

## CYCADACEAE

苏铁科 su tie ke

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Trees or shrubs evergreen, dioecious, mostly palmlike; trunk columnar, sometimes dichotomously branched at apex, rarely ovoid-bulbous and subterranean, clothed with bases of fallen leaves; bark often thickened and roughened. Leaves borne at apex of trunk, 1(–3)-pinnately compound, spirally arranged; new leaves erect (or somewhat inflexed and appearing coiled in *C. multipinnata* group), with circinnate leaflets; petiole with spines representing (reduced basal leaflets), rarely unarmed, base swollen and hairy; leaflets numerous, alternate to subopposite, dichotomously branched in a few species, midvein present, margin usually entire. Cataphylls prominent, alternate with leaves, hairy, apex often rigid and pungent. Pollen cones borne at apex of trunk, cylindric or fusiform; microsporophylls numerous, scalelike, spirally and tightly arranged along axis of cone, with numerous microsporangia in groups abaxially; pollen tubes producing 2 motile sperm cells. Megasporophylls several to numerous, somewhat leaflike, alternating with flushes of leaves, arranged in a loose, “conelike” crown surrounding apex of trunk, each with a linear fertile stalk and an apical, pinnatifid or subentire sterile blade; ovules (1 or)2–5 on each side of stalk. Seeds drupelike, somewhat compressed; seed coat 3-layered, consisting of colored sarcotesta, woody sclerotesta, and membranous endotesta. Cotyledons 2, united at base. Germination hypogeal, cryptocotylar.  $2n = 22^*$ .

One genus and ca. 60 species: E Africa (including Madagascar), E and S Asia, N Australia, Pacific Islands; 16 species (eight endemic) in China. Ornamental species include *Cycas revoluta*, which is widely cultivated worldwide. Other species (e.g., *C. circinalis* Linnaeus, *C. media* R. Brown, *C. pectinata*, *C. rumphii* Miquel, *C. taitungensis*, and *C. thouarsii* R. Brown) have excellent ornamental qualities. The stem starch, “sago” (not to be confused with the true sago as obtained from palms of the genus *Metroxylon* Rottboell), is edible and is used in packing brewers’ yeast after the removal of cycasins which are highly toxic and carcinogenic. A paste of *Cycas* seeds and coconut oil is used for the treatment of skin complaints, wounds, ulcers, sores, and boils.

Fu Shu-hsia, Cheng Wan-chün, Fu Li-kuo & Chen Chia-jui. 1978. Cycadaceae. In: Cheng Wan-chün & Fu Li-kuo, eds., Fl. Reipubl. Popularis Sin. 7: 4–17.

### 1. CYCAS Linnaeus, Sp. Pl. 2: 1188. 1753.

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*Epicycas* de Laubenfels.

Morphological characters and geographical distribution are the same as those for the family.

The angle of insertion of the leaflets to the rachis is that formed between the leaflet and the longitudinal axis of the rachis. Features of leaflets in 1-pinnate leaved species refer to those of the middle part of the leaf blade.

1a. Leaves 2- or 3-pinnate; leaflets dichotomously forked.

2a. Leaves 2-pinnate; leaflets dichotomously 1(–3)-forked into linear, often irregular segments (ultimate leaflets),

each 10–38 cm with apex attenuate to long acuminate ..... 3. *C. micholitzii*

2b. Leaves 3-pinnate; secondary leaflets dichotomously (2 or)3–5-forked into linear, regular segments.

3a. Leaves 1(or 2), to 7 m; segments obovate-linear, apex shortly acuminate to caudate; sterile blade of megasporophylls with 25–35 subulate lobes ..... 1. *C. multipinnata*

3b. Leaves (3–)5–11(–15), to 2.7 m; segments linear, apex long attenuate or long acuminate; sterile blade of megasporophylls with 39–51 filiform lobes ..... 2. *C. debaoensis*

1b. Leaves 1-pinnate; leaflets simple.

4a. Leaves strongly “V”-shaped in cross section, longitudinally recurved; margin of leaflets revolute (slightly recurved in *C. taitungensis*).

5a. Trunk not tomentose at apex; bark pale gray, smooth toward base of trunk; mature leaflets glaucous ..... 15. *C. hongheensis*

5b. Trunk densely tomentose at apex; bark black, scaly; mature leaflets not glaucous.

6a. Leaflets strongly recurved along margin; sterile blade of megasporophylls ovate to narrowly so, deeply lacinate; sclerotesta of seed not grooved on sides ..... 6. *C. revoluta*

6b. Leaflets flat or slightly recurved along margin; sterile blade of megasporophyll suborbicular or rhombic-orbicular, pectinate; sclerotesta of seed with 2 or 3 irregular grooves on each side 7. *C. taitungensis*

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- 4b. Leaves flat to inconspicuously “V”-shaped in cross section, longitudinally flat; margin of leaflets not revolute (except in *C. ferruginea*).
- 7a. Trunk subterranean, base not swollen; median leaflets (12–)18–25 mm wide, margin often undulate; median microsporophylls blunt.
- 8a. Petioles green in 1st year; megasporophylls 5–15(–20), loosely grouped, sterile blade divided into 15–25 lobes ..... 4. *C. balansae*
- 8b. Petioles blue in 1st year, later green; megasporophylls 25–50, densely grouped, divided into 33–45 lobes ..... 5. *C. segmentifida*
- 7b. Trunk not subterranean (or, if so, then base swollen); median leaflets 6–11(–14) mm wide, margin flat (revolute in *C. ferruginea*); median microsporophylls spinose.
- 9a. Leaves (0.7–)1–3 m × 30–60 cm; terminal lobe of sterile blade of megasporophyll usually flattened.
- 10a. Trunk inflated; bark white-gray, nearly smooth toward base of trunk; median leaflets often less than 10 mm wide; petiole densely spinose from base upward; seeds 3.5–4.5 cm 9. *C. hainanensis*
- 10b. Trunk cylindrical; bark dark, scaly; median leaflets often more than 11 mm wide; petiole without spines or with sparse spines near base; seeds 2.5–3 cm.
- 11a. Leaflets longitudinally inserted at 55–75° to rachis; apex of cataphylls with hard point; sterile blade of megasporophyll rhombic-ovate; sclerotesta of seed finely verrucose ..... 10. *C. taiwaniana*
- 11b. Leaflets longitudinally inserted at ca. 50° to rachis; apex of cataphylls with soft point; sterile blade of megasporophyll broadly ovate, obovate, or suborbicular; sclerotesta of seed smooth ..... 11. *C. szechuanensis*
- 9b. Leaves 0.5–1(–1.3) m × (12–)20–30(–40) cm; terminal lobe of sterile blade of megasporophyll subulate, not flattened.
- 12a. Trunk cylindrical, 1–7 m; bark white-gray, gray, or brown, scaly or raised; pollen cones (25–)30–45 × 8–15 cm, microsporophylls 3.5–6 cm; megasporophylls 13–20 cm.
- 13a. Trunk often dichotomously branched toward apex, to 16 m, apex not tomentose; bark gray or white-gray, smooth toward base of trunk; leaflets with midvein sulcate adaxially and margin revolute to slightly recurved; seeds 4.5–6 × 4–4.7 cm ..... 16. *C. pectinata*
- 13b. Trunk simple, to 2(–3) m, apex densely tomentose; bark brown to dark gray, scaly; leaflets with midvein never sulcate adaxially and margin flat to slightly recurved; seeds 2.5–3.5 × 2.2–3 cm ..... 8. *C. panzhihuaensis*
- 12b. Trunk subterranean, base swollen; bark gray, smooth; pollen cones 20–30 × 6–8 cm, microsporophylls 1.5–3 cm; megasporophylls 8–14 cm.
- 14a. Leaflets longitudinally inserted at 55–65° to rachis; petiole with 9–16 spines along each side throughout length (SW Hainan) ..... 14. *C. changjiangensis*
- 14b. Leaflets longitudinally inserted at ca. 90° to rachis; petiole with 0–8(or more) spines along each side often only in apical part (W Guangxi).
- 15a. Young leaves densely rusty brown tomentose abaxially; leaflets not overlapping, light green at maturity, 20–30 cm × 5–12 mm, base attenuate, margin strongly revolute ..... 12. *C. ferruginea*
- 15b. Young leaves sparsely red-brown tomentose abaxially; leaflets often overlapping,

dark green at maturity, 10–18 cm × 14–18 mm, base usually truncate, margin flat  
or only slightly revolute ..... 13. *C. miquelii*

**1. *Cycas multipinnata*** C. J. Chen & S. Y. Yang, Acta Phytotax. Sin. 32: 239. 1994.

多歧苏铁 duo qi su tie

*Cycas longipetiolula* D. Y. Wang; *Epicycas multipinnata* (C. J. Chen & S. Y. Yang) de Laubenfels. Trunk almost subterranean, to 40 × 20 cm above ground; bark brown-gray, scaly. Leaves 1(or 2), 3-pinnate, trullate in outline, flat, 3–7 m × 60–100 cm; petiole subterete, 1.5–2.5 m × 3–6 cm; spines 30–50 along each side, 3–6 cm apart, compressed conical, 3–5 mm; primary leaflets in 12–22 pairs, longitudinally inserted at 60–90° to primary rachis, lanceolate, slightly “V”-shaped in cross section at 100–130° to rachis; middle leaflets largest, 35–60 × 15–20 cm; basal and apical leaflets gradually shorter, 20–40 × 10–15 cm; secondary leaflets flabellate or obtriangular, dichotomously (2 or) 3–5-forked, 20–22 × 5–15 cm, with petiolule 0.5–5 cm; segments (ultimate leaflets) obovate-linear, regular, 7–12 × 1–2 cm, papery, midvein slightly elevated on both surfaces, base decurrent, glabrous, margin entire or somewhat wavy, apex shortly acuminate to caudate. Pollen cones fusiform-cylindric, 15–23 × 4–6 cm; microsporophylls 1.2–2 cm × 8–10 mm, tomentose, apex acute. Megasporophylls 8–12 cm, brown tomentose, glabrescent; stalk ca. 4 cm; sterile blade triangular-ovate, 4–7 × 3–6.5 cm, deeply divided into 25–35 subulate lobes 1–3.5 cm; ovules 3–5 on each side of stalk. Seeds 6–10, greenish to yellowish, obovoid, slightly compressed, 2.5–3.2 × 2.3–2.8 cm; sclerotesta finely verrucose, apex mucronate. Pollination Apr–May, seed maturity Oct–Nov.

• Red soil over granite or limestone in somewhat shaded monsoon forests along valleys; 200–1000 m. SE Yunnan (Gejiu Shi, Hekou Yaozu Zizhixian, Mengzi Xian, Pingbian Miaozu Zizhixian). This and *Cycas debaoensis*, with their 3-pinnate leaves, are the most distinct of all extant cycads. *Cycas multipinnata* is also one of the most endangered cycads in China, mainly as a result of over collection by commercial dealers and habitat damage as forests are opened up for farmland. If conservation measures are not taken immediately, the species will most likely become extinct in the wild within the next ten years.

**2. *Cycas debaoensis*** Y. C. Zhong & C. J. Chen, Acta Phytotax. Sin. 35: 571. 1997.

德保苏铁 de bao su tie

Trunk almost subterranean, to 40(–70) × 25(–40) cm above ground, sometimes clumped; bark brown-gray, scaly toward apex of trunk, subsmooth toward base. Leaves (3–)5–11(–15), 3-pinnate, ovate in outline, ± openly “V”-shaped in cross section at 110–150° between leaflets, 1.3–2.7 × 0.5–1.5 m; petiole obovate-

orbicular in cross section, 0.6–1.3 m × 1.5–3 cm, tomentose when young, later glabrescent except at base, spiny except at base; spines 20–55 along adaxial part of each side, 1–4.5 cm apart, conical, 3–4 mm; primary leaflets in 6–14 pairs, 3–12 cm apart, middle leaflets subopposite, longest, 40–70 × 20–27 cm, “V”-shaped in cross section at 70–90° between secondary leaflets, basal and apical leaflets alternate, gradually smaller toward base and apex of leaf blade, 17–50 × 10–23 cm; secondary leaflets in 3–5 pairs, ovate to obtriangular, dichotomously 2- or 3-forked, 12–25 × 4–15 cm, with petiolule 0.5–2 cm; segments (ultimate leaflets) 3–5, green and shiny above, light green below, linear, 10–22(–28) × 0.8–1.5 cm, thickly papery, glabrous, midvein raised on both surfaces, base decurrent, margin flat or somewhat undulate, apex long attenuate or long acuminate. Cataphylls triangular, 6–8 × 2.5–3 cm, densely brown tomentose, apex acuminate, somewhat soft. Pollen cones ovoid and brown tomentose initially, fusiform-cylindric and glabrescent at maturity, 13–25 × 4–9 cm; microsporophylls narrowly cuneate, 3–3.5 × 1.2–1.6 cm, apical sterile part semiorbicular, slightly revolute, apex broadly rounded with short, upcurved mucro. Megasporophylls 30–50, laxly grouped, 15–20 cm, yellow-brown tomentose, forming an oblate group 18–25 cm in diam.; stalk 9–12 cm; sterile blade green, subcordate or subflabellate, 6–9 × 5–10 cm, glabrescent, deeply divided into 39–51 filiform lobes 3–6 cm, terminal lobe 4–5 cm; ovules 2 or 3 on each side of stalk, glabrous. Seeds 3 or 4, green to yellowish and brown, subglobose or obovoid-globose, slightly compressed, 3–3.5 × 2.5–3 cm, apex mucronate; sclerotesta finely verrucose. Pollination Mar–Apr, seed maturity Nov.

• Thickets and sparse forests of small trees on dry, sunny, open slopes of limestone hills; 700–1000 m. NW Guangxi (Debao Xian). This recently described species is most similar to *Cycas multipinnata* in its 3-pinnate leaf structure, but differs in its more numerous and much shorter leaves, with segments long attenuate or long acuminate at the apex; its megasporophylls, with subcordate or subflabellate, wider sterile blades divided into 39–51 filiform lobes; and its dry and sunny habitat. Unfortunately, this cycad is one of the most endangered in China, restricted to a very small area (ca. 20 ha) in a village, and will become extinct in the wild within the next ten years unless conservation measures are implemented.

**3. *Cycas micholitzii*** Dyer, Gard. Chron., ser. 3, 38: 142. 1905.  
叉叶苏铁 cha ye su tie

?*Cycas micholitzii* f. *distichus* Z. T. Guan; ?*C. micholitzii* f. *stonensis* (S. L. Liang) Z. T. Guan; ?*C. micholitzii* var. *stonensis* S. L. Liang; *C. multifrondis* D. Y. Wang; *C. rumphii* Miquel var. *bifida* Dyer; *Epicycas micholitzii* (Dyer) de Laubenfels.

Trunk almost subterranean, to 60 × 20 cm above ground, base swollen; bark dark gray, scaly, except at base of trunk where nearly smooth. Leaves 3–8, 2-pinnate, flat, 2–3(–4) m × 40–60(–80) cm; petiole 0.5–1(–2) m, with sparse, short spines; leaf blade glaucous when young, flat; leaflets dichotomously 1(–3)-forked into 1 or 2(or 3) segments; segments linear, often irregular, 10–38 × 1.5–3 cm, papery, base constricted into a short petiolule 0.5–5 cm, decurrent, margin somewhat undulate, apex attenuate to long acuminate. Cataphylls broadly deltoid, 3–4 × 4–5 cm, densely brown velutinous. Pollen cones fusiform-cylindric, 15–23 × 4–6 cm; microsporophylls 1.2–2 cm × 8–10 mm, tomentose, apex acute. Megasporophylls 8–12 cm, brown tomentose, glabrescent; stalk ca. 4 cm; sterile blade obovate, ca. 4 × 3 cm, deeply divided into 13–17 subulate lobes 1–2 cm; ovules 1 or 2 on each side of stalk. Seeds 2–4, greenish to yellowish, obovoid, slightly compressed, 2.3–2.8 × 1.8–2.4 cm; sclerotesta finely verrucose, apex mucronate. Pollination Apr–May, seed maturity Oct–Nov.

Semishaded thickets, broad-leaved monsoon forests; 130–600 m. W Guangxi, SE Yunnan [Laos, Vietnam].

Endangered in China as a result of over collection by commercial dealers and habitat destruction.

**4. *Cycas balansae* Warburg, *Monsunia* 1: 179. 1900.**

宽叶苏铁 *kuan ye su tie*

*Cycas chevalieri* Leandri; ?*C. micholitzii* Dyer var. *simplicipinna* Smitinand; *C. palmatifida* Hung T. Chang & al.; ?*C. parvula* S. L. Yang ex D. Y. Wang; *C. shiwandashanica* Hung T. Chang & Y. C. Zhong; *C. siamensis* Miquel subsp. *balansae* (Warburg) Schuster; ?*C. simplicipinna* (Smitinand) K. D. Hill; ?*C. tanqingii* D. Y. Wang.

Trunk subterranean, to 40 × 35 cm above ground; bark dark brown, densely scaly. Leaves 5–20(–30), 1-pinnate, 1.5–3 m × 40–60 cm; petiole green in 1st year, 20–70 cm, subterete, with 10–25 spines 3–8 mm along each side, 2–6 cm apart; leaf blade oblong, flat; leaflets in 20–75 pairs, longitudinally inserted 1–3 cm apart at 60–100° to rachis, straight, 20–38 × (1.2–)1.8–2.5 cm, papery, base constricted into a very short petiolule, margin flat or somewhat undulate, apex long acuminate. Cataphylls triangular, 4–6 × 1.2–1.5 cm, brown tomentose. Pollen cones subcylindric, 15–25 × 4–7 cm; microsporophylls broadly cuneate, 1.4–1.7 cm × 7–10 mm, pale brown tomentose abaxially, apex of median microsporophylls shortly acute, blunt. Megasporophylls 5–15(–20), loosely grouped, 9–13 cm, pale brown tomentose, glabrescent; stalk 5–7 cm; sterile blade broadly ovate, subcordate, or rarely obovate, 3.5–5.5 × 2.5–5 cm, deeply divided into 15–25 subulate, pointed lobes 2–3.5 cm, terminal lobe somewhat flattened, 2.5–4 cm; ovules 2 or 3 on each side of distal

part of stalk, glabrous. Seeds often 2, yellowish when fresh, brown when dry, broadly ovoid or ellipsoid, 1.8–2.7 × 1.5–2.5 cm; sclerotesta smooth. Pollination Mar–May, seed maturity Sep–Nov.

Lateritic soil in monsoon forests, deep sand on limestone-derived soil in forests; 100–800 m. S Guangxi (Fangcheng Gezu Zizhixian), S Yunnan [Laos, Myanmar, Thailand, Vietnam].

There are taxonomic problems with the species delimitation of *Cycas balansae*. For example, *C. simplicipinna* and the recently described *C. parvula* and *C. tanqingii*, here tentatively placed in synonymy, may merit recognition as distinct species. However, a meaningful evaluation cannot be made until more material has been studied, particularly of fertile specimens. Chinese plants of *C. balansae* have been misidentified as *C. siamensis* Miquel (e.g., in FRPS). The latter species occurs only in Cambodia, Laos, Malaysia, Myanmar, Thailand, and Vietnam.

**5. *Cycas segmentifida* D. Y. Wang & C. Y. Deng, *Encephalartos* 43: 11. 1995.**

叉孢苏铁 *cha bao su tie*

*Cycas acuminatissima* Hung T. Chang & al.; *C. longiconifera* Hung T. Chang & al.; *C. longlinensis* Hung T. Chang & Y. C. Zhong; *C. multifida* Hung T. Chang & Y. C. Zhong; *C. xilingensis* Hung T. Chang & Y. C. Zhong.

Trunk subterranean, to 70 × 70 cm above ground; bark dark brown, densely scaly. Leaves 15–25, 1-pinnate, 2–3.3 m × 45–60 cm; petiole blue in 1st year, later green, 0.6–1.5 m, subterete, with 25–55 spines (1–)2–3.5 mm along each side, 1–2.5 cm apart; leaf blade oblong, flat, pale brown tomentose when young; leaflets in 55–110 pairs, longitudinally inserted 1–1.8 cm apart at 75–90° to rachis, straight, 21–40 × 1.2–1.8 cm, leathery, glabrous abaxially, midvein raised on both surfaces only when fresh, flat abaxially when dry, base decurrent, margin flat or somewhat undulate, apex attenuate, pungent. Cataphylls triangular, 7–9 × 1.5–2.5 cm, densely pale brown tomentose, apex long, somewhat soft. Pollen cones yellow, narrowly ellipsoid-cylindric, 30–60 × 5–12 cm; microsporophylls narrowly cuneate, 2–2.5 × 1–1.2 cm, apex with short, upcurved mucro or nearly blunt. Megasporophylls 25–50, densely grouped, 10–16(–20) cm, pale brown tomentose; stalk 6–9(–13) cm, yellowish brown tomentose; sterile blade ovate, broadly ovate, or cordate-ovate, 5–9 × 4–8(–11) cm, margin glabrescent and pectinate, with 33–45 sometimes forked lobes 1.5–7 cm, terminal lobe subulate to rhombic-lanceolate, 2–7 cm × 2–8 mm, margin usually irregularly serrulate; ovules (1 or)2 or 3 on each side of distal part of stalk, glabrous. Seeds (2 or)3–5, pale yellowish, globose or broadly obovoid, slightly compressed, 2.8–3.5 × 2.6–3 cm, base contracted into point; sclerotesta finely verrucose. Pollination Mar–Jun, seed maturity Nov–Dec.

• Lateritic soil derived from sandstone in semishade of broad-leaved or mixed forests; 600–900 m. S Guizhou, W Guangxi, SE Yunnan (Funing Xian).

Differs from *Cycas szechuanensis* in its subterranean trunk, blue young petioles, and wider leaflets. As defined here, *C. segmentifida* is close to *C. balansae*, but is a wide-ranging, more northern species, differing in its blue young petioles, with much shorter spines, and its more numerous megasporophylls (30–50 together), with more lobes on the sterile blade.

**6. *Cycas revoluta*** Thunberg, Verh. Holl. Maatsch. Weetensch. Haarlem 20(2): 424, 426–427. 1782.

苏铁 su tie

Trunk to 3(–8) m × 45(–95) cm, base and sometimes distal part with numerous adventitious lateral branches or bulbils, apex tomentose; bark gray-black, scaly. Leaves 40–100 or more, 1-pinnate, 0.7–1.4(–1.8) m × 20–25(–28) cm; petiole subtetragonal in cross section, 10–20 cm, with 6–18 spines along each side; leaf blade oblong- or elliptic-lanceolate, strongly “V”-shaped in cross section, recurved, brown tomentose when young; leaflets in 60–150 pairs, horizontally inserted at ca. 45° above rachis, not glaucous when mature, straight to subfalcate, 10–20 cm × 4–7 mm, leathery, sparsely pubescent abaxially, base decurrent, margin strongly recurved, apex acuminate, pungent. Cataphylls triangular, 4–5 × 1.5–2.3 cm, densely brown tomentose, apex acuminate. Pollen cones pale yellow, ovoid-cylindric, 30–60 × 8–15 cm; microsporophylls narrowly cuneate, 3.5–6 × 1.7–2.5 cm, apex rounded-truncate, cuspidate. Megasporophylls yellow to pale brown, 14–22 cm, densely tomentose; stalk 7–12 cm; sterile blade ovate to narrowly so, 6–11 × 4–7 cm, deeply lacinate, with 21–35 lobes 1–3 cm; ovules 2 or 3 on each side of stalk, densely pale brown tomentose. Seeds 2(–5), orange to red, obovoid or ellipsoid, somewhat compressed, (3–)4–5 × 2.5–3.5 cm, sparsely hairy; sclerotesta not grooved on sides. Pollination May–Jul, seed maturity Sep–Oct.

Thickets on hillsides on islands, sparse forests on mainland; 100–500 m. Fujian (Lianjiang Xian, Ningde Xian, and some islands) [S Japan (Kyushu, Ryukyu Islands)].

A vulnerable, if not endangered, species in China. Its formerly wide distribution in E Fujian has now been severely reduced as a result of over collection by commercial dealers and habitat destruction. It was sporadically distributed in Fujian in the 1960s, but it is now uncertain that any wild populations still exist. *Cycas revoluta* is the most commonly cultivated cycad because of its ornamental appearance, hardiness, and adaptability.

**7. *Cycas taitungensis*** C. F. Shen & al., Bot. Bull. Acad. Sin. 35: 135. 1994.

台东苏铁 tai dong su tie

Trunk sometimes branched, to 5 m × 45 cm, apex very tomentose; bark black, scaly. Leaves to 50 or more, 1-pinnate, (1.1–)1.3–1.6(–2) m × 20–30(–40) cm; petiole (10–)15–25 (–30) cm, subtetragonal in cross section, with 7–14 spines along each side; leaf blade oblong, strongly “V”-shaped in cross section, recurved, densely orange-brown tomentose when young; leaflets in 130–200 pairs, horizontally inserted at 55–65° above rachis, straight to subfalcate, not glaucous when mature, 14–20

cm × 5–8 mm, leathery, sparsely pubescent abaxially, base decurrent, margin flat or slightly recurved, apex attenuate, pungent. Cataphylls triangular, 4–7 × 1.7–2.5 cm, densely pale brown tomentose, apex pungent. Pollen cones ovoid-cylindric, 45–55 × 8–13 cm; microsporophylls narrowly obtriangular, 3.5–4.5 × 1.1–1.5 cm, apex cuspidate. Megasporophylls bright orange-red, spadellike, 15–28 cm, pale brown tomentose, glabrescent; stalk 8–17 cm; sterile blade suborbicular or rhombic-orbicular, 7–14 × 6–11 cm, pectinate, with 29–39 lobes 2–4.5 cm; ovules 2(or 3) on each side of stalk, densely pale brown tomentose. Seeds 2–6, orange-red, narrowly obovoid or subellipsoid, 4–5 × 2.5–3.3 cm, often with remnant hairs; sclerotesta with 2 or 3 irregular grooves on each side. Pollination Apr–Jun, seed maturity Sep–Oct.

• Mixed, sparse forests in exposed sites on rocky and steep slopes or well-drained gravel; (300–)400–800(–1000) m. Taiwan (Taidong Xian).

Plants now treated as *Cycas taitungensis* were formerly misidentified as *C. taiwaniana*, a species occurring in Guangdong, E Guangxi, SW Hunan, SE Yunnan, and possibly Vietnam.

**8. *Cycas panzhihuaensis*** L. Zhou & S. Y. Yang in L. Zhou & al., Acta Phytotax. Sin. 19: 335. 1981.

攀枝花苏铁 pan zhi hua su tie

*Cycas baguanheensis* L. K. Fu & S. Z. Cheng.

Trunk cylindric, simple, to 2(–3) m × 25(–30) cm, apex densely tomentose; bark brown to dark gray, scaly. Leaves 30–60(–80), 1-pinnate, 0.7–1.3 m × 18–25 cm; petiole subrhombic in cross section, 7–20 cm, with 5–13 spines along each side of apical part, base densely brown tomentose; leaf blade oblong, flat to irregularly and slightly “V”-shaped in cross section, brown tomentose when young; leaflets in 70–120 pairs, longitudinally inserted at 50–60° to rachis, straight to slightly falcate, 12–20 cm × 6–7 mm, leathery, glabrous, midvein never sulcate adaxially, base decurrent, margin flat or slightly recurved, apex acuminate, pungent. Cataphylls triangular-lanceolate, 6–9 × 2–2.5 cm, densely brown tomentose. Pollen cones fusiform- or ovoid-cylindric, 25–45 × 8–12 cm; microsporophylls narrowly cuneate, 4–6 × 1.8–2 cm, apex broadly rounded, shortly cuspidate. Megasporophylls more than 30, tightly grouped, 15–20 cm, densely brown tomentose; stalk 8–12 cm; sterile blade rhombic or rhombic-ovate, 8–10 × 4–6 cm, margin glabrescent and pectinate, with 23–41 subulate lobes 1–3 cm, terminal lobe subulate, longer than lateral lobes; ovules 2 or 3 on each side of distal part of stalk, glabrous. Seeds 2–4, bright orange-red when mature, globose or obovoid-globose, slightly compressed, 2.5–3.5 × 2.2–3 cm, apex shortly mucronate; sclerotesta smooth, shortly mucronate. Pollination Apr–May, seed maturity Sep–Oct.

• Grassy places and thickets with sparse trees on limestone and sand shale along the arid Jinsha Jiang valley; 1100–2000 m. SW Sichuan, N Yunnan.

An endangered species.

**9. *Cycas hainanensis*** C. J. Chen in W. C. Cheng & al., *Acta Phytotax. Sin.* 13(4): 82. 1975.

海南苏铁 *hai nan su tie*

Trunk to 1.5(–2.5) m × ca. 40 cm, inflated toward base; bark dark gray and scaly toward apex of trunk, white-gray and nearly smooth toward base. Leaves 50–80, 1-pinnate, 1–2.2 m × 30–50 cm; petiole rhombic in cross section, 20–70 cm, with 50–80 spines along each side from base upward; leaf blade elliptic-oblong, flat; leaflets in 50–80 pairs, longitudinally inserted 0.8–1.5 cm apart at 40–50° to rachis, straight, 15–30 cm × 6–9(–11) mm, leathery, glabrous abaxially, base decurrent, margin flat or slightly recurved, apex acuminate, pungent. Cataphylls triangular, 5–5.5 × 2–2.3 cm, densely brown tomentose, apex abruptly tapered into a long point, soft and recurved when fresh, becoming hard and straight when dry. Pollen cones unknown. Megasporophylls more than 30, tightly grouped, 14–20 cm, brown tomentose; stalk 7–12 cm; sterile blade greenish, ovate or broadly so, 6.5–9 × 6–9(–12) cm, glabrescent, margin pectinate, with 13–27 lobes 1–3 cm, terminal lobe flattened, oblong or triangular, 2–3(–4) × 0.7–2(–3) cm, remotely serrulate; ovules 1 or 2 on each side of distal part of stalk, glabrous. Seeds greenish to yellowish, broadly ovoid or subglobose, slightly compressed, 3.5–4.5 × 2.8–3.6 cm; sclerotesta finely verrucose. Pollination Mar–May, seed maturity Sep–Oct.

• Tropical jungles and thickets with sparse trees; 100–1000 m. Hainan.

**10. *Cycas taiwaniana*** Carruthers, *J. Bot.* 31: 2. 1893.

广东苏铁 *guang dong su tie*

*Cycas diannanensis* Z. T. Guan & G. D. Tao; *C. fairylakea* D. Y. Wang; *C. pectinata* Griffith subsp. *manhaoensis* C. Chen & P. Yun; *C. revoluta* Thunberg var. *taiwaniana* (Carruthers) Schuster.

Trunk cylindrical, to 3.5 m × 35 cm; bark dark brown or gray-brown, scaly. Leaves 60–90, 1-pinnate, 1.5–3 m × 40–60 cm; petiole obovate in cross section, 40–120 cm, with 30–60 spines along each side of basal part, glabrous; leaf blade oblong, flat, orange-brown tomentose when young; leaflets in 70–150 pairs, longitudinally inserted at 55–75° to rachis, often falcate, 18–35 cm × 11–14 mm, leathery, glabrous abaxially, midvein raised on both surfaces only when fresh, slightly raised or flat abaxially when dry, base decurrent, margin flat, apex attenuate, pungent. Cataphylls triangular-lanceolate, ca. 8 × 2.5 cm, densely brown tomentose, apex with long, hard point. Pollen cones ovoid or ellipsoid-cylindrical, 30–45 × 8–10 cm; microsporophylls narrowly cuneate, 2–3 cm × 5–8 mm; apex obtuse-rounded, with very short, upcurved

mucro. Megasporophylls more than 30, tightly grouped, 15–22 cm, pale brown tomentose; stalk 8–12 cm; sterile blade rhombic-ovate, 7–12 × 6–7 cm, margin glabrescent and pectinate, with (11–)23–47 lobes 2–3.5 cm, terminal lobe ± flattened, 2–3.5 cm × 5–10 mm, margin usually irregularly serrulate, apex acute; ovules 2 or 3 on each side of distal part of stalk, glabrous. Seeds 2(–4), pale yellowish, globose, or broadly obovoid, slightly compressed, 2.8–3.3 × 2.5–3 cm; sclerotesta finely verrucose. Pollination Apr–May, seed maturity Sep–Nov.

Sunny, grassy places or sparse, mixed forests, often disturbed places, long cultivated in S China but now only sporadically distributed in the wild; 400–1100 m. Guangdong, E Guangxi, SW Hunan, SE Yunnan [?Vietnam].

**11. *Cycas szechuanensis*** W. C. Cheng & L. K. Fu in W. C. Cheng & al., *Acta Phytotax. Sin.* 13(4): 81. 1975.

南盘江苏铁 *nan pan jiang su tie*

*Cycas guizhouensis* K. M. Lan & R. F. Zou; *C. multiovula* D. Y. Wang.

Trunk to 2.9(–5) m × 40(–50) cm; bark dark gray, scaly. Leaves 60–90, 1-pinnate, 1–2.5(–3) m × 35–50 cm; petiole subrhombic in cross section, 40–70 cm, with 25–50 spines along each side; leaf blade oblong, flat, pale brown villous when young; leaflets in 60–120 pairs, longitudinally inserted at ca. 50° to rachis, straight or slightly falcate, 15–35 × 0–1.3 cm, thick, leathery, glabrous, midvein strongly raised on both surfaces, base decurrent, margin flat or slightly recurved, apex acuminate. Cataphylls triangular, 4–5 × 1.5–2.2 cm, brown tomentose, apex with long, soft point. Pollen cones fusiform-cylindrical, ca. 25 × 6 cm; microsporophylls cuneate, 2–3 × 0.8–1.2 cm. Megasporophylls more than 30, tightly grouped, 14–23 cm, densely yellowish brown tomentose; stalk 5–14 cm; sterile blade broadly ovate, obovate, or suborbicular, 6–11 × 5–9 cm, margin glabrescent and pectinate, with 17–27 subulate lobes 2–6 cm, terminal lobe subulate to flattened, a little longer than lateral lobes; ovules (2 or)3 or 4(or 5) on each side of stalk, orange, glabrous. Seeds pale yellow when fresh, pale brown when dry, subglobose or obovoid, slightly compressed, 2.5–3 × 2.3–2.8 cm, apex mucronate; sclerotesta smooth. Pollination Apr–Jun, seed maturity Oct–Nov.

Thickets and sparse forests along hot and dry valleys of the Nanpan Jiang; 400–1300 m. NW Guangxi, SW Guizhou, E Yunnan; cultivated in Guizhou, Sichuan, and Yunnan [Vietnam].

Described from sterile plants introduced to Sichuan from the Napan Jiang valley. As defined here, *Cycas szechuanensis* is a very wide ranging species, close to *C. hainanensis*, but differs in its smaller seeds. Recently, several wild populations and material in cultivation have been segregated as distinct species. However, more studies are necessary before it can be determined whether or not these entities appropriately represent the range of variability found within and between populations, and whether or not variation within vegetatively propagated material in cultivation merely represents extreme forms selected for their ornamental value.

**12. *Cycas ferruginea*** F. N. Wei, *Guihaia* 14: 300. 1994.

锈毛苏铁 *xiu mao su tie*

Trunk generally subterranean, sometimes to 60 × 25 cm above ground, base swollen; bark dark gray and scaly toward apex of trunk, white-gray and nearly smooth toward base. Leaves 25–40, 1-pinnate, 1–2 m × 25–55 cm; petiole subterete, 30–70 cm, with (0–)8–21 spines along each side, densely rusty brown tomentose when young; leaf blade oblong, flat; leaflets in 60–100 pairs, longitudinally inserted at ca. 90° to rachis, not overlapping, straight or downcurved, 13–18 cm × 5–12 mm, papery to subleathery, densely red-brown tomentose abaxially when maturing, later becoming light green and sparsely tomentose, midvein raised on both surfaces, base attenuate, symmetric, margin strongly revolute, apex acute to acuminate, somewhat soft at maturity. Cataphylls triangular, 3–4 × 1–1.3 cm, brown tomentose, apex soft. Pollen cones ovoid-fusiform, 20–30 × 6–8 cm; microsporophylls broadly cuneate, 1.5–3 × 1.2–1.5 cm, apical (sterile) part subrhombic, thickened, densely pale brown tomentose, margin inconspicuously toothed, apex with upcurved mucro. Megasporophylls more than 30, tightly grouped, 8–14 cm, tawny tomentose; stalk 4.5–7.5 cm; sterile blade rhombic-ovate, 3.5–5.5 × 3–5 cm, margin glabrescent and pectinate, with 17–31 subulate lobes 1–2.5 cm, terminal lobe subulate, 3–4 cm; ovules 2 or 3 on each side of stalk, glabrous. Seeds 2–4, yellowish when fresh, brown when dry, obovoid or subglobose, 2–2.8 × 1.8–2.5 cm, apex mucronate; sclerotesta smooth. Pollination Mar–Apr, seed maturity Aug–Oct.

Semishaded, rocky crevices in broad-leaved forests in limestone mountains; 200–500 m. W Guangxi [Vietnam].

**13. *Cycas miquelii*** Warburg, *Monsunia* 1: 179. 1900.

石山苏铁 *shi shan su tie*

*Cycas brevipinnata* Hung T. Chang & al.; *C. longisporophylla* F. N. Wei; *C. septemsperma* Hung T. Chang & al.; *C. sexseminifera* F. N. Wei; *C. spiniformis* J. Y. Liang; *Epicycas miquelii* (Warburg) de Laubenfels. Trunk generally subterranean, often ellipsoid or abruptly tapered apically, sometimes to 60 × 20 cm above ground; bark white-gray, nearly smooth toward base of trunk. Leaves 25–40, 1-pinnate, 50–100 × 15–22 cm; petiole subterete, 10–20 cm, with 0–8 spines along each side of apical part; leaf blade oblong, flat; leaflets in 60–100 pairs, longitudinally inserted at ca. 90° to rachis, often overlapping, straight, 13–18 × 1.4–1.8 cm, thick, leathery, sparsely red-brown tomentose abaxially when young, later becoming dark green and glabrous, midvein nearly flat adaxially, raised abaxially, base usually truncate, decurrent, sometimes contracted, margin flat or only slightly revolute, apex mucronate, pungent at maturity. Cataphylls triangular, 3–4 × 1–1.3 cm, brown tomentose, apex soft. Pollen cones ovoid-fusiform, 20–30 × 6–8 cm; microsporophylls broadly cuneate, 1.5–3 × 1.2–1.5 cm, apical, sterile part sub-

rhombic, thickened, densely pale brown tomentose, margin inconspicuously toothed, apex with short, upcurved mucro. Megasporophylls more than 30, tightly grouped, 8–14 cm, tawny tomentose when young, later glabrescent; stalk 4.5–7.5 cm; sterile blade rhombic-ovate, 3.5–5.5 × 3–5 cm, margin pectinate, with 17–31 subulate lobes 1–2.5 cm, terminal lobe subulate, 3–4 cm; ovules 2 or 3 on each side of stalk, glabrous. Seeds 2–4, yellowish when fresh, brown when dry, obovoid or subglobose, 2–2.8 × 1.8–2.5 cm, apex mucronate; sclerotesta smooth. Pollination Mar–Apr, seed maturity Aug–Oct.

Semishaded, rocky crevices in broad-leaved forests in limestone mountains, often on N-facing slopes; 200–500 m. W Guangxi [N Vietnam].

There are taxonomic problems with the species delimitation in the various populations of *Cycas miquelii*. The authors have chosen to recognize only two closely related species, *C. ferruginea* and *C. miquelii*, from among the many described because ample material was available and the characters separating them have no intermediate states. *Cycas miquelii* has dark green, leathery, glabrous leaflets that are truncate basally and mucronate and pungent apically, whereas *C. ferruginea* has light green, papery, adaxially pubescent leaflets that are attenuate basally and acute to acuminate and not pungent apically. Moreover, although their general distribution patterns are the same, there is no sympatry within individual populations. However, a more meaningful evaluation cannot be made until more material has been studied from more populations throughout the range. Chinese plants of *C. miquelii* have been misidentified as *C. siamensis* Miquel by some authors.

**14. *Cycas changjiangensis*** N. Liu, *Acta Phytotax. Sin.* 36: 552. 1998.

葫芦苏铁 *hu lu su tie*

Trunk often subterranean, cylindrical or flask-shaped, sometimes moniliform, to 50 × 15 cm, base abruptly swollen to 25 cm in diam., apex almost glabrous; bark gray, nearly smooth toward base of trunk. Leaves 25–45, 1-pinnate, 50–130 × 20–40 cm; petiole suborbicular in cross section, 10–40 cm, with 9–16 spines along each side throughout length, base densely brown tomentose; leaf blade ovate-oblong in outline, flat; leaflets in 40–70 pairs, longitudinally inserted 0.8–1.8 cm apart at 55–65° to rachis, straight, 10–17(–23) cm × 4–7(–9) mm, leathery, glabrous, midvein prominent on both surfaces, especially adaxially, base decurrent, margin flat or slightly recurved, apex attenuate, pungent. Cataphylls triangular-lanceolate, 4–7 × 1–1.3 cm, densely yellowish brown tomentose, apex long attenuate, subsoft at tip. Pollen cones conical-cylindric, 15–25 × 4–6 cm; microsporophylls cuneate or broadly cuneate, 1.5–2 × 0.6–1 cm; apical sterile part subrhombic, thickened, densely yellow or brown tomentose, margin subentire, with short, upcurved mucro. Megasporophylls 40–60, tightly grouped, 8–13 cm, densely yellowish brown silky tomentose; stalk 3–8 cm; sterile blade broadly ovate or flabellate, 5–6 × 4–8 cm, margin pectinate, with 17–35 lobes 2–3.8 cm, terminal lobe broadly

lanceolate, 1.5–3.5 cm, margin irregularly serrulate or biserrulate; ovules 1 or 2 on each side of distal part of stalk, glabrous. Seeds 2–4, green to yellowish brown, broadly obovoid or subglobose, ca.  $2 \times 1.8$  cm; sarcotesta not spongy or fibrous. Pollination Apr–May, seed maturity Oct–Nov.

• Hills and rocky slopes among grass and low shrubs, or in open broad-leaved forests, with tropical climate of hot, wet summers and hot, dry winters; 600–800 m. Hainan (Changjiang Xian).

Similar to *Cycas siamensis* Miquel in its gray and abruptly swollen trunk base, but quite different from that species in its strongly adaxially raised midvein and small seeds (ca. 1.8 cm in diam.) with sarcotesta not spongy or fibrous.

**15. *Cycas hongheensis*** S. Y. Yang & S. L. Yang ex D. Y. Wang in F. X. Wang & al., *Cycads in China* 62. 1996.

灰干苏铁 hui gan su tie

*Cycas pectinata* Buchanan-Hamilton f. *hongheensis* (S. Y. Yang & S. L. Yang ex D. Y. Wang) Z. T. Guan.

Trunk cylindrical, sometimes branched, to  $8 \text{ m} \times 60 \text{ cm}$ , apex not tomentose; bark gray, smooth toward base of trunk, with fine, longitudinal fissures. Leaves 20–50(–60), 1-pinnate,  $50\text{--}120 \times 15\text{--}35 \text{ cm}$ ; petiole subterete, 10–25 cm, with 25–50 spines along each side; leaf blade oblong to elliptic-lanceolate, strongly “V”-shaped in cross section, recurved, pale brown tomentose when young; leaflets in 50–70 pairs, horizontally inserted at  $45\text{--}50^\circ$  above middle of rachis, glaucous when mature,  $8\text{--}18 \text{ cm} \times 6\text{--}8 \text{ mm}$ , leathery, densely pubescent when young, midvein flat adaxially when fresh (but sulcate when dry), prominent abaxially, base decurrent, margin  $\pm$  revolute, apex

acuminate, pungent. Cataphylls lanceolate,  $3\text{--}5 \times 1\text{--}1.5 \text{ cm}$ , densely pale brown tomentose adaxially, apex acuminate, pungent. Pollen cones and megasporophylls unknown.

• Dry and hot, sunny forests with sparse trees on sharp limestone slopes; 400–600 m. SE Yunnan (Gejiu Shi).

Very rapidly disappearing in the wild as a result of over collection by commercial dealers and habitat destruction; it should be considered an endangered species in China. There is no doubt as to the distinctiveness of this species on the basis of vegetative characters, although its affinities are difficult to ascertain in the absence of fertile material.

**16. *Cycas pectinata*** Buchanan-Hamilton, Mem. Wern. Nat. Hist. Soc. 5: 322. 1826.

篾齿苏铁 bi chi su tie

*Cycas circinalis* Linnaeus var. *pectinata* (Griffith)

Schuster; *C. dilatata* Griffith; *C. jenkinsiana* Griffith; *C. pectinata* Griffith; *C. wallichii* Miquel.

Trunk cylindrical, often dichotomously branched toward apex and gradually thickened toward base, up to  $16 \text{ m} \times 60$  (–90) cm, apex not tomentose; bark gray or white-gray, smooth toward base of trunk. Leaves 40–80(–100), 1-pinnate,  $0.7\text{--}1.2$  (–1.5) m  $\times$   $20\text{--}30$  (–40) cm; petiole compressed orbicular in cross section, 10–35 cm, with 6–15 spines along each side above middle part; leaf blade oblong-lanceolate, flat or occasionally slightly “V”-shaped in cross section, pale brown tomentose when young; leaflets in 50–100 pairs, longitudinally inserted at  $50\text{--}60^\circ$  to rachis, straight to falcate,  $9\text{--}20 \text{ cm} \times 5\text{--}7 \text{ mm}$ , thickly, leathery, midvein flat adaxially, sulcate when dry, raised abaxially, base decurrent, margin slightly recurved, apex acute, pungent. Cataphylls triangular,  $3.5\text{--}4.5 \times 1.5\text{--}2 \text{ cm}$ , brown tomentose, apex soft. Pollen cones fusiform,  $30\text{--}45 \times 10\text{--}15 \text{ cm}$ ; microsporophylls cuneate,  $3.5\text{--}5 \times 1.2\text{--}2.5 \text{ cm}$ , densely pale brown tomentose, apex thickened, with an upcurved point 3–4 cm.

Megasporophylls more than 30, tightly grouped, 13–18 cm, densely yellowish brown silky hairy; stalk 4–7 cm; sterile blade deltoid-ovate or suborbicular,  $7\text{--}9 \times 6\text{--}10 \text{ cm}$ , margin pectinate, with 29–37 lobes  $2.5\text{--}3.5 \text{ cm}$ , terminal lobe subulate, 3–4.5 cm; ovules 1(–3) on each side of distal part of stalk, glabrous. Seeds 2(–4), orange, becoming dark brown, often obovoid, compressed,  $4.5\text{--}6 \times 4\text{--}4.7 \text{ cm}$ ; sclerotesta smooth, sarcotesta with a mixed, thick, fleshy, fibrous layer. Pollination Jun–Jul, seed maturity Feb–Mar.

Dry, open thickets in limestone mountains, red soil in sparse monsoon forests; 1000–1800 m. S Yunnan [Bangladesh, Bhutan, Cambodia, NE India, Laos, Myanmar, Nepal, Sikkim, Thailand, Vietnam].

A vulnerable species in China. Cultivated as an ornamental in S Yunnan and elsewhere in SE Asia. Chinese plants have been misidentified as *C. rumphii* Miquel (e.g., in FRPS), which occurs only in Indonesia and Papua New Guinea.

