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TETRASTIGMA PLANCH. (VITACEAE) OF SINGAPORE: WITH A SPECIAL NOTE ON *TETRASTIGMA DICHOTOMUM* (BL.) PLANCH.

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ABSTRACT. — The conservation statuses in Singapore of the four native species of *Tetrastigma* (Vitaceae) are reviewed here in light of recently collected plant specimens and sightings. All four species are still extant, but under-collected probably owing to the rarity of sighting reproducing specimens. *Tetrastigma dichotomum* had previously been thought to be extinct in Singapore, but was rediscovered recently as a remnant population in the Bukit Timah Nature Reserve. A voucher specimen was made from a cultivated plant in the Native Plant Nursery of the National University of Singapore and deposited in the Herbarium, Raffles Museum of Biodiversity Research, National University of Singapore (SINU). This shows that more work should be done by field workers when sampling for these species, with special effort made to collect more reproductive specimens. To this end, cultivating the plants can ensure that the plants can be collected when reproducing. This is also a practical way for ex situ conservation, though more genetically diverse individuals would have to be represented as the genus is dioecious.

KEY WORDS. — Vitaceae, *Tetrastigma*, *Tetrastigma dichotomum*, Singapore

INTRODUCTION

The grape family (Vitaceae) is represented by 25 native species in Singapore with over 20 species still extant in seven genera (Chong et al., 2009). The genus *Tetrastigma* (Miq.) Planch. is represented by four species native to Singapore, namely *Tetrastigma curtisii* (Ridl.) Suesseng., *Tetrastigma dichotomum* (Bl.) Planch., *Tetrastigma lawsoni* (King) Burkill, and *Tetrastigma leucostaphylum* (Dennst.) N.P.Balakr. They were listed by Chong et al. (2009) as Critically Endangered, Only Cultivated, Critically Endangered, and Extinct, respectively. We noted that *Tetrastigma dichotomum* is native, but was not recognised as such by Chong et al. (2009). Being only recollected recently, it should be considered Critically Endangered. *Tetrastigma curtisii* and *Tetrastigma lawsoni* are rightly considered Critically Endangered in our view as they are only restricted to a few localities of good quality forest, while *Tetrastigma leucostaphylum* was also collected at a few localities, but overlooked by Chong et al. (2009). Thus, it is also considered to be Critically Endangered.

Tetrastigma was first described by Miquel (1861) as a section of *Vitis*, but was later recognised as a genus by Planchon (1887) for its 4-lobed stigma. Ren et al. (2011) showed that the genus is a well-supported clade with close affinity to *Cayratia*. It consists of dioecious woody climbers with leaf-opposed tendrils not ending in adhesive discs. The species found in Singapore have simple, lobed to compound and toothed leaves. The inflorescence is corymbose, and the flower has a cupuliform calyx, 4 or 5 petals, 4 or 5 stamens in a staminate flower or staminodes in a pistillate flower, and a disc adnate to the gynoecium in a pistillate flower, but free in a staminate flower. The stigma is lobed in a pistillate flower but minute and entire in a staminate flower. The fruit is a 1–2-seeded berry. The above description mostly follows Latiff (1984).

PAST AND PRESENT RECORDS

Tetrastigma dichotomum was originally thought to be extinct as it was not recollected for a considerable period in Singapore since I. H. Burkill collected it in Mandai in 1920 (specimen in the Singapore Botanic Gardens Herbarium [SING] with bar code no. 0019172). In the first recollection it was made in Bukit Timah Nature Reserve (BTNR) near the Jungle Fall Hut, in 2000 by CKY. It was sighted again at the same location in 2010, and propagated in the Native Plant Nursery at the National University of Singapore (NUS). A vegetative specimen was made from the plant under cultivation and deposited recently in the Herbarium, Raffles Museum of Biodiversity Research, National University of Singapore (SINU) by the authors (Table 1). The species is known only from one location and should be categorised as

Critically Endangered. According to Latiff (1984), it is a climber found in the fringes of hill dipterocarp and submontane forests of the Malay Peninsula, Sumatra, and Java.

In Singapore, *Tetrastigma curtisii* was first collected by H. N. Ridley in 1894 (SING 0019171), but not recollected until CKY encountered it in 2000 at the BTNR (SINU specimen with accession no. 2007012338) and the Singapore Botanic Gardens (SBG) Jungle (SINU 2007012337; see Table 1 for details of the collections). It was therefore previously thought to be Presumed Nationally Extinct. Latiff (1984) reported that it is a species found at the edges of lowland and hill dipterocarp forests and secondary forests of the Malay Peninsula. It could have been overlooked and under-collected, and for now it should be categorised Critically Endangered.

In Singapore, *Tetrastigma lawsoni* was a species first collected by W. Fox at the Singapore Botanic Gardens in 1891 (SING 0038300). This is a species found at the fringes of lowland dipterocarp forest in the west coast of the Malay Peninsula (Latiff, 1984). It has recently been collected in the Singapore Botanic Gardens Jungle (SBG), the BTNR, and the Central Catchment Nature Reserve (CCNR) near MacRitchie Reservoir (Table 1). Being a dioecious species, it probably still deserves the status of Critically Endangered though it is known from several locations. The separation of the sexes in different individuals would necessarily mean that the effective population size is much smaller than the number of individuals encountered.

Tetrastigma leucostaphylum was first collected by H. N. Ridley from Bukit Timah in 1893 (SING 0019173). It has recently been collected in the Nee Soon Swamp Forest (NSSF) and Upper Seletar Reservoir, but not in the BTNR or the SBG (Table1). Thus, it could have disappeared from the BTNR and is now restricted to the CCNR, notably near the NSSF. The distribution of the remnant populations suggests that it could require wetter habitats for its survival. Being a locally abundant species, it probably still deserves the status of Critically Endangered. Turner (1995) listed *Tetrastigma lanceolarium* (Roxb.) Planch., as a synonym of *Tetrastigma leucostaphylum*. Following Latiff (1984), who had used the former name, it is found in Bangladesh, Bhutan, India, Nepal, Sri Lanka, Kampuchea, Laos, Myanmar, Thailand, Vietnam, Java, and the Malay Peninsula.

Table 1. Previous Singapore collections of *Tetrastigma lawsoni* species, deposited in the Herbarium, Raffles Museum of Biodiversity Research, National University of Singapore (SINU).

Species	Accession No.	Herbarium	Collector(s)	Collector's No.	Date	Locality
Tetrastigma curtisii	19171	SING	H. N. Ridley	s.n.	1894	Bukit Timah
	2007012338	SINU/UKMB	C. K. Yeo	26	1 Aug.2000	BTNR, Rock Path
	2007012337	SINU	C. K. Yeo	238	8 Sep.2000	SBG, Jungle
Tetrastigma dichotomum	19172	SING	I. H. Burkill	6105	25 Aug.1920	Mandai
	Not assigned	SING	W. F. Ang, C. K. Yeo	s.n.	27 Feb.2012	NUS
Tetrastigma lawsoni	38300	SING	W. Fox	4649	2 May 1891	SBG, Fern Rockery
	144592	SING	A. T. Gwee	2010-044	5 Jan.2010	BTNR
	2007012371	SINU	C. K. Yeo	163	23 Aug.2000	NSSF
	2007012389	SINU	C. K. Yeo	237	8 Sep.2000	SBG, Jungle
	2007012388	SINU	C. K. Yeo	30	1 Aug.2000	BTNR, Tiup Tiup Path
	2007012366	SINU	C. K. Yeo	267	22 Sep.2000	Bukit Kalang Service Reservoir
	2007012383	SINU	C. K. Yeo	69	6 Aug.2000	MacRitchie Reservoir
	2007012380	SINU	C. K. Yeo	336	23 Oct.2000	BTNR, South View Path
Tetrastigma leucostaphylum	19173	SING	H. N. Ridley	5711	Sep.1893	Bukit Timah
	19174	SING	H. N. Ridley	s.n.	1894	Bukit Timah
	45795	SING	A. Samsuri	87	8 Jul.2003	NSSF
	2007012358	SINU/UKMB	C. K. Yeo	170/3	23 Aug.2000	NSSF
	2007018332	SINU	C. K. Yeo, A. T. K. Yee, K. Y. Chong, S. Y. Teo, L. Neo	s.n.	6 Mar.2010	Upper Pierce Reservoir
	2007012352	SINU	A. B. H. Loo, C. K. Yeo	3	7 Jul.2000	Upper Seletar Reservoir
	2007012343	SINU	C. K. Yeo	325	18 Oct.2000	NSSF
	1007012342	SINU	C. K. Yeo	274/1	24 Sep.2000	Nee Soon Range

All the species above seem to require good quality forest for survival, and thus must have been affected adversely by the deforestation of Singapore (Corlett, 1991).

KEY TO *TETRASTIGMA* SPECIES OF SINGAPORE

1. Leaf simple, lobed to 3–5-foliolated; young stem flattened ..... ***Tetrastigma dichotomum***
– Leaf 3–7-foliolated; young stem round 2
2. Leaf 3-foliolate, rarely 5-pedate; stem round up to 4 cm ..... ***Tetrastigma curtisii***
– Leaf 3–7-foliolate; stem round but flattens with age 3
3. Leaf 3-foliolate, rarely to 5-pedate; terminal leaflet elliptic to lanceolate, lateral leaflet elliptic to oblong, petiolule 1.4–1.8 cm; stem up to 3 cm wide and 1 cm across ..... ***Tetrastigma lawsoni***
– Leaf 3-foliolate to 5–7-pedate; terminal leaflet lanceolate, petiolule 0.6–3.3 cm; lateral leaflet elliptic, petiolule 0.4–2.5 cm; stem up to 4 cm across ..... ***Tetrastigma leucostaphylum***

The following short descriptions of the species have been based partly on the authors' own observations, and were greatly supplemented by earlier works including those by Backer & Bakhuizen van den Brink (1965) and Latiff (1984).

Tetrastigma curtisii (Ridl.) Suesseng.

(Fig. 1)

Fig. 1. a, *Tetrastigma curtisii* herbarium sheet specimen deposited by H. N. Ridley in SING. (Photograph by: Yeo Chow Khoon). b, a leafy branch at the BTNR, along Rock Path; c, close up of a young leaf; d, close up of a shoot tip showing forked tendril (arrowed); e, close up of a young stem; f, close up of an old stem that is not flattened. (Photographs by: Ang Wee Foong).

It is a woody climber with stem up to 4 cm wide. The tendrils are forked (Fig. 1d). The leaf is 3-foliolate and rarely 5-pedate. The terminal leaflet is broad obovate to elliptic, 9–12.5 × 4.5–6 cm, and the base is acute. The lateral leaflet is oblong, 7–9.5 × 3.5–4.5 cm, and the base is obtuse. The berry is ellipsoid, about 13–17 × 7–11 mm, with one seed. The seed has a reticulate testa and is ellipsoid, and is about 12–16 mm × 7–9 mm.

This species is found to be easily confused with *Tetrastigma lawsoni* in leaf characters based on our comparisons of herbarium specimens. The stem seems to be consistently cylindrical and may help to avoid confusion with the latter, which has a flattened stem when older. However, thick stems are rarely encountered in the field except with old established plants (Fig. 1f). We were able to conclude that the collection at the BTNR (SINU 2007012338, as determined by A. Latiff) had round woody stems, but this criterion cannot be satisfactorily applied to non-productive juveniles, and thus presents a problem for identification in the field.

***Tetrastigma dichotomum* (Bl.) Planch.**

(Fig. 2)

It is a woody climber with stems up to 1.2 cm wide. The stem is minutely hairy and slightly flattened when young, becoming lenticellate with age. The forked tendril has equal-length branches, and sometimes with the opposite leaves reduced or missing (Fig. 2a–c). The leaf is simple to 3-foliolate and rarely 5-foliolate (Fig. 2b). The leaf blade is elliptic in simple leaf, 8.5–10 × 3.5–5 cm, and the base is acute with a jointed petiole (Fig. 2e). The terminal leaflet and lateral leaflet are elliptic with decurrent bases, 5.5–9.5 × 2.5–4.5 cm, and 5–9.5 × 2–5.5 cm, respectively. The berry is ellipsoid, about 12–22 × 6–10 mm with one seed usually. The seed is oblong, and about 12 × 5 mm.

It is the only species of *Tetrastigma* in Singapore having the peculiar set of characters for the young shoot and the simple leaves. Thus, it is easily distinguished from the other species even when vegetative. However, it has been uncollected for many years probably owing to its very limited range in Singapore and it being rarely encountered reproductive and thus unattractive to workers in the field.

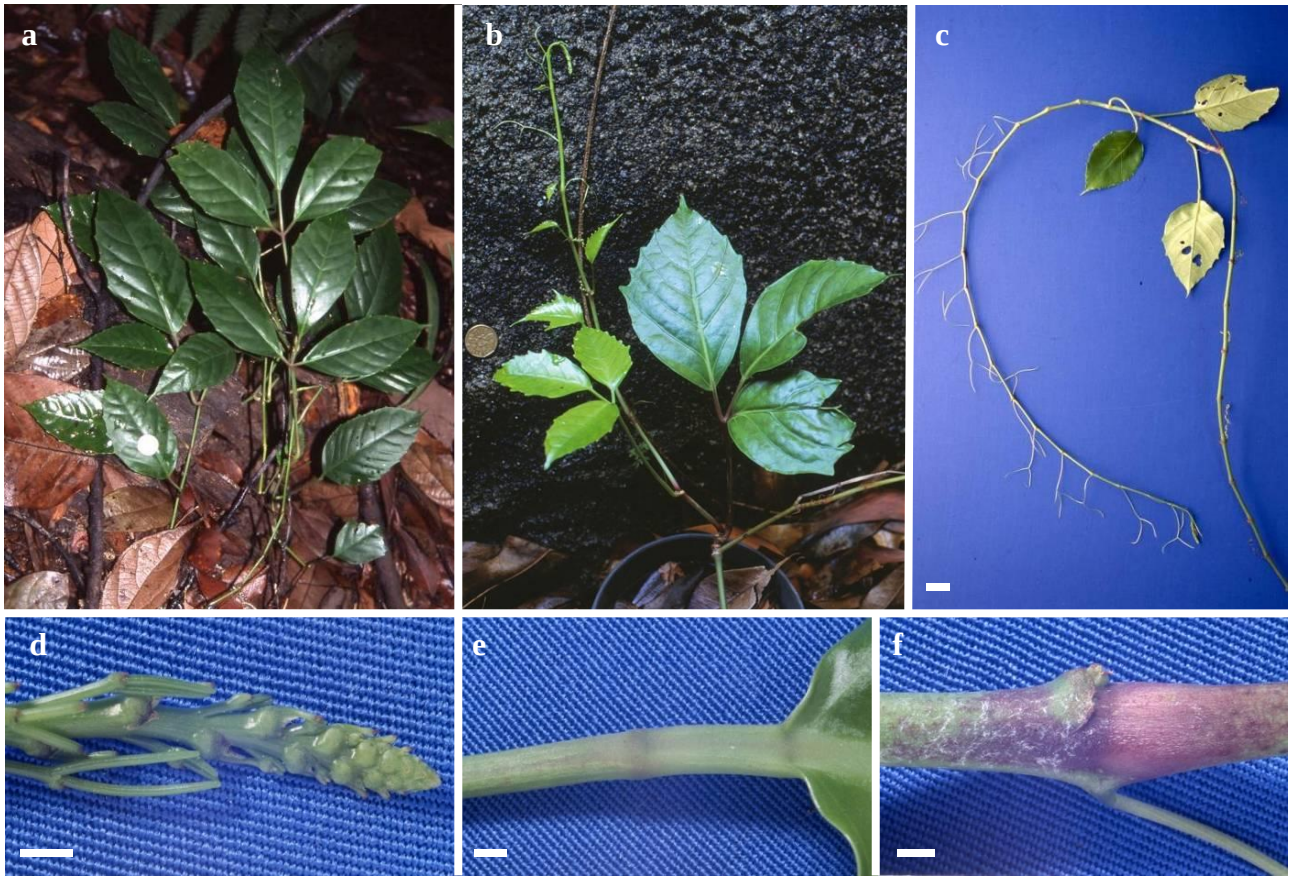

Fig. 2. a, *Tetrastigma dichotomum* habit taken near the Jungle Fall Hut, BTNR; b, a leafy branch showing transition from trifoliolate, trilobed to simple leaves; c, a branch showing the appearance of a mostly leafless creeping branch with forked tendrils. Scale bar = 2 cm. d, close up on shoot tip. Scale bar = 2 mm. e, close up on the jointed petiole. Scale bar = 2 mm. f, close up on the young stem. Scale bar = 2 mm. (Photographs by: Yeo Chow Khoon).

***Tetrastigma lawsoni* (King) Burkill**
(Figs. 3, 4)

It is a woody climber with round cross-sectioned stems when young, but the stems flatten with age, growing to 3 × 1 cm in cross section. The leaf is 3-foliolate and rarely 5-pedate. The terminal leaflet is elliptic to lanceolate, 10.5–14 × 5–6 cm, and the lateral leaflet is elliptic to oblong, 9.5–10.5 × 2.5–4 cm with both bases decurrent. The petiolule is 1.4–1.8 cm long. The berry is round and about 1.5–2 cm wide. The seed is oblong, about 12 × 6 mm.

There are few good specimens of this species in both herbaria especially of reproductive plants. It is fortunate that the original collection of W. Fox is well preserved in the care of SING (Fig. 3a). As mentioned above, we depended heavily on the flattened old stems to differentiate *Tetrastigma lawsoni* from *Tetrastigma curtisii*. However, the plants found are often juveniles or are non-reproductive, thus the leaflet shapes were used to distinguish the two. We do not find this satisfactory, as the character is not distinctive enough to allow us to do so with great certainty. Future systematics researchers should investigate this.

We would also like to report on a plant growing at the NUS Native Plant Demonstration Garden (Block S1, 14 Science Drive 4) that was propagated from a cutting of a cultivated plant, collected at the SBG in 2000. It was originally labelled as "*Tetrastigma lanceolarium*" in the SBG, and a number of morphologically similar plants encountered at the SBG Jungle were also presumed to be of this same species (pers. obs., CKY). However, it was noted that it does not fit well with the description of this species provided by Latiff (1984), especially with respect to the leaflet shape and length of petiolule. In these respects, it was felt that the plant is more similar to *Tetrastigma lawsoni*. The plant in NUS has never been observed to reproduce to date, and it has up to five leaflets per leaf rather than three, which is more typical of *Tetrastigma lawsoni*. We have decided to withhold judgment on the correct application of the name for this plant until more evidence is available, but would like to suggest that there could be an affinity to *Tetrastigma lawsoni*. See Fig. 4 for images of this plant.

Fig. 3. a, *Tetrastigma lawsoni* herbarium sheet specimen deposited by W. Fox in SING; b, specimen recently collected by A. T. Gwee deposited in SING. (Photographs by: Yeo Chow Khoon).

Fig. 4. a, plant of an unknown *Tetrastigma* species with affinity to *Tetrastigma lawsoni* grown in a nursery near the Native Plant Demonstration Garden, Block S1, 14 Science Drive 4, to provide shade for younger plants grown underneath. b, flattened woody stems; c, plant draping a *Fagraea fragrans* (*Tembusu*) tree at NUS; d, close up view of the leaves. (Photographs by: Yeo Chow Khoon).

***Tetrastigma leucostaphylum* (Dennst.) N.P.Balakr.**

(Fig. 5)

It is a woody climber, with stems up to 4 cm across and slightly flattened with age (Fig. 5c). The leaf is 3-foliolate to radially 5–7-foliolate (Fig. 5a). The terminal leaflet is lanceolate, 13.5–20.5 × 4–9.5 cm, with the base acute and petiolule 0.6–3.3 cm long. The lateral leaflet is elliptic, 6–13.5 × 2.5–6.5 cm, with rounded base and petiolule 0.4–2.5 cm long. We also noted that the tendril appears to be simple (unbranched) but is in fact in a forked condition where the branches do not grow beyond the bract (Fig. 5e).

Many old specimens are deposited in the two herbaria as *Tetrastigma lanceolarium* (Roxb.) Planch. This we find problematic as the stem is supposed to be clearly flattened for the species, while the older individuals we encounter in the field have almost round and slightly flattened stems.

Fig. 5. a, *Tetrastigma leucostaphylum* habit at the edge of the NSSF; b, close up of lenticellate young stem; c, close up of old stems; d, close up of a shoot tip. Scale bar = 2 mm. e, close up of the reduced forked tendril. (Photographs by: Yeo Chow Khoon [a, c, d] and Ang Wee Foong [b, e]).

CONCLUSIONS

Tetrastigma is an overlooked genus in Singapore, especially when its members are often found vegetative, and thus are not attractive to herbarium collectors. This dearth of specimens, especially reproductive ones, makes it difficult to study the systematics of the genus and this has resulted in the mistaken conclusions that some species were extinct when they were not collected for prolonged periods. Cultivating the species would enable ready access to live reproductive specimens, alleviating the problem of the dearth of material for study.

All these species have ornamental value as woody climbers with attractive foliage, and can be promoted for use in gardens and parks as a further means of ex situ conservation. Most species are easily propagated from cuttings except for *Tetrastigma leucostaphylum*, which was observed to be harder to root. However, it has been propagated vegetatively by air-layering with an acceptably higher success rate than when rooted in aerated tapwater (CKY, pers. obs.).

However, we should be mindful that *Tetrastigma* are dioecious species, thus any ex situ conservation effort needs to ensure the conservation of varied genotypes of both sexes to preserve viable populations of these species. The

protection of the forest habitats seems to be the best and most cost-effective way of conserving these species, but given the severity of the loss of forest habitats in Singapore owing to landuse pressure (Corlett, 1991), the option of making better use of human-managed landscapes to support native species may be an unavoidable development.

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