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RESEARCH ARTICLE

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Studies in Papuasian *Syzygium* (*Myrtaceae*): 1. Subgenus *Perikion* revised

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Key words

identification key
maps
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Abstract *Syzygium* subgenus *Perikion* is revised in Papuasia. Descriptions are provided for each of the ten species recognised, four of which are new. An identification key, distribution maps and an exsiccatae list are provided.

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INTRODUCTION

Syzygium P.Browne ex Gaertn. is well represented in the Papuasian biogeographic region but there are few taxonomic treatments available to assist in the identification of its numerous species. For some decades, the only works that could assist with the identification of specimens from the region have been the publications of Merrill & Perry (1937 for *Cleistocalyx*, a segregate from *Syzygium*; 1938 for *Acmena*; 1942 for *Syzygium*), although the 1942 *Syzygium* paper lacked a key to the many species that Merrill and Perry recognised. More recently an enumeration of, and an identification key to, the Papuasian species of *Syzygium* as it has conventionally been circumscribed since the 1940s was published by Hartley & Perry (1973), and an account of *Acmena* in Papuasia was published by Hartley & Craven (1977). Uncertainties as to the circumscription of *Syzygium* and the validity of the various segregate genera that had been proposed (Craven 2001, Parnell et al. 2007) was resolved by DNA studies by Harrington & Gadek (2004) and Biffin et al. (2006). Drawing on the molecular results, Craven et al. (2006) concluded that *Syzygium* is better circumscribed broadly with the various segregate genera (i.e., *Acmena*, *Acmenosperma*, *Cleistocalyx* and *Waterhousea*) merged with it, and they published names in *Syzygium* for those species for which there was no valid name available (Craven et al. 2006). Craven & Biffin (2010) published an infrageneric classification of the genus using the ranks of subgenus and section to give formal effect to the structure suggested by the inferred phylogeny that they presented.

The species treated in the present paper belong in subg. *Perikion*. Species of this taxon are characterised by the possession of numerous, closely abutting, fibre bundles in the hypanthium wall (Craven & Biffin 2010). This feature is readily observed, can be determined in both flowering and fruiting stages, and is the most useful character to distinguish the species of subg. *Perikion* from those of the other subgenera. The vascular bundles in the hypanthium wall of species of *Syzygium* supply nutrient to the calyx, corolla and stamens and are very dissimilar to the fibre bundles in *Perikion*. A function for the fibre bundles is not known; however, they may confer some protection against herbivorous insects chewing through the hypanthium wall to feed upon the developing embryo.

Several morphological features warrant or require discussion. The seasonal flush of growth that comprises or includes the inflorescence of a *Syzygium* plant may include leaves or be leafless. This growth flush, termed 'reproductive seasonal growth unit' for descriptive purposes, has a form that is characteristic and often very consistent for the various species. It may be leafless but may have leaves, typical of vegetative seasonal growth units (i.e., growth flushes), in the proximal axils. Sometimes the leaves within the reproductive seasonal growth unit are very distinct in their size and form to those of the vegetative growth units. The staminal disc is the tissue upon which the stamens are inserted. The form of the staminal disc and associated tissues is a valuable character state in the discrimination of species. The disc may be flat or variously curved or sloping and there may be a 'lip' at its inner edge, all of which combine to give a particular form to the disc and the adjacent tissues at the hypanthium apex. The staminal disc types applicable to the species treated in the present paper are shown in diagrammatic form in Fig. 1 (an excerpt from a complete overview of disc types in *Syzygium* in Craven & Damas in prep.). The species group including *S. claviflorum* and its immediate allies (in Papuasia these are *S. leptopodium*, *S. subamplexicaule*, *S. suberosum* and perhaps *S. sleumeri*, the seeds of which are unknown) have seeds in which there is an intrusive, ramifying tissue that interlocks the cotyledons. This may be homologous with the intrusive, interlocking tissue that occurs in species of subg. *Acmena* and is of chalazal origin (Biffin et al. 2006, Biffin 2008).

The conservation status of many of the species treated in this revision is Data Deficient according to the criteria of the IUCN Red List (IUCN 2012). Individual assignments of the several criteria are therefore not made to the species. Reference to the distribution maps provides a ready approximation of the likely conservation status of the species and it can be seen that the criterion of Least Concern will apply to species such as *S. attenuatum*, *S. claviflorum* and *S. leptopodium*. Even a species to date known from only a single locality, such as *S. kokomo*, and warranting the criterion Vulnerable due to its limited range, etc., may in reality be of Least Concern if there are no threats

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to its habitat; in the interim, however, all such species should be classed as Data Deficient.

The term 'Papuasia' is applied in the conventional way, i.e., it encompasses the island of New Guinea, the Bismarck Archipelago, the Solomon Islands, the Aru Islands, and the associated smaller islands.

The morphological data for drafting the descriptions and keys were managed using Open DELTA (Anonymous 2013) which is based upon the DELTA package of Dallwitz et al. (1993).

TAXONOMY

Key to Papuasian Syzygium subg. Perikion species based on vegetative and flowering characters.

1. Leaf lamina base cuneate, narrowly cuneate, attenuate, obtuse or sometimes rounded 2
1. Leaf lamina base cordate or truncate . . . . . 9. *S. subamplexicaule*
2. Branchlet bark corky . . . . . 10. *S. suberosum*
2. Branchlet bark not corky 3
3. Hypanthium dull 4
3. Hypanthium glossy . . . . . 7. *S. saundersii*
4. Hypanthium up to 9 mm long 5
4. Hypanthium more than 9.5 mm long 8
5. Reproductive seasonal growth unit with a reproductive zone only (i.e., leaves not present within the growth flush) . . . 6
5. Reproductive seasonal growth unit with distinct vegetative and reproductive zones (i.e., leaves present within the growth flush) . . . . . 1. *S. attenuatum*
6. Calyx lobes 2–4 7
6. Calyx lobes 5 . . . . . 5. *S. kokomo*
7. Leaf lamina up to 3 cm long, elliptic or obovate, apex acute or obtuse . . . . . 3. *S. carrii*
7. Leaf lamina usually more than 4 cm long (rarely as short as 2 cm long), narrowly elliptic, elliptic, narrowly ovate or ovate, apex long or short acuminate or acute . 6. *S. leptopodium*
8. Leaf lamina apex acuminate or acute 9
8. Leaf lamina apex obtuse, rounded or retuse . . . . . 8. *S. sleumeri*
9. Inflorescence branchlet bark granular-papillate; staminal disc flat (Fig. 1: 1.1) . . . . . 4. *S. claviflorum*
9. Inflorescence branchlet bark glandular-verrucose or smooth; staminal disc raised (Fig. 1: 4.2) or flat (Fig. 1: 1.4 to 1.5) 10
10. Leaf lamina chartaceous or coriaceous; staminal disc raised (Fig. 1: 4.2); ovules c. 6–12 per locule 6. *S. leptopodium*
10. Leaf lamina cartilaginous; staminal disc flat (Fig. 1: 1.4 to 1.5); ovules c. 12–22 per locule . . . . . 2. *S. bicolor*

1. *Syzygium attenuatum* (Miq.) Merr. & L.M.Perry — Fig. 1; Map 1

Syzygium attenuatum (Miq.) Merr. & L.M.Perry (1939) 185. — *Jambosa attenuata* Miq. (1855) 437. — Type: *Junghuhn s.n.* (L n.v.), Indonesia, Java, Uangaram.

Tree to 33 m tall, to 90 cm dbh; bark grey, reddish brown, pink, grey and brownish, brown, flaky-fibrous, flaking longitudinally in long fibrous pieces, papery, or smooth. *Vegetative branchlet* terete or angled, 2–4 mm diam; bark dull, very finely cracked, not glandular-verrucose, persistent. *Leaf lamina* 5–12 by 2.6–5.4 cm, 1.4–2.5 times as long as wide, elliptic, narrowly elliptic or oblong; base cuneate; apex acuminate or long acuminate; acumen recurved; margin flat or very slightly revolute; coriaceous; primary and secondary venation generally similar with all or nearly all secondaries joining the intramarginal vein; primary veins 14–34 on each side of the mid-rib, in median part of the lamina at a divergence angle of 60–70° and 1.5–8 mm apart; intramarginal vein present, 0.5–1 mm from margin, secondary intramarginal vein absent. *Petiole* 4–11 mm long. *Reproductive seasonal growth unit* with distinct vegetative and reproductive zones. *Inflorescence* terminal, few- to many-flowered, paniculate, up to 4.2–7.5 by 2.4–5 cm, major axis 0.5–1.3 mm thick at the midpoint, bark glandular-verrucose; bracts caducous; bracteoles subtending each flower or subtending lateral flowers of a triad but with the terminal flower ebracteolate, caducous. *Flowers* pinkish white, calyptrate (petals coherent and falling

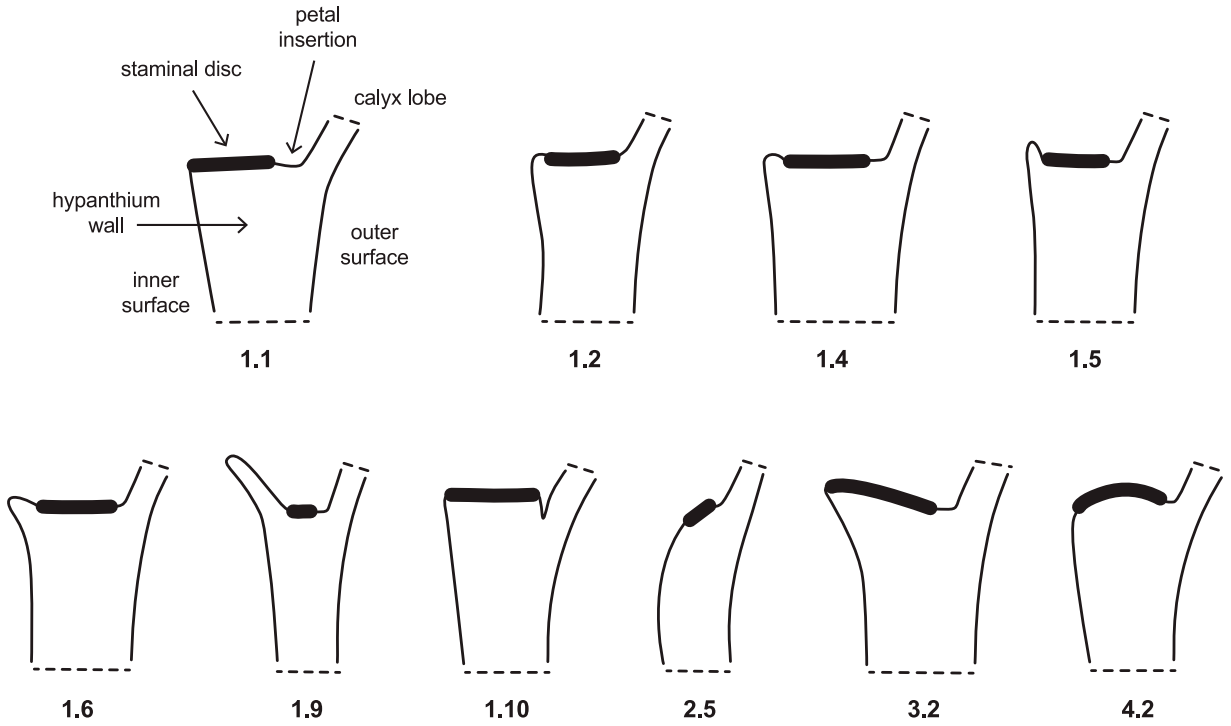
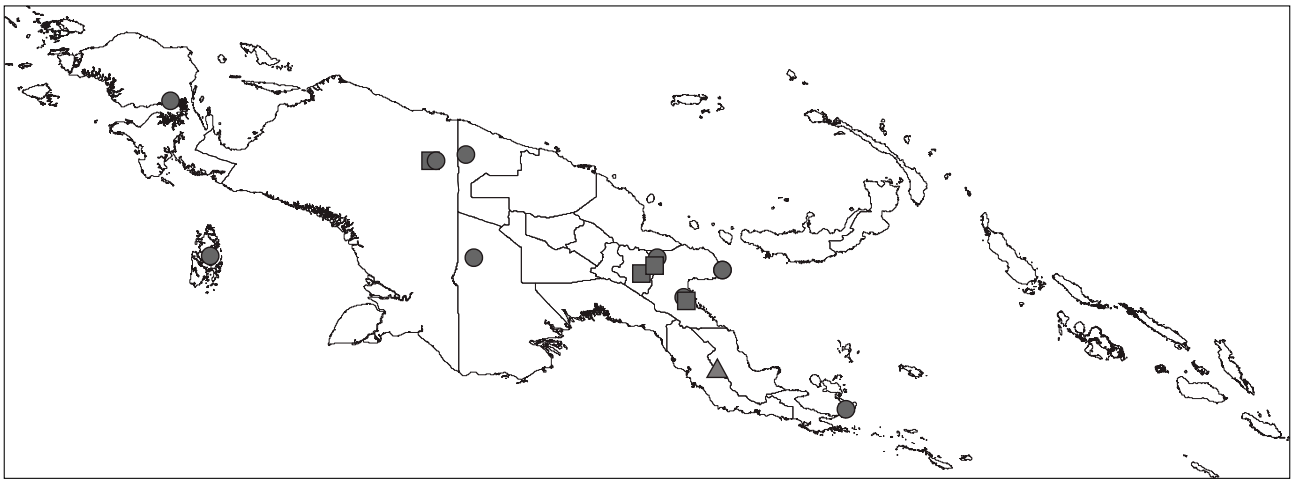


Fig. 1 Diagrams of staminal disc types occurring in *Syzygium* subg. *Perikion* species, showing staminal discs that are flat (1.1–1.10), descending (2.5), ascending (3.2) and raised (4.2). Within the flat staminal disc type, structure may differ in the degree of 'lip' projection at the inner edge of hypanthium apex (1.4, 1.5, 1.6 and 1.9) and the presence of a grooved petal insertion point (1.10).



Map 1 Distribution of *Syzygium attenuatum* (Miq.) Merr. & L.M.Perry (●), *S. bicolor* Merr. & L.M.Perry (■) and *S. carrii* T.G.Hartley & L.M.Perry (▲).

as a cap). *Hypanthium* dull, smooth, visibly gland-dotted or not; angled laterally (i.e., 2-costate) to ribbed; stipitate; elongated goblet-shaped; 6–8.5 by 3–4 mm; stipe 1.5–2.5 mm long. *Calyx lobes* 5, triangular, 0.4 mm long. *Petals* 5, coherent and caducous, 1.2–1.8 mm long. *Staminal disc* descending (Fig. 1: 2.5). *Stamens* c. 80, 2 mm long. *Style* 1.5 mm long. *Placentation* axile-median; placenta narrowly oblong, very slightly prominent, not peltate. *Ovules* c. 16 per locule, pendulous, arranged in two longitudinal rows (one row on each placental lobe). *Mature fruit* white, or cream, or greenish white with apex pinkish, smooth, wrinkled or ribbed, obconic, 8–13 by 5–6.5 mm (excluding the calyx), the hypanthium rim or scar appreciably expanding in fruit; seed not seen.

Distribution — Indonesia (Aru Islands, Papua Barat, Papua), Papua New Guinea.

Habitat & Ecology — Lower montane forest (moderately dry, *Eucalyptopsis* dominant), primary rainforest, *Castanopsis*-dominated lower montane ridge forest, relict tree in cleared montane forest. Altitude 0–1300 m.

Note — Fruit with seeds have not been seen. All studied fruiting collections have been either galled or not seeded (in which case fruit development per se apparently can proceed without seed development).

2. *Syzygium bicolor* Merr. & L.M.Perry — Fig. 1; Map 1

Syzygium bicolor Merr. & L.M.Perry (1942) 286. — Type: *Brass 13018* (holo A n.v.; iso BRI !, LAE !), Indonesia, Papua Province, Idenburg River, 6 km SW of Bernhard Camp, alt. 1200 m, Mar. 1939.

Tree to 30 m tall, to c. 60 cm dbh; bark reddish brown or grey, flaky or slightly rough. *Vegetative branchlet* terete, compressed or quadrangular; rounded, angled or weakly winged, 1–2.5 mm diam; bark dull, smooth to slightly striate; not glandular-verrucose, persistent. *Leaf lamina* 3–6 by 1.3–4 cm, 1.3–2.3 times as long as wide, elliptic to broadly elliptic; base cuneate, obtuse or narrowly cuneate; apex short acuminate, acuminate or acute; acumen flat or recurved; margin flat or revolute; cartilaginous; primary and secondary venation distinctly different with secondaries relatively little developed and not or rarely joining the intramarginal vein; primary veins 5–7 on each side of the mid-rib; in median part of the lamina at a divergence angle of 50–70° and 4–12 mm apart; intramarginal vein present, weakly or strongly arched, 1–4 mm from margin, secondary intramarginal vein present (rarely absent, in large leaves a tertiary intramarginal vein may be evident also). *Petiole* 2.5–5 mm long. *Reproductive seasonal growth unit* with a reproductive zone only. *Inflorescence* terminal, or terminal and distal axillary, few- to many-flowered, paniculate, up to 2–5 by 1–5 cm, major axis 1–1.5 mm thick at the midpoint, bark glandular-verrucose; bracts caducous or deciduous; bracteoles caducous. *Flowers* white, calyptrate (petals coherent and falling as a cap). *Hypanthium* dull, glandular-verrucose or striate (sometimes distinctly glandular-verrucose distally and striate for the remainder), visibly gland-dotted; stipitate; stipitately very narrowly obconic; 10–12 by 3–4 mm; stipe 2–4.5 mm long. *Calyx lobes* 4 or 5, transversely semielliptic or semicircular, 1 mm long. *Petals* 4–6, coherent and caducous, 3–3.5 mm long. *Staminal disc* flat (Fig. 1: 1.4, 1.5). *Stamens* numerous, 6–8.5 mm long. *Style* 6–8.5 mm long. *Placentation* axile-median; placenta oblong, narrowly oblong or narrowly oblong-triangular, the 2 distal lobes appressed, or subobtriangular and proximally rounded with the 2 distal lobes well separated. *Ovules* c. 12–22 per locule, ascending, arranged in two longitudinal rows (one row on each placental lobe). *Fruit* not seen.

Distribution — Indonesia (Papua), Papua New Guinea.

Habitat & Ecology — Rainforest, moist mid-mountain forest. Altitude 1200–1800 m.

Note — Flowers occur in groups of 2, 3, 4 or 6 (rarely singly) on the terminal internodes and often the axis apex is 'knobbly' with two or more insertion points for flowers, perhaps indicating that a reduction in the number of internodes has occurred in the inflorescence. It may be that axis reduction has been a feature of inflorescence evolution in this species.

3. *Syzygium carrii* T.G.Hartley & L.M.Perry — Fig. 1; Map 1

Syzygium carrii T.G.Hartley & L.M.Perry (1973) 209. — Type: *Carr 13511* (holo A n.v.; iso CANB, LAE), Papua New Guinea, Central Province, Boridi, forest, c. 1525 m, 25 Nov. 1935.

Tree to c. 30 m tall. *Vegetative branchlet* quadrangular, winged, 0.7–1 mm diam; bark dull, smooth, slightly glandular-verrucose, persistent. *Leaf lamina* 1.5–2.8 by 0.7–1.7 cm, 1.9–2.1 times as long as wide, elliptic or obovate; base cuneate; apex acute or obtuse; margin revolute; coriaceous; primary and secondary venation distinctly different with secondaries relatively little developed and not or rarely joining the intramarginal vein (few secondary veins are present); primary veins 8–10 on each side of the mid-rib; in median part of the lamina at a divergence angle of 60–70° and 1–3 mm apart; intramarginal vein present, weakly arched, 0.5–1 mm from margin, secondary intramarginal vein absent. *Petiole* 0.7–1 mm long. *Reproductive seasonal growth unit* with a reproductive zone only. *Inflorescence* terminal to median axillary; 1- to few-flowered, racemose or paniculate, up to 1–2 by 0.2–0.7 cm wide, major axis 0.3–0.5 mm thick

at the midpoint; bracts caducous or deciduous; bracteoles subtending each flower; deciduous. *Flowers* possibly calyptrate (petals coherent and probably falling as a cap). *Hypanthium* dull, glandular-verrucose, visibly gland-dotted; stipitate; stipitately very narrowly obconic or elongated goblet-shaped; 8 by 2 mm; stipe 2 mm long. *Calyx lobes* 4; transversely narrowly semielliptic, c. 0.5 mm long. *Placentation* axile-median. *Ovules* c. 10 per locule, pendulous, arranged in two longitudinal rows (one row on each placental lobe). *Staminal disc* and *fruit* not seen (see note).

Distribution — Papua New Guinea.

Habitat & Ecology — Forest. Altitude 1520 m.

Note — This species is known only from one collection in late bud. The buds are not in good condition with some tissue breakdown evident, making observation difficult for determining some characters.

4. *Syzygium claviflorum* (Roxb.) Steud. — Fig. 1; Map 2

Syzygium claviflorum (Roxb.) Steud. (1841) 657. — *Eugenia claviflora* Roxb. (1832) 488. — *Acmenosperma claviflorum* (Roxb.) Kausel (1957) 609. — Type: Icones Roxburghianae no. 2499 (lecto K, selected by Soh & Parnell 2015).

Eugenia leptantha Wight (1841) 14. — *Syzygium leptanthum* Nied. (1893) 85. — *Eugenia leptalea* Craib (1931) 649. — *Eugenia claviflora* Roxb. var. *leptalea* (Craib) M.R.Hend. (1949) 255. — Type: *Griffith* (holo, n.v.), Burma, Mergui.

Tree (sometimes flowering as a treelet) to 28 m tall, to 60 cm dbh; bark brown, dark brown, grey-brown, brownish, light-grey, creamy-grey, mottled grey, light fawn. *Vegetative branchlet* terete or compressed, rounded or angled, 0.8–2.1 mm diam; bark dull, smooth or cracked (occasionally slightly striate), not glandular-verrucose, flaking in relatively large pieces. *Leaf lamina* 5–19.3 by 1.6–6.6 cm, 1.6–3.9 times as long as wide, narrowly elliptic, elliptic, ovate, narrowly ovate, narrowly obovate or obovate; base narrowly cuneate, cuneate, obtuse or attenuate (sometimes approaching rounded); apex long acuminate or acuminate; acumen recurved (or occasionally flat); margin flat (or occasionally slightly revolute, often appears undulate but this may be an artefact of drying); primary and secondary venation distinctly different with secondaries relatively little developed and not or rarely joining the intramarginal vein; primary veins 12–27(–37) on each side of the mid-rib, in median part of the lamina at a divergence angle of 60–70° and 2–10 mm apart; intramarginal vein present, 0.5–3 mm from margin, secondary intramarginal vein present (sometimes difficult to discern). *Petiole* 2–7 mm long. *Reproductive seasonal growth unit* with a reproductive zone only. *Inflorescence* among the leaves or below the leaves and then ramuline or ramine, rarely terminal, 2- to many-flowered, spicate, umbellate or paniculate, up to 1.5–5 by 2–6 cm, major axis 0.3–1.8 mm thick at the midpoint, bark smooth or commonly granular-papillate; bracts deciduous; bracteoles subtending each flower, caducous. *Flowers* white, cream or green, calyptrate or not (petals coherent and falling as a cap or discrete and falling individually). *Hypanthium* dull, visibly gland-dotted, minutely (but distinctly) wrinkled; stipitate; elongated goblet-shaped or extremely narrowly funnel-shaped; 9.8–23 by 1.7–5.6 mm; stipe 6.5–17 mm long. *Calyx lobes* 4 or 5, very depressedly triangular, transversely narrowly semielliptic or transversely oblong, 0.3–0.8 mm long. *Petals* 6–8, coherent and then caducous and falling as a cap or deciduous and then falling individually, 2–3 mm long. *Staminal disc* flat (Fig. 1: 1.1). *Stamens* numerous, 3–8 mm long. *Style* 3–8 mm long. *Placentation* axile-median; placenta distinctly lobed, narrowly semiobovoid to semilinear-obovoid. *Ovules* c. 9–16 per locule, pendulous, arranged in two longitudinal rows (one row on each placental lobe). *Mature fruit* red, ellipsoid or very broadly obovoid and flat at the apex, 12–14 by 9–10 mm (excluding the calyx), the hypanthium rim not appreciably expanding in fruit; seed 3 mm across; cotyledons interlocked by an intrusive weakly ramifying tissue.

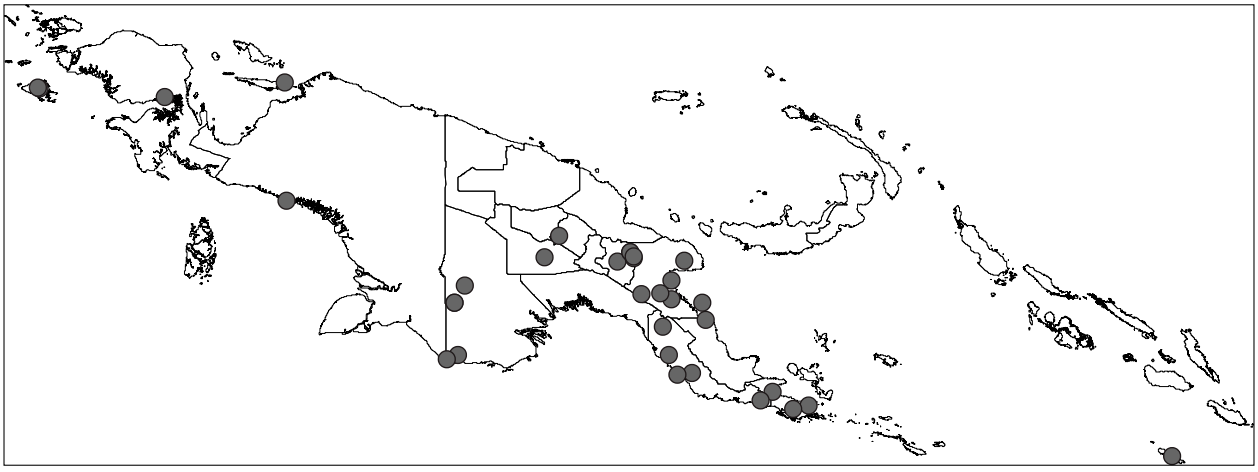
Distribution — Indonesia (Aru Islands, Papua Barat, Papua), Papua New Guinea.

Habitat & Ecology — Oak forest, rainforest, swamp forest, edge of mangroves and riparian forest, riverine forest, lowland hill forest, tall open forest, forest on low stony hills, oak-beech forest. Altitude 0–2750 m.

Notes — A broad circumscription of *S. claviflorum* is taken in the present treatment. The species occurs from India and southern China southwards through Malesia to north-eastern Australia and it merits a detailed study throughout its range. I suspect that several distinct biological entities are included in the present circumscription. One specimen, *Pleyte 1075*, has leaves up to 35 by 11.4 cm wide but its flowers and inflorescences conform to variation within the species. It was recorded as being a shrub of 2 m tall. In Papuasia, flowers are seen to become consistently larger and leaves smaller in specimens from higher altitudes. In addition to being good-sized forest trees, plants may also be treelets or shrubs.

In *S. claviflorum* and the species most closely allied to it (e.g., *S. suberosum*), the hypanthium could be interpreted as being not stipitate (i.e., the hypanthium uniformly tapers from base to apex) but there is a point at which the parenchymatous tissue in the ovarian region stops and a darker-coloured proximal tissue begins. The darker tissue is interpreted as being the stipe.

Syzygium claviflorum is similar to *S. leptopodium* but in general it differs in having larger leaves, a cuneate vs an often ± rounded



Map 2 Distribution of *Syzygium claviflorum* (Roxb.) Steud.

leaf base, subcoriaceous vs chartaceous leaves (in montane material), larger flowers, more flowers per inflorescence, a tendency towards a lateral rather than terminal inflorescence, rounded or compressed branchlets vs ± tetragonous branchlets. These features all more or less break down. Anther size, however, appears to distinguish flowering material, the anthers being about 0.6–0.8 mm long in *S. claviflorum* and 0.2–0.4 mm long in *S. leptopodium*. Also, *S. claviflorum* usually has glandular, ± twisted staminal filaments; those in *S. leptopodium* are eglandular and ± straight.

The style articulates about 1 mm above its base, leaving a stub in mature fruit. Fruit sometimes develops without seeds, and then lacks the characteristic shape of fertile fruit, being narrowly obovoid.

5. *Syzygium kokomo* Craven, *sp. nov*. — Fig. 1; Map 3

From *Syzygium claviflorum* (Roxb.) Steud. it differs in the quadrangular vegetative branchlets; the flat leaf lamina acumen; and the stipitately very narrowly obconic hypanthium with a stipe 6–7.5 mm long. (In *S. claviflorum* the vegetative branchlets are terete or compressed, the leaf lamina acumen is recurved, and the hypanthium is funnel-shaped or elongated goblet-shaped with a stipe 6.5–17 mm long.) — Type: *Henty & Foreman NGF 42673* (holo L !; iso A !, BISH, BO, BRI, CANB, K, LAE, NSW, SING, all n.v.), Papua New Guinea, West Sepik (Sandaun) Province, Telefomin Subprovince, Kokomo Creek (a tributary of Frieda River), ridge forest, alt. c. 670 m, 28 June 1969.

Etymology. The specific epithet is a noun in apposition derived from the locality Kokomo Creek.

Tree to 27 m tall, to 25 cm dbh; bark dark brown outside, red brown inside. *Vegetative branchlet* quadrangular initially but at length terete, winged or angled, 0.8–1.4 mm diam; bark dull, smooth or cracked (cracking is fine and longitudinal), not glandular-verrucose, persistent or peeling in relatively thin strips. *Leaf lamina* 3.5–5 by 1.3–1.8 cm, 2.5–3.9 times as long as wide, narrowly ovate or ovate; base cuneate or narrowly cuneate; apex long acuminate, acumen flat and up to 1.5 cm long; margin flat; thickly coriaceous, approaching cartilaginous; primary and secondary venation distinctly different with secondaries relatively little developed and not or rarely joining the intramarginal vein (in some cases not even the primary veins reach the intramarginal vein); primary veins 3–6 on each side of the mid-rib, in median part of the lamina at a divergence angle of 40–60° and 3–6 mm apart; intramarginal vein present, weakly arched, 0.8–1 mm from leaf margin, secondary intramarginal vein present or absent. *Petiole* 3.5–5 mm long. *Reproductive seasonal growth unit* with a reproductive zone only. *Inflorescence* terminal, or distal or median axillary, few- to many-flowered, paniculate up to 1–3.5 by 1–2.5 cm, major axis 0.5–0.7 mm thick at the midpoint, bark glandular-verrucose; bracts deciduous; bracteoles apparently subtending each flower, deciduous (rarely a few persisting). *Flowers* (immature) with free calyx lobes. *Hypanthium* dull, smooth; stipitate; stipitately very narrowly obconic; 6–7.5 by 2 mm. *Calyx lobes* 5. *Petals* probably 5. *Staminal disc*, *stamens* and *fruit* not seen (see note).

Distribution — Papua New Guinea.

Habitat & Ecology — Ridge forest. Altitude 670 m.

Notes — This species is known from a single collection only, this being in the bud stage.

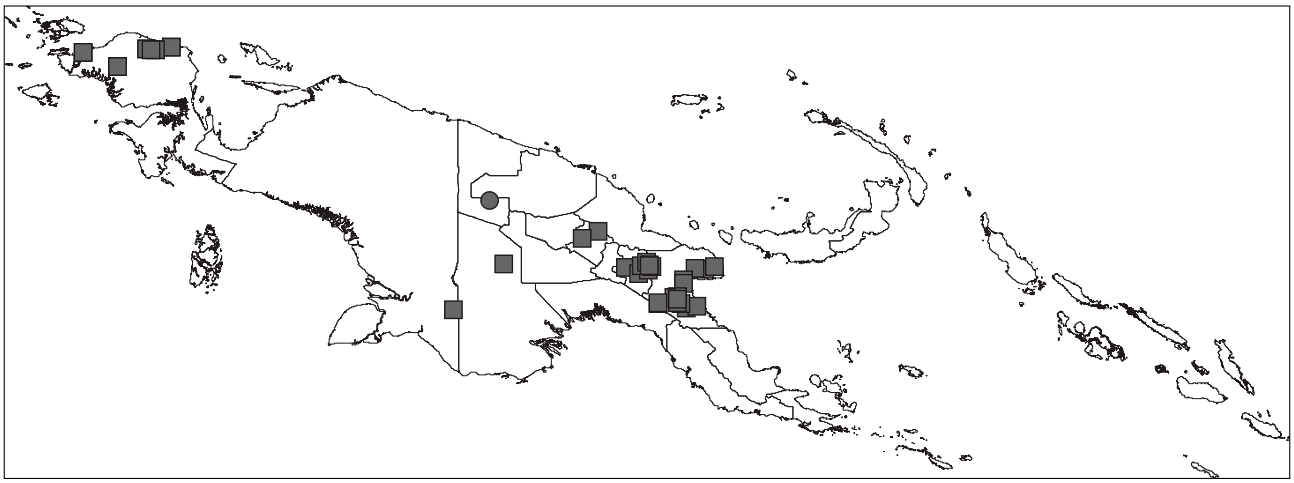
The inflorescence is a simple paniculate structure, often with 2 pairs of lateral branches and then a terminal cluster of flowers at the apex of the final internode of the main axis. Flowers may terminate axes in groups of 3 or 7 (the latter presumably being 2 triads and 1 monad). Occasionally, perhaps through abortion, monads or dyads occur. There can be up to 7 inflorescences at the apex of a vegetative seasonal growth unit.

The figure of 6–7.5 mm given above for the hypanthium length is the total length of the buds at what is possibly the mid-bud stage.

6. *Syzygium leptopodium* Merr. & L.M.Perry — Fig. 1; Map 3

Syzygium leptopodium Merr. & L.M.Perry (1942) 284. — Type: *Clemens 5326* (holo A n.v.; iso L !), Papua New Guinea, Morobe Province, Ogeramnang, forest, c. 1770–1830 m, 8 Feb. 1937.

Treelet, shrub or tree, usually to 8 m tall (once recorded as being c. 27 m tall), to 8 cm dbh. *Vegetative branchlet* terete, compressed or quadrangular, rounded or winged (if present, wings are narrow), 0.8–1.5 mm diam; bark dull, bark smooth or cracked (cracking is fine and approaching striate), not or only slightly glandular-verrucose, persistent or peeling in relatively thin strips. *Leaf lamina* (2–)4–7(–8.5) by (1.2–)1.7–2.4(–4) cm, 2–3.2 times as long as wide, narrowly elliptic, elliptic, narrowly ovate or ovate; base narrowly cuneate, cuneate, obtuse or occasionally rounded; apex long or short acuminate or acute (rarely abruptly acuminate); acumen flat; margin flat or slightly; chartaceous or coriaceous; primary and secondary venation distinctly different with secondaries relatively little developed and not or rarely joining the intramarginal vein; primary veins 6–17 on each side of the mid-rib, in median part of the lamina at a divergence angle of 50–90°, (1–)2–3(–5) mm apart; intramarginal vein present, weakly or strongly arched, (0.3–)0.5–1(–2) mm from margin; secondary intramarginal vein often present at the margin but not strongly developed. *Petiole* 0.5–4 mm long. *Reproductive seasonal growth unit* with a reproductive zone



Map 3 Distribution of *Syzygium kokomo* Craven (●) and *S. leptopodium* Merr. & L.M.Perry (■).

only. *Inflorescence* terminal, distal or median axillary, or lateral below the leaves (ramuline or ramine), 1- or 2- to few-flowered, paniculate or racemose up to 1.2–3.5 by 0.2–3 cm, major axis 0.4–0.6 mm thick at the midpoint; bark glandular-verrucose or smooth; bracts deciduous or caducous; bracteoles sometimes present but apparently not in all flowers, caducous (rarely a few persisting to anthesis). *Flowers* white, cream or mauve (once described as whitish lilac), calyptrate (petals coherent and falling as a cap). *Hypanthium* dull, glandular-verrucose, visibly gland-dotted, plane or weakly ribbed; stipitate; elongated goblet-shaped, very elongatedly stipitate-bowl-shaped, or thickly narrowly obconic (occasionally very narrowly obconic); 7.5–14.5 by 2–3 mm wide; stipe 1–3 mm long. *Calyx lobes* 2–4, depressedly triangular, very depressedly triangular, oblong or triangular, (0.2–)0.3–0.5(–0.7) mm long. *Petals* c. 4–7; coherent and caducous, c. 1.5–2.3 mm long. *Staminal disc* raised (Fig. 1: 4.2). *Stamens* numerous, 1.75–7 mm long. *Style* 4–7 mm long. *Placentation* axile-median; placenta more or less flattened, narrowly obovoid. *Ovules* c. 6–12 per locule, pendulous, arranged in two longitudinal rows (one row on each placental lobe). *Mature fruit* wine red, orange red, dark or red, magenta, maroon or purplish black, glandular-verrucose, plane or weakly ribbed, subpyriform or ellipsoid, 10–12 by 6–9 mm (excluding the calyx), the hypanthium rim not appreciably expanding in fruit; seed a spheroid or broadly obovoid and deeply impressed at the apex, 5.5–6 mm across; cotyledons interlocked by an intrusive weakly ramifying tissue, collateral or superposed.

Distribution — Indonesia (Papua Barat, Papua); Papua New Guinea.

Habitat & Ecology — Mossy mid-montane forest, montane rainforest with *Castanopsis*, oak forest, mixed degraded rainforest, forest remnant in river gorge, secondary forest, lower montane rainforest, *Nothofagus* forest, mossy fagaceous forest, primary forest, edge of *Barringtonia-Leptospermum* swamp, rocky open situation. Altitude 50–2200 m.

Notes — See under *S. claviflorum* for notes on differences between that species and *S. leptopodium*.

The basic floral units within the inflorescence are monads and triads. Sometimes an inflorescence consists of a single monad, or an axis with 2 proximal monads on short axes then 2 sessile monads with a terminal triad or 5-flowered cluster. Often it consists of an axis with 2 sterile monads and the terminal 3- or 5-flowered unit, or it may be a sessile 3- or 5-flowered unit without any peduncle.

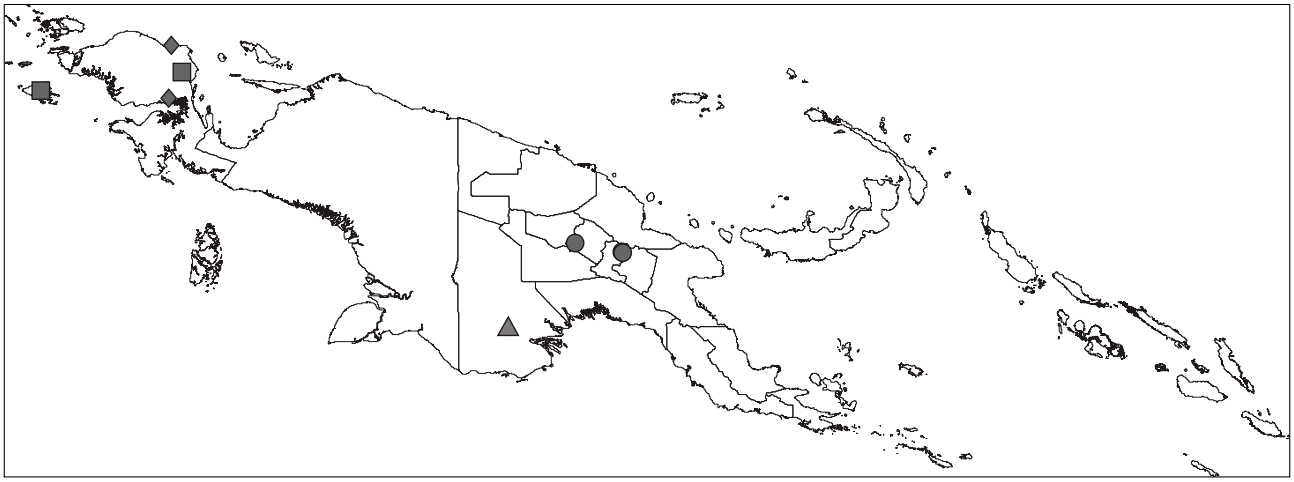
Flowers with only 2 calyx lobes were observed in *Van Royen 4945*.

7. *Syzygium saundersii* Craven, *sp. nov.* — Fig. 1; Map 4

From *Syzygium claviflorum* (Roxb.) Steud. it differs in the obtuse, rounded or truncate leaf lamina apex; the glossy, non-stipitate and 8–10 mm long hypanthium; the 7–11 mm long stamens; the 5–5.5 mm long style; and the c. 10 ovules per locule. (In *S. claviflorum* the leaf lamina apex is long acuminate or acuminate, the hypanthium is dull, stipitate and 9.8–23 mm long, the stamens are 3–8 mm long, and there are 9–16 ovules per locule.) — Type: *Saunders 663* (holo CANB !; iso A, BISH, BM, BO, BRI, G, K, L, LAE, MEL, US, all n.v.), Papua New Guinea, Western Highlands Province, c. 800 m S of Tomba, forest, alt. c. 2440 m, 2 July 1957.

Etymology. The species is named in honour of John Campbell Saunders (1930–2001), forest botanist in the CSIRO Division of Land Research & Regional Survey's New Guinea survey team and its successors from 1954 to 1995. John's herbarium collections are sometimes scanty as they were collected as vouchers for his many wood samples; the type of the present species is a notable exception. He encouraged CSIRO herbarium collectors such as R.D. Hoogland, R. Pullen, R. Schodde and LAC to also collect wood samples and is directly responsible for the significant CSIRO contribution to Papua New Guinean wood samples, deposited primarily in FPAw and PMPw.

Tree to 26 m tall (bole to 15 m), to 45 cm dbh; bark grey. *Vegetative branchlet* quadrangular to compressed, angled to slightly winged, 2–6 mm diam; bark dull, smooth, not glandular-verrucose, persistent. *Leaf lamina* 4.5–13 by 2.7–8 cm, 1.3–1.7 times as long as wide, broadly obovate, obovate or broadly elliptic; base attenuate or cuneate; apex truncate, rounded or obtuse; margin revolute; cartilaginous; primary and secondary venation distinctly different with secondaries relatively little developed and not or rarely joining the intramarginal vein (secondary veins are few); primary veins 10–16 on each side of the mid-rib, in median part of the lamina at a divergence angle of 65–75°, 3–10 mm apart; intramarginal vein present, weakly arched, 1.5–3 mm from margin, secondary intramarginal vein absent. *Petiole* 12–27 mm long. *Reproductive seasonal growth unit* with distinct vegetative and reproductive zones, or with a reproductive zone only (the vegetative zone is weakly developed and consists at most of a few pairs of leaves (that often are reduced in size). *Inflorescence* terminal or distal axillary, few- to many-flowered, paniculate, up to 3.5–12 by 2.5–9 cm, major axis 2–3 mm thick at the midpoint; bark smooth; bracts deciduous; bracteoles subtending each flower, caducous. *Flowers* calyptrate (petals coherent and falling as a cap). *Hypanthium* glossy, smooth (*in sicco* strongly wrinkled but this presumably is an artefact of drying), visibly but not strongly gland-dotted; not stipitate (tapering evenly to the base or truncate or rounded); thickly narrowly obconic; 8–10 by 3.5–4.5 mm. *Calyx lobes* 4, transversely semielliptic or semielliptic, 1–2 mm long. *Petals* 4; caducous (falling at anthesis); coherent (outer petal apparently falls separately but inner 3 seemingly fall as a unit), 5.5 mm long. *Staminal disc* flat (Fig. 1: 1.9). *Stamens* c. 55, 7–11 mm



Map 4 Distribution of *Syzygium saundersii* Craven (●), *S. sleumeri* Craven (■), *S. subamplexicaule* Merr. & L.M.Perry (▲) and *S. suberosum* Craven (♦).

long. *Style* 5–5.5 mm long. *Placentation* axile-median; placenta apparently more or less oblong and not very prominent. *Ovules* c. 10 per locule, ascending, arranged in two longitudinal rows (one row on each placental lobe) or possibly arranged irregularly. *Fruit* not seen.

Distribution — Papua New Guinea.

Habitat & Ecology — Forest, mountain forest on steep slope, mixed montane forest. Altitude 2440–2600 m.

Note — The relationships of this species may lie with *S. bicolor*.

8. *Syzygium sleumeri* Craven, *sp. nov.* — Fig. 1; Map 4

From *Syzygium claviflorum* (Roxb.) Steud. it differs in the winged branchlets; the obtuse, rounded or retuse leaf lamina apex; the glandular-verrucose, ribbed, and 10 mm long hypanthium; the 6–9 mm long stamens; and 8–10 ovules per locule. (In *S. claviflorum* the branchlets are rounded or angled; the leaf lamina apex is long acuminate or acuminate; the hypanthium is minutely wrinkled and generally plane, and 9.8–23 mm long; the stamens are minutely wrinkled, generally plane, and 3–8 mm long; and there are 9–16 ovules per locule.) — Type: *Sleumer & Vink BW 14247* (holo CANB !; iso L n.v., MAN n.v.), Indonesia, Papua Barat, Mt Gwamongga, Anggi Gigi Lake, fire-vegetation of *Ericaceae* and *Baeckea* on clay, alt. 2250 m, 21 Jan. 1962.

Etymology. The species is named in honour of Hermann Otto Sleumer (1906–1993), a prolific author on the taxonomy of several plant families and an expert in *Ericaceae* in particular.

Shrub to 2 m tall. *Vegetative branchlet* quadrangular, winged, 0.6–1.3 mm diam; bark dull-glossy, smooth, not glandular-verrucose, persistent. *Leaf lamina* 1.5–3.5 by 0.7–1.6 cm, 1.6–2.4 times as long as wide, elliptic, narrowly elliptic, broadly elliptic or obovate; base cuneate or narrowly cuneate; apex obtuse, rounded or occasionally retuse; margin flat to revolute; cartilaginous; primary and secondary venation obscure; primary veins 5–8 on each side of the mid-rib, in median part of the lamina at a divergence angle of c. 60°, 1–3 mm apart; intramarginal vein present (often obscure), weakly arched, 0.2–0.5 mm from margin. *Petiole* 0.5–0.7 mm long. *Reproductive seasonal growth unit* with a reproductive zone only. *Inflorescence* leafless, terminal or distal axillary (sometimes terminal and distal axillary), 1- to few-flowered, racemose, up to 1–3 by 1.5–2 cm, major axis 0.4–0.5 mm thick at the midpoint; bark glandular-verrucose; bracts caducous or deciduous, bracteoles subtending each flower; deciduous. *Flowers* white (noted as calyx lobes red, petals and filaments white), calyptrate (petals coherent and falling as a cap). *Hypanthium* dull, glandular-verrucose, visibly gland-dotted, weakly ribbed; stipitate; generally elongated goblet-shaped (at the apex curved slightly), 10 by 3–3.3 mm wide; stipe 2.5–3 mm long. *Calyx lobes* 4; transversely narrowly semielliptic, 0.5 mm long. *Petals* 7, coherent and caducous, 2.3 mm long. *Staminal disc* flat (intermediate between Fig. 1: 1.2, 1.6). *Stamens* c. 75, 6–9 mm long. *Style* 8.5 mm long. *Placentation* axile-median; placenta is an obscure, flattened and narrowly obovate structure (bilobed in the distal part). *Ovules* c. 8–10 per locule, pendulous, arranged in two longitudinal rows (one row on each placental lobe). *Fruit* not seen.

Distribution — Indonesia (Papua).

Habitat & Ecology — Fire-vegetation of *Ericaceae* and *Baeckea*, steppe. Altitude 50–2250 m.

Additional specimen examined. Indonesia, Papua, Misool, Sorong, between Fakal and Tip, *Pleyte 897*.

Note — The shrub habit is characteristic, if not diagnostic. The inflorescence is a racemose structure, 1- to c. 6-flowered, terminal and/or distal axillary. The flowers are in monads or triads, or sometimes clustered in 4's and then always at the apex of the inflorescence.

9. *Syzygium subamplexicaule* Merr. & L.M.Perry — Fig. 1; Map 4

Syzygium subamplexicaule Merr. & L.M.Perry (1942) 285. — Type: *Brass 8218* (holo A n.v.; iso BRI !), Papua New Guinea, Western (Fly River) Province, Lower Fly River, E bank opposite Sturt Island, Oct. 1936.

Treelet to 2.5 m tall. *Vegetative branchlet* terete, rounded, 2.5 mm diam; bark dull-glossy, smooth, not glandular-verrucose, persistent. *Leaf lamina* 22–27 by 5–9 cm wide, 3.5 times as long as wide, narrowly ovate to narrowly oblong-ovate; base cordate or truncate; apex acuminate; margin flat; coriaceous (chartaceous fide M&P), primary and secondary venation distinctly different with secondaries relatively little developed and not or rarely joining the intramarginal vein; primary veins 22–25 on each side of the mid-rib, in median part of the lamina at a divergence angle of 70–80°, 8–20 mm apart; intramarginal vein present, weakly arched, 2.5–4 mm from margin, secondary intramarginal vein absent. *Petiole* 1.5–3 mm long. *Reproductive seasonal growth unit* with a reproductive zone only. *Inflorescence* terminal, 2- to few-flowered, paniculate, up to c. 2 cm long, major axis 1 mm thick at the midpoint, bark smooth; bracts deciduous to persistent; bracteoles absent from each flower in the unit. *Hypanthium* dull, glandular-verrucose, visibly gland-dotted, ribbed; stipitate. *Calyx lobes* 4, triangular, 0.75–1 mm long. *Staminal disc* ascending (Fig. 1: 3.2). *Stamens* 4–6 mm long (fide M&P). *Mature fruit* pink, glandular-verrucose, ribbed, stipitately narrowly ellipsoid, 14–17 by 6–7.5 mm wide (excluding the calyx), the hypanthium rim not appreciably expanding in fruit; seed narrowly ellipsoid-obovoid and deeply impressed at the apex, 3–5 mm across; cotyledons interlocked by an intrusive weakly ramifying tissue, collateral.

Distribution — Papua New Guinea.

Habitat & Ecology — Rainforest. Altitude 10 m.

Note — The BRI sheet of the type collection is the only material seen. Flowers have not been seen and the data presented here includes information in Merrill & Perry's (1942) description. The species is closely related to *S. claviflorum*.

10. *Syzygium suberosum* Craven, *sp. nov.* — Fig. 1; Map 4

From *Syzygium claviflorum* (Roxb.) Steud. it differs in the often corky branchlets; the persistent calyx lobes; and the strongly ramifying chalazal tissue in the embryo. (In *S. claviflorum* the branchlets are always smooth; the calyx lobes are deciduous; and the chalazal tissue in the embryo is weakly ramifying.) — Type: *Van der Sijde BW 5565* (holo CANB !; iso L n.v., MAN n.v.), Indonesia, Papua Barat, Sidei (c. 50 km W of Manokwari), primary forest, alt. 50 m, 28 Mar. 1958.

Etymology. The specific epithet is derived from the Latin *suber*, cork, in reference to the corky branchlet bark.

Shrub, treelet or tree; to 7 m tall; bark grey, fissured and flaking. *Vegetative branchlet* terete or quadrangular, rounded, or winged, 1.5–5 mm diam; bark dull, smooth and corky, not glandular-verrucose, persistent. *Leaf lamina* 8.5–19 by 2.5–7.4 cm, 2.6–4 times as long as wide, narrowly elliptic or elliptic; base cuneate, obtuse, narrowly cuneate or attenuate; apex long acuminate or acuminate; acumen flat or recurved; margin flat; chartaceous to coriaceous; primary and secondary venation distinctly different with secondaries relatively little developed and not or rarely joining the intramarginal vein; primary veins 10–17 on each side of the mid-rib, in median part of the lamina at a divergence angle of 60–70°, 4–17 mm apart; intramarginal vein present, weakly arched, 1.5–8 mm from margin, secondary intramarginal vein present or absent. *Petiole* 3–5 mm long. *Reproductive seasonal growth unit* with a reproductive zone only. *Inflorescence* leafless, median axillary or lateral (ramuline), 1- to few-flowered, cymose, up to 2 by 0.5–2.5 cm wide (0.5 cm when 1-flowered), major axis 1 mm thick at the midpoint, bark smooth; bracts persistent; bracteoles subtend-

ing each flower, persistent to deciduous. *Flowers* white, calyptrate (petals coherent and falling as a cap). *Hypanthium* dull, glandular-verrucose to smooth, visibly gland-dotted; stipitate; stipitately very narrowly obconic, or elongated-goblet-shaped to very narrowly elongated-goblet-shaped, 18–21 by 2.5–3 mm wide; stipe 6–8 mm long. *Calyx lobes* 5 (often irregular in size and sometimes nearly obsolete), transversely semielliptic or transversely narrowly semielliptic, 0.3–1 mm long, persistent. *Petals* c. 8, coherent and caducous, up to 2 mm long. *Staminal disc* flat (Fig. 1: 1.10). *Stamens* numerous, 9–10 mm long. *Style* c. 10.5 mm long. *Placentation* axile-median; placenta more or less linear and flattened. *Ovules* c. 10 per locule, pendulous, arranged in two longitudinal rows (one row on each placental lobe). *Fruit* red, yellow or orange (probably mature (but galled) fruit recorded as red, youngish fruit recorded as yellow-orange), glandular-verrucose, finely ribbed, very narrowly obconic or very narrowly pyriform, 20–28 mm by 5 mm wide (excluding the calyx), the hypanthium rim not appreciably expanding in fruit; seed narrowly obovoid and deeply impressed at the apex, 3 mm across; cotyledons interlocked by an intrusive strongly ramifying tissue, collateral.

Distribution — Indonesia (Papua Barat).

Habitat & Ecology — Oak-dominated primary forest, primary forest. Altitude 5–50 m.

Note — The inflorescence is a short, cymose structure consisting of monads and/or triads. The smallest inflorescence seen consisted of a single monad, and the largest comprised two lateral monads and a terminal triad. The shape of the staminal disc is very distinctive.

Acknowledgments Studies of Papuasian *Syzygium* at CANB were commenced by Tom Hartley and LAC in the 1970s. It is a matter of regret they could not be pursued to fruition at that time; two papers only being produced. Tom's enthusiasm for the genus and his excellent field knowledge then assisted the project considerably in refining species concepts; these have been further refined in recent years by LAC as the work has progressed. Cath Busby obtained geocode data for those collections for which the data was not recorded on labels. Nunzio Knerr generated the distribution maps ready for final editing. Siobhan Duffy, in good humour, printed numerous digital images of type specimens for study, prepared the staminal disc diagrams from LAC's crude drawings, and prepared the final versions of the distribution maps. The curators and/or directors of the following herbaria have made available specimens and/or images that have been used in my ongoing studies of Papuasian *Syzygium* and I sincerely thank them for this assistance: A, B, BISH, BM, BO, BRI, CANB, E, K, L, LAE, LY, MEL, NY, P, WRSL. The facilitation of loans, provision of digital images, and/or examination of specimens have been of great benefit to the research on *Syzygium*. Those who have assisted me variously in the foregoing and other matters include, in no particular sequence, Emily Wood, Melinda Peters, Wayne Takeuchi, Eve Lucas, Ana Claudia Araujo, Shelley James, Frédéric Danet, Gaëtan Guignard, Mélanie Thiébaut, Jan-Frits Veldkamp, Wim Vink, Gerard Thijsse, Nicolien Sol, Kirsten Cowley, Thomas Zanoni, Rusty Russell, Anton Igersheim, Adele Smith.

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