

CONSERVATION STATUS OF *CISSUS* L. (VITACEAE) OF SINGAPORE: WITH A SPECIAL NOTE ON *CISSUS REPENS* LAM.

C. K. Yeo^{1*}, W. F. Ang², Alvin F. S. L. Lok and K. H. Ong

¹Department of Biological Sciences, National University of Singapore
14 Science Drive 4, Singapore 117543, Republic of Singapore

²Horticulture and Community Gardening Division, National Parks Board
100K Pasir Panjang Road, Singapore 118526

(* Corresponding author: dbsyck@nus.edu.sg)

ABSTRACT. — The conservation statuses of the four native and one commonly cultivated *Cissus* L. species (Vitaceae) are reviewed here in the light of recently collected plant specimens and sightings. All four native species are still extant. *Cissus repens* Lam. is noted to include two recognisable forms with one that corresponds to the now no longer recognised *Cissus diffusa* (Miq.) Burkill. The possible impact of the recent introduction of *Cissus sicyoides* is also discussed.

KEY WORDS. — Vitaceae, *Cissus*, Singapore

INTRODUCTION

The grape family of Vitaceae is represented by 25 native species in Singapore with over 20 extant species in seven genera (Chong et al., 2009). The genus of interest, *Cissus* L., has four species native to Singapore all currently extant, namely *Cissus hastata* Miq., *Cissus nodosa* Bl., *Cissus repens* Lam., and *Cissus rostrata* (Miq.) Planch (Chong et al., 2009). A commonly cultivated species, *Cissus quadrangularis* L., the type species of the genus (Linnaeus, 1767), and the two forms *Cissus repens* collected in Singapore will be described. A recently introduced New World species, *Cissus sicyoides* L., will be featured as it has been reported to be potentially invasive (French et al., 2003).

The genus *Cissus* was first described by Linnaeus (1753), and the name probably originated from the Greek word κισσός [*kissos*], meaning ivy. The integrity of the genus has recently been corroborated by Ren et al. (2011), whose work shows that the clade was well-supported and monophyletic. *Cissus* species in Singapore are creepers or climbers with leaf-opposed tendrils not ending in adhesive discs, inhabiting the fringes of lowland dipterocarp forest and secondary forest. Some species are also found on cultivated land and human-modified habitats. All species in Singapore have simple, toothed leaves. The inflorescence is an umbellate, leaf-opposed cyme, with bisexual flowers, each with a cupuliform calyx, four petals and stamens, and gynoecium with a short style and sub-capitate stigma that is adnate to a disc. The fruit is a one-seeded berry. The description above mostly follows Keng (1990) and Latiff (1982), and is supplemented by our own observations.

PAST AND PRESENT RECORDS OF NATIVE *CISSUS* SPECIES

All the native *Cissus* species were listed as Critically Endangered, except for *Cissus hastata* Miq., which was thought to be a weed of uncertain origin (Chong et al., 2009). However, it is proposed here that the species should be given a conservation status of Common instead as there is no strong basis for considering it to be exotic to this region, other than its preference for human-modified habitats (CKY, pers. obs.). Furthermore, it can be found at the fringes of lowland dipterocarp, swamp and limestone forests, frequently in wet places (Latiff, 1982), which probably constitute its natural habitats, while the exotic *Cissus quadrangularis* is only found in cultivation (Tables 1, 3). The former has a range including India, Myanmar, Vietnam, Thailand, and Malesia (Latiff, 1982), while the latter is reported from East Africa to Pakistan, India, and Sri Lanka (Nazimuddin & Qaiser, 1982).

The remaining native species are either coastal species, in the case of *Cissus repens*, or inland forest edge species, in the cases of *Cissus nodosa* Bl. and *Cissus rostrata* (Miq.) Planch. It seems that the coastal *Cissus repens* is doing relatively better, with more open habitats available for colonisation following the deforestation of Singapore (Corlett, 1991), and it has recently been collected on Pulau [=Island] Ubin, the coastal Khatib Bongsu, and deeper inland at Orchard Boulevard and Jalan Bahar (Table 4). Previously, it was reported from Fort Canning (SING 0019148) and Pulau Merembong (SING 0019146) by R. W. Hullett and E. J. H. Corner respectively, which are coastal and insular locations

(Table 4). In the light of the current widespread distribution, we propose a change in the conservation status of *Cissus repens* to Endangered.

Interestingly, some recent collections of *Cissus repens* from spontaneously regenerated forests at Khatib Bongsu and Springleaf Road are morphologically distinguishable from those collected at other locations. The most distinctive feature being the bifid tendrils, which are unbranched in specimens collected from the other locations. It is also a plant with smaller leaves and more slender stems, which root more freely in the air. We have also ascertained that these characteristics are not plastic under culture (CKY, pers. obs.). It is therefore suspected that there are two forms of *Cissus repens*, with one corresponding to *Cissus diffusa* (Miq.) Burkill, which was sunk by Latiff (1988) into *Cissus repens*.

Both species were recognised by Latiff (1982), and he originally listed the range of *Cissus repens* sensu stricto, inhabiting the fringes of lowland dipterocarp and swamp forests and limestone vegetation, to include India, Myanmar, Kampuchea, Vietnam, Thailand, and Malasia. *Cissus diffusa*, on the other hand, was reported only from the Malay Peninsula, Java, Sumatra, and Borneo, inhabiting the fringes of lowland dipterocarp forest (Latiff, 1982). As the range and habitats of the two previously recognised distinct species overlap, there is probably enough distinctiveness for distinguishing the two entities now recognised as *Cissus repens*.

Cissus nodosa was previously collected from Bukit Timah in 1890 (SING 0019135) and Seletar in 1889 (SING 0019138) by H. N. Ridley. However, in recent collections, it has been found only in and around Nee Soon Swamp Forest (NSSF) and Jalan Ulu Sembawang (Table 2), and no longer in Bukit Timah. This represents a reduction of its range in Singapore, and shows its dependence on good forest habitats for its continued existence. It was reported to be a species of fringe and understorey lowland dipterocarp forests, exposed parts of limestone vegetation, and swamp forests in the Malay Peninsula, Sumatra, Borneo, and the Philippines (Latiff, 1982). Given the recently more restricted occurrence, we support the currently assigned Critically Endangered status.

Cissus rostrata was reported from Sungei Tuas (SING 0019152), Seletar (SING 0019150), and Choa Chu Kang (SING 0019149) at the end of the 1900s by Ridley. However, it has lately only been collected from the Bukit Timah Nature Reserve (BTNR; SING 00076866), suggesting a shrinkage in range (Table 5). As far as we know, it exists as only one population at and around the summit of Bukit Timah, which attests to the dire situation the species is in and supports it being considered Critically Endangered. The species is known to inhabit the fringe and understorey of hill and lowland dipterocarp forests and limestone vegetation in the Malay Peninsula, Sumatra, Java, and Borneo (Latiff, 1982), and the locality of the last known local remnant population suggests that it is a species tolerant of drier conditions.

KEY TO NATIVE *CISSUS* SPECIES AND THE CULTIVATED *CISSUS QUADRANGULARIS*

1. Stem four-winged, sometimes constricted at the nodes 2
 - Stem not winged, cylindrical, sometimes swollen at the nodes 3
2. Stem often red with a white waxy bloom, tendrils bifid and red; leaf ovate with acuminate apex and reddish at the margin or below; berry ripens black *Cissus hastata*
 - Stem green, tendrils simple; leaf ovate or tri-lobed with acuminate or rounded apex and not reddish, except sometimes at the margin; berry ripens red *Cissus quadrangularis*
3. Stem often with white bloom, slightly flattened and covered in corky bark when older, often up to more than 3 cm across; leaf ovate with cordate base, almost as broad as it is long (length:width \leq 1.2) *Cissus repens* (form a)
 - Stem not as thick or waxy bloom not as apparent in fresh plant or bark not corky; leaf oblong, ovate, oblong-ovate to ovate lanceolate, much longer than wide 4
4. Stem smooth with dark green or red spots and glabrous, tendrils simple; leaf oblong to oblong-ovate
 - *Cissus nodosa*
 - Stem green, without spots, tendrils bifid; leaf ovate, ovate-oblong to ovate-lanceolate 5
5. Stem smooth or tuberculate, glabrous, sometimes glaucous, freely rooting along stem in the air, flattened and covered in non-flaking bark when older, up to 5 cm across; leaf blade ovate to ovate-oblong, glabrous, drying without a bloom *Cissus repens* (form b)
 - Stem with longitudinal ridges, slightly hairy when young, not freely rooting in air, not as wide; leaf blade ovate to ovate-lanceolate, sparsely hairy below, drying with a bloom above *Cissus rostrata*

The following short descriptions of the species have been gathered from our own observations, but were greatly supplemented by the work of earlier workers including Henderson (1959), Backer & Bakhuizen van den Brink (1965), Nazimuddin & Qaiser (1982), Latiff (1982, 1988), and Keng (1990).

Cissus hastata Miq.

It is a herbaceous climber with a four-winged stem, with red wings and a waxy white bloom and growing corky with age. The tendrils are red and bifid. The leaf blade is ovate to lanceolate. It is often red on the margins and sometimes below, with a pronounced hastate, cordate to auriculate base. The petiole is angular (Fig. 1b). The inflorescence is 1–2.5 cm across (Fig. 1e). The flower has four petals that are cream above and reddish below with a yellow disc (Fig. 1e). The berry ripens black through red, and is about 5 mm across (Fig. 1f). The seed coat is reticulate (Fig. 1g), and the germination of the seeds takes about 2 months (CKY, pers. obs.).



Fig. 1. *Cissus hastata* Miq.: a, hanging from a supporting tree; b, a leafy branch; c, shoot tip; d, fruiting branch; e, an inflorescence; f, close up of berries; g, close up of seeds. Scale bars = 2 mm (c, f, g) and 1 cm (d). (Photographs by: Yeo Chow Khooon [a, c, d, f, g] and Ong Kwan Han [b, e]).

Table 1. Previous Singapore collections of *Cissus hastata* Miq. deposited in the Herbarium, Singapore Botanic Gardens (SING; bar code no.), and the Herbarium, Raffles Museum of Biodiversity Research, National University of Singapore (SINU; accession no.).

S/No.	Accession/ Bar Code No.	Herbarium	Collector(s)	Collector's No.	Date	Locality
1.	0019129	SING	R. W. Hullett	3	2 Dec.1885	—
2.	0019130	SING	H. N. Ridley	Unnumbered	9 Jan.1890	Sungei Jurong
3.	0036308	SING	H. N. Ridley	1929	11 Feb.1890	Singapore Botanic Gardens
4.	0019128	SING	J. F. Maxwell	82-244	2 Sep.1982	Labrador Park
5.	2007012227	SINU	C. K. Yeo	98	9 Aug.2000	Bukit Timah Nature Reserve

Cissus nodosa Bl.

It is a herbaceous climber with smooth stems covered in dark green or red spots, swollen at the nodes, and bearing unbranched tendrils (Fig. 2d, e). The leaf blade is glabrous, oblong to oblong-ovate, 4–16.5 × 2–6 cm, with a cuneate, rounded to truncate base. The inflorescence is up to 10 cm across. The flower has four reddish petals and a yellow disc. The berry, which ripens dark red, is up to 1.5 cm across (Fig. 2b). The seed coat is smooth (Fig. 2c).

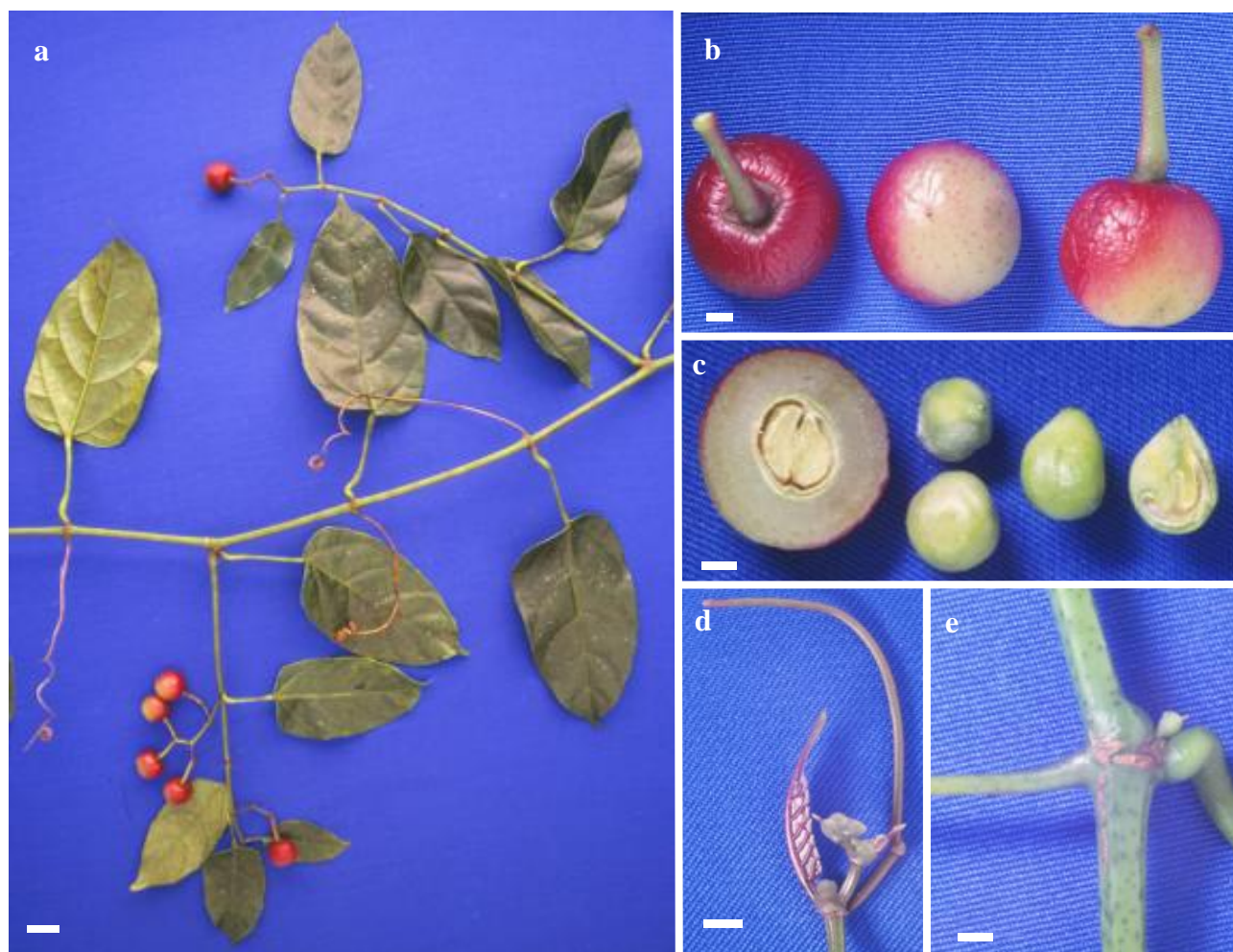


Fig. 2. *Cissus nodosa* Bl.: a, fruiting branch; b, close up of berries; c, sections of berry and seeds; d, close up of a shoot tip; e, close up of a stem. Scale bars = 2 cm (a) and 2 mm (b–e). (Photographs by: Yeo Chow Khoo).

Table 2. Previous Singapore collections of *Cissus nodosa* Bl. deposited in the Herbarium, Singapore Botanic Gardens (SING), and the Herbarium, Raffles Museum of Biodiversity Research, National University of Singapore (SINU) referred to in this work.

S/No.	Accession/ Bar Code No.	Herbarium	Collector	Collector's No.	Date	Locality
1.	0019135	SING	H. N. Ridley	1924	Dec.1890	Bukit Timah
2.	0019138	SING	H. N. Ridley	s.n.	27 Mar.1889	Seletar
3.	2007012262	SINU	C. K. Yeo	139	17 Aug.2000	Nee Soon Swamp Forest
4.	2007012264	SINU	C. K. Yeo	205	28 Aug.2000	Jalan Ulu Sembawang

Cissus quadrangularis L.

It is a succulent, herbaceous climber that often creeps and roots along nodes. The four-winged stem is constricted at the nodes, with wings sometimes red, and bearing unbranched tendrils. The leaf blade is ovate to 3-lobed, 2.5–4 cm × 2–5 cm, with a cordate to obtuse base (Fig. 3b). The leaves and tendrils tend to be caducous in creeping plants. The inflorescence is up to 3 cm across. The flower has four petals that are reddish below and pinkish above, and a cream disc. The berry ripens red, and is about 6–10 mm across (Fig. 3d).

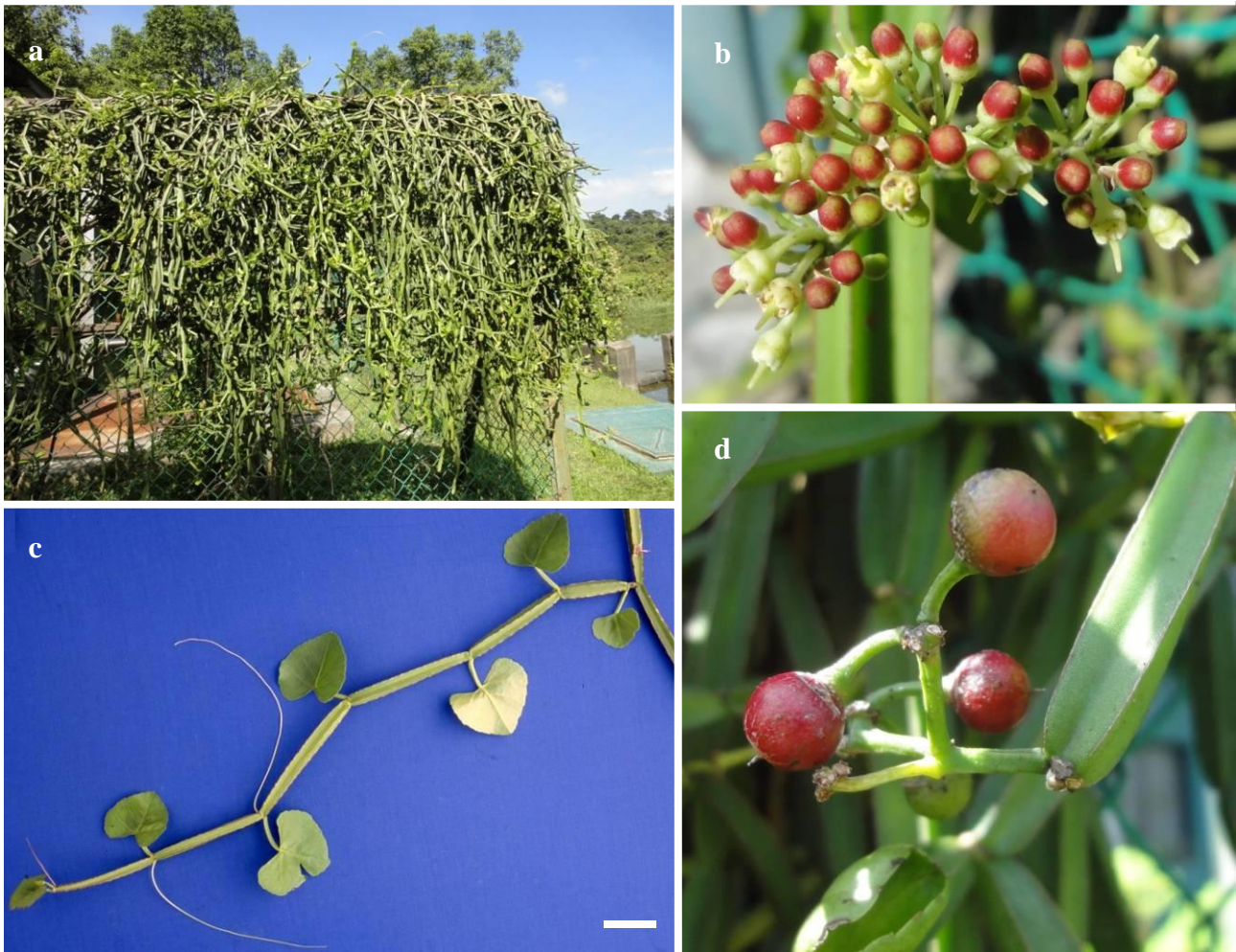


Fig. 3. *Cissus quadrangularis* L.: a, habit of plant at MacRitchie Reservoir near the Singapore Island Country Club; b, close up of an inflorescence; c, close up of a leafy shoot. Scale bar = 2 cm. d, close up of an infructescence. (Photographs by: Ong Kwan Han [a, b, d] and Yeo Chow Khoo [c]).

Table 3. Previous Singapore collections of *Cissus quadrangularis* L. deposited in the Herbarium, Raffles Museum of Biodiversity Research, National University of Singapore (SINU) referred to in this work.

S/No.	Accession/ Bar Code No.	Herbarium	Collector	Collector's No.	Date	Locality
1.	2007012266	SINU	C. K. Yeo	224	30 Aug.2000	Singapore Botanic Gardens

Cissus repens Lam.

Two forms of this species have been observed in Singapore (see Table 4 for herbarium specimens examined). In form a, the older stem is up to 3 cm across, slightly flattened and covered by corky bark (Fig. 4d). It is a climber with stems swollen at the nodes, acquiring a white bloom when older, and often rooting in leaf litter. The leaf blade is glabrous, broad ovate, rarely 3-lobed, 5.0–16.5 × 4.5–14.0 cm (length:width = 1.1–1.2), with a cordate base. The inflorescence is up to 4 cm across. The flower has four pale green petals and a yellow disc (Fig. 4e, f). The berry ripens black through red, and is about 6 mm across (Fig. 4g, h). The seed coat is smooth. We encountered this form at Orchard Boulevard, Pulau Ubin, and Jalan Bahar. This we feel corresponds to the original circumscription of the species by Latiff (1982), who also noted, as we observed, that the stems become brittle when dried.

For form b, a number of collections made: those from a bund of a prawn pond in Khatib Bongsu are distinctive for their bifid tendrils, and stems that often root at the nodes in the air, sending down long, aerial roots. Similar specimens were collected from a regenerating forest near the edge of a field along Springleaf Road, where it was first noticed by KHO. This form tends to have narrower leaf blades, and narrower and sometimes tuberculate stems, sometimes with a white bloom. Older stems flatten with age and can be up to about 5 cm wide, acquiring a thin non-peeling bark (Fig. 5c). Compared to form a, it also appears to be less free-flowering in cultivation as well as in the wild (CKY, pers.



Fig. 4. *Cissus repens* Lam. (form a, aff. *Cissus diffusa* (Miq.) Amshoff): a, habit taken at the Native Plant Demonstration Garden in National University of Singapore; b, close up of an inflorescence; c, close up of a shoot tip showing the transition between inflorescence, a reduced branch and simple tendril; d, old and young stems; e, side view, flower; f, top view, flower; g, infructescence with a ripe berry; h, top view, berries with sections; i, side view. Scale bars = 5 mm (c, g), 1 mm (e, f), and 2 mm (h, i). (Photographs by: Yeo Chow Khoo [a–c, e–i] and Ang Wee Foong [d]).

obs.), and its inflorescence is also laxer (Fig. 5e). The flower is about 2 mm across, with four cream to yellow petals and a yellow disc (Fig. 5g). The berry ripens black through dull pink with cream spots (Fig. 5f). The leaf blade is ovate to ovate-oblong, $5.0\text{--}13.5 \times 2.5\text{--}7.0$ cm (length:width = 1.6–2.3), with a truncate to cordate base. We had also noticed that while the stems of the dried specimens of this form is brittle, they occasionally do not break as easily or cleanly as those of form a. This form we feel is similar to the *Cissus diffusa* (Miq.) Amshoff that Latiff (1982) described. Keng (1990) had also recognised both species, and noted that one of the species had a foetid smell. We noticed that fresh plants of form b did not have a foetid smell when the leaves or stems were crushed, while those of form a did. Thus, there are two very distinct forms in Singapore with no intermediate known to us. However, it should be noted that the leaf and tendril morphology could be variable for a species over its range, thus what we observed may be limited to Singapore specimens (B. R. Jackes, pers. comm.). We have therefore chosen to follow the newer circumscription of Latiff (1988), who sunk *Cissus diffusa* into *Cissus repens*, while noting the interesting differences in the two forms.



Fig. 5. *Cissus repens* Lam. (form b): a, habit of plant at Springleaf Road; b, close up of a flowering branch with bifid tendrils; c, close up of old and young stems; d, hanging freely rooting stems; e, close up of an inflorescence; f, fruiting branch bearing infructescences; g, close up of a flower. (Photographs by: Ong Kwan Han [a, b, e–g] and Ang Wee Foong [c, d]).

Table 4. Previous Singapore collections of *Cissus repens* Lam. deposited in the Herbarium, Singapore Botanic Gardens (SING; bar code no.), and the Herbarium, Raffles Museum of Biodiversity Research, National University of Singapore (SINU; accession no.) referred to in this work. Note that the specimens of the two forms mentioned in the text have been separated for clarity.

S/No.	Accession/ Bar Code No.	Herbarium	Collector(s)	Collector's No.	Date	Locality
<i>Cissus repens</i> Lam. (form a)						
1.	0019146	SING	E. J. H. Corner	29961	29 Sep.1935	Pulau Merembong
2.	0019148	SING	R. W. Hullett	241	9 Jan.1886	Fort Canning
3.	2007012291	SINU	C.K. Yeo	229	30 Aug.2000	Pulau Ubin
4.	2007012269	SINU	W. L. Chen, J. P. Foo	OBCR04	19 Sep.2003	Orchard Boulevard
5.	2007012288	SINU	W. L. Chen, J. P. Foo	NTUCR02	10 Sep.2003	Jalan Bahar
<i>Cissus repens</i> Lam. (form b, aff. <i>Cissus diffusa</i> (Miq.) Amshoff)						
1.	2007012282	SINU	W. L. Chen, J. P. Foo	KBCR02	4 Nov.2003	Khatib Bongsu
2.	2007012268	SINU	K.-X. Tan, C. K. Yeo	619	26 Jun.2003	Khatib Bongsu

***Cissus rostrata* (Miq.) Planch.**

It is a herbaceous climber with bifid tendrils and slightly hairy stems with swollen nodes and longitudinal ridges, which become rounded and hairless with age (Fig. 6b, c). The leaf blade is ovate-oblong to ovate-lanceolate, 3.5–13 × 1.5–9 cm, with a truncate, obtuse to rounded base. The leaf blade is sparsely hairy below and dries with a bloom above. The inflorescence is about 2 cm across. The berry ripens red through cream, and is about 10 × 7 mm (Fig. 6e). The seed coat is rough.



Fig. 6. *Cissus rostrata* (Miq.) Planch.: a, fruiting branch; b, close up of a ridged stem; c, close up of a shoot tip showing bifid tendril; d, close up on infructescence; e, close up of berries with section. Scale bars = 2 cm (a, d) and 2 mm (b, c, e). (Photographs by: Yeo Chow Khoon).

Table 5. Previous Singapore collections of *Cissus rostrata* (Miq.) Planch. deposited in the Herbarium, Singapore Botanic Gardens (SING), and the Herbarium, Raffles Museum of Biodiversity Research, National University of Singapore (SINU) referred to in this work.

S/No.	Accession/ Bar Code No.	Herbarium	Collector	Collector's No.	Date	Locality
1.	0019149	SING	H.N. Ridley	4748	1893	Choa Chu Kang
2.	0019150	SING	H.N. Ridley	s.n.	2 Apr.1894	Seletar
3.	0019152	SING	H.N. Ridley	s.n.	2 Apr.1894	Sungei Tuas
4.	00076866	SING	J. F. Maxwell	83-9	13 Feb.1983	Bukit Timah Nature Reserve
5.	2007012300	SINU	C.K. Yeo	35	1 Aug.2000	Bukit Timah Nature Reserve

A SHORT NOTE ON A RECENTLY INTRODUCED SPECIES: *CISSUS SICYOIDES* L.

The recent introduction of the exotic species, *Cissus sicyoides* L., is a concern for conservation as it has been reported to be an invasive species elsewhere (French et al., 2003), and there is a small risk that it could out-compete the native



Fig. 7. a, *Cissus sicyoides* at the Singapore Botanic Gardens showing the attractive dense hanging roots; b, a closer view of the foliage. (Photographs by: Yeo Chow Khoo).

Cissus repens form b, which currently occupies spontaneously regenerated forests recovering from human disturbance. We feel that we should mention the contrasting characters of the two species as an aid for differentiating between them. A good live specimen of this exotic species can be seen in the Singapore Botanic Gardens (Fig. 7). It was probably introduced for its attractive hanging roots (Fig. 7a), which interestingly are also found growing less profusely in form b of the native *Cissus repens* (Fig. 5d).

Compared to *Cissus repens*, *Cissus sicyoides* has more slender stems that flatten early in development, and when mature are covered with a peeling bark. *Cissus repens* has clearly cylindrical stems that flatten much later in development to be covered with a non-peeling bark. Both species have bifid tendrils, similarly-shaped leaves, and caducous stipules that are ovate to ovate-oblong. However, it was noted that the stipules of *Cissus sicyoides* are reflexed and often fall off early and cleanly, while those of *Cissus repens* are held erect close to the stem and often remain attached to the stem when dried, falling off much later (CKY, pers. obs.). We also observed that *Cissus sicyoides* did not have the foetid smell that we detected in form a of *Cissus repens*.

It should be noted that these differences are based on the few living specimens of this exotic species in Singapore. As *Cissus sicyoides* was reported by Woodson et al. (1968) to be a variable species from southern United States of America, Central America, northern South America, and the West Indies, it is likely that we have not encountered the full extent of the variations found in this species. Thus, a comprehensive description of this recently introduced species was not attempted, but only a short mention of what we hope are the relevant details to enable these species to be distinguished is provided above. These characters are illustrated in Fig. 8 for comparison.

CONCLUSIONS

It is fortunate that all the native species of *Cissus* are still extant in Singapore. From their distributions, it is clear that *Cissus nodosa* and *Cissus rostrata* prefer good forest habitats, and habitat destruction is the only significant threat to their continued survival. For the former, the importance of the NSSF for its conservation is clear, as has been reported for many other species (Ng & Lim, 1992). Other than the rather common *Cissus hastata*, all the other native species could benefit from ex situ conservation, and should be promoted for their ornamental potential. All these nationally threatened native species can be easily propagated and have been successfully rooted from stem cuttings in water or soil-less potting mix consisting of commercial media such as Plantaflor Humus (Verkaufs-GmbH, Germany) (CKY, pers. obs.), so their introduction into cultivation is a straightforward matter.

The occurrence of *Cissus rostrata* at the summit of Bukit Timah suggests that it can be planted in more exposed locations, while *Cissus nodosa* also seems to be able to tolerate more exposure when well-watered (CKY, pers. obs.), thus both species could also be planted as ornamental climbers in parks and gardens in locations that suit them. Furthermore, the flowers and berries of all the species not only add to their aesthetic value, but could also attract pollinating insects and avian frugivores, and thus support the faunal biodiversity of the locations where they are planted.

We have brought *Cissus repens* (form a) under cultivation in the Native Plant Demonstration Garden at Blk S1 of the National University of Singapore Kent Ridge Campus at Science Drive 4, and have shown that it can be grown on a trellis or gazebo as an ornamental. Similar attempt at bringing the other form of the species (form b) under cultivation is



Fig. 8. a, young shoot of *Cissus sicyoides* showing the reflexed stipules; b, compared to the young shoot of *Cissus repens* (form a); c, the young shoot of *Cissus repens* (form b). d, close up of a node of *Cissus sicyoides* showing caducous stipules, compared to the nodes of e, *Cissus repens* (form a), and f, *Cissus repens* (form b). g, old and young stems of *Cissus sicyoides* showing flattened stems with tubercles; h, old stems of *Cissus sicyoides* showing bark peeling to reveal dark green stems under it. Old stems of i, *Cissus repens* (form a), and j, *Cissus repens* (form b) with more persistent bark. Scale bars = 1 cm. (Photographs by: Yeo Chow Khooon [a–i] Ang Wee Foong [j]).

currently underway, and as this form has hanging roots, it is a potentially attractive climber similar to the recently introduced *Cissus sicyoides*.

Furthermore, the native species appears to be generally pest-free (CKY, pers. obs.) unlike *Cissus sicyoides*, which is known to be afflicted by the smut fungal pathogen *Mycosyrinx cissi* in its native range of Panama (Woodson et al., 1968). The plants introduced to Singapore may not remain pest-free for long, as the pathogen could follow the host in later introductions. Therefore, though the hanging roots of *Cissus repens* (c.f. *Cissus diffusa*) may not be as profuse as those of *Cissus sicyoides*, its ornamental potential as a native replacement of the introduced species should be investigated.

Lastly, though we considered *Cissus repens* as Nationally Endangered rather than Nationally Critically Endangered and thus not in as dire a state as the two earlier mentioned native species *Cissus nodosa* and *Cissus rostrata*, it is important to conserve both forms of the species and their genetic diversity. The conservation status may have to be reconsidered if *Cissus sicyoides* naturalises and competes with the native species, or if future taxonomic revision recognises the two forms of *Cissus repens* as two distinct species.

In conclusion, there is ornamental potential for the threatened species of *Cissus* in Singapore. They can be utilised in landscaped gardens and parks. Their cultivation can be a viable means of ex situ conservation of these species, which are currently threatened mostly because of the loss of their natural habitats. Furthermore, the cultivation of these species could also benefit the native insect pollinators and avian frugivores associated with them. Given the significant loss in natural habitats owing to great land-use changes in Singapore (Corlett, 1991), the option of making the best use of human-managed landscape to support native species may be unavoidable.

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