

## Additions to the flora of Singapore—new and overlooked records of naturalised plant species (2)

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**Abstract.** Eight non-native plant species and infraspecific taxa from seven families (Crassulaceae, Convolvulaceae, Linderniaceae, Malvaceae, Plantaginaceae, Talinaceae and Urticaceae) are added to the flora of Singapore. *Ipomoea carnea* Jacq. subsp. *fistulosa* (Mart.) D.F.Austin, *Talinum fruticosum* (L.) Juss., and *Torenia fournieri* Linden ex E.Fourn. were previously overlooked records. Another five species, namely, *Ambroma augustum* (L.) L.f., *Bacopa caroliniana* (Walter) B.L.Rob., *Bryophyllum × houghtonii* (D.B.Ward) P.I. Forst., *Operculina turpethum* (L.) Silva Manso, and *Pilea nummulariifolia* (Sw.) Wedd., are new records of naturalisation for Singapore. *Ambroma* L.f. and *Operculina* Silva Manso are new generic records for the flora of Singapore.

**Key words.** casual, new generic and species records

## INTRODUCTION

Routine plant collection and identification work in preparation for the Flora of Singapore project yielded a number of new records as well as previously overlooked collections of non-native species for Singapore. Nine species were presented in an earlier paper (Chen et al., 2018), and eight more species are reported here as part of this ongoing project to document the naturalised flora of Singapore.

## MATERIALS AND METHODS

The checklist of the vascular plant of Singapore, compiled by Chong et al. (2009), was taken as the baseline to decide if a taxon is new for Singapore. As the plants documented here are exotics, we have assigned a ‘Local’ status and categorised the occurrence of each species in Singapore as ‘Casual’, ‘Naturalised’, or as a ‘Weed of Uncertain Origin’, which correspond to the status accorded to exotic species in Chong et al. (2009). The specimens examined in this current study include existing specimens from the Singapore Botanic Gardens’ Herbarium (SING) and Herbarium, Lee Kong Chian Natural History Museum, National University of Singapore (SINU) while specimens newly collected by the authors were deposited in SING. All the specimens examined and cited in this study were identified based on relevant taxonomic literature for the respective genera or families. A brief description for each new record for the Singapore flora is provided based on the specimens studied.

### 1. *Ambroma augustum* (L.) L.f., Suppl. Pl. (1782) 341(Malvaceae) (Fig. 1a, b)

**Description.** Large heterophyllous shrub 2–4 m tall. Stems woody, with spreading branches, twigs unarmed. Leaves alternate; petiole 0.8–29 cm long; lamina variable, with two main forms: (1) on the vegetative or non-flowering branches, often 3–5 lobed, cordate-ovate, or (2) on base of fertile branches or on upper parts of flowering and fruiting branches often unlobed, lanceolate-cordate, 7.3–27 × 5.4–26 cm, with 5–7 basal veins. Flowers pendulous, sepals fused at the base, lobes 1.2–2.1 cm long, lanceolate, puberulent, persistent in fruit even after dehiscence; petals dirty red or maroon, spatulate, clawed, limb 1.8–2.7 cm long, basal part as long as wide, 5-ribbed, with dark purple hairs. Capsules dehiscent, 5-winged, armed with irritant hairs, when unripe obconical, 3.5–4.5 × 4–5.4 cm, appearing as a shallow cup 7–7.5 cm wide after dehiscence, with long, dirty white hairs on the septae.

In Singapore this species flowers and fruits all year round, although flowering is seasonal in some parts of its native range such as China (Tang et al., 2007).



Fig. 1a. Habit of *Ambroma augustum* (L.) L.f. from H. K. Lua & L. M. J. Chen SING 2018-294. (Photograph by: H. K. Lua).

**Taxonomic notes.** There have been disagreements on the monotypy of *Ambroma* owing to the large morphological variations observed, including colour of flowers, number of seeds, and presence of armature on twigs. The three species in contention are *Ambroma augustum* sensu stricto, *Ambroma molle* DC., and *Ambroma fastuosum* R.Br. *Ambroma molle* differs from *Ambroma augustum* by having yellow flowers, whereas *Ambroma fastuosum* differs from *Ambroma augustum* by having spines on its twigs and fewer seeds in each capsule. Brink & Escobin (2003) tentatively accepted the view of a single, widespread and highly variable species of *Ambroma* but called for a critical taxonomic assessment of the genus. Pending the availability of a comprehensive revision or support from molecular phylogenetics, our specimen from Singapore is deemed be *Ambroma augustum* sensu stricto based on the unarmed twigs and maroon or dirty red petals.

**Distribution.** *Ambroma augustum* is widely distributed from India, Southern China, Vietnam, Thailand, Malaysia, and south to Australia. It is often cultivated as an ornamental, for its fibre or for medicinal purposes (Brink & Escobin, 2003; Tang et al., 2007).

**Occurrence in Singapore.** We encountered 20 individuals of *Ambroma augustum* during a recent visit to a forested stateland in Tengah that was formerly a Chinese resettlement village with several brick-making factories. The individuals were growing alongside other naturalised species in scrubby vegetation. This prompted a search through the herbarium records as *Ambroma* has no published record in Singapore (see Chong et al., 2009). *Ambroma* L.f. is thus also a new generic record for the flora of Singapore.

Handwritten records of plant introductions kept by the Singapore Botanic Gardens (SBG) showed that seeds of this species were received from various sources for cultivation, but the earliest sample was received in 1882 from John Cameron, superintendent of the Lal Bagh Garden in Bangalore (India). Two of the specimens that were collected in 1927 (Furtado s.n.) in the SBG, most likely the progeny of these early introductions, were noted to be ‘self-sown plants’. All other specimens collected outside the SBG, including the recent collection, were from cemeteries or scrubland.

**Local status.** Casual—while Singapore is certainly within its range of occurrence, including Malaysia (Tang et al., 2007), its occurrence in Singapore can be traced to deliberate introductions for horticulture as the plants were found in close

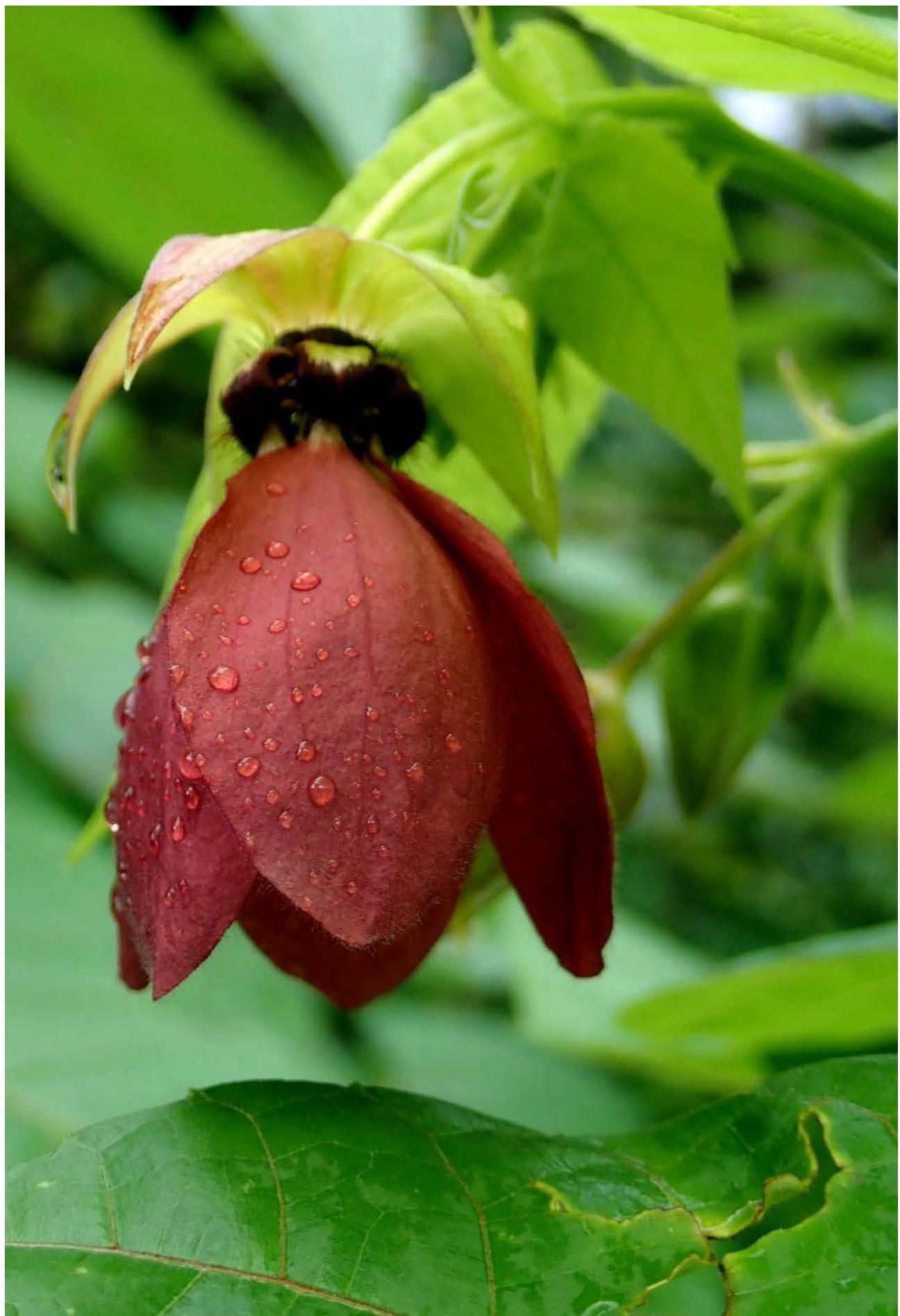


Fig. 1b. Flower of *Ambroma augustum* (L.) L.f., from H. K. Lua & L. M. J. Chen SING 2018-294. (Photograph by: H. K. Lua).

association with areas subjected to human activities and cultivation. Our records show that this species is largely reported from three localities (SBG, Fort Canning [Government Hill], and Tengah state land area), and we thus consider its status as ‘Casual’ as the plants in Singapore are likely to be escapes from repeated introductions.

**Specimens examined.** SINGAPORE: Tengah forest, Jalan Lam Sam, 26 March 2018, *Lua, H.K. & Chen, L.M.J. SING 2018-294* (SING); Government Hill, by cemetery, June 1885, *Hullett, R.W. s.n.* (SING); *ibid.*, June 1885, *Hullett, R.W. 61* (SING); Singapore Botanic Gardens, 16 August 1919, *Flippance, F. s.n.* (SING); 14 April 1921, *Mhd. Nur s.n.* (SING); 29 August 1928, *Deshmukh, G.B. s.n.* (SING); 18 September 1929, *Mhd. Nur s.n.* (SING); 23 November 1934, *Deshmukh, G.B. ?617*, (SING); 04 July 1936, *Anonymous s.n.* (SING); Self-sown, 30 November 1927, *Furtado, C.X. s.n.* (SING) (3 sheets); 05 September. 1989, *Samsuri, A. & Nuss SA3* (SINU); 22 May 1995, *Sidek, Hj. & Leow, P. 599* (SING); November–December 1994, *Chua, K.S. et al. s.n.* (SING).

**2. *Bacopa caroliniana* (Walter) B.L.Rob., Rhodora 10 (1908) 66 (Plantaginaceae)**  
**(Fig. 2a, b)**

**Description.** Aquatic rhizomatous herb, forming mats in water or growing immersed in periodically flooded areas. Stems fleshy, c. 4–23 cm long, rooting at the nodes, pubescent, more densely so on the upper nodes. Leaves opposite; lamina ovate–oblong ovate or more or less orbicular, 0.9–1.4 × 0.7–0.9 cm, rounded-clasping at the base, margins entire, apices obtuse to rounded, punctate, palmately veined, veins 3–7, with hairs on the mid-vein on the undersurface, strongly aromatic when bruised. Flowers axillary, solitary, in uppermost nodes, pedicel 0.5–0.6 cm long; bractlets subtending calyx 2, subulate; corolla 1.2–1.6 cm long, sky blue–purplish blue. Capsule ovoid, c. 0.5 × 0.2 cm.

**Taxonomic notes.** Chong et al. (2009) listed *Bacopa monnieri* (L.) Wettst. as the only species in the genus that has been recorded as having naturalised in Singapore. *Bacopa monnieri* can be distinguished from *Bacopa caroliniana* by the venation. The former is usually 1-veined or with 1–2 or more obscure veins and cuneate leaf bases. The leaves of *Bacopa caroliniana* are aromatic when bruised (with an almost citrus-like scent), but *Bacopa monnieri* is not aromatic (Center for Aquatic and Invasive Plants, 2018). Based on these characteristics, our two specimens are identified as *Bacopa caroliniana*.



Fig. 2a. Habit of *Bacopa caroliniana* (Walter) B.L.Rob. from H. K. Lua SING 2014-283. (Photograph by: H. K. Lua).



Fig. 2b. *Bacopa caroliniana* (Walter) B.L.Rob. from L. M. J. Chen SING 2018-133. (Photograph by: L. M. J. Chen).

**Distribution.** *Bacopa caroliniana* is native to southeastern United States but has also naturalised in the Sydney region in Australia, where it has escaped since its introduction via the aquatic plant trade (Romanowski, 2011).

**Occurrence in Singapore.** The population encountered recently from the Bishan-Ang Mo Kio Park, consists of a large number of individuals growing immersed in waterlogged areas along the waterway. The other specimen was collected from the edge of a water-filled abandoned quarry, which had since been drained and filled.

**Local status.** Naturalised—it is likely that the populations in Singapore were escapes from the aquatic plant trade as this species is widely circulated amongst freshwater aquarists. This species is propagated by cuttings (Keener et al., 2016), which suggests that dislodged pieces of the stems could also be efficient units of its dispersal. As the population of *Bacopa caroliniana* in Bishan-Ang Mo Kio Park has been observed to be fruiting, it would be interesting to see if it will naturalise successfully in other locations, especially in connected waterways.

**Specimens examined.** SINGAPORE: Mandai, Gali Batu area, edge of quarry area, *Lua, H.K.* SING 2014-283 (SING); Bishan-Ang Mo Kio Park, base of slope opposite waterway, 8 February 2018 *Chen, L.M.J.* SING 2018-133 (SING).

### 3. *Bryophyllum × houghtonii* (D.B.Ward) P.I.Forst., *Austrobaileya* 7 (2006) 383 (Crassulaceae) (Fig. 3a, b)

**Description.** Herbaceous succulent plant, to c. 50 cm tall, terrestrial or occasionally epiphytic. Stems unbranched, glabrous, erect or ascending, greyish-pinkish green. Leaves opposite, cymbiform, 1–3.1 × 0.6–1.3 cm, dull bluish-greyish green or olive green or brownish, sometimes tinged with pink, with dark green-purplish irregular streaks or blotches on both surfaces of the blade, margins coarsely serrate; petiole sub-cylindrical, 0.3–1.3 cm long, adventitious plantlets borne on the spatulate-oblong spurs arising from the sinus; plantlets often rooting while attached to the parent plant. Flowers and fruits not seen.

For a detailed description of *Bryophyllum × houghtonii* that includes floral and fruit characters, see Ward (2006). *Bryophyllum × houghtonii* is monocarpic and dies after setting seeds (Ward, 2006). However, as this hybrid is day-length sensitive (N.P. Taylor, pers. comm., July 2018), it does not readily bloom in Singapore owing to the lack of environmental triggers to elicit a flowering response. Locally, reproduction is achieved mainly by the production of asexual adventitious plantlets.



Fig. 3a. Habit of *Bryophyllum × houghtonii* (D.B.Ward) P.I.Forst. from L. M. J. Chen SING 2018-255. (Photograph by: L. M. J. Chen).



Fig. 3b. Close up of young plant of *Bryophyllum × houghtonii* (D.B.Ward) P.I.Forst. from L. M. J. Chen SING 2018-255. (Photograph by: L. M. J. Chen).

**Taxonomic notes.** The genus *Bryophyllum* is sometimes included in the broadly circumscribed *Kalanchoe*. However, the relationship between them remains controversial and has not been resolved. Molecular phylogenetic studies suggest that they form a clade (Gehrig et al., 2001; Mort et al., 2001), but there is a need to increase the taxon sampling and the number of DNA markers used to better define the relationships between them. Pending resolution of this debate, we prefer to consider them as distinct genera following Moran (2009). The well-known hybrid in our current discussion, with pendulous flowers and viviparous plantlets on the notches of leaf margins, clearly belongs to the genus *Bryophyllum* sensu stricto.

*Bryophyllum × houghtonii* is a hybrid first reported by Houghton (1935), who had artificially crossed *Bryophyllum daigremontianum* (Raym.-Hamet & H.Perrier) A.Berger and *Bryophyllum delagoense* (Eckl. & Zeyh.) Schinz. He named it *Bryophyllum tubimonanum* Houghton, *nom. nud.*, but the name is not considered validly published. This hybrid has been widely circulated in horticultural circles as *Kalanchoe* ‘Hybrida’ hort., *Kalanchoe* ‘Houghton’s Hybrid’, and *Kalanchoe* ‘Houghtonii’ (Shaw, 2008). This hybrid was only validly published 70 years later, from a population that had naturalised in Florida (Ward, 2006).

**Distribution.** This hybrid was first reported as naturalised in Florida, but there was some uncertainty as to whether the plants were introduced from other locations, or if they had resulted from recent, direct crosses from the presumed parents (Ward, 2006). It has also naturalised in Queensland, where it is considered a serious environmental pest (Queensland

Government, 2016). Recent published records have indicated that it has also successfully naturalised in China, Taiwan, and Hong Kong (Wang et al., 2016).

**Occurrence in Singapore.** We were first alerted to the occurrence of a ‘wild’ population of *Bryophyllum* growing on a tree via a post on social media. The population was located along with several others in its vicinity. We also found, in the immediate area, several other clusters of another *Bryophyllum* hybrid or cultivar growing on the trunks of rain trees (*Samanea saman* [Jacq.] Merr.), and in the persistent leaf sheaths of dwarf ornamental palms.

**Local status.** Casual—in Singapore, three members of *Bryophyllum*—*Bryophyllum × houghtonii*, *Bryophyllum delagoense*, and *Bryophyllum pinnatum* (Lam.) Oken—are cultivated as ornamental plants. *Bryophyllum × houghtonii* is reported here as the second member of the genus to be considered a casual weed in Singapore, the other being *Bryophyllum pinnatum*, also known as *Kalanchoe pinnata* (Lam.) Pers. (Chong et al., 2009). The local population of *Bryophyllum × houghtonii* reproduces mainly asexually by adventitious plantlets and has not been observed to set seed even in cultivation.

**Specimens examined.** SINGAPORE: Toa Payoh, Kim Keat Palm estate, 14 February 2018, Chen, L.M.J. SING 2018-255 (SING) (3 sheets).

#### 4. *Ipomoea carnea* Jacq. subsp. *fistulosa* (Mart.) D.F.Austin, Taxon 26 (1977) 237 (Convolvulaceae)

**Description.** Small to medium-sized shrub, 1–3 m tall. Stem erect, not climbing. Leaves alternate; petiole 4–6 cm long; lamina cordate, ovate or ovate-lanceolate, 7–15 × 4–9.1 cm, base cordate, subcordate or more or less truncate, apex acuminate to mucronulate, margins entire or ± undulate, undersurface of leaves with 2 prominent glands at the base of the midrib. Flowers diurnal, sepals ovate or subcircular, 0.5–0.6 mm long, apex broadly rounded; corolla infundibular, 7–9 cm long, pink to mauve, a shade darker inside, outer surface covered with fine, mealy trichomes; stamens and gynoecium included. Fruits not seen.

For a detailed description of *Ipomoea carnea*, see Staples & Syahia-Emiza (2015).

**Distribution.** *Ipomoea carnea* is native to Tropical America, and two subspecies are accepted, *Ipomoea carnea* subsp. *fistulosa* and *Ipomoea carnea* subsp. *carnosa*. The former has erect stems and is shrub like in growth, while the latter is a vine (Staples & Syahia-Emiza, 2015). *Ipomoea carnea* subsp. *fistulosa*, to which our specimens belong, has been cultivated extensively for ornamental purposes and has naturalised in many parts of Asia and the Pacific Islands (Fang & Staples, 1995).

**Occurrence in Singapore.** In Singapore, it was first collected in 1927 growing on waste ground in Orchard Road, where it was noted as a possible “garden escape”. This population was documented on the herbarium label as being very vigorous, forming a large, continuous mat and effectively outcompeting other weedy species that grew in the same area. Although it has subsequently been collected from an offshore island in the military live-firing zones, these records of naturalisation were not included by Chong et al. (2009).

**Local status.** Casual—the last specimen was collected as recently as 2007, however, we were not able to verify the existence of this population as it occurred on an offshore island which is within a restricted military training area. Although *Ipomoea carnea* subsp. *fistulosa* is sold in local nurseries and has been planted in various parks in Singapore Island, we have yet to locate any recent collections or sightings of this species today since 1927. On Singapore Island, the original population from which the first and only specimen was collected is unlikely to exist today. The taxon may reappear elsewhere as a casual weed given the available sources from local nurseries and parks, albeit no other wild populations are located yet.

**Specimens examined.** SINGAPORE: Orchard Road, 16 August 1927, *Furtado*, C.X. s.n. (SING); Pulau Tekong, 26 March 1996, Tan, H.T.W. & Chua, K.S. Tekong-944 (SINU); Pulau Sarimbun, 23 October 2007, Gwee, A.T. SING 2007-592 (SING).

#### 5. *Operculina turpethum* (L.) Silva Manso, Enum. Subst. Braz. (1836) 16 (Convolvulaceae)

**Description.** Herbaceous climber. Stems reddish, angular with 3 prominent wings along its length, c. 3 mm across. Leaves: alternate; petiole 15–20 mm long; lamina cordate-lanceolate, 4.2–5.5 × 2.2–3.6 cm, base cordate to truncate, margin entire, apex narrowly acute. Flowers and fruits not seen.

The angular stems with 3–4 prominent wings is distinctive for *Operculina turpethum* (G.W. Staples, pers. comm., April 2017). The specimen reported here probably represents a young plant with a smaller stature. For a detailed description, see Staples & Syahia-Emiza (2015).

**Distribution.** This species has a very wide distribution, and has been recorded from many localities across Africa, Asia and Australia. While it is also recorded from Southeast Asia, Ooststroom (1953) has considered this species a “recent” introduction to the region. It has also been introduced into the Caribbean area and the northern part of South America, where it has also naturalised, albeit sparingly (Fang & Staples, 1995).

**Occurrence in Singapore.** It is known only from a single collection made from the eastern part of Singapore Island. The area, a piece of reclaimed land c. 1 km east of Tanah Merah Country Club, is where Changi Airport now stands. The specimen also represents the first record of the genus *Operculina* Silva Manso for Singapore.

**Local status.** Casual—this species is rather prominent and can hardly be missed by any collectors (G.W. Staples, pers. comm., April 2017). However, no other sightings or records have been reported. It is likely that this species is no longer extant at the original site. While pending any further sightings of this species, it is considered here as a casual weed.

**Specimens examined.** SINGAPORE: Tanah Merah, 1988, *Tan, H.T.W.* 1988-14 (SINU).

**6. *Pilea nummulariifolia* (Sw.) Wedd., Ann. Sci. Nat., Bot., sér. 3, 18 (1852) 225 (Urticaceae)**  
**(Fig. 4)**

**Description.** Much-branched, perennial herb. Stems creeping or more or less ascending, densely hirsute when young and gradually becoming pilose; stipules conspicuous, membranous, 0.35–0.4 cm long, orbicular, with sparse hairs along the margins. Leaves opposite; petioles 0.5–2.7 cm long, pilose to hirsute; lamina very broadly ovate to orbicular, usually equal in size, 1.1–3.5 × 1.1–3.2 cm, base truncate to subcordate, margins crenate, apex rounded to obtuse, triplinerved from base, chartaceous, both surfaces hairy but hairs on undersurface on leaves only along veins. Flowers and fruits not seen.

For a complete description of this species that includes the floral and fruit characters, see Wu et al. (2009).

A check against the commonly cultivated *Pilea* species in Singapore (Boo et al., 2006) yielded *Pilea nummulariifolia* as a possible identity of our specimen. The identity was subsequently confirmed with identification keys and descriptions in relevant taxonomic accounts (Standley & Steyermark, 1952; Friis, 1989; Monro, 2001; Wu et al., 2009). Wu et al. (2009: 179) stated that “rounded leaves with toothed edges and long ascending or procumbent stem with densely hairs” in particular, are diagnostic to this species.

**Distribution.** This species is native to the Tropical America (from Panama to Peru) and the Caribbean region and has long been cultivated as an ornamental in many parts of the tropics (Standley & Steyermark, 1952). According to the Pacific Island Ecosystems at Risk (PIER) website (2012), it has also naturalised in a number of islands in the Pacific region. More recently, it has naturalised in Taiwan, where it was initially introduced as an ornamental (Wu et al., 2009).

**Occurrence in Singapore.** In Singapore *Pilea nummulariifolia* is cultivated for its attractive foliage and often used in landscaping as a ‘ground cover’ for areas under shade. Sterile material of the species was only recently collected from a stateland bordering the Adam Park estate where it has run wild beside a vegetated earth drain, growing alongside other naturalised species such as *Hydrocotyle verticillata* (L.f.) Royle. This recent collection is, thus far, the only record that we could locate of this species growing wild in Singapore.

**Local status.** Casual—Chong et al. (2009) listed *Pilea nummulariifolia* as ‘cultivated only’. The proximity of the locality to a residential area in our recent collection suggests that it is likely an escape from cultivation. However, the species currently seems to be restricted to only a single location in Singapore. We thus consider this species to be of ‘Casual’ occurrence till we can locate further evidence of its spread.

**Specimens examined.** SINGAPORE: Arcadia Road, *Lua, H.K.* SING 2018-257 (SING).

**7. *Talinum fruticosum* (L.) Juss., Gen. Pl. (1789) 312 (Talinaceae)**

**Description.** Perennial herb c. 0.8 m tall. Stems succulent. Leaves alternate; lamina elliptic to obovate, 3.8–6.6 × 0.3–2.5 cm, apex attenuate-obtuse, base cuneate, margin entire. Flowers in a corymboid thyrsse, inflorescence rachises triangular in cross section, 7.3–18 cm long, with 2–5 branches; pedicels thickened distally; calyx lobes (in mature flower bud) 4–5 mm long, lanceolate; mature flowers not seen. Fruit ellipsoid, 0.5–0.6 cm long.

*Talinum fruticosum*, better known as *Talinum triangulare* (Jacq.) Willd., can be distinguished from the other naturalised congener, *Talinum paniculatum* (Jacq.) Gaertn. by the flowering axes, with the latter having terete rachises (Geesink, 1971).



Fig.4. Habit of *Pilea nummularifolia* (Sw.) Wedd. from H. K. Lua SING 2018-257. (Photograph by: L. M. J. Chen).

Both species are used interchangeably as pot herbs in Singapore, where the leaves and young shoots are cooked in soups. The genus is known to the local Chinese community as ‘Tu Ren Shen’ or ‘Local Ginseng’ (Boo et al., 2006), probably in reference to the tuberous roots that resemble those of the well-known Korean ginseng (*Panax ginseng* C.A.Mey.).

**Distribution.** *Talinum fruticosum* is native to Tropical America and a pantropical weed (Geesink, 1971). Wagner & Herbst (1995) has also reported it as a weed from cultivation in Hawaii (Oahu).

**Occurrence in Singapore.** A single gathering consisting of three herbarium sheet specimens were located in SING, and these were collected while the area was still under construction. The collector (Wong Yew Kuan, then Commissioner of Parks and Recreation Department) noted on the specimen label that the plants were “associated with the base of newly planted trees... in the supplied soil. [They] Could have been brought in through the topsoil or sludge used in the planting holes”.

**Local status.** Casual—we could not locate any recent specimens of this species, and it is likely that it did not naturalise successfully.

**Specimens examined.** SINGAPORE: Tanah Merah Golf Club, 04 July 1981, Wong, Y.K. s.n. (SING) (3 sheets).

**8. *Torenia fournieri* Linden ex E.Fourn., Ill. Hort. 23 (1876) 129 (Linderniaceae) and its cultivars or hybrids.  
(Fig. 5)**

**Description.** Herbaceous annual, 15–38 cm tall when mature. Stems 4-angled, sparsely hairy. Leaves opposite; petiole 0.6–2 cm long; lamina ovate-lanceolate, 2.7–4.8 × 1.1–2.2 cm, base truncate-cordate, margins coarsely serrate; apex attenuate, upper surface very sparsely hairy—glabrous, on undersurface only hairy on veins. Flowers often in a terminal inflorescence 3.8–20 cm long; pedicel 1.3–2 cm long; calyx ellipsoid, green or tinged with red at the edges, 1–1.7 cm long, 5-winged, margins of wings hairy; corolla 2.2–2.7 cm long, 2-lipped, tube and upper lip pale purple, upper lip undivided, emarginate, lower lip lobes 3, dark purple, with a yellow spot on the middle lobe, throat yellow; stamens didynamous. Fruits not seen.



Fig. 5. Cultivar or hybrid of *Torenia fournieri* Linden ex E.Fourn. from L. M. J. Chen LCMJ 2018-2019. (Photograph by: L. M. J. Chen).

The treatment of Yamazaki (1990) noted that the flowers of *Torenia fournieri* are pale blue with deep purple lips. According to the Missouri Botanical Gardens Plant Finder website, a number of cultivars of *Torenia fournieri* have been developed by the horticultural trade, and these have flowers with corollas that include shades of burgundy, pink, rose, lavender, and white. The collections made by C.X. Furtado were of the species, but in the recent collection, the corolla tube is white, and the distal third to half of the upper and lower lips are dark purple. It is most likely one of the many colour cultivars or hybrids of this popular ornamental species.

**Distribution.** *Torenia fournieri* occurs naturally in Thailand, Cambodia, Laos and Vietnam (Yamazaki, 1990), and has been cultivated extensively in many parts of the world as an ornamental plant. It has naturalised in Australia (Holtze, 1892), as well as in parts of tropical Africa and Asia (D'Arcy, 1979). *Torenia fournieri* is also known from Panama, where it is considered to have naturalised (Standley, 1928). Although it has been recorded in Panama only by a single collection, reintroduction is expected from imported seeds (D'Arcy, 1979).

**Occurrence in Singapore.** The two specimens from SINU were collected from the “University of Singapore” grounds (the current site of the National University of Singapore Bukit Timah Campus and adjacent areas) in the 1960s, but with no indication of the origin of the plants. However, the exact collection localities were not specified on the herbarium sheet specimen labels.

**Local status.** Casual—being a popular ornamental plant, *Torenia fournieri* is likely to be repeatedly introduced to Singapore and thus, a prospective escapee from cultivation. Incidentally, the recent collection was from a waste ground site near a commercial plant nursery.

**Specimens examined.** SINGAPORE: Singapore Botanic Gardens, 21 July 1928, *Furtado*, C.X. s.n. (SING) (2 sheets); *ibid.*, 18 April 1921, *Deshmukh*, G.B. s.n. (SING); University of Singapore, 08 October 1962, *Jumali K.*?3295 (SINU); *ibid.*, 26 October 1961, *Anonymous*, L.C. 40 (SINU); Choa Chu Kang Track 14, 09 June 2018, *Chen, L.C.M.J. LCMJ 2018-019* (SING).

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## LITERATURE CITED

- Boo CM, Omar-Hor K & Ou-Yang CL (2006) 1001 Garden Plants in Singapore, 2nd Edition. National Parks Board, Singapore, 780 pp.
- Brink M & Escobin RP (2003) Plant Resources of South-East Asia No. 17. Fibre Plants. Backhuys Publishers, Leiden, 456 pp.
- Center for Aquatic and Invasive Plants (2018) *Bacopa caroliniana*. University of Florida, Institute of Food and Agricultural Sciences. <https://plants.ifas.ufl.edu/plant-directory/bacopa-caroliniana/>. (Accessed 1 June 2018).
- Chen LMJ, Ho BC, Choo LM & Koh SL (2018) Additions to the flora of Singapore, new and overlooked records of naturalised plant species (1). Garden's Bulletin Singapore, 70: 91–101.
- Chong KY, Tan HTW & Corlett RT (2009) A Checklist of the Total Vascular Plant Flora of Singapore: Native, Naturalised and Cultivated Species. Raffles Museum of Biodiversity Research, National University of Singapore, Singapore, 273 pp. Uploaded 12 November 2009. [https://lkcnhm.nus.edu.sg/app/uploads/2017/04/flora\\_of\\_singapore\\_tc.pdf](https://lkcnhm.nus.edu.sg/app/uploads/2017/04/flora_of_singapore_tc.pdf). (Accessed 11 June 2018).
- D'Arcy WG (1979) Flora of Panama, Part IX Family 171. Scrophulariaceae. Annals of the Missouri Botanical Garden, 66: 173–274.
- Fang RC & Staples GW (1995) Convolvulaceae. Flora of China, 16: 271–325.
- Friis I (1989) A revision of *Pilea* (Urticaceae) in Africa. Kew Bulletin, 44: 557–660.
- Geesink R (1971) Portulacaceae. Flora Malesiana, Series 1, 7: 121–133.
- Gehrig H, Gaubmann O, Marx H, Schwarzkott D & Kluge M (2001) Molecular phylogeny of the genus *Kalanchoe* (Crassulaceae) inferred from nucleotide sequences of the ITS-1 and ITS-2 regions. Plant Science, 160: 827–835.
- Holtze MW (1892) Introduced plants in the Northern Territory. Transactions of the Royal Society of South Australia, 15: 1–4.
- Houghton AD (1935) An interesting hybrid. Cactus and Succulent Journal, 7: 44.

- Keener BR, Diamond AR, Davenport LJ, Davison PG, Ginzburg SL, Hansen CJ, Major CS, Spaulding DD, Triplett JK & Woods M (2016) Alabama Plant Atlas. [Landry SM & Campbell KN (original application development), Florida Center for Community Design and Research. University of South Florida]. University of West Alabama, Livingston. <http://atlas.uwa.edu/Default.aspx>. (Accessed 12 July 2018).
- Missouri Botanical Gardens (undated) Plant Finder. <http://www.missouribotanicalgarden.org/plantfinder/plantfindersearch.aspx>. (Accessed 18 June 2018).
- Monro AK (2001) Synopsis of Mesoamerican *Pilea* (Urticaceae), including eighteen typifications and a key to the species. Bulletin of the Natural History Museum, 31: 9–25.
- Moran RV (2009) Crassulaceae. Flora of North America North of Mexico, 8: 147–229.
- Mort ME, Soltis DE, Soltis PS, Francisco-Ortega J & Santoes-Guerra A (2001) Phylogenetic relationships and evolution of Crassulaceae inferred from matK sequence data. American Journal of Botany, 88: 76–91.
- van Ooststroom SJ (1953) Convolvulaceae. Flora Malesiana, Series 1, 4: 388–512.
- Pacific Island Ecosystems at Risk (PIER) (2012) *Pilea nummulariifolia*. Institute of Pacific Islands Forestry, US Forest Service. [http://www.hear.org/pier/species/pilea\\_nummulariifolia.htm](http://www.hear.org/pier/species/pilea_nummulariifolia.htm). (Accessed 1 April 2018).
- Queensland Government (2016) *Bryophyllum × houghtonii*. Weeds of Australia, Biosecurity Queensland Edition. [https://keyserver.lucidcentral.org/weeds/data/media/Html/bryophyllum\\_x\\_houghtonii.htm](https://keyserver.lucidcentral.org/weeds/data/media/Html/bryophyllum_x_houghtonii.htm). (Accessed 5 July 2018).
- Romanowski N (2011) Wetland Weeds: Causes, Cures and Compromises. CSIRO Publishing, Collingwood, 184 pp.
- Shaw JMH (2008) An investigation of the cultivated *Kalanchoe daigremontiana* group, with a checklist of *Kalanchoe* cultivars. Hanburyana, 3: 17–79.
- Standley PC (1928) Flora of the Panama Canal Zone. Contributions from the United States National Herbarium, 27: 1–416.
- Standley PC & Steyermark JA (1952) *Pilea*. Flora of Guatemala, Fieldiana: Botany, 24: 410–422.
- Staples GW & Syahida-Emiza S (2015) Convolvulaceae. Flora of Peninsular Malaysia, Series II, 5: 55–198.
- Tang Y, Gilbert MG & Dorr LJ (2007) Sterculiaceae. Flora of China, 12: 302–330.
- Wagner WL & Herbst DR (1995) Contributions to the Flora of Hawai'i. IV. New records and name changes. Bishop Museum Occasional Papers, 42: 13–27.
- Wang ZQ, Guillot D, Ren MX & López-Pujol J (2016) *Kalanchoe* (Crassulaceae) as invasive aliens in China—new records, and actual and potential distribution. Nordic Journal of Botany, 34: 349–354.
- Ward DB (2006) A name for a hybrid *Kalanchoe* now naturalized in Florida. Cactus and Succulent Journal, 78: 92–95.
- Wu SH, Chang CY, Tsai JK, Chen, CF, Liu YY, Deng YC & Hsieh TH (2009) A newly naturalized species in Taiwan: *Pilea nummulariifolia* (Swartz) Weddell (Urticaceae). Taiwania, 54: 179–182.
- Yamazaki T (1990) Scrophulariaceae. Flora of Thailand, 5: 139–238.