CHECKLIST



A comprehensive checklist of the deciduous photinia genus *Pourthiaea* (Maleae, Rosaceae), with emphasis on their validity and typification

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Academic editor: Hanno Schaefer | Received 26 April 2022 | Accepted 21 June 2022 | Published 19 July 2022

Citation: Lou Y-L, Jin Z-T, Ma D-K, Liu B-B (2022) A comprehensive checklist of the deciduous photinia genus *Pourthiaea* (Maleae, Rosaceae), with emphasis on their validity and typification. PhytoKeys 202: 1–33. https://doi.org/10.3897/phytokeys.202.85822

Abstract

Due to the complicated evolutionary history in *Pourthiaea*, ninety-seven taxa have been described since 1784, and ninety-one of them are validly published taxa, five are naked names, and one is an invalid name. After a comprehensive and critical evaluation, 213 names have been published, including new combinations, new status, and new names; this may be due to the controversial taxonomic position of *Pourthiaea* in the apple tribe, Maleae. We herewith provide a taxonomic checklist of *Pourthiaea* for further taxonomic and evolutionary studies. We also lectotypify two taxa: *Photinia amphidoxa* var. *stylosa* and *P. glabra* var. *fokienensis*.

Keywords

Lectotype, nomenclature, Photinia, Stranvaesia, taxonomy, typification

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Introduction

Pourthiaea Decne. (Maleae, Rosaceae) is a small genus of deciduous shrubs or trees distributed from East to Southeast Asia (Kuan and Yu 1974; Gu and Spongberg 2003). The taxonomic identity of *Pourthiaea* has been controversial for decades, either as a section of *Photinia* Lindl. (Kuan and Yu 1974; Robertson et al. 1991; Gu and Spongberg 2003; Campbell et al. 2007; Potter et al. 2007), or a synonym of *Aronia* Medik. (Kalkman 2004), or a separate genus *Pourthiaea* (Iketani and Ohashi 1991; Guo et al. 2011; Liu et al. 2019, 2022). The controversial taxonomic status of *Pourthiaea* makes the published names unstable regarding generic membership. According to our comprehensive review in the present study, nearly 213 names, including new combinations, new statuses, and new names, exist in the literature, representing 91 validly published taxa. For example, a deciduous shrub species endemic to South China was described as *Photinia benthamiana* Hance in 1866. This taxon was then transferred either to *Pourthiaea* as *P. benthamiana* (Hance) Nakai in 1916 or to *Stranvaesia* as *S. benthamiana* (Hance) Merr. in 1917, as well as *Pyrus* as *P. benthamiana* (Hance) M.F.Fay & Christenh. in 2018.

Several recent phylogenetic studies have struggled to resolve the phylogenetic relationship between *Pourthiaea* and its closely related genera. Guo et al. (2011) firstly confirmed the monophyly of *Pourthiaea* using two plastid regions (trnL-trnF and psbA-trnH) and nuclear ribosomal ITS sequences. Unfortunately, they did not resolve the phylogenetic relationships between Pourthiaea and its relatives due to limited informative sites and taxon sampling. Based on transcriptomic data, Xiang et al. (2017) recovered a sister relationship between *Pourthiaea* and a combined clade, including Chaenomeles Lindl., Cydonia Mill., and Pseudocydonia (C.K.Schneid.) C.K.Schneid. Furthermore, results from the whole plastome and/or plastid regions (Liu et al. 2019, 2020a, 2020b, 2022) supported a close relationship between Pourthiaea and part of Malus Mill., i.e., the Eastern North American and Mediterranean Europe clade (clade II of figure 5 in Liu et al. 2022). However, the nuclear phylogeny inferred from 785 single-copy nuclear genes in our recent study (Liu et al. 2022) supported a close relationship between Pourthiaea and a combined clade, Cydonia and Pseudocydonia, not including Chaenomeles, contradicting Xiang et al. (2017)'s result inferred from transcriptomic data. The discordant phylogenetic position between nuclear and plastid topologies indicated a possible chloroplast capture event in the evolutionary history of Pourthiaea (Liu et al. 2022). This series of phylogenetic and phylogenomic studies confidently resolved the monophyly and phylogenetic position of Pourthiaea. In addition, the monophyly of *Pourthiaea* was also supported by some morphological characters, such as deciduous leaves, warty peduncles and pedicels, Kribs'III-I heterogeneous rays in the wood, and clusters of stone cells surrounded by parenchymatous cells in the flesh of pomes (Iketani and Ohashi 1991; Lu et al. 1991; Zhang 1992).

Liu et al. (2019) provided a robust phylogeny of the *Photinia* complex using whole plastomes and entire nuclear ribosomal DNA (nrDNA) sequences with a comprehensive taxon sampling. They proposed a redefined generic circumscription of *Pourthiaea*, transferring two species and a variety of *Stranvaesia* Lindl. to *Pourthiaea*, i.e.,

S. amphidoxa C.K.Schneid., S. amphidoxa var. amphileia (Hand.-Mazz.) T.T.Yu, and S. tomentosa T.T.Yu & T.C.Ku. Unfortunately, Guo et al. (2020) repeated these new taxonomic combinations, resulting in three illegitimate later homonyms. Recent systematic studies confidently resolved the generic circumscription of Pourthiaea, including all members of the previously recognized Photinia sect. Pourthiaea C.K.Schneid. and three newly transferred taxa from Stranvaesia (Guo et al. 2011, 2020; Liu et al. 2019, 2020a, 2020b, 2022). Furthermore, species delimitation within Pourthiaea has been controversial. Recent taxonomic treatments in *Pourthiaea* have been proposed solely from morphological evidence, either narrowly circumscribed (Kuan and Yu 1974; Gu and Spongberg 2003) or broadly circumscribed (Liu and Hong 2016a, 2016b, 2017). However, our recent phylogenomic evidence did not support these two proposals (unpublished data), indicating the need for an updated species delimitation in *Pourthiaea*. Hybridization, allopolyploidy, and apomixis have promoted the diversification of the apple tribe Maleae (Campbell et al. 1991; Robertson et al. 1991; Kalkman 2004; Liu et al. 2022). These complex evolutionary processes extensively diversified the genetic and morphological resources and greatly challenged the species delimitation in *Pourthiaea*. It is still premature to confidently delimit species in Pourthiaea.

Evaluating all the names published in *Pourthiaea* is the first step and will be helpful for further species delimitation. In this study, we made a comprehensive checklist of *Pourthiaea*. It should be noted that the checklist defined in this study is a summary of taxa (97) related to *Pourthiaea* rather than the species recognized currently in *Pourthiaea*, and these taxa have been described under *Crataegus* L., *Myrtus* L., *Photinia*, *Pourthiaea*, *Pyrus*, *Viburnum* L., and *Stranvaesia*. This checklist will provide a solid foundation for future taxonomic and evolutionary studies. In the genomic age, integrating hundreds of nuclear genes, plastomes and morphological characters make it possible to explore species delimitation in lineages with complicated evolutionary histories (Liu et al. 2021, 2022; Su et al. 2021).

Materials and methods

To comprehensively explore all the names published under *Pourthiaea* and other related genera, we took over nine years (2013–2021) for this taxonomic study. We reviewed all names in the online databases, such as Tropicos (https://www.tropicos.org), IPNI (https://www.ipni.org/), The Plant List (http://www.theplantlist.org/), as well as all the literature related to *Pourthiaea*. In addition, we evaluated the validity of all names based on the Shenzhen Code (Turland et al. 2018). A total of 568 type specimens were checked; they are from the following 54 herbaria: A, AU, BNU, BM, BO, CDBI, CSFI, E, GH, GXMI, GZAC, HBG, HENU, HGAS, HHBG, HIB, HIMC, HITBC, HTC, HUST, HX, HZU, IBK, IBSC, JJF, JN, JXAU, K, KUN, KYO, L, LBG, M, N, NAS, NKU, NTUF, NY, P, PE, PH, QTPMB, SM, SNU, SYS, SZ, TAI, TI, U, UPS, US, WUK, ZJFC, and ZM, and the herbarium code followed the Index Herbariorum (http://sweetgum.nybg.org/science/ih/) hosted by New York Botanical Garden.

Results

We reviewed 213 names published in *Pourthiaea* and its related genera, and they belong to 91 validly published taxa, five naked names, and one invalid name. We also lectotypified two taxa, i.e., *Photinia amphidoxa* var. *stylosa* and *P. glabra* var. *fokienensis*. All these names in *Pourthiaea* have been arranged chronologically in the following text.

Taxonomic checklist

Pourthiaea Decne., Nouv. Arch. Mus. Par. Ser. I, x. 146. 1874.

Lectotype, designated by Iketani and Ohashi (1991: 353): *Pourthiaea villosa* (Thunb.) Decne. \equiv *Crataegus villosa* Thunb.

1. Crataegus laevis Thunb., Fl. Jap. (Thunberg) 204. 1784.

- *≡ Photinia laevis* (Thunb.) DC., Prodr. [A. P. de Candolle] 2: 631. 1825.
- *≡ Photinia villosa* (Thunb.) DC. var. *laevis* (Thunb.) Dipp. ex C.K.Schneid., Ill. Handb. Laubholzk. i. 710. 1906.
- *≡ Pourthiaea villosa* (Thunb.) Decne. var. *laevis* (Thunb.) Stapf, Bot. Mag. tab. 9275. 1929.
- *≡ Pourthiaea laevis* (Thunb.) Koidz., Fl. Symb. Orient.-Asiat. 52. 1930.

Type: JAPAN. s. loc., C.P. Thunberg s. n. (holotype: UPS [accession no. 11864]!).

2. Crataegus villosa Thunb., Fl. Jap. (Thunberg) 204. 1784.

- *≡ Photinia villosa* (Thunb.) DC., Prodr. [A. P. de Candolle] 2: 631. 1825.
- *≡ Pourthiaea villosa* (Thunb.) Decne., Nouv. Arch. Mus. Par. Ser. I, x. 147. 1874.
- ≡ Photinia laevis (Thunb.) DC. var. villosa (Thunb.) Koidz., Bot. Mag. (Tokyo) 39: 313. 1925.
- ≡ Pourthiaea laevis (Thunb.) Koidz. var. villosa (Thunb.) Koidz., Fl. Symb. Orient.-Asiat. 52. 1930.

Type: JAPAN. s. loc., C.P. Thunberg s. n. (holotype: UPS [accession no. 11881]!).

3. Myrtus laevis Thunb., Fl. Jap. (Thunberg) 198. 1784.

Type: JAPAN. s. loc., C.P. Thunberg s. n. (holotype: UPS [accession no. 11735]!).

4. Photinia arguta Lindl., Edwards's Bot. Reg. 23: sub t. 1956. 1837.

≡ Pourthiaea arguta (Lindl.) Decne., Nouv. Arch. Mus. Par. Ser. I, x. 147. 1874.

- ≡ Pourthiaea arguta (Lindl.) Decne. var. wallichii Hook.f., Fl. Brit. India [J. D. Hooker] 2(5): 382. 1878. nom. illeg.
- ≡ Sorbus arguta (Lindl.) Zabel, Handb. Laubh. Benenn. 200. 1903, non T.T.Yu, Acta Phytotax. Sin. viii. 223. 1963.
- *≡ Pyrus arguta* (Lindl.) M.F.Fay & Christenh., Global Fl. 4: 95. 2018.

Type: INDIA. West Bengal: Pandua, *N. Wallich 672* (lectotype, designated by Liu and Hong (2017: 18): K [barcode K000758328]!; isolectotypes: BM [barcode BM000602136, BM000946990]!, E [barcode E00011328]!, K [barcode K000758327]!, M [barcode M0213888, M0213889]!). (Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.k000758328).

5. Photinia pustulata Lindl., Edwards's Bot. Reg. 23: sub t. 1956. 1837.

≡ Pourthiaea arguta (Lindl.) Decne. subsp. pustulata (Lindl.) B.B.Liu & D.Y.Hong, Phytotaxa 325(1): 21. 2017.

Type: CHINA. "China prope Cantonem, Parkes" [Guangdong]. *Parkes s. n.* (holotype: K [barcode K000758265]!). (Image of holotype available from https://plants.jstor.org/ stable/10.5555/al.ap.specimen.k000758265).

6. *Stranvaesia digyna* Siebold & Zucc., Abh. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. 4(2): 129. 1845.

Type: JAPAN. *H. Bürger s. n.* (lectotype, designated by Akiyama et al. (2014: 296): M [barcode M-0154027]!; isolectotypes: M [barcode M-0154026]!, M [barcode M-0154028]!). (Image of lectotype available from https://plants.jstor.org/sta-ble/10.5555/al.ap.specimen.m0154027).

7. Photinia benthamiana Hance, Ann. Sci. Nat., Bot. sér. 5, 5: 213. 1866.

- *≡ Pourthiaea benthamiana* (Hance) Nakai, Bot. Mag. (Tokyo) 30: 24. 1916.
- *≡ Stranvaesia benthamiana* (Hance) Merr., Philipp. J. Sci., C 12: 105. 1917.
- *≡ Pyrus benthamiana* (Hance) M.F.Fay & Christenh., Global Fl. 4: 98. 2018.

Type: CHINA. Guangdong: Whampoa [Huangpu], April 1865, *H.F. Hance 1501* (lectotype (selected by Vidal (1968), first step; second step, designated by Liu and Hong (2017: 21)): K [barcode K000758275]!; isolectotypes: K [barcode K000758280]!, P [barcode P02143118, P02143182]!, U [barcode U0005861]!). Whampoa [Huangpu], May 1860, *H.F. Hance 1501* (syntype: K [barcode K000758276]!). ibidem, 20 September 1869, *H F. Hance 1501* (syntypes: GH [barcode 00045596]!, K [barcode K000758277]!). (Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.k000758275].

8. *Photinia villosa* (Thunb.) DC. var. *formosana* Hance, Ann. Sci. Nat., Bot., sér. 5 5: 212. 1866.

≡ Pourthiaea formosana (Hance) Koidz., Acta Phytotax. Geobot. 3(3): 147. 1934.

Type: CHINA. Taiwan: Formosa [Taiwan]: Tamsuy [Danshui District], April 1864, *R. Oldham 146* (holotype: BM [barcode BM000602134]!; isotype: P [barcode P02143147]!). (Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.bm000602134).

9. Pourthiaea calleryana Decne., Nouv. Arch. Mus. Par. Ser. I, x. 147. 1874.

 \equiv *Photinia calleryana* (Decne.) Cardot, Bull. Mus. Natl. Hist. Nat. xxvi. 568. 1920. \equiv *Pyrus decaisnei* M.F.Fay & Christenh., Global Fl. 4: 99. 2018.

Type: CHINA. Macao [Aomen], 1844, *J. Callery 97* (lectotype, designated by Liu and Hong (2017: 22): P [barcode P02143186]!; isolectotype: P [barcode P02143187]!). (Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p02143186).

10. Pourthiaea coreana Decne., Nouv. Arch. Mus. Par. Ser. I, x. 148. 1874.

- ≡ Pourthiaea villosa (Thunb.) Decne. var. coreana (Decne.) Nakai, Bot. Mag. (Tokyo) 30: 25. 1916.
- ≡ Photinia villosa (Thunb.) DC. var. coreana (Decne.) Rehder, J. Arnold Arbor. 2: 45. 1920.

Type: JAPAN. "Tsu-sima Island, St. of COREA", 1859, *C. Wilford s. n.* (lectotype, designated by Liu and Hong (2016a: 211): P [barcode P03650663, excluding COREA. Port Chusan, 1859, *C. Wilford s. n.*]!; isolectotypes: GH [barcode 00026817, excluding COREA. Port Chusan, 1859, *C. Wilford s. n.*]!, P [barcode P03650621, excluding Japonia. Yokohama, 1862, *s. coll. s. n.*]!). (Image of lectotype available from https://science.mnhn.fr/institution/mnhn/collection/p/item/ p03650663).

11. Pourthiaea cotoneaster Decne., Nouv. Arch. Mus. Par. Ser. I, x. 149. 1874.

≡ Photinia cotoneaster (Decne.) Cardot, Bull. Mus. Natl. Hist. Nat., xxvi. 569. 1920.

Type: JAPAN. *s. loc.*, *H. Zollinger 549* (lectotype, designated by Liu and Hong (2016a: 209): P [barcode P02143213]!; isolectotype: P [barcode P03650725]!). (Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen. p02143213).

12. Pourthiaea hookeri Decne., Nouv. Arch. Mus. Par. Ser. I, x. 148. 1874.

- ≡ Pourthiaea arguta (Lindl.) Decne. var. hookeri (Decne.) Hook.f., Fl. Brit. India [J. D. Hooker] 2(5): 382. 1878.
- *≡ Photinia hookeri* (Decne.) Merr., Brittonia 4: 82. 1941.
- *≡ Photinia arguta* Lindl. var. *hookeri* (Decne.) J.E.Vidal, Adansonia, n.s. 5: 229. 1965.

Type: INDIA. Sikkim, 1855, *J.D. Hooker & T. Thomson 652* (holotype: P [barcode P02143252]!). (Image of holotype available from https://plants.jstor.org/sta-ble/10.5555/al.ap.specimen.p02143252).

13. Pourthiaea lucida Decne., Nouv. Arch. Mus. Par. Ser. I, x. 148. 1874.

 \equiv *Photinia lucida* (Decne.) C.K.Schneid., Ill. Handb. Laubholzk. i. 710. 1906. \equiv *Pyrus pourthiaea* M.F.Fay & Christenh., Global Fl. 4: 116. 2018.

Type: CHINA. Formosa [Taiwan]: Tamsuy [Danshui District], 1864, *R. Oldham 99* (lectotype, designated by Liu and Hong (2017: 20): P [barcode P02143146]!; isolectotypes: P [barcode P02143145, excluding the fruit branches]!, K [barcode K000758283]!, K [barcode K000758284]!). ibidem, *R. Oldham 99* (syntypes: P [barcode P02143145, excluding the flowering branch]!, K [barcode K000758284]!). (Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p02143146).

14. Pourthiaea oldhamii Decne., Nouv. Arch. Mus. Par. Ser. I, x. 149. 1874.

Type: JAPAN. Yokohama, 1863, *R. Oldham 242* (holotype: P [barcode P02143122]!, isotypes: GH [barcode 00026818]!, M [barcode M-0213882]!). 1853–56, *C. Wright s. n.* (syntype: P [barcode P02143123]!). (Image of holotype available from https:// plants.jstor.org/stable/10.5555/al.ap.specimen.p02143122).

15. Pourthiaea salicifolia Decne., Nouv. Arch. Mus. Par. Ser. I, x. 148. 1874.

- ≡ Pourthiaea arguta (Lindl.) Decne. var. salicifolia (Decne.) Hook.f., Fl. Brit. India [J. D. Hooker] 2(5): 382. 1878.
- ≡ *Photinia salicifolia* (Decne.) C.K.Schneid., Ill. Handb. Laubholzk. i. 709. 1906. "later homonym", non C.Presl, Abh. Königl. Böhm. Ges. Wiss. ser. 5, 6: 564. 1851.
- *≡ Photinia arguta* Lindl. var. *salicifolia* (Decne.) J.E.Vidal, Adansonia, n.s. 5: 229. 1965.
- ≡ Pourthiaea arguta (Lindl.) Decne. var. salicifolia (Decne.) Iketani & H.Ohashi, J. Jap. Bot. 66(6): 353. 1991. "later homonym", non (Decne.) Hook.f., Fl. Brit. India [J. D. Hooker] 2(5): 382. 1878.

Type: BANGLADESH. "East Bengal" or INDIA. [Khasia] Meghalaya: Khasi, *W. Griffith* 2099 (lectotype, designated by Vidal (1968: 51): P [barcode P02143251]!; isolectotype:

K [barcode K000758337]!). (Image of lectotype available from https://plants.jstor.org/ stable/10.5555/al.ap.specimen.p02143251).

16. Pourthiaea thunbergii Decne., Nouv. Arch. Mus. Par. Ser. I, x. 149. 1874.

Type: JAPAN. Nagasaki, 1862, *R. Oldham s. n.* (holotype: P [barcode P02143124]!). (Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p02143124).

17. Pourthiaea zollingeri Decne., Nouv. Arch. Mus. Par. Ser. I, x. 149. 1874.

- ≡ Photinia villosa (Thunb.) DC. var. zollingeri (Decne.) C.K.Schneid., Ill. Handb. Laubholzk. i. 710. 1906.
- ≡ Pourthiaea villosa (Thunb.) Decne. var. zollingeri (Decne.) Nakai, Bot. Mag. (Tokyo) 30: 25. 1916.
- ≡ Pourthiaea laevis (Thunb.) Koidz. var. zollingeri (Decne.) Koidz., Fl. Symb. Orient.-Asiat. 52. 1930.

Type: JAPAN. *s. loc.*, *H. Zollinger 548* (lectotype, designated by Liu and Hong (2016a: 215): P [barcode P02143126]!; isolectotype: P [barcode P03240057]!). (Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen. p02143126).

18. Stranvaesia calleryana Decne., Nouv. Arch. Mus. Par. Ser. I, x. 179. 1874.

Type: CHINA. Macao [Aomen], 1844, *J. Callery 38* (lectotype, designated by Liu and Hong (2017: 22): P [barcode P02143183]!; isolectotypes: P [barcode P02143184]!, P [barcode P02143185]!). (Image of lectotype available from https://plants.jstor.org/ stable/10.5555/al.ap.specimen.p02143183).

19. Photinia mollis Hook.f., Fl. Brit. India [J. D. Hooker] 2(5): 381. 1878.

Type: INDIA. Sikkim Himalaya, at lower elevation, *J.D. Hooker s. n.* (holotype: K [barcode K000758335]!). Darjiling [Darjeeling], April 1876, *J.S. Gamble 451* (syntype: K [barcode K000758332]!). ibidem, *J.S. Gamble 451A* (syntype: K [barcode K000758333]!). ibidem, *J.S. Gamble 451E* (syntype: K [barcode K000758334]!). (Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen. k000758335).

20. *Pourthiaea arguta* (Lindl.) Decne. var. *latifolia* Hook.f., Fl. Brit. India [J. D. Hooker] 2(5): 382. 1878.

≡ Photinia birmanensis C.K.Schneid., Ill. Handb. Laubholzk. i. 709. 1906. replacement name. **Type:** MYANMAR. Kachin, Myitkyina, Tanaing, Hookhoom valley [Hukawng valley], 27 March 1827, *W. Griffith 2103* (holotype: K [barcode K000758346]!; isotypes: GH [barcode 00045582]!, P [barcode P03665952]!). (Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.k000758346).

21. *Pourthiaea arguta* (Lindl.) Decne. var. *membranacea* Hook.f., Fl. Brit. India [J. D. Hooker] 2(5): 382. 1878.

Type: not designated.

22. *Pourthiaea arguta* (Lindl.) Decne. var. *parvifolia* Hook.f., Fl. Brit. India [J. D. Hooker] 2(5): 382. 1878.

Type: not designated.

23. *Photinia glabra* (Thunb.) Maxim. var. *fokienensis* Finet & Franch., Bull. Soc. Bot. France 47: 207. 1899.

- ≡ Photinia fokienensis (Finet & Franch.) Franch., Bull. Mus. Natl. Hist. Nat. xxvi. 570. 1920.
- ≡ Pourthiaea fokienensis (Finet & Franch.) Iketani & H.Ohashi, J. Jap. Bot. 66(6): 353. 1991.
- *≡ Pyrus fokienensis* (Finet & Franch.) M.F.Fay & Christenh., Global Fl. 4: 104. 2018.

Type: CHINA. Fujian: Wuyishan County, Mount Wuyi, Kuatun [Guadun village], May 1998, *J.D.D. La Touche s.n.* (lectotype, designated here: P [barcode P02143166]!; isolectotypes: A [barcode 00026744, 00026745, 00026746]!, K [barcode K000758282, K000758354]!, L [barcode L0019504]!, MA [barcode MA628501, MA631213]!, P [barcode P02143167, P02143168]!). (Image of lectotype available from https://plants. jstor.org/stable/10.5555/al.ap.specimen.p02143166).

24. Pourthiaea parvifolia E.Pritz. ex Diels, Bot. Jahrb. Syst. 29(3-4): 389. 1900.

- *≡ Photinia parvifolia* (E.Pritz. ex Diels) C.K.Schneid., Ill. Handb. Laubholzk. i. 711. 1906.
- = Pourthiaea laevis (Thunb.) Koidz. var. parvifolia (E.Pritz. ex Diels) Migo, Bull. Shanghai Sci. Inst. 14: 311. 1944.
- ≡ Photinia villosa (Thunb.) DC. var. parvifolia (E.Pritz. ex Diels) P.S.Hsu & L.Chu Li, Acta Phytotax. Sin. 18(3): 264. 1980.
- ≡ Pourthiaea villosa (Thunb.) Decne. var. parvifolia (E.Pritz. ex Diels) Iketani & H.Ohashi, J. Jap. Bot. 66(6): 354. 1991.
- *≡ Pyrus fantabulosa* M.F.Fay & Christenh., Global Fl. 4: 103. 2018.

Type: CHINA. Prov. de Hupeh. [Hubei]: Ichang, 1885–88, *A. Henry 5830* (lectotype, designated by Liu and Hong (2016a: 215): P [barcode P02143150]!; isolectotypes:

A [barcode 00045590]!, E [barcode E00011320, E00285981]!, GH [barcode 00045587]!, P [barcode P02143151]!). Szech'uan [Sichuan]: nanch'uan [Nanchuan], Tao kuo kou, *C. Bock & A. von Rosthorn 211* (syntype: A [barcode 00045589]!); ibidem, 1885–88, *A. Henry 3002* (syntypes: P [barcode P03342556]!; image A [barcode 00045569, with fragments from B]!). (Image of lectotype available from https://plants. jstor.org/stable/10.5555/al.ap.specimen.p02143150).

25. *Photinia beauverdiana* C.K.Schneid., Bull. Herb. Boissier Ser. II. vi. 319. 1906. (31 March 1906).

- ≡ Pourthiaea beauverdiana (C.K.Schneid.) Hatus., Bull. Exp. For. Kyushu Univ. 3: 99. 1933.
- ≡ Pourthiaea beauverdiana (C.K.Schneid.) Migo, Bull. Shanghai Sci. Inst. 14: 310. 1944, "later homonym". nom. illeg. superfl.
- *≡ Pyrus beauverdiana* (C.K.Schneid.) M.F.Fay & Christenh., Global Fl. 4: 98. 2018.

Type: CHINA. Szetschwan [Sichuan]: S. Wushan County "now belongs to Chongqing", *A. Henry 5599* (lectotype, designated by Vidal (1968: 43): K [barcode K000758272]!; isolectotypes: E [barcode E00010993]!, P [barcode P03373765]!). (Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.k000758272).

26. *Photinia bergerae* C.K.Schneid., Ill. Handb. Laubholzk. i. 709. 1906. (1 May 1906).

≡ Pourthiaea bergerae (C.K.Schneid.) Iketani & H.Ohashi, J. Jap. Bot. 66(6): 353. 1991. *≡ Pyrus bergerae* (C.K.Schneid.) M.F.Fay & Christenh., Global Fl. 4: 98. 2018.

Type: CHINA. W. Hupei [Hubei]: Patung [Badong County], *E.H. Wilson 86* (lectotype, designated by Liu and Hong (2017: 19): K [barcode K000758281]!; isolectotypes: A [barcode 00026737]!, NY [barcode 00436111]!). (Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.k000758281).

27. *Photinia notabilis* C.K.Schneid., Ill. Handb. Laubholzk. i. 711. 1906. (1 May 1906).

- ≡ Photinia beauverdiana C.K.Schneid. var. notabilis (C.K.Schneid.) Rehder & E.H.Wilson, Pl. Wilson. 1(2): 188. 1912.
- *≡ Pourthiaea beauverdiana* (C.K.Schneid.) Hatus. var. *notabilis* (C.K.Schneid.) Hatus., Bull. Exp. For. Kyushu Univ. 3: 99. 1933.

Type: CHINA. W. Hupei [Hubei]: *E.H. Wilson 359* (lectotype, designated by Liu and Hong (2017: 19): K [barcode K000758271, excluding the fruit branches]!; isolectotypes: A [barcode 00038570, excluding the fruit branches]!, E [barcode E00010995, excluding the fruit branches]!, K [barcode K000758270, excluding the fruit branches]!, P [barcode

P02143174, excluding the fruit branches]!, US [barcode 00097501, excluding the fruit branches]!). W. Hupei [Hubei], *E. H. Wilson 359* (syntypes: A [barcode 00038570, excl. the branch in flowering phase]!, E [barcode E00010995, excl. the branch in flowering phase]!, K [barcode K000758270, excl. the branch in flowering phase], excl. the branch in flowering phase]!, P [barcode P02143174, excl. the branch in fruiting phase]!, US [barcode 00097501, excl. the branch in flowering phase]!, US [barcode 00097501, excl. the branch in flowering phase]!). (Image of lecto-type available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.k000758271).

28. Stranvaesia amphidoxa C.K.Schneid., Bull. Herb. Boissier Ser. II. vi. 319. 1906.

- ≡ Photinia amphidoxa (C.K.Schneid.) Rehder & E.H.Wilson, Pl. Wilson. (Sargent) 1(2): 190. 1912.
- *≡ Pourthiaea amphidoxa* (C.K.Schneid.) Stapf, Bot. Mag. 155: sub t. 9275. 1929.
- ≡ Pyrus amphidoxa (C.K.Schneid.) M.F.Fay & Christenh., Global Fl. 4: 95. 2018.

Type: CHINA. Szetschwan [Sichuan]: 1885–1888, *A. Henry 5565* (holotype: K [barcode K000758302]; isotypes: E [barcode E00010990]!, GH [barcode 00033523]!, US [barcode 00097546]!). (Image of holotype available from https://plants.jstor.org/ stable/10.5555/al.ap.specimen.k000758302).

29. Photinia cavaleriei H.Lév., Repert. Spec. Nov. Regni Veg. 4: 334. 1907.

Type: CHINA. Kouy-Tchéou [Guizhou]: Ly-Po [Libo County], 10 May 1899, *J. Cavalerie 2631* (lectotype, designated by Liu and Hong (2017: 19): E [barcode E00010994]!; isolectotypes: image A [barcode 00045601]! with fragments from E [barcode E00010994], P [barcode P02143180]!). (Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.e00010994).

30. Pyrus mokpoensis H.Lév., Repert. Spec. Nov. Regni Veg. 7: 200. 1909. "Pirus".

Type: SOUTH KOREA. "Circa Mokpo, Maio 1907", *U. Faurie 1556* (holotype: E [barcode E00011325]!; isotype: A [barcode 00032499]!). (Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.a00032499).

31. Viburnum komarovii H.Lév. & Vaniot, Repert. Spec. Nov. Regni Veg. 9: 78. 1910.

≡ Photinia komarovii (H.Lév. & Vaniot) L.T.Lu & C.L.Li, Acta Phytotax. Sin. 38(3): 278, 2000.

Type: CHINA. Kouy-Tchéou [Guizhou]: Ma-Jo, 8 October 1908, *J. Cavalerie 1303* (lectotype, designated by Lu (2000: 278): A [barcode 00045609]!; isolectotypes: E [barcode E00011319]!, E [barcode E00011318, excluding the flower branches], P [barcode P03342568]!). (Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.a00045609).

32. Photinia taiwanensis Hayata, J. Coll. Sci. Imp. Univ. Tokyo xxx. Art. 1, 104. 1911.

Type: CHINA. Taiwan: Taipei, Taihoku, 15 November 1896, *T. Makino s. n.* (holotype: TI [barcode T00596]!).

33. Photinia lancifolia Rehder & E.H.Wilson, Pl. Wilson. (Sargent) 1(2): 191. 1912.

Type: CHINA. Yunnan: Meng-lieh [Menglian County], 1,100 m, *A. Henry 12833* (holotype: A [barcode 00045581]!; isotypes: E [barcode E00010992]!, K [barcode K000758269]!, NY [barcode 00436113]!, US [barcode 00097498]!). Puer, Szemao [Simao], 1,300 m, *A. Henry 13412* (paratype: A [barcode 00137805]!). (Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.a00045581).

34. *Photinia schneideriana* Rehder & E.H.Wilson, Pl. Wilson. (Sargent) 1(2): 188. 1912.

- ≡ Pourthiaea schneideriana (Rehder & E.H.Wilson) Iketani & H.Ohashi, J. Jap. Bot. 66(6): 354. 1991.
- ≡ Pyrus schneideriana (Rehder & E.H.Wilson) M.F.Fay & Christenh., Global Fl. 4: 120. 2018.

Type: CHINA. Western Hupeh [Hubei]: Changyang Hsien, woodlands, 1300–1600 m, May 1907, E.H. Wilson 476 (lectotype, designated by Liu and Hong (2017: 20): A [barcode 00045605]!; isolectotypes: A [barcode 00045585, excluding the fruit branches and the material in the packet]!, E [barcode E00011322, excluding the fruit branches and the material in the packet]!, GH [barcode 00038558]!, HBG [barcode HBG511071, excluding the fruit branches]!, K [barcode K000758288]!, K [barcode K000758289, excluding the fruit branches and the material in the packet]!, US [barcode 00097503, excluding the fruit branches]!). Changyang, woodlands, October 1907, E.H. Wilson 476 (syntypes: A [barcode 00045585, excl. the branch in flowering phase]!, E [barcode E00011322, excl. the branch in flowering phase and the inflorescences from packet; E00284666]!, HBG [barcode HBG-511071, excl. the branch in flowering phase]!, K [barcode K000758289, excl. the branch in flowering phase and the inflorescences from packet]!, PE [barcode 01656469]!, SYS [barcode SYS00075135]!, US [barcode 00097503, excl. the branch in flowering phase]!). Chang-lo Hsien, woods, 1,000-1,500 m, May 1907, E.H. Wilson 2973 (paratypes: HBG [barcode HBG-511072]!, SYS [barcode SYS00075134]!). (Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.a00045605).

35. *Photinia subumbellata* Rehder & E.H.Wilson, Pl. Wilson. (Sargent) 1(2): 189. 1912.

Type: CHINA. Western Hupeh [Hubei]: Changyang Hsien, 1300 m, 7 May 1907, *E.H. Wilson 488* (holotype A [barcode 00038568, excluding the fruit branches]!; isotypes: E

[barcode E00011321, excluding the fruit branches]!, HBG [barcode HBG511074, excluding the fruit branches]!, K [barcode K000758299, excluding the fruit branches]!, NY [barcode 00022711]!, US [barcode 00097505, excluding the fruit branches]!); ibidem, 7 October 1907, *E.H. Wilson 488* (paratypes: A [barcode 00038568, excl. the material collected in 7 May 1907, i.e. the branches in flowering phase]!, E [barcode E00011321, excl. the material collected in 7 May 1907, i.e. the branches in flowering phase]!, HBG [barcode HBG-511074, excl. the material collected in 7 May 1907, i.e. the branches in flowering phase]!, K [barcode K000758299, excl. the material collected in 7 May 1907, i.e. the branches in flowering phase]!, K [barcode K000758299, excl. the material collected in 7 May 1907, i.e. the branches in flowering phase]!, US [barcode 00097505, excl. the material collected in 7 May 1907, i.e. the branches in flowering phase]!, S [barcode 1907, *E.H. Wilson 398* (paratype: Hupeh, side of stream, 1,600–2,000 m, October 1907, *E.H. Wilson 398* (paratype: HBG [barcode HBG-511076]!). *A. Henry 7664* (paratype: P [barcode P03342557]!). Prov. Szech'uan [Sichuan], *A. Henry 5518* (paratype: P [barcode P03342562]!). (Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen. a00038568).

36. *Photinia villosa* (Thunb.) DC. var. *sinica* Rehder & E.H.Wilson, Pl. Wilson. 1(2): 186. 1912.

≡ Pourthiaea villosa (Thunb.) Decne. var. sinica (Rehder & E.H.Wilson) Migo, Bull. Shanghai Sci. Inst. 14: 311. 1944.

Type: CHINA. Western Hupeh [Hubei]: Fang Hsien, 1300–1600 m, 4 June 1907, E.H. Wilson 610 (lectotype, designated by Liu and Hong (2016a: 215): A [barcode 00045573, excluding the seeds in the packet]!; isolectotypes: A [barcode 00045572, excluding the fruit branches and the seeds in the packet]!, HBG [barcode HBG511081, excluding the fruit branches]!, K [barcode K000758296]!, US [barcode 00097507, excluding the fruit branches]!); ibidem, November 1907, E.H. Wilson 610 (paratypes: A [barcode 00045572, excl. the materials collected in 4 June 1907, i.e. the branches in flowering phase]!, A [barcode 00045573, only including the seeds in the packet]!, HBG [barcode HBG-511081, excl. the materials collected in 4 June 1907, i.e. the branches in flowering phase]!, K [barcode K000758295]!, US [barcode 00097507, excl. the materials collected in 4 June 1907, i.e. the branches in flowering phase]!). Western Hupeh, woods, 1,000-1,300 m, May 1907, E.H. Wilson 2972 (paratype: HBG [barcode HBG-511084]!). Xingshan, Western Hupeh, 1,000-1,500 m, May and October 1907, E.H. Wilson 333 (paratype: HBG [barcode HBG-511083]!). W. Hupeh, E.H. Wilson 714 (paratype: HBG [barcode HBG-511082]!). (Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.a00045573).

37. Pyrus brunnea H.Lév., Repert. Spec. Nov. Regni Veg. 10: 377. 1912. "Pirus".

- ≡ Pourthiaea villosa (Thunb.) Decne. var. brunnea (H.Lév.) Nakai, Bot. Mag. (Tokyo) 30: 25. 1916.
- *≡ Pourthiaea brunnea* (H.Lév.) Nakai, Jap. J. Bot. 18: 617. 1942.

Type: SOUTH KOREA. "Quelpaert, in silvis Hallaisan, 800m, October 1909", *L. Ta-quet 2819* (holotype: E [barcode E00011324]!; isotype: A [barcode 00045571]!). (Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen. e00011324).

38. *Pyrus sinensis* Lindl. var. *maximowicziana* H.Lév., Repert. Spec. Nov. Regni Veg. 10: 377. 1912. "*Pirus*".

Type: SOUTH KOREA. "Quelpaert, in silvis Haitchenam, aug. 1909", *L. Taquet 2821* (holotype: E [barcode E00011326]!). (Image of holotype available from https://plants. jstor.org/stable/10.5555/al.ap.specimen.e00011326).

39. *Pyrus spectabilis* Aiton var. *albescens* H.Lév., Repert. Spec. Nov. Regni Veg. 10: 377. 1912. "*Pirus*".

≡ Pourthiaea laevis (Thunb.) Koidz. var. albescens (H.Lév.) Nakai, Bull. Natl. Sci. Mus. Tokyo 31: 62. 1952.

Type: SOUTH KOREA. "Quelpaert, in silvis Hallaisan, 800m, jun. 1909", *L. Taquet 2815* (holotype: E!; isotypes: A [barcode 00045577]!, image A [barcode 00045578] with a fragment ex E!).

40. Pyrus feddei H.Lév., Repert. Spec. Nov. Regni Veg. 12: 189. 1913. "Pirus".

Type: CHINA. Kouy-Tchéou [Guizhou]: Pin-Fa [Pingfa Village, Guiding County], 8 October 1905, *J. Cavalerie & Fortunat 2533* (holotype: E [barcode E00010991]!; isotype: P [barcode P02143242]!). (Image of holotype available from https://plants.jstor. org/stable/10.5555/al.ap.specimen.e00010991).

41. *Photinia amphidoxa* (C.K.Schneid.) Rehder & E.H.Wilson var. *stylosa* Cardot, Notul. Syst. (Paris) 3: 377. 1914.

Type: CHINA. Kouy-tcheou [Guizhou]: "Tsin-gai, Kao-po", 8 August 1903, *J. Cavalerie* & Fortunat 1248 (lectotype, designated here: P [barcode P02143239]!). "Pin-fa, pentes boisées et humides", 25 May 1905, *J. Cavalerie & Fortunat 2361* (syntypes: P [barcode P02143240, P02143241]!). "Ma-Jo, bo, comestille", 24 June 1907, *J. Cavalerie 3107* (syntypes: P [barcode P02143243, P02143244]!). "Long-ly", May 1908, *J. Cavalerie 3291* (syntypes: P [barcode P02143245, P02143246]!); ibidem, 8 August 1908, *J. Cavalerie 3839* (syntype: P [barcode P02143247]!). "bois près de Thong-oua", May 1913, *J. Esquirol 4204* (syntype: P [barcode P02143248]!). (Note A) (Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p02143239).

Note A: In the protologue, the specimen, *J. Cavalerie & Fortunat 2533*, was designated as the syntype of *Photinia amphidoxa* var. *stylosa* by Cardot (1914); however, Léveillé (1913) had designated it as the type of *Pyrus feddei*. Therefore, we exclude this specimen

from the syntype of *Photinia amphidoxa* var. *stylosa*. Considering the better condition of the specimen *J. Cavalerie & Fortunat 1248*, we designated it as the lectotype herein.

42. Photinia arguta Lindl. var. sinensis Cardot, Notul. Syst. (Paris) 3: 377. 1914.

- ≡ Cotoneaster esquirolii H.Lév., Fl. Kouy-Tcheou 345. 1914–15. nom. illeg. superfl. (Note B)
- *≡ Photinia esquirolii* (H.Lév.) Rehder, J. Arnold Arbor. 17: 334. 1936.

Type: CHINA. Kouy-tcheou [Guizhou]: "bois de Bai-gnin (Xingren County, Baling)", 25 May 1911, *J. Esquirol 2624* (holotype: P [barcode P02143214]!; isotypes: image A [barcode 00026238]! with fragments from E [barcode E00011308], E [barcode E00011308]!). (Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p02143214).

Note B: Léveillé (1915) designated the specimen (*J. Esquirol 2624*) as the type of *Cotoneaster esquirolii*; however, this specimen has been designated as the type of *Photinia* arguta var. *sinensis* by Cardot (1914). According to Article 52.1 & 52.2 in the International Code of Nomenclature for algae, fungi, and plants (Shenzhen Code) (Turland et al. 2018), *Cotoneaster esquirolii* definitely included the type of an earlier name, *Photinia* arguta var. *sinensis*, so the former name is illegitimate and nomenclaturally superfluous and is to be rejected.

43. *Photinia beauverdiana* C.K.Schneid. var. *brevifolia* Cardot, Notul. Syst. (Paris) 3: 378. 1914.

≡ Pourthiaea beauverdiana (C.K.Schneid.) Hatus. var. brevifolia (Cardot) Iketani & H.Ohashi, J. Jap. Bot. 66(6): 353. 1991.

Type: CHINA. Western Hupeh [Hubei]: C. China, Shing-shan [Xingshan County] or Nanto, May 1900, *E.H. Wilson 794* (lectotype, designated by Liu and Hong (2017: 19): P [barcode P02143175]!; isolectotype: A [barcode 00045593]!). "Su-tchuen oriental: district de Tchen-keou-tin" [Chongqing: Chengkou County], *R.P. Farges s. n.* (syntypes: K [barcode K000758274]!, NY [barcode 00436110]!, P [barcode P02143177, P02143178, P02143179]!). C. China, Wushan, June 1900, *E.H. Wilson 1056* (syntypes: A [barcode 00045588]!, P [barcode P02143176]!). (Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p02143175).

44. *Photinia benthamiana* Hance var. *glabrescens* Cardot, Notul. Syst. (Paris) 3: 375. 1914.

≡ Pourthiaea benthamiana (Hance) Nakai var. *glabrescens* (Cardot) Iketani & H.Ohashi, J. Jap. Bot. 66(6): 353. 1991.

Type: VIETNAM. "Annam: massif du Lang-bian, entre Klou et Danhim, 900–1200m", 19 February 1914, *A.J.B. Chevalier 30950* (lectotype, designated by Liu and Hong (2017: 21): P [barcode P02143197]!; isolectotypes: P [barcode P02143198, P02143199]!). (Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p02143197).

45. *Photinia benthamiana* Hance var. *glabrescens* Cardot f. *angustifolia* Cardot, Notul. Syst. (Paris) 3: 376. 1914.

Type: VIETNAM. "Annam: massif du Lang-bian, Dalat, alt. 1400m", 12 February 1914, *A.J.B. Chevalier 30739* (lectotype, designated by Liu and Hong (2017: 22): P [barcode P02143200]!; isolectotypes: P [barcode P02143201]!, P [barcode P02143202]!). (Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen. p02143200).

46. *Photinia benthamiana* Hance var. *glabrescens* Cardot f. *latifolia* Cardot, Notul. Syst. (Paris) 3: 376. 1914.

Type: VIETNAM. "Annam: Plateau du Lang Bian, prov. du Haut-Donaï, 2500m", *Jacquet 626* (lectotype, designated by Liu and Hong (2017: 22): P [barcode P02143188]!; isolectotype: P [barcode P02143189]!). (Image of lectotype available from https:// plants.jstor.org/stable/10.5555/al.ap.specimen.p02143188).

47. *Photinia benthamiana* Hance var. *salicifolia* Cardot, Notul. Syst. (Paris) 3: 376. 1914.

≡ Pourthiaea benthamiana (Hance) Nakai var. salicifolia (Cardot) Iketani & H.Ohashi, J. Jap. Bot. 66(6): 353. 1991.

Type: VIETNAM. "Annam: province de Thuan-tien, haut bassin du Bo-giang", *P.A. Eberhardt 1999* (lectotype, designated by Vidal (1968: 47): P [barcode P02143194]!). "Annam: province de Thuan-tien, haut bassin du Bo-giang", *P.A. Eberhardt 2738* (syntype: P [barcode P02143195, P02143196]!). (Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen. p02143194).

48. Photinia brevipetiolata Cardot, Notul. Syst. (Paris) 3: 379. 1914.

Type: CHINA. "Kouy-tcheou: route de Pin-fa à Kouy-yang, haut plateau" [Guizhou: on the road from Pingfa village, Yunwu, Guiding County to Guiyang], *J. Cavalerie & Fortunat 2607* (holotype: P [barcode P02143212]!). (Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p021432).

49. *Photinia calleryana* (Decne.) Cardot var. *laosensis* Cardot, Notul. Syst. (Paris) 3: 377. 1914.

Type: LAOS. "Bassin d'Attopeu", March 1877, *J.H.A.J. Harmand 1131* (lectotype, designated by Liu and Hong (2017: 22): P [barcode P02143190]!; isolectotypes: P [barcode P02143191, P02143192, P02143193]!). (Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p02143190).

50. Photinia fauriei Cardot, Notul. Syst. (Paris) 3: 376. 1914.

Type: CHINA. Formosa [Taiwan]: Kelung [Jilong], 1914, *U.J. Faurie 81* (lectotype, designated by Liu and Hong (2017: 19): P [barcode P02143116]!; isolectotype: BM [barcode BM000629115]!). (Image of lectotype available from https://plants.jstor.org/ stable/10.5555/al.ap.specimen.p02143116).

51. Photinia parviflora Cardot, Notul. Syst. (Paris) 3: 378. 1914.

- *≡ Pourthiaea parviflora* (Cardot) Iketani & H.Ohashi, J. Jap. Bot. 66(6): 353. 1991.
- ≡ Photinia schneideriana Rehder & E.H.Wilson var. parviflora (Cardot) L.T.Lu & C.L.Li, Acta Phytotax. Sin. 38(3): 277. 2000.
- ≡ Pyrus eyola M.F.Fay & Christenh., Global Fl. 4: 103. 2018.

Type: CHINA. Kouy-tcheou [Guizhou]: "Kin-tchen-hia" [Longli County, Chengxia], 3 May 1907, *J. Cavalerie 3080* (holotype: P [barcode P02143181]!). (Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p02143181).

52. *Photinia subumbellata* Rehder & E.H.Wilson var. *villosa* Cardot, Notul. Syst. (Paris) 3: 379. 1914.

≡ Photinia cardotii F.P.Metcalf, J. Arnold Arbor. 20(4): 440. 1939. replacement name.

Type: CHINA. Fu-tschan [probably Ku-shan], 1883, *Popow s. n.* (holotype: P [barcode P02143152]!; isotype A [barcode 00045583]!-fragment ex P [barcode P02143152]). (Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p02143152).

53. *Photinia villosa* (Thunb.) DC. var. *emergens* Cardot, Notul. Syst. (Paris) 3: 378. 1914.

Type: JAPAN. "montagne de Hakodate, octobre 1887", *U. Faurie 3224* (lectotype, designated by Liu and Hong (2016a: 211): P [barcode P03650697]!; isolectotype: P [barcode P02143125]!). "Province d'Akita, octobre 1885", *U. Faurie 1431* (syntype: P [barcode P03650628]!). (Image of lectotype available from https://science.mnhn.fr/institution/mnhn/collection/p/item/p03650697).

54. Photinia impressivena Hayata, Icon. Pl. Formosan. 5: 67. 1915.

≡ Stranvaesia impressivena (Hayata) Masam., Ann. Rep. Taihoku Bot. Gard. ii. 127. 1932.

≡ Pourthiaea impressivena (Hayata) Iketani & H.Ohashi, J. Jap. Bot. 66(6): 353. 1991.

≡ Pyrus impressivena (Hayata) M.F.Fay & Christenh., Global Fl. 4: 108. 2018.

Type: CHINA. Fokien [Fujian]: Fuzhou, Mt. Kozan, November 1909, *Nagasawa s. n.* (holotype: TI!; isotypes: A [barcode 00038572, 00038573]!).

55. *Pourthiaea villosa* (Thunb.) Decne. var. *longipes* Nakai, Bot. Mag. (Tokyo) 30: 25. 1916.

≡ Pourthiaea longipes (Nakai) Nakai, Bot. Mag. (Tokyo) 48: 781. 1934.

Type: SOUTH KOREA. Jeollanam-do: "Hab. in silvis Wangtô et montis Chirisan", 20 June 1913, *T. Nakai s. n.* (lectotype, designated by Liu and Hong (2016a: 215): TI [barcode T00010502]!). in silvis montis Hakuyôzan, *S. Tate s. n.* (syntype: TI). in silvis montis Wangto, *T. Nakai 11358* (syntype: TI). Shinkinri insulae Gai-Rarôtô, *T. Nakai 11354* (syntype: TI). in silvis montis Hakuyôzan, *Reisui, T. Nakai 11355* (syntype: TI). in silvis montis Hakuyôzan, *T. Nakai 11356* (syntype: TI). in silvis montis Hakuyôzan, *T. Nakai 11356* (syntype: TI). in silvis montium Chirisan, *T. Nakai 139* (syntype: TI). in silvis montis Wangto, *T. Nakai 1358* (syntype: TI). Shinkinri insulae Gai-Rarôtô, *T. Nakai 11358* (syntype: TI). Shinkinri insulae Gai-Rarôtô, *T. Nakai 11354* (syntype: TI). in silvis montis Wangto, *T. Nakai 11358* (syntype: TI). Shinkinri insulae Gai-Rarôtô, *T. Nakai 11354* (syntype: TI). In silvis montis Hakuyôzan, *T. Nakai 11355* (syntype: TI). In silvis montis Hakuyôzan, *Reisui, T. Nakai 11355* (syntype: TI). in silvis montis Hakuyôzan, *T. Nakai 11356* (syntype: TI). In silvis montis Hakuyôzan, *T. Nakai 11355* (syntype: TI). In silvis montis Hakuyôzan, *T. Nakai 11356* (syntype: TI). In silvis montis Hakuyôzan, *T. Nakai 11356* (syntype: TI). In silvis montis Hakuyôzan, *T. Nakai 11356* (syntype: TI). In silvis montis Hakuyôzan, *T. Nakai 11356* (syntype: TI). In silvis montis Hakuyôzan, *T. Nakai 11356* (syntype: TI). In silvis montis Hakuyôzan, *T. Nakai 11356* (syntype: TI). In silvis montis Hakuyôzan, *T. Nakai 11356* (syntype: TI). In silvis montis Hakuyôzan, *T. Nakai 11356* (syntype: TI). In silvis montis Hakuyôzan, *T. Nakai 11356* (syntype: TI). In silvis montis Hakuyôzan, *T. Nakai 11356* (syntype: TI). In silvis montium Chirisan, *T. Nakai 139* (syntype: TI).

56. Cotoneaster blinii H.Lév., Cat. Pl. Yun-Nan 229. 1917.

≡ Photinia blinii (H.Lév.) Rehder J. Arnold Arbor. 17(4): 335. 1936.

- *≡ Pourthiaea blinii* (H.Lév.) Iketani & H.Ohashi, J. Jap. Bot. 66(6): 353. 1991.
- *≡ Pyrus blinii* (H.Lév.) M.F.Fay & Christenh., Global Fl. 4: 98. 2018.

Type: CHINA. Kouy-tcheou [Guizhou]: "Goui-reou, lit même du fleuve", 600 m, 2 October 1912, *J. Esquirol 3700* (holotype E [barcode E00010997]!; isotype: image A [barcode 00026738]! with a fragment ex E [barcode E00010997]. (Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.e00010997).

57. Photinia obliqua Stapf, Bot. Mag. 149: sub t. 9008. 1924.

≡ Pourthiaea obliqua (Stapf) Iketani & H.Ohashi, J. Jap. Bot. 66(6): 354. 1991.

≡ *Pyrus obliqua* (Stapf) M.F.Fay & Christenh., Global Fl. 4: 114. 2018.

Type: CHINA. Fokien [Fujian]: Foochow [Fuzhou], *W.R. Carles 839* (holotype: K [barcode K000758285]!; isotypes: image A [barcode 00038559]! with fragments from K

[barcode K000758285]). (Image of holotype available from https://plants.jstor.org/ stable/10.5555/al.ap.specimen.k000758285).

58. *Photinia amphidoxa* (C.K.Schneid.) Rehder & E.H.Wilson var. *amphileia* Hand.-Mazz., Symb. Sin. 7(3): 481. 1933.

- ≡ *Stranvaesia amphidoxa* C.K.Schneid. var. *amphileia* (Hand.-Mazz.) T.T.Yu, Fl. Reipubl. Popularis Sin. 36: 214. 1974.
- *≡ Pourthiaea amphidoxa* (C.K.Schneid.) Rehder & E.H.Wilson var. *amphileia* (Hand.-Mazz.) B.B.Liu & J.Wen, J. Syst. Evol. 57(6): 687. 2019.
- ≡ Pourthiaea amphidoxa (C.K.Schneid.) Rehder & E.H.Wilson var. amphileia (Hand.-Mazz.) W.Guo, W.B.Liao & LongY.Wang, Phytotaxa 447(2): 111. 2020. nom. illeg. superfl.

Type: CHINA. Hunan: Wugang, Yunshan, 6–8 August 1917, 1150–1300 m, *H.R.E. Handel-Mazzetti 11205* (holotype: WU [barcode WU0059456]!; isotypes: A [barcode 00045586]!, IBSC [barcode 0362055]!, NY [barcode 00436109]!). ibidem, 15 April 1918, 1,100–1,190 m, *H.R.E. Handel-Mazzetti 11205* (syntype: WU [barcode WU0059455]!). April 1919, 1,100–1,300 m, *T.H. Wang 11205* (syntypes: WU [barcode WU0059455]!, A [barcode 00045592]!). (Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.wu0059456].

59. Photinia hirsuta Hand.-Mazz., Symb. Sin. Pt. vii. 481. 1933.

≡ Pourthiaea hirsuta (Hand.-Mazz.) Iketani & H.Ohashi, J. Jap. Bot. 66(6): 353. 1991. *≡ Pyrus hirsuta* (Hand.-Mazz.) M.F.Fay & Christenh., Global Fl. 4: 107. 2018.

Type: CHINA. Hunan: Changsha, "Hartlaubwalde des Yolu-schan bei Tschangcha, str. St., Sandstein, 100–300m", 10 December 1917, *H.R.E. Handel-Mazzetti 11416* (holo-type: WU [barcode WU0059450]!; isotype: A [barcode 00045606]!). (Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.wu0059450).

60. Pourthiaea kankoensis Hatus., Bull. Exp. For. Kyushu 3: 99. 1933.

■ Photinia parvifolia (E.Pritz. ex Diels) C.K.Schneid. var. *kankoensis* (Hatus.) T.T.Yu & K.C.Kuan, Fl. Reipubl. Popularis Sin. 36: 259. 1974.

Type: CHINA. Taiwan: Mt. Rohon, 900 m, November 1932, *S. Hatusima 793* (syntype FU).

61. *Pourthiaea zollingeri* Decne. var. *yesoensis* Nakai, Bot. Mag. (Tokyo) 48: 782. 1934.

≡ Pourthiaea laevis (Thunb.) Koidz. var. *yesoensis* (Nakai) Nakai, Jap. J. Bot. 18: 618. 1942.

Type: JAPAN. Prov. Hidaka: Mt. Apoi, August 1928, *T. Nakai s. n.* (lectotype, designated by Liu and Hong (2016a: 215): TI [barcode 00002995]!). Prov. Hidaka: Samani, 18 June, *K. Miyabe s.n.* (syntype: TI [barcode T00002996]!).

62. Photinia euphlebia Merr. & Chun, Sunyatsenia 2: 239. 1935.

Type: CHINA. Hainan: Qiongzhong, Fanyi village, 24 October 1932, 3000 m, N.K. Chun & C.L. Tso 44134 (holotype: IBSC [barcode 0318867]!; isotypes: A [barcode 00026741]!, F [barcode f0068223f]!, IBK [barcode IBK00062249]!, IBSC [barcode 0318866]!, KUN [barcode 0641709]!, NY [barcode 00436119]!, P [barcode P02143171]!, PE [barcode 00336450]!, SYS [barcode SYS00095743]!, SZ [barcode 00197141]!, US [barcode 00097495]!, WIS [barcode v0255003WIS]!). Guangdong: Tsing Uen Dist. 4 April 1925, F.A. McClure 1606 (paratypes: IBSC [barcode 0318815]!, SYS [barcode SYS00095741, SYS00095742]!). Zengcheng, Nankunshan, 1 May 1932, W.T. Tsang 20396 [paratypes: IBSC [barcode 0318853, 0318858]!, NAS [barcode NAS00353222]!, PE [barcode 00336441]!, SYS [barcode SYS00074995, SYS00095748]!); ibidem, 3 April 1932, W.T. Tsang 20072 (paratypes: IBSC [bardoce 0318864]!, KUN [barcode 0641700]!, NAS [barcode NAS00071254]!, PE [barcode 00336430, 00336432]!, SYS [barcode SYS00074996, SYS00095749]!). Meizhou, Jiaying, Yinnashan, 4 August 1932, W.T. Tsang 21320 (paratypes: IBSC [barcode 0318859]!, NAS [barcode NAS00353223]!, PE [barcode 00336431]!, SYS [barcode SYS00095744]!). Dabu, Tonggushan, 8 September 1932, W.T. Tsang 21703 (paratypes: IBSC [barcode 0318857]!, N [barcode 126077196]!, NAS [barcode NAS00353224, NAS00353231]!, PE [barcode 00336447, 00336448]!, SYS [barcode SYS00095747]!); Damaoshan, 26 June 1932, W.T. Tsang 21033 (paratypes: IBSC [barcode 0318862]!, NAS [barcode NAS00374064, NAS00353218]!, PE [barcode 00336443, 00336425]!, SYS [barcode SYS00095745]!); ibidem, 3 July 1932, W.T. Tsang 21060 (paratypes: IBSC [barcode 0318860]!, NAS [barcode NAS00353220, NAS00353221, NAS00353230]!, PE [barcode 00336445, 00336449]!, SYS [barcode SYS00095746]!).

63. Photinia tsaii Rehder, J. Arnold Arbor. 19: 274. 1938.

- \equiv *Pourthiaea tsaii* (Rehder) Iketani & H.Ohashi, J. Jap. Bot. 66(6): 354. 1991.
- *≡ Pyrus tsaii* (Rehder) M.F.Fay & Christenh., Global Fl. 4: 124. 2018.

Type: CHINA. Yunnan: Shang-pa-hsien [Fugong County, Shangpa], 1500 m, 28 September 1933, *H.T. Tsai 54959* (holotype: A [barcode 00045570]!; isotypes: IBSC [barcode 0004377]!, KUN [barcode 313254]!, NAS [barcode NAS00071263]!, PE [barcode 00020610, 00020612]!). Shangpa, 1,500 m, 2 September 1933, *H.T. Tsai 54688* (paratypes: IBSC [barcode 0319885]!, KUN [barcode 0640795, specimen accession no. 0683743]!, NAS [barcode NAS00071262]!, PE [barcode 00337715, 00337717]!]; ibidem, 2,000 m, 24 October 1934, *H.T. Tsai 58945* (paratypes: IBSC

[barcode 0004376]!, KUN [barcode 0640794]!, NAS [barcode NAS00354327]!, PE [barcode 00337716, 00337718]!). (Image of holotype available from https://plants. jstor.org/stable/10.5555/al.ap.specimen.a00045570).

64. *Photinia amphidoxa* (C.K.Schneid.) Rehder & E.H.Wilson var. *kwangsiensis* F.P.Metcalf, J. Arnold Arbor. 20(4): 442. 1939.

Type: CHINA. Guangxi: Sanjiang County, Lingwang Shan [Yuanbao Shan], 19 September 1933, 2100 m, *A.N. Steward & H.C. Cheo 1011* (holotype: A [barcode 00026736]!; isotypes: N [barcode 126077161, 126077161_1]!). (Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.a00026736).

65. *Photinia beauverdiana* C.K.Schneid. var. *lohfauensis* F.P.Metcalf, J. Arnold Arbor. 20(4): 440. 1939.

Type: CHINA. Kwantung [Guangdong]: Loh-fau [Luofu Mountain], 14 August 1917, *C.O. Levine 1377* (holotype: A [barcode 00045595]!). ibidem, *C.O. Levine 1381* (paratypes: AU?, A?); ibidem, *C.O. Levine 1553* (paratype: AU?). Lechang, 29 May 1929, *C.L. Tso 20832* (paratypes: IBSC [barcode 0004360, 0319644, 0319655]!). Yunan: Lung T'au Shan [Longtang Shan], 18 June 1924, *Lingnan (To and Tšang) 12503* (pratypes: PE [barcode 00337413, 00337414]!); ibidem, 7 June 1924, *Lingnan (To and Tšang) 12432* (IBSC [barcode 0319637]!). Xiamen: *H.H. Chung 6399* (paratypes: AU [barcode 010130, 010132]!). (Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.a00045595).

66. *Photinia mollis* Hook.f. var. *angustifolia* C.E.C.Fisch., Bull. Misc. Inform. Kew 7: 335. 1939.

Type: MYANMAR. Myitkyina District: Tanpangkha, about 3 miles from Seniku, on rocks beside the stream, 300 m, 22 March 1938, *C.W.D. Kermode 16608* (holotype: K (barcode K000758336)!). (Image of holotype available from https://plants.jstor.org/ stable/10.5555/al.ap.specimen.k000758336).

67. *Pourthiaea laevis* (Thunb.) Koidz. var. *crassiuscula* Nakai, Jap. J. Bot. 18: 619. 1942.

Type: JAPAN. Prov. Sinano: in monte Togakusi, 11 July 1884, *Z. Mutamura s. n.* (lectotype, designated by Liu and Hong (2016a: 215): TI [barcode 00031786]!). Prov. Uzen: Yonezawa, October 1914, *G. Koidzumi* (paratype: TI [barcode T00031788]!). Prov. Simotuke: Tyûzenzi, 29 September 1879, *K. Sawada* (paratype: TI). Prov. Yamasiro: Hattyôdaira oppidi Kuta, 29 September 1934, *Y. Momiyama 660* (paratype: TI). Prov. Uzen: Yonezawa, October 1914, *G. Koidzumi s. n.* (syntype: TI [barcode T00031788]!).

68. *Pourthiaea villosa* (Thunb.) Decne. var. *yokohamensis* Nakai, Jap. J. Bot. 18: 618. 1942.

Type: JAPAN. Yokohama, Musasi, 23 June 1932, *K. Hisauchi s. n.* (lectotype, designated by Liu and Hong (2016a: 215): TI [barcode 00010504]!). Yokohama, Musasi, 15 May 1933, *K. Hisauchi s. n.* (paratype: TI [barcode T00010505]!).

69. Pyrus moiorum A.Chev., Rev. Bot. Appl. Agric. Trop. xxii. 375. 1942.

- *≡ Photinia moiorum* (A.Chev.) J.E.Vidal, Fl. Cambodge, Laos & Vietnam Fasc. 6, 48. 1968.
- *≡ Pourthiaea moiorum* (A.Chev.) Iketani & H.Ohashi, J. Jap. Bot. 66(6): 354. 1991.
- *Photinia pirocarpa* J.E.Vidal, Notul. Syst. (Paris) 13(4): 300. 1948. nom. illeg. superfl. (referring to the Note 15 in Liu and Hong (2017)).

Type: Laos. "Nord de Pakson plateau des Boloven, Pro. de Bassac", 1300 m, 31 October 1928, *E. Poilane 16225* (lectotype (selected by Vidal (1968), first step; second step, designated by Liu and Hong (2017)): P [barcode P02143149]!; isolectotypes: A [barcode 00026801], K [barcode K000758355, K000758356)!, L [barcode L0019508]!, P [barcode P02143148, P02143204]!). (Image of lectotype available from https://plants. jstor.org/stable/10.5555/al.ap.specimen.p02143149).

70. *Photinia benthamiana* Hance var. *obovata* H.L.Li, J. Arnold Arbor. 25(2): 208. 1944.

≡ Pourthiaea benthamiana (Hance) Nakai var. obovata (H.L.Li) Iketani & H.Ohashi, J. Jap. Bot. 66(6): 353. 1991.

Type: CHINA. Hainan: Lingshui County, 300 ft., 20 October 1935, *F.C. How 73904* (holotype: A [barcode 00045597]!; isotypes: IBSC [barcode 0318212]!, P [barcode P03240040]!). (Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.a00045597).

71. Photinia lancilimbum J.E.Vidal, Notul. Syst. (Paris) 13(4): 298. 1948.

Type: VIETNAM. "Annam: Nui Bach Ma station d'altitude de Huê" [Hué, Bach Ma National Park], 1200–1500 m, 13 December 1940, *E. Poilane 31128* (lectotype, designated by Liu and Hong (2017: 22): P [barcode P02143249]!; isolectotypes: K [barcode K000758351]!, P [barcode P02143253]!). Lac Duong, "Annam: Nui Bach Ma station d'altitude de Hué" [Hué, Bach Ma National Park], 13 December 1940, *E. Poilane 31137* (syntypes: P [barcode P03373767, P03373771]!). "massif du Lang Bian" [Dà Lạt Plateau Liang Bian], 1,000–1,200 m, 29 April 1919, *A.J.B. Chevalier 40347* (syntypes: P [barcode P03373769, P03373770]!). "Annam: Nui Bach Ma

station d'altitude près de Hué Grand cascade - Altitude 1,000 m[°] [Hué, Bach Ma National Park], 15 April 1939, *E. Poilane 29737* (syntypes: P [barcode P03373734, P03156772, P03373735]!). (Image of lectotype available from https://plants.jstor.org/ stable/10.5555/al.ap.specimen.p02143249).

72. *Photinia lancilimbum* J.E.Vidal var. *petaloconstricta* J.E.Vidal, Notul. Syst. (Paris) 13(4): 299. 1948.

Type: LAOS: "M. Xuong, prov. Luang Prabang", 400 m, 26 March 1932, *E. Poilane* 20517 (lectotype, designated by Liu and Hong (2017: 22): P [barcode P02143215]!; isolectotypes: K [barcode K000758352]!, P [barcode P02143216]!). (Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p02143215).

73. *Photinia lancilimbum* J.E.Vidal var. *racemosa* J.E.Vidal, Notul. Syst. (Paris) 13(4): 299. 1948.

Type: VIETNAM. "Tonkin: cours de la Rivière Noire en aval de Lai Chau", 21 January 1938, *E. Poilane 27159* (lectotype, designated by Liu and Hong (2017: 15): P [barcode P02143217]!; isolectotypes: K [barcode K000758353]!, P [barcode P02143218]!). (Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p02143217).

74. *Photinia lancilimbum* J.E.Vidal var. *turbinata* J.E.Vidal, Notul. Syst. (Paris) 13(4): 299. 1948.

Type: VIETNAM. "Plateau d'altitude de Bach Ma, près Hué" [Hué, Bach Ma National Park], 16 June 1944, *J.E. Vidal 33A* (holotype: P [barcode P02143219]!). (Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p02143219).

75. *Photinia lancilimbum* J.E.Vidal var. *urceolocarpa* J.E.Vidal, Notul. Syst. (Paris) 13(4): 299. 1948.

- ≡ Photinia impressivena Hayata var. urceolocarpa (J.E.Vidal) J.E.Vidal, Fl. Cambodge, Laos & Vietnam 6: 51, pl. 6, f. 4–5. 1968.
- *≡ Pourthiaea impressivena* (Hayata) Iketani & H.Ohashi var. *urceolocarpa* (J.E.Vidal) Iketani & H.Ohashi, J. Jap. Bot. 66(6): 354. 1991.

Type: VIETNAM. "bords du torrent de Muong Xen, Km. 19 Route de Lao Cai à Cha Pa", 1 August 1944, *J.E. Vidal 32* (lectotype, designated by Vidal (1968: 52): P [barcode P02143250]!). LAO CAI. "bords du torrent de Muong Xen, Km. 19 Route de Lao Cai à Cha Pa", August 1943, *A. Pélelot 8407* (syntype: P [barcode P03342482]!). ibidem, 1 August 1944, *J.E. Vidal 32A* (syntypes: P [barcode P02143172, P02143173]!). (Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p02143250).

76. *Pourthiaea villosa* (Thunb.) Decne. var. *oblongifolia* Murata, Acta Phytotax. Geobot. 15: 177. 1954.

≡ Pourthiaea villosa (Thunb.) Decne. var. laevis (Thunb.) Stapf f. oblongifolia (Murata) Satomi, J. Phytogeogr. Taxon. 28(1): 32. 1980.

Type: JAPAN. "Honshiu Prov. Yamato: Inter Misen et Shakadake in Montibus Oomine", 1750 m, 16 July 1954, *G. Murata & T. Shimizu 122* (holotype: KYO [barcode 00081202]!; isotype: KYO [barcode 00081203]!).

77. Photinia callosa Chun ex T.T.Yu & K.C.Kuan, Acta Phytotax. Sin. 8: 229. 1963.

- ≡ Pourthiaea callosa (Chun ex T.T.Yu & K.C.Kuan) Iketani & H.Ohashi, J. Jap. Bot. 66(6): 353. 1991.
- ≡ Pyrus callosa (Chun ex T.T.Yu & K.C.Kuan) M.F.Fay & Christenh., Global Fl. 4: 99. 2018.

Type: CHINA. Guangdong: Xinyi County, Dadong, Shuiyinshan, 20 April 1932, Z. Huang 32130 (holotype: IBSC [barcode 0004361]!; isotypes: IBK [barcode IBK00062047, IBK00062048]!, KUN [barcode 607112, 607113]!, PE [barcode 00004608, 00004609]!, SZ [barcode 00196906]!). Xinyi, Daguowei, Huochangping, 4,500 ft, 28 April 1932, Z. Huang 32255 (paratypes: IBK [barcode IBK00062046, IBK00062049]!, IBSC [barcode 0318299]!, KUN [barcode 0641136]!, PE [barcode 00299777]!, SZ [barcode 00196905]!]. Fenshui'ao, 26 April 1931, X.P. Gao 51361 (paratypes: IBK [barcode IBK00061932]!, IBSC [barcode 0318293, 0318294, 0318295, 0318296]!]. Fangcheng, 13 April 1956, Guangdong Hepu District Expedition of CAS 2371 (paratypes: IBSC [barcode 0318234]!, PE [barcode 00299778]!. Longsheng, Pingshui, Taoshan, 11 August 1954, Longsheng Expedition 157 (paratypes: IBK [barcode IBK00190806]!, IBSC [barcode 0318300]!). Shangsi, Me-kon, Sch-feng Dar Shan, S.Nanning, ca. 850 m, 3 November 1928, R.C. Ching 8373 (paratypes: IBSC [barcode 0004362]!, NAS [barcode NAS00071251, NAS00352714, NAS00352716]!, PE [barcode 00299789]!). "Shap Man Taai Shan, near Iu Shan village, S. E. of Shang-sze, Kwangtung Border" [Shangsi, Shiwan Dashan], 2 June 1933, W.T. Tsang 22441 (paratypes: IBK [barcode IBK00062034]!, IBSC [barcode 0318297]!, P [barcode P03373754]!, SYS [barcode SYS00074925]!). Shiwan Dashan, Denglong village, 9 September 1934, W.T. Tsang 24222 (paratypes: IBSC [barcode 0318298]!, SYS [barcode SYS00074926]!). Wuming, Shanglin, Damingshan, the seventh district, Lahen, 22 August 1951, T.S. Tsai 5335 (paratypes: IBK [barcode IBK00190807]!, IBSC [barcode 0318302]!). Yongfu, "Pai-shou district city, near Shih-lung ts'un" [Yongfu], 20–23 August 1937, Y.W. Taam 25 (paratypes: IBSC [barcode 0318301]!, PE [barcode 00299784]!, SYS [barcode SYS00074927]!).

78. *Photinia hirsuta* Hand.-Mazz. var. *lobulata* T.T.Yu, Acta Phytotax. Sin. 8(3): 231. 1963.

Type: CHINA. Fujian: Liancheng, Luodi, 24 October 1932, *Y. Ling 4167* (holotype: PE [barcode 00004605]!; isotypes: AU [barcode 010148]!, PE [barcode 00004604]!).

79. Photinia pilosicalyx T.T.Yu, Acta Phytotax. Sin. viii. 231. 1963.

≡ Pourthiaea pilosicalyx (T.T.Yu) Iketani & H.Ohashi, J. Jap. Bot. 66(6): 354. 1991.

≡ Pyrus pilosicalyx (T.T.Yu) M.F.Fay & Christenh., Global Fl. 4: 116. 2018.

Type: CHINA. Guizhou: Anlong County, Longshan, Qiaoling, 1,200 m, 9 June 1960, *Z.S. Zhang & Y.T. Zhang 4035* (holotype: PE [barcode 00934236]!; isotypes: IBSC [barcode 0335502]!, KUN [barcode 607037]!).

80. Photinia podocarpifolia T.T.Yu, Acta Phytotax. Sin. viii. 230. 1963.

- ≡ Pourthiaea podocarpifolia (T.T.Yu) Iketani & H.Ohashi, J. Jap. Bot. 66(6): 354. 1991.
- *≡ Pyrus podocarpifolia* (T.T.Yu) M.F.Fay & Christenh., Global Fl. 4: 116. 2018.

Type: CHINA. Guizhou: Luodian, Bamao, Dating, Hongshui River, 200 m, 8 April 1959, Qiannan Expedition 408 (lectotype, designated by Liu and Hong (2016b: 225): PE [barcode 00004600]!; isolectotypes: HGAS [barcode 021090]!, KUN [barcode 606957, 747408]!, PE [barcode 00020608, 01498393, 01498394]!). Hongshui River, riverside, 8 April 1959, Qiannan Expedition 709 (paratypes: HGAS [barcode 021089]!, KUN [barcode 606956]!, NAS [barcode 00071260]!, PE [barcode 00337090, 00337091, 01651162]!). Guangxi: Baise City, Yangxu Zhen, 280 m, 25 December 1955, Baise Expedition 1534 (paratypes: IBK [barcode IBK-00190813]!, IBSC [barcode 0004370]!, KUN [barcode 606955]!, NAS [barcode 00071259]!, PE [barcode 00337094]!). Petseu, 1914, J. Cavalerie 4283 (paratype: P [barcode P03342555]!). ibidem, 1900-1920, J. Cavalerie 4498 (paratypes: K [barcode K000758287]!, P [barcode P03373739]!). Longlin County, Gebu Xiang, Wuchong Village, on the rocks by river, 13 May 1957, C.F. Liang 32325 (paratypes: IBK [barcode IBK00190814]!, IBSC [barcode 0004369]!). Tian'e County, Baiyang Zhen, Hongshui River, riversides, 150 m, 27 March 1960, Guizhou Expedition 14 (paratypes: IBK [barcode 00062433]!, IBSC [barcode 0319277]!, NAS [barcode 00071258]!, PE [barcode 00337093]!). Liupai Zhen, 21 May 1957, Z. Huang 43389 (paratypes: IBK [barcode IBK00190812]!, IBSC [barcode 0319273]!, KUN [barcode 606954]!). Tianlin County, on the way from Leli Xiang to Lizhou Xiang, on the rocks in valley, 22 November 1957, Z.Q. Zhang 10921 (paratypes: IBK [barcode IBK00062427]!, IBSC [barcode 0319272]!).

81. *Pourthiaea chingshuiensis* T.Shimizu, Journ. Fac. Text. Sci. & Techn., Shinshu Univ. No. 36, Biol., No. 12 (Stud.Limest. Fl. Jap. & Taiwan, Pt. 2) 36. 1963; et in Acta Phytotax. & Geobot., Kyoto, xxi. 20. 1964.

- ≡ Photinia chingshuiensis (T.Shimizu) T.S.Liu & H.J.Su, Fl. Taiwan 3: 74. 1977.
- ≡ Photinia parvifolia (E.Pritz. ex Diels) C.K.Schneid. var. chingshuiensis (T.Shimizu) S.S.Ying, Coloured Illustr. Fl. Taiwan 1: 358. 1985.
- ≡ Pourthiaea villosa (Thunb.) Decne. var. chingshuiensis (T.Shimizu) Iketani & H.Ohashi, J. Jap. Bot. 66(6): 354. 1991.
- ≡ Pyrus chingshuiensis (T.Shimizu) M.F.Fay & Christenh., Global Fl. 4: 100. 2018.

Type: CHINA. Taiwan: Hualien, Mt. Chingshui, 600–1400 m, 29 March 1961, *T. Shimizu & M.T. Kao 11749* (holotype: TAI [barcode 055602]!; isotypes: KYO [barcode KYO00022343]!, SHIN [barcode 155840]!, TI [barcode TI00031789]!).

82. Stranvaesia tomentosa T.T.Yu & T.C.Ku, Acta Phytotax. Sin. 13(1): 102. 1975.

- \equiv Pyrus ganymedes M.F.Fay & Christenh., Global Fl. 4: 104. 2018.
- *≡ Pourthiaea tomentosa* (T.T.Yu & T.C.Ku) B.B.Liu & J.Wen, J. Syst. Evol. 57(6): 687. 2019.
- ≡ *Pourthiaea tomentosa* (T.T.Yu & T.C.Ku) Long Y.Wang, W.Guo & W.B.Liao, Phytotaxa 447(2): 111. 2020. nom. illeg. superfl.

Type: CHINA. Chongqing: Nanchuan, Jinfoshan, Dafengpo, 1,350 m, 9 July 1964, *K.C. Kuan et al. 1319* (holotype: PE [barcode 00026319]!; isotypes: CDBI [barcode CDBI0172158]!, PE [barcode 00026320]!). Nanchuan, Guandi, 650 m, 3 May 1957, *G.F. Li 60885* (paratypes: HIB [barcode 0037841]!, KUN [barcode 0643094]!, PE [barcode 00739363]!, SZ [barcode 00215295, 00215296]!). Beibei, Jinyunshan, NE of Qingyunzhai, 820 m, 31 May 1956, *Sichuan-Guizhou Expedition 471* (paratype: PE [barcode 00739360]!); Jinyunshan, Pokongta, 780 m, *T.H. Tu 5110* (paratypes: IBSC [barcode 0335389]!, PE [barcode 00739362]!); Jinyunshan, 670 m, 29 April 1930, *K.S. Hao 61* (paratype: PE [barcode 00739362]!); ibidem, 6 July 1930, *S.F. Zhang 659* (paratype: PE [barcode 00739352]!); ibidem, 11 January 1940, *C. Pei 7516* (paratype: PE [barcode 00739361]!).

83. *Photinia villosa* (Thunb.) DC. var. *tenuipes* P.S.Hsu & L.ChuLi, Acta Phytotax. Sin. 18(3): 264. 1980.

- ≡ Photinia parvifolia (E.Pritz. ex Diels) C.K.Schneid. var. tenuipes (P.S.Hsu & L.Chu Li) P.L.Chiu, J. Zhejiang Forest. Coll. 4(1): 67. 1987.
- ≡ Pourthiaea villosa (Thunb.) Decne. var. tenuipes (P.S.Hsu & L.ChuLi) Iketani & H.Ohashi, J. Jap. Bot. 66(6): 354. 1991.

Type: CHINA. Zhejiang: Lin'an, Changhua, Kuliwan, 20 May 1958, X.Y. He 28542 (holotype: FUS, isotypes: IBSC [barcode 0335093]!, PE [barcode 00394001]!); Jingning: Yingchuan, Laoyue, in the bushes of the valley, 9 May 1959, S.Y. Zhang 4928 (paratypes: FUS, HHBG [barcode HZ016336]!, KUN [barcode 608586]!, NAS [barcode NAS00353328, NAS00353262]!; PE [barcode 00337971]!); Jingning, Dajun, Quankeng, roadsides of the slope, 9 May 1959, S.Y. Zhang 5131 (paratypes: FUS, HHBG [barcode HZ016335]!, NAS [barcode NAS00353274, NAS00353275, NAS00353278]!; PE [barcode 00337983]!; WUK [barcode WUK-0264321]!); Lishui, Dagangtou, Xiaojing, roadsides of the slope and in the woods beside the stream, 28 July 1959, S.Y. Zhang 6041 (paratypes: FUS, HHBG [barcode HZ016334]!; KUN [barcode 608587]!, NAS [barcode NAS00353302, NAS00353270]!, PE [barcode 00337997]!); Lishui, Yunfeng, roadsides and in the woods on the slope, 17 August 1959, S.Y. Zhang 6387 (paratypes: FUS, HHBG [barcode HZ016346]!, KUN [barcode 608588]!, NAS [barcode NAS00353325]!, PE [barcode 00337995]!); ibidem, 21 August 1959, S.Y. Zhang 6700 (paratypes: FUS, HHBG [barcode HZ016345]!, KUN [barcode 608594], NAS [barcode NAS00353326, NAS00353327]!, PE [barcode 00337994]!); Lin'an, Changhua, south-east of Jinkeng in the woods beside the stream, 25 May 1958, X.Y. He 28699 (paratypes: FUS, HHBG [barcode HZ016316]!, NAS [barcode NAS00353263]!, PE [barcode 00337972]!); Lin'an, Changhua, the centre part of Kuliwan in the woods on a north-western slope, 27 May 1958, X.Y. He 28745 (paratypes: FUS, HHBG [barcode HZ016325]!, NAS [barcode NAS00353323, NAS00353264, NAS00353267]!, PE [barcode 00338000]!); Longquan, Jinxi, Xiaozhuang, in the woods in the valley or beside the stream, 20 September 1959, S.Y. Zhang 6869 (paratypes: FUS, HHBG [barcode HZ016338]!, KUN [barcode 608589]!, NAS [barcode NAS00353330, NAS00353331]!, PE [barcode 00337982]!); Pingyang, Juxi, in the woods of the valley, 26 June 1959, S.Y. Zhang 5805 (paratypes: FUS, KUN [barcode 608591]!, NAS [barcode NAS00353277, NAS00353298]!, PE [barcode 00337985]!); Rui'an, Shiyang, Baiyanwan, in the woods beside the stream, 27 July 1959, S.Y. Zhang 5479 (paratypes: FUS, HHBG [barcode HZ016349]!, KUN [barcode 608590]!, NAS [barcode NAS00353301]!, PE [barcode 00337996]!); Suichang, Guanshan (Fengping), 24 October 1965, B.L. Qiu 1390 (paratypes: FUS, HHBG [barcode HZ016348]!). Fujian: Yanshan, on the slope, 800 m, 18 August 1958, M.X. Nie & S.S. Lai 4290 (paratypes: FUS, IBSC [barcode 0319956]!, KUN [barcode 607929, 608566]!, LBG [barcode 00010452]!, PE [barcode 00394011]!, WUK [barcode WUK-265890]!).

84. Photinia zhejiangensis P.L.Chiu, Acta Phytotax. Sin. 18(1): 97, pl. 2. 1980.

- ≡ Pourthiaea zhejiangensis (P.L.Chiu) Iketani & H.Ohashi, J. Jap. Bot. 66(6): 354. 1991.
- *≡ Pyrus zhejiangensis* (P.L.Chiu) M.F.Fay & Christenh., Global Fl. 4: 126. 2018.

Type: CHINA. Zhejiang: Jingning County, Gulou, 13 November 1958, *S.Y. Zhang* 4505 (holotype: HHBG [specimen accession no. 10236]!, isotypes: KUN [barcode 0642805, 0642806]!, PE [barcode 00020624, 00020625]!). Jingning, Yingchuan, 9 May 1959,

S.Y. Zhang 4920 (paratypes: HHBG [barcode HZ016561]!, KUN [barcode 0642803]!, NAS [barcode NAS00354331, NAS00354332]!, PE [barcode 00394064]!). Longquan County, Guanpuyang, 650 m, 26 July 1958, *S.Y. Zhang* 3236 (paratypes: HHBG [barcode HZ016558]!, NAS [barcode NAS00354333, NAS00354334]!, PE [barcode 00394365, 00394067, 00394068, 00394069)!]; ibidem, 9 November 1959, *S.Y. Zhang* 7390 (paratypes: HHBG [barcode HZ016559]!, KUN [barcode 0642804]!, PE [barcode 00394006]!); ibidem, 2 December 1968, *Z.G. Mao* 10720 (paratype: HHBG [barcode HZ016560]!). Taishun County, on the way from Liguang to Huangshikeng, 120 m, 27 November 1958, *Zhejiang Plant Resource Expedition* 23822 (paratypes: HHBG [barcode HZ016556]!, NAS [barcode NAS00354335, NAS00354337, NAS00354338]!).

85. Photinia wuyishanensis Z.X.Yu, J. Jiangxi Agric. Univ. 9(1): 5. 1982.

Type: CHINA. Jiangxi: Yanshan, Wuyishan, Xikeng, 1000 m, 26 April 1975, *Raowu Expedition Team 437* (holotype: JXAU; isotypes: LBG [barcode 00010454]!, LBG [barcode 00010455]!); Wuyishan, Dongkeng, 800 m, 11 May 1975, *Raowu Expedition 260* (paratypes: JXAU [barcode JXAU0003629]!, LBG [barcode 00010394]!, LBG [barcode 00010456, 00010457]!); ibidem, 810 m, 21 October 1981, *Q.G. Zhang W001* (paratypes: JXAU [barcode JXAU0003627, JXAU0003628]!); ibidem, 1,000 m, 24 October 1981, *Q.G. Zhang W030* (paratypes: JXAU [barcode JXAU0003628]!); ibidem, 1,000 m, 24 October 1981, *Q.G. Zhang W030* (paratypes: JXAU [barcode JXAU0003626, JXAU0003630]!); Yushan: Longshou, Huaiyu Shan, 450 m. 19 September 1977, *Huaiyushan Forest Vegetation Expedition 220* (paratypes: JXAU, LBG [barcode 00010448, 00010449]!).

86. *Photinia dabeishanensis* M.B.Deng & G.Yao, Bull. Nanjing Bot. Gard. Mem. Sun Yat Sen 1984–1985: 126. 1986.

Type: CHINA. Anhui: Jinzhai County, Baimazhai Forest Farm, 1,100 m, 17 May 1984, *M.B. Deng 81741* (lectotype, designated by Liu and Hong (2017: 19): NAS [barcode NAS00072797]!; isolectotype: NAS [barcode NAS00072798]!). Baimazhai Forest Farm, Zaoqian'ao, 1,500 m, 18 May 1984, *G. Yao 8988* (paratypes: NAS [barcode NAS00354378, NAS00354379]!).

87. Photinia magnoliifolia Z.H.Chen, J. Zhejiang Forest. Coll. 3: 35. 1986.

Type: CHINA. Zhejiang: Lin'an County, Qingshan Reservoir, 35 m, 15 April 1984, *Z.H. Chen & L.H. Ren 84006* (holotype: HHBG). Lin'an: Qingshan Reservoir, 24 July 1985, *Z.H. Chen & L.H. Ren 85003* (paratype: HHBG).

88. *Photinia subparvifolia* Y.K.Li & X.M.Wang, Bull. Bot. Res., Harbin 6(4): 108. 1986.

≡ Photinia parvifolia (E.Pritz. ex Diels) C.K.Schneid. var. subparvifolia (Y.K.Li & X.M.Wang) L.T.Lu & C.L.Li, Acta Phytotax. Sin. 38(3): 278. 2000.

Type: CHINA. Guizhou: Libo, Jidong, 550 m, 17 April 1983, *X.M. Wang 191* (holo-type: HGAS; isotype: PE [barcode 01432749]!).

89. Photinia zhijiangensis T.C.Ku, Acta Phytotax. Sin. 31(2): 192. 1993.

≡ Pyrus zhijiangensis (T.C.Ku) M.F.Fay & Christenh., Global Fl. 4: 126. 2018.

Type: CHINA. Hunan: Zhijiang County, Dashu'ao Xiang, Zhupo village, 600 m, 17 October 1988, *Wulingshan Expedition 2302* (holotype: PE [barcode 01896033]!; isotype: IBSC [barcode 0344337]!). nom. illeg. (referring to Liu and Hong (2017)).

90. *Photinia villosa* (Thunb.) DC. var. *glabricalycina* L.T.Lu & C.L.Li, Acta Phytotax. Sin. 38(3): 279. 2000.

Type: CHINA. Jiangxi: Shangyou, Wuzhifeng, 1 May 1972, Jiangxi Expedition Team 1002 (holotype: PE [barcode 00337886]!; isotype: PE [barcode 01641097]!); Anfu, Wugong Shan, Kenzhichang, Yantian, the foot of the mountain, 10 August 1959, S.S. Lai 1765 (paratypes: KUN [barcode 608499]!, LBG [barcode 00010381]!, PE [barcode 00337906]!); Ji'an, Donggu, Yingxu, Yangtian Shan, the forest edge, 16 May 1970, s. coll. 272 (paratype: PE [barcode 00337923]!); Jinggangshan, along road between Xiaojing and Ciping, on the slope, 860 m, 13 October 1971, Jiangxi Expedition 894 (paratypes: PE [barcode 00337912, 00337913]!); Nanfeng, Qia Cun, roadsides in the bushes, 23 April 1958, M.X. Nie 2265 (paratypes: LBG [barcode 00010363]!, LBG [barcode 00014991]!, PE [barcode 00337934]!); ibidem, roadsides in the bushes, 25 April 1958, M.X. Nie & S.S. Lai 2350 (paratypes: KUN [barcode 608524]!, LBG [barcode 00014974, 00014975]!, PE [barcode 00337933]!); Pingxiang, Xindian, sunny slope on the forest edge of Camellia oleifera plantation, 300 m, 28 April 1954, W.T. Wang 28 (paratype: PE [barcode 00337915]!); ibidem, sunny slope on the forest edge of Camellia oleifera plantation, 300 m, 28 April 1954, W.T. Wang 29 (paratype: PE [barcode 00337914]!); Ruijin: Liantang, longwangting, roadsides in the woods, 9 August 1958, Q.M. Hu 4148 (paratypes: IBSC [barcode 0335603]!, KUN [barcode 608607]!, KUN [barcode 608539]!, LBG [barcode 00010431]!, PE [barcode 00337929]!); Xunwu, along road between Zhonghe and Guizhumao, 500 m, 1958, Q.M. Hu 1252 (paratypes: IBSC [barcode 0335623]!, KUN [barcode 608525]!, LBG [barcode 00014988]!, PE [barcode 00337918]!); Xunwu, the valley in the east of Guizhumao, 700 m, 1 May 1958, Q.M. Hu 1462 (paratypes: IBSC [barcode 0319949]!, KUN [barcode 608518]!, LBG [barcode 00010412]!, PE [barcode 00337931]!); Xunwu, vicinity of Guizhumao Forest Farm, 700 m, 3 May 1958, Q.M. Hu 1584 (paratypes: KUN [barcode 608536, 608517], LBG [barcode 00010386]!, PE [barcode 00337930, 00337932]!). Guangxi: Lingui, Wantian, 120 m, 19 April 1955, C.F. Liang 31703 (paratypes: IBK [barcode IBK00062287]!, IBSC [barcode 0319934]!, PE [barcode 00337965]!, SZ [barcode 00197053]!); Xing'an, Simen, May 1953, Guangxi Team 4 (paratypes: PE [barcode 00337963, 00337964, 00337966, 01641095]!); Huajiang, 27 May 1953, Guangxi Team 841 (paratype: PE [barcode 00337968]!). Guizhou:

Leishan, vicinity of Wudong, 950 m, 6 May 1959, South Guizhou Expedition 1310 (paratypes: KUN [barcode 608544]!, NAS [barcode NAS00354188, NAS00354321]!, PE [barcode 00337961, 01641101]!); Leishan, Xijiang, Leigongping, in the bushes on the slope, 1,100 m, 22 May 1959, South Guizhou Expedition 2107 (paratypes: HGAS [barcode 021267]!, PE [barcode 00337869, 00337955]!); Leishan, Taoyao, Jieli, in the bushes on the slope, 108°8'20"E, 26°22'30"N, 950 m, 21 May 1965, Z.B. Jian et al. 50082 (paratypes: HGAS [barcode 021282], KUN [barcode 608543], PE [barcode 00337958, 01498535]); Leishan, Wudong, Xiaoshuiyan, in the woods on the slope, 26°21'30"N, 108°9'E, 1,140 m, 22 May 1965, Z.B. Jian et al. 50167 (paratypes: KUN [barcode 608541]!, PE [barcode 00337962, 01498532]!); Rongjiang, Bakai, Jihua, Baila, vicinity of Shangbaila, on the slope, 900 m, 25°39'30"N, 108°14'20"E, 8 August 1965, Z.B. Jian et al. 51682 (paratypes: HGAS [barcode 021277]!, KUN [barcode 608655]!, PE [barcode 00337957, 01498533]!]); Tianzhu, 15 June 1937, B.Q. Zhong 1090 (paratypes: PE [barcode 00337956, 00337959]!). Hunan: Hongjiang, Qianyang, District One or Two, 18 April 1953, Anjiang Agricultural School 182 [paratypes: IBSC [barcode 0335715]!, PE [barcode 00337947]!]; ibidem, 12 August 1953, Anjiang Agricultural School 645 (paratypes: IBSC [barcode 0319171]!, PE [barcode 00337943, 00337944]!). Jiangsu: Lianyungang, Yuntai Shan, Liuhe, 80 m, 27 August 1958, FX. Liu et al. 10848 (paratypes: IBSC [barcode 0335666, 0335668]!, NAS [barcode NAS00116611], PE [barcode 00337887, 00337888, 00337890, 00337891]!); Qiaya, Shendongcun, 260 m, 21 June 1956, FX. Liu et al. 2171 (paratypes: HHBG [barcode HZ016566]!, IBSC [barcode 0335662]!, NAS [barcode NAS00116596]!, PE [barcode 00337889]!). Zhejiang: Lin'an, Changhua, the tea plantation of Longtang Shan, in the stone crevices of the valley, 217 m, 2 October 1957, X.Y. He 29819 (paratypes: HHBG [barcode HZ016611]!, NAS [barcode NAS00354049]!, PE [barcode 00337896]!); Ningbo, s. coll. 1536 (paratype: PE); Yinxian, G.R. Chen 2265 (paratypes: PE [barcode 00337893, 00337897]!).

91. Photinia sorbifolia W.B.Liao & W.Guo, Ann. Bot. Fenn. 47(5): 394. 2010.

≡ Pourthiaea sorbifolia (W.B.Liao & W.Guo) B.B.Liu & D.Y.Hong, Phytotaxa 325(1): 18. 2017.

Type: CHINA. Hunan: Xinhuang County, Tianlei Shan Forest Farm, 760 m, 23 May 2008, W. Guo & R.J. Shen 840 (holotype: SYS [barcode SYS00164356]!; isotypes: IBSC, SYS [barcode SYS00164354, SYS00164355]!). ibidem, 760 m, 10 May 2008, W. Guo & R.J. Shen 841 (paratypes: IBSC, SYS); Mibei, Shiyangdong, Gualoupo, 900 m, 17 July 1988, Wuling Expedition 909 (paratypes: IBSC [barcode 0335431]!, PE [barcode 01364106]!). Zhijiang: Longping, Baishuidong, 28 May 1959, P.X. Tan 60949 (paratypes: IBK [barcode IBK00062671]!, IBSC [barcode 0317981]!)].

Naked names:

1. *Photinia latouchei* Franch. ex Cardot, Bull. Mus. Natl. Hist. Nat. xxvi. 570, 1920. nom. nud.

- 2. Photinia variabilis Hemsl., J. Linn. Soc., Bot. 23: 263. 1887.
- ≡ Pourthiaea variabilis (Hemsl.) Palib., Trudy Imp. S.-Peterburgsk. Bot. Sada xvii. I. 76. 1899. nom. nud.
- 3. Pourthiaea lanata Nakai, Bull. Natl. Sci. Mus., Tokyo No. 31, 62. 1952. nom. nud.
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Acknowledgements

We thank Richard G. Hodel (National Museum of Natural History, Smithsonian Institution) for polishing the language. National Natural Science Foundation of China supports this research (Grant No. 32000163 & 31620103902).

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RESEARCH ARTICLE



A new species of *Cinnamomum* (Lauraceae) from southwestern China

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Academic editor: Elton John de Lirio | Received 10 October 2021 | Accepted 16 June 2022 | Published 21 July 2022

Citation: Yang Z, Deng C, Wang L, Ban Q, Yang Y (2022) A new species of *Cinnamomum* (Lauraceae) from southwestern China. PhytoKeys 202: 35–44. https://doi.org/10.3897/phytokeys.202.76344

Abstract

Field investigations in Guizhou, China, in 2020 resulted in the discovery of an unknown species of Lauraceae. Morphological studies revealed that it is a new species of *Cinnamomum* Schaeff. sect. *Camphora* Meisn., based on the large terminal buds, and alternate leaves with pinnate veins. It is distinguished from other species of sect. *Camphora* by the rather large perulate terminal buds with numerous bracts, larger flowers, oblong-elliptic linear tepals twice as long as the stamens, and the deep cup-shaped fruiting cupule. It is here described and illustrated as a new species, *Cinnamomum guizhouense* C.Y.Deng, Zhi Yang et Y.Yang. A key to distinguish it from related species in the same area is provided. In addition, we list the new species as Critically Endangered (CR), and suggest to conduct *ex situ* conservation, collect seeds and plant the species in botanic gardens.

Keywords

Guizhou, morphology, sect. Camphora, taxonomy

Introduction

Cinnamomum Schaeff. (Schaeffer 1760: 74; Lauraceae) is known for the spice, cinnamon, derived from the bark of *Cinnamomum aromaticum* Nees (Nees von Esenbeck 1831: 74), which is well known worldwide (Rohwer 1993). For a long time, the genus was circumscribed to contain and ca. 350 species and to have a pan-Pacific distribution (Rohwer 1993; Lorea-Hernández 1996; van der Werff 2001). Recent phylogenetic and taxonomic studies have transferred the Neotropical species of *Cinnamomum* to other genera so that Cinnamomum is now treated as being restricted to Tropical/Subtropical Asia and Oceania (Huang et al. 2016; Rohde et al. 2017; Zeng et al. 2021). Two sections have been recognized in Cinnamomum, sect. Camphora Meisn. (Meissner 1864: 24) and sect. Cinnamomum. Sect. Camphora differs from sect. Cinnamomum in having perulate terminal buds (vs. naked terminal buds), pinnately veined alternate leaves (vs. tripliveined opposite/subopposite leaves), and domatia usually present in the axils of the lateral leaf veins (vs. lacking domatia in the axils of the lateral leaf veins) (van der Werff 2001; Huang et al. 2016). Sect. Camphora is restricted to the northern hemisphere while sect. Cinnamomum is distributed from eastern Asia to Oceania (Soh 2011). Interestingly, Trofimov and Rohwer (2020) suggest that Cinnamomum is polyphyletic with sect. Camphora being sister to Sassafras J.Presl (Presl 1825: 230) and sect. Cinnamomum being sister to Kuloa Trofimov & Rohwer (2020: 527). Until there is a modern taxonomic treatment, we accept species of *Cinnamomum* as belonging to a single genus.

Recent botanical investigations to Wangmo County of Guizhou Province, one of the most botanical diverse regions of China, resulted in the discovery of a *Cinnamomum* species with unusual morphology, which led us to conclude that it is a new species for science. We conducted field investigations, estimated the population size and extent/ area of occupancy, and collected several flowers and fruits of the plant. Specifically, we carried out morphological studies to answer the following questions: 1) what are the morphological affinities of the new species; and 2) what is the conservation status of the new species?

Material and methods

Field investigations were conducted and observations were made during February of 2020 and February of 2022. Specimens were collected, and flowers were fixed in FAA. Fresh and pickled flowers were dissected, observed and measured under a light microscope (GP-M101). Photographs were taken using a Nikon D7100 and a Sony A7M3 camera. We assessed the conservation status of the species by observing the population size and estimating the extent of occurrence (EOO) and the area of occupancy (AOO) and applying IUCN red list categories and criteria and guidelines (IUCN 2012, 2022). Line drawings were prepared manually with a pen and black ink. Line drawings and figures were edited, arranged, and merged using Adobe Photoshop CS2 ver. 9.0 and Adobe Illustrator. The distribution map was generated with ArcGis ver. 10.0.
Results

Taxonomy

Cinnamomum guizhouense C.Y.Deng, Zhi Yang & Y.Yang, sp. nov.

urn:lsid:ipni.org:names:77302159-1 Figs 1–2

Type. CHINA. Guizhou, Wangmo Co., Jiaona Tw., Babu Village, Liji Sect., 25°21'8"N, 106°17'44"E, elev. 1081 m, 20 Feb 2021, *C.Y. Deng & Q.M. Ban 2021001* (holotype: NF; isotypes: NF, NAS, XIN).

Diagnosis. *Cinnamomum guizhouense* is close to *C. foveolatum* (Merr.) H.W.Li et J.Li (Li et al. 2008: 170) in having leaves that lack domatia in the axils of the lateral leaf veins and in the long fruiting cupule, but differs from the latter by the longer leaves (12–21 cm vs. 9–15 cm in *C. foveolatum*), longer petioles 2–4 cm long (vs. 1–1.3 cm in *C. foveolatum*), longer tepals (3–4 mm long vs. 1.7–2 mm long in *C. foveolatum*), and shorter campanulate or cup-shaped cupules ca. 15 mm long (vs. cupules up to 20 mm long in *C. foveolatum*).

Description. Trees, evergreen, 11–13 m tall, D.B.H. ca. 36 cm (Fig. 1a); crown columnar to pyramid shaped, ca. 3 m in diam. Trunk straight; bark gray, longitudinally fissured. Twigs angular, glabrous, with multiple circular scale scars at base of twigs. Terminal buds prominent, to 2.5 cm long, 1.5 cm in diam. (Fig. 1b); bracts many (to 15), obovate to oblanceolate, apex obtuse, acute to cuspidate, abaxially pubescent, adaxially glabrous, margin ciliate. Leaves alternate; petioles glabrous, channeled abaxial, 2-4 cm long (Figs. 1c-e, 2a); blade coriaceous, elliptic to obovate-elliptic, 6-9×12-21 cm, base acute to cuneate, more or less decurrent, apex acuminate, pinnately veined, secondary veins 5-7 pairs, midrib and secondary veins immersed or slightly raised on adaxial surface, elevated on abaxial surface; adaxially green, abaxially glabrous and glaucous. Panicles terminal (Figs. 1c, 1f, 2a), 7-10 cm long, peduncles, pedicels and tepals pubescent, lateral flowers of ultimate cymes opposite, pedicels 4-6 mm long. Flowers bisexual, receptacle prominent, obconic, ca. 1 mm long, 1 mm in diam.; perianth in two whorls, tepals 6-8, subequal, oblongelliptic to linear, 3-4 mm long, 1 mm wide, both surfaces pubescent, margin ciliate (Figs. 1g, 1h); stamens in three whorls, 3 or 4 in each whorl, 1.5-2 mm long, filaments subequalling anthers, glabrous, each stamen of third whorl with two globose glands at base; anthers yellow, 4-locular, those of outer two whorls introrse, those of third whorl extrorse (Figs. 1i-1k, 2d-2e); staminodes of fourth whorl sagittate, filaments pubescent (Fig. 2f); pistil glabrous, ovary ovoid to ellipsoid, 1.2 mm long, ca. 0.8 mm in diam., style glabrous, ca. 1 mm long, stigma peltate when fresh, inconspicuous when dry (Figs. 1l, 2g). Infructescences 6–15 cm long. Young fruit together with cupules obovoid-ellipsoid,15-20 mm long, 13-17 mm in diam., 3/4 or more of fruit enclosed in cupule (Fig. 1m). Fruit black when mature, cupulate, cupules campanulate to cup-shaped, ca. 1.5 cm long, 1.5 cm in diam. (Fig. 1n, 2i); pedicels



Figure 1. Morphology of *Cinnamomum guizhouense* C.Y. Deng, Zhi Yang et Y. Yang, sp. nov. **a** trunk **b** bud **c** flower branch **d** leaf adaxial surface **e** leaf abaxial surface **f** inflorescence **g** trimerous flower **i** stamen of first whorl **j** stamen of second whorl **k** stamen of third whorl with two glands at base **l** pistil **m** a young fruit with pedicel and cupule enclosing inner fruit **n** mature infructescence with deep, cup-shaped cupule. Bars: 30 cm (**a**); 1 cm (**b**, **f–h**, **m**, **n**); 3 cm (**c-e**); 1 mm (**i–l**).

thickened, 4–6 mm in diam.; seeds ellipsoid to subglobose (Fig. 2J), ca. 1 cm long, 8 mm in diam., yellowish-brown, longitudinally ridged. Flowering February; fruiting September and October.

Etymology. The species is named after the province, Guizhou, where it occurs.

Distribution. *Cinnamomum guizhouense* is known only from Wangmo Xian, Guizhou Province, southwestern China (Fig. 3).

Ecology and habitat. The new species lives in bamboo (*Phyllostachys* sp.) colonies in acidic soil with mean annual temperature 13–15 °C, annual precipitation 1000–



Figure 2. Illustration of morphological characters of *Cinnamomum guizhouense* C.Y. Deng, Zhi Yang & Y. Yang, sp. nov. **A** leafy flowering branch with alternate, elliptic and obovate leaves, large terminal buds and inflorescences **B**, **C** variation in floral merosity **B** tetramerous flower **C** trimerous flower **D** stamen of first and second whorl **E** stamen of third whorl **F** staminode of fourth whorl **G** pistil **H** longitudinal section of young fruit with pedicel and cupule partially enclosing inner fruit **I** mature infructescence with peduncle and pedicel and deep cup-shaped cupule **J** subglobose seed.



Figure 3. Map showing distribution of *Cinnamomum guizhouense* C.Y. Deng, Zhi Yang et Y. Yang, sp. nov. (gray triangle).

1200 mm. It is heliophilous and lives on western slopes. The species lives near a village road with human disturbance, and the disturbance will not stop unless a new nature reserve is established to conserve the species. The species has an extremely small population, and only two individuals were found in the region. The living individuals occupy an area (EOO, \approx AOO) ca. 100 m².

Conservation. On four instances of field investigations in the area, we found only two mature plants living within ca. 100 m². We thus designate the species to be Critically Endangered (CR B1+2ab(iii); C1+2a(i); D) according to the IUCN red list categories and criteria (IUCN 2012, 2022), but we acknowledge that further assessments are necessary as new populations are found.

Vernacular name. The local people refer to *C. guizhouense* as Da Mu Jiang Zi (big *Litsea*), which is not in accordance with its formal taxonomic position. Here we name it Guizhou Cinnamon.

Additional specimens examined. CHINA. Guizhou, Wangmo Xian, Jiaona Tw., Babu Village, Liji Section, 25°21'8"N, 106°17'44"E, elev. 1081 m, 20 Feb 2021, *C.Y. Deng & Q.M. Ban 2021002* (NF, XIN), *2021003* (NF, XIN); 21 Oct 2020, *C.Y. Deng et al. 2020102111* (XIN); 20 Oct 2020, *C.Y. Deng & J.B. Xu 2020102802* (XIN); 10 Jun 2021, *C.Y. Deng & Q.M. Ban 2021061001 & 2021061002* (XIN).

Discussion

Recent phylogenetic studies have suggested that *Cinnamomum* comprises two groups that largely, but not strictly, correspond to two sections of the genus (Huang et al. 2016; Liu et al. 2021; Zeng et al. 2021). Huang et al. (2016) reported that *C. saxatile* H.W.Li (Li 1975: 44) and *C. longipetiolatum* H.W.Li (Li 1975: 47) and an unidentified species *C.* sp. C684 actually belong to sect. *Cinnamomum* and not to sect. *Camphora* as traditionally circumscribed. *Cinnamomum guizhouense* belongs to sect. *Camphora* according to our plastome phylogeny (unpubl. data). This finding was corroborated by the large perulate buds and pinnately veined, alternate leaves of *C. guizhouense*.

Cinnamomum guizhouense is characterized by the large perulate terminal buds, flowers with tepals twice as long as the stamens, and deep fruiting cupules. This unique combination of morphological characteristics distinguishes *C. guizhouense* from all other species of sect. *Camphora* (Li et al. 1982, 2008). We made a morphological comparison of *C. guizhouense* with other species of sect. *Camphora* in Guizhou (Table 1). *Cinnamomum guizhouense* is similar to *C. foveolatum* in the deep fruiting cupules, but differs from the latter in the longer leaves 12–21 cm (vs. leaves 9–15 cm long in *C. foveolatum*), oblong-elliptic to linear tepals 3–4 mm long (vs. ovate to broadly ovate tepals 1.7–2 mm long in *C. foveolatum*), longer stamens 1.5–2 mm long (vs. stamens 1.2–1.4 mm long in *C. foveolatum*) and shorter fruiting cupules ca. 15 mm (vs. fruiting cupules ca. 20 mm

Species	Leaf size (cm)	Lateral veins	Petiole length (cm)	Inflorescence pubescence	Tepal shape	Tepal length (mm)	Stamen length (mm)	Cupule length (mm)
C. bodinieri	8-17 × 3-10	4-6	2-3	glabrous	ovate	1.2	1 or a little longer	/
C. camphora	6-12 × 2.5-5.5	1-5(-7)	2-3	glabrous or gray- to yellow-brown puberulent	elliptic	2	2	5
C. foveolatum	9-15 × 3-5.5	6-8	1-1.3	sparsely villous	outer ones ovate, inner ones broadly ovate	outer ones ca. 2×1.1 , inner ones ca. 1.7×1.2	1.2-1.4	20
C. glanduliferum	6-15 × 4-6.5	4 or 5	1.5-3.5	glabrous	broadly ovate	2 × 1.7	1.4-1.6	10
C. guizhouense	12-21 × 6-9	5-7	2-4	pubescent	oblong-elliptic to linear	3-4	1.5-2	15
C. micranthum	7.5-10 × 4-6	4 or 5	2-3	subglabrous or slightly puberulent	narrowly ovate	1.3	1	9
C. migao	$4.5-16 \times 2.5-7$	4 or 5	1.3-3	pubescent	/	/	/	12
C. parthenoxylon	6-12 × 3-6	4 or 5	1.5-3	glabrous	narrowly elliptic	2 × 1.2	1.5-1.7	10 mm or less
C. rufotomentosum	15-16.5 × 4-5	4-6	2-2.9	reddish brown tomentose	/	/	/	/
C. saxatile	5-13 × 2-5	5-7	0.5-1.5	brownish puberulent	ovate	3	4-4.5	shallow

Table 1. Morphological comparison of species of Cinnamomum sect. Camphora from Guizhou, China.

*Morphological data was extracted from Flora of China (Li et al. 2008).

in C. foveolatum). Cinnamomum guizhouense resembles C. saxatile in the tepals 3-4 mm long (Li et al. 1982, 2008), but differs in having shorter stamens 1.5-2 mm (vs. tepals subequalling stamens, ca. 4 mm in C. saxatile). Cinnamomum saxatile was ascribed to sect. Camphora because of its alternate, pinnately veined leaves (Li et al. 1982, 2008), but has been demonstrated to belong to sect. Cinnamomum according to the leaf anatomy and phylogenetic evidence (Huang et al. 2016; Zeng et al. 2021). Cinnamomum guizhouense was close to C. camphora (L.) J.Presl (Presl 1825: 47) and C. bodinieri H.Lév. (Léveillé 1912: 369) in sect. Camphora in our plastome phylogeny (unpubl. data), but differed from C. camphora and C. bodinieri in the absence of domatia in the axils of the leaves, much longer tepals (3-4 mm vs. 1.5-2 mm in C. camphora and C. bodinieri), and the deep, cup-shaped fruiting cupules (vs. flat cupules in *C. camphora* and *C. bodinieri*). A key to these closely related species is provided. Moreover, we found that floral merosity of our new species is variable. Variation of floral merosity, including tetramerous flowers, has also been recorded in Beilschmiedia appendiculata (C.K.Allen) S.K.Lee & Y.T.Wei (Li et al. 1979: 65) and Syndiclis spp (Zeng et al. 2017, 2021), and also in Caryodaphnopsis sp. (pers. observ.). The variable merosity of flowers in the family may have been caused by change of selection pressure. Further studies are necessary to figure out what kind of selection pressure works on the change of floral merosity. Our finding not only increases species diversity of Cinnamomum in Guizhou and China but also expands our knowledge of the morphological diversity of *Cinnamomum*.

We conducted field investigations on *C. guizhouense* on four occasions and found only two individuals in the area, suggesting that the species has an extremely small population. In addition, the new species lives near a village with human disturbance, the living habitat of *C. guizhouense* has not been improved and deterioration continues. We thus suggest to plan an *ex situ* conservation strategy for the new species, collect seeds and plant the species in botanic gardens.

Key to similar species in the same region

1a	Tepals of flowers short, 1–2 mm long	2
1b	Tepals of flowers 3-4 mm long	4
2a	Fruiting cupule up to 20 mm long C. foveolatur	n
2b	Fruiting cupule ca. 5 mm long	3
3a	Leaves 8-17 cm long; tepals ovate, 1.2 mm long; stamens 1 mm long	
	C. bodinier	ri
3b	Leaves 6-12 cm long; tepals elliptic, 2 mm long; stamens 2 mm long	
		a
4a	Buds 2-5 mm long; domatia present in the axils of lateral leaf veins; panicle	es
	3-6 cm long; stamens 4-4.5 mm long; fruiting cupule shallow, 5-6.5 mm i	n
	diam <i>C. saxati</i> l	le
4b	Buds to 25 mm long; domatia absent in the axils of lateral leaf veins; panicle	es
	7-10 cm long; stamens 1.5-2 mm long; fruiting cupule deep to 15 mm i	n
	diam C. guizhouens	e

Acknowledgements

We thank to J.B. Jin for his kind help with the field collections, H. Peng, B. Liu, and F.N. Wei for their valuable suggestions, D.E. Boufford for his kind help with language, and E.J. de Lirio, L. Li, A. Ortiz and M.L. Broto for their constructive suggestions on revision of the manuscript. We are also grateful to Z.X. Gu for the line-drawing. This work was supported by the National Natural Science Foundation of China [31770211, 31470301, 31270238] to YY and the *Metasequoia* fund of the Nanjing Forestry University.

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RESEARCH ARTICLE



Chrysanthemum dabieshanense, a new name for Chrysanthemum vestitum var. latifolium (Asteraceae, Anthemideae)

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Academic editor: Alexander Sukhorukov | Received 14 January 2022 | Accepted 3 July 2022 | Published 21 July 2022

Citation: Fu Z, Liu X, Zhen A, Zhu X, Konowalik K, Ma Y, Li P (2022) *Chrysanthemum dabieshanense*, a new name for *Chrysanthemum vestitum* var. *latifolium* (Asteraceae, Anthemideae). PhytoKeys 202: 45–52. https://doi.org/10.3897/phytokeys.202.80554

Abstract

Recent phylogenetic analyses have revealed that *Chrysanthemum vestitum* var. *latifolium* and *C. vestitum* var. *vestitum* were placed in different clades based on their chloroplast genomes and nuclear LFAFY gene sequences. Accordingly, based on previous morphological analysis, molecular phylogenetic results, field-work, and herbarium studies, *Chrysanthemum vestitum* var. *latifolium* should be raised to the species level. Considering the condition of the material found and Articles 6.9, 6.11, 41.2, 58.1 of the International Code of Nomenclature for Algae, Fungi, and Plants (*Shenzhen Code*) that is currently in force, *Chrysanthemum vestitum* var. *latifolium* J.Zhou & Y.P.Ma, **nom. nov.** is proposed as the new name for *Chrysanthemum vestitum* var. *latifolium* J.Zhou & Jun Y.Chen. The detailed emended description, distribution map, insights into its habitat, and an updated comparative morphological study are presented in this study.

Keywords

Asteraceae, China, Chrysanthemum endemism, taxonomy

Introduction

Chrysanthemum L. is a genus of the tribe Anthemideae that contains approximately 40 species. This genus is mainly distributed in temperate Asia (Oberprieler et al. 2007), with approximately 23 species in China (Shih et al. 2011; Meng et al. 2020). The genus is characterized by subshrubs or perennial herbs with pinnately or palmately divided alternate leaves, female ray florets, white or red apical appendages of anthers, and faintly 5–8-ribbed achenes (Shih et al. 2011). Furthermore, recent molecular phylogenetic studies have demonstrated that Chinese *Chrysanthemum* should be divided into two groups: the *Chrysanthemum zawadskii* group, which is distributed in northern China and has erect stems and large capitula with white or purple ray florets, and the *Chrysanthemum indicum* group, which is distributed from north to south China and has creeping stems and capitula with yellow or white ray florets (Liu et al. 2012; Li et al. 2014; Ma et al. 2020).

According to the phylogenetic study of chloroplast genomes and the nuclear *LFAFY* gene by Ma et al. (2020), *Chrysanthemum vestitum* var. *vestitum* from the Funiu Mountain in Henan Province and *C. vestitum* var. *latifolium* from the Tianzhu Mountain in Anhui Province represent two distinct clades. Morphologically, *C. vestitum* var. *latifolium* is not similar to other species of Clade I (Shih et al. 2011). Accordingly, based on the morphological and molecular results, we propose that the variety *Chrysanthemum vestitum* var. *latifolium* should be raised to the species level.

This evidence of phylogenetic results seems to be sufficient for a new taxonomic decision. This study aimed to describe one of the species of *Chrysanthemum* and investigate its phylogenetic affinities based on molecular and morphological data. Combined with previous morphological and field studies, we also provide a distribution map and information on the taxonomy of *Chrysanthemum dabieshanense*.

Materials and methods

We employed standard techniques for morphological studies of herbarium specimens and digital images of the most closely related species from the herbaria CSH, HIB, K, KUN, PE, WUK; acronyms follow Thiers (2022), including the holotype specimens of *Chrysanthemum vestitum* (Hemsl.) Stapf (Fig. 1A) (K, images seen). Dr Z.X. Fu visited the PE herbarium (Institute of Botany, Chinese Academy of Sciences) in June 2021 and compared and checked the holotype specimen of *Chrysanthemum vestitum* (Hemsl.) Stapf. var. *latifolium* J.Zhou et J.Y.Chen (East China Station Inst. Bot. 6935, Fig. 1B, PE). We also verified that morphological characteristics of voucher specimen MYP-20160826 (Fig 2, Ma et al. 2020, photo from Y.P. Ma) are identical to those of the type specimen of *C. vestitum* var. *latifolium*.

The morphological characteristics of *C. vestitum* var. *latifolium* and its related species were examined for comparative research based on measurements of herbarium



Figure 1. The images of the holotype of *Chrysanthemum vestitum* and *Chrysanthemum vestitum* (Hemsl.) Stapf. var. *latifolium* **A** the lectotype of *Chrysanthemum vestitum* (Hemsl.) Stapf. Image courtesy of the Royal Botanic Gardens, Kew (K). (Type: CHINA. Hubei: Yichang city, "Ichang and immediate neighborhood", Sep 1886, *A. Henry 1115* lectotype, K000891712) **B** the holotype of *Chrysanthemum vestitum* (Hemsl.) Stapf. var. *latifolium* J.Zhou et J.Y.Chen. Image courtesy of the Herbarium PE, (Type: CHINA, Anhui Province: Yuexi County, Baojia River, alt. 1500 m, 24 Sep 1953, *East China Station Inst. Bot. 6935* holotype, PE 00544099!).

specimens (Table 1), supplemented by photos of mature living plants collected from the field (photos from A.G. Zhen and X.X. Zhu). The localities were sorted according to county-level administrative divisions of the People's Republic of China.

Results and discussion

Zhou and Chen (2010) reported a new variety: *Chrysanthemum vestitum* (Hemsl.) Stapf. var. *latifolium* J.Zhou et J.Y.Chen from China (Fig. 1B). In their study, the holotype specimen of *Chrysanthemum vestitum* var. *latifolium* was collected from the Tianzhu Mountain (Anhui Province, Fig. 1B). The variety *Chrysanthemum vestitum* var. *latifolium* is mainly distributed on the western slopes of the Dabie Mountains, throughout the Anhui and Hubei provinces (Qi et al. 2021). It has long been treated as a variety of *Chrysanthemum vestitum* (Fig. 1A). Based on a recent study by Meng et al. (2020), principal component analysis of leaf length (L), leaf width (W), petiole length (P), and relative petiole length (B = P/L) between *C. vestitum* and *C. vestitum*



Figure 2. A plant of *Chrysanthemum vestitum* (Hemsl.) Stapf var. *latifolium* collected at Tianzhu Mountain, Dabieshan mountains (The voucher no. MYP-20160826, WUK, Ma et al. 2020) **A** plant growing in natural habitat **B** the adaxial side of leaf **C** the abaxial side of leaf. Scale bar: 2 cm (**B**, **C**). Photographed by Yue-ping Ma.

var. *latifolium* was conducted, and the two varieties of *C. vestitum* differed slightly. The difference between the new variety and the original species is that the new variety is less branched and has orbicular and ovoid leaves that are 4–7 cm long and 3–5 cm wide, and the diameter of its capitula is larger, reaching 4.5–5.0 cm (Table 1). The morphology of *C. vestitum* var. *latifolium* is distinct from other species in the same clade in terms of the leaf shape and length of capitula (Shih et al. 2011; Ma et al. 2020) (Table 1).

Based on a phylogenetic study of whole chloroplast genomes (Ma et al. 2020), two distinct clades were recognized in the genus *Chrysanthemum*. Clade I comprised *C. chanetii*, *C. indicum*, *C. lavandulifolium*, *C. nankingense*, *C. zawadskii*, *C. dichrum*, *C. mongolicum*, *C. oreastrum*, *C. glabriusculum*, *C. boreale*, and *C. vestitum* var. *latifolium* from Tianzhu Mountain in the Dabieshan Mountain area (the *Chrysanthemum zawadskii* group). Clade II consisted of *C. rhombifolium*, *C. indicum* var. *aromaticum*, *C. potentilloides*, *C. hypargyrum*, *C. argyrophyllum*, and *C. vestitum* var. *vestitum* (Fig. 3 A, C) (the *Chrysanthemum indicum* group). Based on the nuclear *LFAFY* gene, *Chrysanthemum vestitum* var. *latifolium* and *C. vestitum* var. *vestitum* were treated as two distinct species in different clades (Ma et al. 2020). Accordingly, based on the morphology and molecular results, we propose that the variety *Chrysanthemum vestitum* var. *latifolium* should be raised to the species level.

	C.dabieshanense	C. vestitum var.	C. mongolicum	C. indicum	C. zawadskii	C.lavandulifolium
		vestitum	(Clade I)	(Clade I)	(Clade I)	(Clade I)
Leaf	orbicular or	ovate, broadly	broadly ovate or	ovate, long	ovate, broadly ovate,	ovate, broadly
blades	ovate-orbicular,	ovate, oblong,	elliptic 1–2 cm	ovate, or elliptic-	1.4-4 ×1-3.5 cm,	ovate, elliptic-ovate,
	4–7 × 3–5 cm,	3.5–7 cm × 2–4	× 1.5–1.8 cm,	ovate,3–7	bipinnatisect	narrowly elliptic,
	obtusely 2- or	cm, margin	bipinnatisect	cm × 2–4m,		2–7 × 1.5–4.5 cm,
	3-lobed	repand-dentate		bipinnatisect		bipinnatisect
Phyllaries	4 rows	4 rows	5 rows	5 rows	4 rows	5 rows
Capitula	4.5–5 cm in dia.	2–3 cm in diam.	3–4.5 cm in diam.	2.5–4 cm in diam.	1.5–4.5 cm in diam.	1–1.5 cm in diam.

Table 1. Comparative measurements in *Chrysanthemum dabieshanense* (= *C. vestitum* var. *latifolium*) and its related species (based on Shih et al. 2011 and additional specimens at the herbaria visited).

Taxonomic treatment

Chrysanthemum dabieshanense Z.X.Fu, A.G.Zhen, & Y.P.Ma, nom. nov. urn:lsid:ipni.org:names:77302160-1

≡ Chrysanthemum vestitum var. latifolium J.Zhou & J.Y.Chen, Bull. Bot. Res. Harbin. 30: 649. 2010.

Note. According to International Code of Nomenclature for algae, fungi, and plants (ICN) Articles 6.9, 6.11, 41.2, and 58.1 (Turland et al. 2018), *Chrysanthemum dabieshanense* Z.X.Fu, A.G.Zhen, & Y.P.Ma, nom. nov. is proposed here as an explicit substitute for the legitimate name *Chrysanthemum vestitum* var. *latifolium*, because the epithet *latifolium* cannot be used for the present combination because of the existence of the name *Chrysanthemum latifolium* (DC.) Baksay, Ann. Hist. Nat. Mus. Natl. Hung. 8: 161, 1957 (online resource from https://www.tropicos.org/name/50268974). The specific epithet "*dabieshanense*" refers to the name of the Dabieshan (= Ta-pieh) mountain area, located at the border of the Anhui, Hubei, and Henan Provinces, where the species occurs. *Chrysanthemum dabieshanense* is endemic and restricted to the Dabieshan Mountain area (Hubei and Anhui provinces). Therefore, we accept *Chrysanthemum dabieshanense* as a replacement name for *Chrysanthemum var. latifolium*. A taxonomic treatment is presented.

Type. CHINA. Anhui Prov. Yuexi County, Baojia River, shady slope at the top of the hill, alt. 1500 m, 24 Sep 1953, East China Station Inst. Bot. 6935 (holotype, PE 00544099!, isotype NAS 00486826 photo seen) (Fig. 1B)

Description. Perennial rhizomatous herbs, 60-100 cm tall. Stems sprawling, not much branched. Lower stem leaves withered at anthesis. Middle stem leaf blades orbicular or ovate-orbicular, 4-7 cm \times 3-5 cm, grayish-green adaxially, grayish-white abaxially, margin above middle obtusely repand-dentate, distal stem leaves sessile or subsessile, capitula 3-10, 4.5-5 cm in diameter. Involucres cup-shaped; phyllaries in 4 rows, abaxially densely pubescent, scarious margin brown, outer phyllaries triangular or triangular-ovate, 3.5-4.5 mm, middle phyllaries lanceolate-ovate, ca. 6.5 mm, inner phyllaries obovate or oblanceolate-elliptic, 6-7 mm long. Ray floret lamina white, 1.2-2 cm long. Achenes ca. 1.5 mm long (Fig. 2, Fig. 3 B, D).



Figure 3. The images of *Chrysanthemum vestitum* and *Chrysanthemum dabieshanense* **A**, **B** plants growing in natural habitat **C**, **D** adaxial side of leaf (**A**, **C** *Chrysanthemum vestitum*, voucher *Z.X. Fu 610*, PE, Lushi county, Henan province, China, Photographs by Zhixi Fu). (**B**, **D** *Chrysanthemum dabieshanense*, voucher *X.X.Zhu 089* CSH, Yingshan county, Hubei province, China. Photographs by Xinxin Zhu).



Figure 4. Distribution map of *Chrysanthemum dabieshanense* (black circles) in Anhui and Hubei provinces, China, based on the voucher specimen information.

Specimens examined. CHINA – Anhui Prov. Jinzhai County, [without exact locality], *M.B. Deng & H.T. Wei 81350, 81196* (NAS); ibidem, *B. Chen CB07550* (CSH), Qianshan City, *S. J. Yang et al. 7193* (NAS), Y.P. Ma *MYP-20160826* (WUK); Hubei Prov. Yingshan County, Wujiashan Forest Farm, *X.X. Zhu 089* (KUN, CSH); Luotian County, Tiantangzai, *A.G. Zhen DBSYS708* (HIB); *X.X. Zhu 211858* (KUN).

Distribution and habitat. Endemic to the Dabieshan mountain area (Anhui and Hubei Provinces, China, Fig. 4). It grows on shaded slopes, hills, and streamsides, at alt. 800–1600 m.

Phenology. Flowering and fruiting are observed in October. **Chinese name.** Da-Bie-Shan-Ju (大别山菊).

Acknowledgements

The authors thank curators and relevant staff of the CSH, HIB, K, KUN, PE, WUK herbaria who granted access to their collections and images. We also thank Dr. Caifei Zhang (Wuhan Botanical Garden, the Chinese Academy of Sciences), Dr. Guojin Zhang (Pennsylvania State University), Dr. Shuai Liao (East China Normal University) and Dr. Peiliang Liu (Northwest University), Associate Prof. Longfei Fu (Guangxi Institute of Botany, Guangxi Zhuang Autonomous Region and Chinese Academy of Sciences) for their critical comments and great help, Mr. Xingyong Cui (Beijing Forestry University) for drawing distribution map. We also thank the anonymous reviewers and editor for constructive criticism of the original manuscript. This study was financially supported by the National Natural Science & Technology Fundamental Resources Investigation Program of China (No. 2019FY101809, 2021XJKK0702) and the Foundation of Sustainable Development Research Center of Resources and Environment of Western Sichuan, Sichuan Normal University (No. 2020CXZYHJZX03).

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SHORT COMMUNICATION



Nomenclatural notes of Sabina convallium var. microsperma (Cupressaceae)

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Academic editor: Dennis Stevenson | Received 7 June 2022 | Accepted 9 July 2022 | Published 21 July 2022

Citation: Yang Y, Rushforth K (2022) Nomenclatural notes of *Sabina convallium* var. *microsperma* (Cupressaceae). PhytoKeys 202: 53–58. https://doi.org/10.3897/phytokeys.202.87464

Abstract

The name Sabina convallium var. microsperma W.C.Cheng & W.T.Wang was not validly published when it was first described in 1975, but was validated in 1978 at the same time as the specific combination Sabina convallium (Rehder & E.H.Wilson) W.C.Cheng & W.T.Wang was validly published in Flora Reipublicae Popularis Sinicae. Under Art. 41.6 of the Shenzhen Code, other names based on Sabina convallium var. microsperma were valid, including Sabina microsperma (W.C.Cheng & L.K.Fu) W.C.Cheng & L.K.Fu, Juniperus convallium var. microsperma (W.C.Cheng & L.K.Fu) Silba, Juniperus microsperma (W.C.Cheng & L.K.Fu) R.P.Adams, despite the reference of the basionym being erroneously cited when these authors made the new combinations.

Keywords

Conifer, Cupressacae, nomenclature, Sabina convallium var. microsperma

Introduction

When working on an updated catalogue of gymnosperms, we noticed that the smallseeded juniper has nomenclatural problems. The small-seeded juniper was treated either as a species, e.g., *Juniperus microsperma* (W.C.Cheng & L.K.Fu) R.P.Adams (Adams 2008, 2014; Shang et al. 2015), *Sabina microsperma* (W.C.Cheng & L.K.Fu) W.C.Cheng & L.K.Fu (Fu 1983, in Fl. Xizang. 1: 390), or a variety, e.g., *Sabina convallium* var. *microsperma* W.C.Cheng & L.K.Fu (Cheng et al. 1975; Wang et al. 1978), *Juniperus convallium* var. *microsperma* (W.C.Cheng & L.K.Fu) Silba (Silba 1984; Fu et al. 1999; Farjon 2010). However, it remained ambiguous whether these scientific names used in previous taxonomic works were validly published.

Sabina convallium var. microsperma W.C.Cheng & L.K.Fu was first recognized and described in Cheng et al. (1975, Acta Phytotax. Sin. 13: 86), but was not validly published in that work under Art. 35.1 of the Shenzhen Code (Turland et al. 2018), because the specific name Sabina convallium (Rehder & E.H.Wilson) W.C.Cheng & W.T.Wang was not validly published at that time. W.C.Cheng & W.T.Wang made the new combination Sabina convallium (Rehder & E.H.Wilson) W.C.Cheng & W.T.Wang (Cheng 1961, in Trees of China, 1: 257), but they did not validly publish the combination under Art. 41.5 because this combination was made after Jan. 1st of 1953 and the authors cited only the basionym but without the reference citation. W.C.Cheng & W.T.Wang unintentionally but validly published the specific combination in Flora Reipublicae Popularis Sinicae (Wang et al. 1978, 7: 372) where they correctly cited the basionym and its reference. In the same work, the varietal name Sabina convallium var. microsperma W.C.Cheng & L.K.Fu was validated by citing the reference of the protologue (Wang et al. 1978, 7: 373).

There are a few later names based on the invalid name Sabina convallium var. microsperma W.C.Cheng & L.K.Fu (Cheng et al. 1975). In 1983, W.C.Cheng & L.K.Fu intended to make a new combination Sabina microsperma (W.C.Cheng & L.K.Fu) W.C.Cheng & L.K.Fu (Fu 1983, Fl. Xizang. 1: 390), but they cited the invalid name Sabina convallium var. microsperma W.C.Cheng & L.K.Fu as the basionym and its publication in 1975. Silba (1984) made a new combination Juniperus convallium var. microsperma (W.C.Cheng & L.K.Fu) Silba based on the invalid name Sabina convallium var. microsperma W.C.Cheng & L.K.Fu (Cheng et al. 1975); Adams (2000) treated it as a species in Juniperus making the combination Juniperus microsperma (W.C.Cheng & L.K.Fu) R.P.Adams based on the same invalid basionym. Under Art. 41.6, all these combinations are valid though the reference of the basionym should be corrected.

Adams (2008, 2014) divided *Juniperus* into three sections, viz. sect. *Caryocedrus* Endl., sect. *Juniperus*, and sect. *Sabina* (Mill.) Spach, and indicated that the three sections can be distinguished using morphological characters, e.g. leaves decurrent or not (decurrent in sect. *Sabina* vs. jointed in sect. *Caryocedrus* and *Juniperus*), leaf shape (acicular in sect. *Caryocedrus* and *Juniperus* vs. scale-like in sect. *Sabina*), seed cones size

(8–25 mm in sect. *Caryocedrus* vs. 6–18 mm in sect. *Juniperus* and *Sabina*), seeds fusion (fused in sect. *Caryocedrus* vs. free in sect. *Juniperus* and *Sabina*). Mao et al. (2010) suggested that all of the three sections are monophyletic. Yang et al. (2022) treated *Sabina* as a separate genus from *Juniperus* considering phylogeny, morphology, and utilization purposes. Based on the phylogeny of nuclear markers, Shang et al. (2015) suggested that *Juniperus microsperma* is not closely related to *J. convallium*, but sister to a small clade including *J. semiglobosa* and *J. sabina*. Therefore, we treated the generic name *Sabina* and the specific name *Sabina microsperma* as accepted.

Nomenclature

Sabina convallium (Rehder & E.H.Wilson) W.C.Cheng & W.T.Wang in W.C.Cheng & L.K.Fu, Fl. Reipubl. Popularis Sin. 7: 372 (1978).

Juniperus convallium Rehder & E.H.Wilson in Pl. Wilson. (Sargent) 2(1): 62 (1914); *Sabina convallium* (Rehder & E.H.Wilson) W.C.Cheng & W.T.Wang in W.C.Cheng, Trees of China, 1: 257 (1961) et in W.C.Cheng et al., Acta Phytotax. Sin. 13(4): 76 (1975), nom. inval.

Type. CHINA (中国). Sichuan (四川), arid places, alt. 2500 m, Aug. 1904, Vietch Exped. 3010 (holotype: A00056809, Fig. 1; isotypes: BM000959921, K001090508, K001090509, K000089628, P00748989, S-C-6511, SYS00001562).

Note. Rehder and Wilson (1914) cited one single collection (Veitch Exped. 3010) in the protologue which should be considered as the type specimen. Adams (2008, 2014) and Farjon (2010) indicated that the specimen in A is the holotype and the isotypes are in BM and K. We found five additional isotypes in international herbaria.

Sabina microsperma (W.C.Cheng & L.K.Fu) W.C.Cheng & L.K.Fu in Fl. Xizang. 1: 390 (1983).

 Sabina convallium var. microsperma W.C.Cheng & L.K.Fu in W.C.Cheng et al., Acta Phytotax. Sin. 13(4): 86 (1975), nom. inval.; Sabina convallium var. microsperma W.C.Cheng & L.K.Fu in W.C.Cheng & L.K.Fu, Fl. Reipubl. Popularis Sin. 7: 373 (1978); Juniperus convallium var. microsperma (W.C.Cheng & L.K.Fu) Silba in Phytologia Mem. 7: 33 (1984); Juniperus microsperma (W.C.Cheng & L.K.Fu) R.P.Adams in Biochem. Syst. Ecol. 28(6): 540 (2000).

Type. CHINA (中国). Xizang (西藏), Qamdu (昌都), Sumzom (松宗), 26 Oct. 1961, Forestry Exped. (森林调查队) 10019 (holotype: PE00002535, Fig. 2).



Figure 1. Holotype of Juniperus convallium Rehder & E.H.Wilson: Vietch Exped. 3010 (A00056809).



Figure 2. Holotype of *Sabina convallium* var. *microsperma* W.C.Cheng & L.K.Fu: Forestry Exped. 10019 (PE00002535).

Acknowledgements

This work was supported by the National Natural Science Foundation of China (31970205) and the Metasequoia funding of the Nanjing Forestry University.

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RESEARCH ARTICLE



A new classification of C4-Atriplex species in Russia, with the first alien record of Atriplex flabellum (Chenopodiaceae, Amaranthaceae) from North Siberia

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Academic editor: Stephen Boatwright | Received 2 June 2022 | Accepted 15 July 2022 | Published 22 July 2022

Citation: Sukhorukov AP, Kushunina M, Sennikov AN (2022) A new classification of C4-Atriplex species in Russia, with the first alien record of Atriplex flabellum (Chenopodiaceae, Amaranthaceae) from North Siberia. PhytoKeys 202: 59–72. https://doi.org/10.3897/phytokeys.202.87306

Abstract

For a long time, the systematics of Atriplex was based solely on morphological characters and leaf anatomy. The latest worldwide phylogenetic study of Atriplex significantly improved our knowledge about the relationships within the genus, but a new classification has not been put forward thus far. Here we reevaluate the taxonomy of C₄-species of Atriplex that are native to Russia. Seven species are classified into two sections, A. sect. Obione (incl. A. sect. Sclerocalymma, syn. nov.) (A. altaica, A. centralasiatica, A. rosea, A. sibirica, and A. sphaeromorpha), and A. sect. Obionopsis (incl. A. sect. Psammophila, syn. nov.) (A. fominii and A. tatarica). Although the majority of Eurasian C4-species have similar morphology, leafy inflorescence is a typical character for A. sect. Obione. The members of A. sect. Obionopsis are characterised mostly by aphyllous inflorescences, but some species (A. laciniata, A. pratovii, and A. tornabenei) have leafy inflorescences. Geographically, almost all members of A. sect. Obione are confined to Central Asia, although A. rosea is a typical Mediterranean element and A. argentea occurs in North America. The representatives of A. sect. Obionopsis are distributed mostly in the Mediterranean and the Irano-Turanian floristic region. The alien status of A. rosea, A. sibirica and A. tatarica is discussed. Atriplex flabellum, a desert species from the Irano-Turanian region, is reported for the first time from Russia (Yamalo-Nenets Autonomous District, North Siberia) as a casual alien. This species occupies a phylogenetic position distant from both aforementioned sections. An identification key to all C4-species of the genus growing in Russia is given, and a sectional checklist with updated nomenclature and revised synonymy is provided.

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Keywords

Alien species, Atriplex flabellum, distribution, Russia, systematics, taxonomy

Introduction

Atriplex L. is the largest genus in the subfamily Chenopodioideae (Amaranthaceae *sensu* APG IV 2016), after *Chenopodium* L. s.l. has been disassembled into several genera of different taxonomic placement within the subfamily (Fuentes-Bazan et al. 2012). It encompasses ca. 260 species distributed worldwide (Žerdoner Čalasan et al. 2022). In Eurasia, many species of *Atriplex* are found in deserts, especially in the Irano-Turanian floristic region, and it was suggested that the genus originated in continental Asia (Žerdoner Čalasan et al. 2022).

The classification system of *Atriplex* had been at first based on morphological characters (e.g., Aellen 1939; Wilson 1984); additionally, leaf anatomy was used as an important character for the delimitation of *Atriplex* species. The genus was divided into two physiological groups: with non-Kranz (C_3) and Kranz (C_4) anatomy (Moser 1934; Carolin et al. 1975; Welsh 2001; Sukhorukov 2006). In the latest treatment for Russia and adjacent countries (Sukhorukov 2006), *Atriplex* was divided into two subgenera based on the fusion of the perianth segments (valves) in the female flowers: *A.* subgen. *Atriplex* with marginally connate valves and *A.* subgen. *Pterotheca* (Aellen) Sukhor. with ventrally fused valves. The valves imitate bracteoles and pairs of them form bractlike covers enclosing each female flower. The type subgenus comprised several sections, characterised by the degree of valve fusion and their sclerification, leaf anatomy, the type of diurnal leaf movements, as well as their fruit and seed characters.

Molecular phylogenetic studies (Kadereit et al. 2010; Žerdoner Čalasan et al. 2022) confirmed a close relationship of many Eurasian C_3 -species, especially those of *A.* sect. *Atriplex* and *A.* sect. *Teutliopsis* Dumort. emend. Sukhor. (excl. *A. oblongifolia* Waldst. & Kit.), as well as a distant position of *A. cana* C.A.Mey. from other members proposed by Sukhorukov (2006). All C_3 -species of the genus comprise a monophyletic clade (Kadereit et al. 2010; Žerdoner Čalasan et al. 2022) with ca. 180 members distributed in the arid and mountainous regions around the world (Sage 2016).

In Eurasia, the majority of C₄-species were traditionally united into *A.* sect. *Sclerocalymma* (Asch.) Asch. & Graebn. and *A.* sect. *Obione* (Gaertn.) Reichenb., differing mainly by the degree of valve fusion (Iljin 1936; Aellen 1939; Medvedeva 1996; Sukhorukov 2006). *Atriplex* sect. *Sclerocalymma* included annual species with the valves fused to (nearly) half of their length (*A. altaica* Sukhor., *A. fominii* Iljin, *A. kalafganica* Podlech, *A. laciniata* L., *A. megalotheca* Popov, *A. olivieri* Moq., *A. pallida* (Moq.) Sukhor. [= *A. schugnanica* Iljin], *A. pamirica* Iljin, *A. paradoxa* Nikitina, *A. pratovii* Sukhor., *A. pungens* Trautv., *A. recurva* D'Urv., *A. rosea* L., *A. sphaeromorpha* Iljin, *A. tatarica* L., *A. tianschanica* U.P.Pratov, and *A. tornabenei* Tineo). *Atriplex* sect. *Obione* comprised *A. belangeri* (Moq.) Boiss., *A. centralasiatica* Iljin and *A. sibirica* L. (Sukhorukov 2006, 2014).

Nearly all of the aforementioned species (except *A. belangeri* and *A. tianschanica*) were included in the latest molecular phylogenetic study of the genus, and they fell into two phylogenetic lineages with different positions on the tree within the large C_4 -group (Žerdoner Čalasan et al. 2022). The previous morphology-based classification (Sukhoru-kov 2006, 2014) only partly agrees with the phylogenetic relationships. Thus, the systematics of *Atriplex* needs to be revised, with the re-evaluation of its section-level taxonomy.

The present article is dedicated to a new sectional subdivision of the C_4 -species of *Atriplex* growing in Russia as the first step towards a new taxonomic classification of *Atriplex* worldwide. It summarises the distributional data for all its members including new, unexpected alien occurrences, with further notes on geographical patterns revealed in the new classification.

Materials and methods

Our new classification of C_4 -Atriplex taxa occurring in Russia is based on the most recent phylogenetic study (Žerdoner Čalasan et al. 2022) and follows the principle of strict monophyly.

Historical taxonomic literature was examined for infrageneric classifications in *Atriplex*. A section-level taxonomic and nomenclatural checklist was compiled in order to evaluate the infrageneric names used to classify the species under study. Taxonomic literature was screened for protologues, which were evaluated according to the current rules of botanical nomenclature (Turland et al. 2018).

We used the distribution data for each species given by Hedge (1997) and Sukhorukov (2006, 2014), which were complemented by our recent field and herbarium studies. Herbarium collections from LE, LECB, MHA, MW, MSK, MSKU, MWG, NS and NSK were critically revised for taxonomic identifications and screened for new records.

Distribution maps were prepared using SimpleMappr online tool (http://www. simplemappr.net) based on the literature data and the examined specimens. The results were generalised and schematically presented over the basemap of first-level administrative subdivisions of Russia. Distribution areas were evaluated for their native core and secondary dispersal based on herbarium specimens and our personal observations in the field, thus separating the territories where the species occur in their natural habitats from those where the species are confined exclusively to ruderal or other manmade habitats.

Results and discussion

Taxonomy of the native species

The C_4 -species of *Atriplex* native to Russia are here classified into two sections, *A*. sect. *Obione* (Gaertn.) Reichenb. and *A*. sect. *Obionopsis* (Lange) Dumort., according to their phylogenetic position (Žerdoner Čalasan et al. 2022). The latter sectional

name had been forgotten for a long time but is resurrected here as the earliest name applicable to the group that includes its type species *A. laciniata* and related taxa. In the checklist, previously overlooked protologues are cited for accepted names together with second references (other than protologues) that indicate the works previously considered as places of valid publication.

Atriplex sect. Obione (Gaertn.) Reichenb., Uebers. Gew.-Reich.: 164 (1828); C.A.Mey. in Ledeb. et al., Fl. Altaic. 4: 315 (1833).

- \equiv Obione Gaertn., De Fruct. 2: 198 (1791).
- ≡ Obione sect. Atriplicina Moq., Chenop. Monogr. Enum.: 70 (1840), nom. inval. (Art. 22.2).
- ≡ Atriplex subgen. Obione (Gaertn.) Hook.f., Student Fl. Brit. Isl.: 320 (1870); Volkens in Engler & Harms, Nat. Pflanzenfam. 3: 66 (1893).
- ≡ Atriplex sect. Atriplicina Volkens in Engler & Harms, Nat. Pflanzenfam. 3: 66 (1893), nom. illeg. (Art. 52.1).
- ≡ Obione sect. Protobione Aellen, Verh. Naturf. Ges. Basel 49: 133 (1938), nom. inval. (Art. 22.2). Type species: Obione muricata Gaertn. (≡ Atriplex sibirica L.).
- = Atriplex [unranked] Sclerocalymma Asch., Fl. Prov. Brandenburg 1(2): 578 (1864), syn. nov.
- ≡ Atriplex sect. Sclerocalymma (Asch.) Asch. & Graebn., Syn. Mitteleur. Fl. 5(1): 139 (1919).
- ≡ Atriplex sect. Roseae Aellen, Bot. Jahrb. Syst. 70(1): 39 (1939), "Rosea", nom. illeg. (Art. 52.1). Type species: Atriplex rosea L.
- = Atriplex [unranked] Argenteae Standl. in Britton, N. Amer. Fl. 21: 46 (1916), syn. nov.
- *≡ Atriplex* subsect. *Argenteae* (Standl.) S.L.Welsh, Rhodora 102: 420 (2001). Type species (Art. 10.8): *Atriplex argentea* Nutt.

Description. Annuals; inflorescences leafy; glomerules loosely arranged.

Native distribution and species. Members of the section occur in steppes, semideserts and mountains of Central Asia (e.g. *A. altaica, A. centralasiatica, A. pamirica, A. sibirica*), in the Aralo-Caspian floristic region (*A. sphaeromorpha*), in the Mediterranean (*A. rosea*), and in North America (*A. argentea* Nutt.). Five species are native to Russia (*A. altaica, A. centralasiatica, A. sibirica, A. sphaeromorpha*, and *A. rosea*). The Central Asian species (*A. altaica, A. centralasiatica, A. sibirica*) are mostly confined to mountain steppes and screes in South Siberia, but *A. centralasiatica* and *A. sibirica* can be found also in saline and ruderal habitats. *Atriplex rosea* and *A. sphaeromorpha* are typical lowland species with similar morphology but different distribution patterns. The first species, with predominantly Mediterranean distribution, was considered native in the southern part of Eastern Europe (Medvedeva 1996), whereas we treat it as native only in Krasnodarsky Kray, where it occurs near the shore of the Black Sea and in ruderal places further inland (Sukhorukov 2006; Zernov 2006). *Atriplex sphaeromorpha* is mainly distributed in steppes and semi-deserts of Kazakhstan, with very scattered records in Orenburg and Saratov Oblast, as well as in the North Caucasus (Sukhorukov 1999, 2006). In these regions, *A. sphaeromorpha* could potentially require conservation action according to the IUCN guidelines (IUCN 2022) because of a high level of anthropogenic disturbance to Eurasian grasslands. The native and alien ranges of all Russian species of *A.* sect. *Obione* are displayed in Fig. 1A–E.

Taxonomic notes. The synonymisation of *Atriplex* sect. *Obione* with *A*. sect. *Sclerocalymma* and *A*. subsect. *Argenteae* is undertaken here for the first time. *Atriplex powellii* S.Watson, previously considered as a close relative of *A. argentea* (Standley 1916; Welsh 2001), occupies a distant phylogenetic position (Žerdoner Čalasan et al. 2022).

Nomenclatural notes. The name *A.* sect. *Obione* has usually been credited to Meyer (1833), who accepted this subdivision in 'Flora Altaica'. However, the first author who segregated this section within *Atriplex* was Reichenbach (1828). He accepted the name and provided an indirect reference to the basionym as "Obione. G." The



Figure I. Schematic distribution areas of C_4 -species of *Atriplex* native to Russia **A***A*. *altaica* **B***A*. *centralasiatica* **C***A*. *rosea* **D***A*. *sibirica* **E***A*. *sphaeromorpha* **F***A*. *tatarica*. Green – native distribution range, yellow – alien distribution not confirmed after 1930s, orange – alien distribution confirmed after 1930s.

infrageneric taxa accepted by Reichenbach (1828) were explicitly ranked as sections, as evidenced by a footnote on page 184 in this work. Similarly, Hooker (1870) was the first to accept *A*. subgen. *Obione*, which was explicitly ranked by him. On the contrary, Ascherson (1864) developed complex infrageneric systems that included at least three ranks, with names at all of these ranks, and made no note of their ranking; such classifications are to be treated as unranked (Art. 37.3).

Atriplex sect. Obionopsis (Lange) Dumort., Bull. Soc. Bot. Fr. 20: xiii (1873).

- *Atriplex* [unranked] *Obionopsis* Lange, Haandb. Danske Fl., ed. 2, [7]: 635 (1859).
 Type species: *Atriplex arenaria* J.Woods 1849, non Nuttall 1818 (= *Atriplex laciniata* L.).
- = Atriplex sect. Psammophila Sukhor., Ann. Naturhist. Mus. Wien 108 B: 388 (2006), syn. nov. Type species: Atriplex dimorphostegia Kar. & Kir.

Description. Annuals; inflorescences aphyllous or bracteate, rarely leafy in the lower and middle parts; glomerules loosely or densely arranged.

Species. This section includes *A. dimorphostegia* Kar. & Kir., *A. fominii* Iljin, *A. kalafganica* Podlech, *A. laciniata* L., *A. lasiantha* Boiss., *A. olivieri* Moq., *A. ornata* Iljin, *A. paradoxa* Nikitina, *A. pratovii* Sukhor., *A. pungens* Trautv., *A. recurva* d'Urv., *A. schugnanica* Iljin, *A. tatarica* L., and *A. tornabenei* Tineo.

Native distribution. Members of this section are distributed mostly in the Irano-Turanian floristic region, with extensions into the Mediterranean and Western Europe. *Atriplex paradoxa* is the only species native to Central Asia (Tian-Shan Mountains). Two species are present in Russia: *A. fominii* (not shown on the map), which is restricted to the western shore of the Caspian Sea in Dagestan and Azerbaijan (Iljin 1936; Sukhorukov 2006), and the widely distributed *A. tatarica* (Fig. 1F). In the steppe and desert zones of Russia, *A. tatarica* is considered native based on its presence in natural landscapes (mostly on saline soils).

Nomenclatural notes. Lange (1859) used unranked infrageneric categories in his classification, whereas Du Mortier (1873) was apparently the first to explicitly rank *Obionopsis* as a section of *Atriplex*, but the nomenclatural significance of Du Mortier's publication was overlooked.

The second edition of Lange's 'Haandbog i den Danske Flora' was published in 7 parts during 1856–1859 (Stafleu and Cowan 1979). These parts were distributed separately by commercial publishers and are therefore effectively published, and the nomenclatural novelties in this work should be cited as published in its parts. The complete book bears no note on the parts and their dates, and no information on the book's structure and dates is publicly available. According to contemporary announcements of book sales, the concluding part 7 of Lange's book (with the treatment of Chenopodiaceae) was published in 1859 and consisted of 172 pages, which agrees with the printer's signatures.

Morphological notes on the members of *Atriplex* sect. *Obione* and *A.* sect. *Obionopsis*

Considering the latest phylogenetic results, many morphological characters like annual life form, \pm significant fusion of the valves enclosing the female flowers, inducated lower part of the bract-like cover and heteromorphic seeds, which have been traditionally used in sectional delimitation (e.g., Aellen 1939; Sukhorukov 2006), should be considered as convergent and thus unreliable for the delimitation of *Atriplex* sect. *Obione* and *A.* sect. *Obionopsis*.

The fusion of the valves of the female flowers can vary considerably within a single species as observed, e.g., in *A. centralasiatica* (Grubov 1966). This species is characterised by dimorphic bract-like and smooth covers (with and without dorsal outgrowths), with the latter ones being less fused. The valve fusion was examined in other annual species of both sections (Sukhorukov 2006). In *A. sect. Obione*, the valves are connate to 1/3-1/2 of their length in most species, but to 2/3 or higher in *A. sibirica*. In *A. sect. Obionopsis* the valves are usually fused to 1/3-1/2 of their length, but in *A. dimorphostegia* and *A. ornata* they are free (except the stalks, which are always fused), herbaceous and not inflated.

Seeds are usually dimorphic, red and brown in most members of both sections (Sukhorukov 2006). In light of the recent phylogenetic results (Žerdoner Čalasan et al. 2022), the trimorphic (black, red and brown) seeds mentioned by Sukhorukov (2006) as a key character for *A*. sect. *Psammophila* (now included in *A*. sect. *Obionopsis*) as well as the stalked and herbaceous valves should be re-evaluated as rare synapomorphies among the C_4 -species of the genus.

Leafy inflorescences, which were considered characteristic of *A. sect. Obione* (Sukhorukov 2006), are also present in several species of *A. sect. Obionopsis* (*A. dimorphostegia, A. laciniata, A. ornata, A. pratovii*). We conclude that there are no specific morphological traits that can distinguish both sections.

Notes on alien status of the species under consideration

From all the C_4 -species of *Atriplex* growing in Russia, only *A. tatarica* (Fig. 2A) seems to be able to spread continuously to the north reaching the forest zone (Fig. 1F). It is found in almost all regions of European Russia and Siberia up to 60° – 65° N (e.g., Lomonosova 1992; Medvedeva 1996; Uotila 2011), with potential outposts in the Russian Far East (Ignatov 1988). In the forest zone, *A. tatarica* is usually found along the railway tracks on gravelly soil, where it can be classified as a typical "railway-wandering plant" (terminology after Kornaś et al. 1959). Nevertheless, sometimes it can also be encountered in towns as a ruderal plant (Sukhorukov 2014). In the northern part of Central Russia, it is a neophyte (Vinogradova et al. 2009) rather than a native species or an archeophyte as proposed by Uotila (2011). *Atriplex tatarica* was included in the "Black Book [Invasive and naturalized alien plants] of the flora of Middle Russia" (Vinogradova et al. 2009), but its invasive status was apparently exaggerated,

at least for the provinces situated in the forest zone, due to a limited number of suitable habitats in this area. In steppes of European Russia, *A. tatarica* seems to be native (but allochthonous) and can be found in a wide range of habitats including saline soils, same as in more southern regions of temperate Eurasia.

Atriplex sibirica is native to Central Asia and South Siberia (Sukhorukov 2006) where it grows in steppes, on loamy or stony soils, or as a ruderal plant. Surprisingly, this species is rarely found as an alien taxon in other regions despite the presence of suitable habitats, and almost all of the several recent findings outside of Siberia (Fig. 1D) are located along railway tracks. For example, in the Russian Far East it was found for the first time in 1973 in Kamchatka Kray (MHA0303450, as *A. rosea*) and correctly identified by Ignatov (1988), then collected once in Khabarovsky Kray in 1990 (MHA0303451). The first record of *A. sibirica* in Primorsky Kray is reported here: "Vladivostok town, Ugol'naya railway station, gravely substrate, 9 Aug 1988, *T. Nechaeva s.n.*" (MHA0303481, as *A. tatarica*). Among several sheets collected from this locality by T. Nechaeva, only one specimen belongs to *A. sibirica*, whereas all other specimens were correctly identified as *A. tatarica*. In European Russia, *A. sibirica* was known only from two provinces (Sukhorukov 2014; Fig. 1D in the present paper). Because of its scattered records in both Far East and European Russia, *A. sibirica* should be considered a casual alien without naturalization potential.

Contrary to *A. sibirica* and *A. tatarica*, the secondary range of *A. rosea* (Fig. 2B) in Eastern Europe has dramatically declined (Sukhorukov 2006). Almost all the recent claims about its wide distribution in the central and south parts of European Russia are erroneous, and since the 1930s there were no new records of *A. rosea* except the oc-



Figure 2. General view of the plants: **A***A. tatarica* **B***A. rosea.* Photographs by A. Sukhorukov (**A** Russia, Tambov Oblast, Uvarovo, 20 September 2008) and M. Chambouleyron (**B** Morocco, Jerada, 23 August 2019).

currences in Krasnodarsky Kray, Crimea (MW! MHA! see also Sukhorukov 2006) and Bryansk Oblast (MSK!), the territories with mild climatic conditions. The causes of its disappearance are still unknown, and further observations are needed to revise the distribution and ecological preferences of *A. rosea* in the countries bordering the Black Sea.

A new record of an alien C_{a} -species from Russia

Among the Russian specimens of *Atriplex prostrata* Boucher ex DC. (*A.* sect. *Teutliopsis* Dumort.: Sukhorukov 2006; Žerdoner Čalasan et al. 2022), which are deposited at MW, an unusual plant was found that readily differs from this species by its (sub) opposite leaves with crenate blades and by the leaf venation with remarkable chlorenchyma stripes that is peculiar for the atriplicoid Kranz anatomy. These features indicate that this plant is actually *A. flabellum*, a desert species from Central Asia, Iran and Afghanistan, which has never been reported for Russia (Lomonosova 1992; Sukhorukov 2006). This record is treated in detail here, separate from the other C₄-species because of its novelty and casual non-native origin.

Atriplex flabellum Bunge in Boiss., Fl. Orient. 4: 912 (1879).

≡ Obione flabellum (Bunge) Ulbr. in Engler & Prantl, Nat. Pflanzenfam., ed. 2, 16c: 506 (1934). Type: Iran. "Persia, in montosis salsis ad orientem urbis Meschhed, inter Faz et Tabatkuh prov. Khorassan", A. Bunge (LE!, lectotype designated by Sukhorukov (2006: 408)).

Morphology. For a detailed description, see Iljin (1936), Hedge (1997) and Sukhorukov (2006). The species is recognisable in all stages by its (sub)opposite crenate leaves with the Kranz-type anatomy, and flabellate and stalked bract-like covers of the female flowers with ventrally fused valves. The (sub)opposite leaves are very rarely found in the C_4 -clade of *Atriplex*, and the ventral valve fusion is present only in two Eurasian species of the genus, *A. flabellum* and *A. moneta*.

Specimen seen (Fig. 3). Russia, Tyumen Oblast, Yamalo-Nenetsky Autonomous District, Novy Urengoy Town, Aug 199X [year unknown], *P. Zhmylyov & S. Elansky s.n.* (MW0058941!). Image available at https://plant.depo.msu.ru/public/scan. jpg?pcode=MW0058941.

Habitat. In Russia, the species occupies ruderal habitats. Within its native distribution range, it occurs in the desert zone on sandy and loamy soils in lowlands and foothills.

Introduction status. Casual alien. *Atriplex flabellum* is a typical desert plant, and its populations cannot become established in the extreme north of the boreal zone. For this reason, we presume that this population is most likely extinct now.

Native distribution. Afghanistan, Iran, Kazakhstan (south and south-east), Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan.

Alien distribution. Russia (Tyumen Oblast) (Fig. 4).



Figure 3. The voucher specimen of *Atriplex flabellum* recorded in Russia.



Figure 4. The location of a single alien record of Atriplex flabellum in Russia.

Taxonomy. The phylogenetic position of *A. flabellum* is distant to both *A.* sect. *Obione* and *A.* sect. *Obionopsis*; this species belongs to the basal grade within a large clade encompassing the majority of the Old World species of the genus (Žerdoner Čalasan et al. 2022). It was assigned to *A.* subgen. *Pterotheca* (Aellen) Sukhor. (lecto-type species: *A. moneta* Bunge (Sukhorukov 2006)), whose monophyly has not been confirmed, and the sectional placement of *A. flabellum* has not been evaluated. A new classification of *Atriplex* is currently in preparation by Sukhorukov et al.

This Russian record of *Atriplex flabellum* is unexpected. Two more species of the C_4 -clade of *Atriplex*, *A. dimorphostegia* and *A. pungens* (both belonging to *A. sect. Obionopsis*), occur in West Kazakhstan at their western distribution limit (more detail in Sukhorukov 2006) and can potentially be found in adjacent regions of Russia (e.g., Astrakhan Oblast) as alien or sporadically distributed native plants.

Key to the native and alien C₄-species of Atriplex growing in Russia

1	Leaves (sub)opposite, crenate; valves at fruiting flabellate, stalked, ventrally
	fused
_	Leaves alternate, of different shape; valves marginally fused2
2	Inflorescence leafy (almost) to the top; leaves rhombic, triangular or spatulate,
	entire to lobate
_	Inflorescence not leafy, sometimes one to several leaves present; leaves of different
	shape (linear, lanceolate or rhombic), entire to sinuate7
3	Plants small (up to 20-30 cm), not forming a tumble-weed habit; bract-like cover
	dorsally without outgrowths A. altaica
_	Plants forming a tumble-weed or spreading habit; bract-like cover usually with
	outgrowths

4	At least some valves of female flowers stalked, with thorn-like outgrowths located
	along the seed-containing part; plants native to Siberia, rarely found in other
	regions as aliens
_	Valves sessile, with one to several outgrowths located near their centre, rarely
	smooth; plants native to Europe
5	Valves monomorphic, all with thorn-like outgrowths
_	Valves dimorphic, smooth and with thorn-like outgrowths on the same plant
6	Inflorescence branches almost filiform; each cluster with 1-3 female flowers;
	steppe plants
_	Inflorescence branches not filiform, stout; each cluster with 3-6 female flowers;
	ruderal or coastal habitats
7	Inflorescence bracteate; bract-like cover not inflated
_	Inflorescence leafy in its lower and middle part; bract-like cover inflatedA. fominii

Conclusions

A new, phylogeny-based classification of the C_4 -species of *Atriplex* occurring in Russia, places them into two large groups, which are morphologically similar but geographically rather distinct.

The phylogenetic circumscription of these groups shows that many characters that evolved in these lineages are highly convergent; thus it is impossible to find any clear morphological differences between these lineages. They can be characterised by different tendencies in certain diagnostic characters.

This classification is the first step towards a new phylogeny-based revision of the taxonomy of *Atriplex* worldwide. In addition to the gaps in the recent phylogenetic studies, for which some important species have not been sampled yet, a significant difficulty is presented by the vast corpus of old taxonomic literature, which has never been evaluated for the infrageneric nomenclature.

Many *Atriplex* species readily colonise disturbed habitats and spread widely to new territories next to or even far away from their native distribution areas. In addition to the first record of *A. flabellum*, further records of non-native species are expected in Russia, especially those with the ranges located close to the country, e.g. *A. dimorphostegia* and *A. pungens*.

Acknowledgements

The herbarium studies of APS and MK and interpretations of the results were supported by the Russian Science Foundation (project 22-24-00964). We also thank Stephen Boatwright, Nadja Korotkova and one anonymous reviewer for valuable comments and Mathieu Chambouleyron (Emirates Center for Wildlife Propagation, Missour) for the image of *A. rosea*.

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RESEARCH ARTICLE



Monograph of Doselia (Solanaceae), a new hemiepiphytic genus endemic to the northern Andes

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Academic editor: Leandro Giacomin | Received 11 February 2022 | Accepted 8 June 2022 | Published 26 July 2022

Citation: Orejuela A, Villanueva B, Orozco CI, Knapp S, Särkinen T (2022) Monograph of *Doselia* (Solanaceae), a new hemiepiphytic genus endemic to the northern Andes. PhytoKeys 202: 73–96. https://doi.org/10.3897/ phytokeys.202.82101

Abstract

A new genus, *Doselia* A.Orejuela & Särkinen, **gen. nov.**, is described in the tribe Solandreae (Solanaceae) consisting of four species of hemiepiphytic lianas endemic to the premontane forests of the Colombian and Ecuadorian Andes. The genus is distinguished based on the membranous leaves, usually sparsely pubescent with eglandular simple trichomes, pseudo-verticillate leaf arrangement, and elongated, pendulous, and few-flowered inflorescences with showy flowers and conical fruits. Three new combinations are made to transfer species to the new genus previously described as part of the polyphyletic genus *Markea* Rich. (*Doselia epifita* (S.Knapp) A.Orejuela & Särkinen, **comb. nov.**, *D. huilensis* (A.Orejuela & J.M.Vélez) A.Orejuela & Särkinen, **comb. nov.**, *D. huilensis* (A.Orejuela & J.M.Vélez) A.Orejuela & Särkinen, **comb. nov.**, *D. huilensis* (A.Orejuela & S.A.Orejuela & Särkinen, **comb. nov.**). One new species is described from the western slopes of the eastern cordillera of the Colombian Andes, known only from three localities in the Boyacá, Santander, and Tolima departments (*Doselia galilensis* A.Orejuela & Villanueva, **sp. nov.**). The new species is unique in the genus in having glabrescent adult leaves, green-purplish calyces and long, greenish-white, infundibuliform corollas with delicate purplish veins and large lobes tinged with purple, and pubescent styles. Here we provide a revision of *Doselia* with a distribution map of all species, an identification key, photographs, preliminary conservation assessments, and line drawings of all four species.

Resumen

Un nuevo género, *Doselia* A.Orejuela & Särkinen, **gen. nov.**, es descrito en la tribu Solandreae (Solanaceae), conformado por cuatro especies de lianas hemiepífitas endémicas de los bosques premontanos de los Andes de Colombia y Ecuador. El género se distingue por sus hojas membranáceas con tricomas simples no

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glandulares, el arreglo pseudoverticilado de las hojas y sus inflorescencias paucifloras, largo pedunculadas y péndulas, flores vistosas y frutos cónicos. Se proponen tres nuevas combinaciones para acomodar especies previamente descritas en el polifilético género *Markea* Rich. (*Doselia epifita* (S.Knapp) A.Orejuela & Särkinen, **comb. nov.**, *D. huilensis* (A.Orejuela & J.M.Vélez) A.Orejuela & Särkinen, **comb. nov.** and *D. lopezii* (Hunz.) A.Orejuela & Särkinen, **comb. nov.**) Una nueva especie es descrita aquí proveniente de la vertiente occidental de la cordillera Oriental de los Andes colombianos, y conocida únicamente de tres localidades en los departamentos de Boyacá, Santander y Tolima (*Doselia galilensis* A.Orejuela & Villanueva, **sp. nov.**). La nueva especie se caracteriza por sus hojas glabrescentes cuando adultas, cáliz verde-púrpura, corolas infundibuliformes grandes, blanco-verdosas con una reticulación fina de venas púrpuras, lóbulos corolinos grandes y teñidos de púrpura en su lado ventral y estilos pubescentes. El nuevo género es formalmente descrito incluyendo un mapa de distribución, una clave taxonómica y fotografías e ilustraciones para sus cuatro especies.

Keywords

Colombia, Doselia, Ecuador, endemism, hemiepiphytes, Juanulloeae, lianas, Markea, new species, Solandreae

Palabras clave

Colombia, Doselia, Ecuador, endemismo, hemiepífitas, Juanulloeae, lianas, Markea, nuevas especies, Solandreae

Introduction

The tribe Solandreae Miers (Solanaceae) contains ca. 80 species of mainly epiphytic or hemi-epiphytic lianas and shrubs in a number of genera currently being recircumscribed (Orejuela et al. 2017; Orejuela et al. in prep). The group is restricted to the Neotropics, with species distributed from Mexico and the Caribbean to Bolivia and southern Brazil (Orejuela et al. 2017). A centre of endemism for the tribe lies in Andean Ecuador and Colombia, where ca. 60% of the species are found (Orejuela et al. 2017).

The tribe Solandreae is a unique clade within Solanaceae in that many of its component taxa are epiphytic and hemiepiphytic plants with a great diversity of floral forms, pollinators, and ant associations. Epiphytes are rare in Solanaceae, with only ca. 90 species with this growth form across the family in three distinct tribes (Solandreae 80 spp.; Capsiceae 4–5 spp.; and Solaneae 4–5 spp.), with Solandreae containing most of the epiphytic species (ca. 90%; Hunziker 2001). The tribe is also the only group of Solanaceae with known ant associations (e.g., *Merinthopodium* Donn.Sm., *Markea* Rich., and species of *Hawkesiophyton* Hunz.; Knapp et al. 1997; Hunziker 2001; Orejuela et al. 2017).

Within Solandreae, there is notable morphological variation in corolla shape, size, and colour. Corollas vary from large infundibuliform or campanulate, long tubular, hypocrateriform to minutely campanulate and include pale or dull-coloured to brightly coloured forms. This remarkable variation suggests a diverse coevolutionary history with pollinators; bats, hummingbirds, and bees have all been observed to visit these flowers (Vogel 1958; Cocucci 1999; Muchhala and Jarrin-V 2002; Sazima et al. 2003; Knapp 2010).

Variation in floral form has been used as the basis of previous taxonomic classifications of the tribe. Molecular phylogenetic studies have shown, however, that many of the previously recognised genera in Solandreae are para- or polyphyletic and in dire need of taxonomic revision (Orejuela et al. 2017). In addition to extensive recircumscription of genera, two new lineages have been identified within Solandreae based on nuclear and plastid Sanger sequences and whole plastome data that represent distinct morphological groups comprised of species previously described as members of *Markea* that are distinct at the generic level: the *Markea lopezii* and *Markea antioquiensis* clades (Orejuela et al. 2017; Orejuela et al. in prep).

Here we focus on the morphologically distinct *Markea lopezii* clade (Figs 1, 2; Table 1), a group of four species from mid-elevation moist Andean forests of Ecuador and Colombia. The group includes three previously described species, *M. epifita* S.Knapp, *M. huilensis* A.Orejuela & J.M.Vélez, and *M. lopezii* Hunz. The fourth was discovered in 2018 during fieldwork in Colombia in the Parque Natural Regional Bosque de Galilea in the municipality of Villarrica, Tolima, and is described here. The four species treated here were resolved as a monophyletic group, named the *Markea lopezii* clade, with strong branch support in a molecular phylogenomic study of Solandreae that included 95% of the species (76 spp.; Orejuela et al. in prep).

Materials and methods

All specimens of the tribe Solandreae from 25 Colombian and Ecuadorian herbaria were revised for the study to understand morphological variation across the group (acronyms follow Index Herbariorum http://sweetgum.nybg.org/science/ih/): ANDES, CAUP, COAH, COL, CUVC, FAUC, FMB, HECASA, HUA, HUAZ, HUQ, JAUM, JBB, JBGP, LLANOS, MEDEL, PSO, QCA, QCNE, TOLI, UDBC, UIS, UPTC, UTMC, and VALLE; as well as major herbaria that hold representatives from countries across the Andes (BM, E, F, K, MO, US). Herbarium material of the new species was collected in 2018 and deposited at Universidad del Tolima herbarium (TOLI) and Herbario del Jardín Botánico de Bogotá (JBB). Flowers and fruits were preserved in 70% alcohol to facilitate the preparation of taxonomic description and illustration.

Specimens with coordinates were mapped directly, and those lacking coordinates were located using Google Earth, GeoNames gazetteer (http://www.geonames.org), and GEOLocate Web service (https://www.geo-locate.org/default.html). Distribution maps were created using QGIS (QGIS Development Team 2021). Conservation assessments were made based on the IUCN Red List categories and criteria (IUCN 2012) and the most recent guidelines for using the IUCN Red List Categories and Criteria (IUCN 2022). For the conservation assessments, Extent of Occurrence (EOO) and Area of Occupancy (AOO) were calculated using GeoCat (www.geocat.kew.org; Bachman et al. 2011) with a 2 km² cell size. Herbarium material, field observations, and photos were all used to construct the identification key.

Taxonomic treatment

Doselia A.Orejuela & Särkinen, gen. nov.

urn:lsid:ipni.org:names:77302328-1 Fig. 1

Diagnosis. Like *Solandra* Sw. and *Schultesianthus* Hunz., but differing from both in having membranous leaves (vs. chartaceous or coriaceous), lacking glandular trichomes, having pendulous inflorescences with long slender peduncles (vs. solitary flowers or short erect inflorescences with thick woody peduncles), distally winged pedicels, and actinomorphic corollas (vs. weakly zygomorphic); differing from *Solandra* in its smaller corollas (8.5–15 cm vs. 15–40 cm long), flowers borne in groups (vs. solitary), straight filaments and styles (vs. strongly curved and declinate), and 2-locular ovaries (vs. 4-locular); differing from *Schultesianthus* Hunz. in the chartaceous fruiting calyx with visible venation (vs. a thick, shiny and coriaceous fruiting calyx with no visible venation).

Type species. *Doselia lopezii* (Hunz.) A.Orejuela & Särkinen comb. nov. (basionym *Markea lopezii* Hunz.)

Description. Hemiepiphytic lianas adhering to the trees by adventitious roots. Stems terete when fresh, irregularly angulate when dry, pubescent with simple, uniseriate multicellular eglandular trichomes, older stems with pale brown and papery bark, often peeling, with broad circular foliar scars left by fallen leaves. Leaves alternate on young stems or tightly clustered appearing sub-opposite in adult branches, simple, broadly elliptic to obovate, membranous, concolorous, sparsely to densely pubescent both abaxially and adaxially with simple, uniseriate eglandular trichomes like those on stem; major veins 3-6 pairs; base attenuate to obtuse, sometimes asymmetric; margins entire to undulate; apex acute, acuminate, or mucronate; petioles well-developed, conspicuously articulate, green. Inflorescences axillary to sub-axillary monochasial cymes, simple to one-branched, occasionally bracteate, usually long-pedunculate and pendulous, 1-7-flowered, pubescent with trichomes as on the stems; peduncles (1.2-) 8.5-50 cm long; bracts absent or if present foliaceous and linear, 5-6 cm long, 1-2 cm wide; pedicels 0.5-3.0 cm long, conical, 5-ribbed, distally thickened and winged in some species, articulated at the base. Flowers 5-merous, actinomorphic, perfect, aestivation valvate in the calyx and cochlear in corolla. Calyx cupuliform, green to whitish-green with purple colouration sometimes on the veins or along the margins only; lobes flat to undulate, 2.4–5.2 cm long, 1–1.5 cm wide, long-triangular to lanceolate, apically long-acuminate to acute, pubescent with simple, uniseriate eglandular, transparent to brown trichomes. Corollas 8.5-15 cm long, the inner corolla diameter from 2.5-5.0 cm, infundibuliform, hypocrateriform to tubularcampanulate, orange, purple, white, yellowish-green with purple veins, sparsely pubescent abaxially with trichomes like those on the calyx; lobes 1.6-4.2 cm long, 1.6-4.3 cm wide, triangular to oblong, spreading to reflexed during anthesis, glabrous to sparsely pubescent, the margins entire to undulate to revolute, the apices acute to obtuse. Stamens 5, equal, included within corolla tube or fully exserted beyond the mouth; filaments 1.7-6.1 cm long, adnate to the base of the corolla, white to purple-tinged, glabrous to pubescent at the point of insertion; anthers 1.4–2.7 cm long, 1.3–1.8 mm wide, elongate, basifixed, not connivent. Ovary conical, 2.9–7.5 mm long, 2.9–7 mm in diameter, light yellow to brown, 2-carpellate, 2-locular, glabrous, with a well-developed 5-lobed light green to pale yellow nectariferous disc; style 5.9–8.8 cm long, straight, glabrous to sparsely pubescent with simple uniseriate trichomes 0.3–0.5 mm long; stigma 2-lobed, ca. 1 mm long and wide, usually clavate. Fruit a conical berry, 1.5–4.4 cm long, 1.5–4.4 cm in diameter, pale to dark green, chartaceous to coriaceous when dry, 2-locular, the exocarp 2–2.8 mm thick; fruiting calyx persistent, the lobes 3–5 cm long, 1.2–2.3 cm wide, appressed and enveloping the berry loosely, fully covering the fruit. Seeds numerous, 2.2–3.6 mm long, 1–1.7 mm wide, subreniform, the testa reticulate, the testa cells rectangular and straight in the outline, the embryo slightly curved, the cotyledons accumbent, slightly longer than the embryo rest, endosperm rather scanty. Chromosome number not known.

Etymology. The generic name *Doselia* is derived from the Spanish word "dosel", meaning canopy. It refers to the hemiepiphytic lianescent habit of all species of *Doselia*, with branches rising high up to the canopy to the top of tree crowns. The plants can be challenging to see because of their position on top of the tree canopy unless the plants have their showy pendulous flowers.

Distribution (Fig. 2). Mid-elevation moist Andean forests from 500 to 2,300 m in Ecuador (Provinces of Morona Santiago, Napo, Pastaza) and Colombia (Departments of Antioquia, Boyacá, Caldas, Caquetá, Huila, Putumayo, Risaralda, Santander, Tolima, Valle del Cauca).

Discussion. *Doselia* represents a morphologically distinct group of four hemiepiphytic lianas from mid-elevation moist Andean forests with very long branches extending to the forest canopy through adventitious roots. The combination of hemiepiphytic lianescent habit, membranous leaves arranged in tight clusters on adult branches, indumentum consisting of only simple eglandular trichomes, showy actinomorphic flowers arranged in elongated, pendulous, and few-flowered inflorescences, and conical fruits is unique within the tribe.

Within Solandreae, the lianescent hemiepiphytic habit is also known in *Solandra* and *Schultesianthus*, with the rest of the tribe mainly being epiphytic or rarely terrestrial shrubs (*Markea antioquiensis* clade; Table 1). Leaves of all *Doselia* species are highly clustered on branch tips in whorls of 4–6 similar to species in the *Markea antioquiensis* clade and some species of *Markea* (e.g., *M. plowmanii* Hunz.) and differ from all other genera and species of the tribe where leaves are more spread apart and clearly alternate (Table 1). Leaves in *Doselia* are membranous with simple eglandular trichomes on both surfaces, a character shared with some species of the *Markea antioquiensis* clade (e.g., *M. pilosa* S.Knapp; Table 1). In many other genera of Solandreae, the leaves are chartaceous (e.g., *Hawkesiophyton* Hunz., *Juanulloa* Ruiz & Pav., *Merinthopodium* Donn. Sm., *Solandra* and *Trianaea* Planch. & Linden) or subcoriaceous to coriaceous (e.g., *Schultesianthus*) and often have simple glandular and/or dendritic trichomes in addition to the simple eglandular ones (Table 1).



Figure 1. Doselia A.Orejuela & Särkinen A pseudoverticillate leaves in D. epifita B infundibuliform cream-purplish corolla of D. epifita C infundibuliform greenish-white corolla with subtle purple veins of D. galilensis D tubular-campanulate yellowish-green corolla of D. huilensis with strong purple-tinged reticulation along major and minor veins E developing fruit in D. huilensis F hypocrateriform orange corollas in D. lopezii G pendent long flowering branches in D. lopezii with clustered leaves and orange corollas in frontal view H developing fruit in D. lopezii with a nectariferous disc at the base (Vouchers: A Orozco et al. 3876 (COL), B no voucher, C Corrales et al. 917 (JBB, TOLI), D Coral 34 (HEEA), E Orejuela & Vélez-Puerta 112 (COL) F Orejuela et al. 727 (JBB) G no voucher H Orejuela & Calderon 170 (COL): photos by Alistair Hay, Andreas Kay, Andrés Orejuela, Boris Villanueva, Brayan Coral, and Eduardo Calderon.



Figure 2. Geographic distribution of *Doselia*, including *D. galilensis* (green triangles).

Inflorescences in *Doselia* are long and pendulous (up to 50 cm long), with up to three flowers of which only one or rarely two develops at a time (Table 1). Such inflorescences are not typical in the tribe but are observed only in a few other species in Solandreae, including *Markea coccinea* Rich., *Merinthopodium neuranthum* (Hemsl.) Donn.Sm., *Merinthopodium pendulum* (Cuatrec.) Hunz., and *Trianaea nobilis* Planch. & Linden. Pedicels in some *Doselia* species are distally winged because the sutures of the calyx are winged and continue onto the pedicel. Distally winged pedicels are also known in some species of the *Markea antioquiensis* clade (e.g., *Markea antioquiensis* S.Knapp and *Markea pilosa* S.Knapp; Table 1).

	Doselia	Solandra	Schultesianthus	Markea antioquiensis clade
Habit	Hemiepiphytic lianas	Hemiepiphytic lianas	Hemiepiphytic lianas	Terrestrial/epiphytic shrubs
Leaf texture	Membranous	Chartaceous	Coriaceous	Membranous
Leaf arrangement	Clustered on adult branches	Alternate	Alternate	Clustered on adult branches
Trichome type	Simple, not glandular	Simple or branched, glandular or not glandular	Simple, glandular or not glandular	Simple, not glandular
Inflorescence branching	unbranched to forked	None; flowers solitary	Unbranched, forked or multi-branched	Unbranched
Open flowers per inflorescence	1–2	Solitary	(1)6–10 (>100)	4–6
Peduncles	Long (1–50 cm), hanging & slender	Absent	Short (0–3 cm), stout & woody	Intermediate (4–12 cm), hanging & slender
Pedicels	Unwinged or distally winged	Unwinged	Unwinged	Unwinged or distally winged
Floral bract	0-2	Absent	Absent	2
number and size	5–6 cm long × 1–2 cm wide			0.5–2 cm long × 0.1–0.3 cm wide
Corolla symmetry	Actinomorphic	Weakly zygomorphic	Weakly zygomorphic	Actinomorphic
Corolla lobes	Entire	Fimbriate	Fimbriate	Entire
Corolla shape	Infundibuliform or hypocrateriform to tubular-campanulate	Infundibuliform to cyathiform	Infundibuliform to cyathiform	Infundibuliform
Corolla length	8.5–15 cm	15–40 cm	2.5–21.5 cm	7–12 cm
Fruit shape	Conical	Conical	Globose, rarely conical	Conical or globose
Fruit locule	2	4	2	2
number				

Table 1. Comparison of the new genus *Doselia* with the morphologically most closely related genera and groups in the tribe Solandreae (Solanaceae).

Corollas in *Doselia* are actinomorphic and showy, similar to species of the *Markea antioquiensis* clade, but these two groups can be distinguished based on other characters such as growth form, peduncle length, number of open flowers per inflorescence, and floral bract and calyx size (Table 1). The two groups also differ in their calyx lobes, where lobes have acute to long-acuminate tips in *Doselia* but are rounded in the *Markea antioquiensis* clade. Corollas in the two other morphologically closely related genera *Solandra* and *Schultesianthus* are slightly zygomorphic (Table 1).

Fruits in *Doselia* are conical, leathery, and fully covered by the calyx, like those of *Solandra*, but differ from the latter in being 2-carpellate and 2-locular, in contrast to the 2-carpellate and 4-locular fruits in *Solandra* (Table 1). Fruits in *Schultesianthus* appear similarly leathery but are globose in shape and covered only partially by an irregularly splitting calyx (Table 1). Chromosome number is not known for *Doselia*, but count numbers in other members of Solandreae, have shown a basic chromosome number ×=12 for *Dyssochroma* Miers (Piovano 1989; Acosta and Moscone 2000), *Solandra* (Campin 1924; Lepper 1982) and *Trianaea* (Chiarini et al. 2019). Similar chromosome counts might be expected for *Doselia*, but further research is necessary to confirm this assumption.

Key to the species of Doselia

1	Sparse pubescence throughout the plant, on the leaves confined to the veins
	and margins only, leaves glabrescent with age; style pubescent along its entire
	length
_	Dense pubescence throughout the plant, on the leaves extending to the blade
	mesophyll, leaves persistently pubescent with age; style glabrous or with only
	a few trichomes at the very base
2	Anthers included within the corolla tube; corolla pale purple or purplish-
	cream; style with a few trichomes at the base
_	Anthers partially to entirely exserted beyond the corolla tube; corolla yellow-
	ish-green, brownish-green or orange; style completely glabrous
3	Corolla tubular-campanulate, the tube yellowish-green with a conspicuous
	reticulum of purple veins on both surfaces; anthers completely exserted
	D. huilensis
_	Corolla infundibuliform, the tube orange with a conspicuous reticulum of
	purple veins at the base on the adaxial side only; anthers partially included
	D. lopezii

Species descriptions

1. Doselia epifita (S.Knapp) A.Orejuela & Särkinen, comb. nov.

urn:lsid:ipni.org:names:77302329-1 Figs 1A, B, 3

Markea epifita S.Knapp, Novon 8(2): 155–157, f. 3a, b. 1998. Type. Ecuador. Napo: Canton Archidona, carretera Hollín-Loreto km 25, sector Challua Yacu, faldas al S de Volcán Sumaco, 1°45'S, 77°38'W, 1,200 m, 21 Apr 1989 (fl), *C. Cerón & F. Hurtado 6534* (holotype: QCNE; isotypes: MO! [MO-289398, acc. # 5343691], NY! [00214503]).

Type. Based on Markea epifita S.Knapp

Description. Hemiepiphytic liana with adventitious roots. Stems sparsely pubescent with simple, uniseriate 2–4-celled hyaline trichomes ca. 0.5 mm long, giving the stems a tuberculate look. Leaves tightly clustered towards the branch tips, 11–25 cm long, 6–12 cm wide, obovate, sparsely pubescent with simple uniseriate 2–4-celled trichomes ca. 0.5 mm long, the trichomes denser and stiffer abaxially along the veins on both surfaces; major veins 4–5 pairs, not raised abaxially, drying dark brown; base attenuate, symmetric; margins entire; apex acute to acuminate; petiole 1–5 cm long, pubescent with stiff trichomes abaxially like those of the leaves. Inflorescence 18.5–45 cm long, axillary, unbranched, ebracteate, ca. 4–5-flowered, densely pubescent with simple, uniseriate trichomes like those of the stems; peduncle 8.5–35.2 cm long; pedicels 1.2–1.7 cm

long, winged. Calyx 3.8–4 cm long, 1.4–1.5 cm wide, green tinged with purple, pubescent with simple uniseriate trichomes 0.5–1 mm long; tube 0.5–0.7 cm long; lobes undulate, 3.0–3.3 cm long, 0.8–1 cm wide, long-triangular, apically acuminate, densely pubescent abaxially with simple uniseriate trichomes 0.5–1 mm long, adaxially similar but also with tiny brownish papillate trichomes. Corolla 9–11 cm long, the inner corolla diameter 3–3.5 cm, infundibuliform, gradually widening from the base, glabrous; tube 7.5–8 cm, cream to green with lines or patches of purple; lobes 3.4–4.2 cm long, 2.5–3.3 cm wide, ovate, purple or violet, reflexed at anthesis, the margins slightly undulate, the apex obtuse to rounded, glabrous or with a few minute trichomes along the veins. Stamens 3.6–7.7 cm long, included within corolla tube; filaments 2–5 cm long, adnate to ca. 1 cm from the base of the corolla tube, white to purple-tinged, glabrous; anthers 1.6–2.7 cm long, 1.7–1.8 mm wide, cream. Ovary 3.3–3.4 mm long, 3.3–3.4 mm wide, colour unknown, glabrous; style 5.5–6 cm long, cream, glabrous except for a few simple uniseriate trichomes ca. 0.5 mm long at the very base; stigma clavate. Fruit not known. Chromosome number not known.

Distribution (Fig. 2). On the eastern slopes of the Andes in central Ecuador (Provinces Morona-Santiago, Napo, and Pastaza) and Colombia (Departments Putumayo and Caquetá).

Ecology. In premontane forest between 500–1,500 m elevation.

Preliminary conservation status (IUCN 2022). Our data support the assessment of the species by Knapp et al. (2017) who considered *D. epifita* as vulnerable (VU) based on the criteria B1ab [iii]. *Doselia epifita* is known from a few collections in the Cordillera de los Guacamayos, the protected areas of Sumaco-Napo-Galeras and Sangay, areas near the city of Puyo in Ecuador, the Natural Reserve "La isla escondida" in Putumayo, and the surroundings of the Alto Fragua indiwasi National Park in Caquetá, Colombia. The biggest threat to the species is deforestation (Knapp et al. 2017).

Discussion. *Doselia epifita* is the only species of *Doselia* that reaches Ecuador and has the lowest elevational range within the genus. *Doselia epifita* is morphologically most similar to *D. galilensis*, and a detailed comparison is presented under the latter. The inflorescence morphology of *D. epifita* was unknown until recently because no complete specimens with entire inflorescences were known when the species was first described (Knapp 1998). Recent collections have revealed that the inflorescences are axillary and long (18.5–45 cm long; Fig. 3B), as correctly predicted by Knapp (1998). The fruits of this species remain unknown.

Etymology. The specific epithet refers to the apparent epiphytic habit of the species, though, like other species in the genus, *D. epifita* is a hemiepiphyte rather than an obligate epiphyte.

Specimens examined. COLOMBIA. **Caquetá:** Belén de Los Andaquíes, camino Andaquí, via que comunica Acevedo con Belén de los Andaquíes, vegetación a orilla de quebrada, 12 Mar 2016 (fl), *Cárdenas 45979* (COAH). **ECUADOR. Morona-Santiago:** Parque Nacional Sangay, lagunas de Sardinayacu, 2°05'54"S, 78°09'19"W, 1,400–1,500 m, 18 Jan 2015 (fl), *Pérez et al. 7875* (QCA). **Napo:** Canton Archidona, Carretera Hollin–Loreto, km 25, Sector Challua Yacu, Faldas al sur del Volcán Sumaco, 1°27'00"S, 77°22'48"W, 1,200 m, 26 Aug 1980 (fl), *Cerón 6534* (MO,



Figure 3. *Doselia epifita* **A** branch with clustered leaves **B** floriferous branch **C** flower at anthesis **D** dissected corolla showing inserted stamens **E** detail of gynoecium with a five-lobed nectariferous disc and a clavate stigma (**A–E** *Ceron & Hurtado 6534, Palacios 6893:* Drawing by Omar Bernal).

NY); Cantón Loreto, Parque Nacional Sumaco, Napo-Galeras, Matorral de Bambú, Bloque 19, línea sísmica 22, Compañía Triton, 0°47'00"S, 77°28'00"W, 500 m, 25 Mar 1996 (fl), *Freire & Cerda 271* (MO, QCNE); Cantón El Chaco, Proyecto Hidroeléctrico Coca, Punto ST3, margen derecha del Río Quijos, 10 km al S de Reventador, 0°11'00"S, 77°39'00"W, 1,500 m, 3 Oct 1990 (fl), *Palacios 5893* (MO). **Pastaza:** Cantón Mera, Carretera al Rio Ansu, 5 km al NE de Mera, 1°15'36"S, 78°03'36"W, 1,200 m, 16 Mar 1985 (fl), *Palacios et al. 123* (MO); Cantón Mera, Colonia Pindo, Mirador en la Reserva Pindo, 1°27'23"S, 78°04'47"W, 12 Nov 2011, *Orozco et al. 3876* (COL); Road Veracruz (Indillama) – Canelos, 1°35'00"S, 77°51'00"W, 25 Jun 1968 (fl), *Lugo 75* (MO); Cantón Pastaza, Shell, Río Pindo, 1°29'59"S, 78°03'44"W, 1,050 m, 18 Aug 1992 (fl), *Palacios 10380* (MO).

2. Doselia galilensis A.Orejuela & Villanueva, sp. nov.

urn:lsid:ipni.org:names:77302330-1 Figs 1C, 4, 5

Diagnosis. Differing from all other members of *Doselia* in its mature leaves with sparse pubescence of trichomes on the midvein and along margins only (vs. on entire lamina). Like *D. epifita* (S.Knapp) A.Orejuela & Särkinen but differing in the pale green to purplish-green calyces with flat lobes (vs. calyces green with purple patches with undulate lobes) and larger corolla 12–15 cm long (vs. 9–11 cm long).

Type. COLOMBIA. **Tolima:** Municipio Villarrica, Vereda Galilea, Bosque de Galilea, zona Campo Hermoso, junto a parcela permanente de Monitoreo de 1 ha, 03°46'21"N, 74°39'56"W, 1,543 m, 11 Jun 2018 (fl, fr), *L. Corrales, B. Villanueva, K. Sánchez & H. Díaz 917* (holotype: JBB! [JBB34413]; isotype: TOLI [TOLI26800]).

Description. Hemiepiphytic liana with adventitious roots. Stems sparsely pubescent with simple, uniseriate 4-7-celled, hyaline trichomes 0.4-1.3 mm long, becoming glabrescent with age. Leaves tightly clustered towards the branch tips, 9.2-17.5 cm long, 6.4-8.4 cm wide, ovate to elliptic, sparsely pubescent with a few simple trichomes like those on the stems distributed along the margins and veins on both surfaces, especially on the young growth, glabrescent with age; major veins 3-4 pairs, slightly raised abaxially; base cuneate or obtuse, symmetric or rarely asymmetric; margins entire; apex acuminate to mucronate; petiole 0.8–1.8 cm long, sparsely pubescent with a few simple trichomes like those on the stems, glabrescent with age. Inflorescence axillary, simple, ebracteate, 11.5–17.2(-44) cm long, 1(-3)-flowered, sparsely pubescent with a few simple trichomes like those on the stems; peduncle 1.2-5.7(-32.5) cm long; pedicels 0.5-1.8 cm long, distally winged and thickened. Calyx 3.7-3.8 cm long, 1.7-1.8 cm wide, pale green with purple margins and reticulation along the veins, sparsely pubescent with simple, uniseriate trichomes like those on the stems; tube 0.5-0.7 cm long; lobes flat, 2.4-3.0 cm long, 1.0-1.2 cm wide, short-lanceolate, apically acute. Corolla 12–15 cm long, the inner corolla diameter 3.5–4.0 cm, infundibuliform; tube 8.3-9.5 cm long, with a narrow base 1.4-1.9 cm long, 0.8-0.9 cm wide and a wide distal portion 7.6–7.7 cm long, 3.6–3.8 cm wide, greenish-white with subtle purple veins, glabrous or sparsely pubescent with a few simple uniseriate trichomes like those of the rest of the plant on the tube externally; lobes 3.2-3.8 cm wide, 2.8-3.1 cm long, ovate, greenish-white with bright purple patches within, reflexed at anthesis, the margins revolute, the apex obtuse, glabrous. Stamens 4.1-4.2 cm long, included



Figure 4. *Doselia galilensis* **A** floriferous branch **B** branch with clustered and circular foliar scars **C** flower at anthesis **D** dissected corolla showing inserted stamens **E** detail of a stamen **F** gynoecium with a five-lobed nectariferous disc **G** fruit with an accrescent calyx **H** dissected fruit showing placentation (cross-section) **I** seed (**A–I** *Corrales et al. 917*: Drawing by Marcela Morales).

inside the corolla tube; filaments 3.1-3.4 cm long, adnate at ca. 1.4-1.8 cm from the base of the corolla, white, densely pubescent with simple, uniseriate 4-7(-12)-celled, hyaline trichomes at the insertion point; anthers 1.6-2.1 cm long, 1.4-1.5 mm wide. Ovary 3.7(-5.4) mm long, 6.2-6.3 mm wide, light brown, glabrous; style 5.9-6.5 cm

long, cream, sparsely pubescent with simple short 2–4-celled uniseriate trichomes ca. 0.3 mm long; stigma clavate. Fruit ca. 4.4 cm long, ca. 2.9 cm wide, light green, the exocarp 2.1–2.4 mm thick, coriaceous and light yellow when dry; fruiting calyx persistent, accrescent and covering the fruit, enveloping the berry loosely, the lobes to 4–4.5 cm long, 1.3 cm wide. Seeds numerous, 3.3–3.6 mm long, 1.5–1.7 mm wide, ochre yellow when dry, the testa reticulate, the testal cells rectangular in outline, the embryo slightly curved, the cotyledons accumbent, slightly longer than embryo rest, endosperm rather scanty. Chromosome number not known.

Distribution (Fig. 2). *Doselia galilensis* occurs in the western slopes of the eastern cordillera of the Colombian Andes and is only known from three localities in the municipality of Arcabuco (Department of Boyacá), the natural reserve "Reinita Cielo Azul" (Department of Santander) and the Parque Natural Regional Bosque de Galilea (Department of Tolima).

Ecology. Grows in Andean tropical cloud forest from 1,500 to 2,300 m elevation.

Preliminary conservation status (IUCN 2022). *Doselia galilensis* is considered Data Deficient (DD) due to the small number of known populations. Based on our field observations, the biggest threat to the species is habitat loss due to agricultural expansion near the known localities. The situation has been alarming in the Galilea Forest during the last few years, with several direct threats to forest conservation such as agricultural expansion, unsustainable logging, and oil exploitation activities. Fortunately, the Galilea Forest has been recently declared as a protected area through the Corporación Autónoma Regional del Tolima ("CORTOLIMA" resolution 31 adopted on December 16, 2019). The Arcabuco oak forests in Boyacá do not, however, have any legal protection. It is unclear whether the new species remains in the area based on our unsuccessful attempt to collect *D. galilensis* in Arcabuco in 2019. The third population recently discovered in Santander is under the protection of the Proaves NGO in the natural reserve "Reinita Cielo Azul".

Phenology. *Doselia galilensis* has been collected in flower in May, June and October and with fruits in June.

Etymology. The epithet "*galilensis*" is in honour of the recently created "Parque Natural Regional Bosque de Galilea", where the type specimen was collected. The Galilea Forest is located between 3°53'36"N, 74°31'51"W and 3°40'32"N, 74°44'20"W in the municipalities of Villarrica and Dolores. We hope that the description of this new Colombian endemic species highlights the importance of the Galilea Forest and stimulates more researchers to explore this beautiful reserve. The Galilea Forest covers more than 26,000 hectares and occupies an elevational range from 1,480 to 3,080 m. It represents a mid-elevation Andean montane forest sandwiched between the lowland tropical rain forest and treeline. Besides the typical Andean cloud forest, the Galilea Forests with species adapted to grow in these highly specialised soil conditions (e.g., *Utricularia* L., Lentibulariaceae). The Galilea Forest is considered a strategic ecosystem for water regulation in the watershed area of the Negro River and the Aco and Lusitania ravines that feed the Hidroprado Dam (Quimbayo-Cardona et al. 2019).



Figure 5. *Doselia galilensis* **A** habitat in type locality in Galilea forest, Villarrica, Tolima **B** mid-elevation moist forest habitat in Galilea forest **C** floriferous branch with a flower **D** floriferous branch with a dissected and opened corolla showing corolla colouration inside and the inserted stamens **E** female *Euglossa* bee visiting the flower **F** front view of the corolla showing the purple-tinged lobes and the inserted stamens **G** developing fruit covered by an accrescent calyx (**A–G** *Corrales et al. 917*: Photographs by Boris Villanueva).

Discussion. In the area of Arcabuco, Boyacá, *D. galilensis* is sympatric with *Merinthopodium vogelii* (Cuatrec.) Castillo & R.E.Schult., a vegetatively similar species of Solandreae. *Merinthopodium vogelii* differs in having green campanulate corollas with strongly reflexed lobes at anthesis and partially exserted anthers, while *D. galilensis* has included anthers and to greenish-white, infundibuliform corollas with slightly reflexed lobes that are purple-tinged at anthesis.

Doselia galilensis can be easily differentiated from other species of *Doselia* in its glabrescent mature leaf blades where pubescence is sparse and restricted to midveins and margins (Fig. 1; Table 2). *Doselia galilensis* is morphologically most similar to *D. epifita*; both species share several characters that are not present in other species of *Doselia*, such as infundibuliform corollas and included stamens with very short filaments (Fig. 1; Table 2). Unlike *D. epifita*, *D. galilensis* is sparsely pubescent, with only a few trichomes along the main veins of the leaves and very few trichomes in other parts of the plant. In contrast, *D. epifita* has a dense and persistent pubescence covering the entire plant with persistent trichomes on both sides of the leaves. The calyx lobes in *D. galilensis* are flat and lanceolate compared to the long-triangular undulate calyx lobes in *D. epifita*. *Doselia galilensis* has slightly larger corollas with greenish-white tubes and purple-tinged lobes on the abaxial side (Fig. 5C–F) compared to *D. epifita* with white to purplish corolla tubes with purple lobes on both surfaces (Fig. 1B). Styles are consistently pubescent in *D. galilensis* along their entire length, while *D. epifita* has glabrous styles except for a few simple uniseriate trichomes at the very base.

Specimens examined. COLOMBIA. **Boyacá:** Municipio de Arcabuco, La Cumbre, 2300 m, 22 May 1980 (fl), *Pérez 01* (COL). **Santander**: Municipio de San Vicente de Chucurí, vereda Centro, sector Germania, parte alta, serranía de Los Yariguíes, camino de Lengerke entre Zapatoca y San Vicente de Chucurí, sector Reserva Proaves "Reinita Cielo Azul", 6°50'46"N, 73°22'38W, 1672 m, 20 Oct 2021 (fl), *D. Díaz-Rueda et al. 2272* (JBB). **Tolima**: Municipio Dolores, Vereda El Carmen, Bosque de Galilea, zona

	D. epifita	D. galilensis	D. huilensis	D. lopezii
Distribution	Napo, Pastaza	Boyacá, Santander,	Huila, Putumayo	Antioquia, Caldas,
	(Ecuador), Putumayo,	Tolima (Colombia)	(Colombia)	Risaralda, Valle del Cauca
	Caquetá (Colombia)			(Colombia)
Elevation (m)	500-1,500	1,500-2,300	2,200–2,300	1,700–2,100
$Leaf \ length \times width \ (cm)$	11–25 × 6–12	9.2–17.5 × 6.4–8.4	9.0–16.7 × 4.6–11.7	14–22 × 4–9.8
Leaf shape	Obovate	Ovate to elliptic	Elliptic to broadly elliptic	Elliptic to broadly elliptic
Mature leaf pubescence	Sparsely pubescent	Sparsely pubescent on the	Densely pubescent on	Sparsely pubescent on
	on both surfaces with	main veins and margins	both surfaces with simple	both surfaces with simple
	simple uniseriate	with simple uniseriate	uniseriate trichomes	uniseriate trichomes
	trichomes	trichomes, becoming		
		glabrescent with age		
Peduncle length (cm)	8.5-32.2	1.2-5.7(-32.5)	8.5–39	6-24(-39)
Corolla shape	Infundibuliform	Infundibuliform	Tubular-campanulate	Hypocrateriform
Corolla length (cm)	9-11	12–15	8.5-10	8-11
Corolla lobe	3.4-4.2 × 2.5-3.3	3.2-3.8 × 2.8-3.1	2.3-3.3 × 1.6-1.7	3.2-3.9 × 3.7-4.1
$length \times width (cm)$				
Anther position	Included	Included	Exserted	Partially exserted
Anther length (cm)	1.6-2.7	1.6-2.1	1.4–1.9	1.9-2.2

Table 2. Morphological and geographical comparison of the four species assigned to Doselia.

Riachón, cerca de parcela permanente de monitoreo de 1 Ha No 5, 03°40'53.10"N, 74°41'6.56"W, 2122 m, 08 Aug 2019 (fl) *Rivera et al. 26* (JBB); Municipio Villarrica, La Colonia, vereda La Colonia, Bosque de Galilea 03°52'20.61"N, 74°33'12.12"W, 2000 m, 10 Jan 2020 (fl), *M. F. Valencia & M. Rincón 308* (TOLI).

3. Doselia huilensis (A.Orejuela & J.M.Vélez) A.Orejuela & Särkinen, comb. nov. urn:lsid:ipni.org:names:77302331-1 Figs 1D, E, 6

Markea huilensis A.Orejuela & J.M.Vélez, Phytotaxa 167(2): 156, Figs 6, 7. 2014.
Type. Colombia. Huila: Municipio de La Plata, vereda La María, Finca Meremberg, sitio Agua Bonita, 02°12'13"N, 76°06'33"W, 2,287 m, 5 Aug 2010 (fl,fr), A. Orejuela & J.M. Vélez-Puerta 112 (holotype: COL! [COL000420611]; isotypes: COL! [COL000420613]).

Type. Based on Markea huilensis A.Orejuela & J.M.Vélez

Description. Hemiepiphytic liana with adventitious roots. Stems densely pubescent with simple, uniseriate (2-) 4–7 (-11)-celled, hyaline to ochre-brown trichomes 0.2– 1.8 mm long, with a deciduous apex and a persistent multicellular base giving the surface a tuberculate appearance, stems glabrescent with age. Leaves tightly clustered towards the branch tips, 9.0-16.7 cm long, 4.6-11.7 cm wide, elliptic to broadly elliptic, densely pubescent with simple 4–9-celled uniseriate hyaline to dark olive-brown trichomes 0.3– 2 mm long on both surfaces; major veins 4–6 pairs, slightly raised abaxially; base cuneate or obtuse, asymmetric; margins entire to undulate; apex usually acuminate, mucronate; petiole 0.4–3.8 cm long, densely pubescent. Inflorescence sub-axillary, simple to branched, bracteate, 18-50 cm long, ca. 2-7-flowered, surface tuberculate and densely pubescent with trichomes as on the stems; peduncle 8.5-39 cm long; bracts foliaceous and linear, 5–6 cm long, 1–2 cm wide; pedicels 1.5–2 cm long, distally winged and thickened. Calyx ca. 3.3 cm long, 1.5 cm wide, dark green with purple margins and reticulate along the veins, pubescent with simple 4-7-celled uniseriate white hyaline to brown trichomes; tube 0.5–0.7 mm long; lobes undulate, 2.7–5.2 cm long, 1.3–1.5 cm wide, lanceolate, apically acuminate with an acumen 0.6–0.9 mm long, green with the main vein and the margins purple-brown, pubescent with simple uniseriate trichomes on the abaxial side. Corolla 8.5–10 cm long, the inner corolla diameter 4.5–5 cm, tubular-campanulate; tube 6.2-6.7 cm long, scarcely pubescent with trichomes similar to those of the calyx, yellowish green with strong purple-tinged reticulation along major and minor veins both abaxially and adaxially; tube differentiated into a narrow base ca. 0.2 cm long and 0.8-1 cm wide and a wide distal portion 4.2–4.6 cm long, ca. 5 cm wide; lobes 2.3–3.3 cm long, 1.6-1.7 cm wide, oblong, reflexed during anthesis, colour similar to that of the corolla tube, the margins revolute, the apex obtuse, glabrous. Stamens 6.1-6.9 cm long, fully exserted beyond corolla tube; filaments 4.7–5 cm long, adnate at ca. 2 cm from the base of the corolla, purplish, densely pubescent with simple uniseriate trichomes at the



Figure 6. *Doselia huilensis* **A** floriferous branch **B** indument on the leaf blade **C** indument on young stems **D** leaf arrangement **E** flower bud **F** flower in anthesis **G** stamens **H** gynoecium **I** fruit with sepals removed **J** fruit in cross section **K** seed **L** embryo (**A–L** *A. Orejuela & J.M. Vélez 112*: Drawing by Marcela Morales, first published in Orejuela et al. (2014), reproduced with permission).

insertion point like those on calyx; anthers 1.4–1.9 cm long, 1.3–1.5 mm wide. Ovary ca. 7 mm long, ca. 3.5 mm wide, light yellow, glabrous; style 7.3–8 cm long, cream; stigma clavate. Fruit ca. 4.2 cm long, ca. 2.5 cm wide, dark green, exocarp 2–2.8 mm thick when fresh, coriaceous, black when dry; fruiting calyx persistent, accrescent and covering the fruit, appressed at maturity, the lobes 4–5 cm long, 2.2 cm wide. Seeds numerous, 2.6–3.0 mm long, 1.2–1.4 mm wide, ochre when fresh, dark brown when dry, the testa reticulate, the testal cells rectangular in outline. Chromosome number unknown.

Distribution (Fig. 2). *Doselia huilensis* is known only from the Departments of Huila and Putumayo in southwestern Colombia.

Ecology. *Doselia huilensis* is found in preserved or partially altered oak forests from 2,200 to 2,300 m elevation.

Preliminary conservation status IUCN (2022). *Doselia huilensis* is reaffirmed (following Orejuela et al. 2014) here as an endangered species (EN) according to criteria B1ab [i, iii] based on the small EOO (~750 km²), a small number of known populations, and the highly fragmented condition of the relictual forests where it occurs. The species is known from five collections from three localities. Two of these localities are in the Department of Huila 80 km apart, and one recent collection is known from the Valle del Sibundoy, Department of Putumayo, that extends the species distribution approximately 100 km to the south.

Discussion. *Doselia huilensis* differs from all other *Doselia* species in its tubularcampanulate corollas with fully exserted anthers (Table 2; Fig. 1D). The species is densely pubescent throughout, which is useful in distinguishing it from other *Doselia* species that are either glabrescent or less densely pubescent (Table 2).

Specimens examined. COLOMBIA. **Huila:** Municipio de La Plata,-vereda Agua Bonita, Finca Meremberg, 2,200–2,300 m, 21 Jul 1975 (fl), *Díaz-Piedrahita et al. 793* (COL); Carretera Popayán-La Plata, km 100, Reserva forestal de Fauna y Flora Meremberg, 2,300 m, 12 Dec 1982 (fl), *Murcia 09* (COL); Municipio San Agustín, vereda La Castellana, reserva privada Los Yalcones, interfluvio quebrada El Palmar-río Balseros, sitio El Palmar, 1°47′44″N, 76°21′5″W, 2,400–2,600 m, 15–20 Aug 2005, *Mendoza & Robles 16548* (FMB). **Putumayo**: Valle del Sibundoy, Reserva Natural Yumartán, cuenca alta del río Putumayo, por la garganta del Balsayaco, 3 Mar 2021 (fl), *Coral 34* (HEAA).

4. Doselia lopezii (Hunz.) A. Orejuela & Särkinen, comb. nov.

urn:lsid:ipni.org:names:77302332-1 Figs 1F–H, 7

Markea lopezii Hunz., Lorentzia 5: 9. 1985. Type. Colombia. Valle: Cuenca del Rio Cali, cercanías de Peñas Blancas, 10–11 Jan 1963 (fl), *M. López-Figueiras 8208* (holotype [two sheets]: US! [00385918, acc. # 2451166; 00385936, acc. # 24511165]).

Type. Based on Markea lopezii Hunz.

Description. Hemipiphytic liana with adventitious roots. Stems sparsely pubescent with simple, uniseriate 4-8-celled, hvaline ochre trichomes 0.5-1.2 mm long, with deciduous apex and a persistent multicellular base giving the surface a tuberculate appearance, stems glabrescent with age. Leaves tightly clustered towards the branch tips, (7-)10-22 cm long, 4-9.8 cm wide, elliptic to broadly elliptic, sparsely pubescent with simple uniseriate 4-7-celled hyaline trichomes 0.8-1.2 mm long on both sides; major veins 4–6 pairs, slightly raised abaxially; base cuneate, slightly asymmetric; margins entire; apex acute to acuminate; petiole (7–)10–19(–25) mm long, densely pubescent with simple trichomes as on the leaves. Inflorescence axillary, simple, ebracteate, 7-35(-50) cm long, ~2-5-flowered, densely pubescent with simple, uniseriate trichomes like those on stems; peduncle 6-24(-39) cm long; pedicels 0.8-1.7(-3.0) cm long, distally winged and thickened. Calyx 3.8-5.6 cm long, 1.4-1.9 cm wide, green, sometimes tinged with purple, densely pubescent with simple, uniseriate trichomes like those on leaves; tube 8–9 mm long; lobes flat, 3.5–4.4 cm long, 1.2–1.4 cm wide, long-triangular, apically long-acuminate, green or green with purple margins, sparsely pubescent with simple uniseriate trichomes on the abaxial side. Corolla 8-11 cm long, the inner corolla diameter 2.5–2.8 cm, hypocrateriform; tube 7–10 cm long, orange and tinged with purple in the throat internally, glabrous; lobes 3.2–3.9 cm long, 3.7– 4.1 cm wide, triangular, orange, spreading to slightly reflexed at anthesis, the margins flat and entire, the apex acute, glabrous or with a few minute trichomes along the veins. Stamens 7–8.6 cm long, partially exserted beyond the mouth of corolla tube; filaments 5.3–6.1 cm long, adnate at 1.0–1.3 cm from the base of the corolla tube, purple-tinged, densely pubescent with simple 6–10-celled uniseriate trichomes at the insertion point; anthers 1.9–2.2 cm long, 1.4–1.8 mm wide. Ovary ca. 7.5 mm long, ca. 2.9 mm wide, yellow, glabrous; style 7.9-8.8 cm long, glabrous; stigma clavate. Fruit 2.7-3.2 cm long, 1.5–3.3 cm wide, light green; fruiting calyx persistent, accrescent and fully covering the fruit, the lobes 3–3.3 cm long, 1.2–1.4 cm wide. Seeds numerous, 2.2–2.7 mm long, 1–1.3 mm wide, ochre when fresh, brown when dry, the testa reticulate, the testal cells rectangular in outline. Chromosome number not known.

Distribution (Fig. 2). *Doselia lopezii* is endemic to the pre-montane forests of the Colombian Andes in the departments of Antioquia, Caldas, Valle del Cauca and Risaralda.

Ecology. Mid-elevation moist forests from 1,700 to 2,100 m elevation.

Preliminary conservation status (IUCN 2022). *Doselia lopezii* is classified as vulnerable (VU) according to the B1a criterion with an EOO of ca. 6,000 km². The area where it is distributed is severely fragmented and the species is known from fewer than ten localities..

Discussion. *Doselia lopezii* is the type species of the genus and the easiest species to recognise on account of its showy flowers with large orange corollas (Table 2; Fig. 1F, G). *Doselia lopezii* has anomalous and apparently unique pollen in the genus with prominent spiny supratectal processes (Persson et al. 1994). Preliminary observations in *D. huilensis* (Orejuela et al. 2014) and specimens of *D. epifita* examined by Hunziker (1997, as *M. lopezii*) indicate that the pollen of these two species lack these spiny supratectal processes.



Figure 7. *Doselia lopezii* **A** branch with clustered leaves and an inflorescence axis **B** trichomes on leaves **C** trichomes on the calyx **D** trichomes at the filament insertion point **E** flower at anthesis **F** dissected corolla showing partially exserted stamens **G** stamen in lateral view **H** detail of a stamen showing the insertion of the filament **I** detail of the stigma **J** fruit with an accrescent calyx with two calyx lobes removed (**A–I** *López Filgueiras 8208*: Drawing by Nidia Flury, first published in Hunziker (1985), reproduced with permission, the original drawing was edited by Omar Bernal and the fruit drawn by Humberto Mendoza).

Specimens examined. COLOMBIA. Antioquia: Medellín-Puerto Triunfo, Cocorna, ca. 5 km E of Cocorna Peaje, Quebrada El Biadal, 6°N, 75°10'W, 1,830 m, 23 Nov 1983 (fl), Juncosa 1400 (JAUM); Pulperies 6000, Jul 1880 (fl), Kalbrever 1638 (K, MO). Caldas: Municipio Samaná, corregimiento Florencia, Vereda San Vicente, sector río Claro - Sierra Morena, Parque Nacional Natural Selva de Florencia, 5°31'21"N, 75°3'40"W, 1,840 m, 2 Oct 2012 (fl), Betancur et al. 16698 (COL). Risaralda: Municipio de Pueblo Rico, en cercanías de los límites con el PNN Tatamá, Reserva Santuario-Tatamá, 5°11'03.1"N, 76°01'16.5"W, 1821 m, 18 Mar 2022 (fl), Orejuela et al. 3849 (JBB). Valle del Cauca: Finca Torremolinos, km 22, carretera entre Cali y Buenaventura, cordillera occidental, vertiente occidental, 1,800 m, 13 Oct 1982 (fl), Albert de Escobar et al. 2678 (HUA); km 18, vía Cali-Buenaventura, chemin lateral, 1,920 m, 8 Mar 1997 (fl), Billiet & Jadin 6904 (MO); Estación Microondas Tokio, 8 km W of Queremal (along old road to Buenaventura), 2°27'00"N, 76°45'00"W, 26 Sep 1980 (fl), Croat 50164 (MO); Hoya del río Dígua, Quebrada del San Juan, subiendo a Paragüita desde Queremal, 3°32'09"N, 76°42'42"W, 1,570-1,740 m, 17 Mar 1947 (fl), Cuatrecasas 23830 (F); Hacienda Tokio, wet montane forest behind microwave tower ca. 10 km S of Queremal, 3°30'00"N, 76°42'00"W, 2,000 m, 26 Feb 1983 (fl), Gentry et al. 40820 (MO); La Cumbre, vereda La Sofía, corregimiento de Bitaco, Cerro de Yumbillo, cordillera occidental, vertiente occidental, 1,850 m, 6 Dec 1988 (fl), Klimkiewicz & Cabrera 275 (CUVC); Cuenca del río Cali, cercanías de Peñas Blancas, 3°26'10"N, 76°38'28"W, 10 Jan 1963 (fl), López-Filgueiras 8208 (US); La Cumbre, corregimiento de Bitaco, vereda Chicoral, 3°33'56"N, 76°35'3"W, 2,020 m, 23 Jul 2003 (fl), Mendoza et al. 15275 (FMB); km 18, vía Cali-Buenaventura, vereda Dapa, Finca Zíngara, 1,800 m, 6 Nov 2009 (fl), Orejuela 59 (COL); vía Cali-Dagua, km 23, Reserva Privada El Refugio, 4 Nov 2011 (fl), Orejuela & Calderón-Sáenz 170 (COL); Vía Cali-Dagua, km 23, Reserva Privada El Refugio, 3°32'02"N, 76°36'56"W, 1,870 m, 13 Feb 2014 (fl), Orejuela et al. 727 (COL, JBB).

Acknowledgements

We thank herbarium curators at the herbaria whom we visited for their help and permission to consult the collections in their care, and the following colleagues for their support and expertise during fieldwork in Colombia and Ecuador: Gloria Barboza, Jhoana Castillo, Brayan Coral, Lina Corrales, Rocio Deanna, Daniel Mauricio Diaz Rueda, David Granados, Segundo Leiva, Alvaro Perez, Federico Roda, Gina Sierra, Juan David Tovar, Edwin Trujillo, Carlos Vargas and Jorge Mario Vélez. We extend our thanks to Marcela Morales, Omar Bernal, Nidia Flury and Humberto Mendoza for the excellent illustrations accompanying this paper. The study was funded by the Fundación CEIBA through the scholarship program "Rodolfo Llinás para la promoción de la formación avanzada y el espíritu científico en Bogotá". Additional financial support was provided by the Darwin Trust and the Davis Fund from the University of Edinburgh, and the Royal Botanic Garden Edinburgh, the Systematics Association Fund and the GEME Max Planck Tandem Group (Agreement 566 from 2014 between the Universidad Nacional de Colombia (https://unal.edu.co/) and Colciencias (now called Minciencias https://minciencias.gov.co/). To Alistair Hay, Andreas Kay (deceased), Brayan Coral, and Eduardo Calderon for providing *Doselia* photos. We also thank Lynn Bohs, Gloria Barboza and Leandro Giacomin for their comments and suggestions, which improved this manuscript.

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RESEARCH ARTICLE



Rungia fangdingiana (Acanthaceae), a new species from Guangxi, China

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Academic editor: Alan Paton	Received 17 May 2022	Accepted 10 July 2022	Published 28 July 2022
readenice editor. Than Taton	10001100 17 1110y 2022	I necepted to July 2022	I donished 20 July 2022

Citation: Lin Z-L, Tan Y-H, Huang Y-F, Deng Y-F (2022) *Rungia fangdingiana* (Acanthaceae), a new species from Guangxi, China. PhytoKeys 202: 97–105. https://doi.org/10.3897/phytokeys.202.86653

Abstract

Rungia fangdingiana, a new species of Acanthaceae from Guangxi, China is described and illustrated. This new species belongs to *Rungia* sect. *Rungia*, and resembles *R. sinothailandica* and *R. burmanica* in the erect perennial herbaceous habit, elliptic leaves and inflorescence form, but differs mainly by the indumentum and the morphology of the bracts and corolla. The pollen and seed micromorphology of this new species are studied, with photographs and a line drawing provided.

Keywords

limestone, SEM, taxonomy, tricolporate pollen

Introduction

Rungia Nees is a genus of Acanthaceae, comprising about 50 species and distributed through tropical and subtropical regions of the Old World (Mabberley 2017). It is closely related to *Justicia* L., but differs from the latter mainly by the rising placenta in ripe fruit (Hansen 1989; Hu 2002; Hu et al. 2011; Kiel et al. 2017; Deng 2020; Deng and Gao 2020). Some *Rungia* species were transferred to *Justicia* in regional Floras (Darbyshire et al. 2010; Wood 2014; Vollesen 2015), but the recent systematic studies (Kiel et al. 2017; Manzitto-Tripp et al. 2021) do not agree with this treatment based on molecular and some morphological evidence. In this work, we treat *Rungia* as a separate genus; however, the relationship between *Rungia* and its related genera is awaiting further study.

Sixteen species of *Rungia* were recognized in the "Flora of China" (Hu et al. 2011). Amongst these, *R. monetaria* (Benoist) B. Hansen was misidentified (the collection is actually *R. flaviflora*) and should be excluded from the list of species found in China, *R. axilliflora* and *R. densiflora* were treated as synonyms of *R. stolonifera* (Lin et al. 2020), Whereas *R. burmanica* (C. B. Clarke) B. Hansen is newly recorded in China (Lin and Deng 2017a, 2018), and recently two new species, *Rungia sinothailandica* Z. L. Lin & Y. F. Deng and *R. flaviflora* Z. L. Lin & Y. F. Deng, were described (Lin and Deng 2017b, 2018). Consequently, sixteen species of *Rungia* are still recognized in China at present.

During examination of the specimens in Herbaria (HITBC, PE), a distinctive specimen (*H. Wang 6616*) collected from Napo County, Guangxi in 2002, attracted our attention because of its secund spike, which is the typical character of the genus *Rungia*, but it lacked flower and fruit. Recently, it was collected again in the field complete with flowers and fruits from Napo in 2015 (*Y. H. Tan et al. 4366*) and 2019 (*Y. F. Deng et al. 29030*). After careful study of the specimens and living plants, we confirmed that it represents a new species of *Rungia* and is described below.

Materials and methods

The morphological description of the new species was based on both fresh and dried materials. The voucher specimens (*Y. H. Tan et al. 4366, Y. F. Deng et al. 29030* and *H. Wang 6616*) are deposited in the Herbaria of South China Botanical Garden, Chinese Academy of Sciences (**IBSC**), Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences (**HITBC**) and Institute of Botany, Chinese Academy of Sciences (**PE**).

The pollen and seeds were washed in 70% alcohol and then gilded using the autofine sputter coater (JEOL JFC-1600 Auto Fine Coater, Japan). The micrographs were taken using the scanning electron microscope (JEOL Model JSM-6360 LV, Japan). The polar (P) axis and equatorial (E) diameter of 20 pollen grains were measured and the average, maximum, minimum and ratio (P/E) values were recorded to represent the range of variation. The pollen terminology follows Daniel (1998) and Scotland and Vollesen (2000). The seed terminology follows Graham (1988).

Taxonomic treatment

Rungia fangdingiana Z. L. Lin, Y. F. Deng & Y. H. Tan, sp. nov. urn:lsid:ipni.org:names:77302500-1 Figs 1–3

Type. CHINA. Guangxi Province: Napo County, Baisheng Xiang, Nongmiao Cun, 965 m elev., 24 July 2015, *Y. H. Tan et al. 4366* (holotype: IBSC!; isotypes: IBSC!, HITBC!).

Diagnosis. Similar to *Rungia sinothailandica* and *R. burmanica*, but is readily distinguishable by the flat, entire bract margin (vs. crispate, tawny membranous bract margin in *R. sinothailandica*, and crenulate bract margin in *R. burmanica*), glabrous calyx and capsule (vs. puberulous calyx and puberulent capsule in *R. sinothailandica* and *R. burmanica*), pale yellow corolla with red stripes, upper lip unlobed (vs. white corolla with red stripes, upper lip 2-lobed in *R. sinothailandica*, and white corolla with purple dotted stripes, upper lip unlobed in *R. burmanica*). A detailed comparison of the three species is given in Table 1.

Description. Perennial erect herb, about 1 m tall. Stem terete, glabrous. Leaves usually anisophyllous; petiole 1–2 cm long, glabrous; blade elliptic, $5-15 \times 2-5$ cm, base cuneate, margin entire, apex attenuate or acute, both surfaces glabrous, but densely covered with linear cystoliths, secondary veins 5–10 on each side of mid-vein. Inflorescence of terminal and axillary spikes, 3-7 cm long; peduncle 1-2 cm long, glabrous. Bracts 4-ranked, only two ranks fertile; sterile bracts ovate, oblique at base, $1.4-1.6 \times 0.9-1.1$ cm, green, glabrous, both surfaces covered with linear cystoliths, lacking hyaline margins; fertile bracts rhombic to elliptic, symmetrical, $1.3-1.5 \times 0.9-$ 1.1 cm, green, glabrous, both surfaces covered with linear cystoliths, membranous hyaline margin flat, 0-0.5 mm wide. Bracteoles elliptic, $1.0-1.1 \times 0.3-0.4$ cm, green, glabrous, abaxial surface covered with linear cystoliths, membranous hyaline margin flat, sometimes slightly puberulent at margin, ca. 1 mm wide. Calyx 5-lobed almost to the base, lobes linear, equal, $8-8.5 \times 0.9-1.1$ mm, glabrous. Corolla bilabiate, glabrous, ca. 1.5 cm long, pale yellow with red stripes on lower lip and throat; tube cylindrical at base and enlarged abruptly in throat, ca. 1 cm long; upper lip unlobed, attenuate at apex; lower lip 3-lobed, lobes rounded at apex. Stamens 2, 4.5-5 mm

Characters	R. fangdingiana	R. sinothailandica	R. burmanica
Stem	glabrous	bifariously pubescent	glabrous
Leaves	glabrous	pubescent	glabrous
Sterile bract	without membranous margin,	membranous margin crispate, hyaline with	without membranous margin, mar-
	margin entire	slightly tawny colour, 1.5 mm wide	gin crenulate towards the apex
Fertile bract	rhombic to elliptic, membra-	obovate to elliptic, membranous margin crispate,	obovate, without membranous
	nous margin flat and hyaline,	hyaline at base and tawny at apex, 2 mm wide	margin, margin crenulate towards
	0–0.5 mm wide, margin entire		the apex
Calyx	lobes linear, glabrous	lobes linear, puberulous	lobes linear, puberulous
Corolla	pale yellow with red stripes, up-	white with red stripes, upper lip 2-lobed	white with purple dotted stripes,
	per lip unlobed		upper lip unlobed
Capsule	glabrous	puberulent	puberulent

Table 1. Morphological comparison of Rungia fangdingiana, R. sinothailandica and R. burmanica.



Figure 1. Photographs of *Rungia fangdingiana* sp. nov. **A** habit **B** spike (abaxial view showing the sterile bracts) **C** spike (adaxial view showing the fertile bracts and fruits) **D** spike (adaxial view showing the fertile bracts and corolla) **E** corolla **F**, **G** adaxial view of leaf blade (showing the linear cystoliths) **A–E** by Yun-Hong Tan, **F**, **G** by Zhe-Li Lin.



Figure 2. Fruit, seed and pollen morphology of *Rungia fangdingiana* sp. nov. **A** dehiscent capsule (showing the rising placenta and seeds) **B** seed **C** seed testa (SEM) **D** detail of the vertucae of seed testa (SEM) **E** interapertural view of pollen grain **F** apertural view of pollen grain. Photos by Zhe-Li Lin.

long, inserted at base of corolla throat, base adnate with corolla tube; filaments glabrous; anthers bithecous, superposed, ca. 3 mm long, thecae ovoid, glabrous, lacking a conspicuous basal spur. Pollen prolate, 35.99 (33.2–38.5) × 18.94 (15.7–21.6) μ m, with P/E = 1.90, tricolporate, with one row of insulae on each side of aperture, exine ornamentation reticulate. Ovary glabrous, ca. 1.5 mm long; style slightly puberulent at base and middle part, ca. 1 cm long; stigma minutely 2-lobed. Capsule clavate, stipitate, glabrous, 1.1–1.2 × 0.3–0.35 cm. Seeds suborbicular to elliptic, compressed, dark brown, 2.5–3.5 × 2–2.5 mm, surface covered with brain-like verrucae.

Phenology. It was observed with flower and fruit at the same time from October to December and June to July.

Etymology. This new species is named in honor of Mr. Fang Ding (1924–2017) for his contributions to studies of the family Acanthaceae from Guangxi, China. He was the co-author of the account of family Acanthaceae for "Flora of Guangxi" and has published 37 new taxa of Acanthaceae from Guangxi (Fang and Deng 2017).

Vernacular name. 方鼎孩儿草 (Chinese pinyin: fāng dǐng hái ér cǎo).

Distribution and habitat. This species is currently known from three localities in Napo County of Guangxi Province. It grows close to stream sides in evergreen forest on limestone at elevations of 600 to 1200 m.

Conservation status. During the field investigations, only three scattered populations of *Rungia fangdingiana* were discovered, which all grow in forest on limestone in Napo county. Because of its narrow distribution (extent of occurrence < 20,000 km²), limited locations (< 10), with an estimated population size of < 1000 mature individuals, and there is continuing decline estimated in quality of habitat and number of locations



Figure 3. Line drawings of *Rungia fangdingiana* sp. nov. A flowering branch B spike (abaxial view showing the sterile bracts) C spike (adaxial view showing the fertile bracts and corolla) D sterile bract E fertile bract F bracteole (abaxial view) G bracteole (adaxial view) H calyx I corolla J opened corolla K pistil L stigma M stamen (adaxial view) N stamen (abaxial view) O dehiscent capsule (showing the rising placenta and seeds) P seed. Drawn by Yun-Xiao Liu.

due to human activities as the localities are not protected, it should be assessed as Vulnerable (VU) (B1ab(iii)(iv)) according to the IUCN Red List Categories and Criteria (IUCN 2012, 2022). However, the area around the localities of this new species is poorly investigated, and further rigorous investigations are necessary to confirm this assessment. Additional specimens examined (*paratypes*): CHINA. Guangxi, Napo County: Nonghe Cun, on the way from Nonghe Cun to Tongziwan Power Station, on the rocks near stream-sides, 674 m elev., 11 December 2019, *Y. F. Deng et al. 29030* (IBSC!); Napo County, in limestone forest, 1200 m elev., 24 October 2002, *H. Wang 6616* (HITBC!, PE!).

Discussion

Rungia fangdingiana fits well with the circumscription of *Rungia* sect. *Rungia* according to the infrageneric classification by Gao and Deng (2007), as its flowers are arranged in a secund spike with heteromorphic bracts in two ranks of fertile bracts and two ranks of sterile bracts. Among the species in *Rungia* sect. *Rungia*, this new species is morphologically most similar to *Rungia sinothailandica* and *R. burmanica*, a key to these three similar species are provided as below.

Key to Rungia fangdingiana and morphologically similar species in China

1	Bracts with a crispate, tawny margin, upper lip of corolla 2-lobed
_	Bracts lacking a crispate, tawny margin, upper lip of corolla unlobed2
2	Calyx and capsule glabrous; corolla pale yellow with red stripes
	R. fangdingiana
_	Calyx and capsule puberulous; corolla white with purple dots

Previously, the pollen morphology of ten species were reported in *Rungia* (Raj 1961, 1965; Scotland and Vollesen 2000; Rueangsawang et al. 2013; Lin et al. 2016; Lin and Deng 2017b, 2018; Kiel et al. 2017), amongst which nine species have dicolporate pollen grains and one species (*Rungia flaviflora*) has tricolporate pollen grains. In this study, *R. fangdingiana* is the second species found to have tricolporate pollen grains in *Rungia*.

The seed micromorphology of the four species in *Rungia* has been reported previously (Rueangsawang et al. 2012; Lin et al. 2016; Kiel et al. 2017; Lin and Deng 2017b), with two species having volcano-like verrucae on the seed testa, one species having brainlike verrucae, and *R. repens* was not observed under SEM (Kiel et al. 2017) so the detail of verrucae is not clear. The seed testa of *R. fangdingiana* has brain-like verrucae.

The micromorphology of pollen and seed is important in taxonomy in the family Acanthaceae (Radlkofer 1883; Lindau 1895; Raj 1961; Graham 1988; Daniel 1998; Scotland and Vollesen 2000; Cui and Hu 2005; Hu et al. 2005a, 2005b; Rueang-sawang et al. 2012, 2013; Kiel et al. 2017; Manzitto-Tripp et al. 2021). However, due to the limited number of species studied in *Rungia*, further studies on pollen and seed morphology are necessary to understand its significance in species delimitation and the systematics in this genus.

Acknowledgements

We are grateful to the curators of the Herbaria of HITBC, IBSC and PE for access to the specimens for our study and to Mrs. Yun-Xiao Liu (IBSC) for preparing the line drawings. This work was supported by the National Natural Science Foundation of China (Grant No. 31900182, 31970208), Guangdong Natural Science Foundation (Grant No. 2018A030310390) and Guangxi Chinese Medicine Key Disciplines Construction Projects (GZXK-Z-20-69).

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Selaginella wuyishanensis (sect. Tetragonostachyae, Selaginellaceae), a new species from East China and its phylogenetic position based on molecular data

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Academic editor: Angelo Troia	Received 16 April 2022	Accepted 7 July 2022	Published 28 July 2022
leadenne editerri ingene mona	received to tipin 2022	Theopean , July 2022	1 dononed 20 July 2022

Citation: Xu K-W, Chen S-F, Song Q, Zheng X, Li M, Fang Y-M, Wei H-J, Ding H, Zhou X-M, Duan Y-F (2022) *Selaginella wuyishanensis* (sect. *Tetragonostachyae*; Selaginellaceae), a new species from East China and its phylogenetic position based on molecular data. PhytoKeys 202: 107–119. https://doi.org/10.3897/phytokeys.202.85410

Abstract

A new spikemoss species, *Selaginella wuyishanensis*, is described and illustrated based on materials collected from Fujian Province, East China. The new species can be distinguished from *S. lutchuensis* Koidzumi and *S. albociliata* P. S. Wang by its leaves with extremely long cilia (up to 8 mm) and distinctly white margins, ovate ventral sporophylls, and sporophyll-pteryx completely inverted on dorsal sporophylls. In the present work, a molecular phylogeny, taxonomic description, distribution information, line drawing, and photographs of this new species are presented. A morphological comparison is also given to distinguish it from morphologically similar species in *Selaginella* sect. *Tetragonostachyae* (Hook. & Grev.) Hieron. & Sadeb.

Keywords

Danxia landform, Selaginella albociliata, Selaginella subg. Heterostachys, species diversity

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Introduction

Selaginella P. Beauv. (Selaginellaceae) is the largest genus of seed-free vascular plants with more than 700 species worldwide (Jermy 1990; Zhou and Zhang 2015; PPG 2016; Weststrand and Korall 2016a). It is mainly distributed in tropical and subtropical regions, with a few species reaching the arctic-alpine zones in both hemispheres (Jermy 1990; Zhang et al. 2013). Members of *Selaginella* are heterosporous, and usually have rhizophores, leaves arranged in four rows, and terminal strobili. Though the subgeneric classification of *Selaginella* has been controversial (Zhou and Zhang 2015; Weststrand and Korall 2016b), integrative taxonomy based on morphological, cytological, and molecular data can effectively provide new insights into the species delimitation and discovery of new taxa (Zhou and Zhang 2015; Zhou et al. 2015a, b, 2016; Wu et al. 2017; Ye et al. 2020; Zhang et al. 2021; Wang et al. 2022).

Since 2019, we have conducted investigations into wild vascular plants in Wuyishan National Nature Reserve (**WNNR**) in Fujian Province, East China. Most of the *Selaginella* species we have encountered are common in WNNR and can be easily identified to described species. However, one species collected from Danxia regions of WNNR didn't match species listed in available checklists and monographs or those recently described species from East Asia (Zhang et al. 2013; Zhou et al. 2015a, b; Wu et al. 2017; Shalimov et al. 2019; Ye et al. 2020; Zhang et al. 2021; Wang et al. 2022). Based on morphological study of herbarium specimens and consultation of literature, we found that this species is most similar to *S. albociliata*, but this species has smooth megaspore surfaces and ovate-lanceolate ventral sporophylls. In order to infer the phylogenetic relationships of this species, we conducted a phylogenetic analysis using both plastid and nuclear loci. With evidence from morphological characters and molecular phylogeny, we propose it as a new spikemoss species, and describe and illustrate it herein.

Materials and methods

The gross morphology of the new species was observed and examined both from the fresh plants and dried herbarium specimens using SMZ1270 stereomicroscope (Nikon, Japan). For spore morphology, a scanning electron microscope (SEM) was used to observe the megaspores and microspores. Spore samples obtained from herbarium specimen were mounted on specimen tabs and then coated with platinum in a sputter coater. Observations were conducted using an ESEM-Quanta 200 (FEI, Hillsboro, Oregon, USA) with 15 Kv at Nanjing Forestry University, Nanjing, China. The quantitative characters of the new species were measured using the ImageJ software (Pérez and Pascau 2013). Voucher specimens (see Appendix 1) were deposited at NF and PYU (herbaria acronyms according to Thiers 2018).

For the phylogenetic study, a total of 84 accessions representing 50 species of the genus were included, of which four accessions representing four species were selected
as outgroups based on earlier phylogenetic analysis (Zhou et al. 2016; Weststrand and Korall 2016b). Three samples from three different populations of the new species were newly sequenced. Total genomic DNA was extracted from silica-dried leaves using a TIANGEN plant genomic DNA extraction kit (TIANGEN Biotech, Beijing, China) Mini Kits (Qiagen, Germany) following the manufacturer's protocols. One plastid gene *rbcL* and one nuclear region *ITS* were selected for the phylogenetic analysis based on Zhou et al. (2016). The PCR and sequencing protocols follow Zhou et al. (2016). The newly generated sequences were assembled and edited using Sequencher ver. 4.14 (GeneCodes Corporation, Ann Arbor, Michigan). All sequences of rbcL and ITS regions were initially aligned with MAFFT ver. 7 (Katoh and Standley 2013) and manually adjusted in BioEdit (Hall 1999). The two alignments were concatenated and the final combined dataset was analyzed with maximum likelihood (ML) and Bayesian inference (BI) methods. The ML tree searches were performed using RAxML-HPC2 on XSEDE with 1000 bootstrap replicates. The model GTR+I+G was chosen for the combined dataset using the AIC criterion with JModelTest 2 (Darriba et al. 2012). The BI was conducted using MrBayes ver. 3.2.7a (Ronquist and Huelsenbeck 2003) with temperature parameter set to 0.2, and keeping other parameters consistent with the default parameters of the software. Two independent runs of four Markov chain Monte Carlo chains, each with four chains (one cold, three heated), were conducted, each beginning with a random tree and sampling one tree every 1000 generations of 10 000 000 generations. Convergence among runs and stationarity were assessed using Tracer ver. 1.4 (Rambaut and Drummond 2007), and the first 25% was discarded as burnin. The remaining trees were used to calculate a 50% majority-rule consensus topology and posterior probabilities (PP).

Results and discussion

Based on our phylogenetic analysis, three collections from three different populations of the new species is in a polytomy with *S. lutchensis* and *S. albociliata* (Fig. 1). Three samples of this new species are not resolved as a monophyletic group. However, both *S. lutchuensis* and *S. albociliata* are monophyletic and they form a strongly supported clade together (MLBS = 95% and BIPP = 0.99) (Fig. 1). Morphologically, all the three species have leaves ciliate along the margin. Based on the recent infrageneric classification of *Selaginella* proposed by Zhou and Zhang (2015), *S. wuyishanensis* should be assigned to *S.* subg. *Heterostachys* Baker sect. *Tetragonostachyae* (Hook. & Grev.) Hieron. & Sadeb.

Morphologically, *Selaginella wuyishanensis* is most similar to *S. albociliata* and *S. lutchuensis* in having plants creeping (Fig. 2A), leaf margins white (Fig. 2H–L), axillary and ventral leaves ciliate along the margins (Fig. 2H–L), megaspore surfaces reticulate ornamentation with fine muri (Fig. 2M, N), and microspore surfaces verrucate (Fig. 2O, P), but *S. wuyishanensis* has long cilia on ventral leaves up to 0.6 mm long (Fig. 2H; vs. short cilia up to 0.2 mm long in *S. lutchuensis*), dorsal leaves long



Figure 1. The maximum likelihood phylogeny of *Selaginella wuyishanensis* and its congeners based on plastid gene *rbcL* and nuclear locus ITS. Support values [maximum likelihood bootstrap support (MLBS) \geq 50%, Bayesian inference posterior probability (BIPP) \geq 0.5] are shown above the main branches. The dash (--) indicates MLBS < 50% or BIPP < 0.5.

ciliate (Fig. 2J; vs. loosely serrulate in *S. lutchuensis*), verrucate ornamentation covered with small rodlet in microspore (Fig. 2P; vs. covered with coral-like structures in *S. lutchuensis*: Chang et al. 2009). *Selaginella wuyishanensis* is morphologically also similar to *S. albociliata* in having plants epilithic and leaves ciliate along the margins. However, *S. wuyishanensis* has smooth megaspore surfaces (Fig. 2M, N; vs. megaspore surface with fine and low papillae structure in *S. albociliata*: Zhou et al. 2015b), ventral sporophylls ovate with length-to-width ratio of ca. 2.4 (Fig. 2K; vs. ovate-lanceolate with length-to-width ratio of ca. 3.2 in *S. albociliata*). In geography, *S. wuyishanensis* is only known to occur in the Danxia landform of East China, whereas *S. albociliata* is restricted to the limestone mountains of the karst regions in the Southwest (Guizhou) and South (Guangxi) China.

Taxonomic treatment

Selaginella wuyishanensis K.W.Xu, X.M.Zhou & Y.F.Duan, sp. nov. urn:lsid:ipni.org:names:77302501-1 Figs 2, 3

Type. CHINA. Fujian: Wuyishan City, Mt. Wuyishan, alt. 200m, 27°41'12.82"N, 117°56'12.24"E, 25 Nov. 2021, *Ke-Wang Xu et al. WY21* (holotype: NF!; iso-type: PYU!).

Diagnosis. The new species is most similar to *Selaginella albociliata* and *S. lutchuensis* in the habit, sterile leaves, and spores. However, *S. wuyishanensis* can be distinguished from the latter two species by its long leaf cilia (up to 0.6 mm), ovate ventral sporophylls, and the smooth perispore surface of the megaspores (Figs. 2, 3).

Description. Plants epilithic, evergreen, creeping, without erect or ascending stems. Rhizophores present at intervals throughout the length of creeping stem and branches, born on ventral side in the axil of main branches, slender, glabrous, 2-5 cm long, 0.1-0.2 mm in diameter; roots usually forked at the apex. Stem 5-12 cm long, rarely longer than 12 cm, 3-4 mm in width, irregularly and slightly dichotomously branched. Leaves arranged in four ranks (two dorsal and two ventral). Axillary leaves present at branching points, oblong-ovate, base slightly cuneate, apex acuminate, $0.8-1.2 \times 2.2-2.5$ mm, long ciliate along the margin from base to 2/3 of the axillary leaves, cilia up to 0.8 mm long. Ventral leaves asymmetrical, those on main stem similar to those on branches, imbricate on stem and branch throughout, ovate, $1.5-2.8 \times 0.8-1.2$ mm, apex slightly acute to acuminate, acroscopic base rounded, basiscopic base slightly cuneate, margin conspicuously white-margins; acroscopic margins ciliate at the base, cilia up to 0.6 mm long, basiscopic margins nearly entire at the base, ciliate or denticulate upward. Dorsal leaves symmetrical, ovate to oval, $0.8-1.6 \times 0.6-0.9$ mm, base rounded, apex aristiform, often reflexed, margins conspicuously white-callous, acroscopic margins sparsely ciliate, cilia up to 0.5 mm long, basiscopic margins ciliate, cilia short, no more than 0.1 mm long. Strobili usually in pairs or rarely three on the branches, terminal, resupinate, 1-2 cm long, megasporangia usually present at basal sporophylls and microsporangia present at upper ones; dorsal sporophylls ovate-lanceolate, base nearly rounded, apex acuminate, $1.2-1.8 \times 0.4-0.8$ mm, margin conspicuously white-callous, ciliate along the margin of basal part, cilia short; ventral sporophylls membranous, ovate-lanceolate, base rounded, apex caudate, ca. 0.6×1.3 mm, ciliate along the margin, cilia ca. 0.3 mm long. Megaspores yellow, trilete, oblate spheroid to subglobose, equatorial diameter 240–260 µm; perispore reticulate ornamentation with fine muri. *Microspores* reddish orange, trilete, hemispheric, equatorial diameter 35-42 µm; verrucate ornamentation of microspore covered with dense rodlets.

Distribution and habitat. *Selaginella wuyishanensis* is known only from Fujian Province, East China. Three populations were observed to grow on rocks of the Danxia landform in evergreen broad-leaved forests at elevations of ca. 200–800 m.



Figure 2. *Selaginella wuyishanensis* **A**, **B** habit **C** abaxial view of portion of branch **D** portion of branch showing the dorsal leaves **E** portion of branch showing the ventral and axillary leaves **F**, **G** strobili **H** axillary leave **I** axillary leave **J** dorsal leave **K** ventral sporophyll **L** dorsal sporophyll **M** proximal surface of megaspores **N** detail of megaspore surface **O** microscopic structures of microspore surface **P** proximal surface of microspore.

Additional specimens examined. CHINA. Fujian: Wuyishan City, Mt. Wuyishan, alt. 327 m, 27°41'12.82"N, 117°56'12.24"E, 25 Nov. 2021, *Ke-Wang Xu et al. WY521* (NF); the same locality, alt. 280 m, 27°39'17"N, 117°57'50"E, 27 Nov. 2021, *Ke-Wang*



Figure 3. Illustration of *Selaginella wuyishanensis* **A** habit **B** adaxial view of branch **C** abaxial view of branch with rhizophore **D** axillary leaf **E** ventral leaf **F** dorsal leaf **G** strobili **H** ventral sporophyll **I** dorsal sporophyll (**A–F** drawn by Sun YB based on the isotype at NF **G–I** drawn by Wei HJ based on the paratype at CSH).

Xu et al. WY596 (NF); the same locality, *Ke-Wang Xu et al. WY597* (NF); the same locality, *Ke-Wang Xu et al. WY598* (NF); Yongan City, Tianbaoyan National Nature Reserve, 25°57'11"N, 117°33'14"E, 1 Nov. 2020, *Wei & Chen JSL7744A* (CSH).

Etymology. The species epithet is based on the name of the famous mount Wuyishan, referring to the type locality of the new species.

Key to Selaginella wuyishanensis and its closely related species and morphologically similar species in Fujian Province

1	Leave margins denticulate and not white-margined	2
_	Leave margins more or less ciliate and/or white-margined	
2	Strobili non-resupinate	S. nipponica
_	Strobili resupinate	.S. heterostachys

3	Leaves not white-margined, both sides of ventral leaves long ciliolate at mar-
	gins4
_	Leaves white-margined, acroscopic base of ventral leaves long ciliolate at mar-
	gins, elsewhere denticulate or subentireS. xipholepis
4	Ventral leave margins with short cilia up to 0.2 mm; dorsal leave margins
	loosely serrulate
_	Ventral and dorsal leave margins with cilia up to 0.6 mm5
5	Ventral sporophylls ovate-lanceolate with length-to-width ratio of ca. 3.2;
	megaspore surfaces with fine and low papillae structure S. albociliata
_	Ventral sporophylls ovate with length-to-width ratio of ca. 2.4; megaspore
	surfaces smoothS. wuyishanensis
	•

Acknowledgements

This work was supported by the National Natural Science Foundation of China (#32100167) and the Project of Biological Resources Survey in Wuyishan National Park ([3500]HMGC[GK]2020006). We thank the editor and two anonymous reviewers for their helpful comments. Ke-Wang Xu, Shui-Fei Chen, and Xin-Mao Zhou: Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Software; Validation; Writing – original draft. Ke-Wang Xu, Hong-Jin Wei, Qiang Song, Xiao Zheng, Meng Li, Yan-Ming Fang: Wild investigation (supporting), data curation (supporting), and original draft review and editing (supporting). Ke-Wang Xu, Hui Ding, Xin-Mao Zhou, and Yi-Fan Duan: Conceptualization (lead), Validation (lead), and review and editing (lead).

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Appendix I

List of taxa sampled with information related to taxonomy, GenBank accession numbers (*rbcL*, 5.8S+ITS2), references, and voucher information. Herbarium acronyms follow Index Herbariorum (Thiers 2018).

Selaginella albociliata P.S.Wang (1) L.-B. Zhang et al. 5302 (CDBI), China (Guangxi), KT161379 (Zhou et al. 2016), KT161648 (Zhou et al. 2016); (2) X.-C. Zhang 7242 (PE), China (Guizhou), MH814882 (Shalimov et al. 2019), ---; (3) L.-B. Zhang 526 (CDBI), China (Guizhou), ON994457 (this study), - . Selaginella alutacea Spring Korall 2006-9 (S), Malaysia: KY022958 (Weststrand and Korall 2016b), —. Selaginella amblyphylla Alston (1) X.-C. Zhang 2924 (PE), China (Yunnan), MH814883 (Shalimov et al. 2019), -; (2) X.-C. Zhang 7951 (PE), China (Yunnan), MH814884 (Shalimov et al. 2019), - . Selaginella arbuscula (Kaulf.) Spring (1) Schuettpelz 1941 (US), French Polynesia (Marquesas Islands): MT216108 (Steier and Schuettpelz unpublished); ---; (2) Wood 13746 (PTBG), Hawaii (Maui, Kipahulu): KT161388 (Zhou et al. 2016), KT161657 (Zhou et al. 2016). Selaginella banksii Alston Grant 3563 (L), French Polynesia: KY022972 (Weststrand and Korall 2016b), —. Selaginella behrmanniana Hieron. Johns 8937, (L), Indonesia: KY022973 (Weststrand and Korall 2016b), —. Selaginella bisulcata Spring W.-M. *Chu et al. 31292* (PYU), China (Yunnan): KT161404 (Zhou et al. 2016), KT161673 (Zhou et al. 2016). Selaginella bodinieri Hieron. ex Christ (1) W.-B. Ju & H.-N. Deng HGX13005 (CDBI), China (Sichuan): KT161413 (Zhou et al. 2016), KT161678 (Zhou et al. 2016); (2) *L.-B. Zhang et al. 5177* (CDBI), China (Guangxi): KT161411

(Zhou et al. 2016), KT161679 (Zhou et al. 2016). Selaginella boninensis Baker TNS766618 (TNS), Japan (Tokyo): AB574642 (Ebihara et al. 2010), —. Selaginella brachystachya (Hook. & Grev.) Spring (1) J. Klackenberg 434 (S), Sri Lanka: KY022980 (Weststrand and Korall 2016b), -; (2) W.A. Sledge 913 (L), Sri Lanka: KY022979 (Weststrand and Korall 2016b), —. Selaginella chaetoloma Alston (1) Z.-Y. Guo 2016014 (PE), China (Guizhou): MH814888 (Shalimov et al. 2019), --; (2) X.-C. Zhang 7347 (PE), China (Guizhou): MH814889 (Shalimov et al. 2019), —. Selaginella chingii Alston (1) L.-B. Zhang et al. 6587 (CDBI, MO, VNMN, PYU), Vietnam (Lang Son): KT161417 (Zhou et al. 2016), KT161683 (Zhou et al. 2016); (2) L.-B. Zhang et al. 6594 (CDBI, MO, VNMN, PYU), Vietnam (Lang Son): KT161416 (Zhou et al. 2016), KT161868 (Zhou et al. 2016). Selaginella chrysocaulos (Hook. & Grev.) Spring (1) D. E. Boufford et al. 33036 (A), China (Sichuan): KY022955 (Weststrand and Korall 2016b), -; (2) X.-C. Zhang 86 (PE), China (Sichuan): MH814891 (Shalimov et al. 2019), —. Selaginella ciliaris (Retz.) Spring (1) BVBRI035-20, MT795923 (Patel and Reddy 2020), -; (2) Jiang 310 (PYU, CDBI), China (Hainan): KT161428 (Zhou et al. 2016), KT161691 (Zhou et al. 2016); (3) Unknown (Unknown), Peninsula Malaysia: EU126658 (Yi et al. 2007), -----Selaginella coriaceifolia X.M.Zhou, N.T.Lu & Li Bing Zhang (1) L.-B. Zhang et al. 7307 (CDBI, MO, VNMN), Vietnam (Quang Binh): MT386596 (Ye et al. 2020), MZ570596 (He et al. 2021); (2) L.-B. Zhang et al. 7371 (CDBI, MO, VNMN), Vietnam (Quang Binh): MT386598 (Ye et al. 2020), MT386595 (Ye et al. 2020). Selaginella decipiens Warb. (1) L.-B. Zhang et al. 6764 (CDBI, MO, VNMN, PYU), Vietnam (Bac Kan): KT161438 (Zhou et al. 2016), KT161698 (Zhou et al. 2016); (2) L.-B. Zhang et al. 6761 (CDBI, MO, VNMN, PYU), Vietnam (Bac Kan): KT161439 (Zhou et al. 2016), KT161697 (Zhou et al. 2016). Selaginella denticulata (L.) Spring Korall & Eriksson 715 (S), Unknown: AJ010853 (Korall et al. 1999), ---. Selaginella dianzhongensis X.C.Zhang Zhu Y.-M. 8158 (PE), China (Yunnan): MH814909 (Shalimov et al. 2019), —. Selaginella drepanophylla Alston L.-B. Zhang et al. 5117 (CDBI), China (Guangxi): KT161447, KT161703 (Zhou et al. 2016); Selaginella effusa Alston (1) S.-Y. Dong 2470 (PYU), China (Guangdong): KT161453 (Zhou et al. 2016), KT161705 (Zhou et al. 2016); (2) L.-B. Zhang et al. 5438 (CDBI), China (Guangxi): KT161450 (Zhou et al. 2016), KT161706 (Zhou et al. 2016); (3) L.-B. Zhang et al. 5442 (CDBI), China (Guangxi): KT161451 (Zhou et al. 2016), KT161707 (Zhou et al. 2016). Selaginella goudotiana Spring M. Thulin and H. Razafindraibe 11750 (UPS), Madagascar: KY023039 (Weststrand and Korall 2016b), —. Selaginella goudotiana var. abyssinica (Spring) Bizzarri R.E.G. Pichi Sermolli 6756 (L), Ethiopia: KY023038 (Weststrand and Korall 2016b), ----. Selaginella kanehirae Alston Wood 13568 (PTBG), F.S.M. (Caroline Is., Pohnpei): KT161495 (Zhou et al. 2016), KT161745 (Zhou et al. 2016). Selaginella kurzii Baker (1) X.-M. Zhou et al. PYU-S-2105 (PYU), China (Yunnan): MZ532022 (He et al. 2021); MZ570598 (He et al. 2021); (2) X.-C. Zhang 1934 (PE), China (Yunnan): MH814898 (Shalimov et al. 2019), —. Selaginella labordei Hieron. ex Christ (1) X.-F. Gao et al. DJY03894 (CDBI), China (Sichuan): KT161502 (Zhou et al. 2016), KT161750 (Zhou et al.

2016); (2) H. Smith 2345 (S), China (Sichuan), KY023059 (Weststrand and Korall 2016b), —. Selaginella laxa Spring (1) Schuettpelz 1913 (US), French Polynesia (Marguesas Islands), MT216111 (He et al. 2021); (2) T. G. Yuncker 15994 (U); Tonga, KY023063, —. Selaginella leptophylla Baker (1) L.-B. Zhang et al. 5199 (CDBI), China (Guangxi): KT161511 (Zhou et al. 2016), KT161758 (Zhou et al. 2016); (2) X.-M. Zhou & al. DJY05380 (CDBI), China (Sichuan): KT161513 (Zhou et al. 2016), KT161756 (Zhou et al. 2016). Selaginella lutchuensis Koidz. (1) TNS101683 (TNS), Japan: MT680176 (Zhang et al. 2021), -; (2) TNS759343 (TNS), Japan (Okinawa): AB574648 (Ebihara et al. 2010), - . Selaginella megaphylla Baker (1) X.-H. Jin 19301 (PE), China (Xizang): MH814901 (Shalimov et al. 2019), -; (2) X.-M. Zhou YLZB2185 (CDBI, PYU), China (Xizang): ON994456 (this study), ON994203 (this study). Selaginella menziesii (Hook. & Grev.) Spring D. P. Rogers s.n. (Die XI-10-46) (U), Hawaii, KY023079 (Weststrand and Korall 2016b), ----. Selaginella miniatospora (Dalzell) Bak. (1) J. Klackenberg and R. Lundin 567 (S), India (Kerala): KY023081 (Weststrand and Korall 2016b), -; (2) C. van Hardeveld and H. H. van der Werff 120 (U), India (Tamil Nadu): KY023080 (Weststrand and Korall 2016b), —. Selaginella minutifolia Spring Larsen et al. 1389 (S), Thailand: KY023082 (Weststrand and Korall 2016b), —. Selaginella mittenii Baker van Steenis 24105 (L), South Africa: KY023083 (Weststrand and Korall 2016b), ---. Selaginella monospora Spring (1) L.-B. Zhang & al. 6430 (CDBI, MO, VNMN, PYU), Vietnam (Vinh Phuc): KT161537 (Zhou et al. 2016), KT161782 (Zhou et al. 2016); (2) L. Zhang 1296, China (Yunnan): MZ532023 (this study), —. Selaginella morganii Zeiller P. Korall 2006: 29 (S), Peninsular Malaysia: KY023088 (Weststrand and Korall 2016b), —. Selaginella neocaledonica Baker (1) KY985453 (Klaus et al.2016), —; (2) N. Wikström 244 (S); New Caledonia, KY023095 (Weststrand and Korall 2016b), -. Selaginella nipponica Franch. & Sav. TNS738139 (TNS), Japan (Tokyo): AB574649 (Ebihara et al. 2010), —. Selaginella ornata (Hook. & Grev.) Spring (1) L.-B. Zhang et al. 5200 (CDBI), China (Guangxi): KT161524 (Zhou et al. 2016), KT161770 (Zhou et al. 2016); (2) W.-M. Chu & al. 8226 (PYU), China (Yunnan): KT161525 (Zhou et al. 2016), KT161767 (Zhou et al. 2016). Selaginella qingchengshanensis Li Bing Zhang & X.M.Zhou (1) X.-F. Gao et al. DJY04053 (CDBI), China (Sichuan): KT161381 (Zhou et al. 2016), KT161649 (Zhou et al. 2016); (2) Z.-L. Liang & X. Pu 056 (CDBI, PYU), China (Sichuan): MZ532027 (He et al. 2021), MZ570603 (He et al. 2021). Selaginella reineckei Hieron. (1) K.R. Wood 16944 (PTBG), Samoa (Savaii): MT657902 (Nitta et al. 2020), -; (2) H. S. McKee 2907 P7338 (L); Samoa, KY023129 (Weststrand and Korall 2016b), ---- Selaginella repanda (Desv. & Poir.) Spring (1) Z.-R. He & X.-M. Zhou 119 (PYU, CDBI), China (Yunnan): KT161583 (Zhou et al. 2016), KT161816 (Zhou et al. 2016); (2) He & Jiang 405-1 (CDBI), China (Yunnan): KT161584 (Zhou et al. 2016), ---. Selaginella reticulata (Hook. & Grev.) Spring C.R. Fraser-Jenkins 1653 (L), Nepal: KY022956 (Weststrand and Korall 2016b), —. Selaginella subvaginata X.C.Zhang & Shalimov (1) Liu H. 182 (PE) China (Sichuan): MT680177 (Zhang et al. 2020), ---; (2) X.-C. Zhang et al. 9450 (PE) China (Sichuan): MT680181 (Zhang et al. 2020), ---.

Selaginella trichophylla K.H.Shing (1) L.-B. Zhang et al. 6784 (CDBI, MO, VNMN, PYU), Vietnam (Cao Bang): KT161624 (Zhou et al. 2016), KT161849 (Zhou et al. 2016); (2) W.-M. Chu & al. 29310 (PYU), China (Yunnan): KT161622 (Zhou et al. 2016), KT161846 (Zhou et al. 2016). Selaginella uncinata (Desv.) Spring Zhang & Zhou DJY04101 (CDBI), China (Sichuan): KT161626 (Zhou et al. 2016), KT161852 (Zhou et al. 2016). Selaginella vaginata Spring (1) X.-M. Zhou 012 (CDBI), China (Sichuan): KT161434 (Zhou et al. 2016); ---; (2) X.-M. Zhou & al. DJY07488 (CDBI), China (Sichuan): KT161432 (Zhou et al. 2016), KT161694 (Zhou et al. 2016). Selaginella whitmeei Baker K.R. Wood 17032 (PTBG), Samoa (Savaii), MT657910 (Nitta et al. 2020), —. Selaginella wuyishanensis (1) K.-W. Xu WY596 (PYU), China (Fujian): ON994453 (this study), -; (2) K.-W. Xu WY598 (PYU), China (Fujian): ON994454 (this study), --; (3) H.-J. Wei JSL7744A (CSH), China (Fujian): ON994455 (this study), ON994202 (this study). Selaginella xipholepis Baker (1) S.-Y. Dong 2377 (PYU), China (Guangdong): KT161645 (Zhou et al. 2016), --; (2) L.-B. Zhang & al. 6668 (CDBI, MO, VNMN, PYU), Vietnam (Bac Kan): KT161646 (Zhou et al. 2016), KT161867 (Zhou et al. 2016). Selaginella yunckeri Alston T. G. Yuncker 15933 (U); Tonga, KY023182 (Weststrand and Korall 2016b), ----

RESEARCH ARTICLE



Novelties on the genus Vaccinium (Ericaceae) from Hainan, China: a new species and a new record for the country

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Academic editor: Yasen Mutafchiev | Received 26 February 2022 | Accepted 14 June 2022 | Published 29 July 2022

Citation: Ye X-H, Wang Q-L, Huang M-Z, Tong Y-H (2022) Novelties on the genus *Vaccinium* (Ericaceae) from Hainan, China: a new species and a new record for the country. PhytoKeys 202: 121–132. https://doi.org/10.3897/ phytokeys.202.82786

Abstract

Here we describe a new species, *Vaccinium pseudopubicalyx*, and report a new record for the flora of China, *V. viscifolium*, both from Hainan Province. *Vaccinium viscifolium* also represents the first record of *V.* sect. *Euepigynium* for China. Detailed descriptions and illustrations with analytical photographs of the two taxa are provided.

Keywords

Morphology, new species, taxonomy, Vaccinium pubicalyx

Introduction

The genus *Vaccinium* L., with about 450–500 species distributed worldwide, is the largest genus of the tribe Vaccinieae in Ericaceae (Fang 1991; Fang and Stevens 2005; Vander Kloet and Dickinson 2009; POWO 2022). In China, 97 species of *Vaccinium* have been recorded, with several new species or records reported from the country after the revision completed by Fang and Stevens (2005) in "Flora of China", such as

V. eberhardtii Dop, *V. damingshanense* Y. H. Tong & N. H. Xia, *V. napoense* Y. H. Tong & N. H. Xia, *V. zhangzhouense* Y. H. Tong, Y. Y. Zhu & N. H. Xia, and *V. motuoense* Y. H. Tong & Y. J. Guo (Fang 1991; Fang and Stevens 2005; Tong and Xia 2015; Tong et al. 2018; Tong et al. 2020; Tong et al. 2021a, b). Three species of *Vaccinium* are recorded from Hainan Province in "Flora of Hainan", viz. *V. bracteatum* Thunb., *V. chunii* Merr. ex Sleumer and *V. hainanense* Sleumer, among which *V. hainanense* is endemic to Hainan (Instituti Botanici Austro-Sinensis Academiae Sinicae 1974).

During a recent field trip to Hainan, two species never recorded from the province were respectively found in Wuzhi Mountain and Mazui Mountain. The one from Wuzhi Mountain is similar to *V. pubicalyx* Franch. and *V. bracteatum* Thunb. var. *chinense* (Lodd.) Chun ex Sleumer due to their similar habit and leaf blade shape. The other one from Mazui Mountain firstly reminded us of *V. hainanense*, a species that has never been collected again since 1933 when the type specimens were collected, and owns the similar leathery leaf blades with an obtuse or abruptly obtuse-acute apex as this unknown species. However, its pinnipalmate leaf venation and glabrous floral disk are rather different from *V. hainanense*.

After a detailed examination of our materials and possible similar species from China and neighbouring countries (King and Gamble 1910; Dop 1930; Sleumer 1967; Pham 1999; Nguyen 2005; Newman et al. 2007; Watthana 2015), we concluded that the species from Wuzhi Mountain is new to science, and the other from Mazui Mountain is *V. viscifolium* King & Gamble, which represents a new record for the flora of China. Thus, we report these novelties as follows.

Taxonomy

Vaccinium pseudopubicalyx X. H. Ye, Q. L. Wang & Y. H. Tong, sp. nov. urn:lsid:ipni.org:names:77302514-1 Figs 1–3

Type. CHINA, Hainan, Wuzhishan City, Wuzhi Mountain, montane summit scrub, 18.89°N, 109.69°E,1867 m a.s.l., 20 March 2020, *Yi-Hua Tong, Xue-He Ye, Xin-Ting Ma & Qing-Long Wang YXH-18* (holotype: IBSC; isotypes: IBSC, ATCH).

Diagnosis. *Vaccinium pseudopubicalyx* is morphologically similar to *V. pubicalyx* and its varieties, but can be distinguished by having fewer pairs of secondary veins (3–5 (Fig. 2E) vs. 5–9 (Fig. 5A, B)), smaller $(2-3.5 \times \text{ca. 1 mm vs. } 5-8 \times \text{ca. 1.5}-2 \text{ mm})$ and lanceolate (vs. ovate) floral bracts, young twigs and inflorescences rachis white-pubescent (vs. brown-ish-tomentose), and anthers with smaller dorsal spurs (0.5–1 mm vs. ca 4 mm, Fig. 5F).

Description. Evergreen terrestrial shrubs or small trees, 2–4 m tall; much branched, young twigs pubescent, glabrescent. Petioles 3–5 mm long, pubescent; blades elliptic or ovate, $2.2-5 \times 0.8-1.9$ cm, chartaceous, glabrous on both sides, midvein prominent on both sides, pubescent, glabrescent abaxially, secondary veins 3–5 pairs, visible in vivo, inconspicuous adaxially and slightly raised abaxially when dry, base broadly



Figure 1. *Vaccinium pseudopubicalyx* **A** habit **B** trunk **C** leafy branch **D** flowering branch. Photos **A–C** by Y. H. Tong; **D** by X. H. Ye.

cuneate, margin serrulate, apex acuminate, shortly caudate. Perennating buds monomorphic. Inflorescence pseudo-terminal or axillary on distal part of twigs, racemose, with 10–13 flowers, rachis 1.4–2.5 cm long, densely pubescent; floral bract caducous, 1, inserted at the base of pedicel, lanceolate to linear, 2–3.5 × ca. 1 mm, glabrous adaxially, pubescent abaxially, margin entire, ciliate; bracteoles 2, unequally inserted at the lower part of pedicel, long ovate-triangular to linear, 1–1.6× ca. 1 mm, glabrous adaxially, pubescent abaxially, margin entire, ciliate; pedicel articulated between pedicel and calyx, 3–4.5 mm long, densely pubescent. Hypanthium cupuliform, $1-2 \times 1.5-2$ mm, pubescent; calyx lobes triangular to broadly triangular, $1-2.5 \times 1-1.5$ mm, glabrous adaxially, pubescent abaxially, margin entire, ciliate. Corolla white, tinged with red, tubular, sometimes slightly urceolate, $4.5-8 \times 3.5-4.5$ mm, pubescent outside, pilose



Figure 2. *Vaccinium pseudopubicalyx* **A** inflorescence **B** flower **C** two bracteoles and one floral bract, adaxial (left) and abaxial (right) view **D** calyx lobe, abaxial (left) and adaxial (right) view **E** leaves **F** opened corolla, adaxial (left) and abaxial (right) view **G** stamens, lateral (left), abaxial (middle) and adaxial (right) view **H** anther pores **I** hypanthium, disk and style with front two calyx lobes removed **J** ovary, apical (left) and transverse (right) view. Scale bars: 3 cm (**E**); 1 cm (**A**, **B**); 5 mm (**F**, **I**); 3 mm (**D**, **G**); 2 mm (**D**, **J**); 1 mm (**H**). Photos by X. H. Ye.

inside; corolla lobes slightly reflexed, small, triangular, $1-1.8 \times 1-1.5$ mm; stamens 10, dimorphic, 4.5–5 mm long, filaments 2–3 mm long, densely pilose, anthers dorsifixed with 2 minute spurs, ca. 2.5 mm long, thecae ca. 1 mm long, papillate, spurs on antesepalous anthers ca. 0.1 mm long, those on antepetalous anthers ca. 0.05 mm long, inconspicuous, tubules 1.5–2 mm long, 1.5–2 times as long as anther thecae, apex poricidal, pores 0.45–0.6 mm long, teeth absent; ovary inferior, pseudo-10-locular, disk disciform, 10-ridged, pilose, style cylindrical, 6–6.5 mm long, glabrous, stigma punctate. Fruits not seen.



Figure 3. *Vaccinium pseudopubicalyx* **A** flowering branches **B** bracteoles, adaxial (left) and abaxial (right) view **C** floral bract, adaxial view **D** flower **E** hypanthium, disk and style with front one calyx lobe removed **F** calyx lobe, adaxial view **G** opened corolla, adaxial view **H** stamens, adaxial view **I** dorsal anther spurs of antepetalous anthers (left) and antesepalous anthers (right) **J** ovary, transverse view. Drawn by Mr. D. H. Cui.

Etymology. The specific epithet *pseudopubicalyx*, a noun in apposition, alludes to close alliance to *Vaccinium pubicalyx*.

Vernacular name. 拟毛萼越橘 (Chinese pinyin: nǐ máo è yuè jú).

Phenology. Flowering in January–June; fruiting time unknown.

Distribution and habitat. *Vaccinium pseudopubicalyx* has been found at four localities in Hainan, viz. the type locality, Bawangling National Nature Reserve (19.12°N, 109.08°E), Jianfengling Tropical Forest Nature Reserve (18.72°N, 108.91°E) and Yinggeling National Nature Reserve (19.18°N, 109.45°E) (Fig. 4). It grows in montane forests or scrub on the mountain summits at elevations from 1122 to 1867 m.

Taxonomic notes. Besides the differences mentioned in the diagnosis, *Vaccinium pseudopubicalyx* and *V. pubicalyx* are strictly allopatric: the former one is endemic to Hainan, while the other one is distributed in southwest China and Myanmar.

The new species has also been occasionally identified as *V. bracteatum* var. *chinense* (Champ. ex Benth.) Chun ex Sleumer (Zhang et al. 2007; Xing et al. 2012). It can be easily separated from *V. bracteatum* var. *chinense* by its inconspicuous (vs. prominent) secondary veins on adaxial surface of leaf blade. Besides, the elliptic or ovate (vs. rhombic-elliptic or lanceolate-elliptic) leaf blades with fewer pairs of secondary veins (3–5 vs. 5–7), shorter inflorescence rachis (1.4–2.5 cm vs. 4–10 cm), smaller (2–3.5 × ca. 1 mm vs. 5–20 × 1–3 mm), entire (vs. serrated) and lanceolate to linear (vs. ovate to oblong-ovate) floral bracts, and different ratio of the length of anther tubules to anther thecae (1.5–2 vs. 2–2.5) can also separate the new species from *V. bracteatum* var. *chinense*.

Vaccinium pseudopubicalyx should be assigned to sect. *Eococcus* Sleumer, because its morphological characteristics match well with those of that section, such as a terrestrial habit, serrate leaf blades, axillary racemes with elongate rachis, deciduous bracts, articulation



Figure 4. The distribution of Vaccinium pseudopubicalyx and V. viscifolium in Hainan Island (China).

between hypanthium and pedicel, spurred anthers and a pseudo-10-locular ovary. According to Sleumer (1941), the main difference between sect. *Eococcus* and sect. *Bracteata* Nakai is that the former has caducous bracts during anthesis, whereas the latter has persistent ones. However, when examining specimens of *V. iteophyllum* Hance, a widespread species (distributed in almost every province in southern China) placed in sect. *Eococcus* by Sleumer (1941), we observed that some populations (e.g., *Y. H. Tong & L. Bai 12062414*, IBSC) also have persistent bracts even when fruiting. Thus, the delimitation of the two sections appears to not be natural, and the relationship of the two sections needs further study.

Additional specimens examined. Vaccinium pseudopubicalyx (paratypes): CHINA. Hainan: Baisha County, Yuanmen Town, Yinggeling National Nature Reserve, main peak, 31 May 2005 (fl.), F. W. Xing, Rong-Jing Zhang & Yu-Shi Ye 16371 (IBSC); ibid., same date as above, Sai-Chit Ng 5766 (HK, not seen); Changjiang County, Bawangling National Nature Reserve, mountain top, 1380 m a.s.l., 6 January 1964, Pei Zeng 13511 (HITBC); ibid., the second peak (Axe Peak), 27 April 1988 (fl.), Ze-Xian Li & Fu-Wu Xing 4004 (IBSC0528562); ibid., the second peak (Axe Peak), June 1983 (fl.), Guo-Ai Fu 3408 (IBSC0420642); Ledong County, Jianfengling Tropical Forest Nature Re-



Figure 5. *Vaccinium pubicalyx* and comparison of stamen of *V. pubicalyx* and *V. pseudopubicalyx* **A** young leafy branch of *V. pubicalyx* **B** branch with young inflorescences of *V. pubicalyx* **C** flowering branches of *V. pubicalyx* **D** floral bract of *V. pubicalyx*, abaxial (left) and adaxial (right) view **E** stamens of *V. pubicalyx* (left) and *V. pseudopubicalyx* (right) **F** dorsal anther spurs of *V. pubicalyx* (left) and *V. pseudopubicalyx* (right). Scale bars: 3 mm (**D**, **E**); 2 mm (**F**). Materials of *V. pubicalyx* in **D–F** from *G. Forrest 7637* (IBSC0457011), and those of *V. pseudopubicalyx* in **E–F** from type. Photos **A**, **C** by H. B. Ding; **B** by Y. H. Tong; **D–F** by X. H. Ye.

serve, 1400 m a.s.l., 25 January 1984 (fl.), *Shi-Man Huang 306* (IBSC0420202); ibid., the second peak, 1220 m a.s.l., 29 November 1957, *Qi-Cai He 90777* (IBSC0420580).

Vaccinium pubicalyx: CHINA. Yunnan: Tali [Dali Profecture], Houang-kia-pin [Huangjiaping], 4 July 1888, *P. J. M. Delavay 3311* (syntypes: P04484707, image; P04484708, image; P04484709, image; L008184, image); [Tengchong City], hills at the north end of the Tengyueh Valley, May 1912, *G. Forrest 7637* (IBSC0457011; K00780601, image; E00327780, image; E00327781, image).

Vaccinium bracteatum var. chinense: CHINA. Hong Kong: Champion s. n. (K00780589, image).

Vaccinium viscifolium King & Gamble in J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 74(1): 63. 1906.

Figs 6, 7

Type. MALAYSIA, Perak, *Scortechini 405* (lectotype CAL, not seen, designated by Sleumer in 1961: 84; isolectotypes BM000996430, image!, K, not seen, P00647874, image!)

Description. Evergreen terrestrial shrubs or trees, up to 6 m tall; young twigs pubescent, glabrescent. Petioles flat, 0.5-1.2 cm long, pubescent; blades elliptic, oblanceolate, obovate or oblong-obovate, 4.8-11.1 × 1.3-3.4 cm, coriaceous, stipitateglandular on both sides, pinnipalmate, midvein prominent abaxially, flat or slightly sunken adaxially, secondary veins 3-6 pairs, in vivo visible adaxially, flat or slightly raised, inconspicuous abaxially, in sicco inconspicuous on both sides, apex obtuse or rounded, margin entire, slightly revolute, with 1-3 pairs of glands at the basal part, base attenuate, extended. Perennating buds monomorphic. Inflorescence axillary, racemose, with 11-18 flowers; rachis 3.8-5 cm long, sparsely stipitate-glandular; bract caducous, 1, inserted at the base of pedicel, ovate or lanceolate, $9-16 \times 3-6.5$ mm, glabrous, margin entire, involute; bracteoles oppositely inserted at the base of pedicel, 2, linear, $1.5-2.5 \times$ ca. 0.5 mm, glabrous on both sides, margin entire, ciliate; pedicel articulated between pedicel and calyx, 3-5.5 mm long, glabrous. Hypanthium cupuliform, $2-2.5 \times 2.5-3$ mm, glabrous; lobes triangular to broadly triangular, $1-2.5 \times 1.5-2$ mm, glabrous on both sides, margin ciliate. Corolla pinkish to white, cylindric-urceolate, $8-10 \times 4-5$ mm, glabrous on both sides; lobes reflexed or slightly spreading, small, ovate or triangular, $1.5-2 \times 1.5-2$ mm, glabrous abaxially, papillate adaxially; stamens 10, dimorphic, 6-7 mm long, filaments swollen at base, 3-3.5 mm long, densely pilose, anthers without dorsal spurs, 3-3.5 mm long, thecae 1-1.5 mm long, papillate, tubules 1.5–2.5 mm long, 1.5–2 times as long as anther thecae, apex poricidal, pores ca. 0.5 mm long, antesepalous anthers with 1 tooth at apex of anther tubules, antepetalous anthers with 2 teeth at apex of anther tubules, teeth ca. 0.5 mm long; ovary inferior, pseudo-10-locular, disk disciform, 10 ridged, glabrous, style cylindrical, 0.8–0.9 cm long, glabrous, stigma truncate. Young fruits glaucous, subglobose, persistent calyx lobes incurved, nearly covering disk.

Vernacular name. 槲寄生叶越橘 (Chinese pinyin: hú jì shēng yè yuè jú).



Figure 6. *Vaccinium viscifolium* **A** habitat **B** habit **C** flowering branch **D** fruiting branch. Photos by Y. H. Tong.

Distribution and habitat. *Vaccinium viscifolium* is distributed in China (Hainan, Fig. 4), Southern Indochina to Peninsular Malaysia. So far, Hainan is the northern-most distribution locality of this species. It grows on open limestone of mountainsides or mountain ridges in montane forests at an elevation of ca. 750 m in Hainan.

Taxonomic notes. *Vaccinium viscifolium* has two varieties, viz. the nominate variety and *V. viscifolium* var. *bicalcaratum* Sleumer. The latter differs from the former by having leaves with a shortly (ca. 1 cm) and obtusely attenuate (vs. obtuse or rounded) apex and anthers with (vs. without) 2 distinct dorsal spurs (Sleumer 1967). The plants from Hainan should belong to the nominate variety, as they have leaves with an obtuse or rounded apex and anthers without dorsal spurs.

Vaccinium viscifolium was initially assigned to sect. Euepigynium Schltr. by Sleumer (1941). However, when compiling Flora Malesiana, he reassigned it to sect. Bracteata, which was recognized with an extremely broad sense to include 163 species consisting of members from several sections, such as sect. Bracteata s.s., sect. Nesococcus H. F. Copel., and sect. Euepigynium (Sleumer, 1967). Stevens (1969) pointed out that the leaves of the species of sect. Euepigynium with an entire margin and plinerved venation were very different from those of sect. Bracteata, which have a serrate margin and pinnate venation. Vander Kloet and Dickinson (2009) also treated sect. Euepigynium and sect. Bracteata as two distinct sections. Moreover, the marginal or basal glands often occur to sect. Euepigynium, and are absent in the species of sect. Bracteata s.s. without exception. Thus, we do not adopt Sleumer's broad sense of sect. Bracteata



Figure 7. *Vaccinium viscifolium* **A** flowering branch **B** leaves **C** floral bract, adaxial (left) and abaxial (right) view **D** bracteoles, adaxial (left) and abaxial (right) view **E** calyx lobe, adaxial (left) and abaxial (right) view **F** flower **G** opened corolla, adaxial (up) and abaxial (below) view **H** hypanthium, disk and style with front two calyx lobes removed **I** stamens, lateral (left), abaxial (middle) and adaxial (right) view **J** ovary, apical (left) and transverse (right) view. Scale bars: 5 cm (**A**, **B**); 1 cm (**C**, **F**, **G**, **H**); 5 mm (**I**); 2 mm (**D**, **E**, **J**). Photos by X. H. Ye.

(Sleumer, 1967), and prefer to agree with the assignment of *V. viscifolium* to sect. *Euepigynium* Sleumer (1941). Whereas sect. *Euepigynium* is only found in Malesiana and Indochina formerly, *Vaccinium viscifolium* is the first species of sect. *Euepigynium* reported from China.

Additional specimens examined. Vaccinium viscifolium: CHINA. Hainan: Ledong County, the ridge of Mazui Mountain, 18.61°N, 109.38°E, 750 m a.s.l., 23 March 2020, Yi-Hua Tong, Xue-He Ye & Ming-Zhong Huang YXH-29 (IBSC).

A key to the species of *Vaccinium* from Hainan Province is provided below.

Key to the species of Vaccinium in Hainan

1	Leaves serrate, chartaceous or subcoriaceous2
_	Leaves entire, coriaceous
2	Secondary veins inconspicuous adaxially, 3–5 pairs; inflorescence rachis 1.4–
	2.5 cm long; floral bracts small, 2-3.5 mm long, caducous, lanceolate to
	linear, margin entire; anther tubules 1.5–2 times as long as anther thecae
	V. pseudopubicalyx
_	Secondary veins prominent adaxially, 5–7 pairs; inflorescence rachis 4–10 cm
	long; floral bracts large, leaf-like, 5-20 mm long, usually persistent, ovate to
	oblong-ovate, margin serrate; anther tubules 2-2.5 times as long as anther
	thecae
3	Leaf apex caudate; racemes 5–9 flowered; calyx lobes lanceolate V. chunii
_	Leaf apex obtuse or abruptly obtuse-acute; racemes with 10 flowers or more;
	calyx lobes triangular or broadly triangular4
4	Leaf venation pinninerved; veins conspicuous on both sides; disk tomentose
	V. hainanense
_	Leaf venation pinnipalmate; veins inconspicuous on both sides; disk
	glabrous

Acknowledgements

We are grateful to Mr. Hong-Bo Ding from Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences and Mr. Shu-Peng Dong from Dongguan Botanical Garden for providing the photos of *Vaccinium pubicalyx* and *V. pseudopubicalyx* respectively, Ms Xin-Ting Ma from Hainan University for her kind assistance during the field trip, and Mr. Ding-Han Cui for preparing the line-drawing. Our thanks also go to the curators of E, HITBC, IBSC, L, K and P for allowing us to examine their specimens or providing photographs of specimens for research. This study was funded by Biological Resources Program, Chinese Academy of Sciences (KFJ-BRP-017-33) and the National Natural Science Foundation of China (grant no. 31870180).

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RESEARCH ARTICLE



Erythroxylum austroguangdongense (Erythroxylaceae), a new species from Guangdong, China

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Academic editor: Hugo de Boer	Received 31 March 2022	Accepted 1 July 2022	Published 29 July 2022

Citation: He C-M, Zhou X-X, Ye X-H, Chen W, Tong Y-H (2022) *Erythroxylum austroguangdongense* (Erythroxylaceae), a new species from Guangdong, China. PhytoKeys 202: 133–138. https://doi.org/10.3897/phytokeys.202.84688

Abstract

Erythroxylum austroguangdongense (Erythroxylaceae), a new species from Guangdong Province, China, is described and illustrated. This new species is morphologically most similar to *E. calyptratum*, but is distinguished by the leathery leaf blade with fewer pairs of secondary veins and flowers borne on leafless nodes of the basal part of the current branch with much longer pedicels and sub-rectangular petal appendages. This is the second native species of *Erythroxylum* recorded from China.

Keywords

Coca family, morphology, taxonomy

Introduction

The genus *Erythroxylum* P. Browne (Erythroxylaceae), with about 264 species, is widely distributed in tropics and subtropics with the center of its diversity in Neotropics (POWO 2022). Many species of this genus contain the substance cocaine, and can be used medicinally as a narcotic. In China, only two species of *Erythroxylum* are recorded,

i.e., the introduced *E. novogranatense* (D. Morris) Hieron. and the widely distributed *E. sinense* Y. C. Wu (Liu and Bartholomew 2008).

During field surveys of medicinal plant resources in Guangdong Province, we encountered an unknown *Erythroxylum* species with white flowers, while the species previously recorded from China either has whitish-yellow (*E. novogranatense*) or pinkish (*E. sinense*) flowers. After a morphological comparison with specimens in the herbarium (IBSC) and consulting the relevant literature (e.g. Guillaumin 1907; Chung 1996; Hô 2003; Liu and Bartholomew 2008; Harwood and Chayamarit 2011; Komada et al. 2018), we concluded that this unknown species is morphologically distinct from all the other species previously known in China and its surrounding countries. Thus, we describe and illustrate it as a new species.

Materials and methods

Flowering and fruiting material was collected from Zhuhai and Taishan, Guangdong Province, China during several field trips from 2019 to 2022. Descriptions were based on both living and dried collections, which were deposited at the herbarium of South China Botanical Garden, Chinese Academy of Sciences (**IBSC**). Measurements were performed with a ruler, and small plant parts were observed and measured under a stereo microscope (Mshot-MZ101).

Taxonomic treatment

Erythroxylum austroguangdongense C. M. He, X. X. Zhou & Y. H. Tong, sp. nov. urn:lsid:ipni.org:names:77302515-1 Fig. 1

Type. CHINA. Guangdong Province: Taishan, Chaliao Ao, 22°12'54.87"N, 112°57'34.84"E, 563 m a.s.l., 3 April 2021 (fl.), *Xin-Xin Zhou & Yue-Yao Liu LSX303* (holotype: IBSC, isotypes: IBSC).

Diagnosis. Most similar to *E. calyptratum* Komada & Tagane in having reddish brown to grayish brown branches with dense lenticels, and white petals with appendages, but distinguished by the leathery (vs. thinly chartaceous) leaf blade with fewer pairs of secondary veins (6–8 pairs vs. 11–15 pairs), and flowers borne on leafless nodes of the basal part of current branch (vs. in leaf axils) with longer pedicels (1–1.5 cm vs. 5.2–7 mm) and sub-rectangular petal appendage (vs. bilobed appendage with each lobe consisting of a short anterior auricle and a large posterior auricle). A more detailed comparison of the two species is shown in Table 1.

Description. Shrubs deciduous, 1.5-2 m tall, dioecious. Young branches greenish, old branches reddish-brown to grayish-brown, lenticellate. Stipule triangular to narrowly triangular, $1.8-3 \times 0.7-0.8$ mm, margin entire when young, gradually fimbriate,

Characters	E. austroguangdongense	E. calyptratum
Leaf blade texture	Leathery	Thinly chartaceous
Leaf blade shape	Elliptic or lanceolate	Elliptic, oblong, oblong-lanceolate or ovate
Leaf blade color	Dark green and shining adaxially	Pale green adaxially
Secondary veins	6–8 pairs	11–15 pairs
Flower	Solitary on leafless nodes of the basal part of current branch	Solitary to 3-fascicled in leaf axils
Pedicel length	1–1.5 cm	5.2–7 mm
Petal appendage	Sub-rectangular	Bilobed and each lobe consisting of a short anterior
		auricle and a large posterior auricle

Table 1. Morphological comparison of Erythroxylum austroguangdongense and E. calyptratum.

or dissected, caducous when old. Leaves alternate, simple; petiole 3.5–6 mm long; blade elliptic or lanceolate, 4-7.7 × 1.6-2.5 cm, leathery, apex acuminate, acumen to 5 mm long, base cuneate or attenuate, margin entire, dark green and shining adaxially, pale green abaxially, midrib sunken adaxially, prominent and pale yellow to brownish-yellow abaxially, secondary veins 6-8 pairs, almost flat, faintly visible on both surfaces, tertiary veins reticulate, obscure adaxially, slightly visible abaxially. Flowers solitary on leafless nodes of the basal part of current branch, pedicel 1-1.5 cm long; bracteole triangular, ca. 0.8 mm long, margin fimbriate or serrately dissected; calyx 1.6-1.8 mm long, lobes 5, ovate-triangular, ca. 1 mm long, apex brownish, acute; petals 5, white, oblong, 3.7-4 mm long, apex obtuse or rounded, adaxially with one appendage attached ca. 1.5 mm above from base, appendage sub-rectangular, ca. 1.6×1 mm, papillate throughout, slightly concave on both upper and lower margin. Stamens or staminodes 10. Male flowers: stamens with different length of filaments arranged alternately, short filaments ca. 3.7 mm long, long ones ca. 4 mm long, all basally connate into a tube, tube ca. 2 mm long, densely covered with papillary trichomes; anthers ca. 1.1 mm long; sterile pistil ca. 4 mm long. Female flowers: staminodes ca. 1.2 mm long, staminodal tube ca. 1 mm long, anther absent; ovary ellipsoidal, 2–2.5 mm long, 1–1.3 mm in diam., 3-locular, with 1 fertile locule, styles 3, entirely free at base, ca. 1 mm long including stigma, stigma clavate, ca. 0.5 mm long, reflexed, with papillae. Young fruits green, turning to yellowish, ripening red, ovoid to reniform, apex oblique, $7-9 \times 2.5-3$ mm.

Etymology. The species epithet is named after the distribution area of this new species, South Guangdong.

Vernacular name. 南粤古柯 (Chinese pinyin: nán yuè gǔ kē).

Distribution and habitat. This species is currently known only from Guangdong Province, China. Three populations are found in Yangchun (E'huangzhang), Zhuhai (Fenghuang Mountain) and Taishan (Gudou Mountain) respectively. It grows in evergreen broadleaved forests at elevations of 170–800 m.

Conservation Status. According to the field observation, the number of mature individuals of *Erythroxylum austroguangdongense* is less than 100. Thus, it is assigned a status of 'Endangered' (EN) following the IUCN Red List categories and criteria (IUCN Standards and Petitions Committee 2022). Since most of its distribution area is under the protection of E'huangzhang Natural Reserve and Gudou Mountain Natural Reserve, and it is not economically valuable, the threat risk seems to be low.



Figure 1. *Erythroxylum austroguangdongense* **A** flowering branches **B** leafy branches **C** female flowers **D** male flower **E** stipule, showing fimbriate margin **F** flower bud, showing calyx **G** petals, adaxial (left), lateral (middle) and abaxial (right) view **H** androecium **I** staminodes and pistil **J** cross section of ovary, showing one fertile locule (low right) **K–L** fruits. Scale bars: 3 mm (**H**); 2 mm (**E–G**, **I**); 1 mm (**J**). Photographs **A–B** by Xin-Xin Zhou **D**, **K** by Wei-Jun Chen **H** by Xue-He Ye and others by Chun-Mei He.

Phenology. Flowering in March-April and fruiting in April-August.

Additional specimens examined (paratypes). CHINA. Guangdong, Taishan: Banyuzui, 448 m a.s.l., 28 March 2019 (fl.), *Lei Jiang, Jin-Fan Lin, Jin-Ye Feng, Fu-Jun Chen & Jie-Lin Chen GDS-00291* (IBSC); Chaliao Ao, 205 m a.s.l., 25 April 2019 (fr.), *Teng-Hui Guo, Jin-Fan Lin & Jia-Ming Chen GDS-00484* (IBSC); ibid., 19 May 2019 (fr.), *Taishan Expedition 440781190519024LY* (IBSC). Yangchun: Bajia, Xianjiadong Reservoir, 800 m a.s.l., 1 August 2001 (fr.), *Hua-Gu Ye 6094* (IBSC); Bajia Reservoir, 750 m a.s.l., 5 August 2001 (fr.), *Hua-Gu Ye 6199* (IBSC). Zhuhai: Fenghuang Mountain, 177 m a.s.l., 2 April 2021 (young fr.), *Yi-Hua Tong, Wei-Jun Chen & Feng Ling TYH-2526* (IBSC); ibid. 20 March 2022 (fl.), *Wei-Jun Chen TYH-2561*(IBSC).

Discussion

This new species is the second native species reported from China, and it differs from previously recorded species, i.e., *Erythroxylum sinense*, in having leathery (vs. chartaceous) leaf blades with faintly visible (vs. prominent) veins and white (vs. pinkish) petals with sub-rectangular (vs. ligule-like) appendages.

Erythroxylum species, especially *E. coca* Lam. and *E. novogranatense*, are well known for their tropane alkaloids, such as cocaine (Aynilian et al. 1974). According to Lv et al. (2022), 383 compounds, including diterpenes, triterpenes, flavonoids, alkaloids, and other derivates, have been found in 67 *Erythroxylum* species. Investigating this new taxon for its phytochemical constituents could lead to the discovery of novel sources of these compounds, as well as possibly new compounds unknown to science.

Acknowledgements

We are grateful to Mr. Feng Ling and Mr. Yue-Yao Liu for their help during field trips. Our thanks also go to the curators of IBSC for allowing us to examine their specimens. This study was funded by the Guangdong Provincial Special Fund for Natural Resource Affairs on Ecology and Forestry Construction with the project "Survey of Woody Plant Germplasm Resources in Guangdong", the National Survey of Traditional Chinese Medicine Resources from National Administration of Traditional Chinese Medicine (grant no. GZY-KJS-2018-004) and Forestry Science and Technology Innovation Specific Project of Guangdong Province (grant no. 2018KJCX002).

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