Taiwania 69(2): 207–228, **2024**
DOI: 10.6165/tai.2024.69.207

An updated synopsis of *Lysimachia* L. (Lysimachieae, Primulaceae) of Taiwan

Kuo-Fang CHUNG[1,*], Yoshiko KONO[2], Chia-Lun HSIEH[1], Li-Wei TSAI[1], Hong-Wun CHEN[1], Hsun-An YANG[1], Diego T. VASQUES[3], Goro KOKUBUGATA[4], Ching-I PENG[1,†], Kazuo OGINUMA[2,*]

1. *Research Museum and Herbarium (HAST), Biodiversity Research Center, Academia Sinica, 128 Academia Road, Section 2, Taipei 115201, Taiwan.* ***2.*** *The Community Center for the Advancement of Education and Research, University of Kochi, 5-15 Eikokuji-cho, Kochi 780-8515, Japan.* ***3.*** *Botanical Gardens, Graduate School of Science, the University of Tokyo, 3-7-1, Hakusan, Bunkyo-ku, Tokyo, 112-0001 Japan.* ***4.*** *Department of Botany, National Museum of Nature and Science, 4-1-1 Amakubo, Tsukuba, Ibaraki 305-0005, Japan.* [†]*Deceased* [*]*Corresponding authors' emails: KFC: bochung@gate.sinica.edu.tw; KO: oginuma_kazuo@yahoo.co.jp*

(Manuscript received 21 February 2024; Accepted 20 May 2024; Online published 31 May 2024)

ABSTRACT: Based on literature review, molecular phylogenetics of ITS sequences, and chromosome cytology, the taxonomy of *Lysimachia* s.l. (Primulaceae) of Taiwan is updated. Amongst the 15 taxa recognized in the most recent work of the genus in Taiwan, *L. ardisioides* is synonymized under *L. simulans* that has long been neglected, *L. arvensis* var. *caerulea* is elevated to specific status and replaced with the name *L. loeflingii*, the specific status of the newly described *L. ravenii* is reaffirmed, and *L. congestiflora*, a misapplied name, is corrected to *L. taiwaniana*. We also identify references that represent the genuine first reports of the genus *Lysimachia* and *L. candida* of Taiwan, respectively, and reveals *L. taiwaniana* as an isonym that was published independently twice by two different authors based on the same type. To stabilize the taxonomy of *Lysimachia* of Taiwan, *L. capillipes* Hemsl., *L. consobrina* Hance, *L. decurrens* var. *recurvata* Matsum., *L. formosana* Honda, *L. mauritiana* Lam., *L. lineariloba* Hook. & Arn., and *L. nigropunctata* are lectotypified, and *L. candida* Lindl. is neotypified. The recently described *L. lalashanensis* S.S.Ying and *L. nanhutashanensis* S.S.Ying are synonymized under *L. capillipes* Hemsl. and *L. taiwaniana* Suzuki, respectively.

KEY WORDS: Chromosome cytology, isonym, lectotype, molecular phylogenetics, neotype, TaiCOL, taxonomic literature.

INTRODUCTION

The traditionally defined *Lysimachia* L. (i.e., *Lysimachia* s.str.) comprises ca. 220 species (Yan *et al*., 2018; Pan *et al*., 2022) of annual and perennial herbs known for various therapeutic properties ranging from treating liver and urinary problems to external applications for injuries, inflammations, and detoxification purposes (Chen and Hu, 1979; Ye *et al*., 2022). Together with *Anagallis* L., *Asterolinon* Hoffmanns. & Link, *Glaux* L., *Pelletiera* A.St.-Hil., and *Trientalis* L., *Lysimachia* s.str. constitutes the tribe Lysimachieae of Primulaceae (Chen and Hu, 1979; Hao *et al*., 2004). While molecular phylogenetic studies supported the monophyly of Lysimachieae (e.g., Källersjö *et al*., 2000), the tribe was shown to be closer to and should be classified under the woody plant family Myrsinaceae (Ståhl and Anderberg, 2004). On the other hand, phylogenetic studies showed that *Lysimachia* s.str. is not monophyletic, intermingling with all other five genera of Lysimachieae (Hao *et al*., 2004; Manns and Anderberg, 2005; Anderberg *et al*., 2007; Liu *et al*., 2023). Consequently, Manns and Anderberg (2009) revised its generic delimitation and synonymized all other five genera of Lysimachieae under *Lysimachia* (i.e., *Lysimachia* s.l.). The inclusion of the herbaceous *Lysimachia* s.l. within the woody Myrsinaceae, however, blurred its boundaries with other primuloid families (i.e., Maesaceae, Primulaceae, and Theophrastaceae). To reach a coherent taxonomic solution, APG III (2009) expanded Primulaceae as the sole family of the primuloid Ericales, a treatment widely followed by subsequent studies (e.g., APG IV, 2016; Lin and Chung, 2017; Larson *et al*., 2023).

In the Flora of Taiwan 2nd edition, 11 species of *Lysimachia* s.l. were documented, including "**Anagalis**" *arvensis* L. and 10 species of *Lysimachia* s.str. (Kao and Peng, 1998). Following the infrageneric classification of Handel-Mazzetti (1928) and Chen *et al*. (1989), these 10 species of *Lysimachia* s.str. can be classified under sect. *Apodanthera* Hand.-Mazz. (two species: *L. ardisioides* Masam. and *L. capillipes* Hemsl.), sect. *Lubinia* (Comm.) Klatt (one species: *L. mauritiana* Lam.), sect. *Nummularia* (Gilib.) Klatt (five species: *L. chingshuiensis* C.I Peng & C.M. Hu, *L. congestiflora* Hemsl., *L. japonica* Thunb., *L. nigropunctata* Masam., and *L. remota* Petitm.), sect. *Palladia* (one species: *L. decurrens* G.Forst.), and sect. *Spicatae* (R.Knuth) Hand.-Mazz. (one species: *L. fortunei* Maxim.). Subsequently, the cosmopolitan weed *Anagallis minima* (L.) E.H.L.Krause [≡ *L. minima* (L.) U.Manns & Anderb.] was reported to become naturalized in Taiwan (Hsu *et al*., 2009). Based on specimens at LE and BM [abbreviations of herbaria following Index Herbariorum (https://sweetgum.nybg.org/science/ih/)] collected in the late 19th century, Yang *et al*. (2012) reported the newly recorded and yet extinct species *L. candida* Lind. that was rediscovered in 2020 in northern Taiwan (Chung *et al*., 2020). Meanwhile, *L. ravenii* C.I Peng was published posthumously in the "Illustrated Flora of Taiwan" (Chung,

2018), in which the blue-flowered Scarlet Pimpernel [*L. arvensis* var. *caerulea* (L.) Turland & Bergmeier] was further segregated from *L. arvensis* (L.) U.Manns & Anderb. (≡ *Anagallis arvensis*) that elsewhere denotes the Scarlet Pimpernel much rarer in Taiwan.

However, while molecular phylogenetic analyses supported the resurrection of *L. taiwaniana* (Kokubugata *et al*., 2010) that has long been synonymized under *L. congestiflora* (Chen and Hu, 1979; Chen *et al*., 1989; Hu and Kelso, 1996; Kao and Peng, 1998), the latter name was still adopted by both Yang *et al*. (2012) and Chung (2018). Additionally, although *L. ravenii* C.I Peng is a valid name, it was published posthumously (in Chung, 2018) without sufficient information characteristic of Peng's publication [see Chung (2020) for Peng's academic legacy] to ascertain its specific status. Furthermore, while *L. ardisioides* has generally regarded as an endemic species to Taiwan (Kao and DeVol, 1970; Kao and DeVol, 1978; Hu and Kelso, 1996; Kao and Peng, 1998; Kokubugata *et al*., 2006), the entity was treated by Yamazaki (1993) as two species: *L. sikokiana* Miq. of southern Japan to northern Taiwan and *L. simulans* Hemsl. of central and southern Taiwan. Although the relationship between *L. ardisioides* and *L. sikokiana* had long been debated (Kokubugata *et al*., 2006), the name *L. simulans* had been entirely overlooked after Yang (1982).

This article aims to provide the most updated synopsis of *Lysimachia* s.l. essential to the Catalogue of Life in Taiwan (TaiCOL; https://taicol.tw/), the national database that maintains the most complete authoritative list of Taiwan's species (Lin and Chung, 2017; Tsai *et al*., 2023). ITS sequences, which are richly represented for *Lysimachia* s.l. in NCBI (https://www.ncbi.nlm.nih.gov/), were collected to assure phylogenetic relationships of Taiwanese *Lysimachia* s.l. (Hao *et al*., 2004; Kokubugata *et al*., 2010). Because *Lysimachia* is known for its high chromosomal variation (Ståhl and Anderberg, 2004; Kokubugata *et al*., 2006; Kono *et al*., 2012; Kono *et al*., 2019), data of chromosome cytology of species sect. *Nummularia* were also collected to facilitate species delimitation.

MATERIALS AND METHODS

Taxonomic literature review

In addition to regional floras (e.g., Bentvelzen, 1962; Dyer, 1963; Kao and DeVol, 1978; Chen *et al*., 1989; Yamazaki, 1993; Hu and Kelso, 1996; Kao and Peng, 1998; Takahashi, 2017), taxonomic studies (e.g., Kao and DeVol, 1970; Chen and Hu, 1979; Manns and Anderberg, 2009; Yang *et al*., 2012), and checklists (e.g., Henry, 1896; Matsumura, 1912; Hayata, 1917; Sasaki, 1928; Masamune, 1954; Hsieh and Yang, 1969; Yang, 1982; Editorial Committee of the Red List of Taiwan Plants, 2017), we comprehensively searched for references pertaining to *Lysimachia* s.l. of Taiwan using online resources such as Biodiversity Heritage Library (BHL; https://www.biodiversitylibrary.org/), GBIF (Global Biodiversity Information Facility; https://www.gbif.org/zh-tw/), Plants of TAIWAN (https://tai2.ntu.edu.tw/), JSTOR Global Plants (https://plants.jstor.org/), Plants of the World Online (https://powo.science.kew.org/), etc., for early literatures as well as images of type specimens.

Molecular phylogenetic analyses

To complement previous phylogenetic studies, ITS sequences of 17 accessions representing all 15 species of *Lysimachia* s.l. of Taiwan (Fig. 1) were newly collected using Sanger sequencing method following procedures detailed in Hao *et al*. (2004) and Kokubugata *et al*. (2010). All newly acquired sequences have been registered to NCBI and their accession numbers are shown in Figure 1. DNA sequences were aligned using MAFFT v7.490 (Katoh and Standley, 2013) under Geneious Prime 2022.1.1 (Kearse *et al*., 2012) with default setting. Maximum likelihood (ML) tree was reconstructed using RAxML 8.2.11 (Stamatakis, 2014) with 500 rapid bootstrapping (BS) to search for best-scoring tree ML tree under Geneious Prime. Nodes with the BS value lower than 50 were collapsed as polytomy by TreeCollapseCL4 v3.2 (http://emmahodcroft.com/TreeCollapseCL.html). After a preliminary analysis based on the matrix combining ours with all ITS sequences on NCBI (https://www.ncbi.nlm.nih.gov/), redundant sequences within a monophyletic species were excluded for final analysis. The ML tree was visualized using FigTree v1.4.4 (https://github.com/rambaut/figtree/releases).

Chromosome cytology

Somatic chromosomes were observed using root tips collected from plants cultivated in the Experimental Greenhouse of Biodiversity Research Center, Academia Sinica (Taiwan). Table 1 summarizes accessions of *Lysimachia* sect. *Nummularia* of Taiwan and *L. congestiflora* investigated for chromosome cytology. The method and procedure for pretreatment, fixation and staining of chromosomes detailed in Kono *et al*. (2012) were followed. For karyotype analysis, Levan *et al*. (1964)'s nomenclature of chromosome morphology based on centromeric position was followed.

RESULTS

Taxonomic literature review

We identified 35 names in a total of 45 primary taxonomic references that deal with *Lysimachia* s.l. pertaining to the flora of Taiwan. Table 2 summarizes names reported in these references under the 15 species recognized in current study (see Discussion). Among these, 12 names (bold names in Table 2) were described based on type specimen collected from Taiwan. Table S1

Table 1. Chromosome cytology of ***Lysimachia*** sect. ***Nummularia*** of Taiwan and ***L. congestiflora***. All voucher specimens are deposited in HAST.

Species	Chromosome numbers/karyotype	Reference or voucher information
Sect. *Nummularia*		
L. chingshuiensis	2*n* = 24 = 6m + 4sm + 6st + 8t	TAIWAN: Hualien. Taroko, *C.-I Huang 2124* (https://n2t.net/ark:/18474/b29883b6t)
L. japonica	2*n* = 20 = 6m + 4sm + 8st + 2t	TAIWAN: Taipei. Nangang, *C.-I Peng 18731*
L. nigropunctata	2*n* = 24 = 6m + 4sm + 4st + 10t	TAIWAN: Kaohsiung. *C.-I Huang 3412* (https://n2t.net/ark:/18474/b2nz81m0p)
L. ravenii	2*n* = 42 = 14m + 8sm + 8st + 12t	TAIWAN: Pingtung, Chunjih, *C.-I Huang 2825*
L. remota	2*n* = 22 = 4m + 2sm + 8st + 8t	TAIWAN: New Taipei City, Sandiaojiao, *C.-I Peng 21406*
	2*n* = 22 = 4m + 2sm + 8st + 8t	TAIWAN: Miaoli. *C.-I Peng 21428* (https://n2t.net/ark:/18474/b26d5q678)
	2*n* = 22 = 4m + 2sm + 8st + 8t	CHINA. Guangxi, Chongzuo, 23 Apr 2016, *C.-I Peng s.n.*
L. taiwaniana	2*n* = 70 = 14m + 12sm + 44st(t)	TAIWAN: Ilan. Yuanyang Lake *T.-Y. Liu 1539*
	2*n* = 70 = 14m + 12sm + 44st(t)	TAIWAN: Ilan. *K.-F. Chung 3957*
L. congestiflora	2*n* = 24 = 2m + 4sm + 8st + 10t	CHINA. Guangxi, Debao. *C.-I Peng 21079* (https://n2t.net/ark:/18474/b26689d0p)
	2*n* = 24 = 4m + 4sm + 6st + 10t	CHINA. Yunnan, Maguan. *C.-I Peng 20475* (https://n2t.net/ark:/18474/b2cv4cg2z)
	2*n* = 48 = 8m + 8sm + 12st + 20t	CHINA. Yunnan, Funing. *C.-I Peng 20517* (https://n2t.net/ark:/18474/b21834s2r)

summarizes HTTP URIs of online type specimen images examined in present study.

Molecular phylogenetic analyses

Our final sampling comprised 198 sequences representing 144 taxa of 138 species (Fig. 1) and the alignment is 678 bp in length with 355 bp of parsimony informative sites (52.4% of the total length). The ML tree visualized using FigTree v1.4.4 (https://github.com/rambaut/figtree/releases) is depicted in Figure 1, labelled with infrageneric classification of Lysimachia s.str. based on Ray (1956), Chen and Hu (1979), Hu (1985), and Hu and Kelso (1996).

In general, all newly sequenced Taiwanese samples are placed in clades corresponding to respective infrageneric classification and species clades (Fig. 1). In sect. *Apodanthera*, our *L. capillipes* is placed within an unresolved clade composed several other accessions of the same species sampled from China as well as other species of the section (BS = 73), while *L. ardisioides* (≡ *L. simulans*) is placed in a clade composed of *L. petelotii*, *L. confertifolia*, *L. sikokiana*, and *L. microcarpa* with a BS value of 58. Our newly sequenced accessions of *L. candida*, *L. decurrens*, *L. fortunei*, and *L. mauritiana* are all placed in their respective sections (i.e., sect. *Candidae*, sect. *Palladia*, sect. *Spicatae*, and sect. *Lubinia*) as well as species clade; however, *L. candida* is not monophyletic. The six sampled species of sect. *Nummularia* are all placed in the Section *Nummularia* clade with a BS value of 100. However, while the monophyly of *L. chingshuiensis* and *L. remota* are supported, *L. congestiflora*, *L. japonica*, and *L. nigropunctata* are not monophyletic. Two samples of *L. congestiflora* form the basal grade of the monophyletic *L. taiwaniana*, while one samples of *L. japonica* is nested within a clade largely dominated by *L. congestiflora*. The four samples of *L. nigropunctata* are placed into two clades, with one sister to *L. chingshuiensis* and another one sister to *L. ravenii* (Fig. 1). Of the three sampled species previously placed in *Anagallis*, *L. minima* is sister to another accession of the same species (BS = 100). Although our sampled *L. arvensis* and *L. loeflingii* (sampled from the same locality) are placed into two separate clades (BS = 87 vs. 50, respectively) and thus confirm the Taiwanese entities are indeed two different species, both species clades are not monophyletic.

Chromosome cytology

The chromosome numbers and karyotypes of *Lysimachia* sect. *Nummularia* investigated are summarized in Table 1. The chromosome cytology of each species is detailed as followings:

The chromosome cytology of *L. chingshuiensis* is reported for the first time. The number of chromosomes at mitotic metaphase is 2*n* = 24 (Figs. 2a & 3a). The longest chromosome is ca. 4.0 μm long, and the shortest ca.1.4 μm long. Among the 24 chromosomes, six chromosomes (Nos. 1–6 in Fig. 3A) have centromeres at median position (m-chromosome), four (Nos. 7–10 in Fig. 3A) at submedian position (sm-chromosome), six (Nos. 11–16 in Fig. 3A) at subterminal position (st-chromosome), and eight (Nos. 17–24 in Fig. 3A) at terminal position (t-chromosome). Satellite chromosomes are not observed. The karyotype formula is 2*n* = 24 = 6m + 4sm + 6st + 8t.

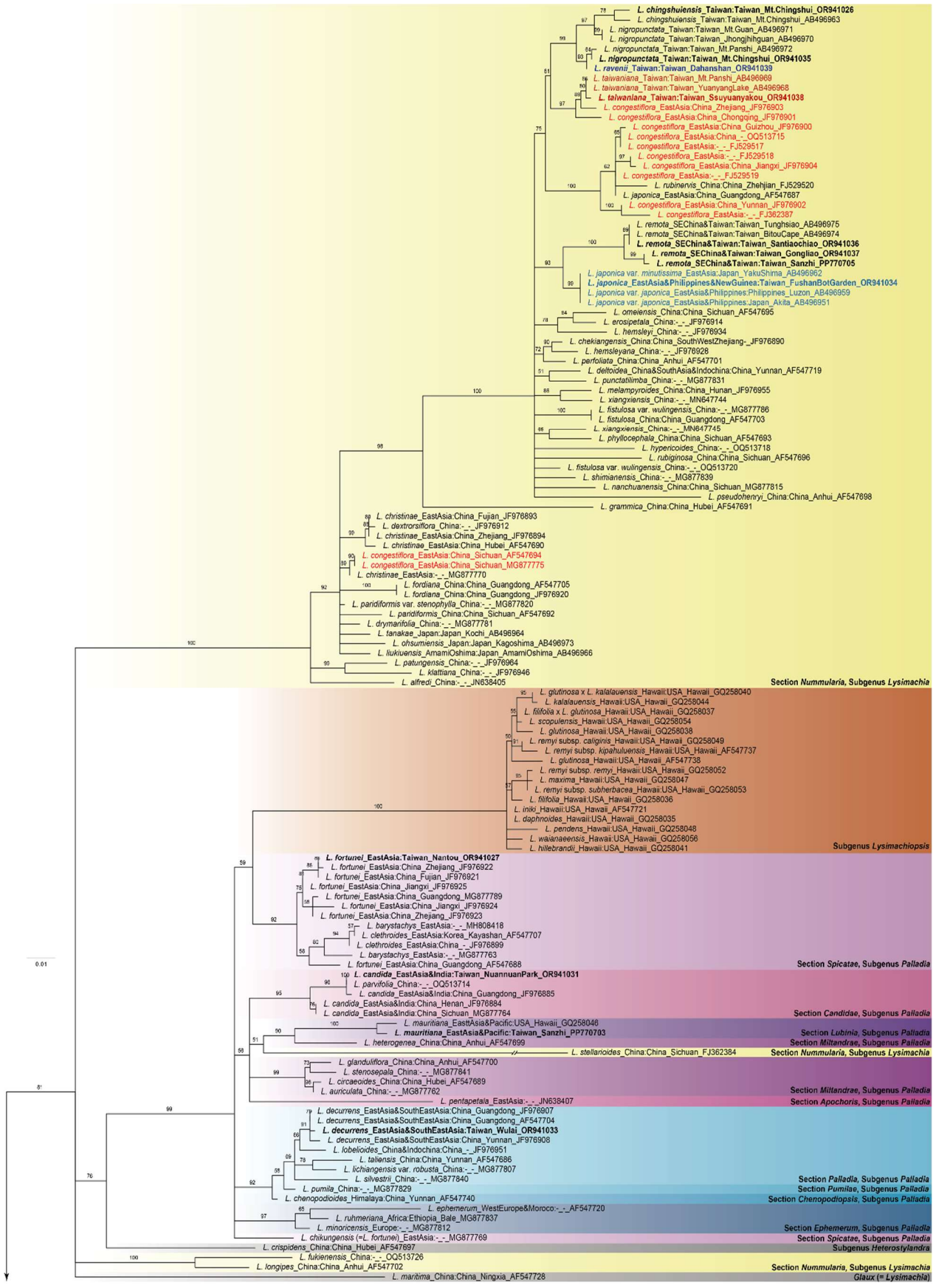
The number of chromosomes in *L. japonica* at mitotic metaphase is 2*n* =20 (Figs. 2B & 3B), congruent with previous studies (e.g., Jinno, 1956; Hara and Kurosawa, 1959; Tanaka and Hizume, 1978; Ko *et al.*, 1986; Shinohara and Murakami, 2006). The longest chromosome is ca. 2.4 μm long, and the shortest ca. 1.2 μm long. Among the 20 chromosomes, six chromosomes (Nos. 1–6 in Fig. 3B) have centromeres at median position, four (Nos. 7–10 in Fig. 3B) at submedian position, eight (Nos. 11–18 in Fig. 3B) at subterminal position, and two (Nos. 19 & 20 in Fig. 3B) at terminal position. Satellite chromosomes are not observed. The karyotype formula is 2*n* = 20 = 6m + 4sm + 8st + 2t, slightly different from that of 2*n* = 20 = 6m + 4sm + 4st + 6t reported by Tanaka and Hizume (1978).

Table 2. Taxonomic history of ***Lysimachia*** of Taiwan. The first column shows the chronological order of references, while the first row lists species recognized in present study. Names in bold denote species described based on type specimen (syntypes or holotype) collected from Taiwan as well as new combinations. Superscript numbers denote numeric order of the name reported in Taiwan.

	L. decurrens	*L. fortunei*	*L. japonica*	*L. loeflingii*	*L. mauritiana*	*L. simulans*	*L. capillipes*	*L. candida*	*L. arvensis*	*L. remota*	*L. nigropunctata*	*L. taiwaniana*	*L. chingshuiensis*	*L. minima*	*L. ravenii*
1863	*L. multiflora*[1]														
1866	***L. consobrina***[2]														
1868		***L. fortunei***[3]													
1877	*L. decurrens*[4]														
1889	+	+	*L. japonica*[5]	*A. arvensis*[6]	*L. linearilobа*[7]	***L. simulans***[8]									
1896	+	+	+	*A. arvensis*	+	+	near *L. alternifolia*[9]								
1900b	+		+	*A. arvensis*	*L. linearilobа*	*L. sikokiana*[11]		***L. candida***[10]							
1905	*L. decurrens var. eudecurrens*[13]	+	+		*L. mauritiana*[14]	*L. sikokiana*		*L. candida ssp. eucandida*[12]							
1906	*L. decurrens* & *L. lobelioides*[16]	+	+	*A. arvensis*	*L. linearilobа*	*L. sikokiana* & *L. simulans*		*L. leucantha*[15]							
1908						*L. sikokiana*									
1910	*L. decurrens* & *L. lobelioides*	+	+	*A. arvensis*	*L. linearilobа*	*L. sikokiana* & *L. simulans*		*L. leucantha*							
1911							***L. fragrans***[17]								
1912	+	+	+	*A. latifolia*[18]	*L. linearilobа*	*L. sikokiana*		+	+						
1917	+	+	+	*A. arvensis*	*L. linearilobа*	*L. sikokiana* & *L. simulans*	*L. fragrans*	*L. leucantha*							
1928						*L. sikokiana*									
1928	+	+	+	*A. arvensis*	+	*L. sikokiana* & *L. simulans*	*L. fragrans*	*L. leucantha*							
1930										***L. formosana***[19]					
1932b											***L. nigropunctata***[20]				
1932a	***L. recurvata****[21]					***L. aridisioides***[22]									
1935							*L. capillipes*[23]								
1936-1	+	+	+	*A. arvensis*	+	*L. ardisioides* & *L. simulans*	+	*L. leucantha*		*L. formosana*	+				
1936-2												*L. taiwaniana*[24]			
1954	+	+	+	*A. arvensis*	+	*L. ardisioides* & *L. simulans*	+	*L. leucantha*		*L. remota*[25]	+	*L. congestiflora*[26] & *L. taiwaniana*			
1962-1	+		+		+	*L. sikokiana*	+								
1962-2								+							
1969	*L. decurrens* & *L. recurvata*	+	+	*A. arvensis*	+	*L. ardisioides* & *L. simulans*	+	*L. leucantha*		+	+				
1970	*L. acroadenia*[27]	+	+	*A. arvensis*	+	*L. ardisioides*	+		*A. arvensis*	*L. formosana*	+	*L. taiwaniana*[28]			
1978	+	+	+	*A. arvensis*	+	*L. ardisioides*	+		*A. arvensis*	*L. formosana*	+	+			
1979											*L. congestiflora*	*L. congestiflora*			
1980				*A. arvensis*	*L. mauritiana* & ***L. mauritiana*** var. ***taiwaniana***[29]					***L. japonica*** var. ***formosana***[30]					
1982	+	+	+	*A. arvensis*	+	*L. ardisioides* & *L. simulans*	+	*L. leucantha*	*A. arvensis*	*L. formosana*	+	+			
1984		+	+		+	*L. sikokiana*									
1989	+	+	+		+	*L. sikokiana*	+		*A. arvensis*	+	*L. congestiflora*	*L. congestiflora*			
1993	+	+	+		+	*L. sikokiana* & *L. simulans*									
1996	+	+	+	*A. arvensis*	+	*L. ardisioides*	+		*A. arvensis*	+	*L. congestiflora*	*L. congestiflora*			
1998	+	+	+	*A. arvensis*	+	*L. ardisioides*	+		*A. arvensis*	+	+	*L. congestiflora*	*L. chingshuiensis*[31]		
1999-1													***L. chingshuiensis***		
1999-2	+	+	+	*A. arvensis*	+	*L. ardisioides*	+		*A. arvensis*	+	+	*L. congestiflora*	+		
2009														*A. minima*[32]	
2012	+	+	+		+	*L. ardisioides*	+	+		+	+	*L. congestiflora*	+		
2017-1	+	+	+	*A. arvensis*	+	*L. ardisioides*	+	+	*A. arvensis*	+	+	*L. congestiflora*	+	*A. minima*	
2017-2	+	+	+		+			+							
2018	+	+	+	*L. arvensis* var. *caerulea*	+	*L. ardisioides*	+	+	+	+	+	*L. congestiflora*	+	+	***L. ravenii***[33]
2022a[34] & 2022b[35]							***L. lalashanensis***[35]					***L. nanhutashanensis***[34]			

*Ref: Swinhoe, 1863; Hance, 1866; Maximowicz, 1868; Hance, 1877; Forbes & Hemsley, 1889; Henry, 1896; Matsumura, 1900b; Pax & Knuth, 1905; Matsumura & Hayata, 1906; Hayata, 1908; Kawakami, 1910; Hayata, 1911; Matsumura, 1912; Hayata, 1917; Handel-Mazzetti, 1928-1; Sasaki, 1928-2; Honda, 1930; Masamune, 1932b; Masamune, 1932a; Odashima, 1935; Mori, 1936-1; Suzuki, 1936-2; Masamune, 1954; Bentvelzen, 1962-1; Okuyama, 1962-2; Hsieh & Yang, 1969; Kao & DeVol, 1970; Kao & DeVol, 1978; Chen & Hu, 1979; Ying, 1980; Yang, 1982; Ohwi, 1984; Chen *et al.*, 1989; Yamazaki, 1993; Hu & Kelso, 1996; Kao and Peng, 1998; Peng & Hu, 1999-1; Yang *et al.*, 1999-2; Hsu *et al.*, 2009; Yang *et al.*, 2012; Editorial Committee of the Red List of Taiwan Plants, 2017-1; Takahashi, 2017-2; Chung, 2018; Ying, 2022a; Ying, 2022b.

The basionym of ***Lysimachia recurvata* (Matsumura) Masam. is ***L. decurrens*** var. ***recurvata*** Matsumura based on type specimen collected from the Ryukyus (Matsumura, 1900a). Masamune (1932a) elevated the taxon to the specific status (i.e., ***Lysimachia recurvata***) and stated that the species is distributed in the Ryukyus and Taiwan, citing a specimen collected in Keelung ("Keelung, May 17, 1932, leg. Simada et Odajima").


L. chingshuiensis_Taiwan:Taiwan_Mt.Chingshui_OR941026
L. chingshuiensis_Taiwan:Taiwan_Mt.Chingshui_AB496963
L. nigropunctata_Taiwan:Taiwan_Mt.Guan_AB496971
L. nigropunctata_Taiwan:Taiwan_Jhongjhihguan_AB496970
L. nigropunctata_Taiwan:Taiwan_Mt.Panshi_AB496972
L. nigropunctata_Taiwan:Taiwan_Mt.Chingshui_OR941035
L. ravenii_Taiwan:Taiwan_Dahanshan_OR941039
L. taiwaniana_Taiwan:Taiwan_Mt.Panshi_AB496969
L. taiwaniana_Taiwan:Taiwan_YuanyangLake_AB496968
L. taiwaniana_Taiwan:Taiwan_Ssuyuanyakou_OR941038
L. congestiflora_EastAsia:China_Zhejiang_JF976903
L. congestiflora_EastAsia:China_Chongqing_JF976901
L. congestiflora_EastAsia:China_Guizhou_JF976900
L. congestiflora_EastAsia:China_-_OQ513715
L. congestiflora_EastAsia:-_-_FJ529517
L. congestiflora_EastAsia:-_-_FJ529518
L. congestiflora_EastAsia:China_Jiangxi_JF976904
L. congestiflora_EastAsia:-_-_FJ529519
L. rubinervis_China:China_Zhehjian_FJ529520
L. japonica_EastAsia:China_Guangdong_AF547687
L. congestiflora_EastAsia:China_Yunnan_JF976902
L. congestiflora_EastAsia:-_-_FJ362387
L. remota_SEChina&Taiwan:Taiwan_Tunghsiao_AB496975
L. remota_SEChina&Taiwan:Taiwan_BitouCape_AB496974
L. remota_SEChina&Taiwan:Taiwan_Santiaochiao_OR941036
L. remota_SEChina&Taiwan:Taiwan_Gongliao_OR941037
L. remota_SEChina&Taiwan:Taiwan_Sanzhi_PP770705
L. japonica var. minutissima_EastAsia:Japan_YakuShima_AB496962
L. japonica_EastAsia&Philippines&NewGuinea:Taiwan_FushanBotGarden_OR941034
L. japonica var. japonica_EastAsia&Philippines:Philippines_Luzon_AB496959
L. japonica var. japonica_EastAsia&Philippines:Japan_Akita_AB496951
L. omeiensis_China:China_Sichuan_AF547695
L. erosipetala_China:-_-_JF976914
L. hemsleyi_China:-_-_JF976934
L. chekiangensis_China:China_SouthWestZhejiang-_JF976890
L. hemsleyana_China:-_-_JF976928
L. perfoliata_China:China_Anhui_AF547701
L. deltoidea_China&SouthAsia&Indochina:China_Yunnan_AF547719
L. punctatilimba_China:-_-_MG877831
L. melampyroides_China:China_Hunan_JF976955
L. xiangxiensis_China:-_-_MN647744
L. fistulosa var. wulingensis_China:-_-_MG877786
L. fistulosa_China:China_Guangdong_AF547703
L. xiangxiensis_China:-_-_MN647745
L. phyllocephala_China:China_Sichuan_AF547693
L. hypericoides_China:-_-_OQ513718
L. rubiginosa_China:China_Sichuan_AF547696
L. fistulosa var. wulingensis_China:-_-_OQ513720
L. shimianensis_China:-_-_MG877839
L. nanchuanensis_China:China_Sichuan_MG877815
L. pseudohenryi_China:China_Anhui_AF547698
L. grammica_China:China_Hubei_AF547691
L. christinae_EastAsia:China_Fujian_JF976893
L. dextrorsiflora_China:-_-_JF976912
L. christinae_EastAsia:China_Zhejiang_JF976894
L. christinae_EastAsia:China_Hubei_AF547690
L. congestiflora_EastAsia:China_Sichuan_AF547694
L. congestiflora_EastAsia:China_Sichuan_MG877775
L. christinae_EastAsia:-_-_MG877770
L. fordiana_China:China_Guangdong_AF547705
L. fordiana_China:China_Guangdong_JF976920
L. paridiformis var. stenophylla_China:-_-_MG877820
L. paridiformis_China:China_Sichuan_AF547692
L. drymanifolia_China:-_-_MG877781
L. tanakae_Japan:Japan_Kochi_AB496964
L. ohsumiensis_Japan:Japan_Kagoshima_AB496973
L. liukiuensis_AmamiOshima:Japan_AmamiOshima_AB496966
L. patungensis_China:-_-_JF976964
L. klattiana_China:-_-_JF976946
L. alfredi_China:-_-_JN638405
Section Nummularia, Subgenus Lysimachia
L. glutinosa x L. kalalauensis_Hawaii:USA_Hawaii_GQ258040
L. kalalauensis_Hawaii:USA_Hawaii_GQ258044
L. filifolia x L. glutinosa_Hawaii:USA_Hawaii_GQ258037
L. scopulensis_Hawaii:USA_Hawaii_GQ258054
L. glutinosa_Hawaii:USA_Hawaii_GQ258038
L. remyi subsp. caliginis_Hawaii:USA_Hawaii_GQ258049
L. remyi subsp. kipahuluensis_Hawaii:USA_Hawaii_AF547737
L. glutinosa_Hawaii:USA_Hawaii_AF547738
L. remyi subsp. remyi_Hawaii:USA_Hawaii_GQ258052
L. maxima_Hawaii:USA_Hawaii_GQ258047
L. remyi subsp. subherbacea_Hawaii:USA_Hawaii_GQ258053
L. filifolia_Hawaii:USA_Hawaii_GQ258036
L. iniki_Hawaii:USA_Hawaii_AF547721
L. daphnoides_Hawaii:USA_Hawaii_GQ258035
L. pendens_Hawaii:USA_Hawaii_GQ258048
L. waianaeensis_Hawaii:USA_Hawaii_GQ258056
L. hillebrandii_Hawaii:USA_Hawaii_GQ258041
Subgenus Lysimachiopsis
L. fortunei_EastAsia:Taiwan_Nantou_OR941027
L. fortunei_EastAsia:China_Zhejiang_JF976922
L. fortunei_EastAsia:China_Fujian_JF976921
L. fortunei_EastAsia:China_Jiangxi_JF976925
L. fortunei_EastAsia:China_Guangdong_MG877789
L. fortunei_EastAsia:China_Jiangxi_JF976924
L. fortunei_EastAsia:China_Zhejiang_JF976923
L. barystachys_EastAsia:-_-_MH808418
L. clethroides_EastAsia:Korea_Kayashan_AF547707
L. clethroides_EastAsia:China_-_JF976899
L. barystachys_EastAsia:-_-_MG877763
L. fortunei_EastAsia:China_Guangdong_AF547688
Section Spicatae, Subgenus Palladia
L. candida_EastAsia&India:Taiwan_NuannuanPark_OR941031
L. parvifolia_China:-_-_OQ513714
L. candida_EastAsia&India:China_Guangdong_JF976885
L. candida_EastAsia&India:China_Henan_JF976884
L. candida_EastAsia&India:China_Sichuan_MG877764
Section Candidae, Subgenus Palladia
L. mauritiana_EastAsia&Pacific:USA_Hawaii_GQ258046
L. mauritiana_EastAsia&Pacific:Taiwan_Sanzhi_PP770703
Section Lubinia, Subgenus Palladia
L. heterogenea_China:China_Anhui_AF547699
Section Miltandrae, Subgenus Palladia
L. stellarioides_China:China_Sichuan_FJ362384
Section Nummularia, Subgenus Lysimachia
L. glanduliflora_China:China_Anhui_AF547700
L. stenosepala_China:-_-_MG877841
L. circaeoides_China:China_Hubei_AF547689
L. auriculata_China:-_-_MG877762
Section Miltandrae, Subgenus Palladia
L. pentapetala_EastAsia:-_-_JN638407
Section Apochoris, Subgenus Palladia
L. decurrens_EastAsia&SouthEastAsia:China_Guangdong_JF976907
L. decurrens_EastAsia&SouthEastAsia:China_Guangdong_AF547704
L. decurrens_EastAsia&SouthEastAsia:Taiwan_Wulai_OR941033
L. decurrens_EastAsia&SouthEastAsia:China_Yunnan_JF976908
L. lobelioides_China&Indochina:China_-_JF976951
L. taliensis_China:China_Yunnan_AF547686
L. lichiangensis var. robusta_China:-_-_MG877807
L. silvestrii_China:-_-_MG877840
Section Palladia, Subgenus Palladia
L. pumila_China:-_-_MG877829
Section Pumilae, Subgenus Palladia
L. chenopodioides_Himalaya:China_Yunnan_AF547740
Section Chenopodiopsis, Subgenus Palladia
L. ephemerum_WestEurope&Moroco:-_-_AF547720
L. ruhmeriana_Africa:Ethiopia_Bale_MG877837
L. minoricensis_Europe:-_-_MG877812
Section Ephemerum, Subgenus Palladia
L. chikungensis (=L. fortunei)_EastAsia:-_-_MG877769
Section Spicatae, Subgenus Palladia
L. crispidens_China:China_Hubei_AF547697
Subgenus Heterostylandra
L. fukienensis_China:-_-_OQ513726
L. longipes_China:China_Anhui_AF547702
Section Nummularia, Subgenus Lysimachia
L. maritima_China:China_Ningxia_AF547728
Glaux (= Lysimachia)
0.01

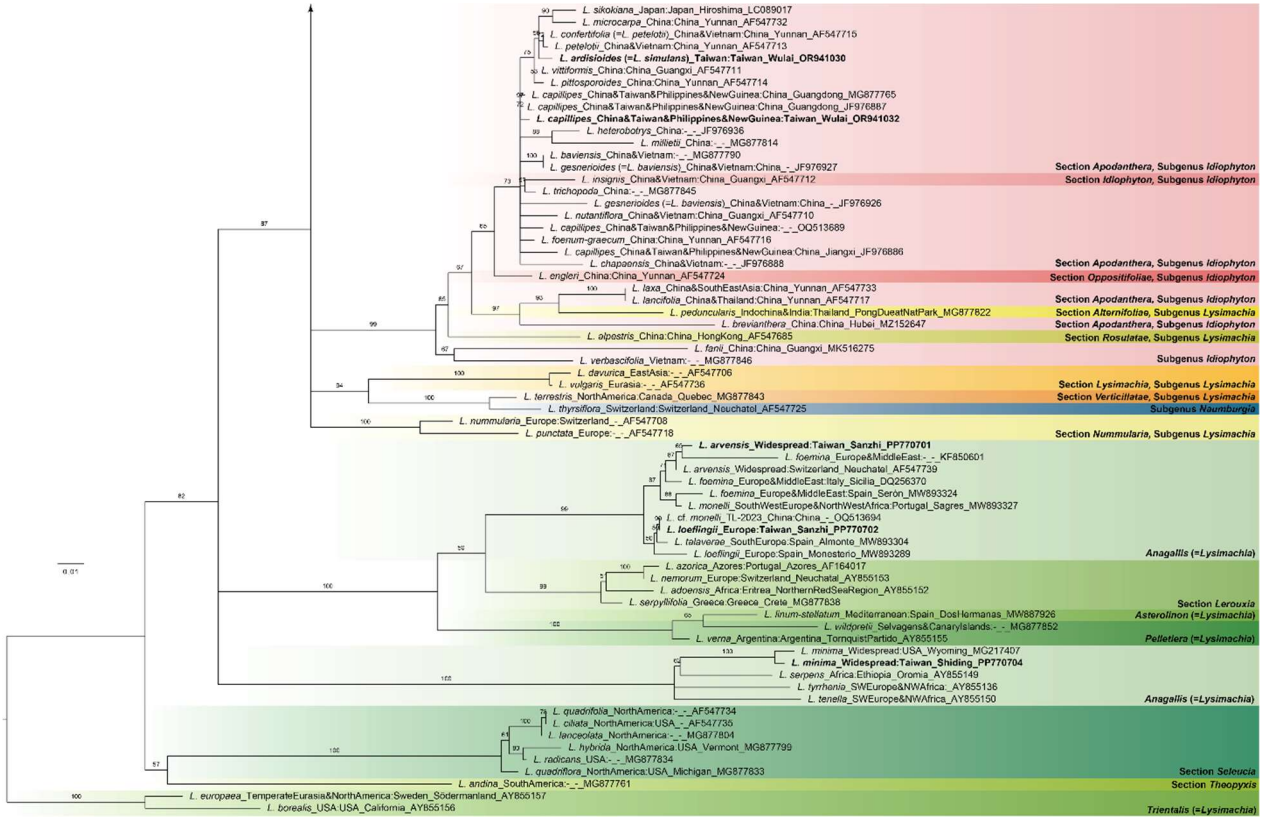


Fig. 1. The maximum likelihood phylogram of ***Lysimachia*** s.l. based on ITS sequences. Nodes with bootstrap value lower than 50 were collapsed. Samples newly sequenced in this study were marked in **bold**. The names of each sample are represented below: "species name"_"native distribution range of the species":"country where the sample was collected"_"second-level locality"_"Genbank accession number". The labelling of the infrageneric classification of ***Lysimachia*** s.l. was mainly based on Ray (1956), Chen and Hu (1979), and Hu (1985).

The chromosome cytology of *L. nigropunctata* is reported for the first time. The number of chromosomes at mitotic metaphase is $2n = 24$ (Figs. 2C & 3C). The longest chromosome is ca. 2.3 µm long, and the shortest ca. 1.2 µm long. Among the 24 chromosomes, six chromosomes (Nos. 1–6 in Fig. 3C) have centromeres at median position, four (Nos. 7–10 in Fig. 3C) at submedian position, four (Nos. 11–14 in Fig. 3C) at subterminal position, and ten (Nos. 15–24 in Fig. 3C) at terminal position. Satellite chromosomes are not observed. The karyotype formula is $2n = 24 = 6m + 4sm + 4st + 10t$.

The chromosome number and karyotype of the three accessions of *L. remota*, including two collected from Taiwan (*C.-I Peng 21406* and *C.-I Peng 21428*) and one collected from Guangxi, China (*C.-I Peng s.n.* 2016), are identical (Table 1). Their numbers of chromosomes at mitotic metaphase are all $2n = 22$ (Figs. 2D, E & 3D, E), congruent with a previous report by Zhou *et al*. (1999). The longest chromosome is ca. 4.0 µm long, and the shortest ca. 1.9 µm long. Among the 24 chromosomes, four chromosomes (Nos. 1–4 in Fig. 3D, E) have centromeres at median position, two (Nos. 5 & 6 in Fig. 3D, E) at submedian position, eight (Nos. 7–14 in Fig. 3D, E) at subterminal position, and eight (Nos. 15–22 in Fig. 3D, E) at terminal position. The secondary constrictions or small constrictions (SC) are observed at the interstitial region of the short arms of a pair of m-chromosomes (Nos. 3 & 4 in Fig. 3D, E). The karyotype formula of each is the same, $2n = 22 = 4m + 2sm + 8st + 8t$, different from that of $2n = 22 = 4m + 6sm + 2st + 10t$ reported by Zhou *et al*. (1999).

The chromosome cytology of *L. ravenii* is reported for the first time. The number of chromosomes at mitotic metaphase is $2n = 42$ (Fig. 4A, B). The longest chromosome is ca. 3.1 µm long, and the shortest ca.1.0 µm long. Among the 42 chromosomes, 14 have centromeres (Nos. 1–14 in Fig. 4B) at median position, eight (Nos. 15–22 in Fig. 4B) at submedian position, eight (Nos. 23–30 in Fig. 4B) at subterminal position, and 12 (Nos. 31–42 in Fig. 4B) at terminal position. Each of m- (No. 1 in Fig. 4B) and sm-chromosomes (No. 15 in Fig. 4b) appears to be formed from two t-chromosomes. The karyotype formula is $2n = 42 = 14m + 8sm + 8st + 12t$.

The chromosome cytology of *L. taiwaniana* is reported for the first time. The number of chromosomes at mitotic metaphase is $2n = 70$ (Figs. 5A & 6A). The longest chromosome is ca. 3.1 µm long, and the shortest ca. 1.2 µm long. Among the 70 chromosomes, 14

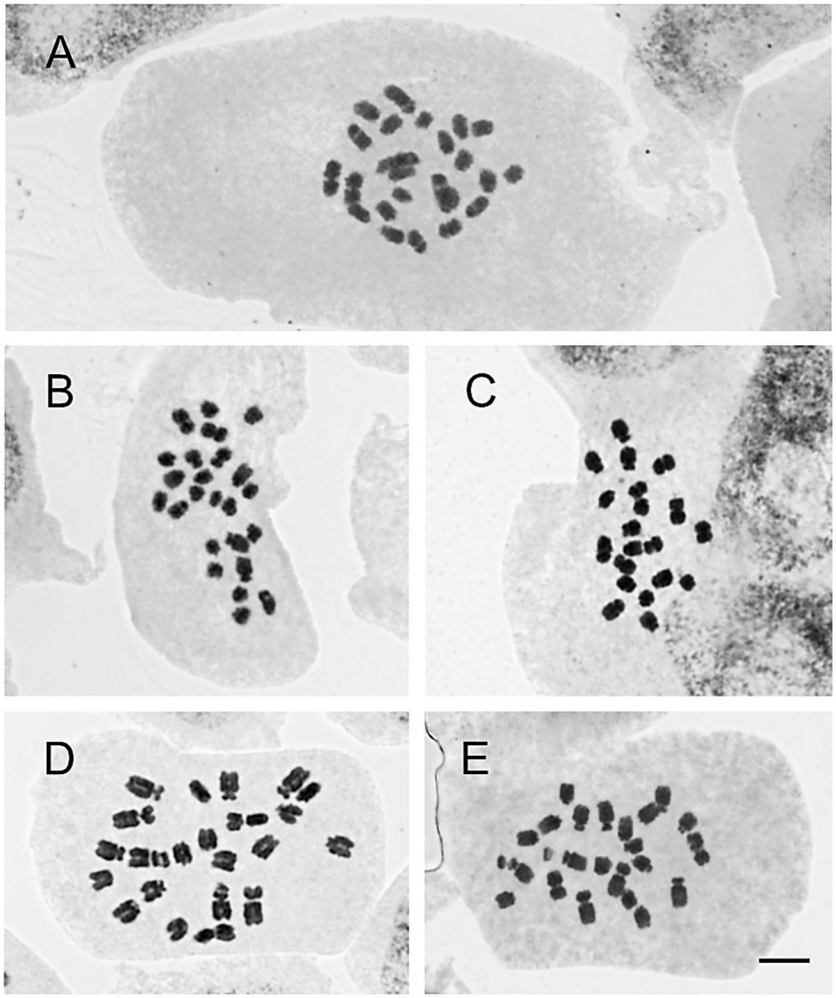


Fig. 2. Somatic chromosomes at metaphase of **A. *Lysimachia chingshuiensis*** (*C.-I Huang 2124*), **B. *L. japonica*** (*C.-I Peng 18731*), **C. *L. nigropunctata*** (*C.-I Huang 3412*), **D. *L. remota*** (*C.-I Peng 21406*), and **E. *L. remota*** (*C.-I Peng s.n.* 2016). Scale bar =5 μm.

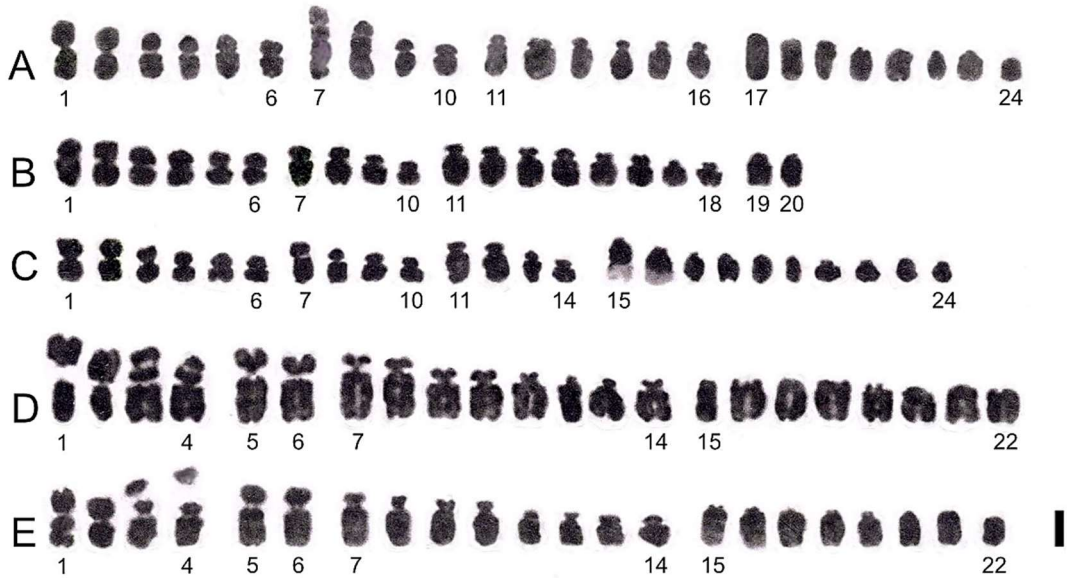


Fig. 3. Karyotypes of **A. *Lysimachia chingshuiensis*** (*C.-I Huang 2124*), **B. *L. japonica*** (*C.-I Peng 18731*), **C. *L. nigropunctata*** (*C.-I Huang 3412*), **D. *L. remota*** (*C.-I Peng 21406*), and **E. *L. remota*** (*C.-I Peng s.n.* 2016). Scale bar =2 μm.

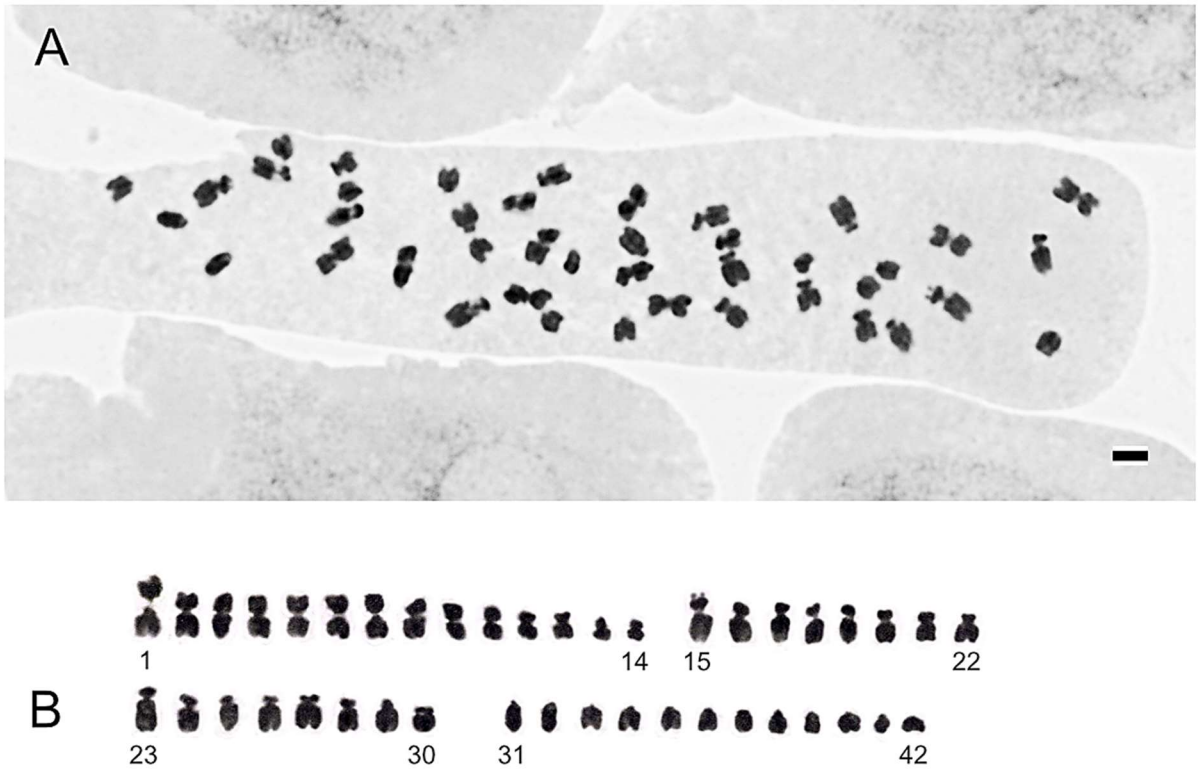


Fig. 4. Chromosome cytology of ***Lysimachia ravenii*** (*C.-I Huang 2825*). **A.** somatic chromosomes at metaphase and **B.** karyotype. Scale bar =2 μm.

chromosomes (Nos. 1–14 in Fig. 6A) have centromeres at median position, 12 (Nos. 15–26 in Fig. 6a) at submedian position, and other 44 (Nos. 27–70 in Fig. 6A) at subterminal or terminal position. A pair of longest m-chromosomes (Nos. 1 & 2) appears to be formed from two st(t)-chromosomes. The karyotype formula is $2n = 70 = 14m + 12sm + 44st(t)$.

The chromosome cytology of three accessions (*C.-I Peng 21079*, *20475*, and *20517*) of *L. congestiflora* collected from China was investigated. The number of chromosomes of *C.-I Peng 21079* at mitotic metaphase is $2n = 24$ (Figs. 5B & 6B). The longest chromosome is ca. 2.2 μm long, and the shortest ca. 0.9 μm long. Among the 24 chromosomes, two chromosomes (Nos. 1 & 2 in Fig. 6B) have centromeres at median position, four (Nos. 3–6 in Fig. 6B) at submedian position, eight (Nos. 7–14, in Fig. 6B) at subterminal position, and ten (Nos. 15–24 in Fig. 6B) at terminal position. The SC-chromosomes were observed at the interstitial region of two sm-chromosomes (Nos. 7 & 8 in Fig. 6B). The karyotype formula is $2n = 24 = 2m + 4sm + 8st + 10t$. The number of chromosomes of *C.-I Peng 20475* at mitotic metaphase is $2n = 24$ (Figs. 5C & 6C). The longest chromosome is ca. 3.3 μm long, and the shortest ca. 1.2 μm long. Among the 24 chromosomes, four chromosomes (Nos. 1–4 in Fig. 6C) have centromeres at median position, four (Nos. 5–8 in Fig. 6C) at submedian position, six (Nos. 9–14, in Fig. 6c) at subterminal position, and ten (Nos. 15–24 in Fig. 6c) at terminal position. The SC-chromosomes were observed at the distal region of the two longest m-chromosomes (Nos. 1 & 2 in Fig. 6C). The karyotype formula is $2n = 24 = 4m + 4sm + 6sm + 10t$. The number of chromosomes of C.-I Peng 20517 at mitotic metaphase is $2n = 48$ (Figs. 5d & 6d). The longest chromosome is ca. 2.3 μm long, and the shortest ca. 0.9 μm long. Among the 48 chromosomes, eight chromosomes (Nos. 1–8 in Fig. 6D) have centromeres at median position, eight (Nos. 9–16 in Fig. 6D) at submedian position, 12 (Nos. 17–28, in Fig. 6D) at subterminal position, and 20 (Nos. 29–48 in Fig. 6D) at terminal position. The karyotype formula is $2n = 48 = 8m + 8sm + 12sm + 20t$. While the chromosome number $2n = 24$ has been previously reported by Shao *et al*. (2004) and Xu *et al*. (2004), their karyotypes [i.e., $2n = 24 = 2m + 4sm + 4st + 14t$ (Shao *et al*., 2004) and $2n = 24 = 2m + 2sm + 10st + 10t$ (Xu *et al*., 2004)] differ from those reported in present study.

DISCUSSION

Based on literature review, ITS phylogeny, and chromosome cytology, the taxonomy of 15 currently recognized taxa of *Lysimachia* s.l. of Taiwan (i.e., Chung, 2018) is updated. In addition to the full citation of relevant references to each individual species, we identify and rectify following issues that have perpetuated in the flora of Taiwan:

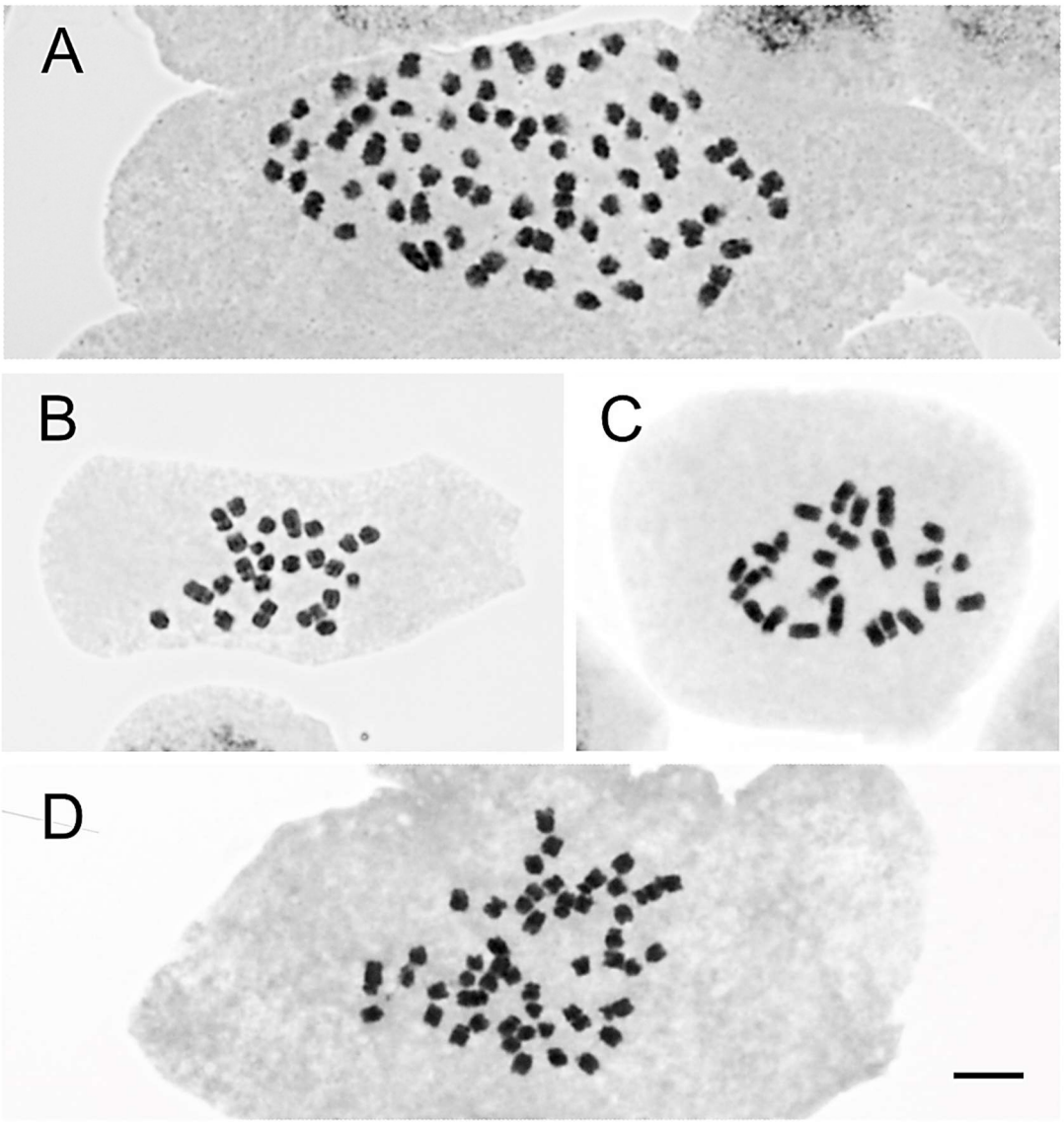


Fig. 5. Somatic chromosomes at metaphase of **A. *Lysimachia taiwaniana*** (*T.-Y. Liu 1539*), **B. *L. congestiflora*** (*C.-I Peng 21079*), **C. *L. congestiflora*** (*C.-I Peng 20475*), and **D. *L. congestiflora*** (*C.-I Peng 20517*). Scale bar = 5 μm.

First report of the genus *Lysimachia* in Taiwan. Yang *et al*. (2012: 434) stated that "The first report of the genus *Lysimachia* in Taiwan was made by Forbes and Hemsley (1889)." However, Swinhoe (1863: 2) in his often overlooked "List of Plants from the Island of Formosa, or Taiwan" had recorded "L. multiflora, *Wall.*" (= *L. decurrens*), which should be the first report of the genus in Taiwan. Subsequently, Hance (1866: 224) and Maximowicz (1868: 68) described *L. consobrina* Hance and *L. fortunei* Maxim., respectively, both based on a type specimen collected by R. Oldham from Formosa (Taiwan). All abovementioned names were cited by Hance (1877: 357) in which *L. multiflora* and *L. consobrina* were both treated as synonyms of *L. decurrens*.

Known as "Index Florae Sinensis", Forbes and Hemsley (1889) listed six species of *Lysimachia* s.l. from Formosa (Table 2), including a new species *L. simulans* Hemsl. (in Forbes and Hemsley, 1889: 57) based on a specimen collected from "Kelung" (Keelung) by C. Ford. All six Formosan species of *Lysimachia* s.l. listed in Forbes and Hemsley (1889), plus a specimen (*Henry 1875*) regarded as "near *L. alternifolia*" locally called "*Hsiang-ts'ao* 香草", were cited in Henry (1896)'s "*A list of plants from Formosa*", the first comprehensive checklist of the flora of Taiwan (Matsumura and Hayata, 1906).

First report of *Lysimachia candida* in Taiwan. The seventh species of *Lysimachia* s.str. recorded in the flora of Taiwan appears to be *L. candida* (Table 2) reported by Matsumura (1900b), a largely neglected paper (e.g., DeVol and Kuo, 1979). As such, *L. candida* was recorded for the first time by Matsumura (1900b), not Yang *et al*. (2012). It should also be noted that Pax and Knuth

Fig. 6. Karyotypes of **A. *Lysimachia taiwaniana*** (*T.-Y. Liu 1539*), **B. *L. congestiflora*** (*C.-I Peng 21079*), **C. *L. congestiflora*** (*C.-I Peng 20475*), and **D. *L. congestiflora*** (*C.-I Peng 20517*). Scale bar = 2 μm.

(1905: 301) also reported the occurrence of *L. candida* (as *L. candida* subsp. *eucandida*) in "Formosa", citing *O. Warburg 10570*, the earliest collection of the species in Taiwan (Yang *et al*., 2012). Although *Lysimachia candida* was treated as a synonym of *L. leucantha* Miq. by Matsumura and Hayata (1906), the latter name was cited in all major floristic literature of Taiwan (Kawakami, 1910; Hayata, 1917; Sasaki, 1928; Mori, 1936; Masamune, 1954) until Okuyama (1962) resurrected the former species. Although the name *L. leucantha* appeared in Hsieh and Yang (1969) and Yang (1982), it was treated as an uncertain species in the first edition of the Flora of Taiwan (Kao and DeVol, 1978) and totally neglected in the second edition of the Flora (Kao and Peng, 1998).

It should be noted that Matsumura (1900b)'s report of *L. candida* was based on a specimen collected from "*Shin-ei-shoo, Tailan* (新營庄, 台南) by C. Owatari in 3 Feb 1898 (Fig. 7). The occurrence of Owatari's collection from southern Taiwan suggests the fact that *L. candida* probably had a much wider distribution than previously envisaged by Yang *et al*. (2012).

***Lysimachia ardisioides* is a synonym of *L. simulans*.** In Hu and Kelso (1996), *L. simulans* was listed as a synonym of *L. ardisioides*. However, *L. simulans* was published earlier (in Forbes and Hemsley, 1889: 57) than *L. ardisioides* (Masamune, 1932a: 302). After a close comparison between the type specimens of *L. simulans* (K-000750731, image available on JSTOR Global Plants: https://plants.jstor.org/) and *L. ardisioides* (TAI-119048, image available on Plants of TAIWAN: https://tai2.ntu.edu.tw/), it is without a doubt that *L. simulans* and *L. ardisioides* are identical. Based on the principle of priority, *L. simulans* is the correct name according to the *Code* (Turland *et al*., 2018). By tracing the taxonomic history of the names (Table 2), this prolonged taxonomic oversight appears to be related to the definition of *L. sikokiana* Miq. (Bentvelzen, 1962).

Lysimachia simulans Hemsl. was described based on a specimen collected by C. Ford from "Kelung" (Keelung), northern Taiwan in June 1884 (Forbes and

Fig. 7. Specimen of ***Lysimachia candida*** Lindl. collected from "*Shin-ei-shoo, Tailan* (新營庄，台南) by C. Owatari in 3 Feb 1898 preserved in TI. Courtesy of the Herbarium of the University of Tokyo (TI).

Hemsley, 1889). While Matsumura (1900b) and Matsumura (1912) treated *L. simulans* as the synonym of *L. sikokiana* that was previously reported from southern Japan and throughout the Ryukyus (Forbes and Hemsley, 1889: 57), Matsumura and Hayata (1906) accepted both *L. sikokiana* and *L. simulans* in Taiwan. Subsequently, whether both *L. sikokiana* and *L. simulans* occurred in Taiwan (Kawakami, 1910; Hayata, 1917; Sasaki, 1928; Yamazaki, 1993) or the Taiwanese entity should be treated as *L. sikokiana* (Hayata, 1908; Matsumura, 1912; Handel-Mazzetti, 1928; Bentvelzen, 1962; Ohwi, 1984; Chen *et al*., 1989) were debated (Table 2). The situation was further complicated when Masamune (1932a) described *L. ardisioides*. After its publication, while some authors replaced *L. sikokiana* with *L. ardisioides* and considered the co-occurrence of *L. ardisioides* and *L. simulans* in Taiwan (Mori, 1936; Masamune, 1954; Hsieh and Yang, 1969; Yang, 1982), Kao and DeVol (1970) accepted only *L. ardisioides*, stating that no specimens of *L. simulans* had been seen. In the first edition of the Flora of Taiwan, *L. simulans* was further treated as an uncertain species by Kao and DeVol (1978) and forgotten by almost all subsequent Taiwanese works (Kao and Peng, 1998; Yang *et al*., 1999; Editorial Committee of the Red List of Taiwan Plants, 2017; Chung, 2018). Meanwhile, Kokubugata *et al*. (2006) demonstrated that *L. ardisioides* and *L. sikokiana* are geographically (Taiwan vs. Japan), morphologically (stem terete vs. alate), and cytologically ($2n$ = 30 vs. 60) different. Given this, *L. simulans* should be the correct name instead of *L. ardisioides*. However, the relationship between *L. simulans* and the Philippine "*L. sikokiana*" (sensu Bentvelzen, 1962) requires further study.

Resurrection of *Lysimachia taiwaniana*. Chen and Hu (1979), Chen *et al*. (1989), and Hu and Kelso (1996) synonymized several species (including *L. nigropunctata* and *L. taiwaniana*) under *L. congestiflora*, resulting in a very widespread and heterogeneous species (Xu and Chang, 2017). Although *L. nigropunctata* had subsequently been resurrected and regarded as an endemic species of Taiwan (Kao and Peng, 1998), the synonymization of *L. taiwaniana* under *L. congestiflora* has been followed (Table 2). However, as demonstrated by Kokubugata *et al*. (2010) and our ITS phylogeny (Fig. 1), both *L. nigropunctata* and *L. taiwaniana* are distantly related to *L. congestiflora*, supporting the resurrection of the former two species. Indeed, Zhang *et al*. (2012) also showed the non-monophyly of *L. congestiflora* sensu Chen and Hu (1979), which likely explain the chromosomal variation revealed by previous [i.e., $2n$ = 24 = 2m + 4sm + 4st + 14t (Shao *et al*., 2004) and $2n$ = 24 = 2m + 2sm + 10st + 10t (Xu *et al*., 2004)] and present (Table 1; Fig. 5B–D & 6B–D) studies. Although intraspecific chromosomal variation has been documented in some *Lysimachia* species (Kono *et al*., 2012; Kono *et al*., 2019), the karyotype of $2n$ = 70 = 14m + 12sm + 44st(t) in *L. taiwaniana* differ substantially from those reported in *L. congestiflora*. Based on our present study, we hypothesize that $2n$ = 70 = 14m + 12sm + 44st(t) is the hypohexaploid of x = 12. The $2n$ = 70 could have resulted from the fusion of the four st(t)-chromosomes in a hexaploid [i.e., $2n$ = 72 = 12m + 12sm +48st(t)] of a $2n$ = 24 = 4m + 4sm + 6st + 10t such as *L. congestiflora*, as shown in our ITS phylogeny that two accessions of *L. congestiflora* form the basal grade of *L. taiwaniana* (Fig. 1).

TAXONOMIC TREATMENT

Lysimachia L., Sp. Fl. 146. 1753.—***TYPE***: *L. vulgaris* L. [lectotype, designated by Hitchcock in Hitchcock and Green (1929: 129)]; Manns & Anderberg, Willdenowia 39(1): 50. 2009.

Anagallis L., Sp. Fl. 148. 1753.—***TYPE***: *A. arvensis* L. [lectotype, designated by Hitchcock in Hitchcock and Green (1929: 129)]; Kao & DeVol in Fl. Taiwan 4: 68. 1978; Kao & Peng in Fl. Taiwan 2nd ed. 4: 57. 1998.

Key to *Lysimachia* of Taiwan

1a. Capsule circumscissile ……..…….. 2
1b. Capsule longitudinally dehiscent or indehiscent …..…….. 4
2a. Calyces 1.5–3 mm, equaling or longer than corollas; corollas 2–3 mm ……. 10. ***L. minima***

2b. Calyces 3.5–6 mm, equaling or shorter than corollas; corollas 3–12 mm ……. 3
3a. Flowers red orange ……. 1. ***L. arvensis***
3b. Flowers purplish blue ……... 8. ***L. loeflingii***
4a. Flowers in terminal racemes, white to pinkish …… 5
4b. Flowers axillary, yellow …….. 8
5a. Leaves obovate-spathulate, succulent; filaments connate at base ……. 9. ***L. mauritiana***
5b. Leaves elliptic-lanceolate, chartaceous; filaments free at base … 6
6a. Pedicels ca. 3 mm long; sepals oblong-ovate, apex obtuse …….. ……. 6. ***L. fortunei***
6b. Pedicels > 10 mm long; sepals lanceolate to linear, apex acuminate ……7
7a. Stems angular; corolla white to pinkish, 5–6 mm long …… ……..…… 5. ***L. decurrens***
7b. Stems terete; corolla white, 6–12 mm long ……. 2. ***L. candida***
8a. Stems erect or ascending, glabrous or nearly so; leaves alternate, glabrous; pedicels > 1 cm; anthers longer than filaments …….. 9
8b. Stems prostrate or decumbent, hairy; leaves opposite (occasionally alternate in terminal branches), pubescent; pedicels < 0.8 cm; anthers shorter than filaments …… 10
9a. Stems alate, always green; leaves evenly spaced on stem; sepals slightly shorter than corolla lobe …….. 3. ***L. capillipes***
9b. Stems terete, usually reddish brown; leaves often confined to upper part of stem; sepals much shorter than corolla lobe …. 14. ***L. simulans***
10a. Leaves subcoriaceous, elliptic to narrowly ovate, sessile …… ….…… 4. ***L. chingshuiensis***
10b. Leaves chartaceous, ovate, cordate or rounded, petiolate …… 11
11a. Leaves broadly ovate to rounded, lower surface with dense black dots ……..…… 12
11b. Leaves ovate to rhomboid-ovate, lower surface without dense black dots ……..…… 14
12a. Leaves 0.3–1 cm long; flowers larger than or as large as leaves, corolla lobes with reddish brown glands on upper surface ……..… ……..……. 11. ***L. nigropunctata***
12b. Leaves 1–3 cm long; flowers smaller than leaves, corolla lobes with or without reddish brown glands on upper surface …….. 13
13a. Stem trichomes appressed; leaves apex rounded to acute; corolla lobes not dotted with reddish brown glands on upper surface; stamens open during anthesis …….. 7. ***L. japonica***
13b. Stem trichomes spreading; leaves apex mucronate; corolla lobes dotted with reddish brown glands on upper surface; stamens remain aggregated during anthesis ……..…..…….. 12. ***L. ravenii***
14a. Leaves 2–3 cm long, lower surface with sparse black dots; corolla lobes margin denticulate in apex part; fruit stalks reflexed when fruiting ……..…….. 13. ***L. remota***
14b. Leaves 2–6 cm long, lower surface without black dots; corolla lobes margin entire; fruit stalks not reflexed when fruiting ……..…… ….……..…… 15. ***L. taiwaniana***

1. *Lysimachia arvensis* (L.) U.Manns & Anderb., Willdenowia 39(1): 51. 2009; Chung, Ill. Fl. Taiwan 6: 106. 2018; Jiménez-López *et al*., Bot. J. Linn. Soc. 199: 570. 2022. **琉璃繁縷**

Anagallis arvensis L., Sp. Pl. 1: 148. 1753.—***TYPE***: Herb. Linn. No. 208.1 [lectotype LINN 208.1 (image!), designated by Dyer (1963: 14)]; Matsumura, Index Pl. Jap. 2(2): 474. 1912; Kao & DeVol, Taiwania 15(1): 52. 1970, *pro parte*; Kao & DeVol in Fl. Taiwan 4: 69. 1978, *pro parte*; Yang, List Pl. Taiwan 1036. 1982, *pro parte*; Ohwi, Fl. Japan 716. 1984, *pro parte*; Chen *et al*. in Fl. Reipubl. Popul. Sin. 59(1): 136, *pl. 36(1–4)*. 1989; Hu & Kelso in Fl. China 15: 81. 1996, *pro parte*; Kao & Peng in Fl. Taiwan 2nd ed. 4: 57. 1998, *pro parte*; Yang *et al*., Manual Taiwan Vasc. Pl. 4: 24. 1999, *pro parte*.

Notes: The Scarlet Pimpernel *Anagallis arvensis* (≡ *Lysimachia arvensis*) is a worldwide-distributed common weed often regarded as a species with red- and blue-flowered morphs (Manns and Anderberg, 2007; Arista *et al*., 2013; Ortiz *et al*., 2015). In Taiwan, the blue-flowered Scarlet Pimpernel is a common spring annual especially in coastal areas, while the red-flowered Scarlet Pimpernel is much rarer, always found amongst the blue-flowered plants. Because Linnaeus described the species from the red-flowered morph, the blue-flowered morph had been treated as a variety *A. arvensis* L. var. *caerulea* (L.) Gouan [≡ *L. arvensis* var. *caerulea* (L.) Turland & Bergmeier] or an independent species known as *A. latifolia* L. (Manns and Anderberg, 2007). In Taiwan, *A. arvensis* had been recorded since Forbes and Hemsley (1889), noting that "*The Chinese specimens are all of the blue-flowered variety*". Matsumura (1912) reported the name *A. arvensis* and *A. latifolia* in "Index Plantarum Japonicarum" for the flora of Japan and Taiwan, however, without any description on the flower colors. Kao and DeVol (1970) appears to be the first literature recording "*corolla bluish-purple to reddish*". However, it is not until Chung (2018) that the blue-flowered morph was recognized as a distinct taxon *L. arvensis* var. *caerulea*, reserving *L. arvensis* for the red-flowered morph (see discussion under *Lysimachia loeflingii*). Our ITS tree shows that the Taiwanese red-flowered Scarlet Pimpernel and blue-flowered Scarlet Pimpernel are indeed two distinct species, corresponding to *L. arvensis* and *L. loeflingii*, respectively (Fig. 1).

2. *Lysimachia candida* Lindl., J. Hort. Soc. London 1: 301. 1846.—***TYPE***: CHINA. 1845, *R. Fortune 12* [neotype K-000832646 (image!), designated here]; Matsumura, Bot. Mag. (Tokyo) 14(161): en83. 1900; Matsumura, Index Pl. Jap. 2(2): 475. 1912; Okuyama, Acta Phytotax. Geobot. 20(1): 29. 1962; Yang *et al*., Taiwania 57: 435, *fig. 1–3*. 2012; Takahasi, Wild Flowers Japan 4: 195, *pl. 136(5, 6)*. 2017; Chung, Ill. Fl. Taiwan 6: 107. 2018; Chung *et al*., Quart. J. Forest Res. 42: 120. 2022. **澤珍珠菜**

Lysimachia candida subsp. *eucandida* R.Kunth in Pax & Knuth in Das Pflanzenreich IV. 237: 300. 1905.

Lysimachia leucantha auct. non Miq.: Matsumura & Hayata, J. Coll. Sci. Imp. Univ. Tokyo. 22: 223. 1906; Kawakami, List Pl. Formosa 66. 1910; Hayata, Icon. Pl. Formos. 6 suppl.: 44. 1917; Sasaki, List Pl. Formosa 326. 1928; Mori in Short Fl. Formosa 164. 1936; Masamune, List Vas. Plant Taiwan 92. 1954; Hsieh & Yang, Nomencl. Pl. Taiwan 765. 1969; Yang, List Pl. Taiwan 1038. 1982.

Notes: In JSTOR Global Plants (https://plants.jstor.org/; accessed 23 Dec 2023; Table S1), *R. Fortune 12* collected in 1845 from China deposited at K (K000832646) was "verified by Yang, T.Y.A." as the 'holotype' of *Lysimachia candida*. However, *L. candida* was described by Lindley (1846) based on a plant "Raised from the soil contained in one of the boxes sent from China by Mr. Fortune, April 6, 1946" without citing any specimen or referring to any specimen nor illustration, indicating that *R. Fortune 12* could not be the holotype according to Art. 9.1 of the *Code* (Turland *et al*., 2018). Consequently, Yang's verification is an error according to Art. 9.10 of

the *Code* (Turland *et al*., 2018). However, *R. Fortune 12* was collected in 1845 that proceeded the arrival (6 Apr 1846) of the soil and prior to the description of *L. candida* (29 Jun 1846), suggesting that Lindley (1846) could have consulted *R. Fortune 12* when he prepared the description of the species and *R. Fortune 12* could have been the "original material …… that the author associated with the taxon" according to Art. 9.4 of the *Code* (Turland *et al*., 2018). Because *R. Fortune 12* (K000832646) is the earliest and a quality specimen of the species collected by R. Fortune also likely consulted when Lindley (1846) described the species, we here designate the specimen as the neotype of *L. candida* according to Art. 9.13 of the *Code* (Turland *et al*., 2018).

3. *Lysimachia capillipes* Hemsl., J. Linn. Soc., Bot. 26(173): 48–49. 1889.—***TYPE***: CHINA. Hupeh: Ichang and immediate neighbourhood, May 1888, *A. Henry 4176* [lectotype K-000750651 (image!), designated here; isolectotypes E-00024978 (image!) & GH-00073486 (image!)]; Odashima, J. Soc. Trop. Agric. 7(1): 82. 1935; Mori in Short Fl. Formosa 163. 1936; Masamune, List Vas. Plant Taiwan 92. 1954; Bentvelzen, Flora Malesiana, Ser. I 6(2): 179. 1962; Hsieh & Yang, Nomencl. Pl. Taiwan 764. 1969; Kao & DeVol, Taiwania 15(1): 59, *pl. 5*. 1970; Kao & DeVol in Fl. Taiwan 4: 74, *pl. 917*. 1978; Yang, List Pl. Taiwan 1037. 1982; Chen *et al*. in Fl. Reipubl. Popul. Sin. 59(1): 38, *pl. 7(2–4)*. 1989; Hu & Kelso in Fl. China 15: 52. 1996; Kao & Peng in Fl. Taiwan 2nd ed. 4: 63, *pl. 24, ph. 42*. 1998; Yang *et al*. in Manual Taiwan Vasc. Pl. 4: 25, *ph. 49*. 1999; Chung, Ill. Fl. Taiwan 6: 107. 2018. **排香草**

Lysimachia alternifolia auct. non Wall.: Henry, Trans. Asiat. Soc. Japan. 24 Suppl.: 57 1896.

Lysimachia fragrans Hayata, J. Coll. Sci. Imp. Univ. Tokyo. 30(1): 175. 1911.—***TYPE***: TAIWAN. Randaizan, Aug. 1908, leg. *B. Hayata & U. Mori 7126* (holotype TI-00265327!; Fig. S1); Hayata, Icon. Pl. Formos. 6 suppl.: 43. 1917; Sasaki, List Pl. Formosa 326. 1928.

Lysimachia lalashanensis S.S.Ying, New Taxa New Names 5: 369, *fig. 496–503*. 2022.— ***TYPE***: TAIWAN. Taoyuan City, Fuhsin District, Lalashan, alt. 1965 m, 18 Aug 2022, *S. S.Ying s.n.* (holotype NTUF), ***syn. nov.*** (Table S1).

Notes: *Lysimachia capillipes* Hemsl. was described based on four collections: "HUPEH: Inchang and immediate neighbourhood (*A. Henry, 679, 1529, 4176!*); Szechuen: on a hill near Chung city (*Faber, 251!*). Herb. Kew" (Forbes and Hemsley, 1889). Currently, seven syntypes are available in JSTOR (https://plants.jstor.org/; accessed 24 Dec 2023; Table S1). To stabilize the application of the name, we select *A. Henry 4176* at K (K000750651) as the lectotype because this quality collection was seen by Hemsley (4176!) with two isolectotypes (E00024978 and GH-00073486).

Lysimachia lalashanensis S.S.Ying was published in the author's (2022b) self-published and poorly edited work of apparent taxonomic vandalism (Wüster *et al*., 2021). Although the name was validly published, it is without a doubt a synonym of *L. capillipes*.

4. *Lysimachia chingshuiensis* C.I Peng & C.M.Hu, Bot. Bull. Acad. Sin. 40(1): 49. 1999.—***TYPE***: TAIWAN. Hualien: Hsiulin, Taroko National Park, at summit of Chingshuishan, *W.-P. Leu 1780* (holotype HAST-26150!; isotypes: A & MO); Kao & Peng in Fl. Taiwan 2nd ed. 4: 63, *pl. 25*. 1998; Yang *et al*. in Manual Taiwan Vasc. Pl. 4: 25, *pl. 42, ph. 48*. 1999; Chung, Ill. Fl. Taiwan 6: 108. 2018. **清水山過路黃**

Notes: Although *Lysimachia chingshuiensis* is a morphological very distinct species in sect. *Nummularia* (Peng and Hu, 1999), this rare species is phylogenetically (Fig. 1) sister to and karyotypically (Fig. 3) very similar to *L. nigropunctata*, also an endemic species of Taiwan.

5. *Lysimachia decurrens* G.Forst., Fl. Ins. Austr. 12. 1786.—***TYPE***: Vanuatu. Tanna. *J.R. Forster & G. Forster s.n.* [holotype BM-001040033 (image!)]; Hance, J. Bot. 6: 357. 1877; Forbes and Hemsley, J. Linn. Soc., Bot. 26(173): 51. 1889; Henry, Trans. Asiat. Soc. Japan. 24 Suppl.: 57 1896; Matsumura, Bot. Mag. (Tokyo) 14(160): en71. 1900; Matsumura & Hayata, J. Coll. Sci. Imp. Univ. Tokyo. 22: 222. 1906; Kawakami, List Pl. Formosa 66. 1910; Matsumura, Index Pl. Jap. 2(2): 475. 1912; Hayata, Icon. Pl. Formos. 6 suppl.: 43. 1917; Sasaki, List Pl. Formosa 326. 1928; Mori in Short Fl. Formosa 163. 1936; Masamune, List Vas. Plant Taiwan 92. 1954; Bentvelzen, Flora Malesiana, Ser. I 6(2): 185. 1962; Hsieh & Yang, Nomencl. Pl. Taiwan 764. 1969; Kao & DeVol in Fl. Taiwan 4: 74, *pl. 918*. 1978; Yang, List Pl. Taiwan 1037. 1982; Chen *et al*. in Fl. Reipubl. Popul. Sin. 59(1): 120. 1989; Yamazaki in Fl. Japan IIIa 82. 1993; Hu & Kelso in Fl. China 15: 74. 1996; Kao & Peng in Fl. Taiwan 2nd ed. 4: 66, *pl. 27*. 1998; Yang *et al*. in Manual Taiwan Vasc. Pl. 4: 26, *ph. 51*. 1999; Takahasi, Wild Flowers Japan 4: 194, *pl. 135(3)*. 2017; Chung, Ill. Fl. Taiwan 6: 109. 2018. **異葉珍珠菜**

Lysimachia multiflora Wall., Numer. List 40. n. 1487. 1829.—***TYPE***: Bangladesh: Pundua, *F. De Silva s.n.* (K-001113211 image!), *nom. nud.*; Swinhoe, List Pl. Island Formosa Taiwan 2. 1863.

Lysimachia consobrina Hance, Ann. Sci. Nat., Bot. sér. 5, 5: 224. 1866.—***TYPE***: CHINA. Cantoniensis; in bambusetis ad *Sai-tung* ad *Sai-nam*, 11 Jun 1864, *C. Sampson 11033* [lectotype K-000750749 (image!), designated here; isolectotype BM-000996958 (image!)]; Yang *et al*. in Manual Taiwan Vasc. Pl. 4: 25. 1999, in syn.

Lysimachia decurrens var. *eudecurrens* Kunth in Pax & Knuth in Das Pflanzenreich IV. 237: 297. 1905.

Lysimachia decurrens var. *recurvata* Matsum., Bot. Mag. (Tokyo) 14(160): en71. 1900.—***TYPE***: JAPAN. Liukiu: prop Nago, ins. Okinawa, Shuri ejusdem ins., May 1874, *J. Matsumura s.n.* [lectotype TI-00265322! (Fig. S2, excl. *Niinami no. 47, B*), designated here] ≡ *Lysimachia recurvata* (Matsum.) Masam., J. Soc. Trop. Agric. 4(3): 302. 1932; Hsieh & Yang, Nomencl. Pl. Taiwan 765. 1969.

Lysimachia acroadenia auct. non Maxim.: Kao & DeVol, Taiwania 15(1): 56, *pl. 3*. 1970.

Lysimachia lobelioides auct. non Wall.: Matsumura & Hayata, J. Coll. Sci. Imp. Univ. Tokyo. 22: 221. 1906; Kawakami, List Pl. Formosa 66. 1910.

Notes: *Lysimachia consobrina* was described by Hance (1866) based on two collections: *Oldham s.n.* 1864 collected from Formosa (Taiwan) and *Sampson 11033* collected from prov. Cantoniensis, China. These two collections are thus syntypes of *L. consobrina* according to Art 9.6 of the *Code* (Turland *et al*., 2018). Currently, two images of *Sampson 11033* are available in JSTOR (https://plants.jstor.org/; accessed 24 Dec 2023; Table S1). To stabilize the application of the name, we select *Sampson 11033* at K (K000750749) as the lectotype.

Lysimachia decurrens var. *recurvata* was described by Matsumura (1900a) based on two collections: *S. Tanaka no. 176* (TI 00265323; Fig. S3) and *J. Matsumura s.n.* 1874 (TI 00265322; Fig. S2), both from "Liukiu: prope Nago". These two collections are thus syntypes of *L. decurrens* var. *recurvata* according to Art 9.6 of the *Code* (Turland *et al*., 2018). To stabilize the application of the name, we select *J. Matsumura s.n.* 1874 (Fig. S2) as the lectotype because this quality collection was collected by the author. It should be noted, however, that *J. Matsumura s.n.* 1874 was mounted with "*Pachina, Formosa. (coll. Niinami no. 47, B.*) *Oct. 23, 1898*" on the same sheet (TI 00265322; Fig. S2). Only *J. Matsumura s.n.* 1874 (left-side plant) of TI 00265322 is chosen as the lectotype.

6. *Lysimachia fortunei* Maxim., Bull. Acad. Imp. Sci. Saint-Pétersbourg 7: 68. 1868.—***TYPE***: China. Borealis. 1845, *Fortune A.7* [lectotype LE (Figure 57 in Yang, 2006), designated by Imchanitzkaja (2002: 267); isolectotypes K-000750755 (image!), LE (Figure 58 in Yang, 2006), & M-0165110 (images!)]; Forbes and Hemsley, J. Linn. Soc., Bot. 26(173): 52. 1889; Henry, Trans. Asiat. Soc. Japan. 24 Suppl.: 57 1896; Pax & Knuth in Das Pflanzenreich IV. 237: 290. 1905; Matsumura & Hayata, J. Coll. Sci. Imp. Univ. Tokyo. 22: 222. 1906; Kawakami, List Pl. Formosa 66. 1910; Matsumura, Index Pl. Jap. 2(2): 476. 1912; Hayata, Icon. Pl. Formos. 6 suppl.: 43. 1917; Sasaki, List Pl. Formosa 326. 1928; Mori in Short Fl. Formosa 164. 1936; Masamune, List Vas. Plant Taiwan 92. 1954; Hsieh & Yang, Nomencl. Pl. Taiwan 764. 1969; Kao & DeVol, Taiwania 15(1): 62, *pl. 6*. 1970; Kao & DeVol in Fl. Taiwan 4: 77, *pl. 920*. 1978; Yang, List Pl. Taiwan 1037. 1982; Ohwi, Fl. Japan 718. 1984; Chen *et al*. in Fl. Reipubl. Popul. Sin. 59(1): 104, *pl. 27(6–10)*. 1989; Yamazaki in Fl. Japan IIIa 80. 1993; Hu & Kelso in Fl. China 15: 72. 1996; Kao & Peng in Fl. Taiwan 2nd ed. 4: 66, *pl. 28, ph. 44*. 1998; Yang *et al*. in Manual Taiwan Vasc. Pl. 4: 26, *ph. 52*. 1999; Takahasi, Wild Flowers Japan 4: 195, *pl. 137(1)*. 2017; Chung, Ill. Fl. Taiwan 6: 109. 2018. **星宿菜**

Notes: *Lysimachia fortunei* was described by Maximowicz (1868: 68), citing two collections "*Fortune (A. 7!)*" from "*China borealis*" and "*Oldham (No. 315!)*" from "*Formosa*" that are syntypes (Table S1) of the name according to Art 9.6 of the *Code* (Turland *et al*., 2018). *Fortune A.7* at LE was effectively designated as the lectotype by Imchanitzkaja (2002: 267). Consequently, duplicates of *Fortune A.7* at K (K000750755), LE (Figure 58 in Yang, 2006), and M (M-0165110 images!) are isolectotypes of *L. fortunei* according to Art. 7.11 Note 2 (Turland *et al*., 2018).

7. *Lysimachia japonica* Thunb. in Murray, Syst. Veg. (ed. 14). 196. 1784.—***TYPE***: JAPAN. *C.P. Thunberg* [holotype UPS V-004249 (image!)]; Thunberg, Fl. Jap. (Thunberg) 83. 1784; Forbes and Hemsley, J. Linn. Soc., Bot. 26(173): 53. 1889; Henry, Trans. Asiat. Soc. Japan. 24 Suppl.: 57 1896; Matsumura, Bot. Mag. (Tokyo) 14(161): e84. 1900; Pax & Knuth in Das Pflanzenreich IV. 237: 262. 1905; Matsumura & Hayata, J. Coll. Sci. Imp. Univ. Tokyo. 22: 222. 1906; Kawakami, List Pl. Formosa 66. 1910; Matsumura, Index Pl. Jap. 2(2): 476. 1912; Hayata, Icon. Pl. Formos. 6 suppl.: 44. 1917; Sasaki, List Pl. Formosa 326. 1928; Mori in Short Fl. Formosa 164. 1936; Masamune, List Vas. Plant Taiwan 92. 1954; Bentvelzen, Flora Malesiana, Ser. I 6(2): 182. 1962; Hsieh & Yang, Nomencl. Pl. Taiwan 764. 1969; Kao & DeVol, Taiwania 15(1): 62, *pl. 8*. 1970; Kao & DeVol in Fl. Taiwan 4: 77, *pl. 921*. 1978; Yang, List Pl. Taiwan 1037. 1982; Ohwi, Fl. Japan 717. 1984; Chen *et al*. in Fl. Reipubl. Popul. Sin. 59(1): 65. 1989; Yamazaki in Fl. Japan IIIa 83–84. 1993; Hu & Kelso in Fl. China 15: 61. 1996; Kao & Peng in Fl. Taiwan 2nd ed. 4: 70, *pl. 29, ph. 45*. 1998; Yang *et al*. in Manual Taiwan Vasc. Pl. 4: 26, *ph. 53*. 1999; Takahasi, Wild Flowers Japan 4: 193, *pl. 134(1)*. 2017; Chung, Ill. Fl. Taiwan 6: 110. 2018.

小茄 Fig. 8E

Notes: According to Taxonomic Literature II (https://www.sil.si.edu/DigitalCollections/tl-2/), Murray's "*Systema Vegetabilium ed. 14*" was received in Jul 1784 and has priority over Thunberg's "Flora Japonica", which was published in 9 Aug 1784 (https://www.tropicos.org/publication/7778).

8. *Lysimachia loeflingii* F.J.Jiménez & M.Talavera in Jiménez-López *et al*., Bot. J. Linn. Soc. 199(2): 571. 2022.

藍花琉璃繁縷

Anagallis latifolia L., Sp. Pl. 1: 148. 1753 [non *Lysimachia latifolia* (Hook.) Cholewa in Phytoneuron 28: 1–2. 2014 ≡ *Trientalis latifolia* Hook., Fl. Bor. Amer. 2(9): 121. 1839].—***TYPE***: Herb. Linn. No. 208.3 [lectotype LINN 208.3 (image!), designated by Jiménez-López *et al*. (2022: 571)]; Matsumura, Index Pl. Jap. 2(2): 474. 1912.

Lysimachia arvensis var. *caerulea* (L.) Turland & Bergmeier, Willdenowia 41(1): 185 2011; Chung, Ill. Fl. Taiwan 6: 106. 2018. ≡ *Anagallis caerulea* L., Amoen. Acad. 4: 479. 1759.—***TYPE***: "*Anagallis foemina*" in Dodoëns, Stirp. Hist. Comment. Imag., 61, 1553 [neotype, designated by Burtt in Kollmann and Feinbrun (1968: 174, 185, 186)].

Anagallis arvensis auct non L.: Forbes and Hemsley, J. Linn. Soc., Bot. 26(173): 59. 1889; Henry, Trans. Asiat. Soc. Japan. 24 Suppl.: 57 1896; Matsumura & Hayata, J. Coll. Sci. Imp. Univ. Tokyo. 22: 223. 1906; Kawakami, List Pl. Formosa 65. 1910; Hayata, Icon. Pl. Formos. 6 suppl.: 43. 1917; Sasaki, List Pl. Formosa 326. 1928;

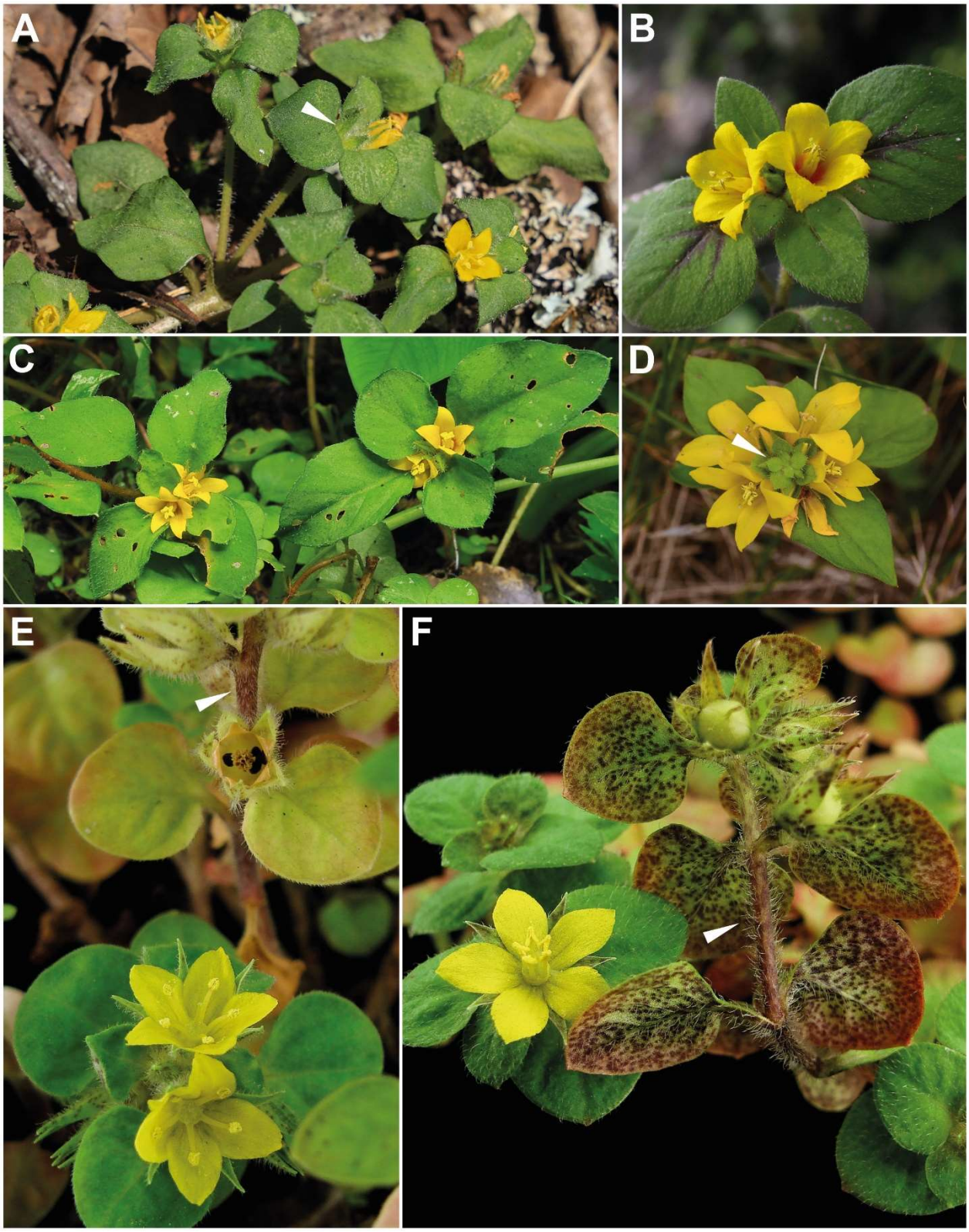


Fig. 8. A & C., *Lysimachia taiwaniana*; B & D. *L. congestiflora*; E. *L. japonica*; F. *L. ravenii*. The triangles indicate the diagnostic features in distinguishing *L. taiwaniana* from *L. congestiflora,* and *L. japonica* from *L. ravenii,* respectively.

Mori in Short Fl. Formosa 163. 1936; Masamune, List Vas. Plant Taiwan 93. 1954; Bentvelzen, Flora Malesiana, Ser. I 6(2): 182. 1962; Kao & DeVol, Taiwania 15(1): 52, *pl. 1*. 1970, *pro parte*; Kao & DeVol in Fl. Taiwan 4: 69, *pl. 914*. 1978, *pro parte*; Ying, Colour. Illustr. Herbac. Pl. Taiwan 1: 155, *ph. 57*. 1980; Yang, List Pl. Taiwan 1036. 1982, *pro parte*; Ohwi, Fl. Japan 716. 1984, *pro parte*; Hu & Kelso in Fl. China 15: 81. 1996, *pro parte*; Kao & Peng in Fl. Taiwan 2nd ed. 4: 57, *pl. 21, ph. 40*. 1998, *pro parte*; Yang *et al*., Manual Taiwan Vasc. Pl. 4: 24, *ph. 46*. 1999, *pro parte*.

Notes: In Taiwan, the blue-flowered Scarlet Pimpernel is a common coastal spring annual recorded since Forbes and Hemsley (1889). Although Matsumura (1912) had recorded both *Anagallis arvensis* (≡ *L. arvensis*) and *A. latifolia* (≡ *L. loeflingii*) for the flora of Japan and Taiwan ("Formosa"), no descriptions on the flower colors were provided. Chung (2018) applied the name *L. arvensis* var. *caerulea* (L.) Turland & Bergmeier to the blue-flowered plants, reserving *L. arvensis* for the red-flower morph. Jiménez-López *et al*. (2022) demonstrated that the two color morphs are reproductively and phylogenetically distinct and proposed to raise the blue-flower morph to the specific status for which the name *Anagallis latifolia* L. has the priority. However, the existence of the name *Lysimachia latifolia* (Hook.) Cholewa (≡ *Trientalis latifolia* Hook.) blocks the direct transfer of *Anagallis latifolia* to *Lysimachia*. Consequently, *L. loeflingii* ***nom. nov.*** was proposed for this common costal plant species of Taiwan (Jiménez-López *et al*., 2022). Our ITS phylogeny is consistent with Jiménez-López *et al*. (2022), confirming the presence of both *L. arvensis* and *L. loeflingii* in Taiwan.

9. *Lysimachia mauritiana* Lam., Encycl. 3(2): 572. 1792.—***TYPE***: BOURBON (Réunion). *P. Commerson 892* [lectotype MPU-013006 (image!), designated here; isolectotypes P-00299870 (image!), P-00299873 (image!), P-00299874 (image!) & P-00299877 (image!)]; Pax & Knuth in Das Pflanzenreich IV. 237: 273, *fig. 58*. 1905; Sasaki, List Pl. Formosa 327. 1928; Mori in Short Fl. Formosa 164. 1936; Masamune, List Vas. Plant Taiwan 93. 1954; Bentvelzen, Flora Malesiana, Ser. I 6(2): 183. 1962; Hsieh & Yang, Nomencl. Pl. Taiwan 765. 1969; Kao & DeVol, Taiwania 15(1): 64, *pl. 9*. 1970; Kao & DeVol in Fl. Taiwan 4: 81, *pl. 922*. 1978; S.S.Ying, Colour. Illustr. Herbac. Pl. Taiwan 1: 153, *ph. 60*. 1980; Yang, List Pl. Taiwan 1038. 1982; Ohwi, Fl. Japan 718. 1984; Chen *et al*. in Fl. Reipubl. Popul. Sin. 59(1): 102. 1989; Yamazaki in Fl. Japan IIIa 82–83. 1993; Hu & Kelso in Fl. China 15: 70. 1996; Kao & Peng in Fl. Taiwan 2nd ed. 4: 70, *pl. 30, ph. 46*. 1998; Yang *et al*. in Manual Taiwan Vasc. Pl. 4: 26, *ph. 54*. 1999; Takahasi, Wild Flowers Japan 4: 194, *pl. 135(4, 5)*. 2017; Chung, Ill. Fl. Taiwan 6: 110. 2018. **茅毛珍珠菜**

Lysimachia lineariloba Hook. & Arn., Bot. Beechey Voy. 268. 1838.—***TYPE***: LOO CHOO (JAPAN. Ryukyus). *Beechey s.n.* [lectotype E-00369157 (image!), designated here]; Forbes and Hemsley, J. Linn. Soc., Bot. 26(173): 53. 1889; Henry, Trans. Asiat. Soc. Japan. 24 Suppl.: 57 1896; Matsumura, Bot. Mag. (Tokyo) 14(161): en83. 1900; Matsumura & Hayata, J. Coll. Sci. Imp. Univ. Tokyo. 22: 221. 1906; Kawakami, List Pl. Formosa 66. 1910; Matsumura, Index Pl. Jap. 2(2): 477. 1912; Hayata, Icon. Pl. Formos. 6 suppl.: 43. 1917.

Lysimachia mauritiana var. *taiwaniana* S.S.Ying, Colour. Illustr. Herbac. Pl. Taiwan 1: 155, *ph. 61*. 1980.—***TYPE***: TAIWAN. Keelung, Hopingtao, Apr. 1980, *S.-S. Ying s.n.* (holotype NTUF).

Notes: *Lysimachia mauritiana* is a common biennial herb widely distributed along coastal areas in East Asia, the Philippines, Micronesia, Polynesia and the Indian Ocean known for extensive intraspecific chromosomal variation (Kono *et al*., 2012; Kono *et al*., 2019). However, its type specimen remains unresolved. In the protologue, Lamarck (1789–1792) stated that "*Commerson a trouvé cette plante dans l'Isle de Bourbon*" (Commerson found this plant on the island of Bourbon.), suggesting that all Commerson's collection from l'Isle de Bourbon (Réunion) could be the original material (Table S1) according to Art. 9.4 of the *Code* (Turland *et al*., 2018). We select MPU013006 as the lectotype for its high quality and previous annotation by Morgane NOULLET. For *Lysimachia lineariloba*, E-00369157 is selected as the lectotype as the specimen was collected during the Beechey's voyage and appears to be the original material according to Art. 9.4 of the *Code* (Turland *et al*., 2018).

10. *Lysimachia minima* (L.) U.Manns & Anderb., Willdenowia 39(1): 52. 2009; Chung, Ill. Fl. Taiwan 6: 111. 2018. ≡ *Centunculus minimus* L., Sp. Pl. 1: 116. 1753.—***TYPE***: Herb. Linn. No. 147.1 [lectotype LINN 147.1 (image!), designated by Dyer (1963: 14)]. ≡ *Anagallis minima* (L.) E.H.L.Krause, Deutschl. Fl. (Sturm), ed. 2. 9: 251. 1901; Hsu *et al*., Taiwania 54(4): 404, *fig. 2, 4*. 2009. **小海綠**

11. *Lysimachia nigropunctata* Masam., J. Soc. Trop. Agric. 4(3): 191. 1932.—***TYPE***: TAIWAN. Higasinoko, Nokogoe, 11 Jul. 1930, *Y. Kudo & K. Mori 34* [lectotype TAI-119056 (image!), designated here; isolectotype TAI-119049 (image!)]; Mori in Short Fl. Formosa 164. 1936; Masamune, List Vas. Plant Taiwan 92. 1954; Hsieh & Yang, Nomencl. Pl. Taiwan 765. 1969; Kao & DeVol, Taiwania 15(1): 66, *pl. 10*. 1970; Kao & DeVol in Fl. Taiwan 4: 81, *pl. 923*. 1978; Yang, List Pl. Taiwan 1038. 1982; Kao & Peng in Fl. Taiwan 2nd ed. 4: 73, *pl. 31, ph. 47*. 1998; Yang *et al*. in Manual Taiwan Vasc. Pl. 4: 26, *ph. 55, 56*. 1999; Chung, Ill. Fl. Taiwan 6: 111. 2018. **黑點珍珠菜**

Lysimachia congestiflora auct. non Hemsl.: Chen & Hu, Acta Phytotax. Sin. 17(4): 38, *pro parte*; Chen & Hu, Fl. Reipubl. Popul. Sin. 59(1): 83. 1989, *pro parte*; Hu & Kelso, Fl. China 15: 66. 1996, *pro parte*.

Notes: Though *L. nigropunctata* was regarded as conspecific with *L. congestiflora* by Chen and Hu (1979), Chen *et al*. (1989), and Hu and Kelso (1996), molecular phylogenetics (Kokubugata *et al*., 2010; Fig. 1) and cytological data (Table 1; Figs. 2c & 3c) unambiguously show the differences between the two species, supporting the specific status of the former species. *Lysimachia*

nigropunctata was described by Masamune (1932b) based on "*Y. Kudo et K. Mori no. 34*", which is represented in TAI by two collections (119049 and 119056) that are both syntypes of the name according to Art 9.6 of the *Code* (Turland *et al*., 2018). We here designate TAI-119056 as the lectotype because this specimen, with the stamp "*Typus*", also includes more plants mounted on the sheet (Table S1). While *L. nigropunctata* is morphologically and phylogenetically distinct from *L. congestiflora*, two ITS clades were recovered in our ITS tree, with the southern clade (Mt. Guan and Jhongihihguan) sister to *L. chingshuiensis* and northern clade (Mt.Panshi and Mt. Chingshui) sister to *L. ravenii* (Fig. 1). Further study is needed to clarify the population structure and species delimitation of *L. nigropunctata*. Moreover, understanding the mechanisms that had triggered the differentiation of *L. nigropunctata* and its related species (*L. chingshuiensi*s and *L. ravenii*), i.e., a clade which is endemic to Taiwan and morphologically and cytologically diverse, is also necessary in the future work.

12. *Lysimachia ravenii* C.I Peng in Chung, Ill. Fl. Taiwan 6: 112. 2018.—***TYPE***: TAIWAN. Pingtung County, Tahanshan Logging Trail 27 km, 1300 m elev., 8 Jul 2011, *T.-C. Hsu 4288* (holotype TAIF; isotype HAST-144747!). **大漢山珍珠菜 Figs. 8F & 9**

Perennial herbs, prostrate or decumbent; **Stems** villous with long spreading hairs. **Leaves** opposite, widely ovate to deltate, 0.5–1.3 cm long, 0.6–1.7 cm wide, apex mucronate, base subcordate to truncate, adaxial and abaxial surface villous, abaxial surface with black dots; petiole 2–5 mm long, villous. **Flowers** axillary, subsessile. Corolla yellow, ca. 1.3 cm across, 4 or 5-lobed; lobes ovate, apex acute, ca. 6 mm long, ca. 4 mm wide, dotted with minute, reddish brown glands. Calyx ca. 7 mm long, deeply divided to 5-lobed, approximately three-fourths of the length of calyx, lobes lanceolate, abaxial surface with black dots, villous. Filaments connate at base into a ring; Anthers ca. 1 mm long, longitudinally dehiscent; Stamens remain aggregated during anthesis. Ovaries globose, villous, ca. 1.5 mm in diam; Styles to 3 mm long. **Caspules** ca. 2.5 mm in diam., dehiscing by 5 valves. Flowering and fruiting Jul–Dec.

Endemic, only known from Tahanshan Logging Trail of Pingtung County.

Notes: *Lysimachia ravenii* C.I Peng was described posthumously in Chung (2018). Contrary to Peng's previous works (Chung, 2020), the description of the species includes only photographs and a brief diagnosis stating that it is similar to *L. japonica*, differing from the latter by its stems covered with erect villous hairs (Fig. 8F), while stems of *L. japonica* are covered with appressed villous hairs (Fig. 8E). In addition to the morphological difference, our present study shows that *L. ravenii* is also cytologically ($2n = 42$ vs. 20; Table 1; Figs. 2B, 3B & 4) and phylogenetically (Fig. 1) distinct, supporting its specific status.

***Specimens examined*: PINGTUNG**: Chunjih, Tahanshan Logging Trail, *Chung et al. 1354* (HAST), *Hsiao et al. 1040* (HAST), *Huang et al. 39* (HAST), *Peng et al. 17821* (HAST), *Peng et al.* 23200 (HAST), *Leu et al. 571* (HAST).

13. *Lysimachia remota* Petitm., Monde Pl. sér. 2, 9: 30. 1907.—***TYPE***: CHINE (CHINA). Kiang-Sou. *d'Argy s.n.* [holotype E-00024969 (image!)]; Masamune, List Vas. Plant Taiwan 92. 1954; Hsieh & Yang, Nomencl. Pl. Taiwan 765. 1969; Chen & Hu, Fl. Reipubl. Popul. Sin. 59(1): 64. 1989; Hu & Kelso, Fl. China 15: 60. 1996; Kao & Peng in Fl. Taiwan 2nd ed. 4: 73, *pl. 32, ph. 48*. 1998; Yang *et al*. in Manual Taiwan Vasc. Pl. 4: 26. 1999; Chung, Ill. Fl. Taiwan 6: 112. 2018. **蓬萊珍珠菜**

Lysimachia formosana Honda, Bot. Mag. (Tokyo) 44: 668. 1930.—***TYPE***: FORMOSA (Taiwan). Bioritus, 1915, *T. Soma* (lectotype TI-00081667!, designated here; Fig. S4); Mori in Short Fl. Formosa 164. 1936; Kao & DeVol, Taiwania 15(1): 61, *pl. 6*. 1970; Kao & DeVol in Fl. Taiwan 4: 77, *pl. 919*. 1978; Yang, List Pl. Taiwan 1037. 1982. ≡ *Lysimachia japonica* var. *formosana* (Honda) S.S.Ying, Colour. Illustr. Herbac. Pl. Taiwan 1: 152, *ph. 59*. 1980.

Notes: Both molecular phylogenetic (Fig. 1) and cytological (Figs. 2D & 3D) data support that the Taiwanese populations of *L. remota* are conspecific with the mainland Chinese population of the species. The name *Lysimachia formosana* was described by Honda (1930) based on three collections: "Formosa: ins. Sharyōtō [B. Hayata, anno 1916 (TI 00265324!; Fig. S5)]; Bioritsu [T. Soma, anno 1915 (TI 00081667!; Fig. S4)]; shinchiku [T. Soma, anno 1914 (TI 00265325!; Fig. S6)]." These three collections are thus syntypes of *L. formosana* according to Art 9.6 of the *Code* (Turland *et al*., 2018). We selected *T. Soma s.n.* 1915 (TI 00081667; Fig. S4) as the lectotype of *L. formosana* for this quality specimen is also stamped with "Typus".

14. *Lysimachia simulans* Hemsl. in Forbes & Hemsley, J. Linn. Soc., Bot. 26(173): 57. 1889.—***TYPE***: FORMOSA (TAIWAN). Kelung (Keelung), June 1884, *C. Ford s.n.* [holotype K-000750731 (image!)]; Henry, Trans. Asiat. Soc. Japan. 24 Suppl.: 57 1896; Matsumura & Hayata, J. Coll. Sci. Imp. Univ. Tokyo. 22: 223. 1906; Kawakami, List Pl. Formosa 66. 1910; Hayata, Icon. Pl. Formos. 6 suppl.: 44. 1917; Sasaki, List Pl. Formosa 327. 1928; Mori in Short Fl. Formosa 164. 1936; Masamune, List Vasc. Pl. Taiwan 93. 1954; Hsieh & Yang, Nomencl. Pl. Taiwan 765. 1969; Yang, List Pl. Taiwan 1038. 1982; Yamazaki in Fl. Japan IIIa 83. 1993. **台灣排香**

Lysimachia ardisioides Masam., J. Soc. Trop. Agric. 4(3): 302. 1932.—***TYPE***: TAIWAN. Taipei, Uraisya (Wulai), 13 May 1929, *Y. Yamamoto s.n.* [holotype TAI-119048 (image!)]; Mori in Short Fl. Formosa 163. 1936; Masamune, List Vas. Plant Taiwan 92. 1954; Kao & DeVol, Taiwania 15(1): 56, *pl. 4*, 1970; Kao & DeVol in Fl. Taiwan 4: 72, *pl. 916*. 1978; Yang, List Pl. Taiwan 1036. 1982; Hu & Kelso, Fl. China 15: 51. 1996; Kao & Peng in Fl. Taiwan 2nd ed. 4: 61, *pl. 23*. 1998; Yang *et al*. in Manual Taiwan Vasc. Pl. 4: 25, *ph. 47*. 1999; Chung, Ill. Fl. Taiwan 6: 105. 2018.

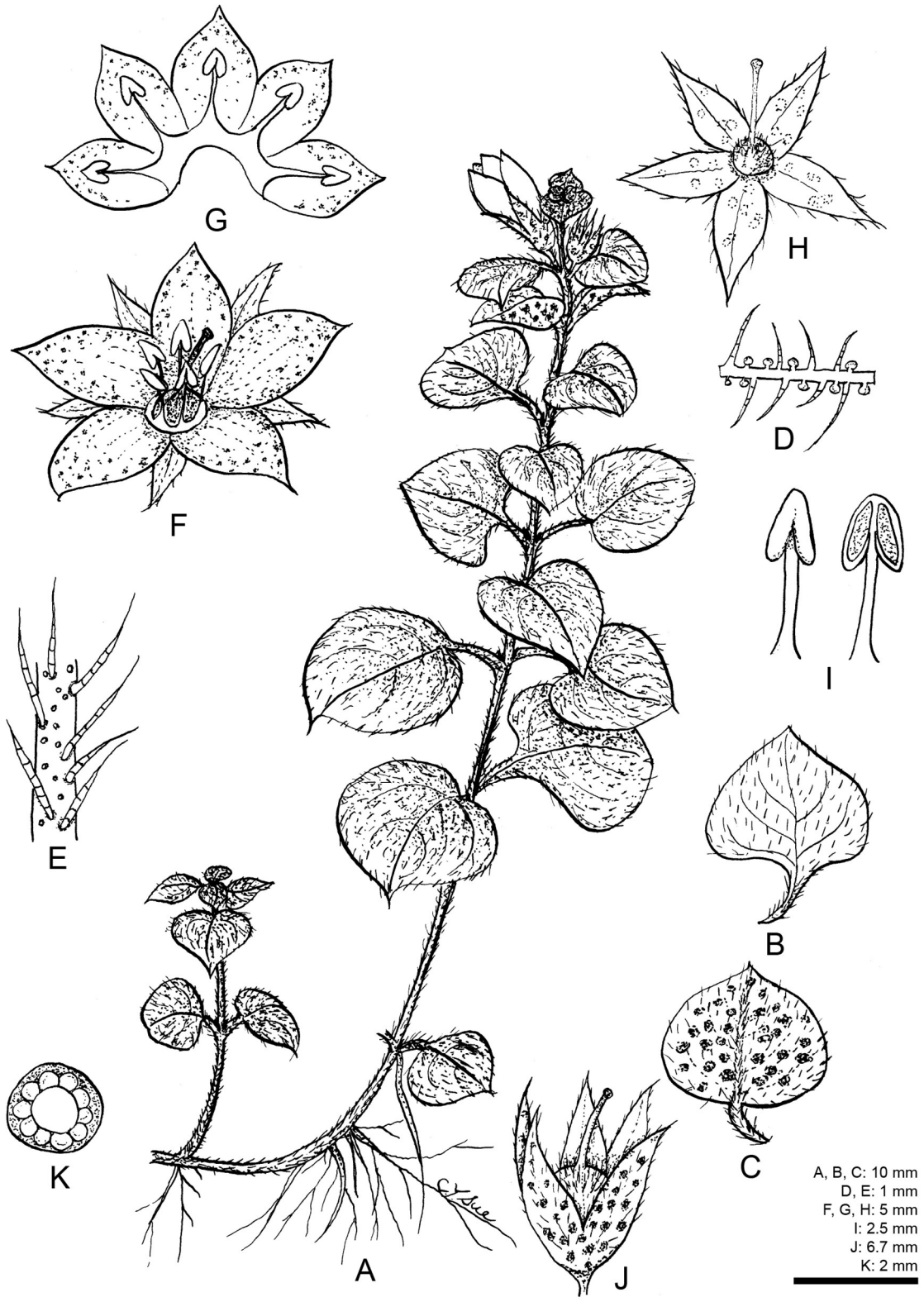


Fig. 9. ***Lysimachia ravenii*** C.I Peng. **A.** Habit; **B.** leaf, adaxial view; **C.** leaf, abaxial view; **D.** Vestiture on petals; **E.** Vestiture on stem; **F.** flower; **G.** corolla and stamens; **H.** flower with corolla and stamens removed; **I.** stamens; **J.** developing fruit enclosed by calyx; **K.** cross section of ovary. Drawn by Chian-Yi Sue.

Lysimachia sikokiana auct. non Miq.: Matsumura, Bot. Mag. (Tokyo) 14(161): e84. 1900, *pro parte*; Pax & Knuth in Das Pflanzenreich IV. 237: 270. 1905, *pro parte*; Matsumura & Hayata, J. Coll. Sci. Imp. Univ. Tokyo. 22: 223. 1906, *pro parte*; Hayata, J. Coll. Sci. Imp. Univ. Tokyo. 25: 157. 1908 ("Sysimachia"), *pro parte*; Kawakami, List Pl. Formosa 66. 1910 ("sokokiana"); Matsumura, Index Pl. Jap. 2(2): 477. 1912; Hayata, Icon. Pl. Formos. 6 suppl.: 44. 1917; Handel-Mazzetti, Notes Roy. Bot. Gard. Edinburgh 16: 74. 1928, *pro parte*; Sasaki, List Pl. Formosa 327. 1928; Bentvelzen, Flora Malesiana, Ser. I 6(2): 178, *fig. 2*. 1962, *pro parte*; Ohwi, Fl. Japan 717. 1984, *pro parte*; Chen & Hu, Fl. Reipubl. Popul. Sin. 59(1): 22, *pl 2(1)*. 1989, *pro parte*; Yamazaki in Fl. Japan IIIa 83. 1993, *pro parte.*

Notes: Based on Kokubugata *et al*. (2006), *Lysimachia ardisioides* (= *L. simulans*) is phylogenetically and cytologically distinguishable from *L. sikokiana*, pending further study of the Philippine populations previously ascribed to the latter species (Bentvelzen, 1962).

15. *Lysimachia taiwaniana* Suzuki, J. Taihoku Soc. Agric. Forest. 1(1): 78. 1936.—***TYPE***: Formosa (Taiwan). Taihoku, Mt. Taiheizan, 1 Jul. 1929, *S. Suzuki 132* [holotype TAI-119050 (image!)]. ≡ *Lysimachia taiwaniana* Suzuki in Sched. ex M.T.Kao in Kao & DeVol, Taiwania 15(1): 66, *pl. 11*. 1970, ***isonym***; Kao & DeVol in Fl. Taiwan 4: 84, *pl. 924*. 1978; Yang, List Pl. Taiwan 1038. 1982. **台灣珍珠菜 Fig. 8A, C**

Lysimachia congestiflora auct. non Hemsl.: Masamune, List Vas. Plant Taiwan 92. 1954, *pro parte*; Chen & Hu, Acta Phytotax. Sin. 17(4): 38, 1979, *pro parte*; Yang, List Pl. Taiwan 1037. 1982; Chen & Hu, Fl. Reipubl. Popul. Sin. 59(1): 83. 1989, *pro parte*; Hu & Kelso, Fl. China 15: 66. 1996, *pro parte*; Kao & Peng in Fl. Taiwan 2nd ed. 4: 66, *pl. 26, ph. 43*. 1998; Yang *et al*. in Manual Taiwan Vasc. Pl. 4: 26, *ph. 50*. 1999; Chung, Ill. Fl. Taiwan 6: 108. 2018.

Lysimachia nanhutashanensis S.S.Ying, New Taxa New Names 4: 255, *fig. 321–328*. 2022.—***TYPE***: TAIWAN. Taichung City, Hoping District, Nanhutashan, alt. 1980 m, 12 August 2021, *S.-S. Ying s.n.* (holotype NTUF), ***syn. nov.***

Notes: Both molecular phylogenetic analyses (Kokubugata *et al*., 2010; Fig. 1) and chromosome cytology (Fig. 5 & 6) presented here demonstratively show the distinction between *L. congestiflora* and *L. taiwaniana*, thereby supporting the resurrection of the specific status of the latter species. However, while a majority of taxonomic literature (Kao and DeVol, 1978; Chen and Hu, 1979; Chen *et al*., 1989; Hu and Kelso, 1996) attributed the name *L. taiwaniana* to M.T.Kao, this designation appears to be illegitimate. Initially, *Lysimachia taiwaniana* was described by Sigeyosi Suzuki in 1936 based on his own collection *S. Suzuki 132* deposited in TAI (TAI-119050). Apparently unaware of Suzuki (1936)'s work, however, "***Lysimachia taiwaniana*** Suzuki in Sched. ex Kao" was published based also on *S. Suzuki 132* (TAI), with a note that "Suzuki suggested the name Lysimachia taiwaniana for this species but so far as we know he never published it" (Kao and DeVol, 1970). Indeed, *L. taiwaniana* Suzuki (1936) remained largely unnoticed until Kao and Peng (1998) and Kokubugata *et al*. (2010) and has been overlooked by major plant names databases such as IPNI (International Plant Name Index; https://www.ipni.org/; accessed 15 Feb 2024) and Tropicos (https://tropicos.org/home; accessed 15 Feb 2024). Because *Lysimachia taiwaniana* Suzuki and *Lysimachia taiwaniana* Suzuki ex M.T.Kao are isonyms (Nicolson, 1975; Veldkamp and Sosef, 1998) that were published independently at different times by different authors based on the same type [i.e., *S. Suzuki 132* (TAI-119050)], only the earliest of these isonyms, i.e., *Lysimachia taiwaniana* Suzuki, has nomenclatural status according to Art. 6.3 Note 2 of the *Code* (Turland *et al*., 2018).

Lysimachia nanhutashanensis S.S.Ying was published in the author's (Ying, 2022a) self-published and poorly edited work of apparent taxonomic vandalism (Wüster *et al*., 2021). Although the name was validly published, it is without a doubt a synonym of *L. taiwaniana* Suzuki.

ACKNOWLEDGMENTS

The authors thank the Herbarium of Tokyo University for the courtesy of using Figures 7 and S1–S6, and Mark Hughes (E), Maxim Nuraliev (MWG), and Cheng-Wei Chen for providing references. This work was supported by the 2023 research grant "Operation and Promotion of Catalogue of Life in Taiwan Database—TaiCOL" (112 林發-08.1-保-05) of Forestry and Nature Conservation Agency, Ministry of Agriculture to K.-F. Chung.

LITERATURE CITED

Anderberg, A.A., Manns, U., Källersjö, M. 2007 Phylogeny and floral evolution of the Lysimachieae (Ericales, Myrsinaceae): evidence from *ndhF* sequence data. Willdenowia **37(2)**: 407–421.

APG III 2009 An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG III. Bot. J. Linn. Soc. **161(2)**: 105–121.

APG IV 2016 An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG IV. Bot. J. Linn. Soc. **181(1)**: 1–20.

Arista, M., Talavera, M., Berjano, R., Ortiz, P.L. 2013 Abiotic factors may explain the geographical distribution of flower colour morphs and the maintenance of colour polymorphism in the scarlet pimpernel. J. Ecol. **101(6)**: 1613–1622.

Bentvelzen, P.A.J. 1962 Primulaceae. Flora Malesiana, Ser. I **6(2)**: 174–192.

Chen, F.-H., Hu, C.-M. 1979 Taxonomic and phytogeographic studies on Chinese species of *Lysimachia*. Acta Phytotax. Sin. **17(4)**: 21–53.

Chen, F.-H., Hu, C.-M., Fang, Y.-I., Cheng, C.-Z. 1989 Primulaceae. In: Chen, F.-H. and C.-M. Hu (eds.), Flora Reipublicae Popularis Sinicae **59**(1): 3–133. Science Press, Beijing.

Chung, K.-F. 2020 In memoriam Ching-I Peng (1950–2018)—an outstanding scientist and mentor with a remarkable legacy. Bot. Stud. **61**: e14.

Chung, S.-W. 2018 Illustrated Flora of Taiwan, Volume 6. Owl Publishing House Co., Taipei, Taiwan. 416 pp.

Chung, S.-W., Huang, W.-J., Su, H.-C. 2020 Rediscovery of *Lysimachia candida* Lindl. (Primulaceae) in Taiwan after 123 years. Quart. J. Forest Res. **42(2)**: 119–126.

DeVol, C.E., Kuo, C.-M. 1979 Bibliography. In: Li, H.-L. *et al*. (eds.), Flora of Taiwan **6**: 189–277. Epoch Publishing Co., Taipei, Taiwan.

Dyer, R.A. 1963 Primulaceae. In: Dyer, R. A. *et al*. (eds.), Flora of Southern Africa **26**: 9–15. Dept. Agricultural Technical Services, Republic of South Africa, Pretoria.

Editorial Committee of the Red List of Taiwan Plants 2017 The Red List of Vascular Plants of Taiwan, 2017. Endemic Species Research Institute, Forestry Bureau, Council of Agriculture, Executive Yuan and Taiwan Society of Plant Systematics, Nantou, Taiwan. 187 pp.

Forbes, F.B., Hemsley, W.B. 1889 An enumeration of all the plants known from China proper, Formosa, Hainan, Corea, the Luchu Archipelago, and the island of Hongkong, together with their distribution and synonymy. J. Linn. Soc., Bot. **26(173)**: 1–120.

Hance, H.F. 1866 Adversaria in stirpes imprimis Asiae orientalis criticas vel minusve notas, interjectis novarum plurimarum diagnosibus. Ann. Sci. Nat. Bot. sér. 5 **5**: 202–261.

Hance, H.F. 1877 Two new species of *Lysimachia*. J. Bot. **6**: 355–357.

Handel-Mazzetti, H. 1928 A revision of the Chinese species of *Lysimachia*, with a new system of the whole genus. Notes Roy. Bot. Gard. Edinburgh **16**: 51–122.

Hao, G., Yuan, Y.-M., Hu, C.-M., Ge, X.-J., Zhao, N.-X. 2004 Molecular phylogeny of *Lysimachia* (Myrsinaceae) based on chloroplast *trn*L-F and nuclear ribosomal ITS sequences. Mol. Phylogenet. Evol. **31(1)**: 323–339.

Hara, H., Kurosawa, S. 1959 Notes on Japanese species of *Lysimachia* Sect. *Nummularia*. J. Jap. Bot. **34(1)**: 8–10.

Hayata, B. 1908 Flora montana Formosae. An enumeration of the plants found on Mt. Morrison, the central chain, and other mountainous regions of Formosa at altitudes of 3,000–13,000 ft. J. Coll. Sci. Imp. Univ. Tokyo. **25**: 1–704.

Hayata, B. 1911 Materials for a Flora of Formosa. J. Coll. Sci. Imp. Univ. Tokyo. **30(1)**: 1–471.

Hayata, B. 1917 General Index to the Flora of Formosa. Bureau of Productive Industry, Government of Formosa, Taihoku, Formosa. 155 pp.

Henry, A. 1896 A list of plants from Formosa. Trans. Asiat. Soc. Japan. **24 Suppl.**: 1–118.

Hitchcock, A.S., Green, M.L. 1929 Standard-species of Linnean genera of Phanerogamae (1753–54). In: Sprague, T. A. *et al*. (eds.), International Botanical Congress Cambridge (England), 1930. Nomenclatural proposals by British botanists: 110–195. Wyman & Sons, Ltd., London.

Honda, M. 1930 Nuntia ad floram Japonicae VIII. Bot. Mag. (Tokyo) **44(528)**: 667–671.

Hsieh, A.-T., Yang, T.-I. 1969 Nomenclature of Plants in Taiwan. College of Agriculture, National Taiwan University, Taipei, Taiwan. 1082 pp.

Hsu, T.-C., Lin, J.-J., Chung, S.-W. 2009. Two newly discovered plants in Taiwan. Taiwania **54(4)**: 403–407.

Hu, C.-M. 1985 Further notes on the genus *Lysimachia* L. in Mainland S.E. Asia. Acta Phytotax. Sin. **23(5)**: 355–368.

Hu, C.-M., Kelso, S. 1996 Primulaceae. In: Wu, Z.-Y. and P.-H. Raven (eds.), Flora of China **15**: 39–189. Science Press & Missouri Botanical Garden, Beijing, China and St. Louis, MO, USA.

Imchanitzkaja, N. 2002 Specimina typica specierum nonnullarum florae Japoniae a C. J. Maximowiczio descriptarum in Herbario Instituti Botanici nomine V. L. Komarovii (LE) conservata. Novosti Sist. Vyssh. Rast. **34**: 260–270.

Jiménez-López, F.J., Viruel, J., Arista, M., Ortiz, P.L., Talavera, M. 2022 Molecular approaches reveal speciation between red- and blue-flowered plants in the Mediterranean and *Lysimachia arvensis* and *L. monelli* (Primulaceae). Bot. J. Linn. Soc. **199(2)**: 557–577.

Jinno, T. 1956 The chromosomes in *Lysimachia*. Jap. J. Genet. **31(3)**: 87–88.

Kao, M.-T., DeVol, C. 1970 The Primulaceae of Taiwan. Taiwania **15(1)**: 51–72.

Kao, M.-T., DeVol, C.E. 1978 Primulaceae. In: Li, H.-L. *et al*. (eds.), Flora of Taiwan **4**: 69–89. Epoch Publishing Co., Taipei, Taiwan.

Kao, M.-T., Peng, C.-I 1998 Primulaceae. In: Huang, T.-C. *et al*. (eds.), Flora of Taiwan, 2nd ed. **4**: 57–78. Editorial Committee, Dept. Bot., NTU, Taipei, Taiwan.

Katoh, K., Standley, D.M. 2013 MAFFT multiple sequence alignment software version 7: Improvements in performance and usability. Mol. Biol. Evol. **30(4)**: 772–780.

Kawakami, T. 1910 A List of Plants of Formosa. Bureau of Productive Industry, Government of Formosa, Taihoku, Formosa. 119 pp.

Kearse, M., Moir, R., Wilson, A., Stones-Havas, S., Cheung, M., Sturrock, S., Buxton, S., Cooper, A., Markowitz, S., Duran, C., Thierer, T., Ashton, B., Meintjes, P., Drummond, A. 2012 Geneious Basic: An integrated and extendable desktop software platform for the organization and analysis of sequence data. Bioinformatics **28(12)**: 1647–1649.

Ko, S.-C., Im, I.T., Kim, Y.-S. 1986 A cytotaxonomic study on the genus *Lysimchia* in Korea. Korean J. Pl. Taxon. **16(3)**: 187–197.

Kokubugata, G., Peng, C.-I, Saito, Y., Yokota, M., Kobayashi, S. 2006 Taxonomic reconsideration of *Lysimachia ardisioides* (Primulaceae) from Taiwan. Mem. Natn. Sci. Mus., Tokyo **44**: 135–140.

Kokubugata, G., Nakamura, K., Shinohara, W., Saito, Y., Peng, C.-I, Yokota, M. 2010 Evidence of three parallel evolutions of leaf dwarfism and phytogeography in *Lysimachia* sect. *Nummularia* in Japan and Taiwan. Mol. Phylogenet. Evol. **54(2)**: 657–663.

Källersjö, M., Bergqvist, G., Anderberg, A.A. 2000 Generic realignment in primuloid families of the Ericales s.l.: A phylogenetic analysis based on DNA sequences from three chloroplast genes and morphology. Am. J. Bot. **87(9)**: 1325–1341.

Kollmann, F., Feinbrun, N. 1968 A cyto-taxonomic study in Palestinian *Anagallis arvensis* L. Notes Roy. Bot. Gard. Edinburgh **28**: 173–186.

Kono, Y., Chung, K.-F., Chen, C.-H., Hoshi, Y., Setoguchi, H., Chou, C.-H., Oginuma, K., Peng, C.-I 2012 Intraspecific karyotypic polymorphism is highly concordant with allozyme variation in *Lysimachia mauritiana* (Primulaceae: Myrsinoideae) in Taiwan: implications for the colonization history and dispersal patterns of coastal plants. Ann. Bot. **110(6)**: 1119–1135.

Kono, Y., Peng, C.-I, Hoshi, Y., Yokota, M., Setoguchi, H., Lum, S.K.Y., Oginuma, K. 2019 Intraspecific karyotype polymorphism and chromosomal evolution of *Lysimachia*

mauritiana (Primulaceae) in the Ryukyu Archipelago of Japan and Taiwan. Cytologia **84(1)**: 93–103.

Lamarck, J.B.A.P.M.d. 1789–1792 Encyclopédie Méthodique, Botanique, Tome Troisieme. Panckoucke, Paris & Liège. 743 pp.

Larson, D.A., Chanderbali, A.S., Maurin, O., Gonçalves, D.J.P., Dick, C.W., Soltis, D.E., Soltis, P.S., Fritsch, P.W., Clarkson, J.J., Grall, A., Davies, N.M.J., Larridon, I., Kikuchi, I.A.B.S., Forest, F., Baker, W.J., Smith, S.A., Utteridge, T.M.A. 2023 The phylogeny and global biogeography of Primulaceae based on high-throughput DNA sequence data. Mol. Phylogenet. Evol. **182**: e107702.

Levan, A., Fredga, K., Sandberg, A.A. 1964 Nomenclature for centromeric position on chromosomes. Hereditas **52(2)**: 201–220.

Lin, C.-T., Chung, K.-F. 2017 Phylogenetic classification of seed plants of Taiwan. Bot. Stud. **58**: e52.

Lindley, J. 1846 New plants, etc., from the Society's Garden. J. Hort. Soc. London **1**: 298–308.

Liu, T.-J., Zhang, S.-Y., Wei, L., Lin, W., Yan, H.-F., Hao, G., Ge, X.-J. 2023 Plastome evolution and phylogenomic insights into the evolution of *Lysimachia* (Primulaceae: Myrsinoideae). BMC Plant Biol. **23(1)**: e359.

Manns, U., Anderberg, A.A. 2005 Molecular phylogeny of *Anagallis* (Myrsinaceae) based on ITS, *trn*L-F, and *ndh*F sequence data. Int. J. Plant Sci. **166(6)**: 1019–1028.

Manns, U., Anderberg, A.A. 2007 Relationships of *Anagallis foemina* and *A. arvensis* (Myrsinaceae): New insights inferred from DNA sequence data. Mol. Phylogenet. Evol. **45(3)**: 971–980.

Manns, U., Anderberg, A.A. 2009 New combinations and names in *Lysimachia* (Myrsinaceae) for species of *Anagallis*, *Pelletiera* and *Trientalis*. Willdenowia **39(1)**: 49–54.

Masamune, G. 1932a Symbolae florae Australi-Japonicae II. J. Soc. Trop. Agric. **4(3)**: 300–304.

Masamune, G. 1932b Symbolae florae Australi-Japonicae I. J. Soc. Trop. Agric. **4(3)**: 191–197.

Masamune, G. 1954 A List of Vasular Plants of Taiwan. Hokurikunoshoku Butzunokai Press, Kanazawa, Japan. 137 pp.

Matsumura, J. 1900a Notulæ ad Plantas Asiaticas Orientales (Continued from p. 59.). Bot. Mag. (Tokyo) **14(160)**: en69–en71.

Matsumura, J. 1900b Notulæ ad plantas asiaticas orientales (Continued from p. 71.). Bot. Mag. (Tokyo) **14(161)**: en83–en85.

Matsumura, J., Hayata, B. 1906 Enumeratio plantarum in insula Formosa sponte crescentinum hucusque rite cognitarum adjectis descriptionibus et figuris specierum pro regione novarum. J. Coll. Sci. Imp. Univ. Tokyo. **22**: 1–704.

Matsumura, J. 1912 Index Plantarum Japonicarum, sive, Enumeratio Plantarum Omnium ex Insulis Kurile, Yezo, Nippon, Sikoku, Kiusiu, Liukiu, et Formosa Hucusque Cognitarum Systematice *et al*phabetice Disposita Adjectis Synonymis Selectis, Nominibus Japonicis, Locis Natalibus, Vol. 2(2). Tokinoni, Tokyo, Japan. 767 pp.

Maximowicz, C.J. 1868 Diagnoses breves plantarum novarum Japoniae et Mandshuriae. Decas Quarta et Quinta. Bull. Acad. Imp. Sci. Saint-Petersbourg, sér. 3 **12**: 60–73.

Mori, K. 1936 Primulaceae. In: Masamune, G. (ed.), Short Flora of Formosa: 163–164. The Editorial Department of Kudoa, Taihoku, Taiwan.

Nicolson, D.H. 1975 Isonyms and pseudo-isonnyms: Identical combinations with the same type. Taxon **24(4)**: 461–466.

Odashima, K. 1935 Plantarum Formosanarum species novae determinatae (I). J. Soc. Trop. Agric. **7(1)**: 79–86.

Ohwi, J. 1984 Flora of Japan. Smithsonian Institute, Washington, D.C., USA. 1607 pp.

Okuyama, S. 1962 On the distribution of some Japanese plants. Acta Phytotax. Geobot. **20(1)**: 29–31.

Ortiz, P.L., Berjano, R., Talavera, M., Rodríguez-Zayas, L., Arista, M. 2015 Flower colour polymorphism in *Lysimachia arvensis*: How is the red morph maintained in Mediterranean environments? Perspect. Plant Ecol. Evol. Syst. **17(2)**: 142–150.

Pan, B., Zou, C.-Y., Xu, W.-B. 2022 *Lysimachia sedoides* (Primulaceae), a rare new species from limestone area in northern Guangxi, China. Taiwania **67(3)**: 318–321.

Pax, F., Knuth, R. 1905 Primulaceae. In: Engler, A. (ed.), Das Pflanzenreich IV. **237**: 1–386. Verlag von Wilhelm Engelmann, Leipzig.

Peng, C.-I, Hu, C.-M. 1999 *Lysimachia chingshuiensis* (Primulaceae), a new species from eastern Taiwan. Bot. Bull. Acad. Sinica. **40(1)**: 49–52.

Ray, J.D., Jr. 1956 The genus *Lysimachia* in the New World. Ill. Biol. Monogr. **24(3-4)**: 1–160.

Sasaki, S. 1928 List of Plants of Formosa. Natural History Society of Formosa, Taihoku, Formosa. 562 pp.

Shao, J.-W., Li, X.-H., Han, L., Zhang, X.-P. 2004 A study on karyotypes of five species in *Lysimachia*. Acta Bot. Yunnan. **26(4)**: 427–433.

Shinohara, W., Murakami, N. 2006 How have the alpine dwarf plants in Yakushima been miniaturized? A comparative study of two alpine dwarf species in Yakushima, *Blechnum niponicum* (Blechnaceae) and *Lysimachia japonica* (Primulaceae). J. Plant Res. **119(6)**: 571–580.

Stamatakis, A. 2014 RAxML version 8: a tool for phylogenetic analysis and post-analysis of large phylogenies. Bioinformatics **30(9)**: 1312–1313.

Ståhl, B., Anderberg, A.A. 2004 Myrsinaceae. In: Kubitzki, K. (ed.), The Families and Genera of Vascular Plants **VI**: 266–281, Flowering Plants: Dicodyledons; Celastrales, Oxalidales, Rosales, Cornales, Ericales. Springer, Berlin.

Suzuki, S. 1936 A new species of genus *Lysimachia* L. from Taiwan (Formosa). J. Taihoku Soc. Agric. Forest. **1(1)**: 77–78.

Swinhoe, R. 1863 List of Plants from the Island of Formosa, or Taiwan. Frederick Bill, Machine Printer, Chelsea, UK. 4 pp.

Takahashi, H. 2017 Primulaceae. In: Ohashi, H. *et al*. (eds.), Wild flowers of Japan, Volume 4: 187–201. Heibonsha Limited, Tokyo.

Tanaka, A., Hizume, M. 1978 Karyomorphological studies on species differentiation in some species of *Lysimachia*. Kromosomo **2(11-12)**: 301–312.

Tsai, S.-Y., Li, Y.-H., Lee, J.-Y., Chung, K.-F. 2023 TaiCOL scientific names management tool: rebuilding the national checklist in Taiwan based on references. Biodivers. Inform. Sci. Stand. **7**: e111652.

Turland, N.J., Wiersema, J.H., Barrie, F.R., Greuter, W., Hawksworth, D.L., Herendeen, P.S., Knapp, S., Kusber, W.-H., Li, D.-Z., Marhold, K., May, T.W., McNeill, J., Monro, A.M., Prado, J., Price, M.J., Smith, G.F. (eds.), 2018 International Code of Nomenclature for Algae, Fungi,

and Plants (Shenzhen Code) Adopted by the Nineteenth International Botanical Congress Shenzhen, China, July 2017. Koeltz Botanical Books, Glashütten, German. 254 pp.

Veldkamp, J.F., Sosef, M.S.M. 1998 A proposal regarding isonyms. Taxon **47(2)**: 491–492.

Wüster, W., Thomson, S.A., O'shea, M., Kaiser, H. 2021 Confronting taxonomic vandalism in biology: conscientious community self-organization can preserve nomenclatural stability. Biol. J. Linn. Soc. **133(3)**: 645–670.

Xu, L.-L., He, J.-X., Fang, L., Zhang, L.-H., Liao, L. 2004 Karyotypes of three species in *Lysimachiai* from China. Guihaia **24(1)**: 25–27.

Xu, Z., Chang, L. 2017 Primulaceae. Identification and Control of Common Weeds: Volume 3: 51–81. Springer Singapore, Singapore.

Yamazaki, T. 1993 Primulaceae. In: Iwatsuki, K. *et al*. (eds.), Flora of Japan, Volume IIIa: 79–95. Kodansha Ltd., Tokyo.

Yan, H.-F., Zhang, C.-Y., Anderberg, A.A., Hao, G., Ge, X.-J., Wiens, J.J. 2018 What explains high plant richness in East Asia? Time and diversification in the tribe Lysimachieae (Primulaceae). New Phytol. **219(1)**: 436–448.

Yang, T.-I 1982. A List of Plants in Taiwan. Natural Publishing Co., Ltd., Taipei, Taiwan. 1281 pp.

Yang, T.Y.A. 2006 Type specimens of Taiwanese plants named by Dr. C.J. Maximowicz and housed at the Herbarium, Komarov Botanical Institute of the Russian Academy of Sciences, St. Petersburg, Russia (LE). National Museum of Natural Science, Taichung, Taiwan. 90 pp.

Yang, T.Y.A., Grabovskaya, A., Illarionova, I., Chen, C.-H. 2012 *Lysimachia candida* Lindl. (Primulaceae), an extinct species and also a new record species to Taiwan. Taiwania **57(4)**: 434–442.

Yang, Y.-P., Liu, H.-Y., Peng, C.-I, Shih, B.-L., Lu, S.-Y. (eds.) 1999 Manual of Taiwan Vascular Plants, Volume 4. The Council of Agriculture, The Executive Yuan, Taipei, Taiwan. 432 pp.

Ye, H., Li, C., Ye, W., Zeng, F., Liu, F., Liu, Y., Wang, F., Ye, Y., Fu, L., Li, J. 2022 Medicinal Angiosperms of Primulaceae. In: Ye, H. *et al*. (eds.), Common Chinese Materia Medica: Volume 7: 565–590. Springer Nature Singapore, Singapore.

Ying, S.-S. 2022a New Taxa and New Names, Volume 4. Research Center of Flora of Taiwan, Taipei, Taiwan. 375 pp.

Ying, S.-S. 2022b New Taxa and New Names, Volume 5. Research Center of Flora of Taiwan, Taipei, Taiwan. 556 pp.

Zhang, C.-Y., Wang, F.-Y., Yan, H.-F., Hao, G., Hu, C.-M., Ge, X.-J. 2012 Testing DNA barcoding in closely related groups of *Lysimachia* L. (Myrsinaceae). Mol. Ecol. Resour. **12(1)**: 98–108.

Zhou, X.-L., Liao, L., Chen, Y., Xu, L.-L. 1999 Study on karyotypes of two species of *Lysimachia* (Primulaceae) from China. Guihaia **19(3)**: 236–238.

Supplementary materials are available from Journal Website