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Authors: Orel, George, Wilson, Peter G., Curry, Anthony S., and Luu, Hong Truong

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GEORGE OREL[1*], PETER G. WILSON[1], ANTHONY S. CURRY[1] & HONG TRUONG LUU[2]

Two new species of *Polyspora* (*Theaceae*) from Vietnam and new combinations for some Asian species

Abstract

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Two new species of *Theaceae* from Vietnam, *Polyspora nivea* and *P. ampla*, are described and illustrated. Although showing close affinities with other Vietnamese species of *Polyspora*, the new taxa possess a number of fundamental morphological dissimilarities, which are here evaluated and discussed. The morphological evidence for the two new taxa supports taxonomic placement in the genus *Polyspora*. In addition, 23 new combinations are made for Asian species of *Polyspora*.

Additional key words: *Gordonia*, taxonomy, Tam Dao, South-East Asia

Introduction

The genus *Polyspora* Sweet is distinguished within the family *Theaceae* by having sepals not distinct from the petals, stamens basally united with the corolla, a woody capsule loculicidally dehiscent into five valves that separate from the columella, and seeds with a large apical wing (Orel & al. 2012). Separation of *Polyspora* species from their traditional placement in *Gordonia* J. Ellis is supported by the work of Prince & Parks (2001) and Yang & al. (2004) based on phylogenetic analyses of DNA data.

The genus *Polyspora* is predominantly Asian, and earlier work recognized six species within the borders of Vietnam (Gagnepain 1941; Ho 1991). To these, the seventh species, *P. huongiana* Orel, Curry & Luu, was added only recently (Orel & al. 2012). Morphological character analysis indicates that two recently discovered taxa are readily distinguishable from these seven, and they are here described as the new species *P. nivea* and *P. ampla*. A table is presented to compare selected vegetative and reproductive characters of all nine Vietnamese species (Table 1).

Results and Discussion

New species

Polyspora nivea Orel, Curry & Luu, **sp. nov.** – Fig. 1.
Holotype: Vietnam, Vinh Phuc Province, Tam Dao National Park, 13 Dec 2011, *G. Orel & A. S. Curry 1245* (NSW; isotype: VNM).

Diagnosis — *Polyspora nivea* differs from the type species, *P. axillaris* (Roxb. ex Ker Gawl.) Sweet, by being a shrub to 4 m tall (not a small tree 7–10 m tall); by having pedicels 7–10(–12) mm long (not pedicels to 3 mm long); by having petals snow-white, waxy (not petals white, yellowish white, or white-pink, not waxy); and by having a style solitary, columnar, 1.2–1.5 cm long (not a style columnar, sulcate, 1.5–2 cm long).

1 Royal Botanic Gardens, Mrs Macquaries Road, Sydney, NSW 2000, Australia; *e-mail: george.orel@rbgsyd.nsw.gov.au (author for correspondence); peter.wilson@rbgsyd.nsw.gov.au
2 Southern Institute of Ecology, Vietnam Academy of Science and Technology, 01 Mac Dinh Chi, District 1, Ho Chi Minh City, Vietnam; e-mail: e-mail: hongtruongluu@yahoo.com

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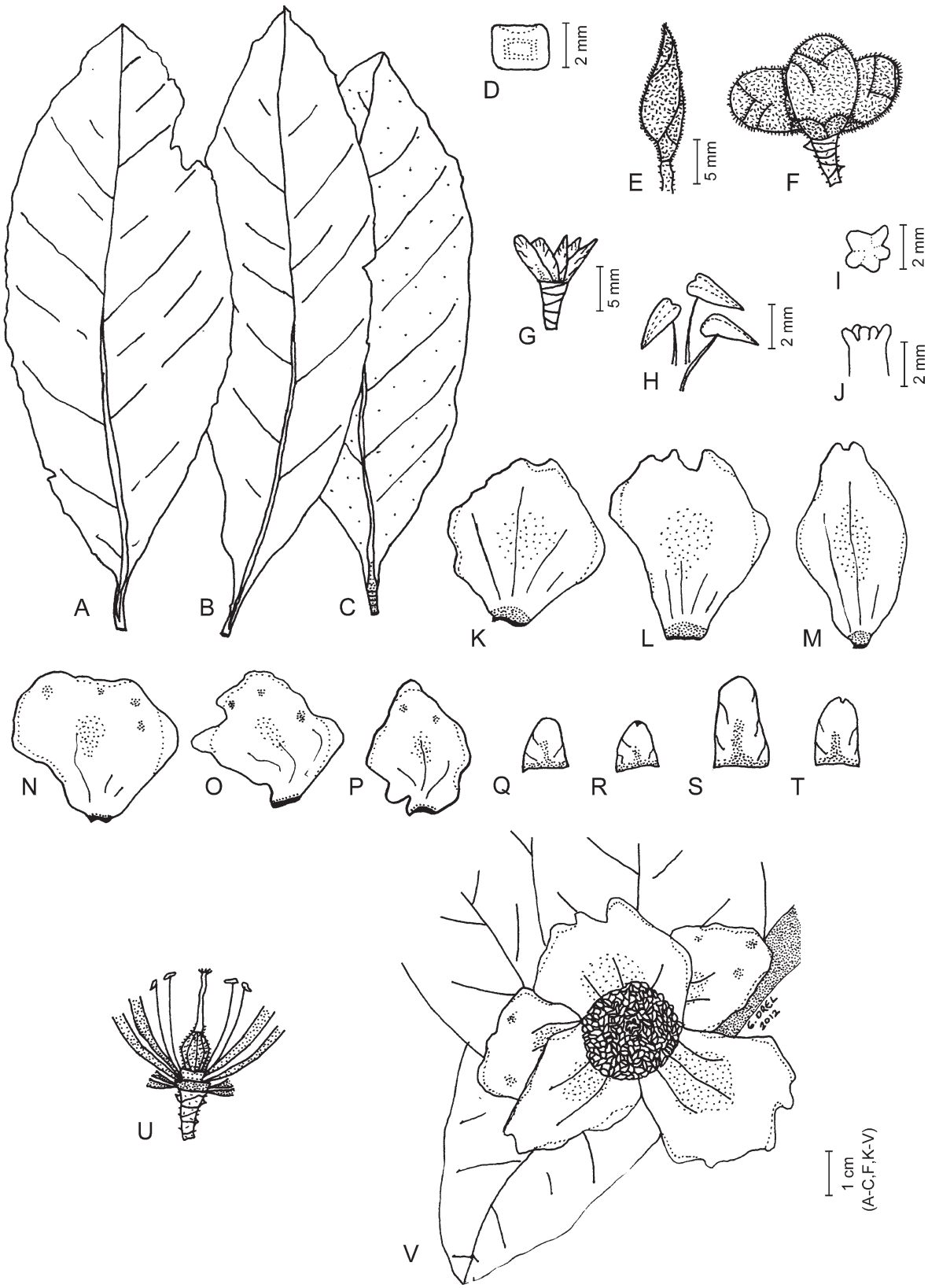

Fig. 1. *Polyspora nivea* – A, B: adult leaves, adaxial view, primary and secondary venation, petiole, leaf base and apex; C: adult leaf, abaxial view, primary and secondary venation, petiole, leaf base and apex; D: petiole, cross-section; E: terminal leaf bud, lateral view; F: developing flower buds, lateral view; G: remnants of bracts forming a cupule, lateral view; H: anthers with apical ends of filaments; I: stigma, apical view; J: stigma with apical end of style, lateral view; K–M: petals; N–P: sepals; Q, R: bracts, inner whorl; S, T: bracts, outer whorl; U: adult flower, longitudinal section with sepals, petals, and stamens truncated; V: branchlet with a flower and leaves. – Drawn by G. Orel from the holotype: *G. Orel & A. S. Curry 1245* (NSW).

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Description – *Shrubs* evergreen, to 4 m tall, with upright habit, multi-stemmed, densely branched; *mature bark* finely corrugated but not striated; *mature branches* grey-brown and covered by lichens (especially on exposed sites); *semimature branches* entirely light grey-brown; *juvenile branches* mid- to light green, not shiny, slightly laterally compressed, mostly glabrous, or very sparsely hairy; *axillary buds* mostly rudimentary, otherwise greenish yellow, long, narrow, slightly falcate, finely tomentose, apex pungent; *terminal buds* long, narrow, slightly falcate, 9–16 mm long, 3–5 mm wide, finely tomentose, apex pungent. *Leaves* with blade conspicuously elevated by 30°–45° from plane of petiole; *petiole* entirely light to yellowish green, shiny, rather long and slim, slightly falcate, compressed in cross-section, thus appearing square, 10–12 mm long, 2–3(–4) mm wide, to 2 mm thick, abaxially corky on some older leaves, adaxially longitudinally divided by a shallow channel (a continuation of adaxial leaf blade midrib); *juvenile leaf blade* initially light orange, almost red on margins, 2–2.5 cm long, 0.5–1 cm wide, glabrous; *developing leaf blade* abaxially lighter-coloured and slightly less shiny, adaxially yellow-green to dark green and lustrous, narrow, variable in size, rigid, glabrous; *mature leaf blade* abaxially lighter green and less shiny, adaxially dark green and shiny, narrowly elliptic to elliptic, 12–13(–14) cm long, 4–5.5 cm wide, coriaceous, glabrous, abaxially verrucose, margin entire, slightly undulate, base acute to cuneate, apex acute or cuspidate; *midrib* yellow-green, abaxially prominent, adaxially conspicuous, narrow, and shallowly sunken, 1–2 mm wide proximally, less than 1 mm wide distally; *secondary venation* pinnate, camptodromous or nearly so, with 5–7(–10) pairs of veins mostly in central part of blade, rather indistinct on both surfaces (indistinguishable on herbarium specimens); *tertiary venation* not apparent. *Bracts* in 2 whorls, light green basally and in proximal centre, otherwise brown, more so on margin, thin, slightly woody, rather flaky, glabrous, margin frayed, apex sometimes emarginate, persistent remnants forming a cupule 1–1.2 cm high and 1.8–2 cm wide; *outer whorl bracts* 3, basally connate for 3–4 mm and slightly overlapping forming a cupular structure, unevenly orbicular, 1.5–2.2 cm long, 1–1.4 cm wide; *inner whorl bracts* 2, generally orbicular but variable in shape, strongly concave, 1–1.5 cm long, 1–1.2 cm wide, abaxially verrucose, adaxially smooth. *Flower buds* always terminal, in clusters of (1 or)2–5 (with new vegetative growth observed growing from centre of flower bud cluster), initially brown, later white and green, mostly asymmetrically ellipsoid, sometimes asymmetrically globose, 2–2.5 cm long, 1–2 cm wide, finely hairy, apex rounded; *flowers* of irregular shape, 7.5–8 cm in diam., odourless; *pedicel* attached at c. 45° to stem, dull green, 7–10(–12) mm long, c. 3 mm wide proximally, to 7 mm wide distally, unevenly and finely hairy; *bracteoles* 3–5, initially covering pedicel, triangular, very small, deciduous, leaving yellowish brown narrow shallow scars; *sepals* 3, in 1 unevenly shaped whorl, connate at base for less than 1 mm, proximally overlapping, white or off-white to distinctly light yellow, with indistinct non-raised striations, translucent at margin, sometimes with distal green blotches, variable in shape, 3–3.5 cm long, 2–3.5(–4) cm wide, thicker in centre, otherwise thin, apex not emarginate; *petals* (3 or)4, in 1 whorl, basally connate and adnate to outer filaments for 2–4 mm forming a shallow ring, otherwise free, snow-white, with a yellowish tinge in senescent flowers, with unevenly distributed faint non-raised striations, sometimes partially translucent at margin, unevenly obovate to narrowly elliptic, asymmetric, relatively flat, 3.5–4.5 cm long, 2.5–3.8 cm wide, thicker in centre, otherwise relatively thin, dense, waxy, glabrous, margin wavy, apex distinctly emarginate; *stamens* numerous, in several short series each somewhat spirally arranged and 2–2.5 cm in diam.; *filaments* light yellow, later darker, almost brown, not straight, 2–2.5 cm long, glabrous; *anthers* dorsifixed, bright yellow, later dark yellow to brown, with 2 distinct brown striations adaxially, 2–4 mm long, c. 1.3 mm wide, glabrous, proximally cordate, distally acuminate; *ovary* superior, resting on a hard woody base, 4- or 5-locular, yellow green with distinct striations, cylindrical, 8–9 mm long, proximally 5–6 mm wide, thickly hairy, hairs white, short, silky; *style* solitary, columnar, 1.2–1.5 cm long, 1.5–3 mm wide proximally, 1–2 mm wide distally, glabrous or very sparsely hairy; *stigma* greenish yellow, indistinctly 5-lobed, c. 3 mm in diam., glabrous, lobes unevenly shaped. *Capsule* and *seeds* not seen.

Phenology — The new species was collected in flower in December. The presence of many flower buds indicates that the flowering period may continue throughout January and possibly February. No mature or immature fruit was observed at the time of collection.

Distribution and ecology — *Polyspora nivea* is known from a single gathering made in the Tam Dao National Park, in Vinh Phuc Province, Vietnam. This is the only known locality for this species so far. Further searching of the relevant area will be undertaken in the near future, as the new species may be sporadically represented within the confines of the Tam Dao National Park. *Polyspora nivea* was found on a rather exposed and very steep site, at an elevation of about 1500 m near the upper gate, which is the entrance to the walking trails in the park. The new species thrives in the pockets of relatively poor, brown-black, rocky, and well-drained soils. The authors were unable to find other specimens of *P. nivea* in any Vietnamese herbarium.

Conservation status — Only one mature individual was found at the type locality, although there are unconfirmed reports from nearby areas. Because the species is apparently uncommon and restricted in distribution, and subject to threat from urban expansion in the vicinity of the

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park entrance, there is an urgent need to search for further individuals within the confines of the Tam Dao National Park. Without this, its conservation status can only be given as DD (Data Deficient) (IUCN 2012).

Etymology — The specific epithet is a reference to the distinctive snow-white petals of this species.

Remarks — Table 1 compares the key features of *Polyspora nivea* with those of the other eight Vietnamese species, including *P. axillaris*, the type species of the genus, and *P. ampla*, newly described below.

Polyspora ampla Orel, Curry & Luu, **sp. nov.** – Fig. 2.
Holotype: Vietnam, Vinh Phuc Province, Tam Dao National Park, 13 Dec 2011, *G. Orel & A. S. Curry 1243* (NSW; isotype: VNM).

Diagnosis — *Polyspora ampla* differs from the type species, *P. axillaris* (Roxb. ex Ker Gawl.) Sweet, by being a large tree to 20 m tall (not a small tree 7–10 m tall); by having flowers terminal, 12–14(–15) cm in diam. (not flowers axillary or subterminal, 7–10 cm in diam.); by having pedicels 10–15 mm long (not pedicels to 3 mm long); and by having a style solitary, columnar, 2.5–3 cm long (not a style columnar, sulcate, 1.5–2 cm long).

Description — *Trees* evergreen, to 20 m tall, with upright habit, well branched, with branches on adult trees on upper half of trunk only; *trunk* single, rather massive, to 1.5 m in diam. at base; *mature bark* mottled in shades of grey-brown, slightly rough, exfoliating in large scales, exposing cinnamon-brown newly formed layer, bark of old trees covered with a thick layer of lichens; *mature branches* mid-brown, with leaf scars; *semimature branches* grey-brown, glabrous, pronouncedly verrucose; *juvenile branches* mid- to light green, not shiny, finely tomentose, later glabrous; *axillary buds* light to mid-green, long, narrow, slightly falcate, finely and unevenly tomentose, apex pungent, bud scales prominent; *terminal buds* long, narrow, slightly falcate, 15–25 mm long, 3–5 mm wide, finely tomentose, apex pungent. *Leaves* with blade conspicuously elevated by 30°–50° (45°–50° on juvenile leaves) from plane of petiole; *petiole* mid-green, rather dull, long, thick, falcate, slightly thicker at proximal end, slightly compressed in cross-section, 12–20 mm long, 3–5 mm wide, to 2 mm thick, slightly textured, adaxially longitudinally divided by a shallow channel (a continuation of adaxial leaf blade midrib); *juvenile leaf blade* abaxially lighter-coloured and less shiny, adaxially light to mid-green and lustrous, narrowly obovate, rigid, coriaceous, glabrous, margin sometimes in part coarsely serrate; *mature leaf blade* abaxially lighter green and dull, adaxially dark green and shiny, narrowly elliptic to elliptic to oval, to 23 cm long, 5.5–8 cm wide, coriaceous, glabrous, base markedly acute, margin entire, undulate, apex acute to bluntly cuspidate, sometimes shallowly emarginate; *midrib* abaxially light green or yellowish and very prominent, adaxially light green, narrow, and shallowly sunken proximally, 3–4(–5) mm wide proximally, less than 1 mm wide distally; *secondary venation* pinnate, imperfectly craspedromous, with 25–27(–30) pairs of indistinct veins, abaxially indistinct, slightly raised adaxially; *tertiary venation* absent. *Flower buds* terminal, solitary, white and green, later white, asymmetrically ellipsoid, sometimes asymmetrically globose, glabrous, apex rounded or acute; *flowers* of irregular shape, 12–14(–15) cm in diam., odourless; *pedicel* attached at c. 45° to stem, mid-green to brown, rather thick, 10–15 mm long, c. 5 mm wide proximally, finely tomentose; *bracteoles* 5–8, covering pedicel, small, deciduous, leaving distinct semicircular scars arranged in 4 asymmetric layers; *sepals* 4 or 5, in 2 unevenly shaped whorls, free at base, proximally overlapping, white or off-white to light brown, roughly semicircular although rather variable in shape and size, 1.5–2.5 cm long, 1.5–2.5(–2.8) cm wide, slightly thicker and woody in centre, finely hairy, margin frayed, apex distinctly emarginate; *petaloids* 2, in 1 whorl situated between sepals and petals, free at base, not overlapping, white, without striations, 3–3.5 cm long, 4–4.5 cm wide, thicker in centre, glabrous, apex distinctly emarginate; *petals* 5, in 2 whorls of 2 or 3, white, almost entirely translucent, with a yellowish tinge in senescent flowers, with faint non-raised striations, unevenly obovate, asymmetric, slightly concave, slightly thicker in centre, otherwise thin, not waxy, glabrous, margin wavy, apex distinctly emarginate; *outer whorl petals* free, to 7(–7.5) cm long, 6–6.5 cm wide; *inner whorl petals* basally adnate to outer filaments for c. 5 mm, 5.5–7(–7.5) cm long, 5–6.5 cm wide; *stamens* numerous, in a circular formation 4–6 cm in diam.; *filaments* light yellow, later darker, almost brown, 3–3.5 cm long, basally to 1.5 mm wide, glabrous; *anthers* dorsifixed, mid-yellow, later dark yellow to brown, with 2 distinct brown striations adaxially, 3–5 mm long, 2–3 mm wide, hairy, proximally slightly cordate, distally bluntly acuminate; *ovary* superior, 4- or 5-locular, yellow-green with distinct striations, barrel-shaped, 6–7 mm long, 5–6 mm wide, thickly hairy, hairs greyish white, short, silky; *style* solitary, yellow-green, columnar, 2.5–3 cm long, to 3 mm wide proximally, 1–1.5 mm wide distally, unevenly and sparsely tomentose; *stigma* greenish-yellow, indistinctly 5-lobed, 2.5–3 mm in diam., finely tomentose to completely glabrous, lobes unevenly shaped. *Capsule* and *seeds* not seen.

Phenology — The new species was collected in flower in mid-December. The presence of many spent flowers indicates that the flowering period may commence in late October and continue throughout November. No mature or immature fruit was observed at the time of collection.

Distribution and ecology — *Polyspora ampla* is known

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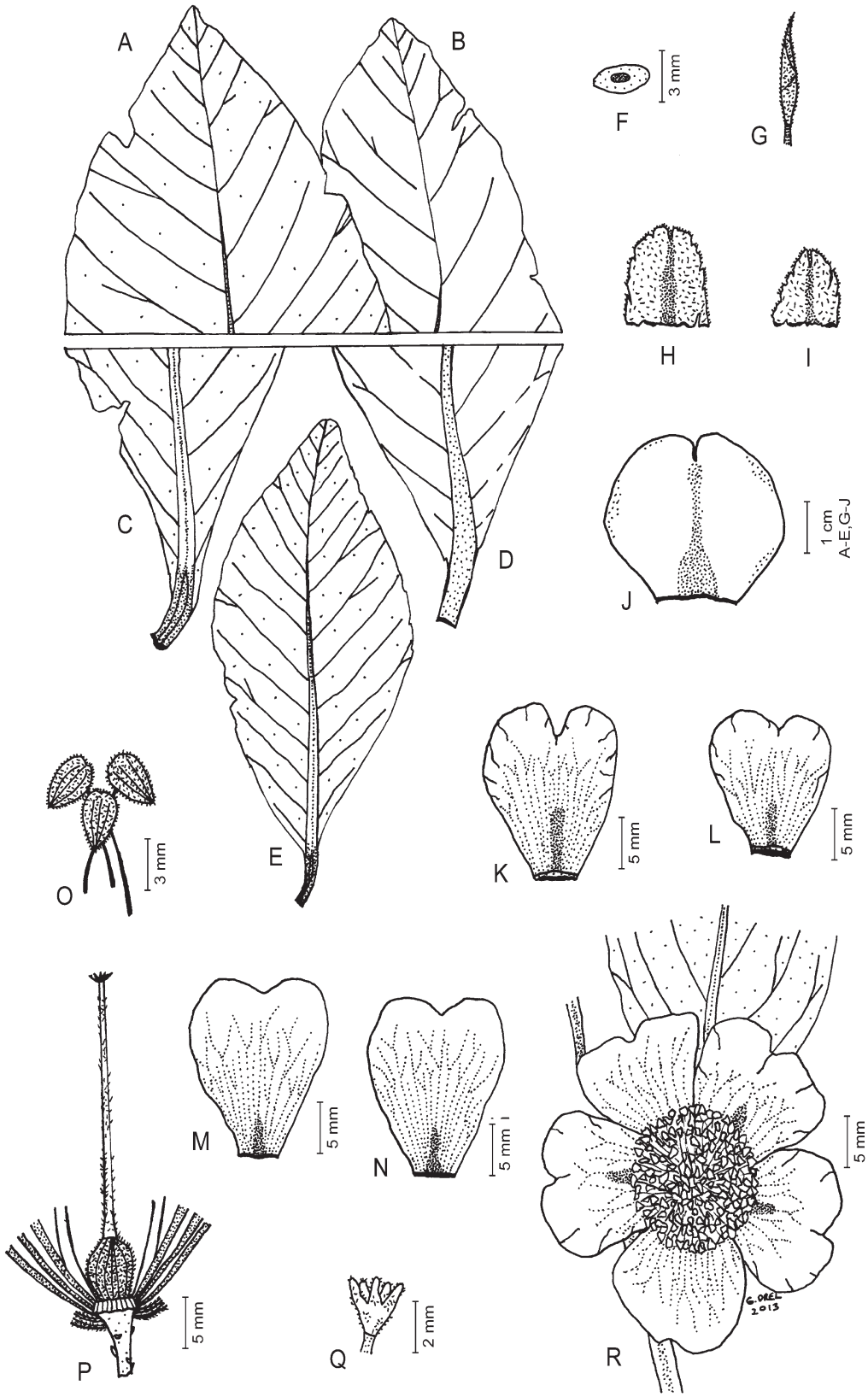

Fig. 2. *Polyspora ampla* – A: adult leaf, adaxial view, primary and secondary venation, apex; B: adult leaf, abaxial view, primary and secondary venation, apex; C: adult leaf, adaxial view, petiole and leaf base; D: adult leaf, abaxial view, petiole and leaf base; E: juvenile leaf, adaxial view, primary and secondary venation, petiole, leaf base and apex; F: petiole, cross-section; G: terminal leaf bud, lateral view; H, I: sepals; J: petaloid; K, L: inner petals; M, N: outer petals; O: anthers with apical ends of filaments; P: adult flower, longitudinal section with sepals, petaloids, petals, and stamens truncated; Q: stigma and apical end of style, lateral view; R: branchlet with a flower and leaves. – Drawn by G. Orel from the holotype: *G. Orel & A. S. Curry 1243* (NSW).

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from a collection made in the Tam Dao National Park, in the Vinh Phuc Province, Vietnam. This is the only known locality for this species. The new species is sporadically distributed throughout the confines of the Tam Dao National Park where it occurs as a large solitary tree. *P. ampla* was found in dense rainforest, at the elevation of about 1400 m. The new species thrives on relatively poor, brown-black, rocky, and well-drained soils. The authors were unable to find any other specimens of *P. ampla* in any Vietnamese herbarium.

Conservation status — Although several adult specimens were found in the area of the type locality, the species has a limited distribution. The presence of a newly constructed access road and the building of the nearby township, which is still under construction, threaten *Polyspora ampla* with further man-made disturbance and invasion by exotic weeds. There is a need to search for further individuals in the area to gather more data on the extent of its distribution. Until then, a conservation rating of DD (Data Deficient) (IUCN 2012) is the only one that can be applied.

Etymology — The specific epithet refers to the thick and bulky trunk of this species.

Remarks — Table 1 compares the key features of *Polyspora ampla* with those of the other eight Vietnamese species, including *P. axillaris*, the type species of the genus, and *P. nivea*, newly described above.

New combinations for some Asian species of *Polyspora*

Apart from the species already transferred to *Polyspora* by Bartholomew & Ming (2005), Yang (2005) and Orel & al. (2012), many Asian *Gordonia* taxa require reassessment for possible transfer to *Polyspora*. However, there are many unanswered questions about some of these taxa, as little work has been done since Keng's review of Malesian *Gordonia* (Keng 1984). We here make new combinations for those taxa that appear to be taxonomically unproblematic, leaving the others to be reassessed in future revisions or local Floras.

Polyspora amboinensis (Miq.) Orel, Peter G. Wilson, Curry & Luu, **comb. nov.** ≡ *Laplacea amboinensis* Miq. in Ann. Mus. Bot. Lugduno-Batavi 4: 114. 1869 ≡ *Gordonia amboinensis* (Miq.) Merr. in J. Straits Branch Roy. Asiat. Soc. 86: 332. 1922.
= *Gordonia rumphii* Merr., Interpr. Herb. Amboin.: 368. 1917.

Polyspora borneensis (H. Keng) Orel, Peter G. Wilson, Curry & Luu, **comb. nov.** ≡ *Gordonia borneensis* H. Keng in Gard. Bull. Singapore 37(1): 11. 1984.

Polyspora concentricicatrix (Burkill) Orel, Peter G. Wilson, Curry & Luu, **comb. nov.** ≡ *Gordonia concentricicatrix* Burkill in J. Straits Branch Roy. Asiat. Soc. 76: 153. 1917.

Polyspora dipterosperma (Kurz) Orel, Peter G. Wilson, Curry & Luu, **comb. nov.** ≡ *Gordonia dipterosperma* Kurz in J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 45(3): 119. 1876.

Polyspora excelsa (Blume) Orel, Peter G. Wilson, Curry & Luu, **comb. nov.** ≡ *Gordonia excelsa* Blume, Bijdr. Fl. Ned. Ind. 3: 130. 1825.

Polyspora grandiflora (Merr.) Orel, Peter G. Wilson, Curry & Luu, **comb. nov.** ≡ *Gordonia grandiflora* Merr. in J. Straits Branch Roy. Asiat. Soc. 86: 331. 1922.

Polyspora havilandii (Burkill) Orel, Peter G. Wilson, Curry & Luu, **comb. nov.** ≡ *Gordonia havilandii* Burkill in J. Straits Branch Roy. Asiat. Soc. 76: 157. 1917.

Polyspora hirtella (Ridl.) Orel, Peter G. Wilson, Curry & Luu, **comb. nov.** ≡ *Gordonia hirtella* Ridl. in J. Straits Branch Roy. Asiat. Soc. 73: 142. 1916.

Polyspora imbricata (King) Orel, Peter G. Wilson, Curry & Luu, **comb. nov.** ≡ *Gordonia imbricata* King in J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 59(2): 204. 1890.

Polyspora integerrima (Miq.) Orel, Peter G. Wilson, Curry & Luu, **comb. nov.** ≡ *Laplacea integerrima* Miq. in Ann. Mus. Lugduno-Batavi 4: 113. 1869 ≡ *Gordonia integerrima* (Miq.) H. Keng in Gard. Bull. Singapore 37(1): 19. 1984.

Polyspora lanceifolia (Burkill) Orel, Peter G. Wilson, Curry & Luu, **comb. nov.** ≡ *Gordonia lanceifolia* Burkill in J. Straits Branch Roy. Asiat. Soc. 76: 150. 1917.

Polyspora luzonica (S. Vidal) Orel, Peter G. Wilson, Curry & Luu, **comb. nov.** ≡ *Gordonia luzonica* S. Vidal, Revis. Pl. Vasc. Filip.: 57. 1886.
= *Gordonia fragrans* Merr. in Philipp. J. Sci. 1(Suppl. 1): 95. 1906.
= *Gordonia benguetica* Burkill in Philipp. J. Sci. 15: 478. 1919.

Polyspora maingayi (Dyer) Orel, Peter G. Wilson, Curry & Luu, **comb. nov.** ≡ *Gordonia maingayi* Dyer in Hooker, Fl. Brit. India 1: 291. 1874.

Polyspora marginata (Korth.) Orel, Peter G. Wilson, Curry & Luu, **comb. nov.** ≡ *Closaschima marginata* Korth., Verh. Nat. Gesch. Ned. Bezitt., Bot.: 141. 1842 ≡ *Gordonia marginata* (Korth.) Endl. ex Walp., Repert. Bot. Syst. 5: 134. 1845.

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Table 1. Comparison of selected vegetative and reproductive characters of the nine Polyspora species native to Vietnam. – Data are summarized from the available literature (Bentham 1861; Pitard 1902; Gagnepain 1941; Keng 1972; Krüssmann 1986; Ho 1991; Hsieh & al. 1996; Bartholomew & Ming 2005; Ming & Bartholomew 2007; Orel & al. 2012); an asterisk (*) indicates where data are augmented by field observations by G. Orel & A. S. Curry.

	Polyspora huongiana*	***Polyspora bidoupensis****	***Polyspora gigantiflora***	***Polyspora intricata***	***Polyspora balansae***	***Polyspora axillaris****	***Polyspora tonkinensis***	***Polyspora nivea***	***Polyspora ampla***
Plant height [m]	to 10	20–25	c. 6	7–8	c. 8	7–10	c. 12	to 4	to 20
Juvenile branches indumentum	glabrous	–	–	–	–	completely glabrous	–	mostly glabrous, or very sparsely hairy	finely tomentose, later glabrous
Terminal buds indumentum	slightly canescent	–	–	–	–	pubescent	–	finely tomentose	finely tomentose
Petiole length [mm]	8–12	10–15	7–8	c. 10	5–8	10–15	8–15	10–12	12–20
Leaf blade shape	narrowly elliptic	elliptic	lanceolate to oblong	elliptic to lanceolate	lanceolate	oblong to oblanceolate to obovate	lanceolate to oblanceolate	narrowly elliptic to elliptic	narrowly elliptic to elliptic to oval
Leaf blade texture	coriaceous	–	–	–	–	coriaceous	–	coriaceous	coriaceous
Leaf blade base shape	cuneate	acute to obtuse	attenuate	acute	cuneate	cuneate	cuneate	acute to cuneate	markedly acute
Leaf blade apex shape	acute to acuminate	attenuate to obtuse	shortly acuminate	acuminate	acuminate	obtuse to emarginate	obtuse	acute or cuspidate	acute to bluntly cuspidate, sometimes shallowly emarginate
Pedicel length [mm]	8–10(–12)	3–4	3–4	flowers sessile	3–4	to 3	3–5	7–10(–12)	10–15
Petal colour	dark pink to red	white	white	white	yellowish	white, yellowish white or white-pink	white or off-white	snow-white	white, translucent
Petal texture*	not waxy	not waxy	not waxy	not waxy	not waxy	not waxy	not waxy	waxy	not waxy
Ovary	3–5-locular	5-locular	7-locular	3-locular	3–5-locular	3–5-locular	3–5-locular	4- or 5-locular	4- or 5-locular
Style form	3–5 connate parts	5-sulcate	basally connate	3-sulcate	parts rarely connate	columnar, sulcate	basally connate	solitary, columnar	solitary, columnar
Style length [mm]	2.2–2.6	–	–	–	–	1.5–2	–	1.2–1.5	2.5–3
Capsule length [cm]	2.5–3	3–5	0.6–0.7	c. 4	3–5	c. 4	c. 2	–	–

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