

An Introduction to the Native Palms of Singapore

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The native palm flora of Singapore can be described as a microcosm of the palm flora of the Malay Peninsula. With 20 genera, Singapore has close to two-thirds of the genera found in the contiguous palm flora that is formed between Peninsular Malaysia (131,598 km²) and Singapore (716.1 km²).

The Singapore flora has long been considered a natural part of the flora of Peninsular Malaysia but distinguished from the eastern islands of Borneo, the Philippines and the eastern Archipelago and aligned with the Sumatran Flora (van Steenis 1950; Takhtajan

1986). It is also notable for its near absence of insular endemic species (Corlett 1992). The native flora consists of 2145 native plant species, of which 639 (29.8%) are already considered nationally or globally extinct (Chong et al. 2009).

With 54 species, the palm flora in Singapore makes up 23.6% of the contiguous palm flora formed by Singapore and Peninsular Malaysia, which is also largely representative of Malaysian palms distributed west of Wallace's Line (Baker & Couvreur 2012). This is remarkable as Singapore's land area is a mere 0.54% of the combined land area. This could largely be attributed to the occurrence of diverse habitats in Singapore comprising saline environments of mangrove forests, freshwater habitats of inland swamps, and mixed dipterocarp forests, with palms occupying various levels of the multi-tiered vegetation.

Habitats

The Republic of Singapore consists of a group of 59 islands located at latitude 1°N and longitude 104°E, off the southernmost tip of continental Asia, separated by the Straits of Johore from Peninsular Malaysia to the north. The mainland measures 49 km east to west and 25 km from north to south with a coastline of 197 km (Singapore Department of Statistics 2014).

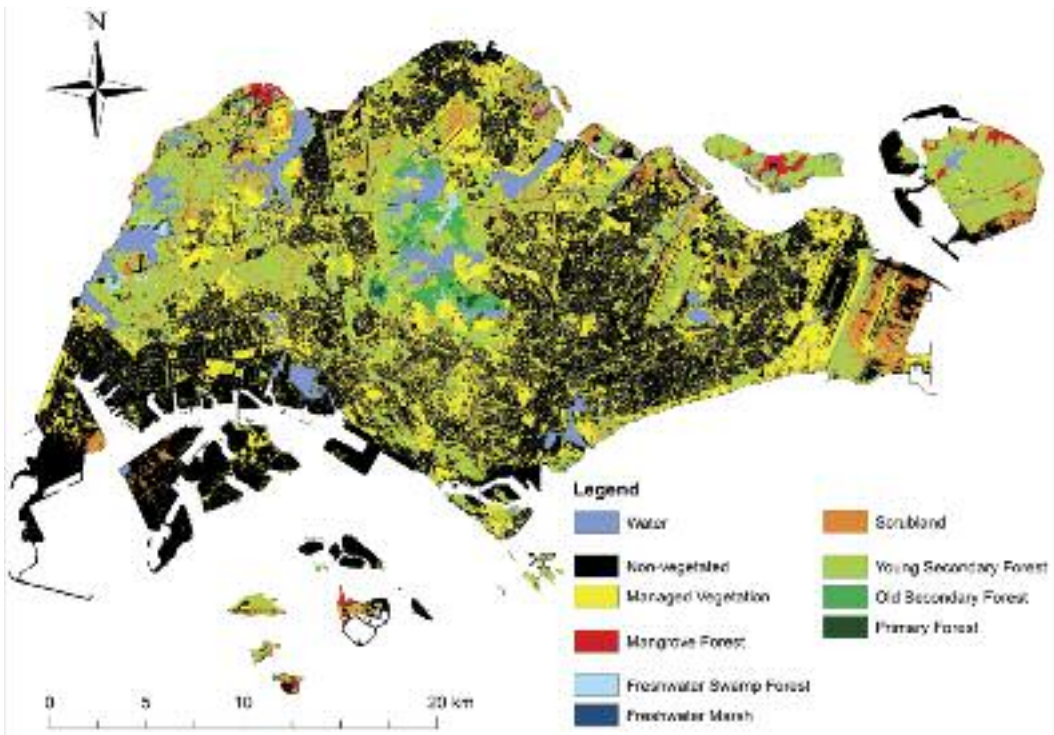
The average daily maximum and minimum temperatures are around 31°C and 24°C respectively. The relative humidity is usually between 61% and 65% on dry afternoons but

frequently exceeds 90% in the early hours of the morning before sunrise. Although rain falls throughout the year, the wettest months are usually during the first part of the Northeast Monsoon season from November to January. During the Southwest Monsoon season from May to September, early morning line squalls occasionally hit the island. The average rainfall per year for the past five years is 2285.7 mm.

While Singapore is immediately known as a highly urbanized and built up city state with lush wayside greenery, there are primeval patches of rainforest in protected reserves that total 3347 hectares (4.67% of the total land area of the island republic) and include Bukit Timah Nature Reserve, Central Catchment Nature Reserve, Sungei Buloh Wetland Reserve and the 10 Ha Labrador Nature Reserve (NParks 2012).

The principal native vegetation of Singapore is lowland dipterocarp rainforest (Corlett 1991). Most of the palm diversity and other native flora is found within the mainland's nature reserves. A small freshwater swamp forest still exists within the central catchment as the Nee Soon Swamp Forest and is a habitat where swamp associates such as *Eleiodoxa conferta*, *Korthalsia flagellaris*, *Daemonorops sabut* and *D. longipes* feature prominently.

1. Vegetation map of Singapore and its surrounding islands. Figure courtesy of Alex Yee.



Tab. 1. Taxonomic representation of the native palms of Singapore with classifications based on Dransfield et al. (2008).

Subfamily	Tribe	Subtribe	Genus	Extant members (Extinct)	
Arecoideae	Areceae	Arecinae	<i>Nenga</i>	1	
			<i>Pinanga</i>	2 (4)	
		Oncospermatinae	<i>Oncosperma</i>	2	
		unplaced	<i>Cyrtostachys</i>	1	
		unplaced	<i>Iguanura</i>	1	
			unplaced	<i>Rhopaloblaste</i>	1
		Oranieae	NA	<i>Orania</i>	1
	Calamoideae	Calameae	Calaminae	<i>Calamus</i>	8 (3)
				<i>Daemonorops</i>	11 (1)
				<i>Ceratolobus</i>	0 (1)
			Korthalsiinae	<i>Korthalsia</i>	4 (2)
Plectocomiinae			<i>Myrialepis</i>	1	
			<i>Plectocomia</i>	1	
			<i>Plectocomiopsis</i>	1	
				Salaccinae	<i>Eleiodoxa</i>
				<i>Salacca</i>	1
Coryphoideae			Caryoteae	NA	<i>Caryota</i>
	Trachycarpeae	Livistoninae	<i>Licuala</i>	2 (1)	
			<i>Pholidocarpus</i>	1	
Nypoideae	NA	NA	<i>Nypa</i>	1	

Outside the nature reserves along coastal areas on the mainland and off-shore islands are back-mangrove associates *Licuala spinosa* and *Oncosperma tigillarium*. *Nypa fruticans* and *Calamus erinaceus* are mangrove associates restricted to pockets of existing mangroves on the mainland and on large offshore islands such as Pulau Ubin and Pulau Tekong (Yee et al. 2001)(Fig.1).

Diversity of Native Palms

Twelve species are considered nationally extinct (Loo et al. 2014). The native palms in Singapore are diverse across higher taxonomic levels with four of the palm subfamilies with six tribes represented (Table 1); Calamoid palms make up the largest group with 28 extant species within four subtribes, namely, Calaminae, Korthalsiinae, Plectocomiinae and Salaccinae. The second largest subfamily is the Arecoideae represented by nine species in seven genera from two tribes. Coryphoid palms are represented by four species in three

genera in two tribes. The subfamily Nypoideae is, of course, represented by the monotypic genus *Nypa*. This also means Singapore palms are morphologically diverse. In habit, we find rattans (e.g., *Plectocomia elongata*), canopy trees (e.g., *Orania sylvicola*), understory trees (e.g., *Nenga pumila*) and understory palms of the ground layer (e.g., *Pinanga simplicifrons*).

Rediscoveries and a new record

Much of Singapore's native palm species were extirpated along with the loss of primeval vegetation over the centuries of rapid development. Swamp forest associates, in particular, are highly endangered due to habitat loss. Freshwater swamps were wiped out early on in Singapore since 1800s due to land conversion for crops such as gambier, pepper, pineapple, rubber, market gardening, aquaculture and in more recent times, for canalization, reservoirs, housing and industrial development (O'Dempsey & Chew 2011). Recent rediscoveries of five species of palms

thought to be previously extinct locally and one new rattan genus record have offered a glimmer of hope for the native palm flora.

A single population of *Pinanga simplicifrons* (Fig. 2) was rediscovered by Ang et al. (2010) in Nee Soon Swamp Forest and subsequently in 2012 another population discovered within the Catchment reserves. This is a diminutive palm that matures at knee-height. Another swamp forest species, *Salacca affinis*, was rediscovered in another part of the same forest (Loo 2011). *Pholidocarpus kingianus*, a rare large canopy palm, was rediscovered in the Central Catchment Nature Reserve (Sunia Teo, pers. comm., 2011) and a small population of *Cyrtostachys renda*, a swamp forest species, was rediscovered in the Western catchment area (Ali Ibrahim, pers. comm.). *Plectocomiopsis geminiflora*, a genus and species previously unrecorded for Singapore was discovered within the Central Catchment Nature Reserve not far from a walking trail (Tan et al. 2011). This perhaps vindicates the observations that collectors have shunned rattans in making herbarium specimens. It could also be that this rattan is morphologically similar to *Myrialepis*

2. *Pinanga simplicifrons* rediscovered in Nee Soon Swamp Forest, a highly threatened habitat in Singapore. Beside it, Bill Baker from Royal Botanic Gardens, Kew



paradoxa in terms of vegetative characters, especially in juvenile stages. The fruits of both rattans, however, are distinguishable. This discovery means that all genera of the Plectomiinae are represented in the Singapore palm flora.

Arecoid Palms

Two species of *Oncosperma* are native to Singapore and both are conspicuous canopy palms that develop into many-stemmed clumps. *Oncosperma tigillarum* (*nibung*) is found near coastal swamps and forests, and its saltwater-resistant wood is used in the building of *kelongs* (Malay for an offshore platform built for fishing). The inland species, *Oncosperma horridum* (*bayas*) (Fig. 3), is common in the lowland dipterocarp forests and can be distinguished by its splayed fronds as opposed to the former which has drooping leaflets. Both are very spiny and have long backward pointing black spines on their stems.

Nenga pumila var. *pachystachya* (Fig. 4a) is fairly common in the forest understory and swamp forests where they are found growing in the water, producing stilt roots at the base. *Pinanga malaiana* (Fig. 4b), which looks similar, is not as easily encountered in the forest. The two genera can be differentiated with certainty through the arrangement of the flowers on the rachis – *Pinanga* has flowers and fruits that are arranged in a distichous pattern throughout the length of the rachillae while *Nenga* has spirally arranged flowers and fruits confined to the base of the rachillae with male flowers only at the tips. Currently, there are only two known small populations of *Pinanga simplicifrons* within the Central Catchment Nature Reserve and this diminutive palm certainly makes a good candidate for *ex situ* conservation efforts. Four other *Pinanga* species (*P. disticha*, *P. limosa*, *P. singaporensis* and *P. subbruminata*) are presumed nationally extinct.

While *Cyrtostachys renda* is a rather ubiquitous wayside plant in Singapore, it was not long ago presumed nationally extinct in the wild (Chong et al. 2009). Fortunately, this charismatic palm of freshwater swamps with its red crownshaft was rediscovered in the Western Water Catchment by the National Parks Board (NParks), Singapore. While this area is not gazetted as a nature reserve, it is a military training area, which offers protection of habitats from development and public access.

Rhopaloblaste singaporensis (*kerinting*) (Fig. 5) is the only member of the genus that has a



3. *Oncosperma horridum* – leaves of this species are splayed out as opposed to droopy leaflets of *O. tigillarum*.



4. A. *Nenga pumila* var. *pachystachya* – note the spiral arrangement of the fruits. B. *Pinanga malaiana* – a distichous arrangement in all *Pinanga* palms.

clustering habit (Banka & Baker 2004). To the north of Singapore, it is distributed in Johor, Pahang and Perak in Peninsular Malaysia. In Singapore there are several clumps in Bukit Timah Nature Reserve, MacRitchie and in and around Nee Soon Swamp Forest. This palm is seen only in areas of good primary forest.

Orania sylvicola is critically endangered with a few individuals left in the wild in Singapore. It is a distinctive single-stemmed feather palm in the Catchment Nature Reserve, as it is the only native canopy arecoid palm that is not spiny.

Calamoid Palms

Baker (2015) recently sank *Daemonorops* and *Ceratolobus* into an expanded *Calamus*. However, for the sake of consistency with the recently published Field Guide to the Palms of Singapore, which this article complements, we adhere to the traditional generic limits here. See Baker (2015) for revised nomenclature.

The Calamoideae contains many varied habits – giant climbing rattans such as *Plectocomia elongata* that punch through the forest canopy or smaller rattans such as *Calamus lobbianus*,

an understory rattan that is often stemless or with a short stem at maturity. The salaks, *Salacca affinis* and *Eleiodoxa conferta* (Fig. 6), are acaulescent, forming tall thickets with their clustering habit that is made up mainly of towering leaves to 3 m tall.

Daemonorops is the most well represented with 12 members of which one (*D. lewisiana*) is presumed nationally extinct. Both the sections *Daemonorops* and *Piptospatha* are represented by *D. angustifolia*, *D. grandis* (Fig. 7) and *D. lewisiana* for the former and *D. didymophylla* (Fig. 8b), *D. micracantha*, *D. leptopus*, *D. hirsuta* (Fig. 8a), *D. kunstleri*, *D. geniculata*, *D. sabut*, *D. periacantha* and *D. longipes* for the latter. The Section *Piptospatha* is further divided (*sensu* Dransfield 1979) to 1) those that have fruits that bear “dragon’s blood” (*D. didymophylla*, *D. micracantha*), 2) those with pale green fruit borne on rusty brown rachillae with enlarged spines around the leaf sheath mouth (*D. hirsuta*, *D. kunstleri*), 3) species with spines that form interlocking galleries occupied by ants (*D. sabut*) and 4) species with short to moderate erect or climbing stems with inflorescences bearing papery bracts and relatively large fruit (*D. periacantha*, *D. longipes*).



5. *Rhopaloblaste singaporensis* is a clustering species found only in certain pockets of forest fragments in the nature reserves of Singapore.

The genus *Calamus* in Singapore is almost as large with 11 species, of which, three (*C. densiflorus*, *C. luridus*, *C. ornatus*) are presumed nationally extinct. *Calamus diepenhorstii*, *C.*

insignis, *C. javensis*, *C. laevigatus* and *C. ridleyanus* belong to the Section *Calamus* and are typically very slender rattans with pencil-thin stems. *Calamus oxleyanus* is a distinctive



6. A cluster of *Eleiodoxa conferta* in Nee Soon Swamp Forest. Freshwater swamp forests are a highly-threatened habitat in Singapore.

7. *Daemonorops grandis* – This inflorescence with its persistent bracts that would have been enclosed within the outermost bract is typical of the section *Daemonorops* within the genus.





8. A. *Daemonorops hirsuta* is as vicious as a rattan can get and gives credence to the genus name which translates to “demon shrub”! B. *Daemonorops didymophylla* – Dragon’s blood, a deep maroon resin exudes from in-between the scales of the fruits. It was used as varnish and in chinese medicine in the past.

understory rattan with its black spines and irregularly-grouped leaflets that are waxy beneath. *Calamus javensis* and *C. laevigatus* have their lowermost pair of leaflets swept backwards to form ant-infested chambers. *Calamus oxleyanus* (Fig. 9) has beautifully grouped leaflets.

Calamus erinaceus (Back Cover) belongs to the Section *Podoccephalus* (*sensu* Furtado 1956) and is morphologically the most robust rattan of the genus in Singapore. It is a mangrove associate, whose habitat has been reduced to a few pockets in Singapore due to extensive development of coastal areas.

The three genera *Plectocomia*, *Myrialepis* and *Plectocomiopsis* belong to the subtribe Plectocomiinae and are hapaxanthic. In the juvenile stage, the three look similar especially *Myrialepis paradoxa* and *Plectocomiopsis geminiflora* (Fig. 10). Stems of *Myrialepis paradoxa* tend to have more complete whorls of spines on their stems and lack the tattering, disintegrating ocreas that feature in young parts of *Plectocomiopsis geminiflora*. Leaflets of *Plectocomiopsis geminiflora* have conspicuous long golden bristles along the upper surface of the mid-nerve. These vegetative characters, as

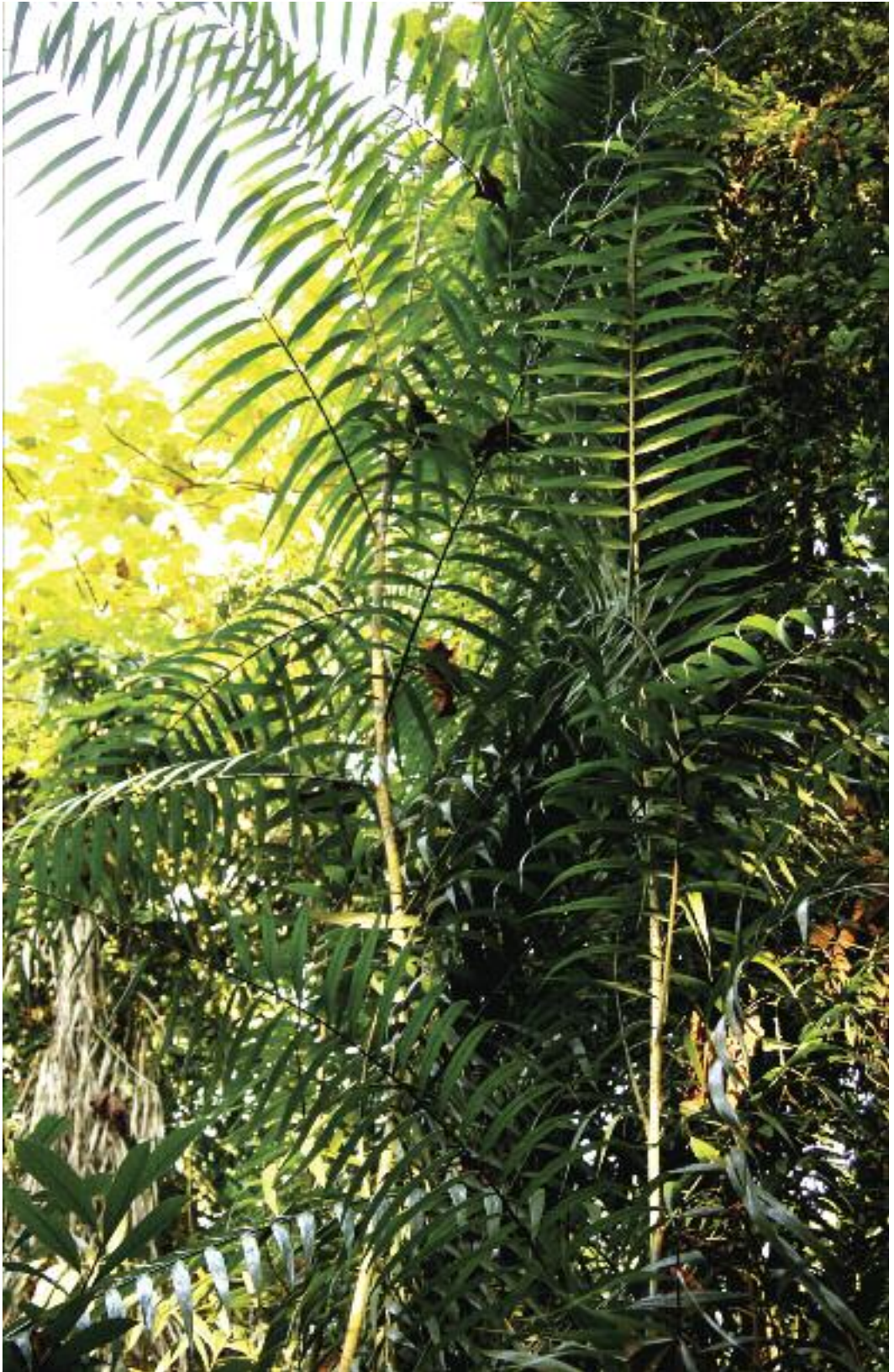
described by Dransfield (1982), easily distinguish the two species in the field.

Plectocomia elongata (Fig. 11) is a magnificent rattan in the nature reserves. It emerges through the canopy and, after flowering and fruiting, litters the forest floor with its large combs of spent infructescences. In Singapore, the rattan is best view atop the tree-top canopy walk in the forests around MacRitchie Reservoir, where the rattan regularly peeks out of the blanket of green rainforest canopy.

There are four extant species of *Korthalsia* in Singapore. Two species, *K. echinometra* (Figs. 12a) and *K. rostrata*, are ant rattans with ocreas that have developed into chambers that allow ants to inhabit. Chan et al. (2012) carried out a study of the diversity of ant species inhabiting the ocrea of the two rattan species in Singapore. They reported two different species of ants in the genera *Dolichoderus* and *Philidris* in *K. rostrata* and a single ant species of *Iridomyrmex* in different clumps of *K. echinometra*. Additionally the study also described the presence of the aphid *Cerataphis orchidearum aptera* in the ocrea of *K. echinometra*, indicating a relationship between the ant and aphid species.



9. *Calamus oxleyanus* in Bukit Timah Nature Reserve with its beautiful grouped leaflets.



10. *Plectocomiopsis geminiflora* – a recent new record for Singapore.



11. *Plectocomia elongata* – View from the Tree-Top Walk in Macritchie, a 250 m long free-standing suspension bridge that offers a bird's eye view of the forest canopy with a highest point at 25 m. Photo by Bill Baker.



12. A. *Korthalsia echinometra* – ferocious ants live within the specialized tubular ochrea. B. Ants tending to the larvae within the ochrea.

Korthalsia rigida is less easily encountered in the forest reserves but easily recognized by its robust form and lack of vicious-looking spines. *Korthalsia flagellaris* (Fig. 13) is a freshwater

swamp forest associate and is thus found in a highly endangered habitat in Singapore. This species has a very large entire leaf when it is a sapling and at this stage has been mistaken

13. The dimorphic leaves of *Korthalsia flagellaris* – Foreground: simple at the seedling stage and Background: splitting to form leaflets as it matures.





14. The common palm civet (*Paradoxurus hermaphroditus*) on *Caryota mitis*, the fruits of which, make up an important part of its diet. Photo by Tze Kwan Fung.

15. The pink-red fruits of *Licuala ferruginea*. The species epithet describes the rusty-brown hairs that cover the infructescence.





16. *Licuala ferruginea* – an acaulescent fan palm found in patches of primary rainforests within the nature reserves.

for *Johannesteijsmannia* species (Dransfield 1979). At maturity, this rattan is like the flagship of the swamp forest, as it emerges out of the canopy, with its versatile leaflets moving in the slightest wind.

Coryphoid Palms

Caryota mitis, the fishtail palm, is the only native palm that is an early secondary forest species. It is also a very common landscape palm in parks and waysides. It is ecologically significant as this medium-sized, clustering palm with a high fecundity is an important food source for the common palm civet, *Paradoxurus hermaphroditus* (Fig. 14) (Sivasothi,

pers. comm), which is Singapore's last wild native urban carnivore.

Licuala ferruginea (Figs. 15 & 16) and *L. spinosa* occupy non-overlapping habitats. The acaulescent *L. ferruginea* is found in late secondary to primary rainforests, while the multi-stemmed *L. spinosa* is found in coastal forest. Wild specimens of *L. spinosa* are less common on the mainland than on islands such as Pulau Ubin, where it can be found along trails further inland from the coastal beach areas on the island. The diminutive *Licuala triphylla* was once common in the western areas of Singapore but is now considered extinct.



17. A stand of *Nypa fruticans* in a mangrove swamp on Pulau Ubin, an offshore island northeast of the mainland. Swollen leaf bases afford stability to the palm in the soft mud of mangrove swamps.

Pholidocarpus kingianus, a large, majestic, single-stemmed fan palm that was presumed nationally extinct was rediscovered in 2011 by the National Parks Board within the Central

Catchment Nature Reserve in a degraded swamp forest, the only location where it is known to exist in Singapore (O'Dempsey & Chew 2011).

18. The infructescence of *Nypa fruticans*.





19. The inflorescence of *Nypa fruticans*. The inflorescence has a terminal head of pistillate flowers and bears lateral branches with spikes of staminate flowers.

Nypa fruticans (Figs. 17–19)

This species is known to locals mostly for its young endosperm which is candied and made into sweet meat for Malayan desserts such as *Cendol* and *Ice-Kacang*. It and some rattans are probably the only native palms with any surviving ethnobotanical use. In generations past, the leaves were used as thatch and its inflorescence stalk cut and tapped for sugar. Pulau Ubin probably has the biggest population of *Nypa* palms in Singapore. All three mangrove species can also be found at the Sungei Buloh Wetland Reserve, a protected area that serves as a good outdoor classroom for anyone keen on learning about tropical mangroves.

Conclusions

Singapore has a wide palm diversity in terms of representation at the subfamily and tribal

level. It remains to be seen if more new records and rediscoveries of native palms once considered locally extinct will be made. Who knows what palm lies undiscovered in the precious pockets of primeval forests found in this “City in a Garden”? Both *in situ* and *ex situ* conservation efforts are underway for the biodiversity in our forest reserves and we are hopeful these will be successful in increasing the numbers of individuals that are highly threatened, such as *Orania sylvicola*, *Pholidocarpus kingianus* and *Pinanga simplicifrons*.

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