

## **Resurrection and New Species of the Neotropical Genus *Adelonema* (Araceae: Philodendron Clade)**

Author(s): Wong Sin Yeng , Alan W. Meerow and Thomas B. Croat

Source: Systematic Botany, 41(1):32-48.

Published By: The American Society of Plant Taxonomists

URL: <http://www.bioone.org/doi/full/10.1600/036364416X690732>

---

BioOne ([www.bioone.org](http://www.bioone.org)) is a nonprofit, online aggregation of core research in the biological, ecological, and environmental sciences. BioOne provides a sustainable online platform for over 170 journals and books published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Web site, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at [www.bioone.org/page/terms\\_of\\_use](http://www.bioone.org/page/terms_of_use).

Usage of BioOne content is strictly limited to personal, educational, and non-commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

## Resurrection and New Species of the Neotropical Genus *Adelonema* (Araceae: Philodendron Clade)

Wong Sin Yeng,<sup>1,2,5</sup> Alan W. Meerow,<sup>3</sup> and Thomas B. Croat<sup>4</sup>

<sup>1</sup>Department of Plant Science and Environmental Ecology, Faculty of Resource Science and Technology, Universiti Malaysia Sarawak, 94300 Samarahan, Sarawak, Malaysia.

<sup>2</sup>Harvard University Herbaria, 22 Divinity Avenue, Cambridge, Massachusetts 02138, U. S. A.

<sup>3</sup>National Germplasm Repository, United States Department of Agriculture/Agricultural Research Service (USDA-ARS), 13601 Old Cutler Road, Miami, Florida 33158-0000, U. S. A.

<sup>4</sup>Missouri Botanical Garden, Monsanto Research Building, Post Office Box 299, St. Louis, Missouri 63166, U. S. A.

<sup>5</sup>Author for correspondence (sywong@unimas.my)

Communicating Editor: Leslie Goertzen

**Abstract**—Previous studies have shown *Homalomena* as traditionally defined to be polyphyletic, with Neotropical species phylogenetically distinct from Asian species. This study of 29 accessions of 10 Neotropical taxa, and a total of 135 accessions representing 92 taxa of *Homalomena*, *Furtadoa*, and *Philodendron* for nuclear ITS and plastid *matK* regions, supports resurrection of the genus *Adelonema* for Neotropical species currently assigned to *Homalomena*. *Adelonema* is here delimited as a Neotropical genus of 16 species divided into two new sections: sect. *Adelonema* and sect. *Curmeria*, based on morphologically supported molecular results. The genus *Adelonema* is distinguished by a hypogean rhizome, crushed vegetative tissues smelling of anise, an extensively sheathing, sometimes prickly petiole, chartaceous often variegated leaf blades, a spadix either obliquely inserted on the spathe/peduncle (sect. *Adelonema*), or stipitate (sect. *Curmeria*), ovaries with 2–4-pluriovulate locules, and anatropous ovules on an axile placenta. Four new species are described: *Adelonema orientalis*, *A. palidineria*, *A. panamensis*, and *A. yanamonoensis*. Eleven new combinations are made: *Adelonema allenii*, *A. crinipes*, *A. hammelii*, *A. kvistii*, *A. moffleriana*, *A. peltata*, *A. picturata*, *A. roezlii*, *A. speariae*, *A. wallisii*, and *A. wendlandii*.

**Keywords**—*Curmeria*, *Homalomena*, ITS, *matK*, new combinations, taxonomy.

Cusimano et al. (2011) resolved *Philodendron* Schott, *Homalomena* Schott, and *Furtadoa* M. Hotta in a clade (the Philodendron clade) equivalent to the combined tribes Homalomeneae and Philodendreae sensu Mayo et al. (1997) and Cabrera et al. (2008), and sister to African tribe Culcasieae. Together these, termed the Homalomena clade (Cusimano et al. 2011, Fig. 2, clade 27), are supported by synapomorphic anatomical character states observed by French (1985, 1987a, b): occurrence of sclerified hypodermis (or known as exodermis tissues in Tenorio et al. 2014) and resin canals in the roots, and absence of endothelial thickenings in the anthers (except in *Homalomena* itself). The Culcasieae clade (11) is supported synapomorphically by a hemiepiphytic climbing habit, and the Philodendron clade (12) by female-sterile-male spadix floral zonation. Plants of *Homalomena* are aromatic (terpenoids), diminutive to robust terrestrial or rheophytic herbs with mainly epigeal stems and almost entirely pleioanthic modules. In most species an obscure pulvinus is present ca. two thirds along the petiole, although a few species have a pronounced pulvinus at the petiole-leaf blade junction. Inflorescences are produced in a simple or gorgonoid synflorescence (most *Homalomena*; see Ray 1987, 1988), or are solitary (*Furtadoa*, some *Homalomena*). Flowers are unisexual with the pistillate flowers below and staminate above on the spadix, with the pistils usually with an associated staminode (most *Homalomena*, *Furtadoa*), and staminate flowers with an associated pistillode (*Furtadoa*). Staminate flowers in *Homalomena* are almost all comprised of 2–6 anthers with a single exception, Sumatran *H. monandra* M. Hotta, with unistaminate flowers. *Furtadoa* has unistaminate flowers. Where observed, placentation is parietal (Asian *Homalomena*), axial (Neotropical *Homalomena*), or basal (*Furtadoa*). In all species of *Homalomena* and *Furtadoa* the entire spathe is persistent throughout fruiting, splitting at the junction of the peduncle at fruit maturity to expose the fruits (where known, ripe fruits are sweetly fragrant). Seeds, where inves-

tigated, are small (> 1.5 mm long) with a longitudinally ribbed testa, and lack micropylar elaboration (Seubert 1993).

*Homalomena* as currently circumscribed (Mayo et al. 1997) is distributed in the Neotropics and Asian tropics. However, Gauthier et al. (2008) and Wong et al. (2013) showed the Neotropical species of *Homalomena* to form a separate clade to the Asian species. The type of *Homalomena* is *H. cordata* Schott, from Java (Asia). *Homalomena* sensu stricto (i.e. excluding the Neotropical species) comprises four sections: *Homalomena* ('*Euhomalomena*' of Engl. & K. Krause); *Cyrtocladon* (Griff.) Furtado; *Chamaecladon* (Miq.) Engl. & K. Krause, and *Geniculatae* M. Hotta. Two pre-existing generic names are available for Neotropical species of *Homalomena*: *Adelonema* Schott (1860) and *Curmeria* Linden & André (1874). The type of *Adelonema* is *A. erythropus* Schott (currently *Homalomena erythropus* (Schott) Engl.). *Curmeria*, typified on *C. picturata* Linden & André, is presently called *Homalomena picturata* (Linden & André) Regel. Engler and Krause (1912), because of the then incompletely known inflorescences, treated *Adelonema*, with a single species, *A. erythropus*, as of uncertain affinity, stating that it probably belonged to *Homalomena* sect. *Curmeria*, in which they placed all other South American species treated: *Homalomena roezlii* (Mast.) Regel, *H. wallisii* Regel, *H. crinipes* Engl., *H. wendlandii* Schott, *H. picturata* (Linden & André) Regel, and *H. peltata* Mast. Section *Curmeria* has been uncritically employed for all the Neotropical species in all subsequent treatments (Furtado 1939; Hotta 1967; Mayo et al. 1997).

Gauthier et al. (2008) and Wong et al. (2013) focused on *Philodendron* and Asian *Homalomena*, respectively (using nuclear ITS region only), and included only five (Gauthier et al. 2008) and six (Wong et al. 2013) representatives of 12 known species of Neotropical *Homalomena* (hereinafter termed *Adelonema*). The aim of the current study was to sample an expanded representation of *Adelonema* for nuclear ITS and plastid *matK* regions. To this end, 29 accessions of 10 *Adelonema* taxa were included to test

support for removal of *Adelonema* species from *Homalomema*. A formal transfer of all *Adelonema* species is made in this study. The other aim of this study was to describe four novel *Adelonema* species based on morphological work.

## MATERIALS AND METHODS

**Taxon Sampling**—One hundred and sixteen accessions of 90 taxa of *Homalomema* (50 accessions of 39 taxa, ca. 30% of described species), *Furtadoa* (two accessions of two taxa, 100% of described species), *Adelonema* (22 accessions of 10 taxa, ca. 62% of species accepted in this paper), *Philodendron* (41 accessions of 38 taxa, less than 10% of described species, but including representation of the three subgenera), and an accession of *Lasia spinosa* (L.) Thwaites as outgroup were included for the analyses of the nuclear ITS region. Fifty-five accessions of 37 taxa (*Homalomema*: 37 accessions of 24 taxa, *Furtadoa*: two accessions of one taxon, *Adelonema*: 10 accessions of six taxa, *Philodendron*: three accessions of three taxa), and one accession each of three outgroups (*Culcasia liberica* and *Cercestis mirabilis*, *Lasia spinosa*) were included for the plastid *matK*+partial 3' *trnK* (*matK*) region. Overall this study included 135 accessions of 92 taxa of *Homalomema* (57 accessions of 41 taxa), *Furtadoa* (3 accessions of two taxa), *Adelonema* (29 accessions of 10 taxa), *Philodendron* (42 accessions of 39 taxa), one accession each of two outgroups (*C. liberica* and *C. mirabilis*), and two accessions of *L. spinosa*. Seventy-six sequences were newly generated and deposited into GenBank. These sequences were combined with previous sequences from Wong et al. (2013), Cusimano et al. (2011), and Cabrera et al. (2008). Voucher information and GenBank accession numbers for all taxa are provided in Appendix 1. Data matrices were deposited to TreeBASE (study numbers S16371, S17301, and S18151).

**DNA Extraction, PCR Amplification, and Sequencing**—Total DNA was extracted using a modified version of the 2 × CTAB protocol (Doyle and Doyle 1987) with the addition of PVP (Polyvinylpyrrolidone; Wong et al. 2010). ITS1, 5.8S subunit, and ITS2 were amplified using the primer pairs 1F/1R and 3F/4R, respectively (White et al. 1990). Polymerase chain reaction (PCR) amplifications for *matK* were carried out using the forward primer 19F (Gravendeel et al. 2001) and reverse primer 2R (Steele and Vilgalys 1994). Two internal primers, 390F or/and 1236R (Cuénoud et al. 2002) were used for sequencing. The PCRs and PCR product cleaning of ITS and *matK* were conducted according to Wong (2013) and Wong et al. (2010), respectively. PCR products were sent for sequencing in forward and reverse directions at BGI Tech Solutions (Hong Kong) Co., Limited, Hong Kong.

**Sequence Alignment and Phylogenetic Analyses**—Newly generated sequences for both regions were manually trimmed and assembled for each taxon. These sequences were combined with previously generated sequences for each region. The data matrices were aligned using MUSCLE (Edgar 2004) as implemented in Geneious Pro v5.6.4 (Biomatters Ltd., Auckland, New Zealand; www.geneious.com; Drummond et al. 2012) followed by minor manual adjustment following the similarity criterion (Simmons 2004). Indels were treated as missing data. To infer phylogenetic relationships, we applied maximum likelihood (ML; Felsenstein 1985) optimization with the software RAxML (7.3.2; Stamatakis 2006) and RAxML- Gui (Silvestro and Michalak 2012), as well as a Bayesian approach (Yang and Rannala 1997) with the software MrBayes (3.2.1; Huelsenbeck and Ronquist 2001). The ML analyses were performed using the generalized time-reversible substitution model with gamma rate heterogeneity, and statistical support was accessed via 1,000 replicates (repeated 10 times). The Bayesian analyses were performed using the Tamura-Nei plus Gamma (for ITS) and General Time Reversible plus Gamma (for *matK* and combined regions), as identified by the Akaike information criterion (AIC; Akaike 1974) in FindModel (<http://hcv.lanl.gov/content/sequence/findmodel/findmodel.html>). Statistical support was accessed via posterior probability (PP). The Markov chain Monte Carlo (MCMC) analyses were conducted twice to check for parameter convergence. The MCMC algorithm was run for 2,000,000 generations with one cold and three heated chains, starting from random trees and sampling one out of every 100 generations. Convergence was assessed by using the standard deviation of split frequencies as convergence index with values < 0.005 interpreted as indicating good convergence. The first 10% of trees were discarded as burn-in. The remaining trees were used to construct 50% majority-rule consensus trees. Throughout this paper, PP of 0.9–0.95 support and ML bootstrap (BS) value of 70–84% are considered as moderate, a PP of 0.95–1 and BS value of 85–100% are considered as strong support.

## RESULTS

**Alignment**—The sequence pherograms for the ITS region provided a clear and unambiguous signal without any indication of polymorphisms. Furthermore, each PCR reaction produced a single band. The length of ITS1 varied between 200 and 453 bp, and the length of ITS2 varied between 169 and 420 bp, while the length of the 5.8S subunit was consistent (160 bp) among all taxa investigated. The length of *matK* region varied between 1,707 and 1,811 bp. A total of 1,394 and 1,859 nucleotide positions were aligned for ITS and *matK* regions, respectively. The ITS and *matK* alignment included no ambiguously aligned sections, and were used in its entire length of 1,394 and 1,859 aligned positions, respectively. Both regions were combined with 38 accessions of 30 taxa (including two outgroup taxa).

**Phylogenetic Analysis**—For ITS analysis, *Adelonema* and *Philodendron* species are members of a clade distinct from *Homalomema* species (Fig. 1). Additionally, *Philodendron* subgen. *Philodendron* and *Meconostigma* are weakly supported as sisters to [*Adelonema* + *Philodendron* subgen. *Pteromisium*] (PP = 0.89). Five accessions of four *Adelonema* taxa are strongly supported (PP = 1.00; BS = 100) and this clade is sister to the remainder of the *Adelonema* species (PP = 1; BS = 83). The rest of the *Adelonema* species are reconstructed in a clade (PP = 0.91), with three accessions of *A. picturata* and *A. sp.* M533 as sister taxa. A clade of Asian *Homalomema* is strongly supported (PP = 1; BS = 90). *Homalomema cochinchinensis* and *H. pygmaea* are resolved in a clade (PP = 1.00; BS = 99). Groupings within the *Homalomema* clade are congruent with Wong et al. (2013): sect. *Cyrtocladon*, sect. *Geniculatae*, sect. *Chamaecladon*, and sect. *Homalomema*. *Homalomema tonkinensis* is sister to sect. *Chamaecladon* and sect. *Homalomema*. *Homalomema sp.* (Ar4054) from Sumatra and two *Homalomema* taxa (Ar4763 and Ar4764) fell within the sect. *Chamaecladon*. Two Philippines taxa, *H. philippinensis* and *H. 'zippelianum'* are sister taxa to sect. *Homalomema*. *Furtadoa* is not supported as a genus: the two described species resolved separately in sect. *Homalomema* (*Furtadoa sumatrensis*) and sect. *Chamaecladon* (*Furtadoa mixta*).

Ten accessions of six *Adelonema* taxa were included in the *matK* analysis (Fig. 2). *Adelonema* formed a distinct group (PP = 1.00; BS = 96) separate from the Asian species. Two accessions of *A. picturata* are sister taxa to this clade (PP = 1.00; BS = 96). The other accession of *A. picturata* resolved together with *A. crinipes* and *A. peltata* (PP = 1.00; BS = 94), suggesting that the taxonomy of *A. picturata* is imperfect. *Adelonema speariae*, *A. allenii* and *A. wallisii* formed a well-supported clade (PP = 1.00; BS = 100). For *Homalomema* species, *Homalomema* sect. *Cyrtocladon* is weakly supported (BS = 60). *Homalomema* sect. *Chamaecladon*, *Geniculatae*, and *Homalomema* are not supported in the *matK* analysis. Two accessions of *F. sumatrensis* resulted in separate clades with one accession forming a weak clade with *H. asperifolia* (BS = 58), and the other accession resolved in sect. *Chamaecladon* (PP = 1.00).

For combined ITS and *matK* regions (Fig. 3), as the number of taxa in *Adelonema* and *Philodendron* is reduced to three and two taxa, respectively, the relationships among the three major clades (*Adelonema*, *Philodendron* and *Homalomema*) are not well resolved. However, individual clades are strongly supported: *Adelonema* (PP = 1.00; BS = 100), *Philodendron* (PP = 0.99; BS = 94), and moderately supported: *Homalomema* (PP = 0.99; BS = 68). For *Homalomema*, sect. *Cyrtocladon* is strongly supported (PP = 1.00; BS = 88) and is sister to one that includes the other three sections

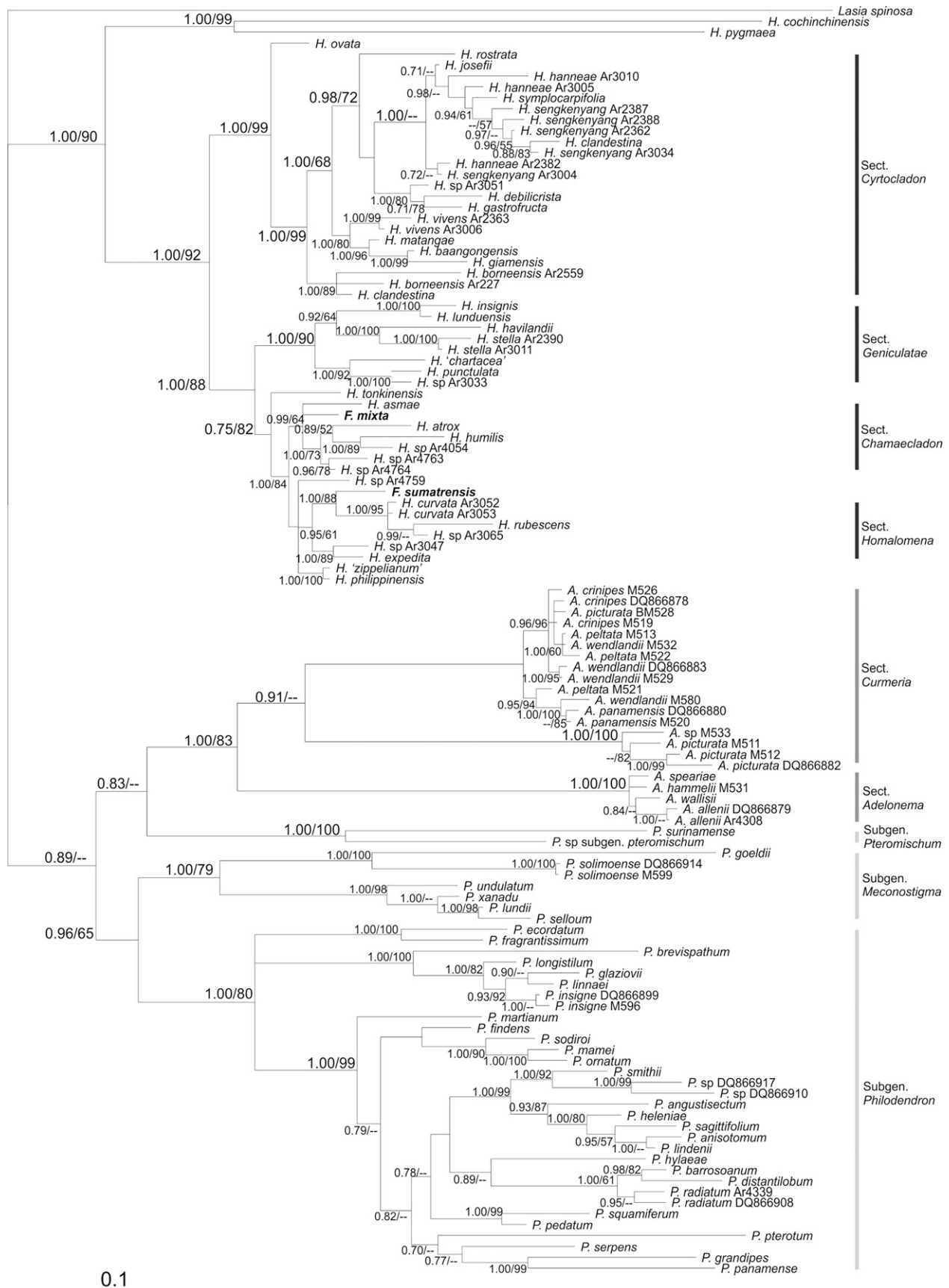
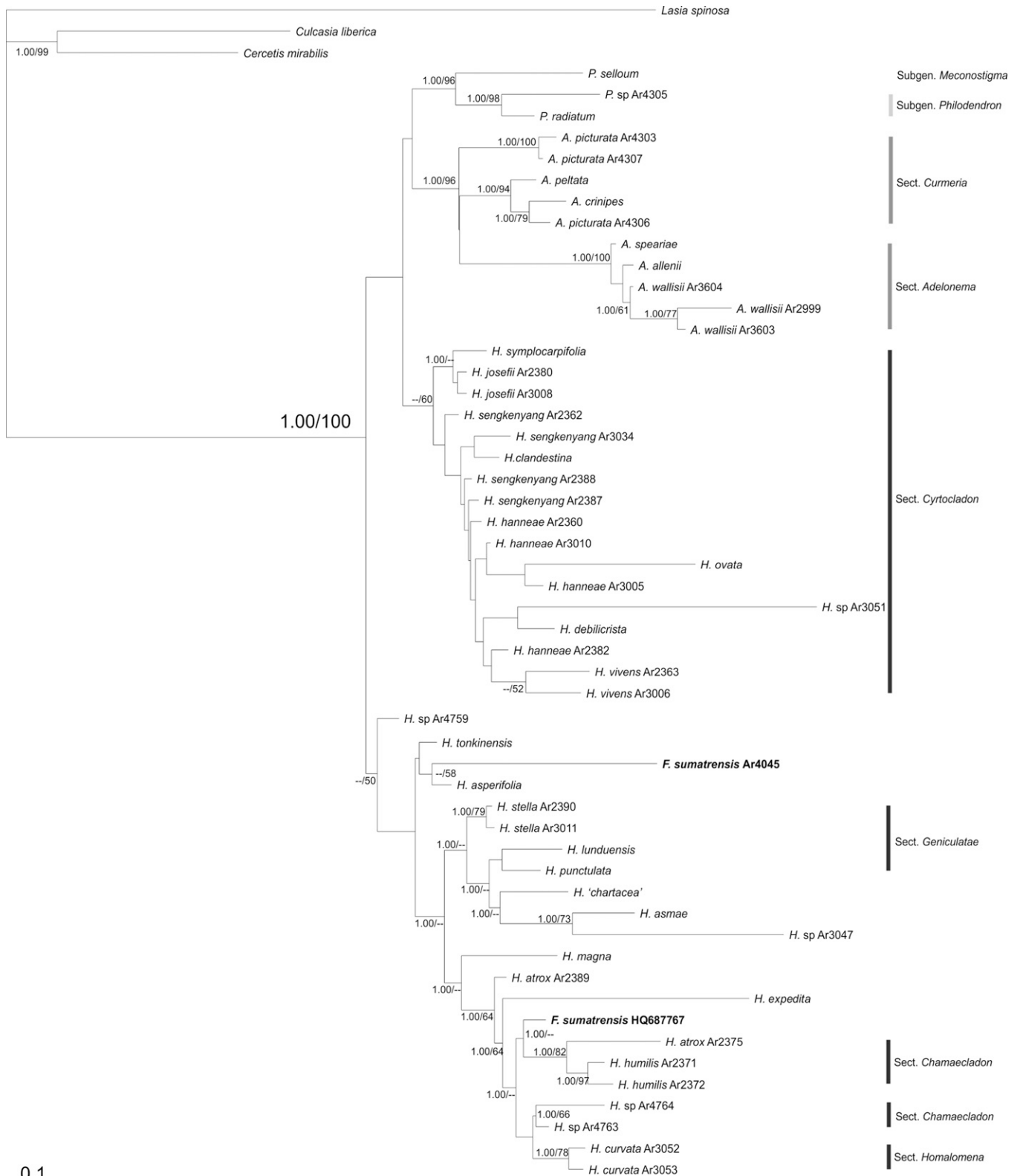


FIG. 1. Bayesian tree of 116 taxa based on the ITS1, ITS2, and the 5.8S regions of the nuclear rRNA gene. Posterior probability (PP, above 0.7) and bootstrap (BS, maximum likelihood, above 50%) values are shown above/below/next to each internal branch. Subgenus/section circumscriptions are indicated at far right. Taxa in single quotation marks are yet to be formally described. *Furtadoa* taxa are highlighted in bold. Sections and subgenera are indicated in shaded bars.





0.1

FIG. 2. Bayesian tree of 55 taxa (*Adelonema*, *Homalomena*, *Philodendron* and outgroup) based on *matK* and partial *trnK* (*matK*) plastid region. Posterior probability (PP, above 0.7) and bootstrap (BS, maximum likelihood, above 50%) values are shown above/below/next to the branch. Subgenus/section circumscriptions are indicated at far right. Taxa in single quotation marks are yet to be formally described. *Furtadoa* taxa are highlighted in bold. Sections and subgenera are indicated in shaded bars.

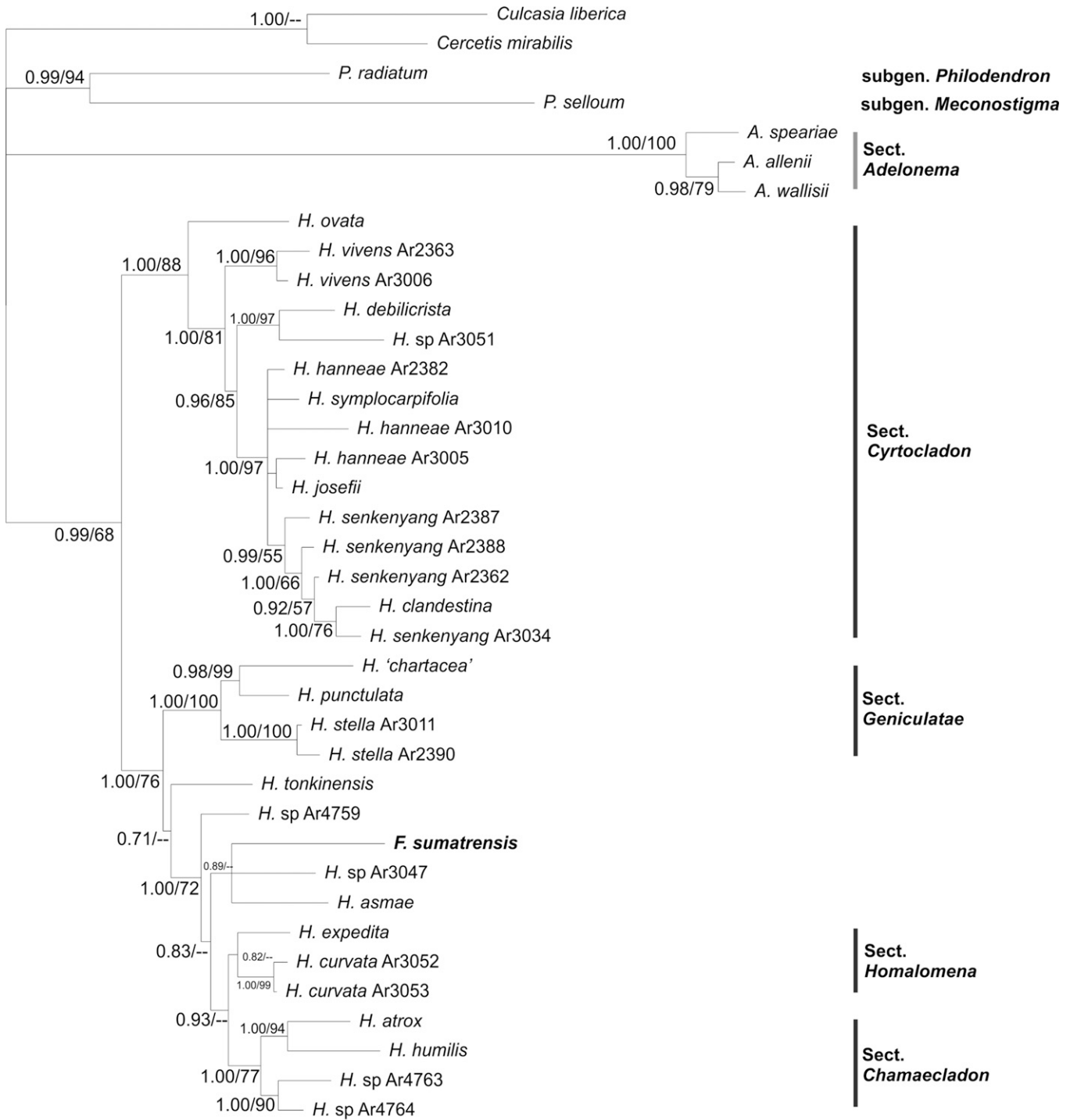


FIG. 3. Bayesian tree of 38 taxa (*Adelonema*, *Homalomena*, *Philodendron* and outgroup) based on combined ITS and *matK* regions. Posterior probability (PP, above 0.7) and bootstrap (BS, maximum likelihood, above 50%) values are shown above/next to the branch. Subgenus/section circumscriptions are indicated at far right. *Furtadoa* taxon is highlighted in bold. Sections and subgenera are indicated in shaded bars.

(PP = 0.99; BS = 68). Sect. *Geniculatae*, Sect. *Homalomena*, and Sect. *Chamaecladon* are moderately supported (PP = 1.00; BS = 76) with Sect. *Geniculatae* as sister to the other two sections. *Furtadoa sumatrensis*, *H. tonkinensis*, and *H. sp* Ar4759 (from Sumatra) are weakly supported within sect. *Homalomena* and sect. *Chamaecladon* clades. Maximum likelihood trees are available from the Dryad Digital Repository: <http://dx.doi.org/10.5061/dryad.rr85h>.

## DISCUSSION

***Adelonema Resurrected***—Twenty-nine accessions of 10 taxa of Neotropical *Adelonema* included in this study were recovered as a clade separate from the Asian *Homalomena* clade, supporting resurrection of *Adelonema* as a genus distinct from Asian *Homalomena*. The estimated divergence between these Asian and Neotropical clades is ca. 25 Ma during the Oligocene, calibrated on fossil records (Nauheimer et al. 2012).

As here defined, *Adelonema* is a Neotropical genus composed of two sections, *Adelonema* and *Curmeria*, totalling 16 species and utilizing the name *Curmeria* for the clade that excludes the type species of *Adelonema*. The sections are distinguished by several distinctive morphological signatures (see key below). Eleven new taxonomic combinations are proposed here, along with descriptions of four taxonomically novel species of *Adelonema*. *Adelonema* is defined by a hypogeal rhizome, crushed vegetative tissue smelling of anise, an extensively sheathing, sometimes prickly petiole, chartaceous and often variegated leaf blades, a spadix either obliquely inserted on the spathe/peduncle (sect. *Adelonema*) or stipitate (sect. *Curmeria*), ovaries with 2–4-pluriovulate locules, and anatropous ovules on an axial placenta.

The chromosome numbers for *Homalomena* sensu Mayo et al. (1997; i.e. Asian and Neotropical species combined) are  $2n = 38, 40, 42$  and  $80$ , while Cusimano et al. (2012) cited  $2n = 38, 40, 42$  and  $56$ . *Furtadoa* has a chromosome count of  $2n = 40$  (Mayo et al. 1997; Cusimano et al. 2012). Moffler and Bogner (1984) recorded chromosome counts of *Adelonema wallisii* and *A. speariae* of  $2n = 42$ .

*Adelonema* is resolved into two sections (Fig. 4): *Adelonema* and *Curmeria*. Sect. *Adelonema* comprises 10 species (*A. erythropus*, *A. allenii*, *A. hammelii*, *A. kvistii*, *A. moffleriana*, *A. orientalis* sp. nov., *A. palidinervia* sp. nov., *A. roezlii*, *A. speariae*, and *A. wallisii*). Sect. *Curmeria* has six species (*A. crinipes*, *A. panamensis* sp. nov., *A. peltata*, *A. picturata*, *A. wendlandii*, and *A. yanamonoensis* sp. nov.).

***Philodendron* subgen. *Pteromisium***—Mayo (1989) elevated the section *Pteromisium* to the subgenus rank (as subgen. *Philodendron*) based on anatomical characters with ca. 75 species (Mayo et al. 1997). Despite marked differences in overall habit (species of subgen. *Pteromisium* are vining), *Adelonema* species display several striking similarities to *Pteromisium* species as compared to other species of *Philodendron* (subgen. *Meconostigma* and *Philodendron*), including adult vegetative shoots with anisophyllous sympodial growth with several to many leaves per stem article, absent (or at least highly inconspicuous) cataphylls, and extensively and conspicuously sheathing petioles. Apart from these characters, the subgen. *Philodendron* and *Meconostigma* have a vascular plexus formed by branched vascular bundles, while the vascular plexus of *Pteromisium* species is composed of simple vascular bundles (Tenorio et al. 2012). With *Adelonema* resurrected in the current paper, *Philodendron* subg. *Pteromisium* should deserve generic recognition with the name *Elopium* (Schott 1865) available. These are patently significant taxonomic changes, and much more comprehensive sampling, especially of subgen. *Pteromisium*, is required before these formal changes are undertaken.

***Furtadoa*, a Synonym of *Homalomena*?**—*Furtadoa* was described based on *Furtadoa sumatrensis* (Hotta 1981), characterized by basal placentation and unistaminate flowers, each associated with a pistillode. A second *Furtadoa* species was described by transfer of *Homalomena mixta* Ridl. (Hotta, 1985). Unistaminate flowers lacking an associated staminode, however, occur in *Homalomena* (uniquely in Sumatran *H. monandra*). None of our trees recovered *Furtadoa* as monophyletic, leading us to speculate that staminate flowers reduced to a single stamen and the presence of a pistillode may have arisen more than once in the *Philodendron* clade. Nevertheless, *Furtadoa* remains a morphologically easily defined taxon and this, together with a dearth of knowledge of the Sumatran species of *Homalomena*, leads us to retain *Furtadoa* at least for the moment.

## TAXONOMIC TREATMENT

**ADELONEMA** Schott, Prodr. Syst. Aroid, 316. 1860.—TYPE: *Adelonema erythropus* Schott. *Curmeria* André, Ill. Hort., 20: 45. 1873.—TYPE: *Curmeria picturata* Linden & André, Ill. Hort., 20: 45. 1873.

***Adelonema* sect. *Curmeria*** (André) S. Y. Wong & Croat, comb. nov. *Curmeria* André, Ill. Hort., 20: 45. 1873. *Homalomena* sect. *Curmeria* (André) Engl., Pflanzenr., 55 (IV.23Da): 30. 1912.—TYPE: *Curmeria picturata* Linden & André, Ill. Hort. 20: 45, t.121, 1873.

***Adelonema allenii*** (Croat) S. Y. Wong & Croat, comb. et stat. nov. *Homalomena erythropus* subsp. *allenii* Croat, Aroideana 27: 131. 2004.—TYPE: COSTA RICA. Puntarenas: Esquinas Experiment Station Residence, area between Río Esquinas and Palmar Sur de Osa, 30 m, 30 May 1950, *Allen 5559* (holotype: MO-2169357!).

**Distribution**—Costa Rica to Colombia.

**Ecology**—Tropical wet forest (bmh-T) and pluvial forest (bp-T), frequently along streams between 20–900 m elevation. Ecological data above and hereinafter are categorized by the Holdridge Life Zone system (Holdridge 1947).

***Adelonema crinipes*** (Engl.) S. Y. Wong & Croat, comb. nov. *Homalomena crinipes* Engl., Bot. Jahrb. Syst. 37: 124. 1905; Engler & K. Krause, Pflanzenr., 55(IV.23Da): 78, Figure 52. 1912.—TYPE: ex. hort. Herrenhausen, *Wendland s.n.* (B †). NEOTYPE (designated here): PERU. Loreto Department: Province Maynas; Iquitos, Munich (Río Itaya), bosque inuindable estacional (Ribera del Río), 03°50'S, 73°20'W, 130 m, *Vasquez & Jaramillo 13038* (K!, MO!, US!, USM!).

**Distribution**—Colombia (Amazonas, Putumayo) to Brazil (Acre), Ecuador (Morona-Santiago, Napo, Pastaza, Zamora-Chinchi), Peru (Amazonas, Loreto, Madre de Dios, Pasco) and Bolivia (Beni, La Paz, Cochabamba).

**Ecology**—Tropical moist forest (bh-T) or tropical wet forest (bh-T), sometimes premontane wet forest (bmh-P). 1,050–1,450 (1,800) m.

**Note**—The neotype collection, *Vasquez & Jaramillo 13038*, was selected based on its very close resemblance to the detailed illustration in Engler and Krause (1912, Fig. 52), and is reasonably well distributed to major herbaria.

**ADELONEMA ERYTHROPUS** Schott, Prodr. Syst. Aroid, 317. 1860. *Philodendron erythropus*

Mart. ex Schott, Syn. Aroid, 76. 1856. *Caladium erythropus* Mart. ex Engl., Fl.

Bras. 3(2): 172. 1878. *Homalomena erythropus* (Schott) Engl., Pflanzenr., 55(IV.23Da): 130. 1912.—TYPE: BRAZIL. Province Río-negro, *Martius s.n.* (holotype: M!).

**Distribution**—Amazon basin, restricted to northern Brazil and southern Colombia.

**Ecology**—Areas of white sand soil under tropical moist forest (bh-T).

***Adelonema hammelii*** (Croat & Grayum) S. Y. Wong & Croat, comb. nov. *Homalomena hammelii* Croat & Grayum, Phytologia 82(1): 37. 1997.—TYPE: COSTA RICA. Heredia: Zona Protectora La Selva, 5 hr. walk S of La Selva Biological Station, between Ríos Peje and Guácimo, 10°21'N, 84°03'W, 300–400 m, 15 Mar. 1985,



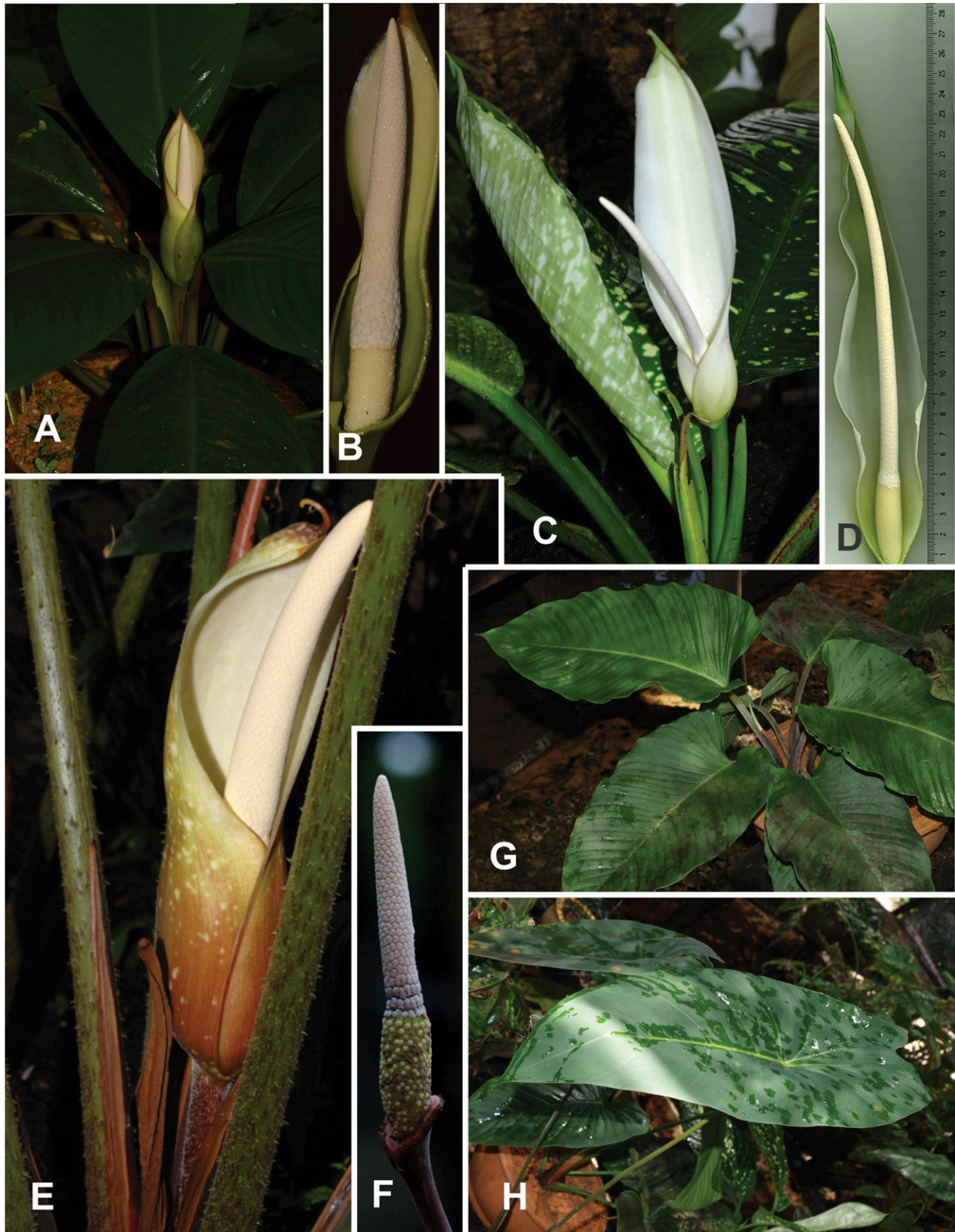


FIG. 4. *Adelonema* Schott. Sect. *Adelonema* (A–D) and Sect. *Curmeria* compared (E–H). In Sect. *Adelonema*, leaf blade is glabrous and petiole is unarmed (A, C), and interstaminal staminodes are absent (B, D); but in Sect. *Curmeria*, leaf blade is puberulent and petiole is armored (E, G, H), and interstaminal staminodes are present (F). A–B. *Adelonema allenii* (Croat) S. Y. Wong & Croat. C–D. *Adelonema speariae* (Bogner & Moffler) S. Y. Wong & Croat. E–F. *Adelonema crinipes* (Engl.) S. Y. Wong & Croat. G. *Adelonema picturata* (Linden & André) S. Y. Wong & Croat. H. *Adelonema peltata* (Mast.) S. Y. Wong & Croat. C, D, F. Photo courtesy of David Scherberich.



*Schatz & Fetcher 1047* (holotype: MO-3382690!; isotypes: CR!, DUKE!, WIS!).

**Distribution**—Endemic to Costa Rica, restricted to the Atlantic slope of Volcán Barva.

**Ecology**—Tropical wet forest (bmh-T), 50–400 m.

**Adelonema kvistii** (Croat) S. Y. Wong & Croat, comb. nov. *Homalomena kvistii* Croat, *Aroideana* 27: 135. 2004.—TYPE: COLOMBIA. Valle: along old rd. from Buenaventura and Cali, 5 km S of Río Sabaletas, 3°44'N, 76°57'W, 145 m, 10 Feb. 1990, *Croat & Watt 70418* (holotype: MO-3784768!; isotypes: JAUM!, K!, US!).

**Distribution**—Colombia and Ecuador, Pacific slope of the Andes.

**Ecology**—Pluvial forest (bp-T) transition to tropical wet forest (bp-PM), 100–145 m.

**Adelonema moffleriana** (Croat & Grayum) S. Y. Wong & Croat, comb. nov. *Homalomena moffleriana* Croat & Grayum, *Aroideana* 27: 137. 2004.—TYPE: COLOMBIA. Chocó: ca. 10–15 km S. of Quibdó on rd. to Istmina, then 8–10 km E. on rd. to petroleum exploration camp, 5°35'N, 76°36'W, 90 m, 9 July 1986, *Grayum et al. 7644* (holotype: MO-3689954!; isotypes: HUA!, K!, US!).

**Distribution**—Colombia (Chocó), Pacific slope.

**Ecology**—Primary and secondary forest in areas of pluvial forest (bp-T), 50–150 m.

**Adelonema orientalis** Croat, sp. nov. —TYPE: PERU. Huánuco: Leoncio Prado, along road to Monzon above Río Huallaga, across the bridge from Tingo María, 9°15'S, 75°59'W, 680 m, 31 Oct. 1980, *Croat 50971* (MO-2817206!; isotype: K!, US!, USM!). Figure 5.

*Adelonema orientalis* is characterized by the stems glabrous except for the often dense puberulence near the apex, by drying shiny yellow, and by peltate leaf blades. It seems to be most closely related to *A. crinipes*, a more widespread species which occurs in the Amazon basin but differs in having basifixed, not peltate, blades. *Adelonema orientalis* could be confused with *A. peltata*, another species with peltate blades occurring in much wetter and relatively non-seasonal areas along the western coast of Colombia and Ecuador.

Herb 1.5–2 m tall; internodes short, 2.5–6 cm diam, dark brown; cataphylls fleshy, light green; petioles (45–)66–115, obtusely flattened adaxially, yellow-green, drying light yellow-brown, finely ribbed; blades peltate (4.5–)7–12 cm, narrowly-ovate-sagittate, 32–62 cm long, 16.5–39.5 cm wide, 1.12–2 times longer than broad (averaging 1.6 times), 0.44–0.86 times as long as petioles, gradually acuminate to acute at apex, prominently lobed at base, thinly coriaceous, semi-glossy and dark green above with the major veins lighter yellow-green, moderately paler and yellow-green, matte below; anterior lobe (21–)28–44 cm long, broadly convex on margins; posterior lobes (9.7–)14–26.5 cm long, narrowly rounded at apex, (6–)10.5–16.5 cm wide at point of fusion of posterior lobes; midrib sunken and slightly paler above, narrowly rounded and paler below; primary lateral veins weakly sunken and concolorous above, narrowly rounded and paler below. Inflorescence solitary, producing strong anise scented aroma at dusk: peduncle (6.5–)11–15 cm long, slightly flattened, 7 × 5 mm diam, brownish-red to faintly

purplish-violet with sparse pale yellowish-green stripes and with a solid pale yellowish-green strip along abaxial surface, sparsely puberulous with short-shanked, T-shaped trichomes, sometimes reddish at base; spathe 16–28 cm long, caudate-acuminate at apex; tube 4.5–8 cm long, 3 × 2.5 cm diam, brownish-red to dark purple-violet with irregular greenish-yellow spots or to purplish-brown, weakly glossy both outside and inside; spathe blade 12 × 17 mm diam when furled, matte, greenish-yellow to greenish-white and tinged weakly with yellow abaxially outside, semi-glossy and greenish-white inside, the minor veins on the blade close and weakly raised outside, slightly darker and flat inside; spadix 12 cm long; sterile staminate portion white, 12 mm diam ca. 3 mm long; fertile staminate spadix creamy-white, 9 mm diam at base, 7 mm diam midway, 3 mm dia. 1 cm below apex; pistilate portion 3.1 cm long in front, 1.7 cm long in rear, 1.3 cm diam at base, 1.4 mm diam midway, 1.3 cm diam at apex, pistils green, arranged in spirals and alternating with spirals of staminodia.

**Etymology**—The specific epithet is from the Latin verb, *orientalis* (meaning eastern) referring to the fact that this species is restricted to the eastern slopes of the Andes.

**Distribution**—*Adelonema orientalis* is endemic to Peru, occurring on the eastern slopes of the Andes in Huánuco and San Martín Departments.

**Ecology**—Tropical moist forest (bh-T), tropical montane moist forest (bh-MBT) and in premontane wet forest (bmh-P) transition to moist forest (bmh-PT), 500–1,550 m.

**Note**—Local names. Peru: “canton masha” (*Schunke-Vigo 12132*); “kushi tsúke” (*Leveau 267*). The inflorescence of *Adelonema orientalis* produces a sweet anise-like aroma, which apparently serves as an attractant for pollination. This scent, which was observed in the area of Tingo María (*Croat 50971*), is sufficiently intense to be smelled up to 10 m away just after dusk. Pollination in this and other species of *Adelonema* is most likely by ruteline scarab beetles.

*Adelonema orientalis* is characterized by the shiny yellow-drying stems and peltate leaf blades. *Adelonema orientalis* could be confused with *A. peltata*, which occurs in much wetter relatively non-seasonal areas along the western coast of Colombia and Ecuador but differs from *A. peltata* by occurring in more seasonally dryer habitats, frequently in tropical moist forest and by having smooth, spineless petioles often more yellowish in color and glabrous except for the often dense puberulence near the apex. Sometimes, such as in populations around Tocache Nuevo (*Croat 57991*, *Schunke 12132*, *Plowman & Schunke 11638* and *Plowman & Rury 11310*), the petioles are wholly glabrous. Detailed bio-systematic studies need to be carried out on *A. peltata* and *A. orientalis* in central Peru and in western South America to determine the degree of their relationship.

**Representative Specimens Examined**—PERU. San Martín: Mariscal Cáceres, Distrito Tocache, Río de la Plata, Gran Fundo La Bella Durmiente Manuel Gatica ca. 5 km NE of bridge over Río Huallaga, 8°08'S, 76°23'W, 1,050 m, 7 Apr. 1984, *Croat 57991* (MO, USM); 15 km SE of Tocache Nuevo, 8°12'S, 76°23'W, 500 m, *Plowman & Rury 11310* (MO, USM); Dist. Campilla, carretera Marginal de la Selva, 7.4 km N of Pulcache, 7°43'S, 70°40'W, 900–950 m, 21 Dec. 1981, *Plowman & Schunke 11638* (MO, SEL, USM); Distrito. Tocache Nuevo, Río de la Plata. Fundo del Sr. Manuel Gatica, 550–700 m, 12 Aug. 1980, *Schunke-V. 12132* (IBE); Ucayali, Coronel Portillo, 968 m, Tingo María-Pucallpa, 3.4 km NE of border with Huánuco, 9°03'45"S, 75°47'45"W, 3 June 1998, *Croat & Sizemore 81737* (MO, USM). Huánuco: on 60° rocky slope above Río Huallaga at Tingo María, 4 Oct. 1972, *Croat 21057* (F, MO); along road from Huánuco to Tingo María, vic. km 479, 9°34'S, 76°03'W, 1,200 m, 1 June 1998, *Croat & Sizemore 81582* (MO, USM); Distrito. Rupa Rupa,



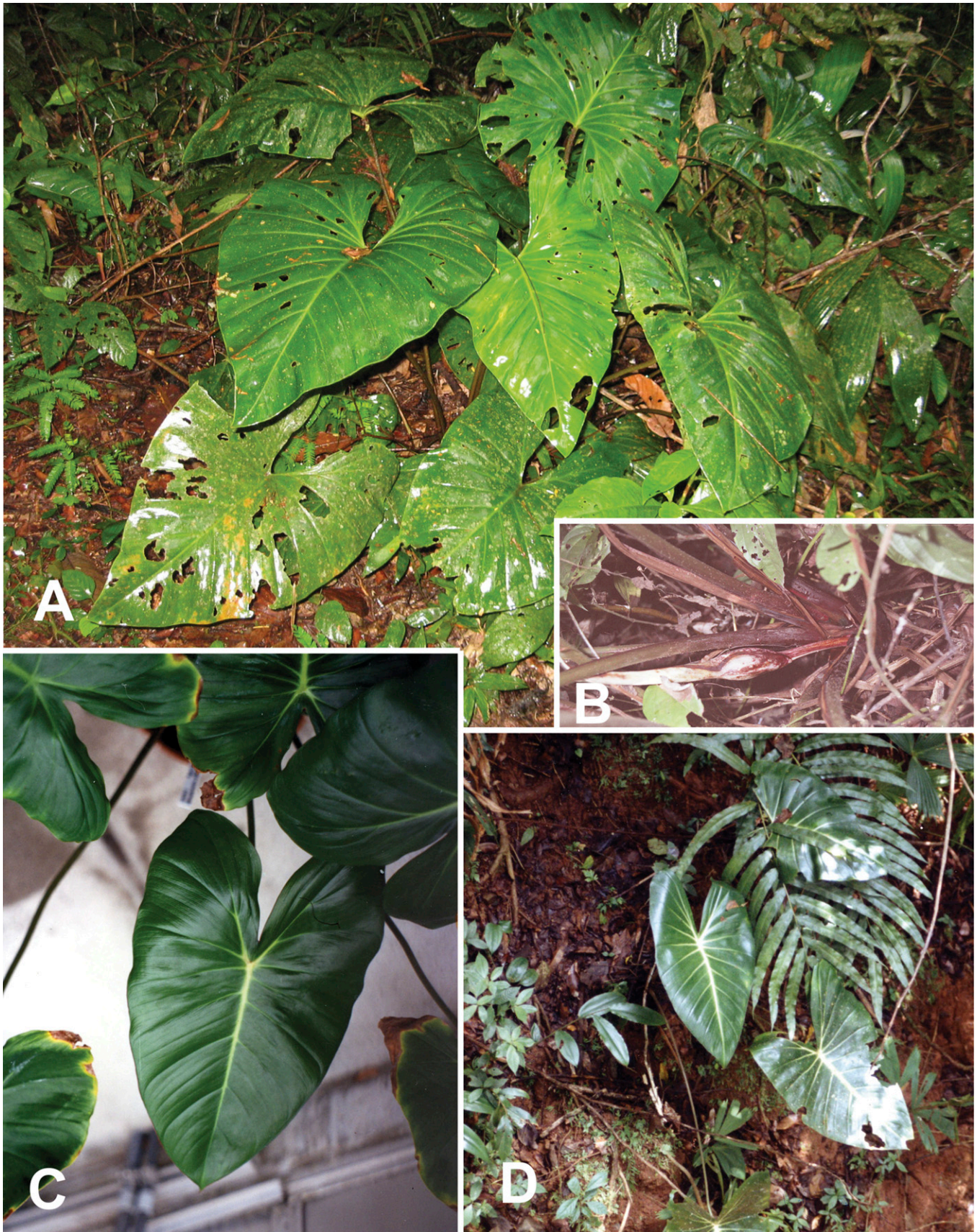


FIG. 5. A–B. *Adelonema orientalis* Croat. A. Note the leaf blade is basifixed. B. Inflorescence. C–D. *Adelonema panamensis* Croat & Mansell. Note the peltate leaf blade with a shiny upper blade surface and white major veins on the upper surface.



al este de Tingo María, cerca al Cerro Quemado, 680 m, 7, 10, 13, 15, 18 Sep. 1978, *Schunke-V. 10605* (MO); La Divisora, Plantación La Margarita, 17 Apr. 1976, *Plowman 5926* (GH); Tingo María airport-Huayna Capac, 10.0 km W of bridge over Río Huallaga, 9°14'56"S, 76°02'16"W, 1294 m, 6 June 1998, *Croat & Sizemore 81874* (MO, USM).

**Cultivated**—Plant from unknown origin, originally from John Banta, cultivated by Richard Mansell, and vouchered as *Croat 83635* (MO).

**Adelonema palidinervia** Croat, sp. nov.—TYPE: ECUADOR.

Orellana: Along road between Coca and Narupa (jct. of Baeza-Tena Hwy.), 12.9 km W of jct. in Coca, 284 m, 00°29'47"S, 77°07'50"W, 7 Oct 2007, *Croat, Carlsen & Levin 99438* (MO-6192212!). Figure 6.

*Adelonema palidinervia* is characterized by its small stature, broadly ovate leaves with subcordate, overlapping lobes and by a broad whitish fish-tail pattern on the midrib. *Adelonema palidinervia* is closest to *A. picturata*, which differs by having narrowly rounded lobes and a usually parabolic to arcuate, sometimes spatulate sinus, as well as by its smaller inflorescence, with the peduncle only weakly puberulent near the apex in contrast to being densely scurfy-pubescent throughout in *A. picturata*.

Terrestrial on steep slopes in lateritic soil; stems growing to ca. 10 cm depth then spreading laterally, usually with plants clustered in small groups; internodes short 1–1.5 cm diam; petioles 19.5–22.5 cm long, creamy pink, pale-striate at base, sheath 6–10 cm long, pale yellow-green, in-curved, sharply flattened adaxially near sheath, broadly sulcate and toward apex, olive-green and matte, tinged red in lower 1/2, finely ridged, the ridges finely pubescent; blades 15–20 cm long, 9–12.2 cm wide, 1.6 times longer than wide, 0.9–1.3 times longer than petioles, subcoriaceous, darker green and matte above with fish-tail feathering of pale gray-green along midrib, this blending to gray-white on midrib; midrib weakly sunken and whitish above narrowly rounded and finely pubescent-ridged, slightly darker below; primary lateral veins 8–10 pairs, quilted-sunken and concolorous above, pleated-raised and concolorous below; minor veins few, moderately visible. Inflorescence solitary, erect; peduncle 3.5–6 cm long, 4–6 mm diam, purplish-violet, finely ribbed, densely puberulent, especially in distal 1/2, drying dark brown, 2.5–4 cm diam; spathe 5.2–6.3 cm long, only weakly constricted above tube; tube 4 cm long, 2.3 cm diam, green heavily tinged purplish-violet, with fine rows of short pale-lineations extending to apex outside reddish inside, finely ribbed throughout, flattening 5.7–6.2 cm wide, drying dark brown and matte outside, slightly paler and semi-glossy inside throughout; blade pale greenish-white, matte outside, greenish, tinged red in lower half inside; spadix 5.3–5.5 cm long; staminate spadix 4–5 cm long, 6 mm diam; staminate portion 3.8 cm long, 6 mm diam; pistillate spadix 4.3 mm long in front, 1.8 mm long in rear, 6.2 mm diam at base, 6 mm diam at apex.

**Etymology**—The epithet is from the Latin *palidus* (pale) and *nervus* (nerve or vein), referring to the pale midvein of the leaf blade.

**Distribution**—Ecuador (Orellana, 284 m).

**Ecology**—Tropical moist forest (bh-T).

**Adelonema panamensis** Croat & Mansell, sp. nov.—TYPE:

PANAMA. Canal Area: Parque Nacional Soberania, Old Pipeline Road N of Gamboa, 6 mi. N of Gamboa, Río Mendoza, 9°11'N, 79°46'W, 23 July 1994, *Croat & Zhu 77079* (holotype: MO-05053131!; isotypes: K!, PMA!). Figure 5.

*Adelonema panamensis* is most similar to *A. wendlandii* and *A. peltata* (Fig. 1). It differs from the former by its peltate leaf blades with a shiny upper surface and from the latter, a species from Colombia and Ecuador, by its shiny upper blade surface, white major veins on the upper surface, as well as by the prominulous rather than flat and inconspicuous minor veins on the upper surface and the relatively pointed posterior lobes — these absent altogether or much shorter and broadly rounded in *A. peltata*.

Internodes very short, 2–4 cm diam; sap anise-scented; petioles 46–106 cm long, 7–10 mm diam, brown more or less terete and obtusely flattened adaxially, firm, semi-glossy, spiny and puberulent throughout, spines denser and longer toward the base, sheathed for 0.15–0.37 their length; blades peltate, petiole attached mostly 1–12 cm above base (rarely basifixed on younger leaves), 2.5–7(–12) cm at base, 38–86.5 cm long, 18–42 cm wide, 1.6–2.3 times longer than broad, 0.7–0.8 times as long as petioles or to about as long as petioles narrowly ovate-triangular, gradually acuminate to narrowly long-acuminate, subcoriaceous, dark green and glossy above, moderately pale and matte below, drying brownish to greenish above, yellow-brown to greenish below (rarely dark brown above, reddish-brown below); anterior lobes 21–46 cm long, broadly convex on margin; posterior lobes directed usually somewhat outward, 12–31.7 cm long, 7.7–17 cm wide, usually and bluntly pointed at apex; basal veins 4–6, the first and sometimes the second free to the base, the third and fourth (fifth) coalesced 5–12 cm; posterior rib straight; midrib, posterior rib and lower portions of lateral veins whitish above; midrib weakly sunken to flat or weakly raised, narrowly rounded and concolorous below; primary lateral veins sunken and marginally discolored above, convex and paler below, pale greenish-white; minor veins prominently visible and weakly raised above but not markedly distinct below. Inflorescence erect at anthesis; peduncle 5–10 cm long at anthesis, 8–10 mm diam (to 18 cm long in fruit); spathe greenish, mottled pinkish-white and brown outside, paler and glossier inside, drying light pinkish-tan inside, grayish-green outside with pinkish-brown mottling, (8–)11–13 cm long (to 18.5 cm in fruit), 3.0–3.3 cm diam, weakly constricted above tube; spadix (7.3–)9.5–11.5 cm long, slightly shorter than spathe; staminate portion 8.5 cm long, slightly constricted above the sterile staminate portion, the latter to 2 cm long, 1.3 cm diam; sterile staminate portion 2 cm long, 1.4 cm diam at base. Diameter 1.1 cm at apex; pistillate portion 2.5–3 cm long in front, 1.5–1.7 cm long in rear, 1.3–2.5 cm diam midway; flowers 14–17 visible per spiral, alternating with an equal number of toadstool-shaped staminodia; pistils 1–1.5 cm long, 1–1.2 cm diam; style not apparent; stigma depressed-globose, 0.8 mm thick, 1.8 mm diam, cream-colored in pickled condition; staminodia equally as long as pistils, bright white in life but yellow-brown in spirit collection, much thickened at apex, subrounded in outline, broadly rounded at apex but tapering to a slender whitish filament; ovary 3(4)-locular; ovules ca. 20, ca. 0.1 mm long; funicle about as long as ovule. Infructescence pendent or reclining on ground; peduncle to 24 cm long, peduncle and spathe purple-brown, ranging from B&K yellow-red 2/10 to yellow 2/7.5; spathe to 21 cm long; pistillate spadix 8–8.5 cm long, 3–3.5 cm diam, fruiting pistils green; old staminate spadix to 11 cm long.

**Etymology**—The species is named for the type locality in Panama.





FIG. 6. *Adelonema palidinervia* Croat. A. Whole plant with an inflorescence emerging. B. broadly ovate leaf with subcordate bases, overlapping lobes and with a broad whitish fish-tail pattern on the midrib. C. Petiolar sheath broadly open with puberulent petioles. D, E. Inflorescence.



**Distribution**—Apparently restricted to eastern Panama from the Canal Area along the Caribbean coast to the Colombian border (and no doubt in adjacent Colombia as well).

**Ecology**—Areas of premontane wet forest (P-wf).

**Note**—*Adelonema panamensis* is recognized by its ovate-cordate, weakly peltate, glossy blades with a rather prominent white midrib on the upper surface. It rather closely resembles *A. peltata* from the Pacific slope of Colombia, but differs by the narrowly ovate-triangular blades, rather than broadly ovate for *A. peltata*, by having a typically much glossier upper blade surface, much paler major veins, prominulous rather than flat and inconspicuous minor veins on the upper surface, and relatively pointed posterior lobes (posterior lobes absent altogether or much shorter and broadly rounded in *A. peltata*). Although living material of the two species is easily separable, dried specimens are more difficult to determine without good field notes. *Adelonema panamensis* differs more readily from the Central American forms of *A. wendlandii*. Despite the strong similarities of the two species based on dried material, the differences in living material where they occur together, such as on the Pipeline Road in the Canal Area, is startling. The two are easily distinguished even from a distance because of the glossy blade surface and the pale upper midrib of *A. panamensis* versus matte to weakly glossy blade with a rather more concolorous midrib for *A. wendlandii*. *Adelonema panamensis* also differs from the Central American material of *A. wendlandii* in having peltate rather than basifixed blades.

**Representative Specimens Examined**—PANAMA. Canal Area: Navy Pipeline Road, ca. 6 km N of Gamboa, ca. 200 m, 13 July 1976, *Croat* 37029 (MO); Pipeline Road at Río Agua Salud, 26 Sep. 1970 (st), *Croat* 12352A (MO); 3.7 km N of Gamboa gate, 5 Mar. 1976, *Croat* 32979; 8 mi. from Gamboa gate, 14 Aug. 1971 (fr), *Croat* 16678 (MO); ca. 90 m, 12 Aug. 1976 (st), *Croat* 38285 (MO, SEL); Pipeline Preserve, NW of Panama City, 12 May 1966 (st), *Nicolson* 3391 (US); N of Frijoles, 19 Dec. 1923 (st); Colón: Matachui, 1 Mar. 1905 (st), *Cowell* 203 (NY, US); Ft. Espinar (Ft. Gulick), along path behind Panama Canal Company water tank, 6 June 1994, *M. Akers* 15 (MO); Río Guanache, ca. 5 km upstream from road to Portobello, 9°30'N, 79°40'W, 50 m, 15 Mar. 1986 (st), *Hammel & Trainor* 14760 (MO); Río Guanache between Puerto Pilón and Portobello, ca. 1.5 mi S of road, 100 m, 19 June 1994, *Croat & Zhu* 76238 (MO, PMA); Puerto Obaldia, ca. 50 m, 18 Aug. 1971, *Croat & Gentry* 16811 (MO).

**Adelonema peltata** (Mast.) S. Y. Wong & Croat, comb. nov.

*Homalomena peltata* Mast., Gard. Chron., new series 7: 273, Figure 46, 1877. —TYPE: COLOMBIA, cultivated by Bull, ex. Shuttleworth, *Masters s. n.* (holotype: K!).

**Distribution**—Colombia (Antioquia) to Ecuador as far south as Los Ríos Province, Ecuador.

**Ecology**—Tropical wet forest (bmh-T) and pluvial forest (bp-T).

**Adelonema picturata** (Linden & André) S. Y. Wong & Croat, comb. nov. *Curmeria picturata* Linden & André, Ill. Hort. 20: 45, t.121, 1873. *Homalomena picturata* (Linden & André) Regel, Gartenflora 26: 33, 1877. —TYPE: COLOMBIA: 1872, cultivated by Linden in Paris, *Roezl s. n.* (type: plate 121 in Ill. Hort.) but an herbarium specimen by Regel at LE could serve as the epitype.

**Distribution**—Southwest Costa Rica, southward through Panama and Colombia to Peru, disjunct to Guyana, Surinam, and French Guiana.

**Ecology**—Premontane wet forest (bmh-P) to tropical moist forest (bh-T), sometimes in premontane moist forest (bh-P), 130–1,170 m.

**Adelonema roezlii** (Mast.) S. Y. Wong & Croat, comb. nov.

*Curmeria roezlii* Mast. Gard. Chron., n. s., 2: 804, 1874. *Homalomena roezlii* (Mast.) Regel, Gartenflora 26: 33, 1877.—TYPE: COLOMBIA, cultivated source, original collection: *Roezl s. n.*, 18 Dec. 1874 (fl), *Masters s. n.* (K!).

**Distribution**—Colombia, Cordillera Central.

**Ecology**—Original collection site is too indefinite for establishing life zone.

**Adelonema speariae** (Bogner & Moffler) S. Y. Wong & Croat, comb. nov. *Homalomena speariae* Bogner & Moffler, Aroideana 7: 37, 1984.—TYPE: COLOMBIA. Caldas: road from Medellín to Bogotá, 1979, living plant collected by Elaine Spear, Miami; vouchered by *Bogner s. n.* (holotype: M!).

**Distribution**—Colombia, Cordillera Central.

**Ecology**—Locality data by Spear is too imprecise for establishing life zone.

**Adelonema wallisii** (Regel) S. Y. Wong & Croat, comb. nov.

*Homalomena wallisii* Regel Gartenflora 25: 320, 1876. *Curmeria wallisii* (Regel) Mast., Gard. Chron., n.s., 1: 108, 1877.—TYPE: Cultivated Source: Colombia: collected by Wallis in Mar. 1877, vouchered by *Masters s. n.* (holotype: K!).

**Distribution**—Costa Rica, Panama and Colombia Panama and Colombia.

**Ecology**—Tropical wet forest (bh-T), premontane wet forest (bmh-P) and tropical wet forest (bmh-T), between 300–500 m.

**Adelonema wendlandii** (Schott) S. Y. Wong & Croat, comb. nov. *Homalomena wendlandii* Schott, Prodr. Syst. Aroid: 308, 1860.—TYPE: COSTA RICA. Cultivated in Berlin, 1876, *Wendland s. n.* (holotype: B!, F-012190).

**Distribution**—Costa Rica to N. Colombia.

**Ecology**—Tropical moist forest (bh-T), premontane wet forest (bh-P) and tropical wet forest life zones (bmh-T), frequently along streams.

**Adelonema yanamonoensis** Croat & Mansell, sp. nov.—TYPE: PERU. Loreto: Maynas, Yanamono Tourist Camp, on Río Sucusari, 50 m. NE of Iquitos, 30°30'S, 72°50'W, 106 m, originally collected by Jack Williford, *Croat* 56925 (holotype: MO!; isotypes: F!, NY!, US!, USF!, USM!). Figure 7.

*Adelonema yanamonoensis* is closely similar to *A. crinipes* but is smaller in stature, growing usually less than 40 cm tall, with leaf blades markedly hastate, and with the spathes purplish rather than greenish at anthesis, such as those of typical *A. crinipes* in the Iquitos region. *Adelonema crinipes* is typically much more robust, ranging between 1 and 2 m tall. Blades of *A. crinipes* are typically not markedly hastate and while they may have narrow posterior lobes they do not typically flare outwards, while the lateral margins of the blades are typically convex, not convex as in *A. yanamonoensis*.

Terrestrial herb to 50 cm tall; stems typically branching and clustered; internodes short, to 2 cm diam; cataphylls to 10 cm long, sharply 2-ribbed, turning reddish-brown, persisting intact; petioles sub-terete, obtusely somewhat flattened adaxially, dark green, variegated with short pale green thick lines, semi-glossy, minutely puberulent, sparsely spiny throughout, but more dense near the base; sheath reddish, 8–12 cm long, turning reddish-brown the thin margins often falling free; blades triangular-hastate, 12–30 cm long



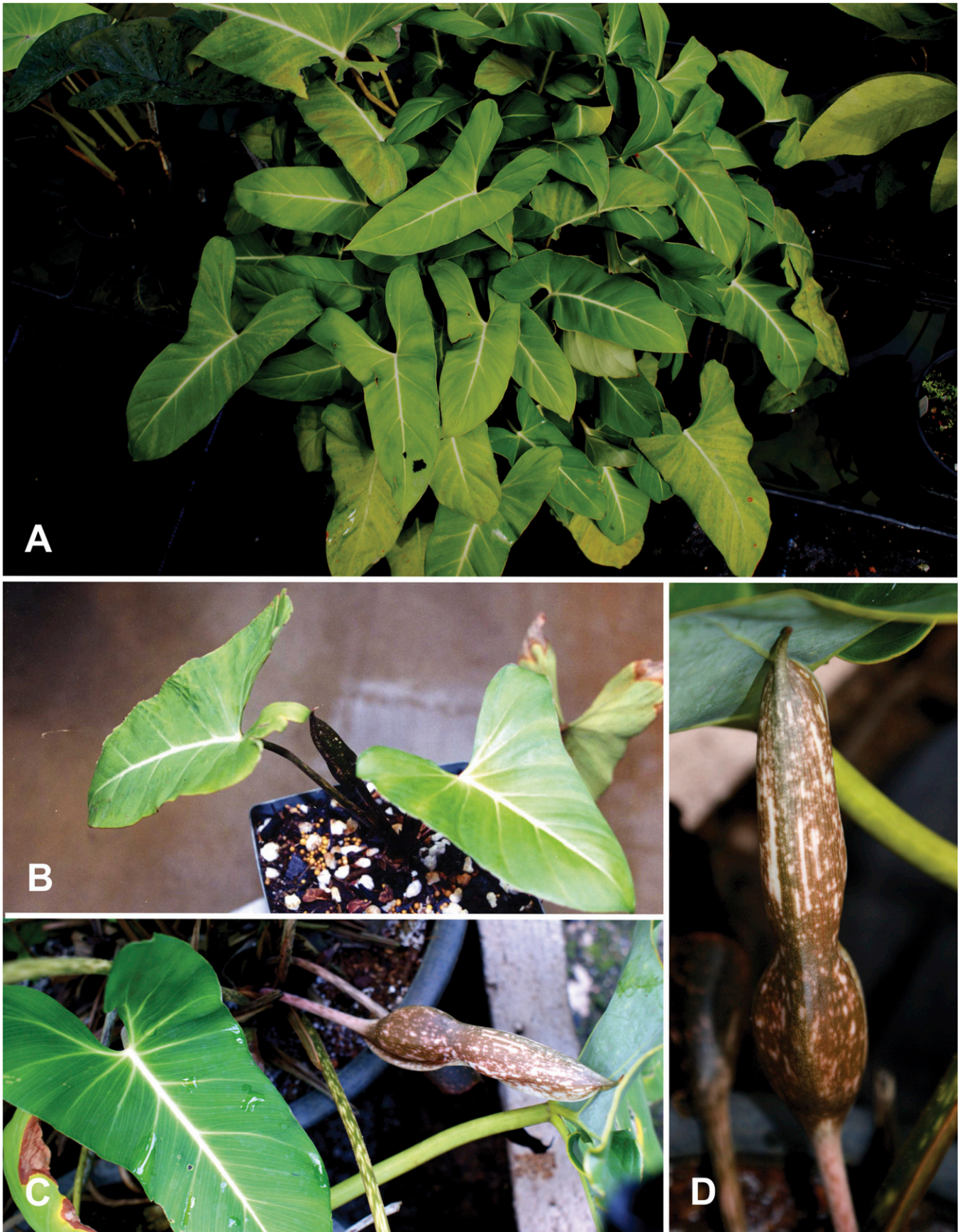


FIG. 7. *Adelonema yanamonoensis* Croat & Mansell. A. Whole plant. B, C. Hastate leaf blade. C, D. Purple spathe.



and wide, usually markedly concave along the margins, subcoriaceous, dark green and matte sub-velvety to weakly glossy above, moderately paler and matte below; anterior lobe acuminate, 5.5–13 cm wide midway; posterior lobes 14–17 cm long, 2–6.5 cm wide, narrowly rounded at apex, flaring from 90–120° angle from the midrib, held more or less flat or directed upward from the plane of the blade; midrib flat to weakly sunken, paler below, moderately paler above, slightly thicker than broad, bluntly angular to narrowly rounded and slightly paler below; primary lateral veins 3–4 per side, arising at 40–50° angle, moderately straight to the margins, etched to weakly sunken and usually slightly paler above (especially in the lower half), drying slightly paler or darker than the surface; minor veins fine, moderately distinct, darker than surface, arising from both the midrib and primary lateral veins; basal veins 4–5 per side, the first free to the base or nearly so, the third to fifth coalesced 2–4.5 cm; posterior rib straight, scarcely or not at all naked along the sinus, the green tissue diminishing very gradually toward the petiole, the naked portion rarely 1 or 2 cm long. Inflorescences one per axil; peduncle 4–5.5 cm long, densely puberulent to scabridulous (extending weakly onto base of spathe), reddish at base, purplish-violet toward apex, subterete; spathe (5–)7–10.5 cm long, 1.5–2.0 cm diam, (flattening to 5–6 cm wide) dark violet-purple, purple-brown, mottled with greenish- to creamy-white spots, weakly glossy to semi-glossy and minutely granular outside with magnification (10×), glossy and much paler, tinged pink inside, densely pale-speckled and white maculate, rather prominently constricted above the tube, caudate-acuminate at apex; spadix 7.3–10.3 cm long; pistillate portion 2.0–3.5 cm long in front, 1.7–2.6 cm long in back, 0.8–1.5 cm diam; pistils medium green, 1.8–2.0 mm long, 1.0–1.2 mm diam, tapered toward the base; stigma disk-shaped, 0.6–0.8 mm diam, pale green; staminodia white, one per pistil, 0.6–1.0 mm diam, borne on slender stalk; stami-

nate spadix 4.8–7.0 cm long, constricted to 7–10 cm diam. At base, the sterile section 2–3 mm long, gradually tapered to a blunt point at apex, drying yellow-brown, the broadest portion 0.7–1.1 cm diam. Infructescence unknown.

**Etymology**—The species is named for the type locality at Yanamono Tourist Camp on the Río Sucusari in Loreto Department.

**Distribution**—*Adelonema yanamonoensis* is restricted to the region of the Amazonas and Napo Rivers in the region of Iquitos, Peru.

**Ecology**—Tropical moist forest (bh-T), between 100–130 m.

**Note**—*Adelonema yanamonoensis* is characterized by its small stature, branching clustered stem, sharply 2-ribbed cataphyll turning reddish-brown and persisting intact; dark green minutely puberulent, sparsely spiny petioles which are variegated with short pale green thick lines, triangular-hastate blades prominently lobed at base and matte-sub-velvety to weakly glossy above, usually markedly concave along margins with 4–5 pairs of basal veins, the first pair of which is free to base or nearly so, a posterior rib that is scarcely or not at all naked along the sinus, as well as by the densely puberulent to scabridulous peduncle, a dark violet-purple or purple-brown spathe that is mottled with greenish- to creamy-white spots outside and tinged pink inside.

**Representative Specimens Examined**—PERU. Loreto: Yanamono, Explorama Tourist Camp, between Indiana and mouth of Río Napo, 130 m, 3°28'S, 72°48'W, 18 Feb. 1981, *Gentry et al.* 31378 (MO); 50 mi. NE of Iquitos, 30°30'S, 72°50'W, 106 m, 17 Oct. 1980, *Vásquez & Jaramillo* 511 (MO, USM); Varadera de Mazan, trail from Río Amazonas to Río Napo, 22 Aug. 1972, *Croat* 19535A (MO); vic. Iquitos, 100 m, 3–11 Aug. 1929, *Killip & Smith* 27445 (NY, US); Río Itaya, ca. 5 km above Iquitos, 6 Aug. 1972, *Croat* 18817 (MO); ca. 6 km upriver from Iquitos, 11 Aug. 1972, *Croat* 19075 (MO); ca. 19 km above Iquitos, 13 Aug. 1972, *Croat* 19137 (MO, USM); 14 Dec. 1979, *Davidson & Jones* 9863 (MO, RSA); 130 m, 3°50'S, 73°20'W, *Vásquez & Jaramillo* 13038 (K, MO, Iquitos, US, USM).

**Cultivated**—ECUADOR. Amazonas: collected by D. Fisk, vouchered as *Croat* 78340 (MO). PERU. Loreto: Explorama Tourist Camp on Río Sucusari near Río Napo, collected and cultivated by M. Johnson, vouchered 29 Sep. 1988, as *Croat* 69710 (MO).

#### REVISED KEY TO PHILODENDRON CLADE

1. Climbing hemiepiphytes, epiphytes or terrestrial herbs with petiolar sheath well-developed then plants climbing; leaf blades highly variable – ranging from linear-lanceolate to complexly bipinnatifid; ovules orthotropous or hemianatropous ..... *Philodendron*
1. Terrestrial mesophytes or helophytes, or rheophytic; petiolar sheath well developed; leaves lanceolate, elliptic, oblong, subtriangular or cordate to sagittate, rarely peltate; ovules anatropous ..... 2
2. Placentation basal or parietal; petiole unarmed; leaf blade usually glabrous, if hairy then pilose or hispid, never pubescent, never variegated; tissues smelling of terpenoids – frequently reminiscent of mango or citrus peel, or ginger. Anthesis (where observed) begins at dawn. Old world tropics ..... 3
3. Staminate flowers monandrous, each associated with a pistillode; placentation basal ..... *Furtadoa*
3. Staminate flowers each with 2–6 stamens, very rarely monandrous (and then staminate flower never associated with a pistillode); placentation parietal ..... *Homalomena*
2. Placentation central; petiole often armored with prickles; leaf blade glabrous or pubescent, often variegated; tissues smelling of anise. Anthesis (where observed) beginning at dusk. Neotropics ..... 4
4. Spadix sessile, inserted obliquely on spathe/peduncle. Petiole not armored; leaf blade glabrous; interpistillar staminodes always absent ..... *Adelonema* sect. *Adelonema*
4. Spadix stipitate. Petiole often armored with prickles; leaf blade pubescent; interpistillar staminodes sometimes present ..... *Adelonema* sect. *Curmeria*

#### KEY TO SPECIES OF ADELONEMA

1. Leaf blades cordate to hastate, base evidently lobed (though sometimes with lobes united with each other through much of their length); foliage with trichomes, those on petiole sometimes much thickened and spinescent ..... 2
2. Petioles sulcate on dorsal surface, densely to slightly pubescent with filamentous trichomes, especially near apex, but never with spines ..... 3
3. Leaf blades broadly ovate with broadly ovate subcordate blades that have overlapping lobes, sinus lacking; peduncle weakly puberulent near apex ..... *A. palidinervia*
3. Leaf blades narrowly ovate with narrowly rounded lobes that have a parabolic to arcuate (rarely spatulate) sinus; peduncle densely scurfy-pubescent throughout ..... *A. picturata*

2. Petioles terete or nearly so, usually with scattered spinose trichomes towards base ..... 4
4. Leaf blades clearly peltate at base ..... 5
5. Blades glossy and glabrous on upper surface, posterior lobes flat; midrib and proximal portion of primary lateral veins pale green to whitish; minor veins of living specimens prominulous and easily visible on upper surface, pale green where they merge with midrib; Central Panama, less than 300 m ..... *A. panamensis*
5. Blades usually matte and obscurely puberulent on upper surface; posterior lobes directed prominently upward at an angle to midrib; midrib and primary lateral veins concolorous to pale green; minor veins of living material flat and not conspicuous, not at all paler than surrounding blade; South America, (Pacific slope and Central Peru), more than 300 m ..... 6
6. Petioles smooth and spineless, glabrous except for dense puberulence near apex, usually yellowish in color; Central Peru (Huánuco and San Martín), 500–1,550 m ..... *A. orientalis*
6. Petioles matte, puberulent and spiny throughout their length, usually brown to yellow-brown and matte; N. slope of Central Cordillera and W. slope of Western Cordillera, 280–1,030 m ..... *A. peltata*
4. Leaf blades basifixed ..... 7
7. Plants to 30–50 cm tall; spathe less than 12 cm long, usually dark violet-purple; Peru, vicinity of Iquitos ..... *A. yanamonoensis*
7. Plants typically to 1 m or more tall; spathe more than 12 cm long, green; widespread species, ranging from Nicaragua to the N. Colombia ..... 8
8. Petioles weakly spiny; Central American and northern Colombia ..... *A. wendlandii*
8. Petioles glabrous to densely spiny; Amazon basin from southern Colombia to Bolivia ..... *A. crinipes*
1. Leaf blades broadly to narrowly ovate or elliptic, base not lobed; foliage without trichomes or spines ..... 9
9. Petioles 1.5–4(–6.5) cm long, sheath usually extending nearly to blade; spathe 5–7(–16) cm long ..... *A. wallisii*
9. Petiole over 6.5 cm long, sheath usually extending to no more than about mid-petiole ..... 10
10. Spathe ca. 25 cm long; leaf blades conspicuously mottled ..... *A. speariae*
10. Spathe 5–20 cm long; leaf blades not mottled or if mottled then mottling very weak ..... 11
11. Leaves broadest above the middle, dark green (almost black) with conspicuous hyaline margins ..... *A. moffleriana*
11. Leaves broadest at or near middle, medium green, hyaline margin usually inconspicuous ..... 12
12. Primary lateral veins more than 15 per side ..... 13
13. Blades matte, ovate to broadly ovate or elliptic, 1.6–1.8 times longer than wide, rounded to weakly subcordate at base; petioles 1.3–2.6 times longer than blades; inflorescences to ca. 20 cm long; Colombia & Ecuador, 100–140 m ..... *A. koistii*
13. Blades semi-glossy, elliptic to narrowly ovate, 2.0–2.2 times longer than wide, broadly cuneate to rounded at base; petioles about as long as blades; inflorescence less than 13 cm long; Atlantic slope of N. Costa Rica (Volcán Barva); 300–400 m ..... *A. hammelii*
12. Primary lateral veins 10 or fewer per side ..... 14
14. Adult blades more than 20 cm wide; Colombia (unknown origin, but probably in Andes of N. Colombia) ..... *A. roezlii*
14. Adult blades less than 15 cm wide ..... 15
15. Leaves membranaceous, minor veins frequently branching moderately distinct; epidermal cells on lower blade surface smooth; Amazon basin; tropical moist forest (bh-T) in areas of mostly white sand soil ..... *A. erythropus*
15. Leaves subcoriaceous (drying chartaceous), minor veins on lower blade surface generally not distinct, epidermal cells on lower blade surface minutely granular at high magnifications; Central America and northern Colombia; tropical wet forest (bmh-T) in areas of alluvial or lateritic soil ..... *A. allenii*

ACKNOWLEDGMENTS. This study was partially funded by Ministry of Higher Education Malaysia through No. ERGS/01(02)/808/2011(03), FRGS/STWN10(01)985/2013 (26) and NRGs/1089/2013-(03). Many thanks to Carla V. Kostelac for her assistance in image searching. We thank two anonymous reviewers for constructive comments on an earlier version of the manuscript.

#### LITERATURE CITED

- Akaike, H. 1974. A new look at the statistical model identification. *IEEE Transactions on Automatic Control* 19: 716–723.
- Cabrera, L. I., G. A. Salazar, M. W. Chase, S. J. Mayo, J. Bogner, and P. Dávila. 2008. Phylogenetic relationships of aroids and duckweeds (Araceae) inferred from coding and noncoding plastid DNA. *American Journal of Botany* 95: 1153–1165.
- Cuénoud, P., V. Savolainen, L. W. Chatrou, M. Powell, R. J. Grayer, and M. W. Chase. 2002. Molecular phylogenetics of Caryophyllales based on nuclear 18S rDNA and plastid *rbcL*, *atpB*, and *matK* DNA sequences. *American Journal of Botany* 89: 132–144.
- Cusimano, N., J. Bogner, S. J. Mayo, P. C. Boyce, S. Y. Wong, M. Hesse, W. Hettterscheid, R. C. Keating, and J. C. French. 2011. Relationships within the Araceae: comparisons of morphological patterns with molecular phylogenies. *American Journal of Botany* 98: 654–668.
- Cusimano, N., A. Sousa, and S. S. Renner. 2012. Maximum likelihood inference implies a high, not a low, ancestral haploid chromosome number in the Araceae, with a critique of the bias introduced by “x”. *Annals of Botany* 109: 681–692.
- Doyle, J. J. and J. L. Doyle. 1987. A rapid DNA isolation procedure for small quantities of fresh leaf tissue. *Phytochemical Bulletin* 19: 11–15.
- Drummond, A. J., B. Ashton, S. Buxton, M. Cheung, A. Cooper, C. Duran, J. Heled, M. Kearse, S. Markowitz, R. Moir, S. Stones-Havas, S. Sturrock, F. Swidan, T. Thierer, and A. Wilson. 2012. Geneious v5.6. Available from <http://www.geneious.com>.
- Edgar, R. C. 2004. MUSCLE: Multiple sequence alignment with high accuracy and high throughput. *Nucleic Acids Research* 32: 1792–1797.
- Engler, A. and K. Krause. 1912. Araceae-Philodendroideae-Philodendreae. Allgemeiner Teil, Homalomeninae und Schismatoglottidinae. Pp. 1–134 in *Pflanzenreich* vol. 55 (IV.23Da), ed. A. Engler. Leipzig: Engelmann.
- Felsenstein, J. 1985. Confidence limits on phylogenies: an approach using the bootstrap. *Evolution* 39: 783–791.
- French, J. C. 1985. Patterns of endothelial wall thickenings in Araceae: subfamilies Calloideae, Lasiodeae and Philodendroideae. *Botanical Gazette (Chicago)* 146: 521–533.
- French, J. C. 1987a. Systematic occurrence of a sclerotic hypodermis in roots of Araceae. *American Journal of Botany* 74: 891–903.
- French, J. C. 1987b. Systematic survey of resin canals in roots of Araceae. *Botanical Gazette (Chicago)* 148: 360–371.
- Furtado, C. X. 1939. Notes on some Indo-Malaysian *Homalomena* species. *Gardens' Bulletin Straits Settlement* 10: 183–238.
- Gauthier, M.-P. L., D. Barabé, and A. Bruneau. 2008. Molecular phylogeny of the genus *Philodendron* (Araceae): delimitation and infra-generic classification. *Botanical Journal of the Linnean Society* 156: 13–27.
- Gravendeel, B., M. W. Chase, E. F. Vogel, M. C. Roos, T. H. M. Mes, and K. Bachmann. 2001. Molecular phylogeny of *Coelogyne* (Epidendroideae; Orchidaceae) based on plastid RFLPS, *matK*, and nuclear ribosomal ITS sequences: Evidence for polyphyly. *American Journal of Botany* 88: 1915–1927.
- Holdridge, L. R. 1947. Determination of world plant formations from simple climatic data. *Science. New Series* 105: 367–368.
- Hotta, M. 1967. Notes on Bornean plants, II. *Acta Phytotaxonomica et Geobotanica* 22: 153–162.
- Hotta, M. 1981. A new genus of the family Araceae from West Sumatra. *Acta Phytotaxonomica et Geobotanica* 32: 142–146.

- Hotta, M. 1985. New species of the genus *Homalomena* (Araceae) from Sumatra with a short note on the genus *Furtadoa*. *The Garden's Bulletin Singapore* 38: 43–54.
- Huelsenbeck, J. P. and F. Ronquist. 2001. MRBAYES: Bayesian inference of phylogenetic trees. *Bioinformatics* 17: 754–755.
- Mayo, S. J. 1989. Observations of gynoeical structure in *Philodendron* (Araceae). *Botanical Journal of the Linnean Society* 100: 139–172.
- Mayo, S. J., J. Bogner, and P. C. Boyce. 1997. *The genera of Araceae*. Richmond, U. K.: Royal Botanic Gardens, Kew.
- Moffler, M. D. and J. Bogner. 1984. A New *Homalomena* Species (Araceae) from Colombia. *Aroideana* 7: 37–41.
- Nauheimer, L., D. Metzler, and S. S. Renner. 2012. Global history of the ancient monocot family Araceae inferred with models accounting for past continental positions and previous ranges based on fossils. *The New Phytologist* 195: 938–950.
- Ray, T. 1987. Diversity of shoot organization in Araceae. *American Journal of Botany* 74: 1373–1387.
- Ray, T. 1988. Survey of shoot organization in the Araceae. *American Journal of Botany* 75: 56–84.
- Schott, H. W. 1865. Beitrage zur Aroideenkunde. *Oesterreichische Botanische Zeitschrift* 15: 33–35.
- Seubert, E. 1993. *Die Samen der Araceen: Die Samenmerkmale der Araceen und ihre Bedeutung für die Gliederung der Familie*. Koenigstein: Koeltz.
- Silvestro, D. and I. Michalak. 2012. raxmlGUI: a graphical front-end for RAxML. *Organisms, Diversity & Evolution* 12: 335–337.
- Simmons, M. P. 2004. Independence of alignment and tree search. *Molecular Phylogenetics and Evolution* 31: 874–879.
- Stamatakis, A. 2006. RAxML-VI-HPC: Maximum likelihood-based phylogenetic analyses with thousands of taxa and mixed models. *Bioinformatics* 22: 2688–2690.
- Steele, K. P. and R. Vilgalys. 1994. Phylogenetic analysis of Polemoniaceae using nucleotide sequences of plastid gene *matK*. *Systematic Biology* 19: 126–142.
- Tenorio, V., C. S. Sakuragai, and R. C. Viera. 2012. Stem anatomy of *Philodendron* Schott (Araceae) and its contribution to the systematics of the genus. *Plant Systematics and Evolution* 298: 1337–1347.
- Tenorio, V., C. S. Sakuragai, and R. C. Viera. 2014. Structures and functions of adventitious roots in species of the genus *Philodendron* Schott (Araceae). *Flora* 209: 547–555.
- White, T. J., T. Bruns, S. Lee, and J. Taylor. 1990. Amplification and direct sequencing of fungal ribosomal RNA genes for phylogenetics. Pp. 315–322 in *PCR protocols*, eds. M. Innis, D. H. Gelfand, J. J. Sninsky, and T. J. White. San Diego: Academic Press.
- Wong, S. Y. 2013. Rheophytism in Bornean Schismatoglottideae (Araceae). *Systematic Botany* 38: 32–45.
- Wong, S. Y., P. C. Boyce, A. S. Othman, and C. P. Leaw. 2010. Molecular phylogeny of tribe Schismatoglottideae based on two plastid markers and recognition of a new tribe, Philonotieae, from the neotropics. *Taxon* 59: 117–124.
- Wong, S. Y., P. J. Tan, K. K. Ng, O. Ahmad Sofiman, H. B. Lee, A. Fasihuddin Badruddin, and P. C. Boyce. 2013. Phylogeny of Asian *Homalomena* (Araceae) based on ITS region combined with morphological and chemical data. *Systematic Botany* 38: 589–599.
- Yang, Z. and B. Rannala. 1997. Bayesian phylogenetic inference using DNA sequences: a Markov Chain Monte Carlo method. *Molecular Biology and Evolution* 14: 717–724.
- (MO), DQ866880. *Adelonema panamensis* Croat & Mansell, Panama, Canal Area, Parque Nacional Soberanía, M520, Croat 77079 (MO), KM580732. *Adelonema peltata* (Mast.) S.Y. Wong & Croat, Colombia, Antioquia, San Luis, valley of Río Claro, 27 km E of Entrada for San Luis, 53 km E of Río Calderas, 05°53'30"N, 074°51'20"W, 500 m, Croat & Felipe Cardona 97902 (MO), cultivated ex Borneo Landscaping Nursery, Ar4309 (SAR), KP986966. *Adelonema peltata* (Mast.) S.Y. Wong & Croat, Ecuador, Pichincha, Centro Científico Río Palenque, M521, Croat 73064 (MO), KM580730. *Adelonema peltata* (Mast.) S.Y. Wong & Croat, Peru, Huánuco, Huánuco a Tingo María, M513, Croat 81582 (MO), KM580727. *Adelonema peltata* (Mast.) S.Y. Wong & Croat, Peru, Huánuco, Huánuco a Tingo María, M522, Croat 81582 (MO), KM580729. *Adelonema picturata* (Linden & André) S.Y. Wong & Croat, MBG90199, Croat 90199 (MO), DQ866882. *Adelonema picturata* (Linden & André) S.Y. Wong & Croat, Bolivia, Bogner s.n., cultivated ex Borneo Landscaping Nursery, Ar4307 (SAR), KP986969. *Adelonema picturata* (Linden & André) S.Y. Wong & Croat, Brazil, Acre, Igarape Ouro Preto, 120 m., tributary of Rio Jurua, Vista Alegre, M528, Croat 85463 (MO), KM580725. *Adelonema picturata* (Linden & André) S.Y. Wong & Croat, Ecuador, Morona-Santiago, Patuca a Santiago, M511, Croat 84898 (MO), KM580734. *Adelonema picturata* (Linden & André) S.Y. Wong & Croat, French Guiana, Saul, Bellizon, M512, Croat 74129 (MO), KM580735. *Adelonema picturata* (Linden & André) S.Y. Wong & Croat, French Guiana, Saul, stream banks at the sources of Rio Mana, at the foot of Mount Galbao, Patrick Blanc 78-227, original collection at Nancy (19803643), cultivated ex Borneo Landscaping Nursery, Ar4303 (SAR), KP986967. *Adelonema picturata* (Linden & André) S.Y. Wong & Croat, Panama, Canal Area, Parque Nacional Soberanía, Pipeline Road N of Gamboa, 6 min of Gamboa, Río Mendoza, 09°11'N, 079°46'W, Croat & Guang Hua Zhu 77080 (MO), cultivated ex Borneo Landscaping Nursery, Ar4306 (SAR), KP986968. *Adelonema sp.*, Ecuador, Napo, Hollin-Loreto, M533, SEL 1992-0029A, KM580733. *Adelonema speariae* (Bogner & Moffler) S.Y. Wong & Croat, Colombia, Caldas, E. Spear s.n., cultivated at Munich, M524 and cultivated ex Borneo Landscaping Nursery, Ar4304 (SAR), KM580737, KP986970. *Adelonema wallisii* (Regel) S.Y. Wong & Croat, Malaysia, Sarawak, Kuching, cultivated ex Borneo Landscaping Nursery, Ar2999 (SAR), KP986971. *Adelonema wallisii* (Regel) S.Y. Wong & Croat, Malaysia, Sarawak, Kuching, cultivated ex Borneo Landscaping Nursery, Ar3603 (SAR), JX076798, KM580683. *Adelonema wallisii* (Regel) S.Y. Wong & Croat, Malaysia, Sarawak, Kuching, cultivated ex Borneo Landscaping Nursery, Ar3604 (SAR), KP986973. *Adelonema wendlandii* (Schott) S.Y. Wong & Croat, Brazil, Acre, Reserva Forestal Huamaitá, Rio Branco-Porto Acre; 9°45'1.9"S, 67°40'18.8"W, 200 m, M529, Croat 86050 (MO), KM580723. *Adelonema wendlandii* (Schott) S.Y. Wong & Croat, Costa Rica, Pontaranas Houg Rd from Palmar Norte to Panama border, M580, Croat 79551 (MO), KM580731. *Adelonema wendlandii* (Schott) S.Y. Wong & Croat, MBG85114a, Croat 85114 (MO), DQ866883. *Adelonema wendlandii* (Schott) S.Y. Wong & Croat, Peru, Huánuco, Tingo María, SEL 1976-0060-009A, M532, KM580728. *Cercestis mirabilis* (N.E. Br.) Bogner, locality not provided, M. Chase 11772 (K), AM920639. *Culcasia liberica* N.E. Br., locality not provided, M. Chase 11777 (K), AM920638. *Furtadoa mixta* (Ridl.) M. Hotta, cultivated in Munich Botanical Garden, Bogner s.n. Ar4781(SAR), KM580747. *Furtadoa sumatrensis* M. Hotta, Indonesia, Sumatra, Jambi, Sungaipunuk, road to Bangko, Nakamoto Ar4045 (SAR), KM580743, KM580686. *Furtadoa sumatrensis* M. Hotta, locality not provided, M. Hotta s.n. (M), HQ687767. *Homalomena asmae* Baharuddin & P.C. Boyce, Malaysia, Perak, Hulu Perak, Tasik Banding, Baharuddin Ar2597 (SAR), JX076771, KM580691. *Homalomena asperifolia* Alderw., Indonesia, Sumatera, Sumatera Barat, Keisuke Hase Ar4761, KM580706. *Homalomena atrox* P.C. Boyce, S.Y. Wong & Fasihuddin, Malaysia, Sarawak, Sri Aman, Lubok Antu, Batang Ai, 01.12 N; 112.03 E, P. C. Boyce et al. Ar2389 (SAR), JQ955571, KM580701. *Homalomena atrox* P.C. Boyce, S.Y. Wong & Fasihuddin, Malaysia, Sarawak, Sri Aman, Lubok Antu, Batang Ai, Nanga Sumpa, Rumah Gumbang, Sungai Delok, 01.12 N; 112.03 E, P. C. Boyce et al. Ar2375 (SAR), KM580693. *Homalomena baangongensis* L.S. Tung & Y.C. Hoe, Malaysia, Sarawak, Kuching, Padawan, Sikog Village, 01.20 N; 112.0 E, P.C. Boyce & S.Y. Wong Ar2574 (SAR), JQ955572. *Homalomena borneensis* Ridl., Malaysia, Sarawak, Kuching, Matang, Maha Mariamman Temple, 01.35 N; 110.13 E, P.C. Boyce & Jeland Ak Kisai Ar227 (SAR), JQ955578. *Homalomena borneensis* Ridl., Malaysia, Sarawak, Kuching, Padawan, Giam Village, 01.19 N; 110. 16 E, P.C. Boyce & S.Y. Wong Ar2559 (SAR), JQ955573. *Homalomena 'chartacea'*, Malaysia, Sarawak, Sri Aman, Lubok Antu, Batang Ai, 01.12 N; 112.03 E, P.C. Boyce et al. Ar 2414 (SAR), JX076773, KM580689. *Homalomena clandestina* P.C. Boyce, S.Y. Wong & Fasihuddin, Malaysia, Sarawak, Sri Aman, Lubok Antu, Batang Ai, 01.12 N; 112.03 E, P. C. Boyce et al. Ar2385 (SAR), JX076774, KM580716. *Homalomena clandestina* P.C. Boyce, S.Y. Wong & Fasihuddin, Malaysia, Sarawak,

APPENDIX 1. List of specimens investigated: taxon, collection locality, GPS where available, voucher, and GenBank numbers (ITS, *matK*). Taxa are arranged alphabetically. Taxa in single quotation marks are yet to be formally described.

*Adelonema crinipes* (Engl.) S.Y. Wong & Croat, MBG81956c, Croat 81956 (MO), DQ866878. *Adelonema crinipes* (Engl.) S.Y. Wong & Croat, Peru, Junín, La Merced to Satipo, M526, Croat 81956 (MO), KM580724. *Adelonema crinipes* (Engl.) S.Y. Wong & Croat, Peru, Junín, La Merced to Satipo, M519, Croat 81956 (MO), KM580726. *Adelonema crinipes* (Engl.) S.Y. Wong & Croat, origin unknown, David Scherberich s.n., cultivated ex Borneo Landscaping Nursery, Ar4713 (SAR), KP986965. *Adelonema allenii* (Croat) S.Y. Wong & Croat, Costa Rica, Puntarenas, Boscosa, M510, Croat 79249 (MO), DQ866879. *Adelonema allenii* (Croat) S.Y. Wong & Croat, MBG79249, Croat 79249 (MO), cultivated ex Borneo Landscaping Nursery, Ar4308 (SAR), KM580739, KP986964. *Adelonema hammelii* (Croat & Grayum) S.Y. Wong & Croat, Costa Rica, Heredia, Estación Biológica La Selva, M531, SEL 1985-0025A, KM580738. *Adelonema panamensis* Croat & Mansell aff., MBG90162, Croat 90162



Sri Aman, Lubok Antu, Batang Ai, 01.12 N; 112.03 E, *Ng Kiaw Kiaw & Jipom Ak Tisai Ar3007* (SAR), JX076775.-. *Homalomena cochinchinensis* Engl., Vietnam, Ninh Binh Province, Cuc Phuong National Park, MBG77907, *Croat 77907* (MO), DQ866877.-. *Homalomena curvata* Engl., Malaysia, Pahang, Jerantut, Krau Wildlife Centre, 03.50 N; 102.13 E, P. C. Boyce et al. Ar3052 (SAR), JX076776, KM580702. *Homalomena curvata* Engl., Malaysia, Pahang, Jerantut, Krau Wildlife Centre, 03.49 N; 102.13 E, P. C. Boyce et al. Ar3053 (SAR), JX076777, KM580703. *Homalomena debilicrista* Y.C. Hoe, Malaysia, Sarawak, Kuching, Matang, Maha Mariamman Temple, 01.35 N; 110.13 E, Y.C. Hoe Ar3057 (SAR), JQ955574, KM580721. *Homalomena expedita* A. Hay & Hersc., Malaysia, Sarawak, Kuching, Lundu, 01.39 N; 109.52 E, P.C. Boyce Ar2357 (SAR), JX076778, KM580685. *Homalomena gastrofructa* S.Y. Wong, Y.C. Hoe & P.C. Boyce, Malaysia, Sarawak, Kuching, Padawan, Sikog Village, 01.20 N; 110.20 E, P. C. Boyce & al. Ar2575 (SAR), JQ955575.-. *Homalomena giamensis* L.S. Tung, S.Y. Wong & P.C. Boyce, Malaysia, Sarawak, Kuching, Padawan, Giam Village, 01.19 N; 110.16 E, P.C. Boyce et al. Ar1691 (SAR), JQ929129.-. *Homalomena hanneae* P.C. Boyce, S.Y. Wong & Fasihuddin, Malaysia, Sarawak, Sri Aman, Lubok Antu, Batang Ai, 01.12 N; 112.03 E, P.C. Boyce et al. Ar2360 (SAR)-, KM580718. *Homalomena hanneae* P.C. Boyce, S.Y. Wong & Fasihuddin, Malaysia, Sarawak, Sri Aman, Lubok Antu, Batang Ai, 01.12 N; 112.03 E, P.C. Boyce et al. Ar2382 (SAR), JX076779, KM580713. *Homalomena hanneae* P.C. Boyce, S.Y. Wong & Fasihuddin, Malaysia, Sarawak, Sri Aman, Lubok Antu, Batang Ai, *Ng Kiaw Kiaw & Jipom Ak Tisai Ar3010* (SAR), JX076803 + JX076804, KM580711. *Homalomena hanneae* P.C. Boyce, S.Y. Wong & Fasihuddin, Malaysia, Sarawak, Sri Aman, Lubok Antu, Batang Ai, *Ng Kiaw Kiaw & Jipom Ak Tisai Ar3005* (SAR), JX076780, KM580708. *Homalomena havilandii* Ridl., Malaysia, Sarawak, Kuching, Bako National Park, P.C. Boyce & Jeland Ak Kisai Ar2451 (SAR), JX076781.-. *Homalomena humilis* (Jack) Hookf., Malaysia, Sarawak, Sri Aman, Lubok Antu, Batang Ai, 01.12 N; 112.03 E, P. C. Boyce et al. Ar2371 (SAR), JX076805 + JX076806, KM580698. *Homalomena humilis* (Jack) Hookf., Malaysia, Sarawak, Sri Aman, Lubok Antu, Batang Ai, Nanga Sumpa, Rumah Gumbang, Sungai Delok, 01.12 N; 112.03 E, P.C. Boyce et al. Ar2372 (SAR)-, KM580699. *Homalomena insignis* N.E. Br., Malaysia, Sarawak, Kuching, Lundu, Gunung Gading National Park, 01.41 N; 109.51 E, P.C. Boyce et al. Ar2066 (SAR), JX076782.-. *Homalomena josefii* P.C. Boyce & S.Y. Wong, Malaysia, Sarawak, Sri Aman, Lubok Antu, Batang Ai, 01.12 N; 112.03 E, P. C. Boyce et al. Ar2380 (SAR), JX076784, KM580715. *Homalomena josefii* P.C. Boyce & S.Y. Wong, Malaysia, Sarawak, Sri Aman, Lubok Antu, Batang Ai, Nanga Sumpa, Sungai Mawang, *Ng K. K. & Jepom Tisai Ar3008* (SAR)-, KM580719. *Homalomena lunduensis* N.E. Br., Malaysia, Sarawak, Kuching, Matang National Park, 01.36 N; 110.11 E, P. C. Boyce et al. Ar2111 (SAR), JX076783.-. *Homalomena lunduensis* Furtado, Malaysia, Sarawak, Kuching, Lundu, Sempadi, Sungai Limau, Bukit Kankar, 01.39 N; 109.59 E, P. C. Boyce et al. Ar2145 (SAR)-, KM580690. *Homalomena magna* A. Hay, locality not provided, *M. Chase 10691* (K)-, AM920596. *Homalomena matangae* Y.C. Hoe, S.Y. Wong & P.C. Boyce, Malaysia, Sarawak, Kuching, Matang, Maha Mariamman Temple, 01.35 N; 110.13 E, P. C. Boyce & Jeland Ak Kisai Ar230 (SAR), JQ955577.-. *Homalomena ovata* Engl., Malaysia, Sarawak, Sri Aman, Lubok Antu, Batang Ai, 01.12 N; 112.03 E, P.C. Boyce et al. Ar2361 (SAR), JX076772, KM580688. *Homalomena philippinensis* Engl., Philippines, MBG 52988, *Croat 52988* (MO), DQ866881.-. *Homalomena punctulata* Engl., Malaysia, Sarawak, Sri Aman, Lubok Antu, Batang Ai, 01.12 N; 112.03 E, P.C. Boyce et al. Ar2424 (SAR), JX076785, KM580694. *Homalomena pygmaea* (Hassk.) Engl., Sumatera, cultivated at Munich #243, M525, *Bognier 1727* (M), KM580722.-. *Homalomena rostrata* Griff., Indonesia, Kalimantan, West Kalimantan, Sekaduu, 00.00 N; 111.04 E, P.C. Boyce & S.Y. Wong Ar2532 (SAR), JX076786.-. *Homalomena rubescens* (Roxb.) Kunth, cultivated at Munich Botanical Garden #6, M527, KM580744.-. *Homalomena sengkenyang* P.C. Boyce, S.Y. Wong & Fasihuddin, Malaysia, Sarawak, Sri Aman, Lubok Antu, Batang Ai, 01.12 N; 112.03 E, P. C. Boyce et al. Ar2362 (SAR), JX076787, KM580714. *Homalomena sengkenyang* P.C. Boyce, S.Y. Wong & Fasihuddin, Malaysia, Sarawak, Sri Aman, Lubok Antu, Batang Ai, 01.12 N; 112.03 E, P. C. Boyce et al. Ar2387 (SAR), JX076788, KM580712. *Homalomena sengkenyang* P.C. Boyce, S.Y. Wong & Fasihuddin, Malaysia, Sarawak, Sri Aman, Lubok Antu, Batang Ai, 01.12 N; 112.03 E, P. C. Boyce et al. Ar2388 (SAR), JX076789, KM580717. *Homalomena sengkenyang* P.C. Boyce, S.Y. Wong & Fasihuddin, Malaysia, Sarawak, Sri Aman, Lubok Antu, Batang Ai, *Ng Kiaw Kiaw & Jipom Ak Tisai Ar3004* (SAR), JX076790.-. *Homalomena sengkenyang* P.C. Boyce, S.Y. Wong & Fasihuddin, Malaysia, Sarawak, Sri Aman, Lubok Antu, Batang Ai, Nanga Sumpa, Sungai Pulau, *Ng K.K. & Jepom Tisai Ar3034* (SAR), KM580740, KM580709. *Homalomena* sp. Indonesia, Mentawi Islands, Pulau Siberut, *Keisuke Hase Ar4763* (SAR), KM580748, KM580700.

*Homalomena* sp., Ar3065, Malaysia, Sarawak, Kuching, Padawan, Sikog Village, 01.20 N; 110.21 E, P.C. Boyce et al. Ar3065 (SAR), JX076794.-. *Homalomena* sp., Indonesia, Mentawi Islands, Pulau Siberut, *Keisuke Hase Ar4764* (SAR), KM580749, KM580697. *Homalomena* sp., Indonesia, Sumatera, Jambi, Sungaipunuk, road to Bangko, *Nakamoto Ar4054* (SAR), KM580746.-. *Homalomena* sp., Indonesia, Sumatera, *Keisuke Hase Ar4759* (SAR), KM580742, KM580705. *Homalomena* sp., Malaysia, Melaka, Machap, Hutan Simpan Bukit Sedana, 02.24 N; 102.20 E, P. C. Boyce et al. Ar3047 (SAR), JX076792, KM580692. *Homalomena* sp., Malaysia, Pahang, Jerantut, Krau Wildlife Centre, 02.37 N; 103.21 E, P.C. Boyce & Ng Kiaw Kiaw Ar3051 (SAR), JX076793, KM580682. *Homalomena* sp., Malaysia, Sarawak, Sri Aman, Lubok Antu, Batang Ai, *Ng Kiaw Kiaw & Jipom Ak Tisai Ar3033* (SAR), JX076791.-. *Homalomena stella* P.C. Boyce & S.Y. Wong, Malaysia, Sarawak, Sri Aman, Lubok Antu, Batang Ai, *Ng Kiaw Kiaw & Jipom Ak Tisai Ar3011* (SAR), JX076809, KM580696. *Homalomena stella* P.C. Boyce & S.Y. Wong, Malaysia, Sarawak, Sri Aman, Lubok Antu, Batang Ai, 01.12 N; 112.03 E, P. C. Boyce et al. Ar2390 (SAR), JX076795, KM580695. *Homalomena symplocarpifolia* P.C. Boyce, S.Y. Wong & Fasihuddin, Malaysia, Sarawak, Sri Aman, Lubok Antu, Batang Ai, 01.12 N; 112.03 E, P.C. Boyce et al. Ar2411 (SAR), JX076807 + JX076808, KM580720. *Homalomena tonkinensis* Engl., Vietnam, Hoa Binh Province, Ba Vi District, Ba Vi National Park, P. C. Boyce & S. Y. Wong Ar4302 (SAR), KM580741, KM580707. *Homalomena vivens* P.C. Boyce, S.Y. Wong & Fasihuddin, Malaysia, Sarawak, Sri Aman, Lubok Antu, Batang Ai, P. C. Boyce et al. Ar2363 (SAR), JX076796, KM580704. *Homalomena vivens* P.C. Boyce, S.Y. Wong & Fasihuddin, Malaysia, Sarawak, Sri Aman, Lubok Antu, Batang Ai, *Ng Kiaw Kiaw & Jipom Ak Tisai Ar3006* (SAR), JX076797, KM580710. *Homalomena 'zippelianum'*, Philippine Islands, Luzon Island, Quezon National Park, M514, *Croat 52988* (MO), KM580745.-. *Lasia spinosa* (L.) Thwaites, Bangladesh, Sylhet Distr. Adampur Beat, Rajkandi Hill Reserve, *Bognier 1812* (M), KM580736.-. *Lasia spinosa* (L.) Thwaites,-, *Chase 11779* (K)-, AM920571. *Philodendron angustisectum* Engl.-, JBM 2801-1950, *Gauthier 2* (MT), DQ866884.-. *Philodendron anisotomum* Schott.-, JBM2803-1950, *Gauthier 38* (MT), DQ866885.-. *Philodendron barrosoanum* G.S.Bunting,-, MBG81932a, *Croat 81932* (MO), DQ866886.-. *Philodendron brevispathum* Schott.-, JBM1518-2003,-, DQ866887.-. *Philodendron distantilobum* Krause,-, JBM2601-1999, *Gauthier 12* (MT), DQ866889.-. *Philodendron ecoratum* Schott, JBM145-2003, *Gauthier 1* (MT), DQ866890.-. *Philodendron findens* Croat & Grayum,-, MBG38218, *Croat 38212* (MO), DQ866892.-. *Philodendron fragrantissimum* Kunth,-, FG, *Barabé 77* (MT), DQ866893.-. *Philodendron glaziovii* Hook. f.-, BM7014-1998, *Gauthier 26*, DQ866894.-. *Philodendron goeldii* Barroso,-, JBM1699-1996, *Gauthier 27* (MT), DQ866895.-. *Philodendron grandipes* Krause,-, MBG79244, *Croat 79244* (MO), DQ866896.-. *Philodendron heleniae* Croat,-, MBG83278, *Croat 83278* (MO), DQ866897.-. *Philodendron hylaeae* G.S. Bunting,-, MBG84578a, *Croat 84578* (MO), DQ866898.-. *Philodendron insigne* Schott,-, FG, *Barabé 75* (MT), DQ866899.-. *Philodendron insigne* Schott, cultivated plant from Venezuela, M596, *Croat 55077* (MO), KM580750.-. *Philodendron lindeni* Wallis,-, JBM7064-1998, *Gauthier 31* (MT), DQ866900.-. *Philodendron limmaei* Kunth,-, *Barabé 76* (MT), DQ866901.-. *Philodendron longistilum* Krause,-, MBG-11-17-78,-, DQ866902.-. *Philodendron lundii* Warm., MBG82932, *Croat 82932* (MO), DQ866903.-. *Philodendron mamei* Andre,-, BM7224-1992, *Gauthier 39* (MT), DQ866904.-. *Philodendron martinum* Engl.-, JBM2424-1946, *Chouteau 6* (MT), DQ866888.-. *Philodendron ornatum* Schott,-, JBM1511-1996, *Gauthier 33* (MT), DQ866891.-. *Philodendron panamense* Krause,-, MBG55184c, *Croat 55184* (MO), DQ866905.-. *Philodendron pedatum* Kunth,-, JBM2043-1997, *Gauthier 44* (MT), DQ866906.-. *Philodendron pterotum* K.Koch & Augustin,-, JBM1840-1955, *Gauthier 42* (MT), DQ866907.-. *Philodendron radiatum* Schott,-, JBM2802-1950, *Gauthier 6* (MT), DQ866908.-. *Philodendron radiatum* Schott, Malaysia, Penang, cultivated ex Penang Botanical Garden, *Ng 1 Ar4339* (SAR), JX076799, KM580687. *Philodendron sagittifolium* Liebm.-, JBM3402-1983, *Gauthier 46* (MT), DQ866909.-. *Philodendron selloum* K. Koch., Malaysia, cultivated at Penang Botanical Garden, *Ng 2 Ar4340* (SAR), JX089318, KM580684. *Philodendron serpens* Hook.-, MBG 97-100, *Croat 97-100* (MO), DQ866911.-. *Philodendron smithii* Engl.-, MBG64524, *Croat 64524* (MO), DQ866912.-. *Philodendron sodiroi* Hort.-, BM7163-1995, *Gauthier 36* (MT), DQ866913.-. *Philodendron solimoense* A.C. Smith,-, FG, *Barabé 60* (MT), DQ866914.-. *Philodendron solimoense* A.C. Smith, Venezuela, Amazonas, M599, *Croat 71771* (MO), KM580751.-. *Philodendron* sp. (pteromischum)-, MBG84914, *Croat 84914* (MO), DQ866915.-. *Philodendron* sp.-, JBM1130-1952, *Gauthier 20* (MT), DQ866910.-. *Philodendron* sp.-, JBM1659-1953, *Gauthier 19* (MT), DQ866917.-. *Philodendron* sp.-, *Thomas B. Croat s.n.*, cultivated ex Borneo Landscaping Nursery, Ar4305 (SAR)-, KP986972. *Philodendron squamiferum* Poepp. & Endl.-, JBM7009-1998, *Gauthier 45* (MT), DQ866916.-. *Philodendron surinamense* (Miq. ex Schott) Engl.-, FG, *Haig et al. 14* (KW), DQ866918.-. *Philodendron undulatum* Engl.-, JBM1930-52, *Gauthier 37* (MT), DQ866919.-. *Philodendron xanadu* Croat, Mayo & J. Boos,-, MBG71897, DQ866920.-.