

# *Drepananthus khaosoi* sp. nov. (Annonaceae) from southern Thailand, with molecular phylogenetic reconstructions

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Abstract. Drepananthus khaosoi sp. nov., a new species from southern Thailand is described and illustrated. It is morphologically most similar to D. ridleyi, especially in the very narrow and elongated petals, but differs in leaf blade size, leaf base, monocarp shape and appearance, monocarp width, length of monocarp stipe, pericarp thickness and seed arrangement. Molecular phylogenetic analyses using chloroplast DNA regions (matK and rbcL exons; trnL intron; atpB-rbcL, psbA-trnH and trnL-trnF intergenic spacers) and including 18 Drepananthus species confirm the monophyly of Drepananthus, but the relationships within the genus are largely unresolved, including a failure to elucidate a sister group of D. khaosoi. The conservation status of the new species is provisionally assessed as Critically Endangered.

Keywords. Canangeae, systematics, taxonomy, tree, tropical diversity.

**Resumen.** Se describe e ilustra *Drepananthus khaosoi* sp. nov, una nueva especie del sur de Tailandia. Esta especie es morfológicamente más similar a *D. ridleyi*, especialmente en los pétalos muy estrechos y alargados, pero difiere en el tamaño de la lámina de la hoja, la base de la hoja, la forma y apariencia del monocarpio, el ancho del monocarpio, la longitud del estípite del monocarpio, el grosor del pericarpio y la disposición de las semillas. Los análisis filogenéticos moleculares de regiones de ADN del cloroplasto (exones *matK* y *rbcL*; intrón *trnL*; espaciadores intergénicos *atpB-rbcL, psbA-trnH* y *trnL-trnF*) incluyendo 18 especies de *Drepanan-thus* confirman la monofilia de *Drepananthus*, pero las relaciones dentro del género están en gran medida sin resolver, incluido el fallo en dilucidar un grupo hermano de *D. khaosoi*. El estado de conservación de la nueva especie se evalúa provisionalmente como En Peligro Crítico.

Palabras clave. Árbol, Canangeae, diversidad tropical, sistemática, taxonomía.

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# INTRODUCTION

Annonaceae, with approximately 2,550 species (Couvreur & al. 2022) in 108 genera (Damthongdee & al. 2023; Schatz & al. 2023), are a pantropical angiosperm family and the largest family in the order Magnoliales (Chatrou & al. 2012). The genus Drepananthus Maingay ex Hook.f. & Thomson belongs to the tribe Canangeae, subfamily Ambavioideae; note that we herein adopt the delimitation of Ambavioideae in a narrow sense (= Ambavioideae s.s.) with the exclusion of the monotypic Meiocarpidium Engl. & Diels, based on Chaowasku (2020). Members of Canangeae also include Cananga (Dunal) Hook.f. & Thomson, Cyathocalyx Champ. ex Hook.f. & Thomson and Lettowianthus Diels, and this tribe is a sister group of Tetramerantheae, another tribe of Ambavioideae s.s. (Chaowasku 2020). Drepananthus is widely distributed in tropical forests of Southeast Asia to the Fiji Islands and contains 27 species of trees (Turner 2018). The genus shares several characteristics with Cyathocalyx (a small genus with seven species; Turner 2018; Saengpho & Chaowasku 2022), for example, terminal (developing to  $\pm$  leaf-opposed or internodal) inflorescences and a tightly constricted basal portion of petals, especially the inner petals. However, Drepananthus mainly differs by its impressed (vs. a raised) midrib on the upper leaf surface, multiple carpels (vs. a solitary carpel) per flower and ± ellipsoid (vs. peltate) stigmas (Surveswaran & al. 2010). Besides, the indumentum of Drepananthus is often stellate, while that of Cyathocalyx is always simple (Surveswaran & al. 2010). There is only one species of Drepananthus reported in Thailand: D. pruniferus Maingay ex Hook.f. & Thomson (Johnson & al. 2022). Recent expeditions in Narathiwat Province, southern Thailand resulted in an unidentified gathering of Drepananthus, which most resembles D. ridleyi (King) Survesw. & R.M.K.Saunders native to Peninsular Malaysia, Singapore and Borneo, especially in the very narrow and elongated petals (Wang 2004; Sinclair 1955). In order to determine the taxonomic status of this gathering, detailed morphological investigations as well as molecular phylogenetic analyses are performed.

## MATERIAL AND METHODS

The macromorphological features of the unidentified gathering of *Drepananthus* (*Drepananthus* sp.) were examined from dried herbarium specimens or spirit material (floral organs). Those of morphologically similar species [*D. ridleyi* and *D. pubescens* (Scheff.) Survesw. & R.M.K.Saunders] for comparisons were derived from literature (King 1892; Sinclair 1955; Wang 2004) as well as their type and representative specimens via online images (Appendix 2), which are, however, of limited utility since other details than shape and size are barely observable. The indumentum terminology used followed Hewson (1988).

#### Molecular phylogenetic analyses

The ingroup was composed of 32 accessions: 30 accessions belonging to Canangeae (three of Cananga, eight of Cyathocalyx, 18 of Drepananthus (including the unidentified accession, Drepananthus sp.) and one of Lettowianthus) and two belonging to Tetramerantheae (one of Cleistopholis Pierre ex Engl. and one of Mezzettia Becc.). Two accessions of Drepananthus (D. pruniferus and the unidentified accession) were newly sequenced in this study. Outgroups consisted of Meiocarpidium oliverianum (Baill.) D.M.Johnson & N.A.Murray (Meiocarpidioideae) and Annickia pilosa (Exell) Setten & Maas (a representative of Malmeoideae). Voucher information of all accessions, including GenBank accession numbers are shown in Appendix 1. Up to six plastid DNA regions (matK and rbcL exons; trnL intron; atpB-rbcL, psbA-trnH and *trnL-trnF* intergenic spacers) were used. The methods for DNA extraction, amplification and sequencing used in the present study, including primer information, followed Chaowasku & al. (2018, 2020) and Chaowasku (2020). Sequences were edited using the Staden package (Staden & al. 2000) and then aligned using MUSCLE (Edgar 2004) in MEGA11 (Tamura & al. 2021). The alignments were subsequently checked manually and adjusted where necessary based on the similarity criterion (Simmons 2004). In some *psbA-trnH* intergenic spacer sequences,

there was an inversion of 15 continuous nucleotides and this was reversed complementarily to be alignable to the remaining sequences, following Pirie & al. (2006). The total 3,767-nucleotide alignment plus seven binary-coded indel characters were included in the analysis. Indel coding followed the simple method of Simmons & Ochoterena (2000), with emphasis on less homoplastic and non-autapomorphic indel structures.

Parsimony analysis was performed in TNT version 1.5 (Goloboff & Catalano 2016). All characters were equally weighted and unordered. The setting of collapsing rules was set to "max. length = 0". Incongruence among chloroplast DNA regions was assessed by analyzing each region individually to detect if there was any significant topological conflict (e.g., Wiens 1998). Most parsimonious trees were generated by a heuristic search of the combined data, with 9000 replicates of random sequence addition, saving 10 trees per replicate and using the tree bisection and reconnection (TBR) branch-swapping algorithm. Clade support was measured by symmetric resampling (SR; Goloboff & al. 2003). A default change probability (P = 33) was used. Two hundred thousand replicates were run, each with four replicates of random sequence addition, saving four trees per replicate. A clade with SR  $\geq$  85%, 70–84% or 50–69% was considered strongly, moderately or weakly supported, respectively.

Maximum likelihood analysis was carried out in IQTREE version 2.1.3 (Minh & al. 2020) under partition models (Chernomor & al. 2016) implemented with the "-p" command, whereas Bayesian Markov Chain Monte Carlo (MCMC; Yang & Rannala 1997) phylogenetic analysis was performed in MrBayes version 3.2.7a (Ronquist & al. 2012) via the CIPRES Science Gateway version 3.3 (Miller & al. 2010). The aligned data matrix was divided into five partitions based on identity of DNA regions (the trnL intron and adjacent trnL-trnF intergenic spacer were combined as a single partition = trnL-F). The most suitable model of sequence evolution for each DNA partition was chosen by the Akaike Information Criterion (AIC; Akaike 1974) scores, using jModelTest version 2.1.10 (Darriba & al. 2012), with the following selections: +F, +G (nCat 4), ML optimized (base tree for likelihood calculations) and Best (base tree search). The General Time Reversible (GTR; Tavaré 1986) substitution model with a gamma distribution for among-site rate variation ( $\Gamma$ ) was selected for three partitions (atpB-rbcL, psbA-trnH and trnL-F), the GTR substitution model without  $\Gamma$  for one partition (*matK*) and the Hasegawa-Kishino-Yano (HKY; Hasegawa & al. 1985) substitution model with  $\Gamma$  for the remaining partition (*rbcL*). In the maximum likelihood analysis, the model "JC2+FQ+ASC" was selected by the corrected AIC scores for the binary indel partition. Clade support was evaluated by a non-parametric bootstrap resampling (BS; Felsen-



Fig. 1. Fifty percent majority-rule consensus phylogram derived from Bayesian inference. Parsimony symmetric resampling (SR) percentages on the left; maximum likelihood bootstrap (BS) percentages in the middle; Bayesian posterior probabilities (PP) on the right; \*\* = < 50%; scale bar unit = substitutions per site.

stein 1985) with 2000 replicates. A clade with BS  $\geq$  85%, 70–84% or 50– 69% was considered strongly, moderately or weakly supported, respectively. In the Bayesian analysis, the setting "coding = variable" was applied for the binary indel partition (employed under a simple F81-like model without  $\Gamma$ ). Four independent runs, each using four MCMC chains, were simultaneously executed; 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 assessed 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 1.7.1 (Rambaut & al. 2018). 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)  $\ge 0.95$ , 0.9–0.94 or 0.5–0.89 was considered strongly supported, weakly supported or unsupported, respectively.

## **RESULTS AND DISCUSSION**

#### Phylogenetic relationships and morphological comparisons

The parsimony analysis generated 120 most parsimonious trees with 510 steps. The consistency and retention indices (CI and RI) were 0.85 and 0.87, respectively. There was no strong conflict (SR  $\geq$  85%) among the analyses of each chloroplast DNA region. As shown on the phylogenetic tree (Fig. 1), the ingroup (Ambavioideae s.s.) as well as the tribe Tetramerantheae was monophyletic with maximum support. Recovered as a sister group of Tetramerantheae, the tribe Canangeae received strong support (SR = 99%, BS = 100%, PP = 1). In Canangeae, Lettowianthus was sister to a strongly supported (SR = 99%, BS = 100%, PP = 1) clade composed of the maximally supported Cananga, the strongly supported (SR = 99%, BS = 100%, PP = 1) *Cyathocalyx* and the moderately to strongly supported (SR = 91%, BS = 76%, PP = 1) Drepananthus. Cyathocalyx and Drepananthus appeared to be sister groups with no support to weak support (SR = 61%, BS = 64%, PP = 0.66). The unidentified accession of *Drepa*nanthus (= Drepananthus sp.) belonged to an unsupported to weakly supported (SR < 50%, BS < 50%, PP = 0.93) clade that also included four other members: D. biovulatus (Boerl.) Survesw. & R.M.K.Saunders, D. hexagynus (Miq.) Survesw. & R.M.K.Saunders, D. pubescens and D. ridleyi. Similar to Surveswaran & al. (2010), the phylogenetic relationships in Drepananthus herein depicted were also largely unresolved.

On the basis of morphological comparisons, the unidentified Drepananthus species is most similar to D. ridleyi (native to Peninsular Malaysia, Singapore and Borneo; Turner 2018). The two can be distinguished by several features as shown in Table 1. Drepananthus sp. also somewhat resembles D. pubescens (native to Peninsular Malaysia and Sumatra; Scheffer 1881; Turner 2018), but a number of traits separate them (Table 1). Based on these findings, we consider the unidentified Drepananthus species deserves recognition as a new species, which is described below (= D. khaosoi sp. nov.). Although the plastid DNA regions sampled in this study fail to provide a resolved phylogenetic hypothesis in Drepananthus and a sister group of the new species, morphological comparisons show it is clearly distinct. Clarifying the relationships of this new species will nonetheless require a more comprehensive phylogenetic analysis, possibly using high-throughput sequencing data (e.g., Couvreur & al. 2019).

The difference in pericarp thickness between *D. ridleyi* and *D. khaosoi* sp. nov. could be associated with different dispersers. In *Drepananthus*, terrestrial mammals, including fruit bats and large frugivory birds such as hornbills are likely to play an important role in seed dispersal because the monocarps are usually medium-sized and display various colors at maturity, including red (Wang 2004). Further studies are needed to verify how the seeds of the new species are dispersed.

#### Taxonomic treatment

*Drepananthus khaosoi* Damth. & Chaowasku, **sp. nov.** Type: Thailand, Narathiwat Province, Sukhirin District, elevation c. 150 m, 16 Mar. 2021, Chanthamrong & Baka 58 (holotype: CMUB [CMUB003998901]; isotypes: BK, CMUB, QBG), fl. & fr. Figs. 2–4.

*Diagnosis.*—The new species is morphologically most similar to *D. ridleyi*, but differs from it by having larger leaf blade, cordate to rounded-subcordate (vs. cuneate, occasionally  $\pm$  obtuse) leaf base, subglobose to ellipsoid (vs. ellipsoid-cylindrical to cylindrical) monocarps which are not constricted between seeds (vs. somewhat constricted between seeds) when dry, wider monocarps, shorter monocarp stipe, thicker pericarp and different seed arrangement (interdigitated vs. uniseriate).

*Description.*—Trees, c. 15 m tall; young twigs puberulous-tomentose with erect and appressed hairs. Petioles 12–23 mm long,  $\pm$  tomentose with erect and appressed hairs, slightly grooved above. Leaf blades elliptic-obovate to obovate, 24–30.6 × 11–15.4 cm, subcoriaceous-coriaceous, almost glabrous (except secondary veins, which are



**Fig. 2.** *Drepananthus khaosoi* Damth. & Chaowasku, sp. nov.: a, inflorescences and flowers; b, flower with petal blades removed, bottom view, particularly showing abaxial side of sepals; c, outer petal claw (above): abaxial (left) and adaxial (right) sides; inner petal claw (below): abaxial (left) and adaxial (right) sides; d, flower with petals, one sepal and stamens removed, side view, particularly showing adaxial side of sepals and carpels on torus; e, stamen (middle: adaxial side; right: abaxial side) and carpel (left); f, fruit with monocarps [all, Chanthamrong & Baka 58 (CMUB); photos: A. Baka (a, f)].

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Fig. 3. Holotype of Drepananthus khaosoi Damth. & Chaowasku, sp. nov. [Chanthamrong & Baka 58 (CMUB)].



Fig. 4. Enlargement of another specimen [isotype] of *Drepananthus khaosoi* Damth. & Chaowasku, sp. nov., showing dried monocarps without constrictions between seeds [Chanthamrong & Baka 58 (CMUB)].

puberulous with erect and appressed hairs) above, puberulous with erect and appressed hairs below, base cordate to rounded-subcordate, often asymmetrical, apex caudately blunt-acuminate (acumen 7-16 mm long); midrib sunken above, ± tomentose with erect hairs, raised below, puberulous-tomentose with erect and appressed hairs; secondary veins 13-18 per side, prominent below, angle with midrib 48°-60° (at middle part of blade). Inflorescences 2- to 4-flowered, terminal, developing to  $\pm$  leaf-opposed; peduncle inconspicuous, with one minute bract; rachis inconspicuous (when present), with minute bracts; pedicel c. 6 mm long, tomentose with erect and appressed hairs, bearing 1 cup-shaped bract, placed at pedicel midpoint or higher. Sepals free, ovate to broadly ovate,  $5-9 \times 5-6.5$  mm, outside and margin tomentose with erect and appressed hairs, inside puberulous with appressed hairs, apex blunt-acuminate. Outer petals linear (overall), portion above constriction  $60-88 \times 2.5-3$  mm, both sides and margin tomentose with mostly appressed hairs, constriction tomentose with mostly appressed hairs on outside and margin, inside tomentose with mostly erect hairs, portion below constriction  $6.5-7 \times 5.5-7$  mm, shortly clawed towards base, outside and margin tomentose with mostly appressed hairs, inside almost glabrous, apex of outer petals obtuse-roun-

Table 1. Main morphological differences between *Drepananthus* sp. [= *D. khaosoi* Damth. & Chaowasku, sp. nov.], *D. ridleyi* (King) Survesw. & R.M.K.Saunders and *D. pubescens* (Scheff.) Survesw. & R.M.K.Saunders.

Feature	Drepananthus sp. [= D. khaosoi, sp. nov.]	Drepananthus ridleyi	Drepananthus pubescens
Leaf blade size (cm)	24–30.6 × 11–15.4	15–25 × 7–9.5	10–23 × 4.4–10
Leaf base	cordate to rounded-subcordate	cuneate, occasionally $\pm$ obtuse	cuneate to rounded
Petal length (cm)	5.7–9.5	6.4–10.5	2–5
Monocarp morphology	subglobose to ellipsoid, not constricted between seeds when dry	ellipsoid-cylindrical to cylindrical, somewhat constricted between seeds when dry	ovoid to ovoid-ellipsoid, somewhat constricted between seeds when dry
Monocarp width (mm)	17–20.3	12–15	14–15
Length of monocarp stipe (mm)	nearly 0 to 1.5	3–6	c. 3
Pericarp thickness (mm)	2–3	0.5–0.7	0.9–1.6
Seed arrangement	interdigitated	uniseriate	uniseriate

ded; inner petals linear (overall), portion above constriction 52–80  $\times$  2–2.5 mm, both sides and margin tomentose with mostly appressed hairs, constriction tomentose with mostly appressed hairs on outside and margin, inside tomentose with erect hairs, portion below constriction  $5-6 \times 4$  mm, outside tomentose with mostly appressed hairs, margin (plus adjacent areas on outside) almost glabrous, inside glabrous, apex of inner petals obtuse. Torus  $\pm$  depressed hemispherical, tomentose-villous with erect hairs on areas surrounding each carpel socket and areas between stamens and carpels. Stamens 67-69 per flower, 1.6-2 mm long, connective apex truncate or with a slanted orientation and prolongation (outermost and innermost stamens). Carpels 11–14 per flower, 2.5–3 mm long; stigmas  $\pm$  elongated ellipsoid; ovaries tomentose-villous with appressed hairs; ovules 5 per ovary, uniseriate. Fruits each consisting of up to 7 monocarps which are subglobose to ellipsoid,  $18-27 \times 17-20.3$  mm, not constricted between seeds when dry, rather smooth, short-puberulous with erect and appressed hairs, stipe nearly 0 to 1.5 mm long; fruiting pedicel up to 10 mm long. Seeds 3-5 per monocarp, with interdigitated arrangement,  $\pm$  flattened D-shaped, 17–17.5  $\times$  11.5–12 mm, smooth, shiny, raphe slightly grooved to flat, hilum  $\pm$  elliptic, aril absent.

*Phenology.*—Flowering and fruiting material was collected in March.

*Distribution and habitat.*—This species is so far endemic to Narathiwat Province, southern Thailand. It occurs in disturbed evergreen forests surrounded by rubber and fruit tree plantations, c. 30 m from a stream.

*Field notes.*—Flowers strongly fragrant, petals pale yellow when mature.

*Provisional conservation status.*—Only five individuals of the new species in a single location were encountered. The area surveyed is about 6 km<sup>2</sup>. We also explored nearby areas, but no more individuals were found. Unfortunately, two of the five individuals were cut recently and the cleared area has been used for agricultural purposes. On the basis of this information, we provisionally assess the conservation status of the new species as Critically Endangered: CR B2ab(iii,v) based on IUCN Standards and Petitions Committee (2022).

*Etymology.*—As a noun in apposition, the specific epithet is derived from Khao Soi, a traditional northern Thai noodle soup claimed to be one of the best soups in the world, in allusion to the similar appearance between petals of the new species (Fig. 2a) and Khao Soi noodles. *Notes.*—As evidenced by a number of species described based on recently collected gatherings, especially in the family Annonaceae (e.g., Jongsook & al. 2020; Bunchalee & al. 2021; Leeratiwong & al. 2021; Wiya & al. 2021; Damthongdee & al. 2023), the discovery of *Drepananthus khaosoi* once again stresses the importance of Narathiwat Province, southern Thailand as one of the most underexplored areas in Thailand.

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#### AUTHORSHIP CONTRIBUTION STATEMENT

Anissara DAMTHONGDEE: Data curation, Investigation, Validation, Visualization, Writing-original draft, Writing-review & editing. Chanwut SAENGPHO: Formal analysis, Investigation, Writing-original draft. Chattida WIYA: Investigation, Validation, Writing-original draft, Writing-review & editing. Abdulromea BAKA: Resources, Writing-original draft. Kithisak CHANTHAMRONG: Resources, Writing - original draft. INPASSING UE-AREE: Investigation, Formal analysis, Funding acquisition, Investigation, Methodology, Supervision, Validation, Writing-original draft, Writing -review & editing.

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Appendix 1. Sample localities, voucher details and GenBank accession numbers for sequences used in the phylogenetic analyses. Accessions listed in the following order: *matK*, *psbA-trnH*, *rbcL*, *trnL-F* and *atpB-rbcL*. New accessions are marked with \*. Unavailable sequences are represented by -.

Annickia pilosa (Exell) Setten & Maas: Gabon, Sosef 1803 (WAG), AY743488, AY841444, AY743450, AY743469, AY841371. Cananga brandisiana (Pierre) I.M.Turner: Thailand, Chaowasku 105 (CMUB), MT810438, MT810383, MT810394, MT810405, MT810427. Cananga odorata (Lam.) Hook.f. & Thomson: Cult. Costa Rica, Chatrou & al. 93 (U), AY841394, AY841431, AY841602, AY841680, AY841372. Cananga odorata var. fruticosa (Craib) J.Sinclair: Thailand, Chaowasku 104 (CMUB), MT810439, MT810384, MT810395, MT810406, MT810428. Cleistopholis glauca Pierre ex Engl. & Diels: Gabon, Wieringa & al. 3278 (WAG), AY841395, AY841432, AY841603, AY841681, AY841373. Cvathocalyx annamensis Jovet-Ast: Vietnam, Poilane 5315 (P), HM173748, HM173719, HM173805, HM173776, -. Cyathocalyx globosus Merr.: The Philippines, Ramos & Edaño (Bureau of Science) 48315 (NY), HM173725, HM173696, HM173782, HM173754, -. Cyathocalyx harmandii (Finet & Gagnep.) R.J.Wang & R.M.K.Saunders: Thailand, Chaowasku 113 (CMUB), MT810440, MT810385, MT810396, MT810407, MT810429. Cyathocalyx magnifuctus R.J.Wang & R.M.K.Saunders: Cult. Thailand, Nakorn-Thiemchan NTC 31 (CMUB), MT810441, MT810386, MT810397, MT810408, MT810408. Cyathocalyx martabanicus Hook.f. & Thomson: Thailand, Nakorn-Thiemchan NTC 34 (CMUB), MT810442, MT810387, MT810398, MT810409, MT810431. Cyathocalyx sumatranus Scheff.: Cult. Bogor Bot. Gard. (XX.D.73), HM173737, HM173708, HM173794, HM173766, -. Cyathocalyx sp.: Cult. Bogor Bot. Gard. (XX.D.79), Chaowasku 117 (CMUB), MT810443, MT810388, MT810399, MT810410, MT810432. Cyathocalyx zeylanicus Champ. ex Hook.f. & Thomson: Sri Lanka, Jayasuriya 1868 (NY), HM173739, HM173710, HM173796, HM173768, - Drepananthus apoensis Elmer: The Philippines, Ramos 1662 (NY), HM173721, HM173692, HM173778, HM173750, -. Drepananthus biovulatus (Boerl.) Survesw. & R.M.K.Saunders: Borneo, Wong 3 (L), HM173722, HM173693, HM173779, HM173751, -. *Drepananthus cauliflorus* (Lauterb. & K.Schum.) Survesw. & R.M.K.Saunders: Papua New Guinea, Takeuchi & Kulang 11615 (NY), HM173723, HM173694, HM173780, HM173752, -. *Drepananthus* deltoideus (Airy Shaw) Survesw. & R.M.K.Saunders: Borneo, Kessler 621 (L), HM173724, HM173695, HM173781, HM173753, -. Drepananthus filiformis (Jovet-Ast) Ban: Vietnam, Nuraliev 849 (CMUB), MT810444, MT810389, MT810400, MT810411, MT810433. Drepananthus havilandii (Boerl.) Survesw. & R.M.K.Saunders: Borneo, Kessler & al. PK 2601 (HKU), HM173727, HM173698, HM173784, HM173756, -. Drepananthus hexagynus (Miq.) Survesw. & R.M.K.Saunders: Sumatra, Forbes 1648 (P), HM173740, HM173711, HM173797, HM173769, -. Drepananthus khaosoi Damth. & Chaowasku: Thailand, Chanthamrong & Baka 58 (CMUB), OR354865\*, OR354866\*, OR354867\*, OR354868\*, OR354868\*, OR354868\*. Drepananthus kingii (Boerl. ex Koord.) Survesw. & R.M.K.Saunders: Sulawesi, Burley & al. 3858 (NY), HM173728, HM173699, HM173785, HM173757, -. Drepananthus magnificus (Diels) Survesw. & R.M.K.Saunders: Borneo, Beaman 7168 (NY), HM173729, HM173700, HM173786, HM173758, -. Drepananthus obtusifolius (Becc. & Scheff.) Survesw. & R.M.K.Saunders: Papua New Guinea, Takeuchi & Regalado 10305 (NY), HM173732, HM173703, HM173789, HM173761, -. Drepananthus pahangensis M.R.Hend.: Peninsular Malaysia, David 032 (KL DB 32) (P), HM173741, HM173712, HM173798, -, -. Drepananthus polycarpus (C.T.White & W.D.Francis) Survesw. & R.M.K.Saunders: New Britain, Frodin NGF 26479 (NY), HM173733, HM173704, HM173790, HM173762, -. Drepananthus pruniferus Maingay ex Hook.f. & Thomson: Thailand, Chanthamrong & Baka 59 (CMUB), OR354870\*, OR354871\*, OR354872\*, OR354873\*, OR354869\*. Drepananthus pubescens (Scheff.) Survesw. & R.M.K.Saunders: Sumatra, Krukoff 4145 (NY), HM173735, HM173706, HM173792, HM173764, -. Drepananthus ramuliflorus Maingay ex Hook.f. & Thomson: Singapore, Chaowasku 150 (CMUB), MT810445, MT810390, MT810401, MT810412, MT810434. *Drepananthus ridleyi* (King) Survesw. & R.M.K.Saunders: Cult., Singapore Botanical Garden, Anon. 20040975 (without herbarium indicated), HM173736, HM173707, HM173793, HM173765, -. Drepananthus vitiensis (A.C.Sm.) Survesw. & R.M.K.Saunders: Fiji, Smith 1791 (NY), HM173738, HM173709, HM173795, HM173767, -. Lettowianthus stellatus Diels: Kenya, Robertson 7505 (WAG), EU169686, EU169730, EU169775, EU169753, -. Meiocarpidium oliverianum (Baill.) D.M.Johnson & N.A.Murray: Cameroon, van den Burg 89 (WAG), MT810446, MT810391, MT810402, MT810413, MT810435. Mezzettia parviflora Becc.: Thailand, Aongyong 13 (CMUB), MT810447, MT810392, MT810403, MT810414, MT810436.

Appendix 2. Specimens of *Drepananthus ridleyi* (King) Survesw. & R.M.K.Saunders and *Drepananthus pubescens* (Scheff.) Survesw. & R.M.K.Saunders [including heterotypic synonyms] studied via online platforms.

## Drepananthus ridleyi (King) Survesw. & R.M.K.Saunders

Lectotype of *Xylopia ridleyi* King [basionym of *Drepananthus ridleyi* (King) Survesw. & R.M.K.Saunders]: Singapore, Changi, 1892, Ridley 4711 (K<sup>1</sup>); isolectotypes CAL<sup>2</sup>, SING<sup>3</sup>; fl.

<sup>1</sup>http://specimens.kew.org/herbarium/K000691224
<sup>2</sup>http://ivh.bsi.gov.in/phanerogams-Details/en?link=CAL0000004605&column=szBarcode
<sup>3</sup>https://herbaria.plants.ox.ac.uk/bol/SING/image/SING0049720.jpg/Zoom?fpi=1
Representative specimens of *Drepananthus ridleyi* (King) Survesw. & R.M.K.Saunders:
Peninsular Malaysia, Pahang, 10 Jun. 2008, Chew FRI 60278 (L<sup>1</sup>); fr.
<sup>1</sup>https://data.biodiversitydata.nl/naturalis/specimen/L.3724901
Peninsular Malaysia, Johore, 21 Oct. 1997, Anon. s.n. (KL 4742) (P<sup>1</sup>); fl.
<sup>1</sup>https://science.mnhn.fr/institution/mnhn/collection/p/item/p01981710
Peninsular Malaysia, Trengganu, 13 May 1976, Chan FRI 25031 (L<sup>1</sup>); fr.
<sup>1</sup>https://data.biodiversitydata.nl/naturalis/specimen/L.1755672
Singapore, Bukit Timah Forest Reserve, 6 Jan. 1949, Sinclair SFN 37930 (L<sup>1</sup>); fr.
<sup>1</sup>https://data.biodiversitydata.nl/naturalis/specimen/L.1755668

## Drepananthus pubescens (Scheff.) Survesw. & R.M.K.Saunders

Neotype of *Cyathocalyx pubescens* Scheff. [basionym of *Drepananthus pubescens* (Scheff.) Survesw. & R.M.K.Saunders]: Indonesia, Java, cult. Kebun Raya Bogor sub XX.D.108, 29 January 1981, Okada 3380 (NY<sup>1</sup>); fl.

<sup>1</sup>https://sweetgum.nybg.org/science/vh/specimen-details/?irn=818656

Lectotype of *Xylopia scortechinii* King [a heterotypic synonym of *Drepananthus pubescens* (Scheff.) Survesw. & R.M.K.Saunders]: Peninsular Malaysia, Perak, Scortechini 1781 (K<sup>1</sup>); isolectotypes CAL<sup>2</sup>, L<sup>3</sup>; fl.

<sup>1</sup>http://specimens.kew.org/herbarium/K000691213

<sup>2</sup>https://ivh.bsi.gov.in/uploads/documents/PhanerogamsTypeHerbarium/english/CAL0000004573.jpg

<sup>3</sup>https://data.biodiversitydata.nl/naturalis/specimen/L%20%200037907

Holotype of *Drepananthus sumatranus* Merr. [a heterotypic synonym of *Drepananthus pubescens* (Scheff.) Survesw. & R.M.K.Saunders]: Sumatra, Sumatera Utara, Air Kandis near Ranta Parapat, Bila, 28 May–26 Jun. 1932, Rahmat Si Boeea 2464 (A<sup>1</sup>); isotypes CAS<sup>2</sup>, MICH<sup>3</sup>, MIN<sup>4</sup>, NY<sup>5</sup>, US<sup>6,7</sup>; fl.

<sup>1</sup>https://data.huh.harvard.edu/databases/specimen\_search.php?mode=details&id=7569 <sup>2</sup>http://ibss-images.calacademy.org/static/botany/originals/2c/f3/2cf31c1f-4b78-49cc-9e89-0dfdfe7daf00.jpg <sup>3</sup>https://quod.lib.umich.edu/cgi/i/image/api/image/herb00ic:1115395:MICH-V-1115395/full/res:0/0/native.jpg <sup>4</sup>https://s3.msi.umn.edu/mbaenrms3fs/images/MIN\_Plants/01002/1002853\_lg.jpg

<sup>5</sup>https://sweetgum.nybg.org/science/vh/specimen-details/?irn=134913

<sup>6</sup>https://ids.si.edu/ids/media\_view?id=ark:/65665/m3ddc5a42bd26043d585675f941868de48&defaultView=image\_dynamic <sup>7</sup>https://ids.si.edu/ids/media\_view?id=ark:/65665/m3b3f583bdc5f34f5ab824df55a31995b5&defaultView=image\_dynamic

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