Flora of China 4: 42–44. 1999.

8. KETELEERIA Carrière, Rev. Hort. 37: 449. 1866.

油杉属 you shan shu

Trees evergreen; bark longitudinally fissured; crown broad; branches irregular, long; branchlets weakly ridged and grooved with poorly defined pulvini and small, circular leaf scars; short branchlets absent. Leaves spirally and usually ± pectinately arranged, or occasionally almost radially spreading, linear to lanceolate, flattened, midvein raised on both sides, stomatal lines usually all abaxial, in 2 bands separated by midvein, sometimes also a few adaxial lines present, vascular bundle 1, resin canals 2, sublateral, marginal. Pollen cones lateral or terminal, 4–8 in umbellate clusters, arising from a single bud; pollen 2-saccate. Seed cones terminal, solitary, erect, cylindric or conical-cylindric, maturing in 1st year; rachis breaking off near base or slowly disintegrating. Seed scales woody, persistent. Bracts ligulate-spatulate, 1/2–3/5 as long as seed scales, apex cuspidate or 3-lobed. Seeds triangular-oblong, covered on 1 side by wing, together as long as seed scales; wing lustrous, semitrullate or cuneate, leathery-membranous. Cotyledons 2–4. Germination hypogeal. 2*n* = 24*.

Three to five species: China, Laos, Vietnam; five species (three endemic) in China.

1a. Leaves narrowly linear-lanceolate or lanceolate; seed scales at middle of cones rhombic-ovate or narrowly so, apex ± emarginate ..... 1. *K. hainanensis*

1b. Leaves linear; seed scales variable in shape, apex entire, erose-denticulate, or slightly concave.

2a. Seed scales compressed orbicular, oblong, or rhombic-orbicular, widest at or above middle, as wide as or wider than long, apex entire, truncate-rounded, or ± convex; wing cuneate; leaves 1.5–4 cm ..... 2. *K. fortunei*

2b. Seed scales variously shaped, widest below or rarely at middle, as long as or longer than wide, distal margin erose-denticulate, emarginate, or entire, apex ± narrowed, recurved; wing semitrullate; leaves often longer.

3a. Seed scales rhombic-ovate, distinctly longer than wide, apex subacute, erose-denticulate; leaves 4–6.5 cm, margin not recurved, apex usually ± mucronate ..... 3. *K. evelyniana*

3b. Seed scales subcordate, rhombic-subcordate, or -ovate, as long as or slightly longer than wide, apex obtuse, entire or concave, rarely weakly denticulate; leaves usually shorter, margin slightly recurved, apex obtuse or truncate.

4a. Branchlets densely rusty brown pubescent in 1st or 2nd year; seed scales black-brown, pentagonal-ovate, densely rusty brown pubescent abaxially, apex concave ..... 4. *K. pubescens*

4b. Branchlets glabrous or slightly pubescent in 1st or 2nd year; seed scales brown-yellow, variously shaped but not pentagonal, glabrous abaxially, apex often ± recurved ..... 5. *K. davidiana*

1. Keteleeria hainanensis Chun & Tsiang, Acta Phytotax. Sin. 8: 259. 1963.

海南油杉 hai nan you shan

Keteleeria evelyniana Masters var. *hainanensis* (Chun & Tsiang) Silba.

Trees to 30 m tall; trunk to 2 m d.b.h.; bark light gray or yellowish brown, rough, irregularly and longitudinally fissured; crown conical; branchlets reddish brown in 1st or 2nd year, finally grayish brown or gray, glabrous. Leaves almost radially spreading, narrowly linear-lanceolate or lanceolate, 5–14 cm × 3–4(–9) mm, stomatal lines abaxial, 8–16 in each band, apex usually acuminate. Seed cones cylindric, 14–18 × ca. 7 cm, base usually narrowed. Seed scales at middle of cones rhombic-ovate, ca. 4 × 2.5–3 cm, exposed part glabrous abaxially, apex narrowed, ± emarginate. Seeds nearly triangular-ellipsoid, 1.4–1.6 cm × 6–7 mm; wing yellowish brown, semitrullate. Pollination Jan–Feb, seed maturity following winter.

• Hills, mountains; 1000–1400 m. Hainan.

An endangered species. However, some authors regard it as representing the juvenile growth of *Keteleeria evelyniana*.

2. Keteleeria fortunei (A. Murray bis) Carrière, Rev. Hort. 37: 449. 1866.

油杉 you shan

Trees to 30 m tall; trunk to 1 m d.b.h.; bark dark gray, rough, longitudinally fissured; crown pyramidal; branchlets initially orange-red or reddish, turning yellowish gray or yellowish brown in 2nd or 3rd year, ± pubescent. Leaves pectinately arranged in lateral sets, linear, 1.2–3(–4) cm × 2–4 mm, stomatal lines (0–)2–4(–10) adaxially and 12–17 in each band abaxially, apex obtuse, rarely acute or slightly notched. Seed cones cylindric or oblong-cylindric, 6–18(–20) × (3.5–

)5–6.5 cm. Seed scales compressed orbicular, rhombic-orbicular, or rarely oblong, thick or thin, (1.8–)2.5–3.2 × (1.8–)2.7–3.5 cm,exposed part glabrous abaxially, margin entire, apex convex, rounded, or rounded-truncate. Seeds oblong, 1–1.3 cm × 5–6 mm; wing yellowish brown, ± cuneate, apex oblique. Pollination Mar–Apr, seed maturity Oct.

Hills, mountains, broad-leaved forests; 200–1400 m. S Fujian, Guangdong, Guangxi, Guizhou, S Hunan, SW Jiangxi, SE Yunnan, SW Zhejiang [N Vietnam].

A vulnerable species in China. The timber is used for construction and furniture. The species is also cultivated for afforestation and as an ornamental.

1a. Leaf scars obviously protruding on branchlets, dark; seed scales thin .. 2c. var. *oblonga*
1b. Leaf scars not obviously protruding on branchlets; seed scales relatively thick.
2a. Margin of seed scales compressed orbicular, truncate-rounded, broadly rounded, or emarginate; wing of seeds broadest distally; apex of leaves obtuse 2a. var. *fortunei*
2b. Margin of seed scales rhombic or rhombic-orbicular, usually rounded; wing of seeds broadest near middle; apex of leaf rounded or notched ..... 2b. var. *cyclolepis*

2a. Keteleeria fortunei var. **fortunei**

油杉(原变种) you shan (yuan bian zhong)

Picea fortunei A. Murray bis, Proc. Roy. Hort. Soc. London 2: 421. 1862.

Leaf scars not protruding on branchlets. Leaves thick, 1.2–3 cm × 2–4 mm, margin narrow and flat or wide and revolute, apex obtuse. Seed scales compressed orbicular, thick, apex truncate-rounded, broadly rounded, or emarginate. Wing of seeds broadest distally.

Hills, mountains, broad-leaved forests; 200–1400 m. S Fujian, E and S Guangdong, Guangxi [N Vietnam (Cao Bang province)].

2b. Keteleeria fortunei var. **cyclolepis** (Flous) Silba, Phytologia 68: 35. 1990.

江南油杉 jiang nan you shan

Keteleeria cyclolepis Flous, Bull. Soc. Hist. Nat. Toulouse 69: 402. 1936.

Leaf scars not protruding on branchlets. Leaves thin, 1.5–4 cm × 2–4 mm, apex rounded or notched. Seed scales rhombic, rhombic-orbicular, or suborbicular, thick, apex rounded (rarely broadly so). Wing of seeds broadest at middle.

• Hills, mountains; 300–1400 m. N Guangdong, E and NW Guangxi, Guizhou, S Hunan, SW Jiangxi, SE Yunnan, SW Zhejiang.

2c. Keteleeria fortunei var. **oblonga** (W. C. Cheng & L. K. Fu) L. K. Fu & Nan Li, Novon 7: 261. 1997.

矩鳞油杉 ju lin you shan

Keteleeria oblonga W. C. Cheng & L. K. Fu in W. C. Cheng & al., Acta Phytotax. Sin. 13(4): 82. 1975.

Leaf scars obviously protruding on branchlets, dark. Seed scales oblong, very thin.

• Hills; 400–700 m. W Guangxi (Tianyang Xian).

3. Keteleeria evelyniana Masters, Gard. Chron., ser. 3, 33: 194. 1903.

云南油杉 yun nan you shan

Keteleeria delavayi Tieghem; *K. dopiana* Flous; *K. evelyniana* var. *pendula* Hsüeh.

Trees to 40 m tall; trunk to 1 m d.b.h.; bark grayish brown, irregularly and longitudinally fissured, flaking; branchlets reddish or brownish red, turning gray-brown, yellow-brown, or brown, usually initially pubescent, glabrous in 2nd or 3rd year. Leaves narrowly linear, usually slightly falcate, (2–)4–6.5 cm × 2–3.5 mm, stomatal lines (0–)4–20 adaxially, 28–38 in each band abaxially, apex usually mucronate. Seed cones cylindric, (7–)9–20(–25) × (3.5–) 4–6.5 cm. Seed scales at middle of cones rhombic-ovate, (2–)3–4 × (2–)2.5–3 cm, exposed part of abaxial surface pubescent or nearly glabrous, apex subacute, erose-denticulate. Seeds oblong, 0.9–1.4 cm × 5–7 mm; wing yellowish brown, semitrullate. Pollination Apr–May, seed maturity Oct.

Mountains, river basins; 700–2900 m. W Guizhou, W Sichuan, Yunnan [Laos, Vietnam].

The timber is used for construction, bridge building, furniture, and wood fiber.

4. Keteleeria pubescens W. C. Cheng & L. K. Fu in W. C. Cheng & al., Acta Phytotax. Sin. 13(4): 82. 1975.

柔毛油杉 rou mao you shan

Keteleeria davidiana (Bertrand) Beissner var. *pubescens* (W. C. Cheng & L. K. Fu) Silba.

Bark dark brown or brownish gray, longitudinally fissured. Branchlets green in 1st or 2nd year, finally dark brown or dark reddish brown, densely pubescent. Leaves irregularly pectinately arranged on lateral branchlets, directed forward on main and cone-bearing branchlets, linear, 1.5–3 cm × 3–4 mm, stomatal lines abaxial, margin reflexed when dry, apex obtuse or acute. Seed cones glaucous when immature, ellipsoid-cylindric, 7–11 × 3–3.5 cm. Seed scales at middle of cones subcordate, ca. 2 × 2 cm, densely pubescent abaxially, distal margin emarginate or truncate, slightly recurved. Wing of seeds light brown, semitrullate.

• Hills, mountains; 600–1000 m. N Guangxi, S Guizhou.

Some authors place this species within *Keteleeria davidiana*.

5. Keteleeria davidiana (Bertrand) Beissner, Handb. Nadelholzk 424. 1891.

铁坚杉 tie jian shan

Trees to 50 m tall; trunk to 2.5 m d.b.h.; bark dark gray, rough, longitudinally fissured, flaking; crown oblate; branchlets initially yellowish gray, yellow, or light gray, turning gray or light brown in 2nd or 3rd year, pubescent or glabrous. Leaves usually pectinately arranged, linear, 2–5 cm × 3–4.5 mm, stomatal lines

few or none adaxially, 20–32 in each band abaxially, margin slightly revolute, apex obtuse or slightly emarginate. Seed cones cylindric or ovoid-cylindric, (5–)8–21 × (3.5–)4–6 cm. Seed scales at middle of cones subcordate or rhombic-subcordate, 2.5–3.2 × 2.2–2.8 cm, glabrous or ± pubescent abaxially, distal margin entire or slightly denticulate, apex ± narrowed, often reflexed. Seeds oblong, 1–1.5 cm × 6–8 mm; wing light brown, semitrullate. Pollination Mar, seed maturity Oct–Nov.

• Hills, mountains, hot and dry valleys; 200–1500 m. SE Gansu, N Guangxi, Guizhou, W Hubei, SW Hunan, S Shaanxi, SE Sichuan, Taiwan, Yunnan.

The timber is used for construction, bridge building, furniture, and wood fiber.

1a. Leaf scars obviously protruding on branchlets, dark ..... 5c. var. *formosana*
1b. Leaf scars obscurely protruding on branchlets.
2a. First-year branchlets yellowish gray or light gray; apex of seed scales ± narrowed; winter buds ovoid ..... 5a. var. *davidiana*
2b. First-year branchlets yellow; apex of seed scales obtuse-rounded; winter buds globose ..... 5b. var. *calcarea*

5a. Keteleeria davidiana var. **davidiana**

铁坚杉(原变种) tie jian shan (yuan bian zhong)

Pseudotsuga davidiana Bertrand, Bull. Soc. Philom. Paris, sér. 6, 9: 38. 1872; *Abies sacra* Franchet; *Keteleeria chienpeii* Flous; *K. davidiana* var. *chienpeii* (Flous) W. C. Cheng & L. K. Fu; *K. davidiana* var. *sacra* (Franchet) Beissner & Fitschen; *K. esquirolii* H. Léveillé; *K. fortunei* (A. Murray bis) Carrière var. *xerophila* (Hsüeh & S. H. Hao) Silba; *K. sacra* (Franchet) Beissner; *K. xerophila* Hsüeh & S. H. Hao; *Podocarpus sutchuenensis* Franchet.

First-year branchlets yellowish gray or light gray. Winter buds ovoid. Leaf scars obscurely protruding on branchlets. Apex of seed scales ± narrowed.

• Hills, mountains, hot and dry valleys; 600–1500 m. SE Gansu, NE Guangxi, Guizhou, W Hubei, SW Hunan, S Shaanxi, SE Sichuan, Yunnan.

5b. Keteleeria davidiana var. **calcarea** (W. C. Cheng & L. K. Fu) Silba, Phytologia 68: 34. 1990.

黄枝油杉 huang zhi you shan

Keteleeria calcarea W. C. Cheng & L. K. Fu in W. C. Cheng & al., Acta Phytotax. Sin. 13(4): 82. 1975.

First-year branchlets yellow. Winter buds globose. Leaf scars obscurely protruding on branchlets. Apex of seed scales obtuse-rounded.

• Usually on calcareous mountains; 200–1100 m. N Guangxi, S Guizhou.

A vulnerable plant. The timber is used for construction and furniture. The plant is also cultivated for afforestation and as an ornamental.

5c. Keteleeria davidiana var. **formosana** (Hayata) Hayata, J. Coll. Sci. Imp. Univ. Tokyo 25(19): 221. 1908.

台湾油杉 tai wan you shan

Keteleeria formosana Hayata, Gard. Chron., ser. 3, 43: 194. 1908.

Leaf scars obviously protruding on branchlets, dark.

• Hills; 300–900 m. Taiwan.

Flora of China 4: 42–44. 1999.