

PODOCARPACEAE

罗汉松科 *luo han song ke*

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Trees or shrubs evergreen, dioecious or rarely monoecious. Leaves decussate, subopposite, or spirally arranged; blade scalelike, subulate, or linear to elliptic, stomatal lines abaxial or present on all surfaces. Pollen cones terminal, solitary or clustered in leaf axils, or borne in spikelike complexes; individual cones pedunculate or sessile; microsporophylls numerous, spirally arranged, with distinct adaxial and abaxial surfaces; microsporangia 2; pollen 2(or 3)-saccate in Chinese species, (rarely nonsaccate). Seed-bearing structures terminal or axillary, solitary, occasionally spikelike, comprising few to several spirally arranged bracts; all or only apical bracts fertile, smooth or warty; basal bracts sometimes fused and succulent (together with peduncle) to form a “receptacle,” or obsolete; ovule (inverted) or inclined in Chinese species. Seed drupelike or nutlike, wholly or (in *Dacrydium*) partly enveloped in a sometimes colored and succulent epimatium derived from fertile ovulate scale. Cotyledons 2.

Eighteen genera and ca. 180 species: tropical, subtropical, and S temperate zones, mainly in S hemisphere but extending to montane tropical Africa, Central America, and Japan; four genera and 12 species (three endemic) in China.

Although strictly a flowering plant term, “receptacle” is used widely in Podocarpaceae literature, e.g., by Tomlinson (Int. J. Plant Sci. 153: 572–588. 1992). Spjut (Mem. New York Bot. Gard. 70: 21, 71–73. 1994) incorrectly used the term “epimatium” to denote the peduncle of *Nageia* and also the receptacle of *Podocarpus* and *Dacrycarpus*.

Cheng Wan-chün, Fu Li-kuo & Chao Chi-son. 1978. Podocarpaceae. In: Cheng Wan-chün & Fu Li-kuo, eds., Fl. Reipubl. Popularis Sin. 7: 398–422.

- 1a. Leaves dimorphic: juvenile leaves needlelike or linear; adult leaves needlelike or scalelike, less than 5 mm.
 - 2a. Juvenile leaves 2-ranked, arranged in 1 plane (forming an oblong-ovate branchlet outline), linear, not scalelike; adult leaves needlelike or scalelike, falcate, 0.8–1.5 mm 2. *Dacrycarpus*
 - 2b. Juvenile leaves not 2-ranked, spreading, not arranged in 1 plane, linear to needlelike or subulate; adult leaves hard and scalelike, 2–5 mm 1. *Dacrydium*
- 1b. Leaves ± monomorphic: adult leaves neither needlelike nor scalelike, more than 5 mm; juvenile leaves similar to adult leaves in shape but often larger and/or wider.
 - 3a. Leaf blade with a single, obvious, often raised midvein on 1 or both surfaces 4. *Podocarpus*
 - 3b. Leaf blade without an obvious midvein but with many, slender, longitudinal veins dichotomous in basal region and converging toward apex 3. *Nageia*

1. DACRYDIUM Solander ex G. Forster, Pl. Esc. 80 [Fl. Ins. Austr. Prod. 92]. 1786.

陆均松属 *lu jun song shu*

Trees or shrubs evergreen, dioecious. Leaves usually dimorphic: juvenile leaves spreading, not 2-ranked, linear to needlelike or subulate, rarely falcately curved; adult leaves crowded, normally appressed, scalelike or subulate, 2–5 mm, hard, base decurrent apex often incurved. Pollen cones terminal or axillary, solitary, sessile; pollen 2-saccate. Seed-bearing structures terminal, usually solitary, small, composed of several bracts normally only 1 fertile; sterile bracts not fleshy (sometimes becoming fleshy and brightly colored at maturity); ovule 1, borne abaxially on middle part of fertile bract, initially partly inverted, becoming more erect at maturity. Epimatium only partly enveloping seed and less than 1/3 its length, forming a somewhat membranous, asymmetric, cupular sheath around its base. Seed maturing in 1st year, suberect or ± inclined.

Twenty-one species: from China and Myanmar to Fiji Islands and New Zealand; one species in China.

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1. *Dacrydium pectinatum* de Laubenfels, J. Arnold Arbor. 50: 289. 1969.

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Trees to 30 m tall; trunk to 3 m d.b.h.; bark grayish white or pale brown when young, finally gray-brown or red-brown, shallowly fissured; main branches whorled; branchlets drooping, green. Juvenile leaves changing gradually to adult state, needlelike, falcately curved forward, 1.5–2 cm × ca. 0.4 mm, apex tapered. Adult leaves dull green, scalelike, “S”-shaped-linear, 4-angled, 2–5 × 0.4–0.6 mm, stomatal rows (2 or)3–5 per surface, with remote, indistinct, stomatal dots, base decurrent, apex obliquely apiculate or obtuse and incurved. Pollen cones in clusters of 1–3, cylindric-ovoid, 0.8–1.2 cm × 1.5–2 mm; microsporophylls ovate, ca. 1 × 1 mm, centrally keeled, apex subacute. Seed-bearing structures sessile; bracts oblique, not fleshy. Epimatium red and fleshy when ripe. Seed ovoid, 4.5–5 × ca. 3 mm. Pollination Mar–May, seed maturity (Jun–) Oct–Nov.

Coniferous, broad-leaved, and mixed tropical montane forests on montane yellow-earth or red-earth soils on sunny, gently sloping ridges; (300–)600–1200(–2100) m. Hainan [Indonesia (Borneo and nearby islands), Philippines].

A vulnerable species in China, formerly dominant in forests in Hainan but excessively logged for more than 20 years. The wood is used in constructing buildings and ships.

Treated in FRPS as *Dacrydium pierrei* Hickel, a synonym of *D. elatum* (Roxburgh) Wallich ex Hooker (London J. Bot. 2: 144. 1843) which occurs in Cambodia, Indonesia (Sumatra), Laos, Malaysia, Myanmar, Thailand, and Vietnam. *Dacrydium elatum* was also recorded from China (Guangxi province) by Z. Z. Mao (in S. K. Lee & C. F. Liang, Fl. Guangxi 1: 60. 1991, as *D. pierrei*), but it is uncertain to which species this record refers because the accompanying illustration (pl. 23, f. 8–16) is a mixture of *D. elatum* and *D. pectinatum*. *Dacrydium elatum* has adult leaves imbricate, scalelike, to 1.5 mm (as in f. 12), showing an abrupt change from juvenile leaves, whereas *D. pectinatum* has adult leaves linear, quadrangular in cross section, 2–5 mm (as in f. 8), gradually changing from juvenile leaves.

2. DACRYCARPUS (Endlicher) de Laubenfels, J. Arnold Arbor. 50: 315. 1969.

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Podocarpus L'Héritier ex Persoon sect. *Dacrycarpus* Endlicher, Syn. Conif. 221. 1847; *Bracteocarpus* A. V. Bobrov & Melikyan.

Trees or shrubs evergreen, dioecious (very rarely monoecious); trunk straight; main branches spreading or drooping; branchlets drooping or ascending, dense. Leaves dimorphic: juvenile leaves 2-ranked and forming an oblong-ovate branchlet outline, linear, not scalelike; adult leaves needlelike or scalelike, falcate, bilaterally or bifacially flattened, or not flattened, 0.8–1.5 mm. Pollen cones lateral (rarely terminal), solitary or few together; microsporophylls numerous, imbricate; microsporangia 2, abaxial. Seed-bearing structures terminal and often borne on short, lateral branchlets, pedunculate, with appressed or spreading, bractlike leaves at base of peduncle; apical 1 or 2 bracts fertile; basal bracts fused to form a succulent, warty receptacle; ovule inverted. Epimatium wholly enveloping seed, united with fertile bract(s) and together bearing a short, free apex forming an asymmetrically projecting crest on immature seed-bearing structure. Seed large.

Nine species: from China and Myanmar to Fiji Islands and New Zealand; one species in China.

1. *Dacrycarpus imbricatus* (Blume) de Laubenfels var. **patulus** de Laubenfels, J. Arnold Arbor. 50: 320. 1969.

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Bracteocarpus kawaii (Hayata) A. V. Bobrov & Melikyan; *Podocarpus kawaii* Hayata.

Trees to 40 m tall; trunk to 2 m d.b.h.; bark superficially dark brown or blackish, weathering gray, red-brown and granular fibrous within, flaking in thin strips; crown spreading; branchlets stiff, erect. Juvenile leaves borne at 60–75° to branchlet axis, 0.2–0.7 mm apart (branchlets 3–4 × 1.2–1.6 cm in outline), sessile, green or ± glaucous, linear, falcate to “S”-shaped, 6–10(–17) × 0.9–1.2 mm, stomata arranged in 2 whitish rows on abaxial surface, base decurrent, margin entire, apex obliquely incurved-apiculate, apiculus 0.2–0.3 mm. Adult leaves spreading, needlelike, falcate, 0.1–1.5 × 0.4–0.6 mm, base keeled, apex acute. Pollen cones ovoid or ellipsoid and ca. 5 mm before shedding pollen, finally cylindric and 6–12

× 2–2.5 mm; microsporophylls 2–4 mm, apex triangular, acute or apiculate. Seed-bearing structures solitary or paired, usually only 1 maturing; bractlike leaves at base of peduncle 1–3 mm. Receptacle glaucous, red when ripe, obovoid, 3–4 × 1–2.5 mm Epimatium initially green with bluish tinge, red when ripe. Seed globose or subglobose, 5–6 × 4–6 mm. Pollination Feb–Apr, seed maturity Oct–Dec.

Montane rainforests (Hainan), mixed evergreen broad-leaved forests (mainland), or in pure stands, in valleys of mountain streams on slightly acid, montane yellow-earth; 400–1500 m. NE Guangxi (Jinxiu Yaozu Zizhixian), Hainan, S Yunnan; cultivated in Guangdong [S Cambodia, Indonesia, Laos, Malaysia, N Myanmar, Papua New Guinea, Philippines, Thailand, Vietnam; Pacific Islands].

A vulnerable plant in China and one of the most important forest trees in Hainan. The varieties recognized by de Laubenfels are distinguishable only by characters of adult leaves; much material in herbaria is juvenile and so identifiable only to species rank. Chinese plants were treated in FRPS as *Podocarpus imbricatus* Blume.

3. NAGEIA Gaertner, Fruct. Sem. Pl. 1: 191. 1788.

竹柏属 zhu bai shu

Trees evergreen, dioecious or rarely monoecious; crown columnar. Leaves spirally arranged or in decussate, opposite pairs on leading shoots, opposite or subopposite on lateral shoots, \pm monomorphic, adult leaves similar to juvenile leaves but often larger or wider (although juvenile leaves larger in *Nageia wallichiana*), more than 5 mm; petiole twisted through 90°; blade broadly ovate-elliptic to oblong-lanceolate, without obvious midvein but with many, slender, parallel, longitudinal veins converging toward base and apex, stomatal lines abaxial or rarely on all surfaces. Pollen cones axillary, solitary or clustered in small, spikelike groups of 3–6, borne on naked peduncles, ovoid-cylindric, with basal sterile scales; pollen 2-saccate. Seed-bearing structures terminal on short, scaly, axillary branchlets, solitary or occasionally paired; bracts usually obsolete, scarcely thicker than peduncle, rarely succulent and thicker than peduncle; ovule inverted. Epimatium wholly enveloping seed, leathery, with bluish black bloom when ripe. Seed drupelike, globose.

Five to seven species: Bangladesh, Cambodia, China, India, Indonesia, Japan (including Ryukyu Islands), Laos, Malaysia, Myanmar, Philippines, Thailand, Vietnam; three species in China.

The leaves of *Nageia* strongly differ from those of *Podocarpus* in their numerous, parallel veins and absence of a midvein, and are superficially much more similar to those of *Agathis* (Araucariaceae). The Chinese species of *Nageia* were treated in FRPS under *Podocarpus*. D. Z. Fu (Acta Phytotax. Sin. 30: 515–528. 1991) placed the genus in its own family, Nageiaceae, but this view has since been refuted by several workers using different lines of evidence.

1a. Leaf blade with stomatal lines present on both surfaces; receptacle thick, very succulent 1. *N. wallichiana*

1b. Leaf blade with stomatal lines present on abaxial surface only, sometimes scarcely visible; receptacle obsolete or absent.

2a. Leaf blade usually 8–18 cm; receptacle absent; seed 1.5–1.8 cm in diam. 2. *N. fleuryi*

2b. Leaf blade to 9 cm; receptacle obsolete; seed 1–1.5 cm in diam. 3. *N. nagi*

1. *Nageia wallichiana* (C. Presl) Kuntze, Revis. Gen. Pl. 2: 800. 1891.

肉托竹柏 rou tuo zhu bai

Podocarpus wallichianus C. Presl, Abh. Königl. Böhm. Ges. Wiss., ser. 5, 3: 540. 1846; *Decussocarpus wallichianus* (C. Presl) de Laubenfels; *Nageia blumei* (Endlicher) Gordon; *Podocarpus blumei* Endlicher; *P. latifolius* Blume (1827) and Wallich (1830), not (Thunberg) R. Brown ex Mirbel (1825).

Trees to 50 m tall; trunk to at least 1 m d.b.h.; bark smooth, dark brown or gray-brown, tan or brown within, peeling in large, irregular flakes. Leaves decussate, 2-ranked, turned so that those on 1 side of branch have adaxial surface uppermost, those on the other side abaxial surface uppermost; petiole 5–10 mm; blade dark green adaxially, paler or grayish green abaxially, elliptic or lanceolate-elliptic, (6–)9–14 × (2–)3–5 cm in adult leaves, or to 23 × 7 cm in juvenile leaves, thick and leathery, stomatal lines present on both surfaces, base cuneate to attenuate, apex acuminate. Bracts of pollen- and seed-cone peduncles deciduous. Pollen cones axillary, in clusters of (1–)3–5 (–7) on peduncle 0.2–1 cm, 1 cone terminal, others decussate, cylindrical, 0.8–1.8 cm × 4–5 mm; microsporophylls lanceolate, 2–3 mm. Seed-bearing structures axillary, solitary or rarely paired; peduncle (0.5–)1.2–1.7(–2) cm. Receptacle of 4–7 sterile scales and 1 or 2 fertile, subterminal scales, green initially, blackish when ripe, very succulent. Epimatium bluish purple or purplish red when ripe. Seed globose, 1.5–1.8 cm in diam., with small, proximal beak.

Evergreen subtropical forests on hillsides. S Yunnan (Xishuangbanna Daizu Zizhizhou) [Bangladesh, Cambodia, NE and SE India, Indonesia, Laos, Malaysia, Myanmar, Papua New Guinea, Philippines, Thailand, Vietnam].

2. *Nageia fleuryi* (Hickel) de Laubenfels, Blumea 32: 210. 1987.

长叶竹柏 chang ye zhu bai

Podocarpus fleuryi Hickel, Bull. Soc. Dendrol. France 76: 75. 1930; *Decussocarpus fleuryi* (Hickel) de Laubenfels.

Trees to 30 m tall; trunk to 70 cm d.b.h.; bark brownish purple, smooth, peeling in thin flakes. Leaves opposite, decussate, held with abaxial surface always uppermost; petiole 2–5 (–10) mm, usually rather indistinct, rotation not continuing along internode; blade dark green and shining abaxially, elliptic or broadly lanceolate, 8–18 × 2.2–5 cm, leathery, stomatal lines present on abaxial surface only, base cuneate, apex abruptly acuminate. Bracts deciduous. Pollen cones axillary, in clusters of 3–6, sessile, elongate-cylindric, 1.5–6.5 cm × ca. 4 cm; microsporophylls triangular. Seed-bearing structures axillary; peduncle scaly, not enlarged, 2–2.8 cm at seed maturity; ovules 1 or 2(or 3), sessile in axils of subterminal bracts, only 1 ovule maturing. Receptacle absent. Epimatium green, turning bluish purple when ripe. Seed globose, 1.5–1.8 cm in diam. Pollination Mar–Apr, seed maturity Oct–Nov. $2n = 26^*$.

Montane rainforests, evergreen broad-leaved forests, on neutral or slightly acid, lateritic or yellow-earth soils in shade or semishade; 800–900 m. Guangdong (Gaoyao Xian, Longmen Xian, Zengchong Xian), Guangxi (Daxin Xian, Hepu Xian), Hainan (Wuzhi Shan), Taiwan (Taibei), SE Yunnan (Dawei Shan, Mengzi Xian, Pingbian Miaozu Zizhixian) [Cambodia, Laos, Vietnam].

A vulnerable species in China.

3. *Nageia nagi* (Thunberg) Kuntze, Revis. Gen. Pl. 2: 798. 1891.

竹柏 zhu bai

Myrica nagi Thunberg in Murray, Syst. Veg., ed. 14, 884. 1784; *Decussocarpus nagi* (Thunberg) de Laubenfels; *D. nagi* var. *formosensis* (Dummer) Silba; *Nageia formosensis* (Dummer) C. N. Page; *N. nagi* var. *formosensis* (Dummer) Silba; *N. nankoensis* (Hayata) R. R. Mill; *Podocarpus formosensis* Dummer; *P. japonicus* J. Nelson (1866), not Siebold ex Endlicher (1847); *P. koshunensis* (Kanehira) Kanehira; *P. nageia* R. Brown ex Endlicher; *P. nagi* (Thunberg) Pilger; *P. nagi* var. *koshunensis* Kanehira; *P. nankoensis* Hayata. Trees or shrubs to 20 m tall; trunk to 50 cm d.b.h.; bark reddish brown, dark purplish red, or light or dark gray, peeling in small, thin flakes; branches and branchlets erect, ascending, spreading, or \pm pendulous, grayish to dark brown, slender, semiterete, stout; branchlets opposite, rarely alternate, compressed-tetragonal, rigid, glabrous, densely leafy. Leaves opposite, decussate; petiole strongly twisted at base, rotation continuing along whole length of internode; blade dark green and glossy adaxially, pale green abaxially, ovate-lanceolate, lanceolate, elliptic-lanceolate, or narrowly elliptic, 2–9 \times 0.7–3 cm, leathery, parallel veins indistinct, stomatal lines present on abaxial surface only, sometimes scarcely visible, base cuneate or cuneate-attenuate into widened, flattened petiole, apex truncate, broadly obtuse, acute, or acuminate, sometimes

blackened. Pollen cones axillary, solitary or in clusters of up to 10, pedunculate or sessile, cylindrical, ovoid-cylindrical, or subglobose, 0.5–2.5 cm; peduncle (when present) short, thick, with a few basal bracts. Seed-bearing structures axillary, solitary rarely paired; peduncle stout, or slightly thickened only distally, 4.5–13 mm, with several deciduous bracts leaving scars. Receptacle obsolete, consisting of few bracts. Epimatium green with white bloom when young, dark purple with sparser white bloom when ripe. Seed globose to pyriform, 1–1.5 cm in diam., with dense punctiform depressions, base pointed, apex rounded. Pollination Mar–May, seed maturity Aug–Nov. $2n = 26^*$, 29^* .

Evergreen broad-leaved and *Quercus* forests, forests on dry mountainsides, thickets, along streams; 200–1200(–1600) m. Fujian, Guangdong, Guangxi, Hainan, Hunan, Jiangxi, Sichuan, Taiwan, Zhejiang; also cultivated as an ornamental [Japan (including Ryukyu Islands)].

A broad concept of *Nageia nagi* is adopted here. However, R. R. Mill indicates that the plants occurring in Taiwan should be treated as two separate species: those from S Taiwan (Hengchun Peninsula area) as *N. formosensis*, and those from N Taiwan (Nanko, Tanshui) as *N. nankoensis*. The taxonomy of this group of taxa is still not fully understood; field observations and cultivation experiments would be desirable.

The wood is used for constructing houses and bridges, making furniture, utensils, and handicraft articles. The seeds yield an edible oil which is also used in industry.

4. **PODOCARPUS** L'Héritier ex Persoon, Syn. Pl. 2: 580. 1807, nom. cons.

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Margbensonia A. V. Bobrov & Melikyan.

Trees or shrubs evergreen, dioecious. Leaves spirally arranged to subopposite, \pm monomorphic, juvenile leaves similar to adult leaves in shape but often larger and/or wider, linear, lanceolate, or ovate-elliptic, more than 5 mm, with single, obvious, often raised midvein on 1 or both surfaces, stomatal lines present on abaxial surface. Pollen cone complexes axillary, solitary or clustered, pedunculate or sessile; microsporophylls numerous, spirally arranged; microsporangia 2; pollen 2-saccate. Seed-bearing structures usually borne in leaf axils (rarely terminal), solitary (rarely more than 1); apical bracts fertile; basal bracts often fused to form a receptacle (obsolete in some species); ovule 1 (rarely few), inverted. Epimatium wholly enveloping seed, sometimes colored and succulent. Seed ripening in 1st year, drupelike, dry, or leathery.

About 100 species: tropical and subtropical regions worldwide, also temperate regions in S hemisphere; seven species (three endemic) in China.

The epiphytic shrub *Podocarpus epiphyticus* de Laubenfels & Silba (Phytologia 64: 290. 1988) was recently described from the Sumprabum region of N Myanmar, at 1800–2600 m, fairly close to the Chinese border. It should be searched for in comparable areas in NW Yunnan.

Podocarpus rumphii Blume (*P. philippinensis* Foxworthy) has been recorded for China, from both Hainan (de Laubenfels, Kalikasan 7: 142. 1978; and in Fl. Malesiana) and Taiwan (in FRPS). The records from Taiwan have been referred to *P. fasciculus* de Laubenfels (Fl. Taiwan, ed. 2), while those from Hainan require confirmation. *Podocarpus rumphii* otherwise occurs in Indonesia, Malaysia, Papua New Guinea, and the Philippines; it has pollen cones borne in clusters of up to 8 and leaf blades linear-lanceolate, with an acute (adult leaves) or acuminate (juvenile leaves) apex.

1a. Shrubs or small trees to 3(–5.5) m.

2a. Pollen cones always solitary; receptacle 1–1.3 cm; coastal rocks in Taiwan 3. *P. costalis*

2b. Pollen cones borne in clusters of 3; receptacle ca. 0.3 cm; inland sites on mainland 4. *P. forrestii*

1b. Trees 15–25 m.

3a. Pollen cones usually borne in clusters of 3–5 7. *P. macrophyllus*

3b. Pollen cones solitary, or borne in clusters of 2 or 3.

4a. Blade of most adult leaves tapered into acuminate apex 2. *P. neriifolius*

4b. Blade of most or all adult leaves rounded, obtuse, subacute, or acute at apex.

- 5a. Blade of most leaves linear-lanceolate or linear, 8–10 × as long as wide 6. *P. annamiensis*
 5b. Blade of most leaves ovate to linear, 3–7 × as long as wide.
 6a. Leaf blade 1.5–3 × 0.5–0.8 cm, 3–6 × as long as wide 1. *P. wangii*
 6b. Leaf blade 5–10.5 × 0.8–1.4 cm, 5–7 × as long as wide 5. *P. nakaii*

1. *Podocarpus wangii* C. C. Chang, Sunyatsenia 6: 26. 1941.

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Trees to 15 m tall; trunk to 30 cm d.b.h., much branched; branchlets usually opposite or ± whorled, erect-spreading, pale brown, glabrous or puberulent. Foliage buds 1.5–3 × 1.5–2 mm; primary scales lanceolate, ± spreading at apex. Leaves alternate, subopposite, or rarely ± whorled, crowded, dispersed ± evenly on branchlets; blade ± linear (sun leaves) or ovate (shade leaves), 1.5–3 cm × 5–8 mm, 3–6 × as long as wide, base narrowed into a short petiole ca. 2 mm, margin slightly revolute (sun leaves), apex ± acute, midvein narrow abaxially, wider adaxially, base narrowed, margin flat, apex obtuse. Pollen cones axillary, solitary or borne in clusters of 2 or 3, cylindrical, 1–3 cm × 1.5–3 mm, with a cluster of ca. 6 small, triangular scales at base; microsporophylls with short, triangular apex to 0.5 mm. Seed-bearing structures solitary; peduncle 0.5–1 cm. Receptacle red when ripe, consisting of 2 bracts, ca. 1 cm, base with 2 sterile, lanceolate bracts ca. 2 mm. Epimatium green and dark violet when ripe, leathery. Seed globose or globose-ellipsoid, ca. 8 × 6 mm, not crested. Pollination Jun, seed maturity Oct.

• Damp, shady places in evergreen broad-leaved forests or subalpine forests, rock crevices; 700–2000 m. S Guangdong, W Guangxi (Jingxi), Hainan (Diaoluo Shan, Limu Ling, Lingshui Xian, Wuzhi Shan), SE Yunnan (Malipo Xian, Xichou Xian).

Podocarpus wangii was identified in FRPS as *P. brevifolius* (Stapf) Foxworthy, which is in fact endemic to Mt. Kinabalu in Malaysia (Sabah). Several authors include *P. wangii* in the synonymy of *P. pilgeri* Foxworthy, from Indonesia, Papua New Guinea, and the Philippines. R. R. Mill has not seen specimens of *P. wangii*, but notes that the description and illustration in the protologue appear to match authentic material of *P. pilgeri*, except that the pollen cones are described as being shorter, and are sometimes borne in clusters of 2, rather than strictly solitary as in *P. pilgeri* throughout the rest of its range. An assessment of the status of *P. wangii* would be desirable. The wood is used for making furniture, utensils, carts, and farm implements.

2. *Podocarpus neriifolius* D. Don in Lambert, Descr. Pinus 2: [21]. 1824.

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Margbensonia neriifolia (D. Don) A. V. Bobrov & Melikyan; *Podocarpus discolor* Blume; *P.*

leptostachyus Blume; ?*P. macrophyllus* (Thunberg) Sweet var. *acuminatissimus* E. Pritzelt; ?*P. neglectus* Blume.

Trees to 25 m tall; trunk usually to 5 cm d.b.h.; bark grayish brown, thin, fibrous, peeling off in longitudinal flakes; branches spreading or ascending. Foliage bud scales erect, triangular, 1–1.5 mm wide, apex acute. Leaf blade lanceolate, usually slightly curved, (4–)7–

15(–20) × (0.5–)0.9–1.3(–2) cm, leathery, midvein raised adaxially, flat or slightly raised abaxially, base cuneate into short petiole, apex long acuminate; juvenile leaves wider, with obtuse, mucronate apex. Pollen cones solitary or in clusters of 2 or 3, normally sessile, 2.5–5 cm, with several spirally arranged, basal bracts. Seed-bearing structures axillary, solitary; peduncle 0.9–2.2 cm. Receptacle orange-red when ripe, obconical-ellipsoid, 8–10 × 5–8 mm, base with 2 subulate bracts 2–6 mm. Epimatium purplish red when ripe. Seed ovoid or ovoid-subglobose, 0.8–1.6 cm, apex rounded or obtuse. Pollination May, seed maturity Aug–Nov. $2n = 34$.

Evergreen broad-leaved forests; 100–1000 m. Fujian, Guangdong, Guangxi, Guizhou, Hunan, Jiangxi, Sichuan, Xizang, Yunnan, Zhejiang [Bhutan, Cambodia, NE India, Indonesia, Laos, Malaysia, Myanmar, Nepal, Papua New Guinea, Philippines, Thailand, Vietnam; Pacific Islands].

R. R. Mill considers that records of *Podocarpus neriifolius* from Taiwan should be referred in part to *P. nakaii* and in part to *P. fasciculus* de Laubenfels (Blumea 30: 277. 1985), which also occurs in the Ryukyu Islands, Japan (*P. macrophyllus* var. *liukuensis* Warburg). *Podocarpus fasciculus* has pollen cones solitary or borne in clusters of 2–5 and leaf blades linear-lanceolate, with an acute apex. Mill also considers *P. subtropicalis* de Laubenfels (Blumea 30: 277. 1985), described from C Sichuan (Emei Shan), to be a separate species. D. J. de Laubenfels regards this as the most widely cultivated species of the genus in the warmer parts of the world (probably including many parts of China), and notes that it has often been misidentified as *P. neriifolius*, which is apparently rarely cultivated. It has pollen cones solitary or borne in clusters of 2–10 and leaf blades linear or linear-lanceolate, with an acute apex. However, L. K. Fu and Y. Li consider both *P. fasciculus* and *P. subtropicalis* to be synonymous with *P. neriifolius*. Further collections are needed to resolve the situation.

The wood is used in making furniture, musical instruments, carvings, and paper.

3. *Podocarpus costalis* C. Presl, Epimel. Bot. 236. 1851.

兰屿罗汉松 lan yu luo han song

Shrubs or small trees to 3 m tall; bark greenish, very smooth; branches spreading horizontally. Foliage buds 2–4 × 2–4 mm, of long, triangular scales with spreading apices. Leaves spirally arranged, crowded at apex of branchlets; blade of adult leaves narrowly oblanceolate or linear-oblanceolate, (2.5–)5–7 × (0.5–)0.8–1.2 cm but juvenile leaves larger, leathery, midvein prominent and raised adaxially, less distinct but more broadly raised abaxially, base tapered into short petiole, margin slightly revolute, apex rounded or obtuse, subacute in juvenile leaves, sometimes mucronate. Pollen cones axillary, always solitary, sessile, cylindrical or ovoid-cylindrical, 3–3.5 cm × ca. 7 mm, surrounded at base by a cluster of membranous scales ca. 2 mm wide. Seed-bearing structures borne

on peduncles ca. 1 cm. Receptacle red when ripe, cylindrical, 1–1.3 cm, base with 2 deciduous, lanceolate sterile bracts ca. 1.5 mm. Epimatium dark blue when ripe. Seed ellipsoid, (8–)9–10 × 6–7 mm, apex rounded, shortly mucronate, mucro ca. 1 mm.

Coastal rocks; near sea level. Taiwan (Lan Yu opposite SE coast) [Philippines].

Misidentified as *Podocarpus polystachyus* R. Brown ex Endlicher (from Indonesia, Malaysia, and the Philippines) by several authors dealing with the Chinese flora.

4. *Podocarpus forrestii* Craib & W. W. Smith, Notes Roy. Bot. Gard. Edinburgh 12: 219. 1920.

大理罗汉松 da li luo han song

Margbensonia forrestii (Craib & W. W. Smith) A. V. Bobrov & Melikyan.

Shrubs to 3 m, to 5.5 m in cultivation; branchlets robust, relatively thick, rather rigid, densely leafy. Leaves densely crowded; petiole 2–4 mm, narrowly winged; blade dark green and matt adaxially, grayish green abaxially, elliptic to linear-elliptic, 2–9 cm × 6–10 mm, rather leathery, midvein prominent, 0.5–1 mm wide, stomatal lines 30–50 on abaxial surface, base cuneate or shortly attenuate, margin thickened abaxially, apex obtuse or subacute. Pollen cones borne in clusters of 3, spikelike, 1.5–2 cm × ca. 2 mm; bracts acute, occasionally irregularly obtuse. Seed-bearing structures axillary, solitary; peduncle ca. 8 cm. Receptacle glaucous blue when immature, cylindrical, relatively thin, slightly narrowed distally, ca. 3 mm, base with 2 linear bracts ca. 2 mm. Seed globose, 7–8 mm in diam. Seed maturity Aug.

• Dry or damp, shady places, open thickets, scrub, also cultivated in gardens and school yards; 2400–3000 m. Yunnan (Dali Xian; Diancang Shan).

Perhaps represents no more than the juvenile state of *Podocarpus macrophyllus* var. *macrophyllus*. It was placed in the synonymy of that species by de Laubenfels (Blumea 30: 276. 1985).

5. *Podocarpus nakaii* Hayata, Icon. Pl. Formos. 6: 66. 1916.

台湾罗汉松 tai wan luo han song

Podocarpus macrophyllus (Thunberg) Sweet var. *nakaii* (Hayata) H. L. Li & H. Keng.

Trees to 18 m tall; trunk to 1.8 m d.b.h.; bark pale gray, fibrous; branches terete, glabrous. Foliage buds globose; scales wholly overlapping, blunt at apex, primary scales triangular, secondary scales rounded. Leaves crowded at apex of branchlets, alternate; blade bright green adaxially, pale green (drying brownish) and glaucous abaxially, linear, linear-lanceolate, or lanceolate, straight or slightly falcate, 5–10.5 × 0.8–1.4 cm, 5–7 × as long as wide, leathery, midvein raised adaxially as a ridge at least 0.5 mm wide, a flat or slightly raised abaxially, base attenuate or cuneate into short petiole ca. 5 mm, margin narrow, slightly raised and thickened abaxially but not revolute, apex subacute or acute. Pollen cones axillary, solitary or in clusters of 2 or 3, sessile, 2–4 cm, with several spirally arranged, basal bracts. Seed-bearing structures axillary, solitary;

peduncle 2–12 mm. Receptacle orange or scarlet when ripe, obconical-ellipsoid, 4–9 × 3–6 mm, with 2 inconspicuous, longitudinal grooves. Epimatium greenish. Seed solitary, axillary, ovoid or ellipsoid-ovoid, 1–1.2 cm × 7–8 mm, with a large crest, apex narrow, pointed.

• Evergreen broad-leaved forests; 300–800 m. C Taiwan.

6. *Podocarpus annamiensis* N. E. Gray, J. Arnold Arbor. 39: 451. 1958.

海南罗汉松 hai nan luo han song

Trees to 16 m tall; trunk to 1 m d.b.h.; bark pale grayish brown. Foliage buds globose; scales wholly overlapping, blunt at apex, primary scales triangular, secondary scales rounded. Leaves radially spreading; petiole 2–4 mm; blade linear-lanceolate or linear, occasionally elliptic-lanceolate, distally tapered, 4–10.5(–18) cm × 5–11(–20) mm, 8–10 × as long as wide, thick, leathery, midvein raised on both surfaces, stomatal bands abaxial, 3.8–4.5 mm wide, base attenuate, apex obtuse or subacute. Pollen cones solitary, occasionally in clusters of 2 or 3, subsessile, pale yellow, spikelike, 3–5 cm. Seed-bearing structures axillary, solitary; peduncle 2–10 mm. Receptacle orange-red when ripe, obconical-ellipsoid, somewhat flattened distally, equaling or slightly longer than seed. Epimatium dark bluish purple and glaucous when ripe. Seed ovoid, 8–10 × ca. 6 mm, not crested. Pollination Mar–Apr, seed maturity Sep–Oct.

Tropical montane rainforests, evergreen broad-leaved forests on laterite and granitic yellow-earth; 600–1600 m. Hainan (Lingshui Xian, Wuzhi Shan) [E Myanmar, Vietnam].

A vulnerable species in China; only a few trees now remain in unexploited forests in S Hainan. The wood is excellent for carving and making writing materials and musical instruments. *Podocarpus annamiensis* has recently been considered a synonym of *P. nerifolius* by N. T. Hiep & J. E. Vidal (Fl. Cambodge, Laos et Vietnam 28: 105. 1996).

7. *Podocarpus macrophyllus* (Thunberg) Sweet, Hort. Suburb. Londin. 211. 1818.

罗汉松 luo han song

Trees to 20 m tall; trunk to 60 cm d.b.h.; bark gray or grayish brown, peeling off in thin flakes; branches spreading or erect-spreading, rather dense; branchlets glabrous or pubescent. Leaves spirally arranged, sessile; blade dark green and glossy adaxially, grayish green, pale green, or tinged white abaxially, linear-lanceolate, oblanceolate, or oblong-oblanceolate, slightly curved, 1.7–12 cm × 2–10 mm, midvein prominently raised adaxially, slightly raised abaxially, base cuneate, apex mucronate or acute to long acuminate. Pollen cones axillary, usually in clusters of 3–5 on very short peduncle, spikelike, 3–5 cm, with several triangular bracts at base. Seed-bearing structures axillary, solitary, pedunculate, with few basal bracts. Receptacle red or purplish red when ripe, columnar. Epimatium purplish black when ripe, with white powder. Seed ovoid, ca. 1

cm in diam., apex rounded. Pollination Apr–May, seed maturity Aug–Sep. $2n = 38$.

Forests, open thickets, roadsides; near sea level to 1000 m. Anhui, Fujian, Guangdong, Guangxi, Guizhou, Hubei, Hunan, Jiangsu, Jiangxi, Sichuan, ?Taiwan, Yunnan, Zhejiang; introduced or status uncertain in Shaanxi [Japan, ?N Myanmar].

- 1a. Branches erect; crown columnar; leaf blade oblanceolate or oblong-oblanceolate 7b. var. *chingii*
crown
not columnar; leaf blade linear-lanceolate.
2a. Leaf blade (5–)7–10 mm wide 7a. var. *macrophyllus*
2b. Leaf blade 2–7 mm wide.
3a. Leaf blade usually 5–12 cm × 3–6 mm, apex acuminate or subacute 7c. var. *angustifolius*
3b. Leaf blade 1.7–7 cm × 5–7 mm, apex shortly acuminate, mucronate, or obtuse.
4a. Branchlets densely blackish brown pubescent 7d. var. *piliramulus*
4b. Branchlets glabrous 7e. var. *maki*

7a. Podocarpus macrophyllus var. **macrophyllus**

罗汉松(原变种) *luo han song* (yuan bian zhong)
Taxus macrophylla Thunberg in Murray, *Syst. Veg.*, ed. 14, 895. 1784; *Margbensoia macrophylla* (Thunberg) A. V. Bobrov & Melikyan; *Nageia macrophylla* (Thunberg) F. Mueller.

Crown not columnar; branches spreading or erect-spreading; branchlets glabrous. Leaf blade 7–12 cm × (5–)7–10 mm, apex acute.

Anhui, Fujian, Guangdong, Guangxi, Guizhou, Hubei, Hunan, Jiangsu, Jiangxi, Sichuan, Yunnan, Zhejiang [Japan].

The wood is used in making furniture, utensils, paper, and farm implements.

7b. Podocarpus macrophyllus var. **chingii** N. E. Gray, *J. Arnold Arbor.* 39: 474. 1958.

柱冠罗汉松 *zhu guan luo han song*
Margbensoia chingiana (S. Y. Hu) A. V. Bobrov & Melikyan; *Podocarpus chingianus* S. Y. Hu.

Crown columnar; branches erect; branchlets covered with dense, prominently projecting, transversely elliptic leaf scars. Leaf blade 0.8–3.5 cm × 1–4 mm, apex obtuse or subacute.

• Forests, open thickets; near sea level to 1000 m. Jiangsu, ?Sichuan, Zhejiang.

This taxon was regarded as a cultivar of *Podocarpus macrophyllus* (cv. *Chingii*) by S. Y. Zhang in *Fl. Zhejiang*.

7c. Podocarpus macrophyllus var. **angustifolius** Blume, *Rumphia* 3: 215. 1847.

狭叶罗汉松 *xia ye luo han song*
Podocarpus macrophyllus f. *angustifolius* (Blume) Pilger.

Crown not columnar; branches spreading or erect-spreading. Leaf blade usually 5–12 cm × 3–6 mm, apex acuminate or subacute.

Guizhou, Jiangxi, Sichuan [Japan].

Perhaps represents no more than the juvenile state of *Podocarpus macrophyllus* var. *maki*.

7d. Podocarpus macrophyllus var. **piliramulus** Z. X. Chen & Z. Q. Li, *Bull. Bot. Res.*, Harbin 9(3): 69. 1989.

毛枝罗汉松 *mao zhi luo han song*

Crown not columnar; branches spreading or erect-spreading; branchlets densely blackish brown pubescent. Leaf blade 1.7–7 cm × 2–4.5 mm, apex mucronate.

• Roadsides. NW Hubei (Zhushan Xian).

7e. Podocarpus macrophyllus var. **maki** Siebold & Zuccarini, *Abh. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss.* 4(3): 232. 1846.

短叶罗汉松 *duan ye luo han song*

Margbensoia maki (Siebold & Zuccarini) A. V. Bobrov & Melikyan; *Myrica esquirolii* H. Léveillé; *Nageia macrophylla* var. *maki* (Siebold & Zuccarini) Voss; *Podocarpus chinensis* Wallich ex J. Forbes; *P. chinensis* var. *maki* (Siebold & Zuccarini) Hao; *P. japonicus* Siebold ex Endlicher (1847), not J. Nelson (1866); *P. macrophyllus* subsp. *maki* (Siebold & Zuccarini) Pilger.

Crown not columnar; branches erect-spreading; branchlets glabrous. Leaf blade (2.5–)3.5–7 cm × 5–7 mm, apex obtuse or shortly acuminate.

Native distribution unclear because of widespread cultivation.

Possibly native in Guangdong, Taiwan, Zhejiang; introduced or status uncertain in Anhui, Fujian, Guangxi, Guizhou, Hubei, Hunan, Jiangsu, Jiangxi, Shaanxi, Sichuan, Yunnan [possibly native in Japan and N Myanmar].

