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IDENTITY AND SPREAD OF AN EXOTIC *SYNGONIUM* SPECIES IN SINGAPORE

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INTRODUCTION

A cultivated, exotic, aroid species was first mentioned in the climbers/creepers section of a guidebook on common horticultural shrubs (Lee & Lum, 1996), and subsequently described by Keng et al. (1998) under the same name, *Syngonium auritum* (L.) Schott as "sometimes planted or found in wild". Currently, this species is not only widely used in horticultural landscaping, but also running wild in unmanaged areas and spreading along roadside trees. Not found in previous checklists of Singapore plants such as Turner (1993), or Turner et al. (1990), nor found in the checklist of Malayan flora by Turner (1995), the naturalisation of this species may have occurred only recently, perhaps in the early 1990s. Many individuals have also been found flowering and fruiting, a likely cause of its rapid spread in addition to vegetative propagation. Its morphology failed to match the description of *Syngonium auritum* by Croat (1981). Boo et al. (2006) listed *Syngonium podophyllum* instead among the cultivated garden plants of Singapore. We explored three possibilities: (1) both *Syngonium auritum* and *Syngonium podophyllum* are present in Singapore; (2) only one species is present in Singapore, hence the other was a misidentification; or (3) both names were misapplied, and that there are one or more other species. We also examined the spread of the species outside of cultivation, and make recommendations here against its continued use as a horticultural species.

MATERIAL AND METHODS

The revision on the genus *Syngonium* by Croat (1981) provided most of the information for the study. All *Syngonium* species are hemiepiphytic or epiphytic climbers with scandent stems and milky white sap. The genus is clearly exotic to Singapore, with the centre of diversity in Central America. Different parts of Singapore were surveyed for presence and absence of *Syngonium* species, which are easily distinguished from the other three exotic climbing genera of the family Araceae known to be present in Singapore: *Epipremnum*, *Monstera*, and *Philodendron.* Voucher specimens of the leaves were collected, pressed and deposited in the Herbarium, Raffles Museum of Biodiversity Research, National University of Singapore (SINU). Where available, flowering and fruiting parts were collected and photographed to aid in identification. We also searched the Singapore Botanic Gardens Herbarium (SING) for records of *Syngonium* species previously collected locally.

RESULTS AND DISCUSSION

Our collections and surveys for *Syngonium* species showed that only one species was currently locally occurring, although leaves may show variegation in colouration owing to the different cultivars introduced (see Boo et al., 2006). Croat (1981) divided the genus into four sections based on differences between juvenile (non-climbing), pre-adult, and adult phases of its foliage parts. Both *Syngonium podophyllum* Schott, and *Syngonium auritum* belong to the section *Syngonium*, the largest and most variable section with widespread species, where adult leaf laminas are markedly divided but the pre-adult climbing phase has simple, hastate or sagittate leaves, as in the species that is found in Singapore. In contrast, species of Sections *Oblongatum* and *Cordatum* have simple leaf laminas all through the phases from juvenile to adult, while the last section *Pinnatilobum* has lobed leaf laminas for both the pre-adult climbing and the adult phases.

Syngonium auritum, however, is differs from the rest of the section *Syngonium* in its longer, cylindroid, spathe tube, a spathe blade twice as long as the staminate part of the spadix, and an elongate or cylindroid, fruiting spadix (Croat, 1981). In contrast, the spathe tubes of the species found in Singapore are ellipsoid (Fig. 1) and the fruiting spadices were ovoid (Fig. 2). The spathe tubes, spathe blades, and spadices are also not as long as those in *Syngonium auritum*. The adult laminas were also thin, 5-, 7-, 9-, 11- or even 13-pedatisect and unequal in size, with more than three peduncles per flowering axil (Fig. 1), and the stems were glaucous, lacking in any projections or emergences. Hence the species found in Singapore are highly congruent with the description for *Syngonium podophyllum* var. *podophyllum*.

Fig. 1. Various stages of flowering on a single reproductive branch of *Syngonium podophyllum* along Kent Ridge Road. (Photograph by: Chong Kwek Yan).

Fig. 2. Ripe infructescence showing the red spathe surrounding the syncarp (fruits on the inflorescence axis). Scale bar in mm. (Photograph by: Ang Pei Ting).

Fig. 3. Ripe infructescence with spadix sliced open to reveal the syncarp within. Scale bar in mm. (Photograph by: Ang Pei Ting).

Fig. 4. Seeds embedded in the syncarp. Scale bar in mm. (Photograph by: Ang Pei Ting).

Fig. 5. Parasitised syncarp. Scale bar in mm. (Photograph by: Ang Pei Ting).

Syngonium podophyllum is the most widespread congener, with its native range extending from Mexico to Brazil, and there are morphological variations observed among its different sub-populations (Croat, 1981). The presence of ripened syncarps (composed of the developed ovaries of the female flowers) also suggest that there is an effective pollinator of its flowers in Singapore. Based on the morphological similarity of its spadix to those of *Syngonium schottianum* H. Wendl. ex Schott, and *Philodendron* species (Beath, 1997), it is suspected that scarab beetles (family Scarabaeidae) are the pollinators (Croat, 1981; Daehler, 2005). Attempts to germinate the seeds extracted from the ripened fruits were successful. Interestingly, we had also collected an infructescence (Fig. 5) suspected to be parasitised by a webspinner (order Embioptera) but the seeds from the syncarp did not germinate. Although the red spathe of the ripe infructescence may suggest that birds are the dispersers of the seeds, the size of the syncarp within the spathe exceeds the gape sizes of most birds in Singapore. Instead, Croat (1981) suggested that mammals may be better dispersers.

Sightings and collections of *Syngonium podophyllum* were made in numerous localities around Singapore Island, leading us to conclude that the species is widespread in Singapore. It can be found cultivated in the Singapore Botanic Gardens, and as an ornamental climber around pillars and slopes of expressways and flyover bridges. It is also commonly used by landscape contractors for cultivation. These agents of introduction for the species are oblivious to (or unconcerned with) its potential to invade native habitats—the species scores 15 on the Australian/New Zealand Weed Risk Assessment, and has escaped in Florida, spread to national parks in Samoa, naturalised in Tonga and become invasive in Niue (Daehler, 2005). We have sighted many individuals of the species in the wasteland vegetation of the Changi, Lim Chu Kang and Punggol areas, Telok Blangah Hill Park, Mount Faber Park, Bukit Batok Nature Park, Dairy Farm Nature Park, Bukit Brown Cemetery, along Clementi Road, Holland Road, Dalvey Road, Thomson Road, Rifle Range Road, Upper Bukit Timah Road, Dunearn Road, Commonwealth Ave West, Jurong Road, Nanyang Avenue, Choa Chu Kang Road, Turf Club Avenue, Woodlands Road, Old Choa Chu Kang Road, Bedok Rise, Rhu Cross and Mandai Road. Many of these appear to be wild plants. Most worryingly, the species is invading into the Bukit Timah Nature Reserve (Fig. 6), and the back mangrove areas of the Sungei Buloh Wetland Reserve (Fig. 7).

Native, closed canopy forests of tropical, continental island ecosystems such as those of Singapore have so far appeared to be resistant to species invasions (Teo et al., 2003; Corlett, 2009). Although reports of its presence elsewhere as an exotic have mostly been in the species-poor oceanic island ecosystems of the Pacific Ocean, its native habitat occurs in the tropical moist forests of Central America. In wetter forests, it may be replaced instead by *Syngonium macrophyllum* Engler (Daehler, 2005). In Singapore, it is found at the fringes of the Central Catchment Nature Reserve, along the roads that border this largest forest reserve in Singapore. Given the drier urban climate of Singapore, and more seasonal

Fig. 6. *Syngonium podophyllum* at Bukit Timah Nature Reserve. (Photograph by: Chong Kwek Yan)

Fig. 7. *Syngonium podophyllum* in the back mangrove at Sungei Buloh Nature Reserve. (Photograph by: Chong Kwek Yan).

rainfall in the wet tropics expected from global warming, it may only be a matter of time before *Syngonium podophyllum* penetrates deeper into the forest. Its dense and aggressive growth form, enveloping the trunks of trees, may exclude other native, epiphytic species such as ferns and orchids from establishing.

The main mechanism for spread in Singapore is likely to be from vegetative fragments in discarded soil, concurring with Daehler (2005), but here we report that its flowers have been pollinated and developed into fruits with viable seeds. We deem the *Syngonium podophyllum* var. *podophyllum* as naturalised in Singapore, and its potential to invade closed canopy, native forests suggests that its use in landscaping and horticulture should be discontinued.

CONCLUSIONS

The identity of the common, wild *Syngonium* species in Singapore is *Syngonium podophyllum* Schott var. *podophyllum*. We document its status as a naturalised exotic, supported by evidence that it produces viable seeds and has spontaneously spread to many parts of Singapore, including the nature reserves. It is strongly recommended that national and private landscaping projects should stop using this species as an ornamental plant and that it should be removed from native ecosystems.

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