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## Research article

# Uncovering five new species of *Polyalthia* (Annonaceae, Miliuseae) from Thailand: molecular and morphological congruence

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**Abstract.** Based on molecular phylogenetic analyses using seven plastid DNA markers (*matK*, *rbcL*, *ndhF* and *ycf1* exons; *trnL* intron; *psbA-trnH* and *trnL-trnF* intergenic spacers) and detailed morphological investigations, five new species of *Polyalthia* Blume (Annonaceae Juss.) from Thailand are recognized, described and illustrated. These species are: *P. acuminatissima* Wiya, Damth. & Chaowasku sp. nov. (from Nakhon Phanom Province, northeastern region), *P. esanensis* Wiya, Damth. & Chaowasku sp. nov. (from eastern and northeastern regions), *P. chiangmaica* Wiya, Damth. & Chaowasku sp. nov. (from Chiang Mai Province, northern region), *P. maxwelliana* Wiya, Chanthamrong & Chaowasku sp. nov. and *P. miliusifolia* Wiya, Chanthamrong & Chaowasku sp. nov. (both from Kanchanaburi Province, southwestern region). All five species belong to one of the three major clades within the genus. Three of them (*P. acuminatissima*, *P. esanensis* and *P. chiangmaica*) were previously misidentified as *P. evecta* (Pierre) Finet & Gagnep., which is polyphyletic. Comparisons with their phylogenetically related or morphologically similar species are provided and a key to the species of this major clade occurring in Thailand is included. The conservation status of all five new species is provisionally assessed as Data Deficient.

**Keywords.** Magnoliids, Malmeoideae, molecular phylogeny, systematics, taxonomy.

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## Introduction

The genus *Polyalthia* Blume (Blume 1830) belongs to Annonaceae Juss., a large angiosperm family prominent in lowland rainforests, comprising ca 108 genera (Damthongdee *et al.* 2024) and about 2550 species (Couvreur *et al.* 2022). It is classified within a recently established subtribe Popowiinae Chaowasku & D.C.Thomas of Miliuseae Hook.f. & Thomson, the largest tribe in the subfamily Malmeoideae Chatrou, Pirie, Erkens & Couvreur (Nge *et al.* 2024). Historically, *Polyalthia* has been taxonomically problematic due to the lack of distinct morphological diagnostic features. However, molecular phylogenetics has helped resolve these complexities, leading to generic realignments across the subfamily (Mols *et al.* 2008; Saunders *et al.* 2011; Xue *et al.* 2011, 2012, 2014, 2016, 2020; Chaowasku *et al.* 2012, 2015, 2018b; Tang *et al.* 2013). In its narrowly defined sense, *Polyalthia* consists of approximately 99 species distributed across tropical Asia and Oceania (Turner 2018; Shailajakumari *et al.* 2019; Bunchalee *et al.* 2019, 2021a, 2021b, 2025; Xue *et al.* 2020; Wiya & Chaowasku 2021). Members of the genus are shrubs, treelets or trees characterized by a combination of the following traits: (1) leaf blades with a usually reticulate tertiary venation, (2) a usually asymmetrical subcordate to cordate leaf base, (3) 1–8 ovule(s) per ovary and (4) seeds with  $\pm$  spiniform endosperm ruminations (Wiya & Chaowasku 2021; Bunchalee 2022).

Phylogenetically, *Polyalthia* is sister to *Popowia* Endl. (Endlicher 1839) and consists of three major clades (Chaowasku *et al.* 2012). One of these clades includes *Polyalthia suberosa* (Roxb.) Thwaites (Thwaites 1864; basionym: Roxburgh 1795) and related species, and has previously been referred to as the *P. suberosa* clade (Wiya & Chaowasku 2021). Members of the *P. suberosa* clade exhibit rather small flowers and free petals, which are (rather) thick and fleshy in inner petals (sometimes also outer petals); note that petals of both whorls in most species are unequal, with the outer petals being smaller and sometimes  $\pm$  sepaloid (Chaowasku *et al.* 2014; Wiya & Chaowasku 2021).

Among the species of *Polyalthia* reported for Thailand, about 11 belong to the *P. suberosa* clade (Wiya & Chaowasku 2021; Bunchalee 2022; Bunchalee *et al.* 2025). However, a particular species, *P. evecta* (Pierre) Finet & Gagnep. (Finet & Gagnepain 1906; basionym: Pierre 1881), is morphologically heterogeneous regarding indumentum on young twigs, leaf texture, length of leaf acumen, flowering pedicel and outer petal length, ratio of outer petal to inner petal length and number of carpels per flower.

In this study, we aim to clarify the taxonomy of *P. evecta* as well as some unidentified gatherings from Thailand by reconstructing molecular phylogenetic hypotheses for the genus *Polyalthia*, with emphasis on the species in the *P. suberosa* clade and inclusion of multiple accessions per species where possible.

## Material and methods

### Molecular phylogenetic analyses

Thirty-eight accessions comprised the ingroup: 37 of *Polyalthia* (representing 28 species plus five unidentifiable accessions from Thailand) and one of *Popowia hirta* Miq. (Miquel 1865). *Mitrephora alba* Ridl. (Ridley 1915), *Monocarpia maingayi* (Hook.f. & Thomson) I.M.Turner (Turner 2012a; basionym: Hooker & Thomson 1872) and *Orophea* sp. were assigned as outgroups. Voucher information and GenBank accession numbers of all accessions are indicated in Appendix 1. Seven plastid DNA regions (*matK*, *rbcL*, *ndhF* and *ycf1* exons; *trnL* intron; *psbA-trnH* and *trnL-trnF* intergenic spacers) were used. Nineteen accessions were newly sequenced for this study (Appendix 1). The methods for DNA extraction, amplification and sequencing used in the present study, including primer information,

followed Chaowasku *et al.* (2018a, 2018b, 2020). Sequences were edited using the Staden package (Staden *et al.* 2000) and, together with GenBank sequences, the data matrix was aligned by Multiple Sequence Comparison by Log-Expectation (MUSCLE; Edgar 2004) in MEGA11 (with default settings; Tamura *et al.* 2021). The aligned data matrix was subsequently manually checked and realigned where necessary using 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 comparable to the remaining sequences, following Pirie *et al.* (2006). In total, 6915 nucleotide plus four binary-coded indel characters were included. The simple method for indel coding of Simmons & Ochoterena (2000) was used, with the emphasis on less homoplastic and non-autapomorphic indel structures.

Maximum parsimony analysis was performed in TNT ver. 1.5 (Goloboff & Catalano 2016). All characters were equally weighted and unordered. The setting concerning collapsing rules was set to ‘max. length = 0’. Incongruence among plastid DNA regions was evaluated 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 *et al.* 2003), with default change probability ( $P = 33$ ). 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 IQ-TREE ver. 2.1.2 (Minh *et al.* 2020) under partition models (Chernomor *et al.* 2016) employed with the ‘-p’ command, whereas a Bayesian Markov chain Monte Carlo (MCMC; Yang & Rannala 1997) phylogenetic analysis was conducted in MrBayes ver. 3.2.7a (Ronquist *et al.* 2012). Both methods of phylogenetic reconstruction were analyzed via the CIPRES Science Gateway ver. 3.3 (Miller *et al.* 2010). The aligned data matrix was divided into six partitions based on DNA-region identity (the *trnL* intron and adjacent *trnL-trnF* intergenic spacer were combined into a single partition [= *trnL-F*]). The most suitable model of sequence evolution for each DNA partition was selected using the Akaike Information Criterion (AIC; Akaike 1974) scores calculated in jModelTest ver. 2.1.10 (Darriba *et 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 was selected for *matK*, *ndhF* and *psbA-trnH* partitions, whereas the Hasegawa-Kishino-Yano (HKY; Hasegawa *et al.* 1985) substitution model was chosen for *trnL-F* (= *trnL* intron + *trnL-trnF* intergenic spacer) and HKY substitution model with a gamma distribution for among-site rate variation was chosen for the remaining partitions (*rbcL* and *ycf1* exons). In the maximum likelihood analysis, the model ‘JC2+FQ+ASC’ was selected using the corrected AIC scores for the binary indel partition. Clade support was assessed by a non-parametric bootstrap resampling (BS; Felsenstein 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 ‘coding=variable’ setting 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 with four MCMC chains, were simultaneously performed; 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 1000<sup>th</sup> 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 ver. 1.7.1 (Rambaut *et al.* 2018). The first 25% of all trees sampled were removed as burn-in and the 50% majority-rule consensus tree was produced from the remaining trees. A clade with posterior probabilities (PP)  $\geq 0.95$ , 0.9–0.94 or 0.5–0.89 was considered strongly supported, weakly supported or unsupported, respectively.

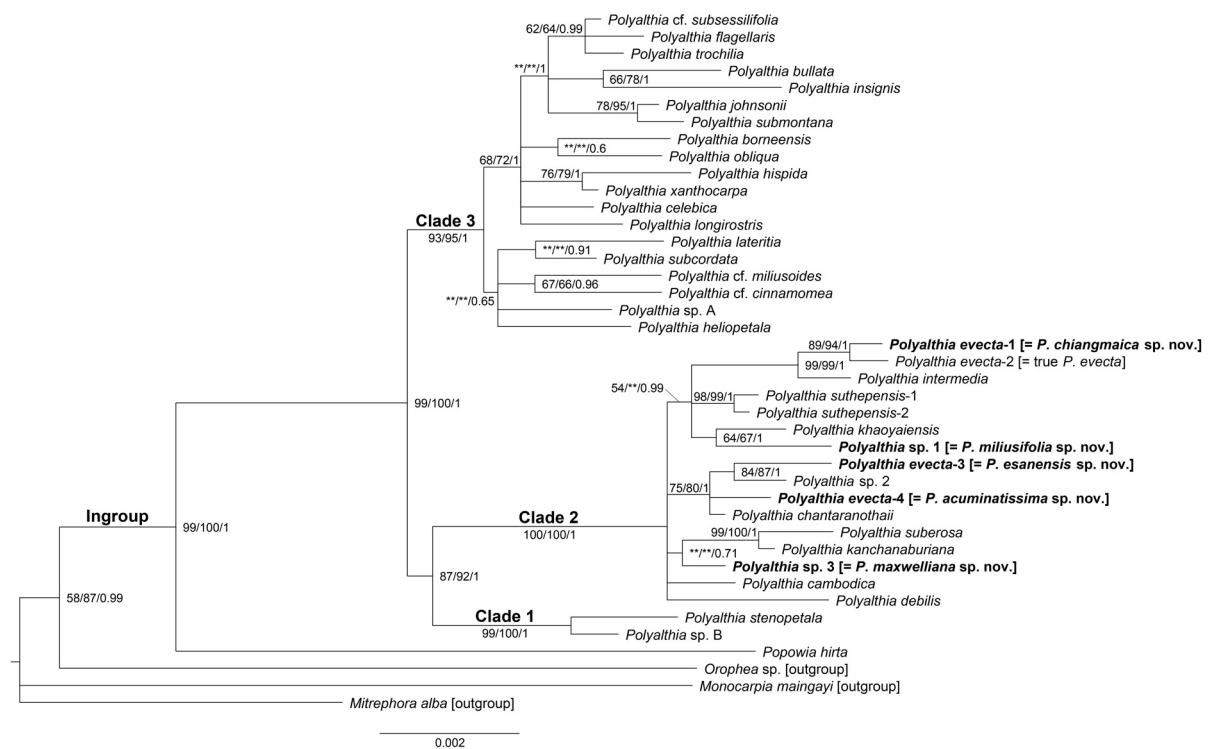
## Morphological study

Morphological data of relevant species of *Polyalthia* were derived from literature (Pierre 1881; Finet & Gagnepain 1906; Ridley 1912; Ast 1938; Jovet-Ast 1940; Bân 2000; Khumchompoo & Thongpukdee 2005; Bunchalee *et al.* 2019, 2021b, 2025; Wiya & Chaowasku 2021; Bunchalee 2022), personal observations based on their type specimens at the herbaria BK, BM, CAL, K, L and P (see Appendix 2) and other specimens [*Chaowasku 234* (QBG): *P. intermedia* (Pierre) Bân (Bân 2000; basionym: Pierre 1881); *Sichaikhan 9* (QBG): *P. khaosokensis* Bunchalee, Leerat. & Sinbumr. (Bunchalee *et al.* 2025)]. Acronyms of herbaria follow Index Herbariorum (Thiers continuously updated). Some floral organs (sepals, petals, stamens and carpels) of the specimens studied were observed and measured using spirit material. The indumentum terminology used followed Hewson (1988).

## Results

### Phylogenetic relationships and morphological comparisons

The maximum parsimony analysis resulted in 21 650 most parsimonious trees with 586 steps. The consistency and retention indices (CI and RI) were 0.87 and 0.89, respectively. There was no strong topological conflict (SR  $\geq 85\%$ ) in the analyses of each plastid DNA region. The phylogenetic results (Fig. 1) showed the monophyly for the ingroup (*Popowia-Polyalthia*) and for the genus *Polyalthia*, both with strong support (SR = 99%, BS = 100%, PP = 1). Three major clades (clades 1–3) in *Polyalthia* were recovered. The strongly supported (SR = 99%, BS = 100%, PP = 1) clade 1 was sister to the maximally supported clade 2 with strong support (SR = 87%, BS = 92%, PP = 1). A larger clade composed of clades 1 and 2 was sister to the strongly supported (SR = 93%, BS = 95%, PP = 1) clade 3, which included, among others, the recently described *P. heliopenetala* Leerat. & Bunchalee (in Bunchalee *et al.*



**Fig. 1.** Phylogram derived from Bayesian inference, with support values indicated: SR (maximum parsimony symmetric resampling values) / BS (maximum likelihood bootstrap values) / PP (posterior probabilities). \*\* =  $< 50\%$ . New species in **bold**. Scale bar unit: substitutions per site.

2021a) and *Polyalthia* sp. A. Clade 1 consisted of two accessions: *P. stenopetala* (Hook.f. & Thomson) Finet & Gagnep. (Finet & Gagnepain 1906; basionym: Hooker & Thomson 1855) and *Polyalthia* sp. B. The relationships in clades 2 and 3 were largely unresolved (Fig. 1). In clade 2, *Polyalthia evecta-1*, *P. evecta-2*, *P. intermedia*, *P. suthepensis-1*, *P. suthepensis-2*, *P. khaoyaiensis* Bunchalee & Chantar. (in Bunchalee *et al.* 2019) and *Polyalthia* sp. 1 were recovered in an unsupported to strongly supported (SR = 54%, BS < 50%, PP = 0.99) clade; in this clade, there was a trichotomy consisting of (1) a strongly supported (SR = 99%, BS = 99%, PP = 1) clade comprising *P. evecta-1*, *P. evecta-2* and *P. intermedia*, with the first two accessions forming a strongly supported (SR = 89%, BS = 94%, PP = 1) clade, (2) a strongly supported (SR = 98%, BS = 99%, PP = 1) clade comprising two accessions of *P. suthepensis* Wiya & Chaowasku (Wiya & Chaowasku 2021) and (3) a weakly to strongly supported (SR = 64%, BS = 67%, PP = 1) clade composed of *P. khaoyaiensis* and *Polyalthia* sp. 1. *Polyalthia evecta-3*, *Polyalthia* sp. 2, *P. evecta-4* and *P. chantaranothaii* Bunchalee & Chalermglin (in Bunchalee *et al.* 2021b) belonged to a moderately to strongly supported (SR = 75%, BS = 80%, PP = 1) clade; in this clade, *P. evecta-3* and *Polyalthia* sp. 2 were sister to each other with moderate to strong support (SR = 84%, BS = 87%, PP = 1). A clade consisting of *P. evecta-3* and *Polyalthia* sp. 2 formed a trichotomy with *P. evecta-4* and *P. chantaranothaii*. *Polyalthia suberosa*, *P. kanchanaburiana* Khumch. & Thongp. (Khumchompoo & Thongpakdee 2005) and *Polyalthia* sp. 3 were retrieved in an unsupported (SR < 50%, BS < 50%, PP = 0.71) clade, with the first two accessions forming a strongly supported (SR = 99%, BS = 100%, PP = 1) clade.

It is apparent that the polyphyletic *P. evecta* (Fig. 1) should be reclassified. Upon comparisons, *P. evecta-2* (collected in Vietnam) morphologically corresponds well with the lectotype and isolectotypes of *Unona evecta*, the basionym of *P. evecta*, which were also collected in Vietnam; thus, it is considered as the true *P. evecta*. *Polyalthia evecta-1* is sister to the true *P. evecta*, but the two are morphologically different in several features as shown in Table 1. *Polyalthia evecta-1* also differs morphologically from *P. intermedia* (Table 1); therefore, it deserves recognition as a new species (*P. Chiangmaica* sp. nov.), which is described below.

Although *Polyalthia* sp. 1 is sister to *P. khaoyaiensis*, their morphology differs substantially (Table 2). *Polyalthia* sp. 1 is morphologically quite similar to *P. minima* Jovet-Ast (Jovet-Ast 1940) endemic to Vietnam, but differs from it in several traits as shown in Table 2. Consequently, it is described below as a new species (*P. miliusifolia* sp. nov.). Unfortunately, *P. minima* has not been included in the molecular phylogenetic inferences because the holotype (collected in 1930) is the only specimen available for this species.

*Polyalthia evecta-3* is sister to *Polyalthia* sp. 2; however, it is morphologically more similar to *P. evecta-4* and *P. chantaranothaii*, both of which are also phylogenetically related to *P. evecta-3* (Fig. 1). Table 3 shows their differences, as well as their differences from the true *P. evecta*, which is more distantly related (Fig. 1). Based on these findings, two new species (*P. esanensis* sp. nov. and *P. acuminatissima* sp. nov.) are warranted and described below.

The phylogenetic affinities of *Polyalthia* sp. 3 are still uncertain (Fig. 1). It is morphologically most similar to *P. khaoyaiensis*, which is quite distantly related (Fig. 1). The two differ from each other in several features (Table 4). Hence, *Polyalthia* sp. 3 is described below as new to science (*P. maxwelliana* sp. nov.).

### **Provisional conservation assessments**

Because each of the five new species is known from a limited number of gatherings collected from one or a few location(s), the conservation category Data Deficient (DD) (IUCN Standards and Petitions Committee 2024) is provisionally applied to all five new species.

## Taxonomy

Order Magnoliales Juss. ex Bercht. & J.Presl  
Family Annonaceae Juss., nom. cons.  
Tribe Miliuseae Hook.f. & Thomson  
Genus *Polyalthia* Blume

*Polyalthia chiangmaica* Wiya, Damth. & Chaowasku sp. nov.  
urn:lsid:ipni.org:names:77365544-1  
Figs 1–3, 12; Table 1

## Diagnosis

Morphologically most similar to *P. evecta* and *P. intermedia* but differs mainly from them by different combinations of features (flowering pedicel and outer petal length, ratio of outer petal to inner petal length and number of carpels per flower) as shown in Table 1.

## Etymology

The specific epithet refers to Chiang Mai Province of northern Thailand where the new species occurs.

## Type material

### Holotype

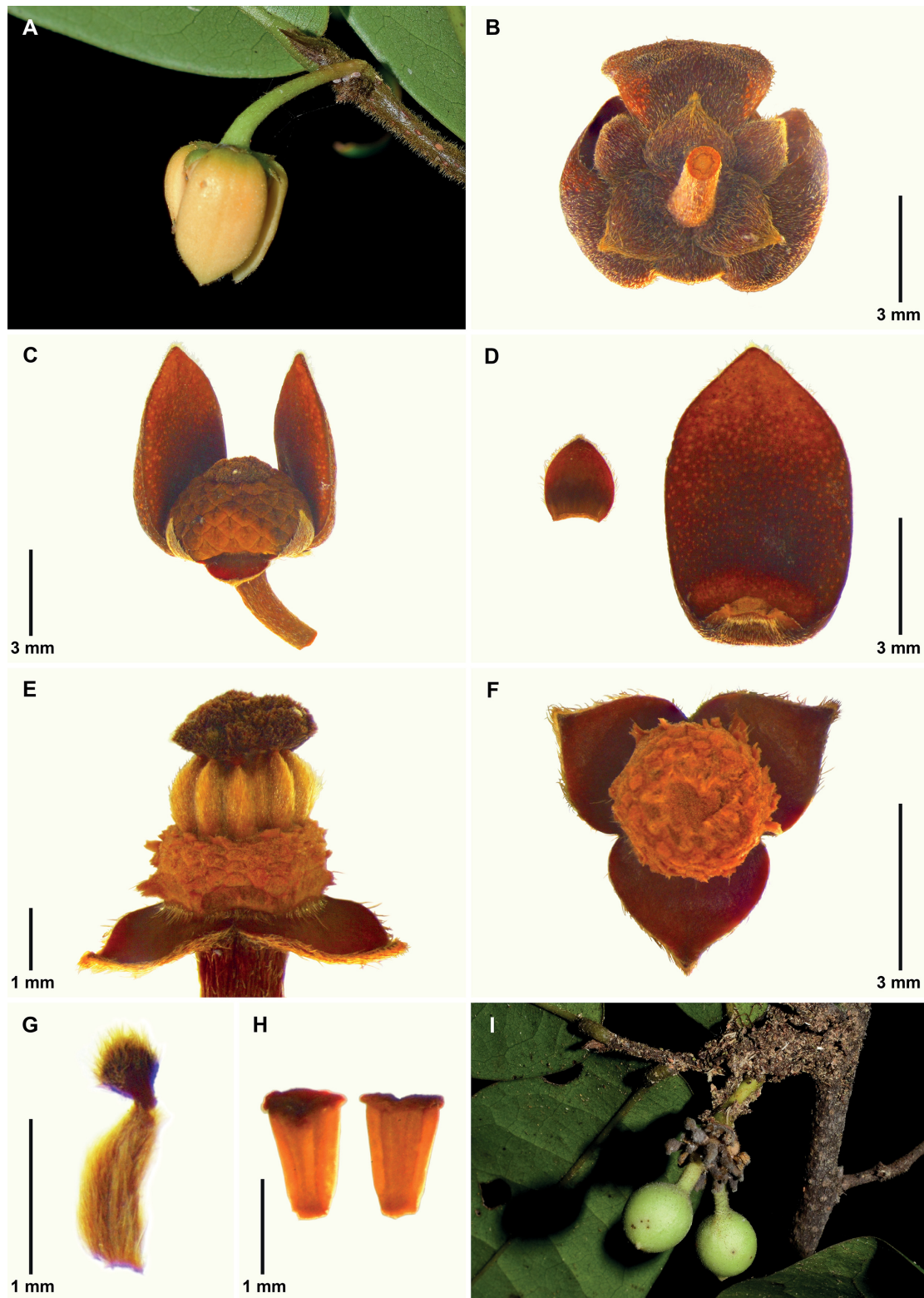
THAILAND • Chiang Mai Province, Chiang Dao District, Chiang Dao Subdistrict; Dec. 2021; fl., fr.; *Chaowasku* 229; holotype: CMUB [CMUB004001201]; isotypes: BK, CMUB, PBM, QBG.

### Paratype

THAILAND • Chiang Mai Province, Chiang Dao District, Chiang Dao Subdistrict; Oct. 2022; fl., fr.; *Chaowasku* 232; QBG.

## Description

Shrubs ca 6 m tall; young twigs tomentose-villous with appressed and erect hairs. Petiole 1.5–3.0 mm long, puberulous-pilose with mostly appressed hairs, slightly grooved above; leaf blade chartaceous, elliptic, rarely elliptic-obovate, 8.0–18.5 × 3.0–7.6 cm, glabrous above, puberulous with appressed hairs below, base obtuse to obtuse-subcordate, apex acute to acute-obtuse, rarely obtuse; midrib slightly sunken above, puberulous with erect hairs, raised below, puberulous with appressed hairs; secondary veins 9–14 per side, rather distinct below, angle with midrib 55°–70° (at middle part of leaf blade). Inflorescences 1- to 4-flowered, terminal (developing to internodal); peduncle inconspicuous to 3 mm long; rachis ca 7 mm long when present, tomentose with appressed and erect hairs, with scars of fallen flowers; pedicel 6.5–8.0 mm long, puberulous intermixed with pilose, hairs appressed and erect, bearing 1 ovate-triangular bract. Sepals free, broadly ovate, 2.0–2.5 × 2.8–3.0 mm, outside and margin tomentose-villous with mostly appressed hairs, inside almost glabrous. Outer petals ovate to broadly ovate, 2.2–2.5 × 1.9–2.0 mm, outside tomentose with appressed hairs, margin tomentose with appressed and erect hairs, inside almost glabrous, apex ± acute; inner petals ± pale yellow-orange in vivo at maturity, elliptic-oblong, 7.5–8.2 × 4.5–5.0 mm, outside tomentose with appressed hairs, margin tomentose with appressed and erect hairs, inside glabrous, apex ± acute. Stamens ca 100 per flower, 1.3–1.5 mm long, connective apex truncate, covering thecae. Carpels 16–22 per flower, 1.7–1.9 mm long; stigmas obovoid; ovaries tomentose-villous with appressed hairs; ovule 1 per ovary, basal. Torus elevated, flat-topped. Each fruit consisting of up to 2 monocarps which are globose to subglobose, 6.0–7.5 × 6.0–6.5 mm, smooth and puberulous-tomentose with mostly appressed hairs, apex short-apiculate, stipe 2.0–5.5 mm long, sometimes slightly obliquely attached to monocarps, tomentose with appressed and erect hairs; fruiting pedicel to 20 mm long. Seed 1 per monocarp, subglobose, ca 6.3 × 5.8 mm.



**Fig. 2.** *Polyalthia chiangmaica* Wiya, Damth. & Chaowasku sp. nov. **A.** Flower, side view. **B.** Flower, bottom view. **C.** Flower with one inner petal removed, side view. **D.** Adaxial side of outer (left) and inner (right) petals. **E.** Flower with petals and stamens removed, side view, showing carpels on torus. **F.** Flower with petals, stamens and carpels removed, top view. **G.** Carpel. **H.** Stamen: adaxial (left) and abaxial (right) sides. **I.** Monocarps. All from *Chaowasku* 229 (CMUB).



**Fig. 3.** Holotype of *Polyalthia chiangmaica* Wiya, Damth. & Chaowasku sp. nov. (*Chaowasku* 229; CMUB004001201).

**Table 1.** Morphological comparisons between *Polyalthia evecta*-1 [= *P. chiangmaica* Wiya, Damth. & Chaowasku sp. nov.], *P. evecta*-2 [= true *P. evecta* (Pierre) Finet & Gagnep.] and *P. intermedia* (Pierre) Bân. Data for the true *P. evecta* are from Pierre (1881) and personal observations; data for *P. intermedia* are from Pierre (1881), Bân (2000) and personal observations.

| Feature                                    | <i>P. evecta</i> -1<br>[= <i>P. chiangmaica</i> sp. nov.] | <i>P. evecta</i> -2<br>[= true <i>P. evecta</i> ] | <i>P. intermedia</i> |
|--|---|---|----------------------|
| Pedicle length (mm; in flower)             | 6.5–8.0   | (12.5–)15.0–30.0                                  | 13.0–28.0            |
| Ratio of outer petal to inner petal length | ca 1/3  | ca 1/2  | ca 1/2               |
| Outer petal length (mm)                    | 2.2–2.5   | 4.5–5.5   | 4.0–5.0(–6.5)        |
| Number of carpels per flower               | 16–22   | (30–)40–60  | 6–20                 |

### Habitat and phenology

The new species occurs in secondary forests adjacent to dry evergreen forests, near a stream. The elevation is ca 500 m. Flowering and fruiting material was collected in October and December.

### Distribution

Chiang Mai Province, northern Thailand.

### Preliminary conservation assessment

Data Deficient (DD).

*Polyalthia miliusifolia* Wiya, Chanthamrong & Chaowasku sp. nov.

urn:lsid:ipni.org:names:77365545-1

Figs 1, 4–5, 12; Table 2

### Diagnosis

Morphologically most similar to *P. minima*, but differs mainly from it in several features (indumentum on young twigs and lower leaf midrib, flowering pedicel length, outer petal shape and apex, number of carpels per flower and stigma shape) as shown in Table 2.

### Etymology

The leaves of the new species look somewhat similar to those of certain species of *Miliusa* Lesch. ex A.DC. (de Candolle 1832), e.g., *M. astiana* Chaowasku & Kessler (Chaowasku & Kessler 2014), *M. fragrans* Chaowasku & Kessler (Chaowasku & Kessler 2013), *M. fusca* Pierre (Pierre 1881) and *M. parvifolia* (Kurz) Damth. & Chaowasku (Damthongdee & Chaowasku 2022; basionym: Kurz 1875); hence, its specific epithet.

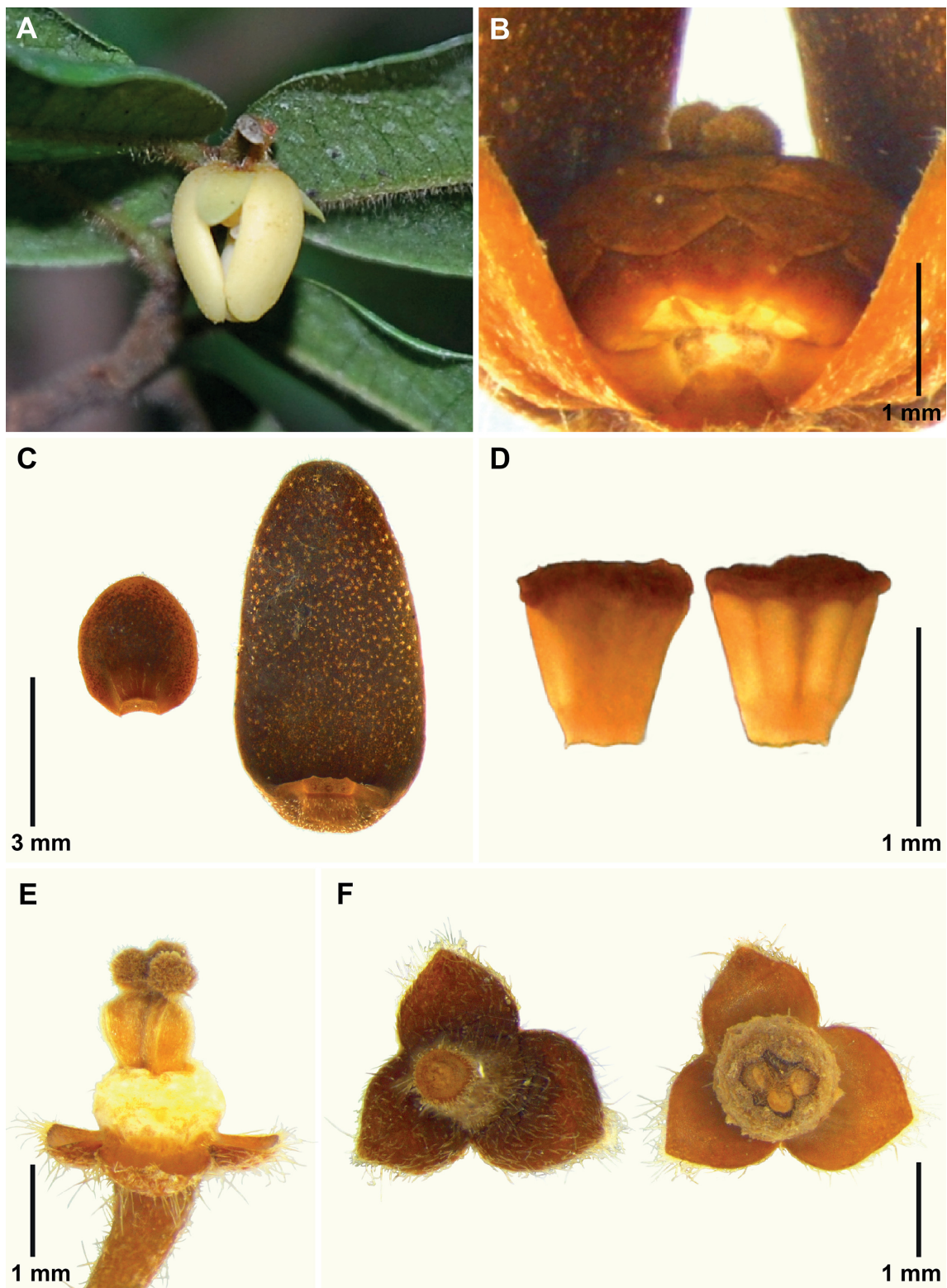
### Type material

#### Holotype

THAILAND • Cult. in Nakhon Si Thammarat Province (originally from Chalae Subdistrict, Thong Pha Phum District, Kanchanaburi Province); Jul. 2022; fl.; *Chanthamrong* 74; holotype: CMUB [CMUB004000901]; isotypes: PBM, QBG.

#### Paratypes

THAILAND • same data as for holotype; Nov. 2020; fl.; *Chaowasku* 228; QBG • same data as for preceding; Nov. 2022; fl.; *Chaowasku* 233; QBG • same data as for preceding; Jul. 2023; fl.; *Chanthamrong* 75; QBG.



**Fig. 4.** *Polyalthia miliusifolia* Wiya, Chanthamrong & Chaowasku sp. nov. **A.** Flower, side view. **B.** Flower enlarged, side view, showing stamens surrounding carpels. **C.** Adaxial side of outer (left) and inner (right) petals. **D.** Stamen: adaxial (left) and abaxial (right) sides. **E.** Flower with petals and stamens removed, side view, showing carpels on torus. **F.** Flower with petals, stamens and carpels removed, bottom (left) and top (right) views. A–B, D–E from *Chanthamrong* 75 (QBG); C, F from *Chaowasku* 228 (QBG).



**Fig. 5.** Holotype of *Polyalthia miliusifolia* Wiya, Chanthamrong & Chaowasku sp. nov. (Chanthamrong 74; CMUB004000901).

**Table 2.** Morphological comparisons between *Polyalthia* sp. 1 [= *P. miliusifolia* Wiya, Chanthamrong & Chaowasku sp. nov.], *P. minima* Jovet-Ast and *P. khaoyaiensis* Bunchalee & Chantar. Data for *P. minima* are from Ast (1938), Jovet-Ast (1940) and personal observations; data for *P. khaoyaiensis* are from Bunchalee *et al.* (2019) and personal observations.

| Feature                         | <i>Polyalthia</i> sp. 1<br>[= <i>P. miliusifolia</i> sp. nov.] | <i>P. minima</i>       | <i>P. khaoyaiensis</i> |
|---------------------------------|--|------------------------|------------------------|
| Indumentum on young twigs       | long and dense   | short and rather dense | short and dense        |
| Leaf size (cm)                  | 3.7–7.5 × 1.4–2.6  | ca 4.5 × 1.5           | 12.0–21.0 × 3.0–8.0    |
| Indumentum on lower leaf midrib | long and dense   | short and sparse       | no data available      |
| Pedicle length (mm; in flower)  | 1.8–2.0  | 5.0–6.0                | 3.0–5.0                |
| Outer petal shape               | broadly ovate to subcircular                                   | ovate                  | ovate                  |
| Outer petal apex                | obtuse to rounded  | acute                  | acute                  |
| Number of carpels per flower    | 3  | numerous               | numerous               |
| Stigma shape                    | globose  | obovoid                | rounded-clavate        |

### Description

Treelets ca 0.6 m tall; young twigs villous with appressed and erect hairs. Petiole 1.0–2.0 mm long, indumentum similar to that of young twigs, slightly grooved above; leaf blade chartaceous, elliptic, rarely elliptic-obovate, 3.7–7.5 × 1.4–2.6 cm, almost glabrous above, villous with appressed and erect hairs below, base obtuse-subcordate to rounded-subcordate, rarely obtuse, apex ± acute, rarely obtuse, rounded or caudately short-acuminate; midrib slightly sunken above, villous with erect hairs, raised below, villous with appressed and erect hairs; secondary veins 7–10 per side, rather indistinct below, angle with midrib 60°–70° (at middle part of leaf blade). Inflorescences 2- or 3-flowered, terminal; peduncle and rachis (when present) inconspicuous; pedicel 1.8–2.0 mm long, velvety with appressed and erect hairs, bearing 1 ovate-triangular bract. Sepals free, broadly ovate to ± transversely ovate, 1.0–1.2 × 1.1–1.8 mm, outside and margin velvety with appressed and erect hairs, inside glabrous. Outer petals broadly ovate to subcircular, 2.3–3.0 × 1.9–2.5 mm, outside tomentose with appressed hairs, margin tomentose with appressed and erect hairs, inside almost glabrous, apex obtuse to rounded; inner petals ± cream in vivo at maturity, ovate-elliptic to elliptic-oblong, 6.8–7.5 × 3.0–3.5 mm, outside tomentose with appressed hairs, margin tomentose with mostly appressed hairs, inside almost glabrous, apex obtuse to rounded. Stamens ca 28 per flower, 1.0–1.1 mm long, connective apex truncate, covering thecae. Carpels 3 per flower, ca 1.5 mm long; stigmas globose; ovaries tomentose with appressed hairs; ovule 1 per ovary, basal. Torus depressed subglobose. Fruit unknown.

### Habitat (at original locality) and phenology

The new species occurs in dry evergreen forests, near a stream. The elevation (at original locality) is ca 450 m. Flowering material was collected in July and November.

### Distribution

Kanchanaburi Province, southwestern Thailand.

### Preliminary conservation assessment

Data Deficient (DD).

*Polyalthia esanensis* Wiya, Damth. & Chaowasku sp. nov.

urn:lsid:ipni.org:names:77365546-1

Figs 1, 6–7, 12; Table 3

**Diagnosis**

Morphologically most similar to *P. chantaranothaii* and *P. acuminatissima* sp. nov. (another new species described below; = *P. evecta*-4), but can be chiefly distinguished from the two by different combinations of traits (indumentum on young twigs, leaf texture, length of leaf acumen and outer petal length) as shown in Table 3.

**Etymology**

Named after ‘Esan’, an informal name for eastern and northeastern regions of Thailand where this species occurs.

**Type material**

**Holotype**

THAILAND • Amnat Charoen Province, Chanuman District, Khok Kong Subdistrict; Jul. 2019; fl.; *Chaowasku* 225; holotype: CMUB [CMUB004001101]; isotype: QBG.

**Paratypes**

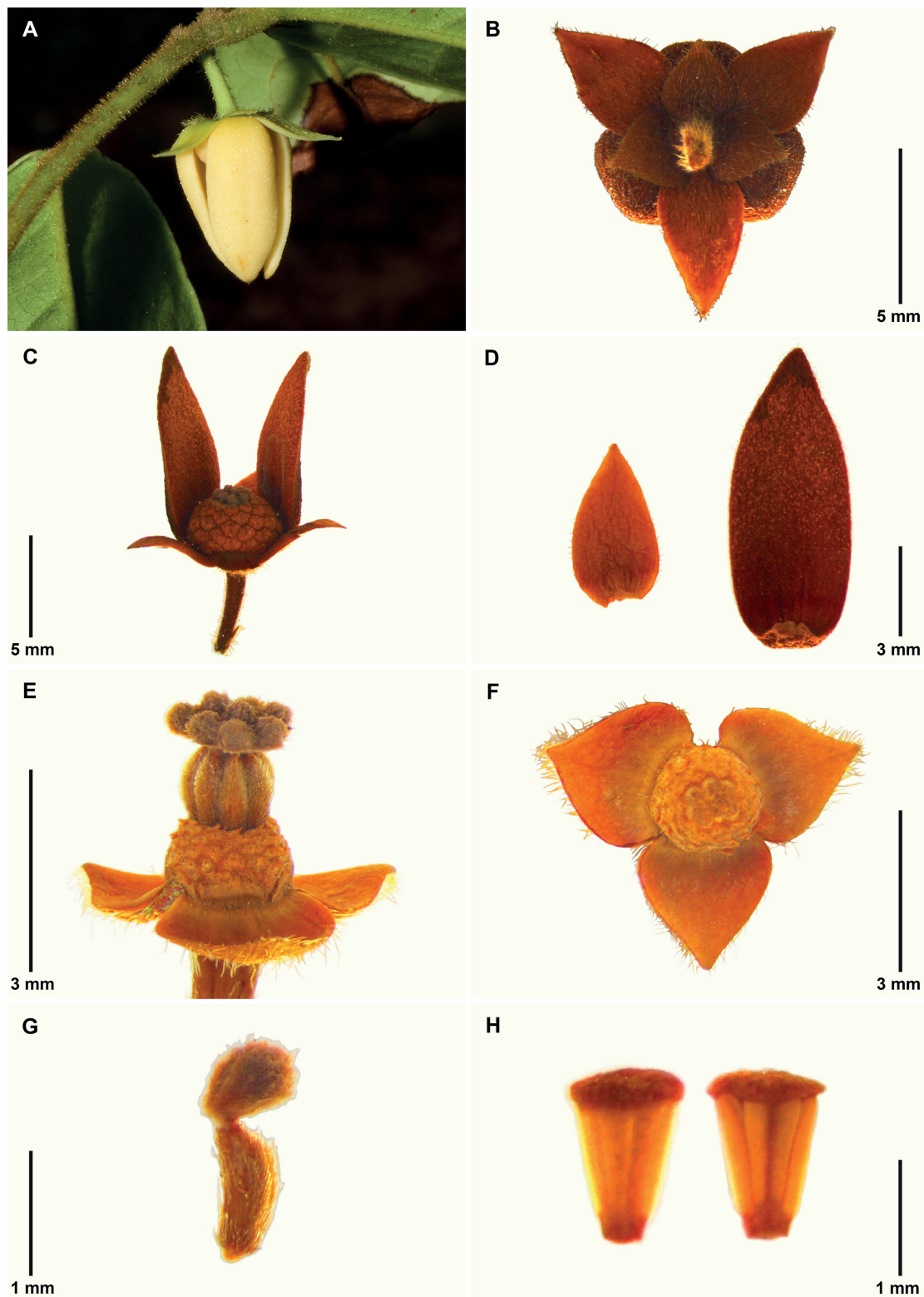
THAILAND • Udon Thani Province, Nong Saeng District, Thap Kung Subdistrict; Jul. 2019; fl., fr.; *Chaowasku* 226; QBG • same data as for holotype; May 2022; fl., young fr.; *Chaowasku* 230; QBG.

**Description**

Treelets ca 1.5 m tall; young twigs tomentose-villous to villous, hairs erect only or appressed and erect. Petiole 2.0–4.0 mm long, velvety with mostly erect hairs, slightly grooved above; leaf blade chartaceous, elliptic to obovate, sometimes narrowly obovate, 7.9–15.8 × 2.5–4.3 cm, puberulous with appressed hairs above, puberulous-tomentose intermixed with pilose below, hairs appressed only or appressed and erect, base obtuse-subcordate to rounded-subcordate, rarely obtuse, apex caudately short-acuminate (acumen 6.0–9.0 mm) to acute-acuminate, rarely acute to obtuse; midrib slightly sunken to flat above, tomentose-villous with erect hairs, raised below, velvety with appressed and erect hairs; secondary veins 8–13 per side, rather distinct below, angle with midrib 50°–70° (at middle part of leaf blade). Inflorescences 1- to 4-flowered, terminal (developing to internodal or ± leaf-opposed); peduncle and rachis (when present)

**Table 3.** Morphological comparisons between *Polyalthia evecta*-3 [= *P. esanensis* Wiya, Damth. & Chaowasku sp. nov.], *P. evecta*-4 [= *P. acuminatissima* Wiya, Damth. & Chaowasku sp. nov.], *P. evecta*-2 [= true *P. evecta* (Pierre) Finet & Gagnep.] and *P. chantaranothaii* Bunchalee & Chalermglin. Data for the true *P. evecta* are from Pierre (1881) and personal observations; data for *P. chantaranothaii* are from Bunchalee *et al.* (2021b) and personal observations.

| Feature                        | <i>P. evecta</i> -3<br>[= <i>P. esanensis</i><br>sp. nov.] | <i>P. evecta</i> -4<br>[= <i>P. acuminatissima</i><br>sp. nov.] | <i>P. evecta</i> -2<br>[= true <i>P. evecta</i> ] | <i>P. chantaranothaii</i> |
|--------------------------------|--|---|---|---------------------------|
| Young twigs                    | densely hairy  | sparsely hairy  | densely hairy                                     | densely hairy             |
| Leaf texture                   | chartaceous  | chartaceous-subcoriaceous                                       | no data available                                 | chartaceous               |
| Length of leaf acumen (mm)     | 6.0–9.0  | (12.0–)16.0–26.0  | 0 (acumen absent)                                 | 10.0–15.0                 |
| Pedical length (mm; in flower) | 5.0–11.0   | 4.5–11.0  | (12.5–)15.0–30.0                                  | 4.0–6.0                   |
| Outer petal length (mm)        | 5.5–5.8  | 4.5–5.5   | 4.5–5.5   | 2.0–2.5                   |
| Number of carpels per flower   | 7–13   | 4–11  | (30–)40–60  | 10–15                     |



**Fig. 6.** *Polyalthia esanensis* Wiya, Damth. & Chaowasku sp. nov. **A.** Flower, side view. **B.** Flower, bottom view. **C.** Flower with one inner petal removed, side view. **D.** Adaxial side of outer (left) and inner (right) petals. **E.** Flower with petals and stamens removed, side view, showing carpels on torus. **F.** Flower with petals, stamens and carpels removed, top view. **G.** Carpel. **H.** Stamen: adaxial (left) and abaxial (right) sides. All from *Chaowasku 230* (QBG).



**Fig. 7.** Holotype of *Polyalthia esanensis* Wiya, Damth. & Chaowasku sp. nov. (Chaowasku 225; CMUB004001101).

inconspicuous; pedicel 5.0–11.0 mm long, velvety with appressed and erect hairs, bearing 1 ovate-triangular bract. Sepals free, broadly ovate, 2.5–3.0 × 2.6–3.1 mm, outside and margin velvety with appressed and erect hairs, inside glabrous. Outer petals ovate to ovate-triangular, 5.5–5.8 × 3.0–3.2 mm, outside tomentose with mostly appressed hairs, margin tomentose with appressed and erect hairs, inside glabrous, apex acute; inner petals ± pale yellow in vivo at maturity, ovate to ovate-elliptic, 9.7–10.5 × 3.8–4.2 mm, outside and margin tomentose with mostly appressed hairs, inside almost glabrous, apex ± acute. Stamens 60–84 per flower, 1.2–1.6 mm long, connective apex truncate, covering thecae. Carpels 7–13 per flower, 1.8–2.0 mm long; stigmas ± obovoid; ovaries tomentose with appressed hairs; ovule 1 per ovary, basal. Torus depressed subglobose. Each fruit consisting of up to 6 monocarps which are ± subglobose, 5.5–7.0 × 5.3–6.0 mm, smooth and puberulous with mostly appressed hairs, apex not apiculate, stipe 5.5–7.0 mm long, often slightly obliquely attached to monocarps, indumentum similar to that of monocarps but a bit denser; fruiting pedicel ca 17.0 mm long. Seed 1 per monocarp, subglobose, ca 6.0 × 5.5 mm.

### Habitat and phenology

The new species occurs in partially disturbed deciduous forests, near a stream. The elevation is 150–570 m. Flowering and fruiting material was collected in May and July.

### Distribution

Eastern and northeastern Thailand.

### Preliminary conservation assessment

Data Deficient (DD).

*Polyalthia acuminatissima* Wiya, Damth. & Chaowasku sp. nov.

urn:lsid:ipni.org:names:77365547-1

Figs 1, 8–9, 12; Table 3

### Diagnosis

Morphologically most similar to *P. chantaranothaii* and *P. esanensis* sp. nov., but principally differs from the two by different combinations of features (indumentum on young twigs, leaf texture, length of leaf acumen and outer petal length) as shown in Table 3.

### Etymology

The specific epithet refers to the usually distinctly elongated leaf apex.

### Type material

#### Holotype

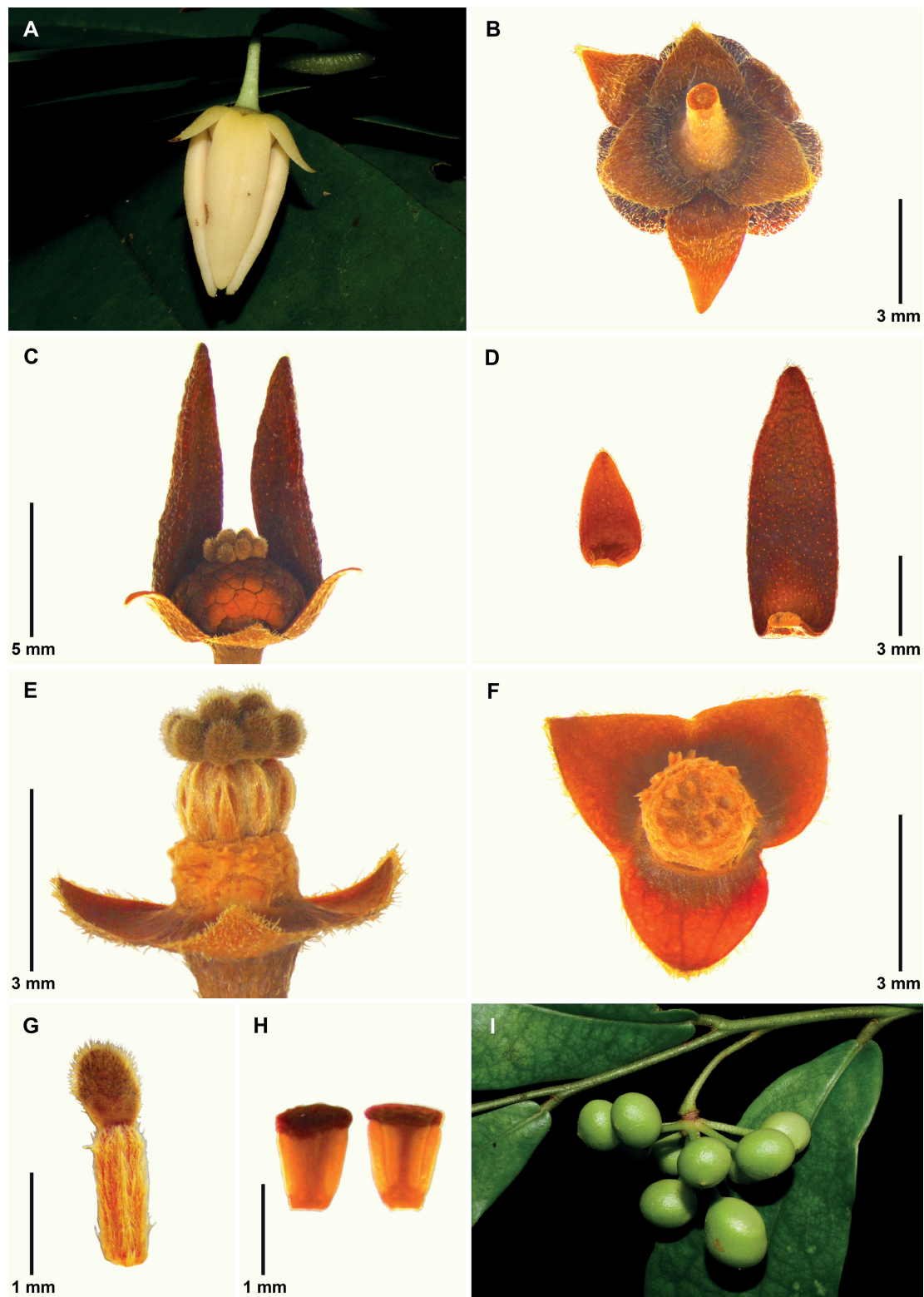
THAILAND • Nakhon Phanom Province, Ban Phaeng District, Phai Lom Subdistrict; May 2022; fl., fr.; *Chaowasku 231*; holotype: CMUB [CMUB004001001]; isotypes: BK, CMUB, PBM, QBG.

#### Paratype

THAILAND • Nakhon Phanom Province, Ban Phaeng District, Phu Langka National Park; 17°57'00" N, 104°09'44" E; elev. 150 m; 25 Aug. 2001; fr.; *Pooma et al. 2617*; L.

### Description

Treelets 1–2 m tall; young twigs puberulous intermixed with pilose, hairs appressed and erect. Petiole 1.5–4.0 mm long, puberulous with mostly appressed hairs, slightly grooved above; leaf blade chartaceous-



**Fig. 8.** *Polyalthia acuminatissima* Wiya, Damth. & Chaowasku sp. nov. **A.** Flower, side view. **B.** Flower, bottom view. **C.** Flower with one inner petal removed, side view. **D.** Adaxial side of outer (left) and inner (right) petals. **E.** Flower with petals and stamens removed, side view, showing carpels on torus. **F.** Flower with petals, stamens and carpels removed, top view. **G.** Carpel. **H.** Stamen: adaxial (left) and abaxial (right) sides. **I.** Monocarps. All from *Chaowasku 231* (CMUB).



subcoriaceous, narrowly elliptic to narrowly elliptic-obovate, rarely narrowly obovate, 12.3–20.2 × 2.3–4.8 cm, glabrous above, puberulous with appressed hairs below, base obtuse-subcordate to obtuse, apex ± caudate-acuminate [acumen (12.0–)16.0–26.0 mm long] to acute-acuminate; midrib slightly sunken above, glabrous, raised below, puberulous with appressed hairs; secondary veins 10–16 per side, rather distinct below, angle with midrib 45°–70° (at middle part of leaf blade). Inflorescences 1- to 4-flowered, terminal (developing to internodal or ± leaf-opposed); peduncle and rachis (when present) inconspicuous; pedicel 4.5–11.0 mm long, puberulous intermixed with pilose, hairs mostly appressed, bearing 1 ovate-triangular bract. Sepals free to nearly half-connate, broadly ovate to ± transversely ovate-triangular, 2.2–3.5 × 2.8–3.5 mm, outside and margin puberulous-tomentose with appressed hairs, sparser at basal half, inside glabrous. Outer petals ovate to ovate-triangular, 4.5–5.5 × 2.2–3.2 mm, outside puberulous with appressed hairs, margin puberulous with appressed and erect hairs, inside glabrous, apex acute to acute-obtuse; inner petals ± pale yellow in vivo at maturity, 10.4–11.0 × 3.2–4.0 mm, (narrowly) ovate to (narrowly) ovate-elliptic, outside and margin puberulous with mostly appressed hairs, inside glabrous to almost glabrous, apex acute-obtuse to obtuse. Stamens 67–75 per flower, 1.3–1.6 mm long, connective apex truncate, covering thecae. Carpels 4–11 per flower, 2.0–2.5 mm long; stigmas ellipsoid-obovoid to obovoid; ovaries tomentose with appressed hairs; ovule(s) 1 (rarely 2) per ovary, basal when containing 1 ovule and lateral when containing 2 ovules. Torus elevated, flat-topped. Each fruit consisting of up to 10 monocarps which are subglobose to subglobose-ellipsoid, 5.5–8.0 × 4.5–6.5 mm, smooth and short-puberulous with mostly appressed hairs, apex short-apiculate, stipe 4.0–6.0 mm long, always attached obliquely to monocarps, indumentum similar to that of monocarps but a bit denser; fruiting pedicel to 11.0 mm long. Seed(s) 1 (rarely 2) per monocarp, ± subglobose (but flattened on one side when there are two seeds in a monocarp), ca 6.5 × 5.5 mm.

#### Habitat and phenology

The new species occurs in dry evergreen forests. The elevation is 150–180 m. Flowering material was collected in May. Fruiting material was collected in May and August.

#### Distribution

Nakhon Phanom Province, northeastern Thailand.

#### Preliminary conservation assessment

Data Deficient (DD).

*Polyalthia maxwelliana* Wiya, Chanthamrong & Chaowasku sp. nov.

urn:lsid:ipni.org:names:77365548-1

Figs 1, 10–12; Table 4

#### Diagnosis

Morphologically most similar to *P. khaoyaiensis*, but primarily differs from it in several traits (leaf texture, flowering pedicel length, inner petal shape and number of carpels per flower) as shown in Table 4.

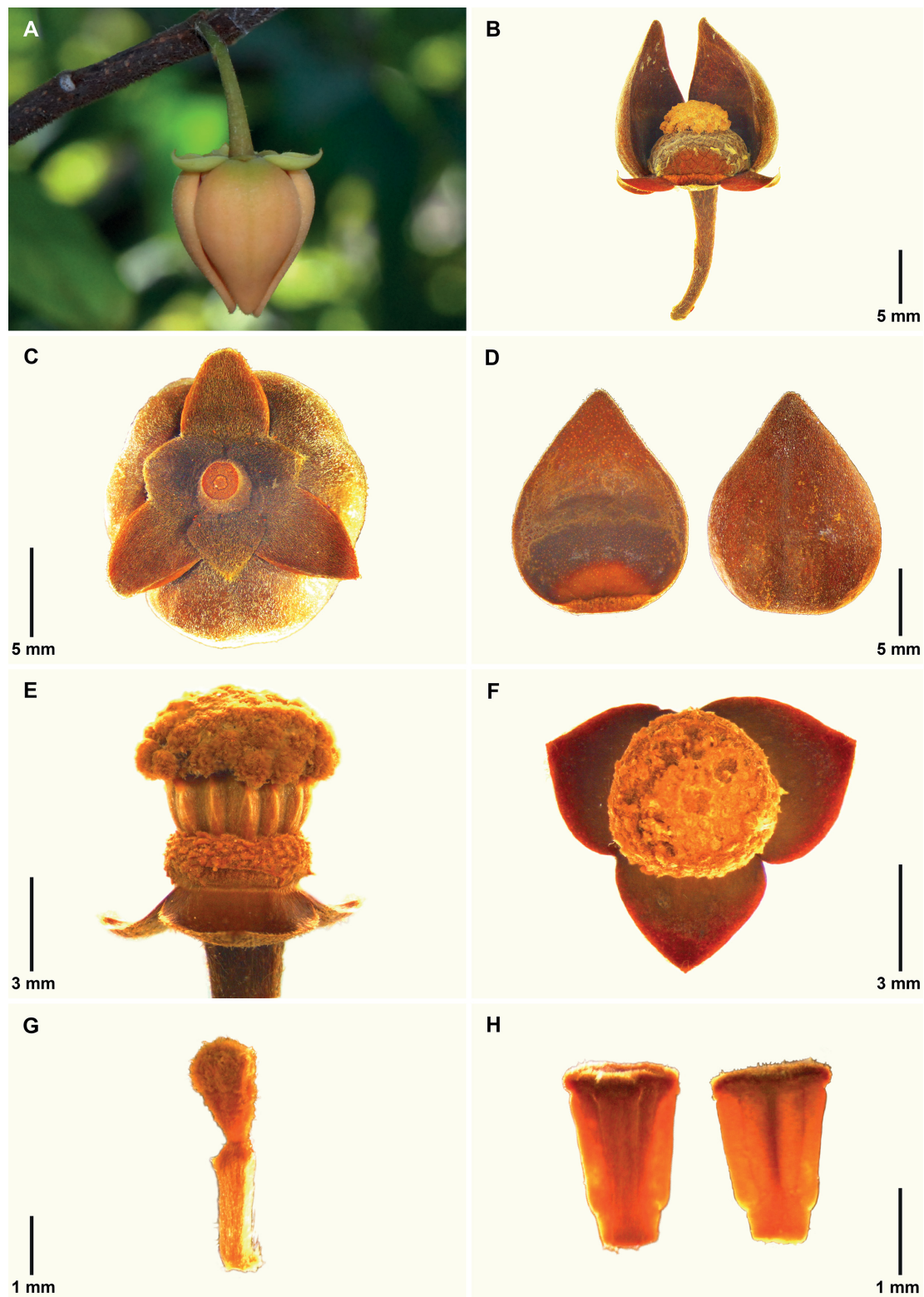
#### Etymology

The specific epithet honors James Franklin Maxwell (1945–2015), an extraordinary collector of Thai plants. Besides, he was the first curator and one of the founders of the herbarium CMUB.

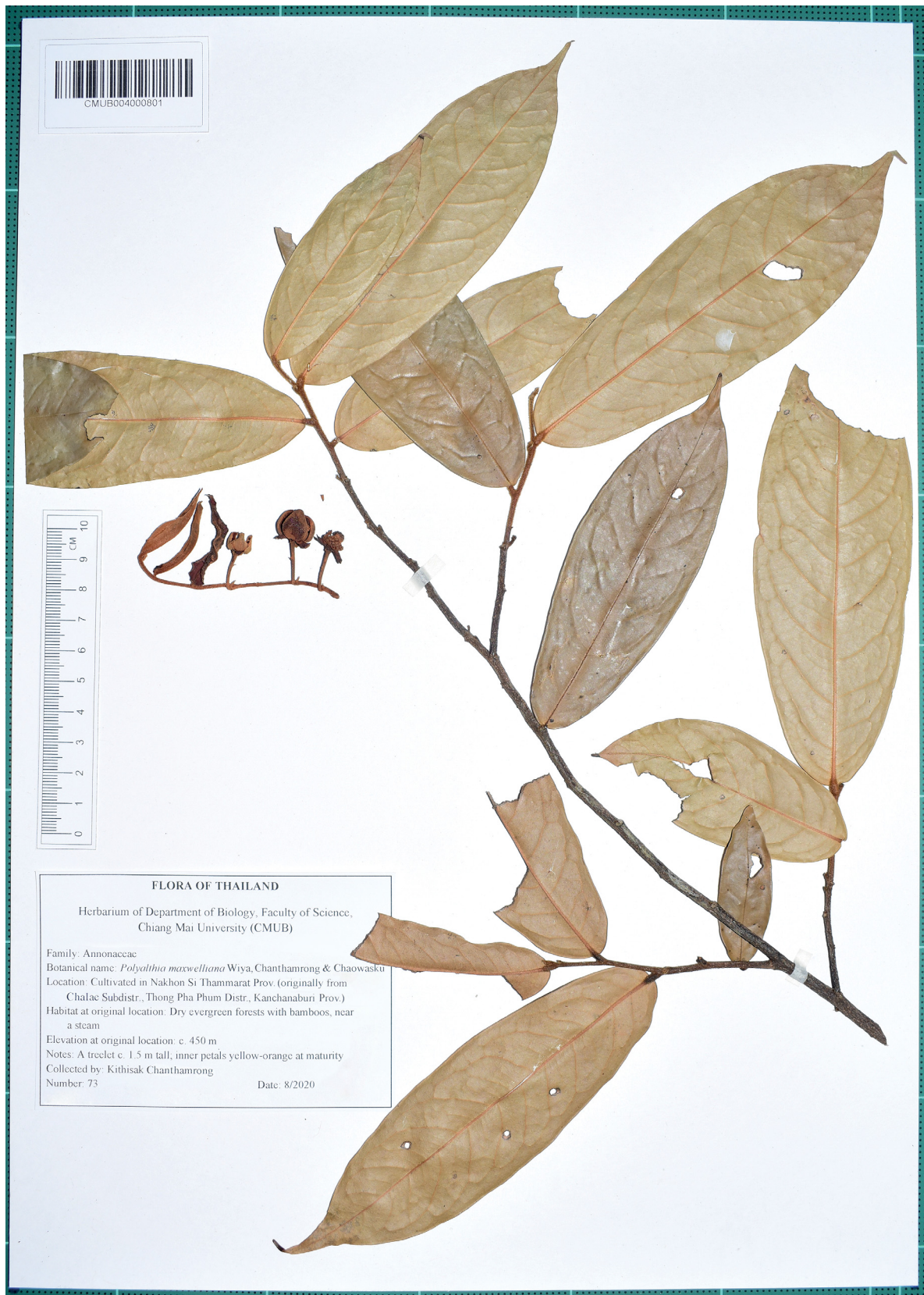
#### Type material

##### Holotype

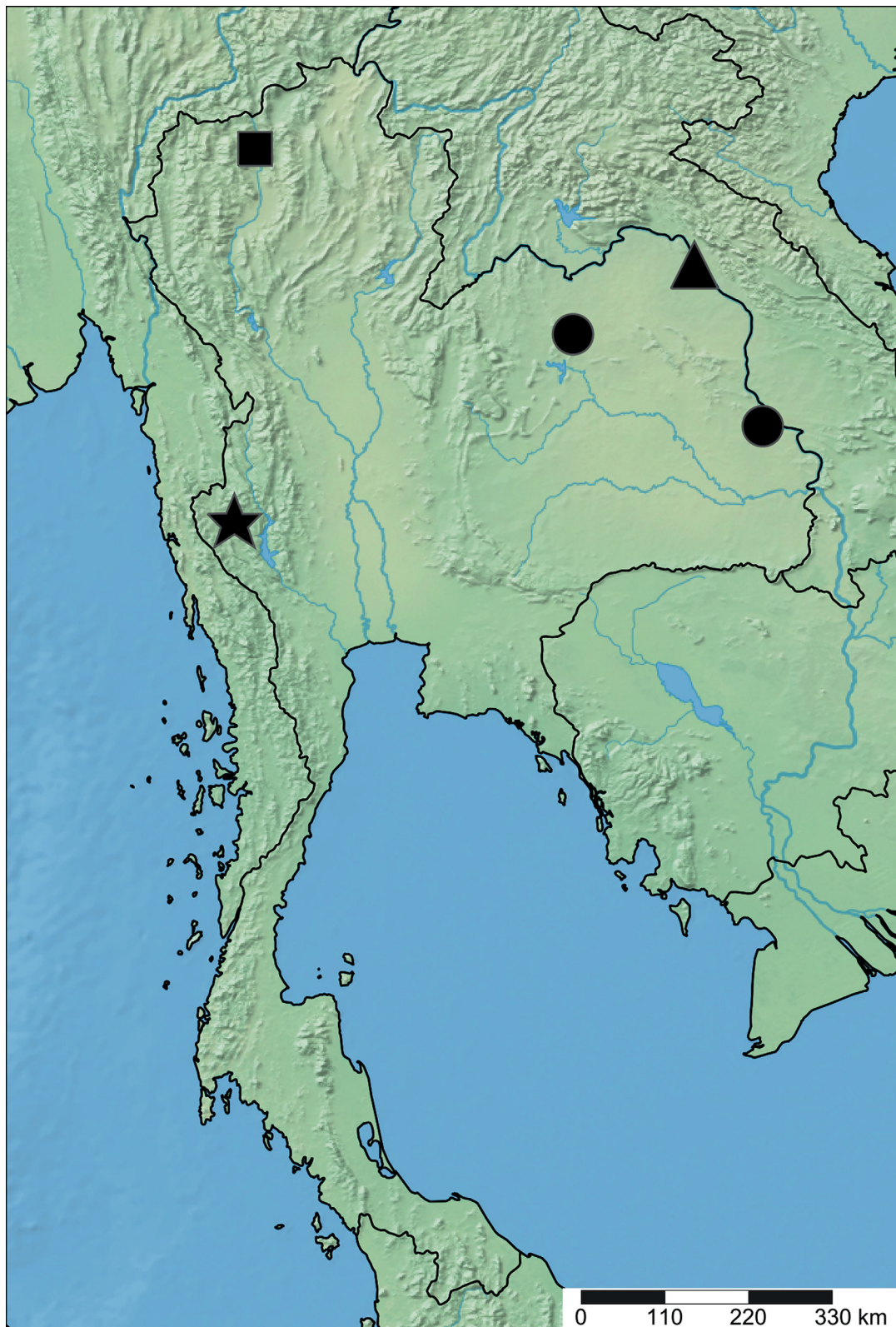
THAILAND • Cult. in Nakhon Si Thammarat Province (originally from Chalae Subdistrict, Thong Pha Phum District, Kanchanaburi Province); Aug. 2020; fl.; *Chanthamrong* 73; holotype: CMUB [CMUB004000801]; isotype: QBG.



**Fig. 10.** *Polyalthia maxwelliana* Wiya, Chanthamrong & Chaowasku sp. nov. **A.** Flower, side view. **B.** Flower with one inner petal removed, side view. **C.** Flower, bottom view. **D.** Adaxial (left) and abaxial (right) sides of inner petal. **E.** Flower with petals and stamens removed, side view, showing carpels on torus. **F.** Flower with petals, stamens and carpels removed, top view. **G.** Carpel. **H.** Stamen: adaxial (left) and abaxial (right) sides. All from *Chanthamrong 73* (CMUB).



**Fig. 11.** Holotype of *Polyalthia maxwelliana* Wiya, Chanthamrong & Chaowasku sp. nov. (Chanthamrong 73; CMUB004000801).



**Fig. 12.** Distribution of *Polyalthia chiangmaica* Wiya, Damth. & Chaowasku sp. nov. (■), *P. miliusifolia* Wiya, Chanthamrong & Chaowasku sp. nov. (★), *P. esanensis* Wiya, Damth. & Chaowasku sp. nov. (●), *P. acuminatissima* Wiya, Damth. & Chaowasku sp. nov. (▲) and *P. maxwelliana* Wiya, Chanthamrong & Chaowasku sp. nov. (★). Note that (★) indicates a shared locality of both species.

**Table 4.** Morphological comparisons between *Polyalthia* sp. 3 [= *P. maxwelliana* Wiya, Chanthamrong & Chaowasku sp. nov.] and *P. khaoyaiensis* Bunchalee & Chantar. Data for *P. khaoyaiensis* are from Bunchalee *et al.* (2019) and personal observations.

| Feature                        | <i>Polyalthia</i> sp. 3<br>[= <i>P. maxwelliana</i> sp. nov.] | <i>P. khaoyaiensis</i>            |
|--------------------------------|---|-----------------------------------|
| Leaf texture                   | subcoriaceous   | chartaceous                       |
| Pedicle length (mm; in flower) | 13.0–15.0   | 3.0–5.0                           |
| Inner petal shape              | ±broadly ovate  | ovate-elliptic to elliptic-oblong |
| Number of carpels per flower   | ca 63   | 25–35                             |

### Description

Treelets 1.5–4 m tall; young twigs tomentose-villous with mostly erect hairs. Petiole 2.5–3.5 mm long, indumentum similar to that of young twigs, grooved or slightly so above; leaf blade subcoriaceous, elliptic, rarely elliptic-obovate, 13.0–22.0 × 4.1–6.1 cm, almost glabrous above, puberulous with appressed hairs below, base obtuse-subcordate to rounded-subcordate, apex caudate-acuminate (acumen 10.0–20.0 mm long), sometimes acute-acuminate, rarely acute-obtuse; midrib slightly sunken above, tomentose-villous with mostly erect hairs, raised below, puberulous with appressed and erect hairs; secondary veins 11–17 per side, distinct below, angle with midrib 50°–60° (at middle part of leaf blade). Inflorescences 1- or 2-flowered, terminal developing to ± leaf-opposed; peduncle inconspicuous; pedicel 13.0–15.0 mm long, ± velvety with appressed and erect hairs, bearing 1–2 bract(s), ± triangular. Sepals free, ± transversely ovate, 4.0–4.5 × 4.5–6.0 mm, outside and margin puberulous-tomentose with appressed and erect hairs, slightly denser on apex, inside glabrous to almost glabrous. Outer petals ovate, 6.8–7.8 × 4.2–5.2 mm, outside and margin tomentose with appressed hairs, inside glabrous, apex ± acute; inner petals yellow-orange in vivo at maturity, ± broadly ovate, 16.0–17.0 × 11.5–13.0 mm, outside puberulous-tomentose to tomentose, hairs appressed, margin tomentose with mostly appressed hairs, sparser on basal half, inside puberulous-tomentose with appressed hairs only near margin on apical half, remaining area glabrous, apex acute-obtuse. Stamens ca 151 per flower, 2.2–2.5 mm long, connective apex truncate, covering thecae. Carpels ca 63 per flower, 4.2–4.6 mm long; stigmas elongated-obovoid; ovaries tomentose-villous with appressed hairs; ovule(s) 1 (rarely 2) per ovary, basal when containing 1 ovule and lateral when containing 2 ovules. Torus elevated, flat-topped. Fruit unknown.

### Habitat (at original locality) and phenology

The new species occurs in dry evergreen forests with bamboos, near a stream. The elevation (at original locality) is ca 450 m. Flowering material was collected in August.

### Distribution

Kanchanaburi Province, southwestern Thailand.

### Preliminary conservation assessment

Data Deficient (DD).

### Key to the species of *Polyalthia* in Thailand belonging to clade 2

1. Petals of both whorls subequal, (rather) thick and fleshy ..... 2
- Petals of both whorls unequal, inner petals (rather) thick and fleshy, outer petals markedly smaller, thinner and less fleshy ..... 3

2. Flowers sessile or subsessile; carpels 6–12(–20) per flower; ovules 2 per ovary; monocarps dark red in vivo at maturity, sessile or subsessile .....  
 ..... *P. debilis* (Pierre) Finet & Gagnep. (Finet & Gagnepain 1906; basionym: Pierre 1881)  
 – Flowers pedicellate (pedicels 7.5–14.5 mm long); carpels 4 per flower; ovules 4–6 per ovary; monocarps yellow in vivo at maturity, stipitate (stipes 6.0–8.0 mm long) .....  
 ..... *P. suthepensis* Wiya & Chaowasku (Wiya & Chaowasku 2021)
3. Carpels 1–2 per flower; ovules 3–8 per ovary ..... *P. cambodica* (Finet & Gagnep.) Wiya & Chaowasku (Wiya & Chaowasku 2021; basionym: Finet & Gagnepain 1906)  
 – Carpels  $\geq 3$  per flower; ovule(s) usually 1–2 per ovary ..... 4
4. Flowering pedicels < 13 mm long ..... 5  
 – Flowering pedicels  $\geq 13$  mm long ..... 13
5. Flowering pedicels < 3 mm long; apex of outer petals obtuse to rounded; carpels 3 per flower .....  
 ..... *P. miliusifolia* Wiya, Chanthamrong & Chaowasku sp. nov.  
 – Flowering pedicels  $\geq 3$  mm long; apex of outer petals acute to acute-obtuse; carpels  $\geq 4$  per flower ..... 6
6. Outer petals < 3 mm long ..... 7  
 – Outer petals  $\geq 3$  mm long ..... 8
7. Leaf apex acuminate; flowering pedicels 4.0–6.0 mm long; carpels 10–15 per flower .....  
 ..... *P. chantaranothaii* Bunchalee & Chalermglin (in Bunchalee *et al.* 2021b)  
 – Leaf apex usually acute to acute-obtuse; flowering pedicels 6.5–8.0 mm long; carpels 16–22 per flower ..... *P. chiangmaica* Wiya, Damth. & Chaowasku sp. nov.
8. Inner petals obovate ..... *P. chalermglinii* Bunchalee & D.M.Johnson (in Bunchalee *et al.* 2021b)  
 – Inner petals (narrowly) ovate, (narrowly) ovate-elliptic or elliptic-oblong ..... 9
9. Carpels 25–35 per flower ..... *P. khaoyaiensis* Bunchalee & Chantar. (in Bunchalee *et al.* 2019)  
 – Carpels < 25 per flower ..... 10
10. Base of inner petals usually orange-red in vivo at maturity; monocarps subsessile .....  
 ..... *P. kanchanaburiana* Khumch. & Thongp. (Khumchompoo & Thongpakdee 2005)  
 – Base of inner petals  $\pm$  pale yellow in vivo at maturity; monocarps stipitate (stipes 3.0–7.0 mm long) ..... 11
11. Outer petals 3.0–3.5 mm long; carpels 18–20 per flower .....  
 ..... *P. khaosokensis* Bunchalee, Leerat. & Sinbumr. (Bunchalee *et al.* 2025)  
 – Outer petals > 3.5 mm long; carpels < 18 per flower ..... 12
12. Young twigs sparsely hairy; leaf blades chartaceous-subcoriaceous, acumen (12.0–)16.0–26.0 mm long .....  
 ..... *P. acuminatissima* Wiya, Damth. & Chaowasku sp. nov.  
 – Young twigs densely hairy; leaf blades chartaceous, acumen 6.0–9.0 mm long .....  
 ..... *P. esanensis* Wiya, Damth. & Chaowasku sp. nov.
13. Leaf blades subcoriaceous, apex usually caudate-acuminate; carpels > 40 per flower .....  
 ..... *P. maxwelliana* Wiya, Chanthamrong & Chaowasku sp. nov.  
 – Leaf blades chartaceous, apex acute to rounded-obtuse; carpels  $\leq 40$  per flower ..... 14

14. Bark (of large stems) corky; carpels 25–40 per flower; monocarps ± black in vivo at maturity .....  
 ..... *P. suberosa* (Roxb.) Thwaites (Thwaites 1864; basionym: Roxburgh 1795)  
 – Bark not corky; carpels <25 per flower; monocarps red in vivo at maturity .....  
 ..... *P. intermedia* (Pierre) Bân (Bân 2000; basionym: Pierre 1881)

## Discussion

This study reveals that clades 1 (*P. stenopetala* clade) and 2 (*P. suberosa* clade) are sister groups. However, no morphological synapomorphies have been identified to unite these two clades. The petals of members of clade 1 exhibit a (much) higher length/width ratio than those of members of clade 2 and their inner petals are also thinner (Bunchalee 2022; C. Wiya & T. Chaowasku, pers. obs.), whereas the petals of members of clade 3 [*P. subcordata* (Blume) Blume (Blume 1830; basionym: Blume 1825) clade] are quite variable (van Heusden 1994; Jessup 2007; Bunchalee 2022; C. Wiya & T. Chaowasku, pers. obs.). Although the relationships of the species within clade 2 are mostly unresolved, they support the previous taxonomic action: disintegration of *P. debilis* (Pierre) Finet & Gagnep. (Finet & Gagnepain 1906; basionym: Pierre 1881), with new combinations made, e.g., *P. cambodica* (Finet & Gagnep.) Wiya & Chaowasku (Wiya & Chaowasku 2021; basionym: Finet & Gagnepain 1906), and establishment of a replacement name (*P. suthepensis* Wiya & Chaowasku) (Wiya & Chaowasku 2021).

As a result of the taxonomic clarification of the *P. evecta* complex presented in this study, it appears that the true *P. evecta* may not occur in Thailand. Further field explorations in Thai areas closest to the type locality of this species are necessary to confirm its presence or absence.

Regarding *Miliusa concinna* Ridl. (Ridley 1920), which was originally described from specimens collected in Siam (now Thailand) and has been considered as a heterotypic synonym of *P. evecta* (Turner 2012b, 2018), its morphology more closely resembles that of *P. intermedia*, especially in the number of carpels per flower (Ridley 1920; Table 1); elucidating the phylogenetic affinities of *M. concinna* is indispensable for the determination of its taxonomic status. It should be noted that, based on comparisons of relevant type specimens, *P. parviflora* Ridl. (Ridley 1912), which is well known in Thailand and Peninsular Malaysia, and *P. debilis* (the lectotype and isolectotypes of *Unona debilis*, the basionym of *P. debilis*, were collected in Vietnam; Turner 2018) are morphologically indistinguishable; thus, we consider them to be conspecific herein, awaiting further phylogenetic validation. Regarding *Polyalthia* sp. 2, only fruiting material is available. When compared with its sister (*P. evecta*-3 [= *P. esanensis* sp. nov.]), there are morphological differences, i.e., the monocarps are sessile (vs stipitate) and larger in *Polyalthia* sp. 2. It is morphologically more similar to *P. cambodica*. Flowering material is nevertheless needed before any taxonomic conclusion could be made.

The recently described *P. heliopetala* is shown for the first time to belong to clade 3 (Fig. 1). Additionally, there are two potentially undescribed species from Thailand (Fig. 1: *Polyalthia* sp. A belonging to clade 3 and *Polyalthia* sp. B belonging to clade 1), but current material is insufficient for formal description.

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## Appendix 1

Specimens for molecular phylogenetic analyses and their GenBank accession numbers. Unavailable sequences are denoted with ---, whereas newly generated sequences are denoted with \*. Taxon: collection location, voucher specimen (herbarium acronym); GenBank accessions: *matK*, *ndhF*, *psbA-trnH*, *rbcL*, *trnL-F*, *ycf1*.

*Mitrephora alba*: Thailand, *Chalermglin 440304-1* (TISTR, Bangkok); AY518855, JQ889983, JQ889978, AY318994, AY319106, JQ889973.

*Monocarpia maingayi*: Thailand, *Gardner & Sidisunthorn ST 0541* (L); MH585801, MH585826, MH585806, MH585811, MH585815, MH585819.

*Orophea* sp.: Thailand, *Chalermglin 440403* (TISTR, Bangkok); AY518815, JQ690416, JQ690417, AY319006, AY319119, JQ690418.

*Popowia hirta*: Borneo, *Kessler B 1628* (L); AY518860, JX544830, JX544806, AY319042, AY319156, JX544816.

*Polyalthia acuminatissima* [= *Polyalthia evecta*-4]: Thailand, *Chaowasku 231* (CMUB); PV469104\*, PV469123\*, PV469142\*, PV469161\*, PV469181\*, PV469200\*.

*Polyalthia borneensis*: Borneo, *Ridsdale DV-SR-7921* (L); AY518821, ---, ---, AY319014, AY319128, ---.

*Polyalthia bullata*: Thailand, *Chaowasku 217* (QBG); PV469115\*, PV469134\*, PV469153\*, PV469172\*, PV469192\*, PV469211\*.

*Polyalthia cambodica*: Thailand, *Chaowasku 235* (QBG); PV469106\*, PV469125\*, PV469144\*, PV469163\*, PV469183\*, PV469202\*.

*Polyalthia celebica*: Bogor Bot. Gard. [IV-C-97], *Mols 9* (L); AY518827, ---, JX544808, AY319016, AY319130, ---.

*Polyalthia chantaranothaii*: Thailand, *Chaowasku 237* (QBG); PV469105\*, PV469124\*, PV469143\*, PV469162\*, PV469182\*, PV469201\*.

*Polyalthia chiangmaica* [= *Polyalthia evecta*-1]: Thailand, *Chaowasku 229* (CMUB); PV469110\*, PV469129\*, PV469148\*, PV469167\*, PV469187\*, PV469206\*.

*Polyalthia* cf. *cinnamomea*: Borneo, *Ridsdale DV-MI-347* (L); AY518828, ---, ---, AY319018, AY319132, ---.

*Polyalthia debilis*: Thailand, *Chanthamrong & Samae 76* (QBG); PV469108\*, PV469127\*, PV469146\*, PV469165\*, PV469185\*, PV469204\*.

*Polyalthia esanensis* [= *Polyalthia evecta*-3]: Thailand, *Chaowasku 225* (CMUB); PV469102\*, PV469121\*, PV469140\*, PV469159\*, PV469179\*, PV469198\*.

*Polyalthia evecta* [= *Polyalthia evecta*-2]: Vietnam, *Ly et al. NY-HN 547* (NY); JX227885, ---, ---, JX227910, JX227861, ---.

*Polyalthia flagellaris*: Borneo, *Duling 38* (K); AY518824, ---, ---, AY319022, AY319136, ---.

*Polyalthia heliopetala*: Thailand, *Chanthamrong & Samae 41* (QBG); PV469114\*, PV469133\*, PV469152\*, PV469171\*, PV469191\*, PV469210\*.

*Polyalthia hispida*: Australia, *Sankowsky 172* (HKU); JX227886, ---, ---, JX227911, JX227862, ---.

*Polyalthia insignis*: Borneo, *Beaman 10112* (NY); JX227887, ---, ---, JX227912, JX227863, ---.

*Polyalthia intermedia*: Thailand, *Chaowasku 234* (QBG); PV469109\*, PV469128\*, PV469147\*, PV469166\*, PV469186\*, PV469205\*.

***Polyalthia johnsonii***: Australia, *Ford AF 3625* (CNS); JX544826, JX544840, JX544810, PV469173\*, JX544801, JX544819.

***Polyalthia kanchanaburiana***: Thailand, *Chanthamrong 77* (QBG); PV469097\*, PV469116\*, PV469135\*, PV469154\*, PV469174\*, PV469193\*.

***Polyalthia khaoyaiensis***: Thailand, *Chanthamrong 78* (QBG); PV469101\*, PV469120\*, PV469139\*, PV469158\*, PV469178\*, PV469197\*.

***Polyalthia lateritia***: Thailand, *Chanthamrong 52* (QBG); PV469113\*, PV469132\*, PV469151\*, PV469170\*, PV469190\*, PV469209\*.

***Polyalthia longirostris***: New Guinea, *Takeuchi & Ama 15656* (L); AY518826, ---, ---, AY318979, AY319091, ---.

***Polyalthia maxwelliana*** [= *Polyalthia* sp. 3]: Thailand, *Chanthamrong 73* (CMUB); PV469098\*, PV469117\*, PV469136\*, PV469155\*, PV469175\*, PV469194\*.

***Polyalthia miliusifolia*** [= *Polyalthia* sp. 1]: Thailand, *Chanthamrong 74* (CMUB); PV469107\*, PV469126\*, PV469145\*, PV469164\*, PV469184\*, PV469203\*.

***Polyalthia* cf. *miliusoides***: Borneo, *Ridsdale DV-M2-11443* (L); AY518829, ---, ---, AY319028, AY319142, ---.

***Polyalthia obliqua***: Borneo, *Ambriansyah & Arifin AA 1694* (L); AY518822, ---, ---, AY319029, AY319143, ---.

***Polyalthia stenopetala***: Thailand, *Chalermglin 540116* (HKU); JX227896, ---, ---, ---, ---, ---.

***Polyalthia stenopetala***: Thailand, *Chalermglin 440302* (TISTR, Bangkok); ---, ---, ---, AY319034, AY319148, ---.

***Polyalthia subcordata***: Java, *Gravendeel et al. 549* (L); AY518830, ---, ---, AY319036, AY319150, ---.

***Polyalthia suberosa***: Utrecht Univ. Bot. Gard., *Chatrou 480* (U); AY238965, AY841417, AY841502, AY238956, AY231289 and AY238949, JX544817.

***Polyalthia submontana***: Australia, *Sankowsky 3182* (HKU); JX227893, ---, ---, JX227918, JX227869, ---.

***Polyalthia* cf. *subsessilifolia***: Borneo, *Beaman 10272* (NY); JX227884, ---, ---, JX227909, JX227860, ---.

***Polyalthia suthepensis*** [= *Polyalthia suthepensis*-1]: Thailand, *Chaowasku 202* (CMUB); PV469099\*, PV469118\*, PV469137\*, PV469156\*, PV469176\*, PV469195\*.

***Polyalthia suthepensis*** [= *Polyalthia suthepensis*-2]: Thailand, *Chaowasku 236* (QBG); PV469100\*, PV469119\*, PV469138\*, PV469157\*, PV469177\*, PV469196\*.

***Polyalthia trochilia***: Borneo, *Burley et al. 807* (NY); JX227894, ---, ---, JX227919, JX227870, ---.

***Polyalthia xanthocarpa***: Australia, *Sankowsky 3150* (HKU); JX227895, ---, ---, JX227920, JX227871, ---.

***Polyalthia* sp. A**: Thailand, *Chalermwong & Sinbumroong 15032021* (CMUB); PV469112\*, PV469131\*, PV469150\*, PV469169\*, PV469189\*, PV469208\*.

***Polyalthia* sp. B**: Thailand, *Chanthamrong & Baka 45* (CMUB); PV469111\*, PV469130\*, PV469149\*, PV469168\*, PV469188\*, PV469207\*.

***Polyalthia* sp. 2**: Thailand, *Chaowasku 238* (QBG); PV469103\*, PV469122\*, PV469141\*, PV469160\*, PV469180\*, PV469199\*.

## Appendix 2

Type specimens of relevant names studied.

### *Milusa concinna* Ridl.

*Milusa concinna* Ridl. (Ridley 1920: 127). – **Type:** SIAM (now THAILAND) • Southwest, Koh Lak; 3 Apr. 1919; fl.; *Hamid FMS Field No. 3802*; [specimen studied: lectotype K<sup>1</sup>].

<sup>1</sup> <https://plants.jstor.org/stable/viewer/10.5555/al.ap.specimen.k000691547>

### *Polyalthia chantaranothaii* Bunchalee & Chalermglin

*Polyalthia chantaranothaii* Bunchalee & Chalermglin (in Bunchalee *et al.* 2021b: 276). – **Type:** THAILAND • Lampang, Me Ping; 21 Jun. 1926; fl.; *Winit 1708*; [specimen studied: holotype BK].

### *Polyalthia debilis* (Pierre) Finet & Gagnep.

*Polyalthia debilis* (Pierre) Finet & Gagnep. (Finet & Gagnepain 1906: 96). – *Unona debilis* Pierre (Pierre 1881: t. 29). – **Type:** VIETNAM • Cochinchine, Ba Ria, Mt Dinh; May 1866; fl.; *Pierre 1771*; [specimens studied: lectotype P<sup>1</sup>, isolectotypes P<sup>2,3</sup>].

<sup>1</sup> <http://coldb.mnhn.fr/catalognumber/mnhn/p/p00372676>

<sup>2</sup> <http://coldb.mnhn.fr/catalognumber/mnhn/p/p00372677>

<sup>3</sup> <http://coldb.mnhn.fr/catalognumber/mnhn/p/p00372678>

### *Polyalthia evecta* (Pierre) Finet & Gagnep.

*Polyalthia evecta* (Pierre) Finet & Gagnep. (Finet & Gagnepain 1906: 91). – *Unona evecta* Pierre (Pierre 1881: t. 31). – **Type:** VIETNAM • Cochinchine, Bien Hoa, Song Lu; Feb. 1877; fl.; *Pierre 1762*; [specimens studied: lectotype P<sup>1</sup>, isolectotypes P<sup>2,3</sup>, BM<sup>4</sup>, L<sup>5,6</sup>].

<sup>1</sup> <http://coldb.mnhn.fr/catalognumber/mnhn/p/p00432205>

<sup>2</sup> <http://coldb.mnhn.fr/catalognumber/mnhn/p/p00432203>

<sup>3</sup> <http://coldb.mnhn.fr/catalognumber/mnhn/p/p00432204>

<sup>4</sup> <https://data.nhm.ac.uk/object/45df18da-ff7c-471d-bf9c-5800216af4fe>

<sup>5</sup> <https://data.biodiversitydata.nl/naturalis/specimen/L%20%200183718>

<sup>6</sup> <https://data.biodiversitydata.nl/naturalis/specimen/L%20%200038114>

### *Unona evecta* var. *attopeuensis* Pierre

*Unona evecta* var. *attopeuensis* Pierre (Pierre 1881: sub t. 31). – **Type:** LAOS • Bassin d'Attopeu; Feb. 1877; fl.; *Harmand 1349*; [specimens studied: lectotype P<sup>1</sup>, isolectotypes P<sup>2,3</sup>].

<sup>1</sup> <http://coldb.mnhn.fr/catalognumber/mnhn/p/p00432210>

<sup>2</sup> <http://coldb.mnhn.fr/catalognumber/mnhn/p/p00432209>

<sup>3</sup> <http://coldb.mnhn.fr/catalognumber/mnhn/p/p00432211>

### *Polyalthia intermedia* (Pierre) Bân

*Polyalthia intermedia* (Pierre) Bân (Bân 2000: 95). – *Unona evecta* var. *intermedia* Pierre (Pierre 1881: t. 31A). – **Type:** VIETNAM • Cochinchine, prov. Baria, Noi; Jul. 1867; fl., young fr.; *Pierre 289b*; [specimen studied: lectotype P<sup>1</sup>].

<sup>1</sup> <http://coldb.mnhn.fr/catalognumber/mnhn/p/p00432221>

***Polyalthia khaoyaiensis* Bunchalee & Chantar.**

*Polyalthia khaoyaiensis* Bunchalee & Chantar. (in Bunchalee *et al.* 2019: 172). – **Type:** THAILAND • Nakhon Ratchasima, Khao Yai National Park; 14 Mar. 1986; fl.; *van Beusekom & Phengklai* 45; [specimen studied: isotype L<sup>1</sup>].

<sup>1</sup><https://data.biodiversitydata.nl/naturalis/specimen/L.1767376>

***Polyalthia minima* Jovet-Ast**

*Polyalthia minima* Jovet-Ast (Jovet-Ast 1940: 75). – **Type:** VIETNAM • Annam, Phan Rang, Ca Na; 16 Jul. 1930; fl.; *Poilane* 17886; [specimen studied: holotype P<sup>1</sup>].

<sup>1</sup><http://coldb.mnhn.fr/catalognumber/mnhn/p/p00601068>

***Polyalthia parviflora* Ridl.**

*Polyalthia parviflora* Ridl. (Ridley 1912: 49). – **Type:** MALAYSIA • Peninsular Malaysia, Pulau Langkawi, Kuala Malacca; Sep. 1890; fl., fr.; *Curtis* 2533; [specimen studied: isolectotype CAL<sup>1</sup>].

<sup>1</sup><https://archive.bsi.gov.in/phanerogams-Image/en?link=CAL0000004428&column=szBarcode>