

## CAYRATIA JUSS. (VITACEAE) OF SINGAPORE: WITH A SPECIAL NOTE ON CAYRATIA JAPONICA (THUNB.) GAGNEP.

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**ABSTRACT.** — The national conservation statuses of the four native species of *Cayratia* Juss. (Vitaceae) are reviewed in light of recently collected plant specimens and sightings. All four species are still extant, and all the currently assigned conservation statuses of Chong et al. (2009) are accepted except for *Cayratia japonica* (Thunb.) Gagnep. which was omitted, for which we would like to suggest the status of Endangered. *Cayratia trifolia* (L.) Domin appears to be the only species that does not require intervention to ensure its continued survival. For the remaining species, bringing them under cultivation in gardens and parks is suggested as a viable means of ex situ conservation.

**KEY WORDS.** — Vitaceae, *Cayratia japonica*

### 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 *Cayratia* Juss. has four species native to Singapore, namely *Cayratia japonica* (Thunb.) Gagnep., *Cayratia mollissima* (Wall.) Gagnep., *Cayratia novemfolia* (Wall. ex Lawson) Burkill, and *Cayratia trifolia* (L.) Domin. The first species is unfortunately omitted from the list of Chong et al. (2009), while the other three species are listed as Nationally Endangered, Critically Endangered, and Vulnerable, respectively.

The genus *Cayratia* was first described by de Jussieu (1789), and it has recently been shown by Ren et al. (2011) to be paraphyletic, forming a clade with *Tetrastigma* and *Cyphostemma*, thus suggesting an affinity to these two taxa. The genus is found as woody or herbaceous climbers with leaf-opposed simple to 4-fid tendrils, along the fringes of lowland dipterocarp forests. All species in Singapore have simple, toothed compound leaves. The inflorescence is an axillary, rarely terminal or leaf-opposed cyme, with bisexual flowers, each with a cupuliform calyx, four petals and stamens, and gynoecium with a stigma on a short style, adnate to a disc. The fruit is a 1–4-seeded berry. The description above mostly follows Latiff (1981).

### PAST AND PRESENT RECORDS

Of the four species of native *Cayratia*, *Cayratia japonica* is probably one of the two least sighted or collected species (see Table 1), the other being *Cayratia novemfolia*. It was collected by Ridley once in MacRitchie Reservoir in 1893 (SING 076889), and only recollected again in 2008 at Admiralty Park by CKY, after KHO spotted the plant (SINU 2007016871), and later by Chong et al. at Hillview Avenue in 2010 (SINU 2007018347). Also, it was collected by K. S. Chua and H. T. W. Tan in 1992 at Mandai Lake Road, but was mistaken as *Cayratia trifolia* (SINU 2007012140). This is a rediscovered species that qualifies to be listed as Endangered given its sparse and patchy distribution.

The mistaken identity for *Cayratia trifolia* is explicable as it is a more common congeneric which has been continuously collected since the collection by R. W. Hullett in 1885 (SING 076891). It has been sighted in locations as varied as offshore islands and along the coast, as well as inland reservoirs (see Table 4), and therefore we feel that it deserves the currently assigned conservation status of Vulnerable. However, both species can be easily told apart even when vegetative by the number of leaflets on a leaf: *Cayratia japonica* has five; *Cayratia trifolia*, three. When reproductive, the flowers and fruits are also very distinct.

The disparity in the abundance of the two species is not expected as they share the same geographical range: Madagascar, Gabon, Rhodesia, India, Myanmar, Thailand, Vietnam, Kampuchea, Malesia, and Australia (Queensland) (Latiff, 1981). Furthermore, both share similar habitats. *Cayratia trifolia* is found at the fringes of lowland dipterocarp and swamp forests, and also on open wasteland, while *Cayratia japonica* is encountered in the fringes of lowland and

hill dipterocarp forests, and limestone vegetation (Latiff, 1981). It may be that the former is able to tolerate human disturbance and spread better in an urbanised and deforested Singapore, while the latter is more of a forest edge species though it may also tolerate disturbed habitats.

*Cayratia mollissima* is the next most common species encountered after *Cayratia trifolia*. The natural habitats of the species include the fringes and understorey of lowland dipterocarp forest, the fringes of hill dipterocarp forest, and limestone vegetation (Latiff, 1981). Its geographical range includes India, Myanmar, Thailand, Vietnam, Kampuchea, and the Malay Peninsula (Latiff, 1981). However, it appears to have experienced a contraction of range, restricting it presently to the Singapore Botanic Gardens (SBG) Jungle and Central Catchment Nature Reserve (CCNR), especially in the Nee Soon Swamp Forest (NSSF). Previously, it had been collected from Changi and Sungei Buloh at the end of the 19<sup>th</sup> century, and Jurong Road at the beginning of the 20<sup>th</sup> century (Table 2). These locations were likely to be forested in the past (Corlett, 1991), thus it is clear that the threat to the species appears to be deforestation.

Interestingly, there appears to be two forms in Singapore: the smaller and less hairy form in the SBG Jungle, and the hairier one in the CCNR. The difference in hairiness persists even under the same cultural condition and so it may reflect underlying genetic distinctiveness of the populations. Though we agree to the current Endangered conservation status of this species, careful management of the two forms of this species should be done to ensure that most of the genetic diversity of the species is conserved until we better understand how the diversity is partitioned into different populations.

*Cayratia novemfolia* is a consistently rare species judging from the paucity of collection relative to the other species. In Singapore it was first collected from Seletar, Chan Chu Kang, SBG, and Pulau [= Island] Buru by H. N. Ridley at the end of the 19<sup>th</sup> century, but presently only found in the NSSF (Table 3). Its natural range includes Thailand, the Malay Peninsula, Sumatra, and the Philippines (Latiff, 1981). Interestingly, Latiff (1981) reported a wide range of habitats for this species, listed all forest types as suitable habitats, and stated that it is especially common in lowland dipterocarp forest. However, judging from the location of the present remnant population in Singapore, the understorey and fringe of swamp forest appear to be the only remaining habitat of the species, and thus we agree with the currently assigned conservation status of Critically Endangered for this species.

#### KEY FOR THE IDENTIFICATION OF CAYRATIA SPECIES

1. Leaves with 3 leaflets..... 2
- Leaves with 5–9 leaflets..... 3
2. Plant glabrous; berry discoid, up to 2 cm across and 1.5 cm high, ripens black ..... *Cayratia trifolia*
- Plant hairy, berry round, 2–3 cm across, ripens pink ..... *Cayratia mollissima*
3. Leaves with 5 leaflets; young stem, leaves and tendrils red; berry about 6 mm across ..... *Cayratia japonica*
- Leaves with 5–9 leaflets; stem, leaves and tendrils green; berry 2–3 cm across..... *Cayratia novemfolia*

The following short descriptions of the species have been composed from the authors' own observations but are greatly supplemented by Henderson (1959), Backer & Bakhuizen van den Brink (1965), and Latiff (1981).

#### *Cayratia japonica* (Thunb.) Gagnep.

It is a herbaceous climber with a longitudinally ridged stem that is up to 5 mm across, often red when young, sometimes acquiring a waxy white bloom or bark when older. The tendril is red and usually 3-fid. The leaf is red when young, slightly hairy below, and pedately 5-foliolate (Fig. 1b). The terminal leaflet is broad elliptic, 5.5–9.5 × 3–4.5 cm, and the lateral leaflet is elliptic, 2.5–6 × 1.5–4.5 cm. The inflorescence is a dichotomous cyme 8–10 cm across, usually terminal on a short shoot. The flower has green petals and a yellow disc (Fig. 1c). The berry ripens white, and is about 6 mm across (Fig. 1d). The seed is ridged, and about 5 × 4 mm.

Table 1. *Cayratia japonica* (Thunb.) Gagnep. specimens in the Herbarium, Singapore Botanic Gardens (SING; with bar code nos.) and Herbarium, Raffles Museum of Biodiversity Research, National University of Singapore (SINU; with accession nos.).

S/No.	Accession/		Herbarium	Collector(s)	Collector's		Locality
	Bar Code No.				No.	Date	
1.	076889		SING	H. N. Ridley	5105	1983	McRitchie Reservoir
2.	2007012140		SINU	K. S. Chua, H. T. W. Tan	747	27 Feb.1992	Track 15, Mandai Lake Road
3.	2007016871		SINU	C. K. Yeo	s.n.	17 Dec.2008	Admiralty Park
4.	2007018347		SINU	K. Y. Chong, P. X. Ng, S. Teo, A. T. K. Yee	s.n.	Jun.2010	Forest next to Meralodge Condominium, Hillview Avenue



Fig. 1 *Cayratia japonica* (Thunb.) Gagnep.: a, climber in Admiralty Park; b, a close up of the leaves; c, close up of an inflorescence; d, berries in an infructescence. (Photographs by: Ang Wee Foong [a, b] and Ong Kwan Han [c, d]).

### *Cayratia mollissima* (Wall.) Gagnep.

It is a climber with a stem up to about 1 cm across. The tendril is green and 3-fid. It is densely hairy on the stem and leaves, but a more sparsely hairy form exists (Fig. 3). The latter has been encountered at the Botanic Gardens Jungle at SBG and MacRitchie Reservoir Park. The leaf is 3-foliolate, with the terminal leaflet broad elliptic,  $6.5\text{--}13.5 \times 2.5\text{--}6.5$  cm, while the lateral leaflet is asymmetric oblong,  $4.5\text{--}12 \times 1.5\text{--}6$  cm (Fig. 2). The inflorescence is up to 2 cm across (Fig. 2). The flower has petals bluish green petals and a white disc (Fig. 4). The berry is sparsely hairy, round, and is about 2–3 cm across, ripening pink (Fig. 3). The seeds are smooth, oblong, about  $12\text{--}16 \times 7\text{--}13$  mm (Fig. 4). Germination from seeds could take about 1–2 months (CKY, pers. obs.).

Table 2. *Cayratia mollissima* (Wall.) Gagnep. specimens deposited in the Herbarium, Singapore Botanic Gardens (SING; with bar code nos.) and Herbarium, Raffles Museum of Biodiversity Research, National University of Singapore (SINU; with accession nos.).

S/No.	Accession/ Bar Code No.	Herbarium	Collector(s)	Collector's No.	Date	Locality
1.	0019116	SING	H. N. Ridley	1621	May 1891	Chan Chu Kang
2.	0019110	SING	H. N. Ridley	s.n.	21 May 1908	Cluny Road
3.	0019109	SING	H. N. Ridley	s.n.	Feb.1889	Changi
4.	0019120	SING	H. N. Ridley	s.n.	1893	McRitchie Reservoir
5.	0019117	SING	Hardial	643	30 Oct.1967	BTNR
6.	0019106	SING	Lc Corporal	s.n.	18 Apr.1890	Sungei Buloh
7.	0019107	SING	Md. Nur	s.n.	4 Nov.1917	Jurong Road
8.	2007012089	SINU	J. F. Maxwell	77-116	8 Mar.1977	NSSF
9.	2007012079	SINU	C. K. Yeo	s.n.	18 Oct.2000	NSSF
10.	2007012081	SINU	C. K. Yeo	185	25 Aug.2000	Upper Seletar Reservoir
11.	2007012090	SINU	C. K. Yeo	255	12 Sep.2000	SBG
12.	2007012098	SINU	C. K. Yeo	324	18 Oct.2000	NSSF

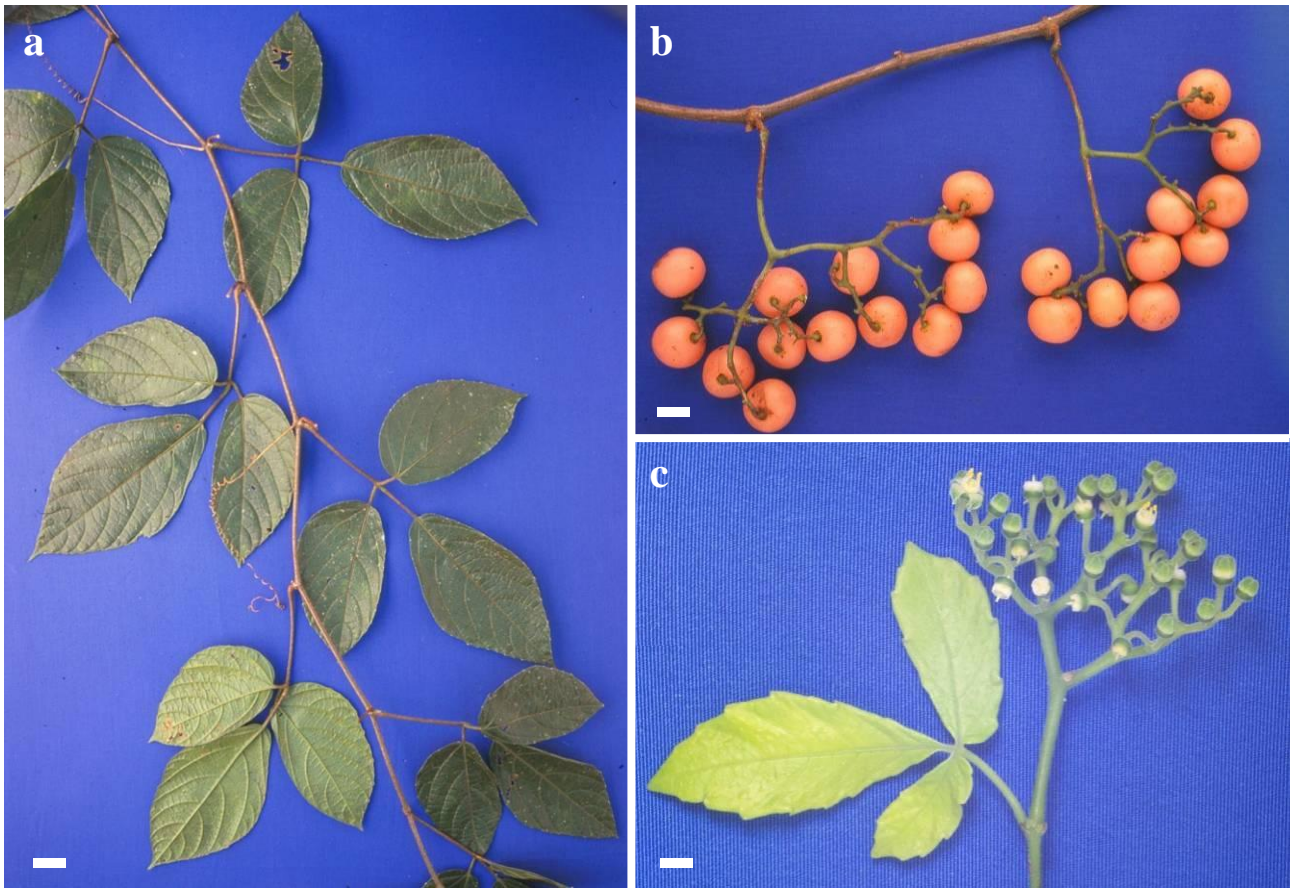


Fig. 2. *Cayratia mollissima* (Wall.) Gapnep.: a, a leafy branch ; b, a fruiting branch with ripe berries; c, a branch bearing a terminal inflorescence rather than the typical axillary inflorescence. Scale bars = 2 cm (a, b), 5 mm (c). (Photographs by: Yeo Chow Khoo).

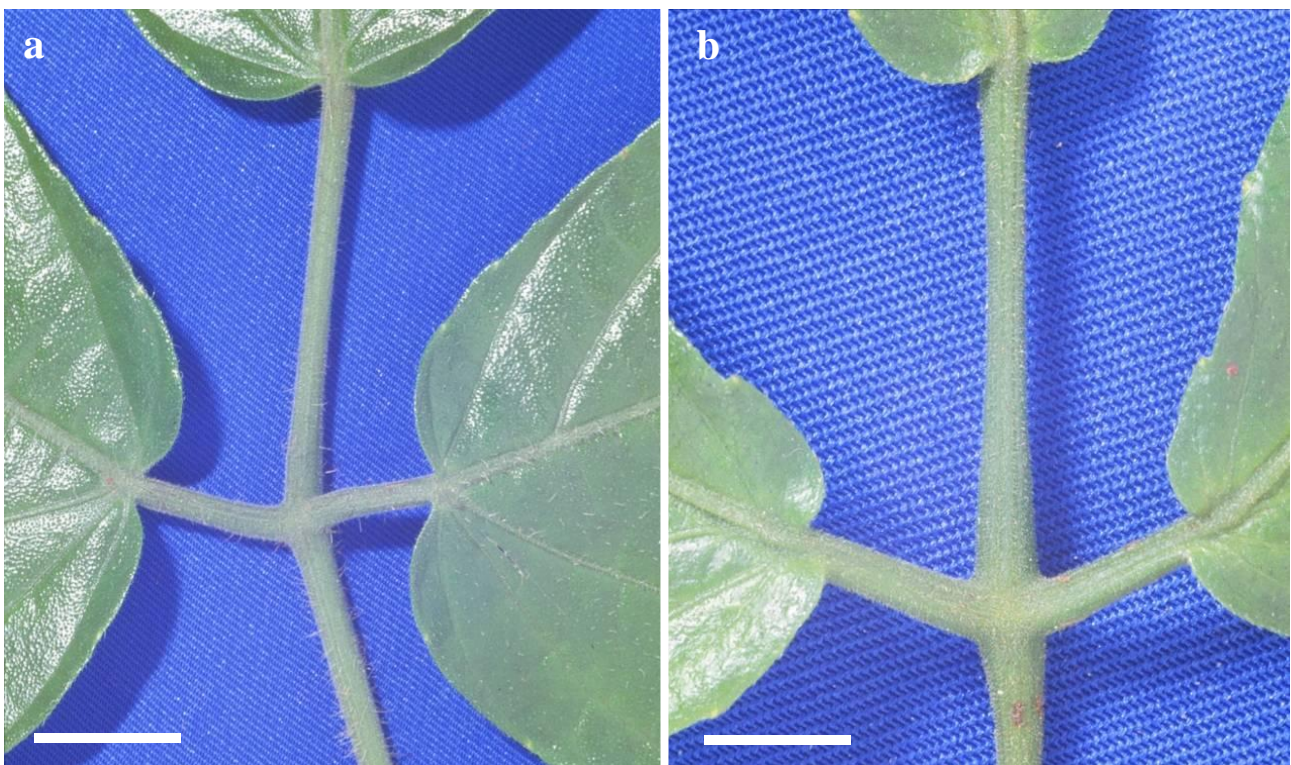


Fig. 3. Two forms of *Cayratia mollissima* with pictures showing the leaves: a, hairy form; and b, less hairy forms. Scale bars = 1 cm. (Photographs by: Yeo Chow Khoo).

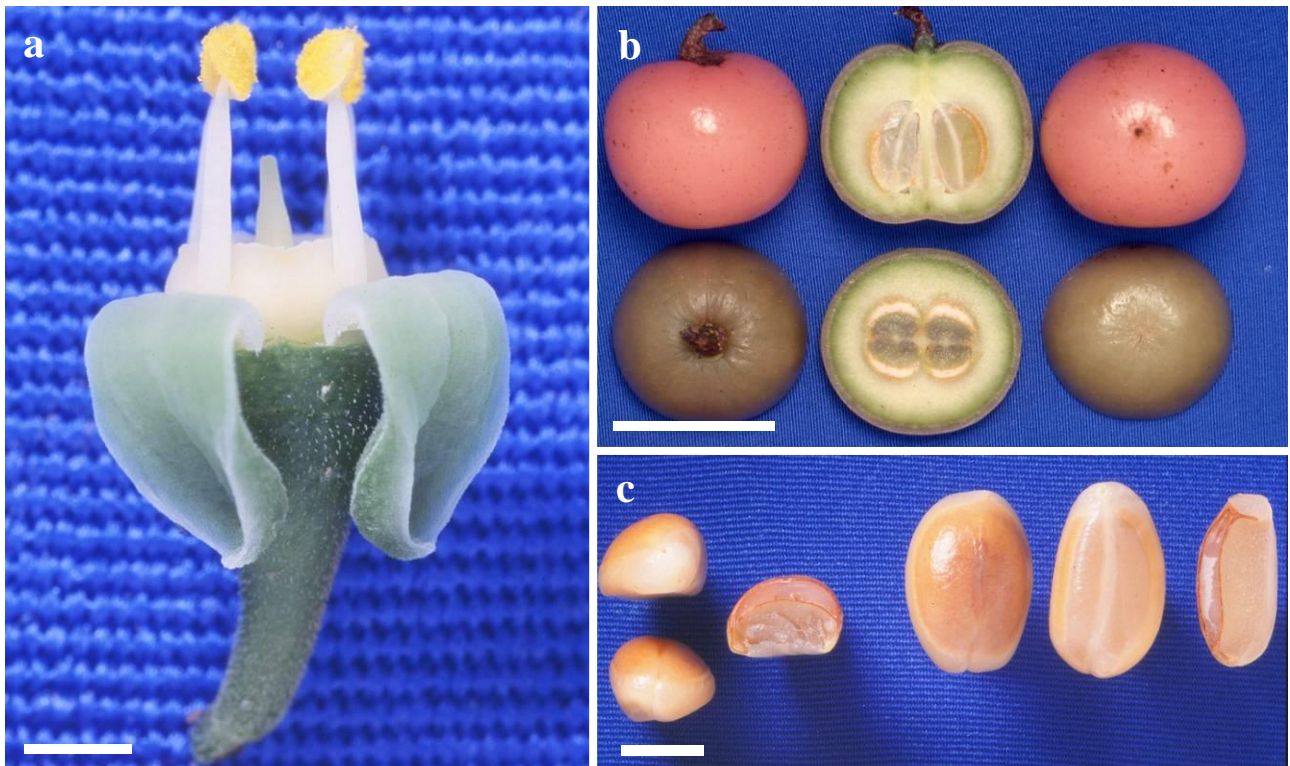


Fig. 4. a, Close up of a flower of *Cayratia mollissima*; b, close up of berries with sections; c, close up of seeds with sections. Scale bars = 1 mm (a), 2 cm (b), 5 mm (c). (Photographs by: Yeo Chow Khoon).

***Cayratia novemfolia* (Wall. ex Lawson) Burkill**

It is a herbaceous climber, with a stem up to 1 cm across. The tendril is green and 2–3-fid. The leaf is pedately compound, from 5–9 foliolate, often with an iridescent sheen when growing in low light. The terminal leaflet is lanceolate to elliptic, 8.5–18.5 × 2–4.5 cm, and lateral leaflet is obovate to oblong, 4–16.5 × 1.5–5 cm. The leaf is minutely hairy. The inflorescence is a dichotomous cyme, up to about 8 cm across (Fig. 5b). The flower has pale green petals and a yellow disc (Fig. 5c,d). The berry is round and about 2–3 cm across. The seeds are smooth, oblong, about 1.4 × 1 cm.

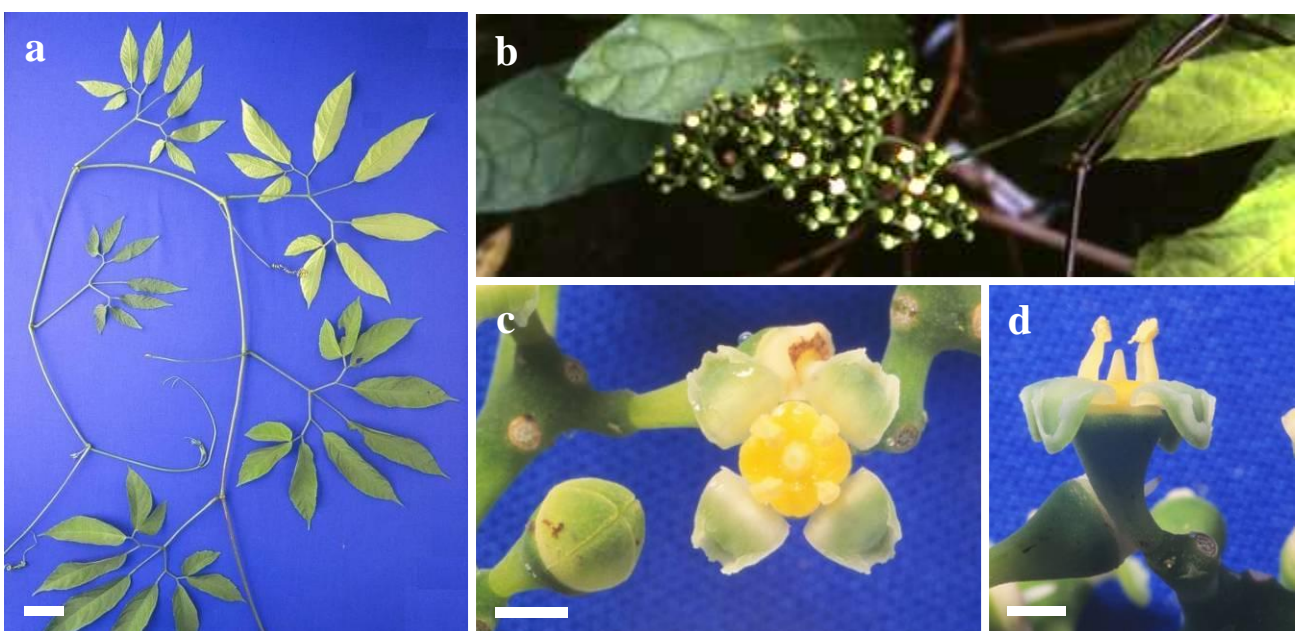


Fig. 5. *Cayratia novemfolia* (Wall. ex Lawson) Burkill: a, a vegetative branch; b, an inflorescence; c, close up of the side view of a flower; d, close up of the top view of the flower. Scale bars = 4 cm (a), 2 mm(c, d). (Photographs by: Yeo Chow Khoon).

Table 3. *Cayratia novemfolia* (Wall.) Gagnep. specimens deposited in the Herbarium, Singapore Botanic Gardens (SING; with bar code nos.) and Herbarium, Raffles Museum of Biodiversity Research, National University of Singapore (SINU; with accession nos.).

S/No.	Accession/ Bar Code No.	Herbarium	Collector(s)	Collector's No.	Date	Locality
1.	0019123	SING	H. N. Ridley	4	3 Nov.1889	Seletar
2.	0019126	SING	H. N. Ridley	6785	1895	SBG
3.	0019124	SING	H. N. Ridley	s.n.	26 May 1890	Pulau Buru
4.	0019125	SING	H. N. Ridley	s.n.	1894	Chan Chu Kang
5.	2007012103	SINU	C. K. Yeo	138	17 Aug.2000	NSSF

*Cayratia trifolia* (L.) Domin

It is a herbaceous climber with longitudinally ridged stem, up to 6 mm across, often red when young, sometimes acquiring a bark when older. The tendril is red and usually 2–3-fid. The leaf is red when young, almost hairless, but just minutely hairy above, and 3-foliolate. The terminal leaflet is oblong to elliptic, 5.5–7 × 3.5–4.5 cm, and the lateral leaflet is elliptic, 3.5–5.5 × 3–4 cm. The petiole, petiolules, and veins of the leaf often remain red. The inflorescence is a dichotomous cyme about 2 cm across. The flower has green petals and a white disc with red stigma (Fig. 6b–d). The berry is discoid, ripens black, and is about 1.5–2 cm across and 1–1.5 cm high (Fig. 6e,f). The seed is ridged, and about 6 × 5 mm (Fig. 6g). The seed germinates between 1–3 months (CKY, pers. obs.).

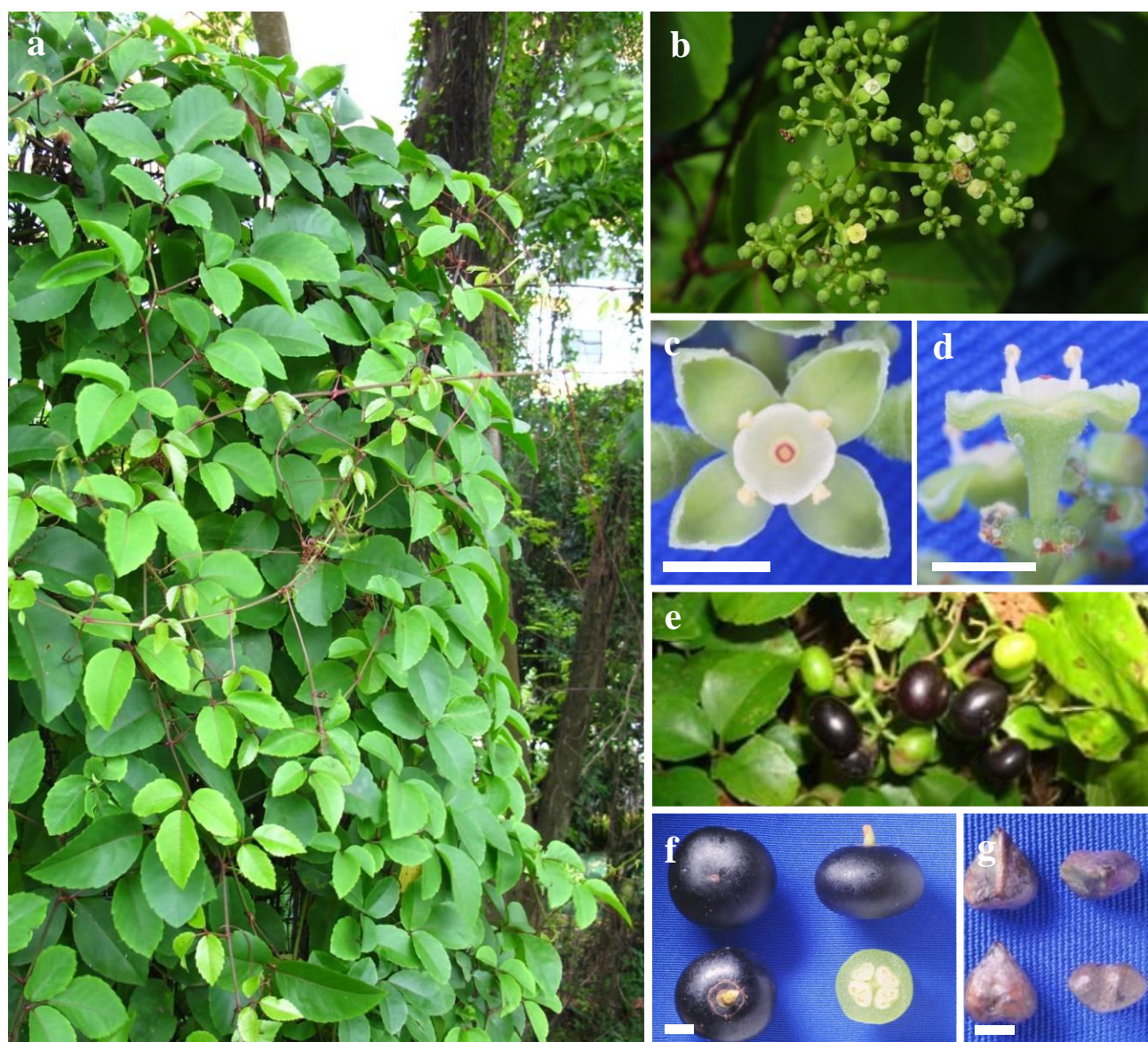


Fig. 6. a, *Cayratia trifolia* draping a wayside tree along New Upper Changi Road; b, an inflorescence; c, close up of the top view of a flower; d, close up of the side view of a flower; e, infructescence with ripe and unripe berries; f, close up of berries; g, close up of seeds. Scale bars = 2 mm. (Photographs by: Yeo Chow Khooon [a–d, f, g] and Ong Kwan Han [e]).

Table 4. *Cayratia trifolia* (L.) Domin specimens deposited in the Herbarium, Singapore Botanic Gardens (SING; with bar code no.) and Herbarium, Raffles Museum of Biodiversity Research, National University of Singapore (SINU; with accession no.).

S/No.	Accession/		Herbarium	Collector(s)	Collector's		Locality
	Bar Code No.	No.			Date		
1.	076891		SING	R. W. Hullett	302	Dec.1885	Race Course
2.	076893		SING	H. N. Ridley	s.n.	1911	Kallang Pudding
3.	076894		SING	I. H. Burkill	1403	19 Aug.1915	Botting Kusa
4.	076892		SING	E. J. H. Corner	s.n.	29 Sep.1935	Pulau Merembong
5.	2007012121		SINU	C. K. Yeo	s.n.	10 Aug.2000	Labrador Park
6.	2007012118		SINU	C. K. Yeo	218	29 Aug.2000	Lower Seletar Reservoir
7.	2007012145		SINU	C. K. Yeo	261	12 Sep.2000	Kheam Hock Road
8.	2007012110		SINU	C. K. Yeo	s.n.	4 Oct.2000	Western Catchment Area
9.	2007012135		SINU	H. T. W. Tan, M. Tangavelu, C. K. Yeo	s.n.	Jul.–Aug.2000	Sungei Jelutong, Kranji Reservoir
10.	2007012129		SINU	D. H. L. Teo	s.n.	2000	Lower Pierce Trail
11.	2007012131		SINU	D. J.-S. Y. P. Tng	s.n.	2000	Pulau Semakau
12.	2007012130		SINU	D. J.-S. Y. P. Tng	s.n.	15 Sep.2000	Pulau Hantu
13.	2007012116		SINU	K. Peh, H. T. W. Tan	149	18 Aug.2000	Lazarus Island
14.	2007015946		SINU	H. T. W. Tan	s.n.	Feb.2001	Kampong Pasir, Pulau Tekong
15.	2007012122		SINU	H. T. W. Tan, K.-X. Tan	s.n.	23 Jun.2003	Sungei Buloh Wetland Reserve

A collection of a specimen similar to *Cayratia trifolia* was made from Khatib Bongsu (SINU 2007012123). It was found to be creeping low on the ground and climbing over a fence next to an abandoned prawn pond. An individual is currently growing in the Native Plant Nursery of NUS. It grows less vigorously than the typical *Cayratia trifolia*, and often grows as a creeper with caducous tendrils. The plant is thickly hairy all over, with tendrils that are often 4-fid. We are currently uncertain about the identity of the species, though it could be a form of *Cayratia trifolia*. Please refer to Fig. 7 for a comparison between this plant and *Cayratia trifolia*.

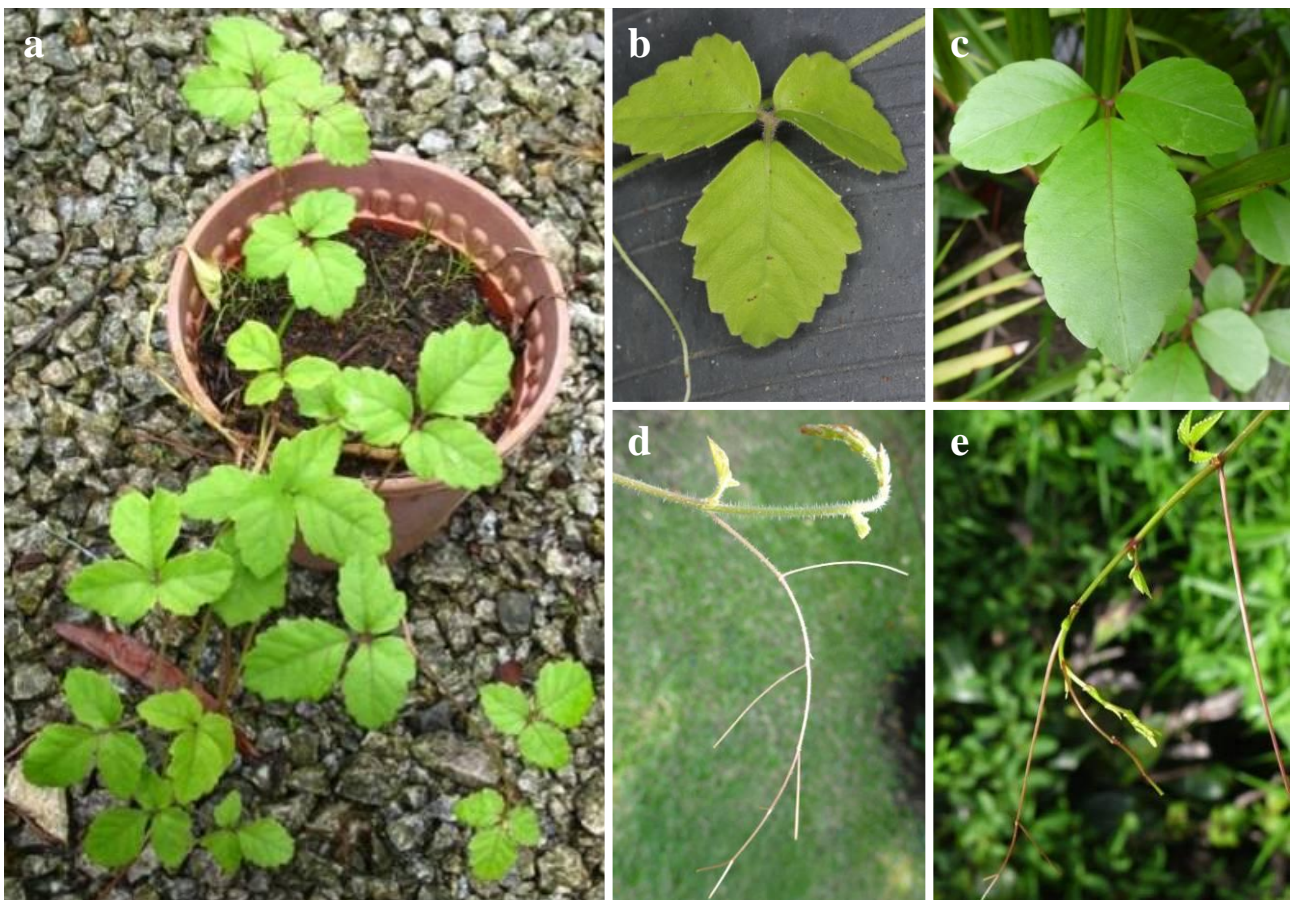


Fig. 7. a. An unknown *Cayratia* species cultivated in the Native Plant Nursery, NUS; b, close up of a leaf of the unknown *Cayratia* species; c, compared to the less hairy leaf of *Cayratia trifolia*; d, a close up of the shoot tip of the unknown *Cayratia* species with a 4-fid tendril; e, comparison with the shoot tip of *Cayratia trifolia* with 3-fid tendrils. (Photographs by: Yeo Chow Khoon).

Table 5. A previous Singapore collection of an unknown *Cayratia* species, most similar to *Cayratia trifolia*, deposited in the Herbarium, Raffles Museum of Biodiversity Research, National University of Singapore (SINU).

S/No.	Accession No.	Herbarium	Collector(s)	Collector's No.	Date	Locality
1.	2007012123	SINU	K.-x. Tan, C. K. Yeo	621	26 Jun.2003	Khatib Bongsu

## CONCLUSIONS

It is fortunate that all the four native species of *Cayratia* are still extant in Singapore. From their collection localities, it is clear that *Cayratia japonica*, *Cayratia mollissima*, and *Cayratia novemfolia* need less disturbed forest habitats to survive, and habitat destruction is probably the only significant threat to their continued survival. As Corlett (1991) has noted, a large proportion of land has been affected by forest clearance owing to land use changes. For *Cayratia novemfolia*, the importance of the NSSF for its conservation is clear, as has been reported for other species (Ng & Lim, 1992). *Cayratia trifolia* appears to be the only species that does not need special conservation effort to ensure its continued survival, and it seems to survive reasonably well in landscapes affected by human disturbances.

Interestingly, there appears to be two forms of *Cayratia mollissima*. One form is found in the wetter parts of the CCNR in and around the NSSF, and the other form is found in the SBG and around MacRitchie Reservoir, in the drier parts of the CCNR. The conservation of both forms may be important to maximise the preservation of genetic diversity in all the populations and to ensure the long term viability of the species in Singapore.

All the species are easy to propagate, and have been successfully grown from stem cuttings rooted in water (except for *Cayratia japonica*) or potting mix (CKY, pers. obs.). Since all species have ornamental value, they should be brought under cultivation in parks and gardens by growing them on trellises and gazebos as a means of ex situ conservation. With the exception of *Cayratia trifolia*, which may have the vigour to escape cultivation, all the remaining species are manageable and suitable for planting parks and gardens. Furthermore, the flowers and fruits of these species are food sources of pollinating insects and avian frugivores, respectively, and therefore it may help to increase the abundance and species richness of these sites if planted more commonly.

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