

CYCADACEAE

S. Lindsay^{1,2}, D.J. Middleton^{1,2} & X.Y. Ng³

Pers., Syn. Pl. 2, fasc. 2 (1807) 630, as ‘Cycadeae’, nom. cons.; Dyer in Hooker, Fl. Brit. India 5, fasc. 15 (1888) 655; Ridley, Fl. Malay Penins. 5 (1925) 283, as ‘Cycadeae’; Smitinand, Fl. Thailand 2(2) (1972) 185; Keng, Ord. Fam. Malayan Seed Pl., ed. 3 (1983) 7; Johnson & Wilson in Kramer & Green (ed.), Fam. Gen. Vasc. Pl. 1 (1990) 370; de Laubenfels & Adema, Blumea 43 (1998) 353; Jutta, Fl. Penins. Malaysia, ser. 2, 3 (2012) 149. **Type:** *Cycas* L.

Palm-like dioecious plants mostly with relatively short trunks bearing persistent bases of fallen leaves or leaf scars, trunks rarely branched; subterranean bulbous base present or absent. **Leaves** large, mostly pinnate, more rarely bipinnate or tripinnate, clustered at stem apex; pinnae usually narrow. **Cataphylls** (reduced and modified leaves that enclose and protect pollen cones and megasporophylls when young) alternating with clusters of leaves. **Pollen cones** terminal, ovoid or cylindrical; microsporophylls numerous, spirally arranged, microsporangia (pollen sacs) many, located below widest point of microsporophyll on lower surface. **Megasporophylls** clustered at stem apex, stem apex eventually continuing to grow; ovules 1 to several, then spaced along the two margins of the megasporophyll, apex sterile. **Seeds** large.

Distribution. A family with 1 genus and c. 120 species in East Africa and Madagascar, India and Sri Lanka, South China, Taiwan, Japan and continental Southeast Asia through Malesia to northern Australia and the Pacific islands. In Singapore, 1 genus with 1 native species.

Taxonomy. Cycadaceae are one of only two families in the Cycadales which, in turn, are most closely related to Ginkgoales (with just one species) and then to the remaining orders of the gymnosperms. De Laubenfels & Adema (Blumea 43 (1998) 351–400) proposed two genera in the family based primarily on habit, but this division has not been accepted by later authors and today a single genus, *Cycas* L., is widely accepted as the sole genus in the family. Various authors have suggested infrageneric classifications (e.g., Hill, Telopea 7 (1996) 1–64; de Laubenfels & Adema, Blumea 43 (1998) 351–400), but not all of the groups recognised have been supported in molecular phylogenetic studies (e.g., Liu et al., Ann. Bot. 129 (2022) 217–230).

Addresses: ¹Singapore Botanic Gardens, National Parks Board, Singapore; ²Royal Botanic Garden Edinburgh, Scotland, U.K.; ³Native Plant Centre, National Parks Board, Singapore.

Doi: 10.26492/fos4.2026-01; 4 September 2026 (online & print).

CYCAS L.

(from a vernacular name of a palm; referring to the palm-like appearance)

Sp. Pl. 2 (1753) 1188; Dyer in Hooker, Fl. Brit. India 5, fasc. 15 (1888) 656; Ridley, Fl. Malay Penins. 5 (1925) 284; Smitinand, Fl. Thailand 2(2) (1972) 185; de Laubenfels & Adema, Blumea 43 (1998) 354; Hill & Yang, Brittonia 51 (1999) 49; Lindstrom et al., Telopea 12(1) (2008) 122; Lindstrom et al., Telopea 12(3) (2009) 387; Jutta, Fl. Penins. Malaysia, ser. 2, 3 (2012) 149. **Type:** *Cycas circinalis* L.

Dyerocycas Nakai, Ord. Fam. Trib. Gen. Sect., nov. ed. (1943) 208. **Synonym:** *Epicycas* de Laub., Blumea 43 (1998) 388, nom. illeg. superfl. **Type:** *Dyerocycas micholitzii* (Dyer) Nakai (= *Cycas micholitzii* Dyer).

Palm-like plants with stems rarely branched, sometimes somewhat decumbent; stems stout, cylindric, more or less woody, usually with persistent leaf bases. **Leaves** clustered at stem apex, large, mostly pinnate, more rarely bipinnate or tripinnate, usually arising in flushes, circinnate; petioles usually with with spines along margins; pinnae opposite, sub-opposite or alternate, straight or falcate, midrib prominent, secondary veins absent. **Cataphylls** produced in flushes, short, narrow, eventually shrivelling but persistent. **Pollen cones:** microsporophylls numerous, apices sterile, often with an apical upturned spine; microsporangia (pollen sacs) covering the lower surface from widest point of microsporophyll to base, dehiscing by slits. **Megasporophylls** spirally arranged, each spatulate, with a long narrow stalk transitioning into an almost equally narrow fertile section and terminating with a slightly wider, slightly flattened apical portion, the margins of the apical portion entire, dentate or pectinate with or without one or more well developed marginal spines; ovules 1 to few along margins of fertile portion. **Seeds** subglobose, ovoid or ellipsoid, large, buoyant in water or not, composed of a soft outer layer (sarcotesta), this fibrous or not, a hard middle layer (sclerotesta), and a soft inner layer; embryo embedded in an endosperm; cotyledons 2.

Distribution. A genus of c. 120 species in East Africa and Madagascar, India and Sri Lanka, South China, Taiwan, Japan and continental Southeast Asia through Malesia to northern Australia and the Pacific islands. In Singapore, 1 native species.

Ecology. In a wide variety of habitats, including tropical forest, grasslands, semi-arid regions, on rocky terrain and in coastal vegetation. Often in more open areas in strongly seasonal habitats and on the coast. Several species in more arid areas are adapted to withstand wildfires.

Uses. Various parts of the cycad plant contain chemicals that are harmful to human and animal health yet, with careful preparation, the young leaves, seeds and starch from the trunk can be eaten. The leaves, seeds, trunk and roots have also been used in traditional medicine.

Cycad species are particularly prized in the horticultural industry. Many species have been introduced to Singapore but the two that are most commonly grown in public spaces are *Cycas revoluta* Thunb. and *C. edentata* de Laub. (the latter native to Singapore but trade plants originate from outside of Singapore).

Taxonomy. The genus has variously been divided into several subgenera, sections and subsections (see de Laubenfels & Adema, Blumea 43 (1998) 351–400; Hill & Yang, Brittonia

51 (1999) 48–73), not all of them monophyletic (Liu et al., *Ann. Bot.* 129 (2022) 217–230), of which the sole species in Singapore belongs to *Cycas* subg. *Truncata* de Laub.

***Cycas edentata* de Laub.**

(Latin, *edentatus* = without teeth; referring to the margins of the apical part of the megasporophylls in the type specimens)

Blumea 43 (1998) 373, fig. 1; Lindstrom et al., *Telopea* 12(1) (2008) 140; Chong et al., *Checkl. Vasc. Pl. Fl. Singapore* (2009) 30, 97, 203; Lindstrom et al., *Telopea* 12(3) (2009) 405; Jutta, *Fl. Penins. Malaysia*, ser. 2, 3 (2012) 157; Lindsay et al., *Gard. Bull. Singapore* 74(Suppl. 1) (2022) 114; Lim et al., *Nat. Singapore*, Suppl. 1 (2022) 219. **Type:** *Kondo & Edaño PNH38877*, Philippines, Sulu Archipelago, Mt Cabucan, January 1957 (holotype L [L0689494]; isotypes A [A02247684], BM [BM014605210]). **Fig. 1.**

Cycas litoralis K.D.Hill, *Brittonia* 51 (1999) 70, fig. 11. **Type:** *Hill 4627*, Thailand, Narathiwat, Ao Manao Nowl, 20 April 1994 (holotype NSW [NSW845317, NSW297726 – a single specimen over two sheets]; isotypes BKF, K [K005154169], L [L.3760224], PE).

Cycas rumphii auct. non Miq.: Ridley, *J. Straits Branch Roy. Asiat. Soc.* 33 (1900) 151; Ridley, *J. Straits Branch Roy. Asiat. Soc.* 60 (1911) 67; Ridley, *Fl. Malay Penins.* 5 (1925) 284, fig. 229; Smitinand, *Fl. Thailand* 2(2) (1972) 186, fig. 13: b, fig. 14: d; Keng, *Gard. Bull. Singapore* 26(2) (1973) 234; Keng, *Concise Fl. Singapore*, vol. 1, *Gymn. Dicot.* (1990) 1, fig. 1.2; Turner, *Gard. Bull. Singapore* 45 (1993) 20; Turner, *Gard. Bull. Singapore* 47 (1997 [‘1995’]) 84.

Stems erect, sometimes decumbent, to 10 m tall, trunk 13–38 cm diam., occasionally branched. **Leaves** numerous, 60–110 per crown, 1-pinnate, imparipinnate or not, densely tomentose when very young and uncurling, hairs caducous, when fully mature 100–166(–250) cm long, to 70 cm wide, with (45–)60–80(–100) pairs of pinnae; petioles 3–4 cm diam. at expanded base, 1–2 cm diam. immediately above, 8–33(–90) cm long, bearing a row of small spines (c. 3 mm long and 1.5–2 cm apart) on each side, either along the entire length or only in the upper part, transition from spiny petiole to lamina abrupt; pinnae circinnate, sessile, subopposite, more or less evenly spaced, close, adjacent pinnae sometimes touching but not overlapping, midribs 1.5–2 cm apart, stiff and brittle, snapping when folded, linear-lanceolate, slightly to strongly falcate, (15–)20–33(–37) × 0.9–2(–2.5) cm, apex acute to acuminate, base narrowed and decurrent to rachis, margin entire, slightly inrolled, midrib strongly raised above (especially proximally, but less so in dry material), slightly raised below, glabrous, dark green and glossy above with strongly contrasting pale yellow-green midribs, similar below but matte, not glossy, glabrous. **Cataphylls** to 12 cm long, to 2.5 cm wide, tomentose below, hairs brown, tortuous, glabrous above. **Pollen cones** solitary, narrowly ovoid, ellipsoid or cylindrical, 30–60 × 11–17 cm when mature; peduncle thick, 4–10 cm long; microsporophylls numerous, in whorls around a thick, to 7 cm diam., central column, coriaceous, spatulate, 30–45 × 14–18(–23) mm, lower surface from base to widest point completely covered with microsporangia (pollen sacs), the corresponding upper surface glabrous, beyond the widest point densely tomentose (both surfaces, hairs brown, tortuous) and abruptly narrowed to a sharply upturned, glabrous, terminal spine 5–15(–25) mm long. **Megasporophylls** initially tightly clustered around the stem apex, the rosette loosening as megasporophylls grow, erect at first, becoming pendent with

the weight of maturing seeds, very narrowly spatulate, 24–40(–50) cm long, each consisting of a thick, narrow (c. 1.5 cm wide), flexible, stalk which is more or less flat above and sharply keeled below, bearing 1–6(–8) ovules/seeds on the margin in the upper part, with a much shorter but slightly wider, (1.6–)2.4–3 cm wide, sterile apical section triangular to rhomboid, margin of apical section entire to irregularly dentate, sometimes with up to 8 short (2–7(–13) mm long) spines each side, usually terminated by a long apical spine (2–)2.5–4.8 cm long, terminal spine occasionally absent, and frequently damaged and incomplete when present, lower surface of megasporophyll densely tomentose, hairs brown, tortuous. **Seeds** subglobose, ovoid or ellipsoid, slightly flattened, minutely apiculate, surface smooth and glabrous, green and shiny when young, ripening orange to reddish brown, 3.9–5.3(–8) cm long, 3.3–4.4(–5) cm diam., on drying (and shrinkage of the fleshy sarcotesta) becoming slightly more flattened but not developing a distinct apical crest; buoyant in water.

Distribution. Andaman Islands, southern Myanmar, southern Thailand, southern Vietnam, Peninsular Malaysia, Sumatra, Java, northern Borneo and the Philippines. In Singapore, there are historical collections from Changi (*Ridley 3940*, 1892, SING [SING0004702]; *Ridley 4408*, 1892, SING [SING0004701]), Tampines (*Ridley s.n.*, 1894, SING [SING0004703]) and Pulau Tekong. More recent collections are from Pulau Semakau (*Turner et al. SEM B14*, 28 Jan 1993, SING [SING0350267, SING0350268, SING0350269]), the Western Catchment (*Gwee et al. WC104*, 18 May 2004, SING [SING0054983]) and Pulau Tekong (*Ng & Lim SING2019-297*, 11 Apr 2019, SING [SING0268535]).

Ecology. In coastal vegetation. Lim et al. (Nat. Singapore, Suppl. 1 (2022) 220, 223, 228) note that both the pollen cone and megasporophylls emit a musky scent at maturity, presumably to attract insects. Terry et al. (in Stevenson et al. (ed.), Mem. New York Bot. Gard. 106 (2012) 352–394) report that cycads are pollinated by small beetles. Beetle visitation has not been reported in Singapore but termites have been found to be frequent visitors. It is unknown whether the termites effect pollination or are pollen predators. De Laubenfels & Adema (*Blumea* 43 (1998) 368, 373) and Lim et al. (Nat. Singapore, Suppl. 1 (2022) 228) also note that the seeds are buoyant in water and have a long viability and pre-germination latency. This would appear to be an adaptation to dispersal over long distances on ocean currents. They also note that the sarcotesta is attractive to mammals which points to an additional dispersal mechanism although perhaps not in Singapore where all the known wild populations are near the sea and there is no evidence of seed dispersal or natural establishment inland.

Cycas edentata is a host plant for the native cycad blue butterfly (*Luthrodes pandava* (Horsfield, 1829)). The caterpillars feed only on young tender leaves but can do extensive damage.

Conservation assessment. Globally, Endangered (EN A2acde+4acde) (IUCN Red List, 2026). Listed as Critically Endangered by Tan et al. (in Davison et al., Singapore Red Data Book, ed. 2 (2009) 213) and by Chong et al. (Checkl. Vasc. Pl. Fl. Singapore (2009) 30, 97, 203) yet reported as extinct in Singapore by Jutta (Fl. Penins. Malaysia, ser. 2, 3 (2012) 157). Reassessed and reinstated as Critically Endangered (CR/D) by Middleton et al. (in Davison et al., Singapore Red Data Book, ed. 3 (2024) 31, 465).



Figure 1. *Cycas edentata* de Laub. **A.** Habit. **B.** Ovules on margins of erect megasporophylls. **C.** Young seeds on margins of erect megasporophylls. **D.** Older, heavier seeds on pendent megasporophylls. Inset: Longitudinal section of seed. **E.** Pollen cone. **F.** Cross-section of pollen cone showing lower surfaces of microsporophylls covered in pollen sacs. (A, C, D inset, E & F from Singapore, Pulau Tekong, Ng & Lim SING2019-297; B & D from a cultivated specimen at the National University of Singapore. Photos: A, C, D inset, E & F, X.Y. Ng; B & D, W.F. Ang).

Uses. A striking ornamental plant that, at least in Singapore, grows well even when planted in non-coastal locations (provided that the young leaves are protected from the cycad blue butterfly).

Vernacular names. *Kwale pahang, paku raja* (Flora & Fauna Web, 2026).

Taxonomy. *Cycas edentata* was only described as a distinct species in 1998 (de Laubenfels & Adema, Blumea 43 (1998) 373, fig. 1). Prior to that, most plants now recognised as *Cycas edentata* were identified as *C. rumphii*. *Cycas rumphii* was a much confused species concept that was greatly clarified by de Laubenfels & Adema (Blumea 43 (1998) 368, 373), Lindstrom (Brittonia 54 (2003 [‘2002’]) 305–309) and Lindstrom et al. (Telopea 12(3) (2009) 386, 401, 405, fig. 4: b, c, fig. 5). *Cycas edentata* and *C. rumphii* are now considered to have distinct and (largely) non-overlapping distributions with *C. rumphii* only found in northeastern Java, southern Borneo, Christmas Island, Sulawesi, Moluccas and New Guinea (Lindstrom et al. (Telopea 12(3) (2009) 403). *Cycas edentata* differs from *C. rumphii* by the dried seed lacking an apical crest (prominent in *C. rumphii*), the apical spines of the microsporophylls being (almost always) more than 5 mm long (see Lindstrom et al., Telopea 12(3) (2009) fig. 5) and the apical spines of the megasporophylls being (almost always) more than 25 mm long.

The epithet ‘*edentata*’ (meaning without teeth) suggests the megasporophylls of *Cycas edentata* lack teeth. However, the text of the protologue allows for the margins of the megasporophylls to be ‘entire, straight or undulating, rarely with a few weak teeth’. In the literature, the distinction between *Cycas edentata* and *C. rumphii* based on the lack or presence of lateral teeth or spines is sometimes confused and/or contradictory. In Singapore, megasporophylls with entire margins, irregularly dentate margins and weakly spiny margins can be found on the same plant at the same time. Jutta (Fl. Penins. Malaysia, ser. 2, 3 (2012) 158) doesn’t mention megasporophyll variation on individual plants in Peninsular Malaysia but does note that megasporophylls with entire to distinctly dentate margins can be found within the same population. Jutta also notes that some seeds of *Cycas edentata* in Peninsular Malaysia are crested, thereby blurring the distinction between *C. edentata* and *C. rumphii* and suggesting that further studies on species delimitation are necessary.

Notes. Several mature plants that had been threatened by habitat destruction in recent years have been rescued and placed in the care of the Native Plant Centre at Pasir Panjang Nursery. Regular monitoring of their reproductive cycles, collection and banking of pollen, hand-pollination of receptive ovules and their subsequent protection from predators, has resulted in the production of large numbers of viable seeds. It has also been possible to more closely study the pollen cone and megasporophyll development in these plants. Lim et al. (Nat. Singapore, Suppl. 1 (2022) 219–230) found that megasporophylls continued to lengthen for c. 1–3 months after their ovules had been fertilised; that it took c. 12–16 months for fertilised ovules to develop into fully mature seeds, each weighing up to 57 g; that individual plants produced c. 100–270 seeds following hand-pollination; that seeds took 6 to 18 months to germinate; and that a 60 cm long pollen cone weighed 3.5 kg and produced c. 140 g of pollen. The same cone was found to be composed of c. 2000 microsporophylls. Seeds from the rescued plants are being used to raise new plants for (re)introduction to suitable sites (to date, Kranji Marshes, Pulau Ubin, Labrador Nature Park and Big Sister’s Island).