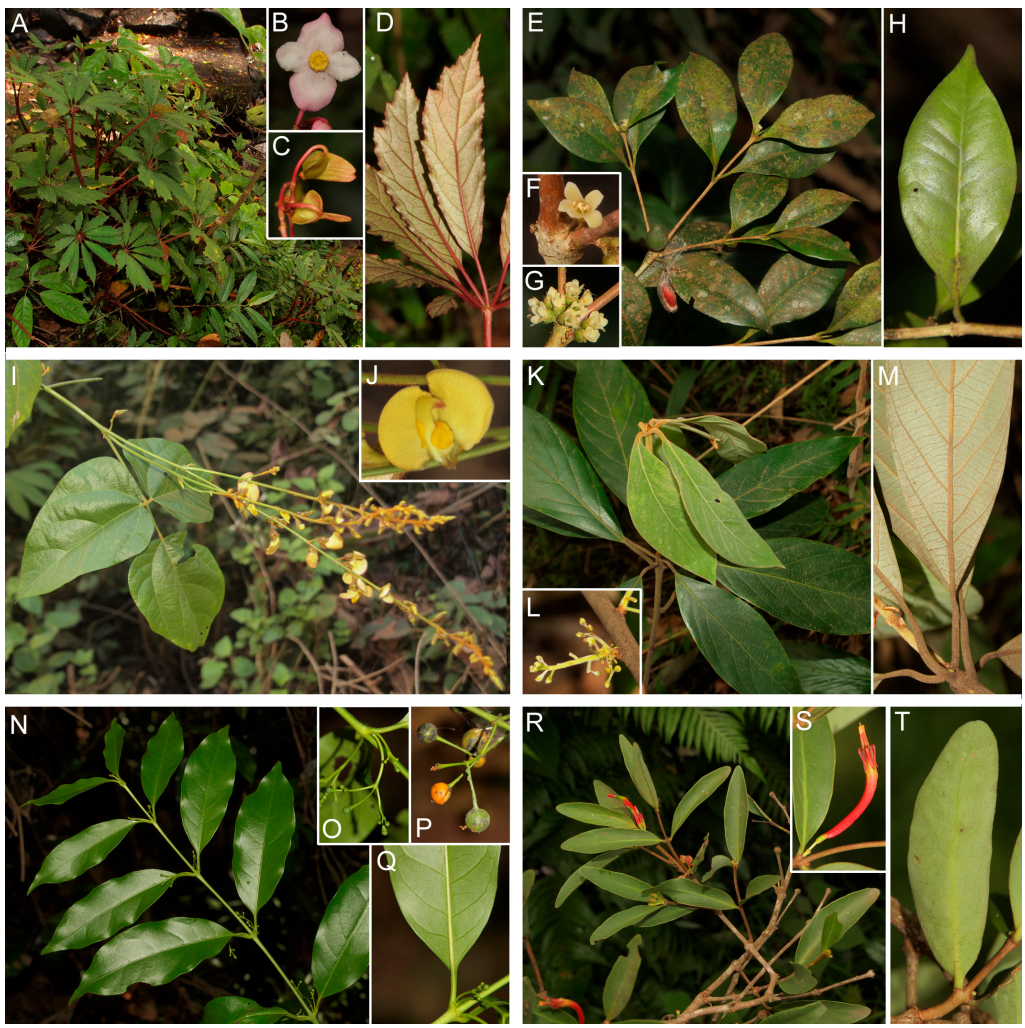

Figure 3. *Begonia hemsleyana* Hook.f.: A. habit, B. male flower, C. fruits, D. lower leaflet surface; *Microtropis crassifolia* Craib: E. fruiting branch, F. male flower, G. female flowers, H. lower leaf surface; *Dunbaria rubella* Span ex Miq.: I. flowering branch, J. flower; *Actinodaphne henryi* Gamble: K. leafy twig, L. inflorescence, M. portion of lower leaf surface; *Gardneria ovata* Wall.: N. branch with flower bud, O. young inflorescence, P. young infructescence, Q. portion of lower leaf surface; *Macrosolen avenis* (Blume) Danser: R. flowering branch, S. flower, T. lower leaf surface.

Julius *et al.*, 2013). This species, especially when sterile, is extremely similar to members of Rubiaceae. However, it can be easily distinguished by the lack of distinct interpetiolar stipules, especially in the young parts, and the superior ovary (Julius *et al.*, 2013).

Specimens examined.— Champasak Province [Paksong District, near Nong Luang Village, 15°04′11.90″N, 106°12′18.42″E, 1,100 m, 18 Dec. 2019, *Souladeth et al. L3428* [fl. bud & fr.] (**BKF**, **FOF**, **KAG**)].

Loranthaceae

Macrosolen avenis (Blume) Danser, Bull. Jard. Bot. Buitenzorg ser. 3, 10: 343. 1929.— *Loranthus avenis* Blume, Verh. Batav. Genootsch. Kunst. 9: 190. 1823. Type: Indonesia, Java, *Blume s.n.* (**NY** [NY00285114, digital image!], **U** [U0228651], digital image!). Fig. 3R–T.

Distribution.— Thailand, Laos (Bolaven), Vietnam, Malaysia (Peninsula), Singapore, Indonesia (Java, Sumatra),

Ecology.— In hill evergreen forest; alt. ca 1,000 m.

Phenology.— Flowering in July.

Note.— This species is characterized by obscure secondary veins, 2-flowered umbels, 3–4 cm long corolla bud (when mature), red corolla with yellow to green part below the mouth of the tube, and curved corolla tube above the middle. Barlow (1997) described its distribution to be "Thailand to Vietnam; Malesia: Sumatra, Peninsular Malaysia, Java" but recent taxonomic checklists of both Cambodia (Cho *et al.*, 2016) and Laos (Newman *et al.*, 2017) did not record this species and we could not find any specimen in major herbaria.

Specimens examined in Laos.— Champasak Province, Paksong District, in the vicinity of Tad Gneuang Waterfall, 15°10′27.38″N, 106°08′54.84″E, alt. 984 m, 5 July 2019, *Souladeth et al. L2975* [fl. and young fr.] (**FOF**, **KAG**).

Malvaceae

Sterculia bolavenensis Tagane & Soulad., **sp. nov.**

Similar to *Sterculia guttata* Roxb. in having ovate-elliptic to elliptic leaves, but differs in the pendulous inflorescence (vs erect in *S. guttata*), calyx lobes sparsely shortly stellate hairy adaxially (vs densely hairy), and longer bract and bracteoles (0.8–1.1 cm long vs less than 0.5 cm long). Type: Laos. Sekong Province, Thateng District, Had Saiy Village, 15°24′16.9″N, 106°22′34.5″E, alt. 1,211 m, 23 Feb. 2019, *Souladeth P., Tagane S., Sengthong A., Nagahama A., Suyama A. & Ishii N. L2770* [fl.] (holotype **FOF!**; isotypes **BKF!**, **KAG** [KAG129020!]). Fig. 4.

Deciduous tree, 23 m tall. *Twigs* to ca 5 mm in diameter at apex (non-flushing), densely covered with yellowish-brown stellate hairs when young, glabrescent when old, sparsely lenticellate. *Terminal bud* ovoid to subglobose, 5–6 mm in diam., bud scales narrowly ovate-elliptic, elliptic-oblong to elliptic, ca 5.5 × 2–2.3 mm, densely covered with yellowish-brown stellate hairs on both surfaces. *Stipule* linear 7–8 mm long, densely covered with yellowish-brown stellate hairs, caducous. *Leaves* simple, crowded at end of twigs; petiole 1.8–5.3 cm long, swollen at both ends, covered with yellowish-brown stellate hairs; leaf blade ovate-elliptic to elliptic, 12.5–18 × 6.2–9.7 cm, papery, apex acuminate, acumen to 1.5 cm long, margin entire, base slightly cordate, almost glabrous except sparse hairs on veins adaxially, densely covered with yellowish-brown hairs abaxially, pinnately-nerved with 5 basal veins, midrib prominent abaxially, secondary veins 12–14 on each sides of midrib, prominent abaxially, tertiary veins scalarforming-reticulate, prominent abaxially. *Inflorescence* reduced panicles of pistillate and staminate flowers, clustered subapically on twigs, produced simultaneously with new leaves, 6–9 per shoot, (3–)6–10.7 cm long (in anthesis), pendulous; (8–)18–46-flowered; peduncle 1–2.5 cm long, with light yellowish-brown stellate hairs; secondary axes subsessile to 3 mm long, with 1–4 flowers; bract and bracteole narrowly ovate-elliptic to lanceolate, 0.8–1.1 cm long, covered with light yellowish-brown stellate hairs, caducous. *Flowers* unisexual; calyx pale pink, funnel-shaped, deeply divided into 5 lobes, tube 2–3 mm long, lobes 5, oblong-lanceolate, 6–7 mm long (in staminate flower) or ca 10 mm long (in pistillate flower), apex acute, margin ciliate, each lobe curved inwards and touching apically at apex when young, curved outwards when old, sparsely hairy and with many glands inside, light yellowish-brown stellate hairs outside; pedicel 2–6 mm long, with light yellowish-brown stellate hairs. *Staminate flowers* ca 9 mm long; androgynophore 2.2–2.5 mm long, glabrous, nodding apically; stamens 7–8, ca 0.3 mm long, subsessile, surrounding the rudimentary

Figure 4. *Sterculia bolavenensis* Tagane & Soulad., sp. nov.: A. leafy branch, B. flowering branch, C. lower leaf surface, D. shoot apex showing stipules, E. bark, F. terminal bud, G. young inflorescence, H. staminate flower, I. pistillate flower, J. pistillate flower (two calyx lobes removed), K. androgynophore of staminate flower, L. androgynophore, style and stigma of pistillate flower, M. isotype *Souladeth et al. L2770* (KAG129020).

gynoecium. *Pistillate flowers* ca 1.3 cm long; androgynophore ca 1 mm long, erect, glabrous; gynoecium, ca 1.8 mm in diam., tomentose; staminodes 8–10, 0.15–0.25 mm long; style ca 1.8 mm long, strongly recurved, with stellate hairs; stigma peltate, obscurely 5-lobed; ovules 4–8 per carpel. *Follicle* (from fallen ones on the ground) oblong-ovate, ca 9 × 3.5 cm, densely covered with short brown hairs outside. *Seeds* not seen.

Distribution.— Laos (so far known only from type locality).

Ecology.— In mixed deciduous forest; alt. 1,200–1,250 m.

Phenology.— Flowering in February.

Note.— *Sterculia bolavenensis* is also similar to *S. euosma* W.W.Sm. of China in having ovate-elliptic to elliptic leaves and a reduced paniculate inflorescence (but occasionally racemose in *S. euosma*), but distinguished by its thinner leaves (papery in *S. bolavenensis* vs leathery in *S. euosma*), leaves with more secondary veins (11–14 pairs vs 8–11 pairs), more flowers per inflorescence ((8–)18–46 vs less than 15), and shorter pedicels (2–6 mm long vs 7–15 mm long).

Other specimens examined.— Laos. Sekong Province [Thateng District, Had Saiy Village, 15°24′16.9″N, 106°22′34.5″E, 1,211 m, 23 Feb. 2019, *Souladeth et al. L2771* [fl.] (**FOF**, **KAG**); ibid., 22 Dec. 2019, *Souladeth et al. L3780* [fr.] (**BKF**, **FOF**, **KAG**)].

Paulowniaceae

Wightia speciosissima (D.Don) Merr., J. Arnold Arbor. 19: 67. 1938.— *Gmelina speciosissima* D.Don, Prodr. Fl. Nepal.: 104. 1825. Type: Nepal, May 1821, *Wallich 2703* (isotype **CAL**, not seen). Fig. 5A & B.

Distribution.— Sikkim, India, Bhutan, Nepal, China, Myanmar, Thailand, Laos, Vietnam.

Ecology.— In dense montane conifer forest; alt. ca 1,200 m.

Phenology.— Flowering in December.

Note.— This is a scandent shrub or tree growing on rocks or semi-epiphytic on other trees, and in dense montane conifer forest on Bolaven Plateau.

Specimens examined.— Champasak Province [Paksong District, near Nong Luang Village, 15°04′29.18″N, 106°12′31.22″E, 1,231 m, 17 Dec. 2019, *Souladeth et al. L3288* [fl.] (**BKF**, **FOF**, **KAG**)].

Rubiaceae

Lasianthus chevalieri Pit., Fl. Indo-Chine [P.H. Lecomte *et al.*] 3: 384. 1924. Type: Vietnam, Annam, Lang-bian, 15 Feb. 1914, *A.J.B. Chevalier 30838* (holotype **P** [P04009921, digital image!]). Fig. 5C–E.

Distribution.— China (Hainan), Thailand, Laos, Cambodia(?), Vietnam.

Ecology.— In hill evergreen forest; alt. 1,200 m.

Phenology.— Flowering and fruiting in December.

Note.— *Lasianthus chevalieri* is characterized by its lanceolate leaves with densely hairy on abaxial side, and long linear calyx lobes 1.2–1.7 cm long. Naiki *et al.* (2015) and Napiroon *et al.* (2020) mentioned its distribution in Cambodia (Bokor). However, the plant reported by Naiki *et al.* (2015) was misidentified and is not *L. chevalieri*, as those of Cambodian species has much shorter calyx lobes ca 5 mm long. Later, Tagane *et al.* (2017) treated this plant [the same materials which is reported as "*L. chevalieri*" by Naiki *et al.* (2015)] as "*Lasianthus* sp.2". Napiroon *et al.* (2020) reported the occurrence in Cambodia without citing any specimens and we have not seen additional firm evidence, it remains doubtful whether it is actually distributed in Cambodia.

Specimens examined.— Champasak Province [Paksong District, near Nong Luang Village, 15°04′10.38″N, 106°12′30.37″E, 1,208 m, 17 Dec. 2019, *Souladeth et al. L3310* [fl. & fr.] (**BKF**, **FOF**, **KAG**)].

Lasianthus sarmentosus Craib, Bull. Misc. Inform. Kew 1933(1): 25. 1933. Type: Thailand, Chantaburi, Khao Soi Dao, 11 Dec. 1924, *A.F.G. Kerr 9614* (holotype **K** [K00077009, digital image!]; isotypes **BK** [SN257394, image!], **BM** [BM001191351, digital image!], **E** [E00327849, digital image!], **K** [K000777008, digital image!], **L** [L0305533, digital image!]). Fig. 5F–H.

Distribution.— Thailand, Laos, Cambodia.

Ecology.— In hill evergreen forest; alt. 1,000–1,100 m.

Phenology.— Fruiting in December.

Note.— *Lasianthus sarmentosus* is characterized by its glabrous twigs and leaves, and relatively small and membranaceous lamina (3.7–6.7 cm long), and 3–5 secondary veins.

Specimens examined.— Sekong Province [Tatheng District, Huay Saiy Village, 15°04′21.6″N, 106°22′44.1″E, 1,081 m, 23 Feb. 2019, *Souladeth et al. L2785* (**FOF**, **KAG**); ibid., 15°24′21.8″N, 106°22′44.4″E, 1,030 m, 22 Dec. 2019, *Souladeth et al. 3769* [fr.] (**BKF**, **FOF**, **KAG**)].

Saprosma latifolia Carib, Bull. Misc. Inform. Kew 1932(10): 485. 1932. Type: Thailand, Korat, Kao Lem, 26 Dec. 1930, *Put 3531* (**BK** [SN2557463, digital image!], **K** [K000761912, digital image!]). Fig. 5I & J.

Distribution.— Thailand, Laos.

Ecology.— In dry evergreen forest; alt. ca 150 m.

Phenology.— Fruiting in December.

Note.— *Saprosma latifolia* is characterized by its subsessile to short petiole (up to 1 mm long), usually in unequal pairs, and terminal and sessile inflorescences. In Laos, two species *S. annamense* Pierre ex Pit. and *S. ternatum* (Wall.) Hook.f. have been known, the latter species is common at higher elevation in Bolaven (e.g. alt. 1,081 m, *Souladeth et al. L3760* [fr.] (**BKF**, **FOF**, **KAG**); alt. 1,208 m, *Souladeth et al. L3315* [fl. & fr.], **BKF**, **FOF**, **KAG**).

Specimens examined.— Champasak Province [Dong Hua Sao NPA, in lowland evergreen forest, 14°53′44.73″N, 106°01′02.36″E, 158 m, 14 Dec. 2018, *Tagane et al. L2374* [fr.] (**FOF**, **KAG**)].

Salicaceae

Casearia flavovirens Blume, Mus. Bot. 1(16): 254. 1850. Type: Indonesia, Java, *van Hasselt s.n.* (lectotype **L** [L0010637, digital image!, designated here by C.M.Pannell]). Fig. 5K–M.

Distribution.— Thailand, Laos, Vietnam, Cambodia, Malaysia (Peninsular), Indonesia (Bali, Java, Sumatra).

Ecology.— In dry evergreen forest; alt. ca 550 m.

Phenology.— Fruiting in December.

Note.— This species is easily distinguished from the other species of *Casearia* in Laos by its coriaceous leaves, glossy above and the distinctly prominent and finely reticulated tertiary veins when dry.

Specimens examined.— Attapu Province [Phouvong District, Vong Somphou Village, 14°32′32.9″N, 106°51′51.8″E, 561 m, 21 Dec. 2019, *Souladeth et al. 3706* [fr.] (**BKF**, **FOF**, **KAG**)].

Symplocaceae

Symplocos pendula Wight var. **hirtistylis** (C.B.Clarke) Noot., Leiden Bot. Ser. 1: 42. 1975. Type: Malaysia, Mt Ophir, *Maingay 2586* (holotype **K** [K000740457, digital image!]). Fig. 5N–R.

Distribution.— China, Japan, Myanmar, Laos, Vietnam, Malaysia, Indonesia.

Ecology.— In dense montane conifer forest; alt. 1,250–1,300 m.

Phenology.— Flowering in December and fruiting in July and December.

Note.— In Indochina, only two species of *Symplocos* belong to Sect. *Symplocos* were recorded: *S. pendula* Wight and *S. henschelii* (Moritzi) Benth. ex C.B.Clarke. This section is characterized by a long corolla tube (at least halfway of petals connate, Nooteboom & Vidal, 1977). *Symplocos pendula* is easily distinguished from *S. henschelii* by its thinly leathery leaves (vs chartaceous in *S. henschelii*) and smaller flowers (1–1.7 cm long vs 2.5–5 cm long).

Specimens examined.— Champasak Province [Paksong District, near Nong Luang Village, 15°03′45.37″N, 106°12′37.74″E, 1,260 m, 4 July 2019, *Souladeth et al. L2938* [fr.] (**FOF**, **KAG**); ibid., 15°03′43.35″N, 106°12′37.47″E, 1,252 m, 17 Dec. 2019, *Souladeth et al. L3351* [fl. & fr.] (**BKF**, **FOF**, **KAG**)].

Thymelaeaceae

Wikstroemia bolavenensis Tagane & Soulad., **sp. nov.**

Similar to *Wikstroemia bokorensis* Oguri & Tagane of Cambodia and *W. nutans* Champ. ex Benth. of China and Vietnam in having opposite leaves and terminal pendulous inflorescences, but distinguished from these two by the number of flowers per inflorescence (10–14-flowered vs 3–6-flowered in *W. bokorensis* and 3–8 in *W. nutans*), and smaller hypanthium (7 mm long vs 9–12 mm long in *W. bokorensis* and (10–)13–16 mm long in *W. nutans*). Type: Laos. Champasak Province, Paksong District,

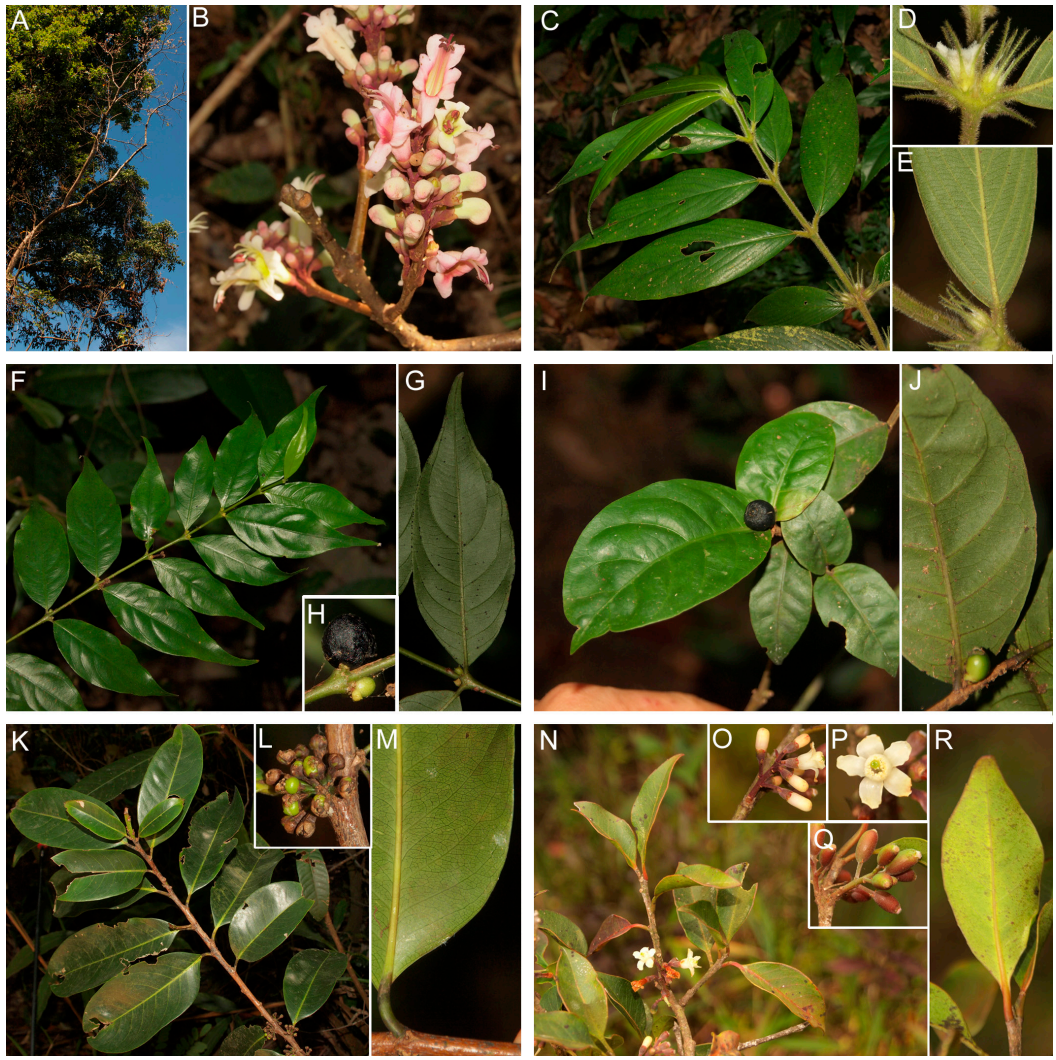

Figure 5. *Wightia speciosissima* (D.Don) Merr.: A. habit, B. Inflorescences; *Lasianthus chevalieri* Pit.: C. branches with flower bud, D. calyx and flowers, E. portion of lower leaf surface; *Lasianthus sarmentosus* Craib: F. leafy twig, G. lower leaf surface, H. fruits; *Saprosma latifolia* Carib: I. fruiting branch, J. portion of lower leaf surface; *Casearia flavovirens* Blume: K. leafy twig, L. young fruits, M. portion of lower leaf surface; *Symplocos pendula* Wight var. *hirtistylis* (C.B.Clarke) Noot.: N. flowering branches, O. inflorescence, P. flower (front view), Q. infructescence, R. lower leaf surface.

near Nong Luang Village, 15°04′14.58″N, 106°12′33.72″E, 1,246 m, 17 Dec. 2019, *Souladeth P., Tagane S., Kongxaysavath D., Rueangruea S., Somran S., Suyama Y. & Suzuki E. L3292* [fl. & fr.] (holotype **FOF!**; isotypes **BKF!**, **KAG** [KAG155657!]). Fig. 6.

Shrub, 2.5 m tall; branches reddish brown, glabrescent. *Leaves* opposite; petiole 1.2–2 mm long, sparsely hairy, slightly concave adaxially, rounded abaxially; blade ovate-elliptic to elliptic, 1.5–4 × 0.7–1.5 cm, thinly chartaceous, grayish-green adaxially, light yellowish green abaxially, glabrous on both surfaces except very sparsely hairy on midveins on abaxial side, apex acuminate to acute, margin entire, slightly recurved when dry, base cuneate, midrib slightly prominent or flat adaxially, prominent abaxially, secondary veins 6–9 pairs, slightly prominent abaxially. *Inflorescence* terminal, racemose, pendulous, 10–14 flowered; peduncle

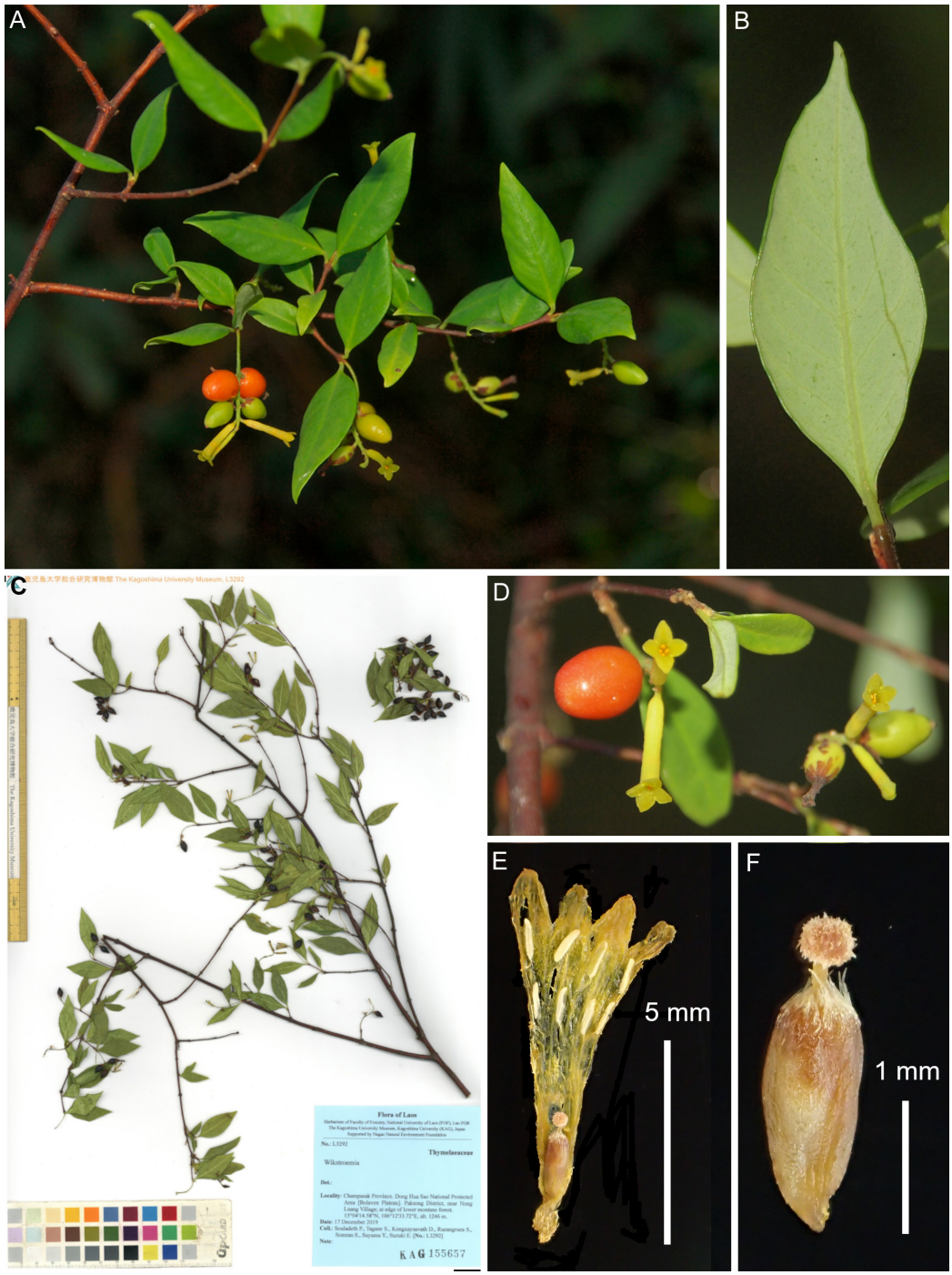

Figure 6. *Wikstroemia bolavenensis* Tagane & Soulad., sp. nov.: A. branches with flowers and fruits, B. lower leaf surface, C. Isotype *Souladeth et al. L3292* (KAG155657), D; flowers and fruits, E. hypanthium opened out showing stamens and pistil, F: pistil. Materials from *Souladeth et al. L3292* (KAG155657).

5–10 mm long, slightly flattened, sparsely covered with short appressed hairs; axis of inflorescences 6–8 mm long, covered with appressed short hairs, without bract and bracteoles. *Pedicels* ca 1.2 mm long, with appressed hairy. *Hypanthium* yellowish green; floral tube cylindrical, ca 7 mm long, covered with short hairs outside, glabrous inside; lobes 4, elliptic, ca 2 × 1.7 mm, sparsely appressed hairy outside, glabrous inside. *Stamens* 8, lower whorls of 4 anthers inserted above middle of hypanthium, upper whorl of 4 anthers inserted near orifice; free portion of filaments ca 0.5 mm long; anther linear-oblong, ca 1.1 mm long, ca 0.3 mm in diam. *Disc* scale 2, oblong, ca 1.1 × 0.2 mm, membranous, glabrous. *Ovary* obovoid, ca 2.1 mm long, ca 0.7 mm in diam., subsessile, glabrous except densely hairy only near the top; style ca 0.1 mm long, glabrous, stigma capitate, globose, ca 0.4 mm in diam., surface papillae. *Drupe* 5.5–7 mm long, black, glabrous, smooth, 1-seeded; fruiting pedicel ca 1.2 cm long, appressed hairy. *Seed* ovoid, ca 6 mm long, ca 4 mm in diam., black, glabrous.

Distribution.— Laos (so far known only from the type locality).

Ecology.— In edge of dense montane conifer forest; alt. ca 1,250 m.

Phenology.— Flowering and fruiting in December.

Note.— In addition to the diagnosis mentioned above, *Wikstroemia bolavenensis* differs from *W. bokorensis* in having shorter petioles (1.2–2 mm long vs 2–3 mm long), racemose inflorescence with axis of inflorescence 6–8 mm long (vs umbellate or very rarely shortly racemose with axis of inflorescence <0.2 mm long) and 2 disc scales (vs 1). It differs from *W. nutans* in having smaller lamina (1.5–4 × 0.7–1.5 cm in *W. bolavenensis* vs 3–6(–8.5) × 1.2–2.5(–4) cm in *W. nutans*) and ovoid fruit (vs ellipsoid). Wang & Gilbert (2007) noted that the flowering period of *W. nutans* is from spring to early summer and fruiting from summer to autumn. Oguri *et al.* (2017) described *W. bokorensis* based on a specimen with flowers and immature fruits collected in May. On the other hand, *W. bolavenensis* had flowers and fruits simultaneously in a single inflorescence/infructescence in December, supporting *W. bolavenensis* as an ecologically distinct species.

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