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Pyramidanthe and Mitrella (Annonaceae, Uvarieae) unified: molecular phylogenetic and morphological congruence, with new combinations in Pyramidanthe

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Abstract: The delimitation of the genera Pyramidanthe and Mitrella in the tribe Uvarieae of the family Annonaceae is assessed by molecular phylogenetic analyses and morphological re-evaluation. Using up to six plastid DNA regions (matK, ndhF, rbcL exons; trnL intron; psbA-trnH, trnL-trnF; intergenic spacers) and including, among others, two accessions of Pyramidanthe and five accessions of Mitrella, the resulting phylogeny shows that Pyramidanthe and Mitrella are recovered in a clade sister to the Fissistigma clade. The Pyramidanthe-Mitrella clade is composed of a trichotomy: a clade consisting of Pyramidanthe accessions and two clades containing Mitrella accessions. In combination with negligible morphological distinctions between the two genera, they are consequently merged, with 11 new combinations under the chosen name Pyramidanthe: P. beccarii, P. clementis, P. cylindrica, P. dielsii, P. elegans, P. kentii, P. ledermannii, P. mabiformis, P. schlechteri, P. sylvatica and P. tiwiensis. The names M. dielsii (the basionym of P. dielsii) and P. rufa (a heterotypic synonym of P. prismatica) are lectotypified. Pyramidanthe s. lat. possesses the following diagnostic traits: usually indistinct secondary leaf veins with a brochidodromous to brochidodromous-eucamptodromous venation, a reticulate tertiary leaf venation, axillary inflorescences, presence of a basal excavation on an inner side of each outer petal, and inner petals that are much smaller than the outer petals and cohering marginally at anthesis.

Keywords: Annonaceae, Annonoideae, Mitrella, nomenclatural combinations, plastid phylogeny, Pyramidanthe, taxonomy, typification, Uvarieae

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Introduction

Annonaceae, a pantropical angiosperm family prominent in lowland rain forests, are the largest family in the order Magnoliales (Doyle & al. 2004), with five subfamilies, 18 tribes, 108 genera and c. 2430 species (Chatrou & al. 2018; Couvreur & al. 2019; Chaowasku 2020; Damthongdee & al. 2021; Photikwan & al. 2021). The generic delimitation in various clades of Annonaceae has been intensely realigned in the past two decades based on molecular phylogenetic analyses; for example, the tribes Canangae (Ambavioideae; Surveswaran & al. 2010), Miliuseae (Malmoideae; e.g. Xue & al. 2011, 2012, 2014, 2018; Chaowasku & al. 2012, 2013, 2015, 2018b; Guo & al. 2014) and Uvarieae (Annonoideae; Zhou & al. 2009, 2010; Guo & al. 2017a). Additionally, molecular phylogenetics also assisted the establishment of new genera (Mols & al. 2008; Couvreur & al. 2009, 2015; Chaowasku & al. 2018a). Nevertheless, there are still some genera that lack adequate phylogenetic data for assessing their delimitation. This can be well exemplified in the Pyramidanthe-Mitrella clade. Pyramidanthe Miq. is a monotypic genus distributed in S Thailand, Peninsular Malaysia, Singapore, Sumatra and Borneo, whereas Mitrella Miq. is a small genus consisting of nine species distributed in S Thailand, Peninsular Malaysia, Singapore, Java, Borneo, New Guinea and the Australian Tiwi Islands (Turner 2018; Johnson & al. 2021). The phylogenetic relationships hitherto reported indicate that these two genera constitute a strongly supported clade sister to Fissistigma Griff., but only one species of Mitrella was included; the three genera form a strongly supported
clade within the tribe Uvarieae of the subfamily Annonoideae (Guo & al. 2017a, 2017b). It is worthwhile noting that most members of Uvarieae are lianas (Chatrou & al. 2012), including the only species of Pyramidanthinae and nine of Mitrella (Turner 2012).

Morphologically, the genera Pyramidanthinae and Mitrella are quite similar; they possess, for example, leaf blades with a reticulate tertiary venation, a basal excavation on an inner side of each outer petal, and inner petals that are much smaller than the outer petals (Turner 2012). As presented in the key in Turner (2012), the two genera differ from each other only in the sepal appearance, and this weak differentiation prompted him to reluctantly consider Pyramidanthinae and Mitrella as distinct from each other. In this study, we reassess the generic delimitation of Pyramidanthinae and Mitrella by molecular phylogenetic inferences (with additions of one new accession of Pyramidanthinae, five new accessions of Mitrella and six new accessions of the closely related Fissistigma) and morphological reappraisal.

Material and methods

Molecular phylogenetic analyses

Thirty-three accessions constituted the ingroup, covering all accepted genera of Uvarieae, including two accessions of Pyramidanthinae and five accessions of Mitrella. The tribe Uvarieae has been demonstrated to form a strongly supported clade (e.g. Guo & al. 2017b). Outgroups were an accession of Xylopieae [Artabotrys hexapetalus (L. f.) Bhandari] and an accession of Monodoreae [Isolona campanulata Engl. & Diels]. The information of voucher specimens and GenBank accession numbers used in this study is shown in Appendix 1. Up to six plastome regions (psbA-trnH, trnL-trnF intergenic spacers; trnL intron; matK, ndhF, rbcL exons) were included. Regarding the DNA extraction, amplification and sequencing used in the present study, their methods, including primer information, followed Chaowasku & al. (2018a, 2018b, 2020). Sequences were edited using the Staden package (Staden & al. 2000) and the data matrix was aligned by Multiple Alignment using Fast Fourier Transform (MAFFT; Katoh & al. 2002) via an online platform (Katoh & al. 2019), with default settings. The aligned data matrix was subsequently manually checked and realigned where necessary using the similarity criterion (Simmons 2004). In some accessions, an inversion and realignment were simultaneously carried out; each run was set for 10 million generations. The default prior settings were

In the maximum likelihood analysis, the model “JC2+FQ+ASC” was chosen by corrected AIC scores for the binary indel partition. Clade support was measured by a non-parametric bootstrap resampling (BS; Felsenstein 1985) with 2000 replicates. A clade with BS ≥ 85%, 70–84% or 50–69% was considered strongly, moderately or weakly supported, respectively. In the Bayesian analysis, the “coding=variable” command was assigned to the binary indel partition, which was implemented under a simple F81-like model without a gamma distribution for among-site rate variation. Four independent runs, each using four MCMC chains, were simultaneously carried out; each run was set for 10 million generations. The default prior settings were used except for the prior parameter of rate multiplier (“ratepr” [=variable]). The temperature parameter was set to 0.08. Trees and all parameter values were sampled every 1000th generation. Convergence was evaluated by checking the standard deviation of split frequencies of
the runs with values < 0.01 interpreted as indicative of a good convergence and by checking for adequate effective sample sizes (ESS > 200) using Tracer version 1.6 (Rambaut & al. 2013). The first 25% of all trees sampled were removed as burn-in and the 50% majority-rule consensus tree was generated from the remaining trees. A clade with posterior probabilities (PP) ≥ 0.95, 0.9–0.94 or 0.5–0.89 was considered strongly supported, weakly supported or unsupported, respectively.

**Morphology**

Morphological data were derived from literature (Sinclair 1955, 1956; van Heusden 1992; van Setten & Koek-Noorman 1992; Turner 2012), as well as observations on type specimens of relevant names, voucher specimens for molecular phylogenetic analyses listed in Appendix 1, a specimen of Fissistigma unicum (Dunn) Merr. [Tutch. 494 (K)] and additional specimens of Mitrella kentii (Blume) Miq. [Anon. s.n. (L [L.1757631]); Anon. s.n. (U [U.1073759]); Janse 1697 (L)].

**Results and Discussion**

The parsimony analysis resulted in 36 most parsimonious trees with 1256 steps. The consistency and retention indices (CI and RI) were 0.8 and 0.87, respectively. There was no strong topological conflict (SR ≥ 85%) among the analyses of each plastome region. Fig. 1 shows the Bayesian 50% majority-rule consensus phylogram, with support values from the other two methods of phylogenetic analysis indicated. The ingroup (Uvarieae) was recovered with maximum support. In Uvarieae, there was a strongly supported (SR 99%, BS 100%, PP 1) clade composed of a strongly supported (SR 99%, BS 100%, PP 1) Fissistigma clade and a maximally supported Pyramidanthinae-Mitrella clade. In the latter clade, there was a trichotomy consisting of (1) a strongly supported (SR 98%, BS 100%, PP 1) clade comprising P. prismaticata (Hook. f. & Thomson) Merr. and P. sp., (2) a strongly supported (SR 99%, BS 100%, PP 1) clade consisting of M. clementis (Merr.) I. M. Turner and M. elegans (Hook. f. & Thomson) D. M. Johnson & N. A. Murray and (3) a strongly supported clade (SR 97%, BS 97%, PP 1) composed of M. cf. beccarii (Scheff.) Diels, M. sp. 1 and M. sp. 2., with the last two accesses forming a strongly supported (SR 96%, BS 100%, PP 1) clade.

Similar to the previously reported phylogenetic hypotheses (Guo & al. 2017a, 2017b), the relationships in the tribe Uvarieae herein depicted (Fig. 1) are still considerably unresolved, especially in the uncertain position of Dielsiothamnus R. E. Fr. and Uvaria L. In the maximally supported Pyramidanthinae-Mitrella clade (Fig. 1), the relationships of the three strongly supported major clades (one of which contains Pyramidanthinae accessions, whereas the other two consist of Mitrella accessions) are unresolved. However, when more data become available, especially from next-generation sequencing approaches, the monophyly of Mitrella could be demonstrated. The two genetically close genera, Pyramidanthinae and Mitrella, are morphologically alike, i.e. they share usually indistinct secondary leaf veins with a brochidodromous to brochidodromous-eucamptodromous venation, a reticulate tertiary leaf venation, axillary inflorescences, adaxially basally excavated outer petals (Fig. 2B [left], D [left]), and inner petals that are much smaller than the outer petals (Fig. 2B, D, Fig. 3A, C) and marginally adjoining at anthesis (Fig. 3A, C) (Turner 2012; personal observations). Pyramidanthinae differs from Mitrella only in sepal appearance (Turner 2012), i.e. nearly completely connate sepals with an indistinct apex (Fig. 2A) in the former genus vs partially connate sepals with a distinct apex (Fig. 2C) in the latter genus. In addition, the monocarps of Pyramidanthinae are more or less warty (Fig. 3B), whereas they are smooth in Mitrella (Fig. 3D) except in M. dielsii J. Sinclair, which has the same monocarp appearance as that of Pyramidanthinae (Sinclair 1955, 1956; Turner 2012). Based primarily on the negligible morphological distinctions between the two genera, unifying them is appropriate. The two genera are of equal nomenclatural priority because they were established on the same date (Miquel 1865); therefore, a choice must be made (see Art. 11.5 of the International Code of Nomenclature for algae, fungi, and plants; Turland & al. 2018). Although the name Mitrella contains several more species, strikingly similar generic names pre-exist: Mitella Tourn. ex L. (Saxifragaceae) and Mitreola L. (Loganiaceae); the three generic names (Mitella, Mitrella and Mitreola) have the same etymology, i.e. they are diminutive forms of the Greek-derived Latin noun mitra (= mitre, cap; Quattrochi 2000). It is worth mentioning that the recent case of near-identical generic names of Hubera Chaowasku (Annonaceae) vs Huberia DC. (Melastomataceae) has resulted in homonymy (Chaowasku 2013; Applequist 2014). Consequently, to avoid possible nomenclatural confusion, we select Pyramidanthinae, with 11 new combinations under the selected name. It is noteworthy that Pyramidanthinae and Mitrella were once considered as congeneric with Fissistigma, the sister group of the Pyramidanthinae inclusive of Mitrella (= Pyramidanthinae s. lat.) clade (Fig. 1), by Merrill (1919). Our molecular phylogenetic results reveal that Fissistigma and Pyramidanthinae s. lat. are better kept apart. The former principally differs from the latter by having distinct secondary leaf veins with a eucamptodromous venation, a usually percurrent tertiary leaf venation, and inner petals that are usually more or less two-thirds to more or less half the size of the outer petals (Turner 2012; personal observations). Furthermore, Fissistigma usually does not show a basal excavation on an inner side of each outer petal (Turner 2012; the excavation, when present, e.g. in F. unicum, is shallow and broad [personal observations]) and generally possesses multi-flowered inflorescences (vs usually 1-flowered or rarely few-flowered in Pyramidanthinae,
The present study will facilitate a future revision of *Pyramidanthe* s. lat. Based on preliminary observations, several new species are anticipated, including *M.* sp. 1 (from Papua New Guinea) and *M.* sp. 2 (from Indonesian New Guinea). Regarding *Pyramidanthe* sp., it was identified as *P. prismatica* in e.g. Guo & al. (2017a, 2017b), but its outer petals are shorter (personal observations) and there are high amounts of nucleotide substitutions (Fig. 1). We believe that a revisionary study, combined with extensive phylogenetic inferences, can finally shed light on its identity.

**Taxonomic treatment**

*Pyramidanthe* Miq. in Ann. Mus. Bot. Lugduno-Batavi 2: 39. 1865 ≡ *Unona* sect. *Pyramidanthe* (Miq.) Baill., Hist. Pl. 1: 213. 1868 ≡ *Melodorum* sect. *Pyramidanthe* (Miq.) Kurz in J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 43: 56. 1870. – Type: *Pyramidanthe rufa* Miq. [= *Pyramidanthe prismatica* (Hook. f. & Thomson) Merr.].

= *Mitrella* Miq. in Ann. Mus. Bot. Lugduno-Batavi 2: 38. 1865 ≡ *Polyalthia* sect. *Kentia* Blume, Fl. Javae Anonac. 71. 1830 ≡ *Polyalthia* sect. *Schmidtspahnia* Rchb., Deut. Bot. Herb.-Buch: 236. 1841, nom. illeg. superfl. ≡ *Melodorum* sect. *Kentia* (Blume) Hook. f. & Thomson, Fl. Ind.: 122. 1855 ≡ *Unona* sect. *Kentia* (Blume) Baill., Hist. Pl. 1: 213. 1868, syn. nov. – Type: *Polyalthia kentii* (Blume) Blume [= *Unona kentii* Blume ≡ *Mitrella kentii* (Blume) Miq.].

**Description** — Woody climbers; indument of simple hairs. Leaves petiolate; petiole often ≥ 10 mm long; abaxial leaf surface somewhat glaucous, secondary leaf veins usually indistinct, brochiodromous to brochiodromous-eucamptodromous, tertiary venation reticulate. Inflorescences axillary (including in axils of fallen leaves), 1-flowered, rarely few-flowered. Flowers bisexual, buds ± (ob)voo-triangular pyramidal to ± narrowly ovid-triangular pyramidal. Sepals 3, valvate, nearly completely connate with indistinct apex or partially connate with distinct apex, persistent in fruit. Petals 6, in 2 whorls,
each whorl valvate; outer whorl much larger than inner whorl, elliptic-obovate, ovate, ovate-triangular to narrowly ovate-triangular; inner whorl marginally cohering at anthesis, base of each inner petal excavated adaxially. Stamens numerous; connective apex discoid to ± tongue-shaped. Carpels (5–)6–15; stigmas ± ellipsoid-cylindric or irregularly shaped; ovaries glabrous or sparsely hairy; ovules (2–)4–18 per ovary, lateral. Fruits each consisting of globose, ellipsoid to cylindric monocarps; each monocarp stipitate, smooth or ± warty. Seeds sometimes pitted; endosperm ruminations ± flattened pegs and often ± lamellate toward raphe, sometimes spiniform.

Diversity and distribution — Twelve species, distributed in S Thailand, Peninsular Malaysia, Singapore, Sumatra, Java, Borneo, New Guinea and the Australian Tiwi Islands.

Accepted names in Pyramidanthe

1. **Pyramidanthe beccarii** (Scheff.) Bangkomnate & Chaowasku, comb. nov. = *Melodorum beccarii* Scheff. in Ann. Jard. Bot. Buitenzorg 2: 24. 1881 = *Mitrella beccarii* (Scheff.) Diels in Bot. Jahrb. Syst. 49: 149. 1912 = *Fissistigma beccarii* (Scheff.) Merr. in Philipp. J. Sci. 15: 131. 1919. – Lectotype (designated by Diels 1912: 150): Indonesia, Papua, Andai, 1872, Beccari P.P. 795 (FI barcode FI007574 [Erb. Coll. Becc. No. 497] [image!]; isolectotypes: A [image!], B [× 2] [images!], FI-B [Erb. Coll. Becc. No. 497A] not seen, K [image!]).

2. **Pyramidanthe clementis** (Merr.) Bangkomnate & Chaowasku, comb. nov. = *Fissistigma clementis* Merr. in J. Straits Branch Roy. Asiat. Soc. 85: 178. 1922 = *Mitrella clementis* (Merr.) I. M. Turner in Malayan Nat. J. 61: 273. 2009. – Lectotype (designated by Turner 2009: 273): Borneo, Sabah, Sandakan and vicinity, Sep–Dec 1920, Ramos 1474 (K barcode K000574737 [image!]; isolectotypes: A [× 2] [images!], BM [image!], US [image!]).

3. **Pyramidanthe cylindrica** (Maingay ex Hook. f. & Thomson) Bangkomnate & Chaowasku, comb. nov. = *Melodorum cylindricum* Maingay ex Hook. f. & Thomson in Hooker, Fl. Brit. Ind. 1: 80. 1872 = *Fissistigma cylindricum* (Maingay ex Hook. f. & Thomson) Merr. in
Remarks — This species was regarded as a heterotypic synonym of *Pyramidanthe prismatica* by Sinclair (1955) and Turner (2012, 2018). After a careful examination on the holotype, some features are different from those of *P. prismatica*, e.g. leaf base (broadly acute, obtuse to rounded [never subcordate or truncate] vs subcordate, more or less truncate to rounded [never broadly acute or obtuse] in *P. prismatica*), outer petal shape and length (ovate-triangular and c. 1 cm long vs narrowly ovate-triangular and (3.8–)5–8 cm long in *P. prismatica*) and monocarp shape (shortly cylindric to cylindric, more or less curved vs ellipsoid to shortly cylindric, never curved in *P. prismatica*). Consequently, *P. cylindrica* deserves recognition as a distinct species.

4. **Pyramidanthe dielsii** (J. Sinclair) Bangkomnate & Chaowasku, *comb. nov.* ≡ *Mitrella dielsii* J. Sinclair in *Gard. Bull. Singapore* 15: 14. 1956 ≡ *Melodorum beccarii* Diels in *Notizbl. Bot. Gart. Berlin-Dahlem* 11: 85. 1931, nom. illeg., non *Melodorum beccarii* Scheff. in Ann. Jard. Bot. Buitenzorg 2: 24. 1881. — Lectotype (designated here): Borneo, Sarawak, near Sungai Igan, Oct 1867, Beccari P.B. 3899 (FI-B [FI007576, FI007577, 1 specimen on 1 sheet with 2 barcodes] [Erb. Coll. Becc. No. 509] [image!]; isolectotypes: B [image!], FI-B [Erb. Coll. Becc. No. 509A] not seen, K [image!]).

Remarks — We follow the reasons given in Johnson & al. (2021) for the recognition of this species.
6. **Pyramidanthe kentii** (Blume) Bangkmnate & Chaowasku, **comb. nov.** \(\equiv\) *Unona kentii* Blume, Bijdr. Fl. Ned. Ind.: 16. 1825 \(\equiv\) *Polyalthia kentii* (Blume) Blume, Fl. Javae Anonac. 77. 1830 \(\equiv\) *Fissistigma kentii* (Blume) Hook. f. & Thomson, Fl. Ind.: 116. 1855 \(\equiv\) *Mitrella kentii* (Blume) Miq. in Ann. Mus. Bot. Lugduno-Batavi 2: 39. 1865 \(\equiv\) *Fissistigma kentii* (Blume) Merr. in Philipp. J. Sci. 15: 132. 1919. – Lectotype (designated by Turner 2011: 54): Java, *Anon. s.n.* (L. [L.1757643] [image!]).

7. **Pyramidanthe ledernannii** (Diels) Bangkmnate & Chaowasku, **comb. nov.** \(\equiv\) *Mitrella ledernannii* Diels in Bot. Jahrb. Syst. 52: 183. 1915. – Lectotype (designated by Kessler & al. 1995: 39): Papua New Guinea, Hauptlager Malu, am Sepik, 19 Mar 1912, *Ledermann 6672* (B barcode B 10 0325315 [image!]; isolectotypes: K [× 2] [images!]).

8. **Pyramidanthe mabiformis** (Griff.) Bangkmnate & Chaowasku, **comb. nov.** \(\equiv\) *Uvaria mabiformis* Griff., Not. Pl. Asiat. 4: 709. 1854 \(\equiv\) *Fissistigma mabiforme* (Griff.) Merr. in Philipp. J. Sci. 15: 133. 1919. – Lectotype (designated by Sinclair 1955: 367): Peninsular Malaysia, Malacca, Aloor Gajah, *Verapha s.n.* [Kew Distrib. No. 389] (K barcode K000574743 [image!]).

**Remarks** — This species was considered as a heterotypic synonym of *Mitrella kentii* (now *Pyramidanthe kentii*) by Sinclair (1955) and Turner (2012, 2018). After a careful examination on the lectotype, some traits differ from those of *P. kentii*, e.g. leaf base (obtuse to rounded vs usually cuneate in *P. kentii*), pedicel length (6–8 mm long vs 12–19 mm long in *P. kentii*), outer petal shape (elliptic-obovate vs ovate in *P. kentii*), and outer petal apex (obtuse-rounded vs acute to obtuse-acute in *P. kentii*). Therefore, *P. mabiformis* deserves recognition as a distinct species.

9. **Pyramidanthe prismatica** (Hook. f. & Thomson) Merr. in J. Straits Branch Roy. Asiat. Soc., Spec. No.: 262. 1921 \(\equiv\) *Melodorum prismaticum* Hook. f. & Thomson, Fl. Ind.: 121. 1855 \(\equiv\) *Fissistigma prismaticum* (Hook. f. & Thomson) Merr. in Philipp. J. Sci. 15: 135. 1919. – Lectotype (designated by Turner 2011: 87): Peninsular Malaysia, Penang, Aug 1822, *Wallich s.n.* [EIC 6455] (K-W barcode K001123943 [image!]; isolectotype: BM not seen). – Fig. 2A, B, Fig. 3A, B.

= *Pyramidanthe rufa* Miq. in Ann. Mus. Bot. Lugduno-Batavi 2: 39. 1865. – Lectotype (designated here): Borneo, Martapoera, *Korthals s.n.* (L. [L.1775037] [image!]).

= *Pyramidanthe rufa* var. *parvifolia* Boerl., Icon. Boga. 1: 131. 1899 \(\equiv\) *Pyramidanthe prismatica* var. *parvifolia* (Boerl.) Merr. in J. Straits Branch Roy. Asiat. Soc., Spec. No.: 263. 1921. – Lectotype (designated by Turner 2011: 88): Borneo, Sarawak, nr Kuching, 1892, *Haviland 421* (BO [sheet no. BO-134059] not seen).

10. **Pyramidanthe schlechteri** (Diels) Bangkmnate & Chaowasku, **comb. nov.** \(\equiv\) *Mitrella schlechteri* Diels in Bot. Jahrb. Syst. 49: 150. 1912 \(\equiv\) *Fissistigma schlechteri* (Diels) Merr. in Philipp. J. Sci. 15: 136. 1919. – Holo-type: Papua New Guinea, Kaiser Wilhelmsland, in den Wäldern des Kani-Gebirges, 23 Dec 1907, *Schlechter 17025* (B barcode B 10 0325314 [image!]; isotype: P [image!]).

11. **Pyramidanthe silvatica** (Diels) Bangkmnate & Chaowasku, **comb. nov.** \(\equiv\) *Mitrella silvatica* Diels in Bot. Jahrb. Syst. 52: 183. 1915. – Lectotype (designated by Turner 2018: 577): Papua New Guinea, Etappenberg, 6 Oct 1912, *Ledermann 9058* (B barcode B 10 0325311 [image!]; isolectotypes: E [image!], K [image!], SING [image!]).

12. **Pyramidanthe tiwiensis** (Jessup & Bygrave) Bangkmnate & Chaowasku, **comb. nov.** \(\equiv\) *Mitrella tiwiensis* Jessup & Bygrave, Fl. Australia 2: 447. 2007. – Holo-type: Australia, Northern Territory, Bathurst Island, 23 km E Rocky Point, 11 Dec 1991, *Russell-Smith & Brock 8573* (BRI barcode BRI-AQ0621374 [image!]; isolectotypes: DNA [image!], K [image!], L [image!], MO not seen).

**Excluded names**

Currently accepted names are indicated in bold italics.

*Mitrella aberrans* (Maingay ex Hook. f. & Thomson) Bân in Bot. Zhurn. (Moscow & Leningrad) 59: 244. 1974 \(\equiv\) *Polyalthia aberrans* Maingay ex Hook. f. & Thomson in Hooker, Fl. Brit. India 1: 67. 1872 \(\equiv\) *Sphaerocoryne aberrans* (Maingay ex Hook. f. & Thomson) Ridl. in J. Straits Branch Roy. Asiat. Soc. 75: 8. 1917.

*Mitrella mesnyi* Bân in Bot. Zhurn. (Moscow & Leningrad) 59: 244. 1974, nom. illeg. superfl. \(\equiv\) *Unona mesnyi* Pierre, Fl. Forest. Cochinch.: t. 17. 1881, nom. illeg. superfl. \(\equiv\) *Melodorum clavipes* Hance in J. Bot. 15: 328. 1877.

= *Melodorum lefevrei* Baill. in Adansonia 10: 108. 1871, as *'lefevrii'* \(\equiv\) *Sphaerocoryne lefevrei* (Baill.) D. M. Johnson & N. A. Murray in Thai Forest Bull., Bot. 49: 170. 2021.

*Mitrella touranensis* Bân, Fl. Vietnam 1: 190. 2000 \(\equiv\) *Sphaerocoryne touranensis* (Bân) I. M. Turner in Gard. Bull. Singapore 70: 685. 2018.

**Author contributions**

T. C. conceived and coordinated the study and obtained the research grant; A. B. and K. A provided crucial plant specimens; R. B. and A. D performed morphological...
examinations; R. B. and T. C. performed molecular phylogenetic analyses; all authors drafted every version of the manuscript.

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References

Akaike H. 1974: A new look at the statistical model identification. – IEEE Trans. Automat. Contr. 19: 716–723. Crossref.

Applequist W. L. 2014: Report of the nomenclature committee for vascular plants: 66. – Taxon 63: 1358–1371. Crossref.

Chaowasku T. 2013: (7) Request for a binding decision on whether *Huberia DC. (Melandostamaceae) and Hubera Chaowasku (Annonaceae)* are sufficiently alike to be confused. – Taxon 62: 412–412. Crossref.

Chaowasku T. 2020: Toward a phylogenetic reclassification of the subfamily Ambavioidae (Annonaceae): establishment of a new subfamily and a new tribe. – Acta Bot. Bras. 34: 522–529. Crossref.

Chaowasku T., Aongyong K., Damthongdee A., Jongsook H. & Johnson D. M. 2020: Generic status of Winitia (Annonaceae, Miliuseae) reaffirmed by molecular phylogenetic analysis, including a new species and a new combination from Thailand. – Eur. J. Taxon. 659: 1–23. Crossref.

Chaowasku T., Damthongdee A., Jongsook H., Nuraliev M. S., Ngo D. T., Le H. T., Lithanatudom P., Osa-thanunkul M., Deroin T., Xue B. & Wipasa J. 2018b: Genus *Huberanthe (Annonaceae)* revisited: erection of *Polyaltheopsis*, a new genus for *H. floribunda*, with a new combination *H. luensis*. – Ann. Bot. Fenn. 55: 121–136. Crossref.

Chaowasku T., Johnson D. M., van der Ham R. W. J. M. & Chatrou L. W. 2012: Characterization of Hubera (Annonaceae), a new genus segregated from *Polyalthia* and allied to *Miliusa*. – Phytotaxa 69: 33–56. Crossref.

Chaowasku T., Johnson D. M., van der Ham R. W. J. M. & Chatrou L. W. 2015: Huberantha, a replacement name for Hubera (Annonaceae: Malmeoideae: Miliuseae). – Kew Bull. 70: article 23. Crossref.

Chaowasku T, van der Ham R. W. J. M. & Chatrou L. W. 2013: Integrative systematics supports the establishment of Winitia, a new genus of Annonaceae (Malmeoideae, Miliuseae) allied to Stelechocarpus and Sageraea. – Syst. Biodivers. 11: 195–207. Crossref.

Chatrou L. W., Pirie M. D., Erkens R. H. J., Couvreur T. L. P., Neubig K. M., Abbott J. R., Mols J. B., Maas J. W., Saunders R. M. K & Chase M. W. 2012: A new subfamilial and tribal classification of the pantropical flowering plant family Annonaceae informed by molecular phylogenetics. – Bot. J. Linn. Soc. 169: 5–40. Crossref.

Chatrou L. W., Turner I. M., Klitgaard B. B., Maas P. J. M. & Utteridge T. M. A. 2018: A linear sequence to facilitate curation of herbarium specimens of Annonaceae. – Kew Bull. 73: article 39. Crossref.

Chernomor O., von Haeseler A. & Minh B. Q. 2016: Terrace aware data structure for phylogenomic inference from supermatrices. – Syst. Biol. 65: 997–1008. Crossref.

Couvreur T. L. P., Helmsetter A. J., Koenen E. J. M., Bethune K., Brandão R. D., Little S. A., Sauquet H. & Erkens R. H. J. 2019: Phylogenomics of the major tropical plant family Annonaceae using targeted enrichment of nuclear genes. – Frontiers Pl. Sci. 9: article 1941. Crossref.

Couvreur T. L. P., Niangadouma R., Sonké B. & Sauquet H. 2015: *Sirdavidia*, an extraordinary new genus of Annonaceae from Gabon. – PhytoKeys. 46: 1–19. Crossref.

Couvreur T. L. P., van der Ham R. W. J. M., Mbelle Y. M., Mbag F. M. & Johnson D. M. 2009: Molecular and morphological characterization of a new monotypic genus of Annonaceae, *Mwasumbia* from Tanzania. – Syst. Bot. 34: 266–276. Crossref.

Damthongdee A., Aongyong K. & Chaowasku T. 2021: *Orophea sichaikhanii* (Annonaceae), a new species from southern Thailand, with a key to the species of *Orophea* in Thailand and notes on some species. – Pl. Ecol. Evol. 154: 307–315. Crossref.

Diels L. 1912: Beiträge zur Flora von Pauwasiän. Serie I, 8. Die Anonaceen von Pauwasiän. – Bot. Jahrb. Syst. 49: 113–167.

Doyle J. A., Sauquet H., Scharaschkin T. & Le Thomas A. 2004: Phylogeny, molecular and fossil dating, and biogeographic history of Annonaceae and Myristi-
Merrill E. D. 1919: On the application of the generic name *Melodoron* of Loureiro. – *Philipp. J. Sci.* **15**: 125–137.

Miller M. A., Pfeiffer W. & Schwartz T. 2010: Creating the CIPRES Science Gateway for inference of large phylogenetic trees. – *Pp. 45–52 in: Gateway Computing Environments Workshop (GCE).* – Piscataway: IEEE. 

Minh B. Q., Schmidt H. A., Chernomor O., Schrempf D., Woodhams M. D., von Haeseler A. & Lanfear R. 2020: IQ-TREE 2: new models and efficient methods for phylogenetic inference in the genomic era. – *Molec. Biol. Evol.* **37**: 1530–1534. 

Miquel F. A. W. 1865: *Annonaceae* Archipelagi indici. – *Ann. Mus. Bot. Lugduno-Batavi* **2**: 1–45.

Mols J. B., Kessler P. J. A., Rogstad S. H. & Saunders R. M. K. 2008: Reassignment of six *Polyalthia* species to the new genus *Maasia* (*Annonaceae*): molecular and morphological congruence. – *Syst. Bot.* **33**: 490–494. 

Photikwan E., Damthongdee A., Jongsook H. & Chaowasu T. 2021: *Artabotrys angustipes* (*Annonaceae*), a new species from Thailand, including a plastid phylogeny and character evolutionary analyses of thorn occurrence in *Artabotrys*. – *Willdenowia* **51**: 69–82. 

Pirie M. D., Chatrou L. W., Mols J. B., Erkens R. H. J. & Oosterhof J. 2006: ‘Andean-centred’ genera in the short-branch clade of *Annonaceae*: testing biogeographical hypotheses using phylogeny reconstruction and molecular dating. – *J. Biogeogr.* **33**: 31–46. 

Posada D. & Crandall K. A. 1998: *MODELLTEST*: testing the model of DNA substitution. – *Bioinformatics* **14**: 817–818. 

Quattrocchi U. 2000: CRC world dictionary of plant names: common names, scientific names, eponyms, synonyms, and etymology 3 (M–Q). – *Boca Raton, New York, Washington D.C.: CRC Press.* 

Rambaut A., Suchard M. & Drummond A. 2013: Tracer, version 1.6. – Published at [http://tree.bio.ed.ac.uk/software/tracer/](http://tree.bio.ed.ac.uk/software/tracer/) [accessed 18 May 2017]. 

Ronquist F., Teslenko M., van der Mark P., Ayres D. L., Darling A., Höhna S., Larget B., Liu L., Suchard M. A. & Huelsenbeck J. P. 2012: MrBayes 3.2: efficient Bayesian phylogenetic inference and model choice across a large model space. – *Syst. Biol.* **61**: 539–542. 

Simmons M. P. 2004: Independence of alignment and tree search. – *Molec. Phylog. Evol.* **31**: 874–879. 

Simmons M. P. & Ochoterena H. 2000: Gaps as characters in sequence-based phylogenetic analyses. – *Syst. Biol.* **49**: 369–381. 

Sinclair J. 1955: A revision of the Malayan *Annonaceae*. – *Gard. Bull. Singapore.* **14**: 149–516. 

Sinclair J. 1956: Miscellaneous notes on *Annonaceae*. – *Gard. Bull. Singapore* **15**: 14–17. 

Staden R., Beal K. F. & Bonfield J. K. 2000: The Staden Package. 1998. – *Pp. 115–130 in: Misener S. & Krawetz S. A. (ed.), Bioinformatics methods and protocols.* – *Totowa: Humana Press.* [= Meth. Molec. Biol. **132**]. 

Goloboff P. A., Farris J. S., Källersjö M., Oxelman B., Ramírez M. J. & Szumik C. A. 2003: Improvements to resampling measures of group support. – *Cladistics* **19**: 324–332. 

Guo X., Wang J., Xue B., Thomas D. C., Tan Y. H. & Saunders R. M. K. 2014: Reassessing the taxonomic status of two enigmatic *Desmos* species (*Annonaceae*): morphological and molecular phylogenetic support for a new genus, *Wangia*. – *J. Syst. Evol.* **52**: 1–15. 

Hasegawa M., Kishino H. & Yano T. 1985: Dating of the human-ape split by a molecular clock of mitochondrial DNA. – *J. Molec. Evol.* **22**: 160–174. 

Johnson D. M., Bunchaloe P., Chalermglin P., Chantaranothai P., Leeratiwong C., Murray N. A., Saunders R. M. K., Sirichamorn Y., Su Y. C. F. & Sutthisakson P. 2021: Additions to *Annonaceae* in the Flora of Thailand. – *Thai Forest Bull., Bot.* **49**: 163–172. 

Katoh K., Misawa K., Kuma K. & Miyata T. 2002: MAFFT: a novel method for rapid multiple sequence alignment based on fast Fourier transform. – *Nucl. Acids Res.* **30**: 3059–3066. 

Katoh K., Rozewicki J. & Yamada K. D. 2019: MAFFT online service: multiple sequence alignment, interactive sequence choice and visualization. – *Briefings Bioinformatics* **20**: 1160–1166. 

Kessler P. J. A., Jessup L. W. & Kruijer J. D. 1995: Provisional checklist of the Asiatic-Australian species of *Annonaceae*. – *Serdang: The Herbarium, Universiti Pertanian Malaysia.* 

Merrill E. D. 1919: On the application of the generic name *Melodoron* of Loureiro. – *Philipp. J. Sci.* **15**: 125–137. 

Miller M. A., Pfeiffer W. & Schwartz T. 2010: Creating the CIPRES Science Gateway for inference of large phylogenetic trees. – *Pp. 45–52 in: Gateway Computing Environments Workshop (GCE).* – Piscataway: IEEE. 

Minh B. Q., Schmidt H. A., Chernomor O., Schrempf D., Woodhams M. D., von Haeseler A. & Lanfear R. 2020: IQ-TREE 2: new models and efficient methods for phylogenetic inference in the genomic era. – *Molec. Biol. Evol.* **37**: 1530–1534. 

Miquel F. A. W. 1865: *Annonaceae* Archipelagi indici. – *Ann. Mus. Bot. Lugduno-Batavi* **2**: 1–45. 

Mols J. B., Kessler P. J. A., Rogstad S. H. & Saunders R. M. K. 2008: Reassignment of six *Polyalthia* species to the new genus *Maasia* (*Annonaceae*): molecular and morphological congruence. – *Syst. Bot.* **33**: 490–494. 

Photikwan E., Damthongdee A., Jongsook H. & Chaowasu T. 2021: *Artabotrys angustipes* (*Annonaceae*), a new species from Thailand, including a plastid phylogeny and character evolutionary analyses of thorn occurrence in *Artabotrys*. – *Willdenowia* **51**: 69–82. 

Pirie M. D., Chatrou L. W., Mols J. B., Erkens R. H. J. & Oosterhof J. 2006: ‘Andean-centred’ genera in the short-branch clade of *Annonaceae*: testing biogeographical hypotheses using phylogeny reconstruction and molecular dating. – *J. Biogeogr.* **33**: 31–46. 

Posada D. & Crandall K. A. 1998: *MODELLTEST*: testing the model of DNA substitution. – *Bioinformatics* **14**: 817–818. 

Quattrocchi U. 2000: CRC world dictionary of plant names: common names, scientific names, eponyms, synonyms, and etymology 3 (M–Q). – *Boca Raton, New York, Washington D.C.: CRC Press.* 

Rambaut A., Suchard M. & Drummond A. 2013: Tracer, version 1.6. – Published at [http://tree.bio.ed.ac.uk/software/tracer/](http://tree.bio.ed.ac.uk/software/tracer/) [accessed 18 May 2017]. 

Ronquist F., Teslenko M., van der Mark P., Ayres D. L., Darling A., Höhna S., Larget B., Liu L., Suchard M. A. & Huelsenbeck J. P. 2012: MrBayes 3.2: efficient Bayesian phylogenetic inference and model choice across a large model space. – *Syst. Biol.* **61**: 539–542. 

Simmons M. P. 2004: Independence of alignment and tree search. – *Molec. Phylog. Evol.* **31**: 874–879. 

Simmons M. P. & Ochoterena H. 2000: Gaps as characters in sequence-based phylogenetic analyses. – *Syst. Biol.* **49**: 369–381. 

Sinclair J. 1955: A revision of the Malayan *Annonaceae*. – *Gard. Bull. Singapore.* **14**: 149–516. 

Sinclair J. 1956: Miscellaneous notes on *Annonaceae*. – *Gard. Bull. Singapore* **15**: 14–17. 

Staden R., Beal K. F. & Bonfield J. K. 2000: The Staden Package. 1998. – *Pp. 115–130 in: Misener S. & Krawetz S. A. (ed.), Bioinformatics methods and protocols.* – *Totowa: Humana Press.* [= Meth. Molec. Biol. **132**].
Surveswaran S., Wang R. J., Su Y. C. F. & Saunders R. M. K. 2010: Generic delimitation and historical biogeography in the early-divergent ‘ambavioid’ lineage of Annonaceae: Cananga, Cyathocalyx and Drepananthus. – Taxon 59: 1721–1734. CrossRef.

Tavaré S. 1986: Some probabilistic and statistical problems in the analysis of DNA sequences. – Lectures Math. Life Sci. 17: 57–86.

Turland N. J., Wiersema J. H., Barrie F. R., Greuter W., Hawksworth D. L., Herendeen P. S., Knapp S., Kusber W.-H., Li D.-Z., Marhold K., May T. W., McNeill J., Monro A. M., Prado J., Price M. J. & Smith G. F. (ed.) 2018: International Code of Nomenclature for algae, fungi, and plants (Shenzhen Code) adopted by the Nineteenth International Botanical Congress Shenzhen, China, July 2017. – Glashütten: Koeltz Botanical Books. [= Regnum Veg. 159]. CrossRef.

Turner I. M. 2009: New species and nomenclatural combinations in Polyalthia, Meiogyne and Mitrella (Annonaceae) from Borneo. – Malayan Nat. J. 61: 267–276. CrossRef.

Turner I. M. 2011: A catalogue of the Annonaceae of Borneo. – Phytotaxa 36: 1–120. CrossRef.

Turner I. M. 2012: Annonaceae of Borneo: a review of the climbing species. – Gard. Bull. Singapore. 64: 371–479.

Turner I. M. 2018: Annonaceae of the Asia-Pacific region: names, types and distributions. – Gard. Bull. Singapore 70: 409–744. CrossRef.

van Heusden E. C. H. 1992: Flowers of Annonaceae: morphology, classification, and evolution. – Blumea, Suppl. 7: 1–218.

van Setten A. K. & Koek-Noorman J. 1992: Fruits and seeds of Annonaceae: morphology and its significance for classification and identification. – Biblioth. Bot. 142: 1–101.

Wiens J. J. 1998: Combining data sets with different phylogenetic histories. – Syst. Biol. 47: 568–581. CrossRef.

Xue B., Su Y. C. F., Mols J. B., Kessler P. J. A. & Saunders R. M. K. 2011: Further fragmentation of the polyphyletic genus Polyalthia (Annonaceae); molecular phylogenetic support for a broader delimitation of Marsypopetalum. – Syst. Biodivers. 9: 17–26. CrossRef.

Xue B., Su Y. C. F., Thomas D. C. & Saunders R. M. K. 2012: Pruning the polyphyletic genus Polyalthia (Annonaceae) and resurrecting the genus Monoon. – Taxon 61: 1021–1039. CrossRef.

Xue B., Tan Y. H., Thomas D. C., Chaowasku T., Hou X.-L. & Saunders R. M. K. 2018: A new Annonaceae genus, Wuodendron, provides support for a post-boreotropical origin of the Asian-neotropical disjunction in the tribe Miliuseae. – Taxon 67: 250–266. CrossRef.

Xue B., Thomas D. C., Chaowasku T., Johnson D. M. & Saunders R. M. K. 2014: Molecular phylogenetic support for the taxonomic merger of Fitzalania and Meiogyne (Annonaceae): new nomenclatural combinations under the conserved name Meiogyne. – Syst. Bot. 39: 396–404. CrossRef.

Yang Z. & Rannala B. 1997: Bayesian phylogenetic inference using DNA sequences: a Markov Chain Monte Carlo method. – Molec. Biol. Evol. 14: 717–724. CrossRef.

Zhou L., Su Y. C. F., Chalermglin P. & Saunders R. M. K. 2010: Molecular phylogenetics of Uvaria (Annonaceae): relationships with Balonga, Dasoclema and Australian species of Melodorum. – Bot. J. Linn. Soc. 163: 33–43. CrossRef.

Zhou L., Su Y. C. F. & Saunders R. M. K. 2009: Molecular phylogenetic support for the taxonomic merger of Fitzalanion, Meioyge and Meiogyne (Annonaceae): new nomenclatural combinations under the conserved name Meiogyne. – Syst. Bot. 39: 396–404. CrossRef.

Supplemental content online

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Original alignments and alignments for phylogenetic analyses, including binary-coded indels.
## Appendix 1

Specimens for molecular phylogenetic analyses and their GenBank accession numbers. Unavailable sequences are denoted with —; newly generated sequences are denoted with **.

| Taxon                                      | Location   | Collector and number (herbarium) | matK          | ndhF          | psbA-trnH     | rbcL          | trnL-F        |
|--------------------------------------------|------------|----------------------------------|---------------|---------------|---------------|---------------|---------------|
| Afroguatteria bequaertii (De Wild.)        | Congo      | Lejoly 4865 (BR)                 | KX786588      | —             | —             | KX786627      | KX786629      |
| Afroguatteria discostigma (Diels) X. Guo & R. M. K. Saunders | Cameroon | Zenker 3023 (P)                  | KX786595      | —             | KX786623      | —             | KX786635      |
| Artabotrys hexapetalus (L. f.) Bhandari    | India      | Chatrou 470 (U)                  | —             | EF179284      | —             | AY841429      | EF179317      |
| Artabotrys hexapetalus                     | cultivated (Utrecht Univ. Bot. Gard., 94GR01614) | Anon. s.n. (U) | AY238962      | —             | —             | AY238953      | —             |
| Cleistochlamys kirkii (Benth.) Oliv.      | Mozambique | Maurin & al. OM 2339             | JX517486      | —             | —             | —             | JX572412      |
| Cleistochlamys kirkii                      | Tanzania   | Couvreur 58 (WAG)                | —             | KM924880      | KM924981      | —             | KM924948      |
| Dasymaschalon halabalum                    | Thailand   | Chaowasku 180 (CMUB)             | MT264033      | MT264001      | MT264009      | MT264017      | MT264025      |
| Dasymaschalon macrocalyx                   | Thailand   | Kessler 3199 (L)                 | FI743748      | EF179290      | EF179313      | AY841610      | AY841688      |
| Desmos goezeanus (F. Muell.) Jessup        | Australia  | Ford & Cinelli 04780 (BRI)       | JQ768572      | JQ768607      | JQ768651      | JQ768691      | JQ768732      |
| Desmos sp.                                 | Thailand   | Aongyong 33 (CMUB)               | OL546467**    | OL546483**    | OL546494**    | OL546510**    | OL546526**    |
| Dielsiothamnus divaricatus (Diels) R. E. Fr. | Tanzania   | Johnson 1903 (OWU)              | EU169692      | EU169736      | EU169759      | EU169781      |                |
| Fissistigma fulgens (Hook. f. & Thomson) Merr. | Thailand | Aongyong & Baka 34 (CMUB)     | OL546473**    | OL546486**    | OL546500**    | OL546516**    | OL546532**    |
| Fissistigma glaucescens (Hance) Merr.     | China      | Anon. s.n. [isolate SCBG353_1] (no herbarium indicated) | AY743482      | —             | —             | AY743444      |                |
| Fissistigma glaucescens                    | Hong Kong  | Law 00/07b (L)                   | —             | —             | —             | KP095606      | —             | AY743463      |
| Fissistigma oblongum (Craib) Merr.         | Thailand   | Chaowasku 214 (CMUB)             | OL546469**    | —             | —             | OL546512**    | OL546528**    |
| Fissistigma polyanthoides (Aug. DC.) Merr. | Thailand  | Kessler 3232 (WAG)               | JQ768575      | JQ768609      | JQ768654      | JQ768694      | JQ768735      |
| Fissistigma rubiginosum (A. DC.) Merr. [accession F. rubiginosum-1] | Thailand  | Aongyong & Dumrongwattiam 35 (CMUB) | OL546470**    | —             | —             | OL546513**    | OL546529**    |
| Fissistigma rubiginosum [accession F. rubiginosum-2] | Thailand  | Chaowasku 215 (CMUB)             | OL546474**    | OL546487**    | OL546501**    | OL546517**    | OL546533**    |

continued on next page
| Taxon                        | Location   | Collector and number (herbarium) | matK      | ndhF      | psbA-trnH   | rbcL      | trnL-F     |
|-----------------------------|------------|----------------------------------|-----------|-----------|-------------|-----------|------------|
| Fissistigma thorelii        | Thailand   | Sichakhun 2 (CMUB)               | OL546472**| OL546485**| OL546499**  | OL546515**| OL546531** |
| Fissistigma unicum          | China      | Anon. s.n. (isolate SCBGP360, 2) |           |           |             |           |            |
| Fissistigma sp.             | Hong Kong  | Low & Kendrick 0005 (L)          | —         | —         | —           | —         | —          |
| Fissistigma sp.             | Vietnam    | Naralee 2125 (CMUB)              | OL546471**| —         | OL546498**  | OL546514**| OL546530** |
| Friesodielsia desmoides     | Thailand   | Kessler 3189 (WAG)               | JQ768577  | JQ768612  | JQ768656    | JQ768696  | Y841696   |
| Friesodielsia sp.           | Thailand   | Aongyong 36 (CMUB)               | OL546468**| OL546484**| OL546495**  | OL546511**| OL546527** |
| Isolona campanulata         | Thailand   | cultivated (Utrecht Univ. Bot. Gard., 86GR00240) | —         | —         | —           | —         | —          |
| Mitrella cf. beccarii       | Indonesia  | Uteride 380 (L)                  | OL546476**| OL546488**| OL546503**  | OL546519**| OL546535** |
| Mitrella clementis          | Borneo     | Ambrianyah & Arifin AA 338 (L)   | OL546475**| —         | OL546502**  | OL546518**| OL546534** |
| Mitrella elegans            | Thailand   | Aongyong & Baka 37 (CMUB)        | OL546479**| —         | OL546506**  | OL546522**| OL546538** |
| Mitrella sp. 1              | Papua New Guinea | Takeuchi & al. 14912 (L)        | OL546477**| —         | OL546504**  | OL546520**| OL546536** |
| Mitrella sp. 2              | Indonesia  | Coode 8031 (L)                   | OL546478**| OL546489**| OL546505**  | OL546521**| OL546537** |
| Monanthotaxis parvifolia    | Kenya      | Lake 7299 (EA)                   | KX761312  | KX78032   | KX78971     | KX761343  | KX78001    |
| Monanthotaxis whytei        | cultivated (Utrecht Univ. Bot. Gard.) | Chatrou 475 (U) | EF179278  | EF179304  | EF179315    | AY841635  | AY841713   |
| Pyramidanthae prismatica    | Thailand   | Aongyong & Baka 38 (CMUB)        | OL546480**| OL546491**| OL546507**  | OL546523**| OL546539** |
| Pyramidanthae sp.           | Borneo     | Kessler & Arifin PK 2773 (L)     | JN175163  | —         | JN175178    | JN175193  | JN175208   |
| Sphaerocoryne affinis       | cultivated (Bogor Bot. Gard.)     | Chaowasku 216 (CMUB)             | OL546466**| OL546482**| OL546493**  | OL546509**| OL546525** |
| Sphaerocoryne gracilis      | Kenya      | Robertson 7554 (WAG)             | EU169688  | KM924888  | EU169732    | EU169755  | EU169777   |
| Toussaintia orientalis      | Tanzania   | Johnson 1957 (OWU)               | EU169689  | EU169710  | EU169733    | EU169756  | EU169778   |
| Uvaria calamistrata         | Hong Kong  | Low & al. 00/11 (HKU)            | FJ743799  | KM924889  | FJ743797    | FJ743831  | FJ743866   |
| Uvaria dasoclema            | Thailand   | Damthongdee AD J (BKF)           | OL546465**| OL546481**| OL546492**  | OL546508**| OL546524** |