

## 6. TSUGA (Endlicher) Carrière, *Traité Gén. Conif.* 185. 1855.

铁杉属 tie shan shu

*Pinus* Linnaeus sect. *Tsuga* Endlicher, *Syn. Conif.* 83. 1847; *Nothotsuga* Hu ex C. N. Page.

Trees evergreen; branches irregularly whorled; branchlets with leaf cushions and persistent winter bud scales at base; winter buds ovoid or globose, not resinous. Leaves pectinately arranged, rarely radially spreading (emerging in false whorls on lateral branchlets), petiolate; petiole twisted at base; blade usually linear and flattened, stomatal lines abaxial, rarely on each surface, in 2 white bands, separated by an elevated midvein, vascular bundle 1, resin canal 1 below vascular bundle. Pollen cones growing from lateral buds, solitary, rarely clustered in umbels from a single bud, ellipsoid or ovoid; pollen with ring-shaped, saccate structure near distal pole, rarely  $\pm$  2-saccate. Seed cones terminal (rarely lateral) on 2nd-year branchlets, solitary, pendulous, rarely erect, ovoid-globose to cylindrical or obovoid-oblong, maturing in 1st year. Seed scales thin, woody, persistent. Bracts included, rarely with slightly exerted, apical cusp. Seeds small, with small resin vesicles adaxially. Cotyledons 3–6. Germination epigeal.  $2n = 24^*$ .

Nine or ten species: E Asia and North America: four species (three endemic) in China.

- 1a. Leaves radially spreading (emerging in false whorls on lateral branchlets), blade with lines of stomata on each surface; pollen cones clustered in umbels from a single lateral bud; seed cones  $\pm$  erect, bracts slightly exerted at apex ..... 1. *T. longibracteata*
- 1b. Leaves pectinately arranged, blade with lines of stomata on abaxial surface only; pollen cones solitary; seed cones pendulous, bracts wholly included
  - 2a. Seed scales thin, slightly recurved distally; branchlets brown lanate ..... 2. *T. dumosa*
  - 2b. Seed scales thick, not recurved distally; branchlets not brown lanate.
    - 3a. Seed scales loosely arranged, narrowly elliptic, ca.  $2 \times$  as long as wide; seed cones ovoid-cylindric or narrowly ovoid ..... 3. *T. oblongisquamata*
    - 3b. Seed scales densely arranged, variable in shape, as long as or only slightly longer than wide; seed cones ovoid-globose or obovoid-oblong ..... 4. *T. chinensis*

**1. *Tsuga longibracteata*** W. C. Cheng, *Contr. Biol. Lab. Chin. Assoc. Advancem. Sci., Sect. Bot.*, 7(1): 1. 1932.

长苞铁杉 chang bao tie shan

*Nothotsuga longibracteata* (W. C. Cheng) Hu ex C. N. Page.

Trees to 30 m tall; trunk to 1 m d.b.h.; bark dark brown, longitudinally fissured; branchlets drying brownish yellow or reddish brown, aging brown-gray or dark brown, glabrous; winter buds scales keeled abaxially. Leaves with petiole 1–1.5 mm; blade 1.1–2(–2.4) cm  $\times$  1–2(–2.5) mm, smooth or faintly grooved, stomatal lines 7–12 adaxially, 10–16 along each surface abaxially, margin entire, apex somewhat acute or slightly obtuse. Seed cones purplish or red, maturing to dark brown, 2–5.8  $\times$  1.2–2.5 cm, persistent for several years, then breaking off whole or sometimes disintegrating. Seed scales at middle of cones broadly rhombic or suborbicular, 0.9–2.2  $\times$  1.2–2.5 cm, base peltate-auriculate, apex truncate-rounded. Bracts subspatulate, 0.7–1.8 cm, apical cusp acute or

acuminate. Seeds triangular-ovoid, 4–8  $\times$  2.5–3 mm; wing ovate-oblong, apex rounded. Pollination Mar–Apr, seed maturity Oct.

• Forming small, pure stands, or in evergreen, broad-leaved, sclerophyllous forests (species of *Castanopsis*, *Lithocarpus*, and *Quercus*), or mixed, mesophytic forests (*Fagus longipetiolata*, *Pinus kwangtungensis*, *Tetracentron sinensis*, etc.) on steep, sunny mountain slopes and ridges on acidic soils in areas with cool, temperate, humid climate and abundant rainfall and fog; (300–)400–1900(–2300) m. C and S Fujian, N Guangdong, C and N Guangxi, E Guizhou, S Hunan, S Jiangxi.

A vulnerable species; few trees survive in most populations because of large scale logging. R. R. Mill concurs with Page and other recent authors that this species is sufficiently distinct to be treated in its own genus as *Nothotsuga longibracteata*. It differs strikingly from other species of *Tsuga* as follows: leaves radially spreading, stomatal lines present on each surface; pollen cones clustered in umbels from a single lateral bud; seed cones  $\pm$  erect; bracts included except for slightly exerted, apical cusp. The name *Tsugo-keteleeria* Van Campo & Gaussen, described as a hybrid between *Tsuga* and *Keteleeria*, is invalid (ICBN, Art. 32.1(b) and H.6.2), as is the combination *Tsugo-keteleeria longibracteata* (W. C. Cheng) Van Campo & Gaussen.

An ideal tree for afforestation in mountains above middle elevations in subtropical regions. The timber is used for construction and furniture.

**2. *Tsuga dumosa*** (D. Don) Eichler in Engler & Prantl, Nat. Pflanzenfam. 2(1): 80. 1887.

云南铁杉 yun nan tie shan

*Pinus dumosa* D. Don in Lambert, Descr. Pinus 2: 55. 1824; *Abies yunnanensis* Franchet; *Pinus brunoniana* Wallich; *Tsuga brunoniana* (Wallich) Carrière; *T. calcarea* Downie; *T. chinensis* (Franchet) E. Pritzel subsp. *wardii* (Downie) E. Murray; *T. dumosa* var. *yunnanensis* (Franchet) Silba; *T. dura* Downie; *T. intermedia* Handel-Mazzetti; *T. leptophylla* Handel-Mazzetti; *T. wardii* Downie; *T. yunnanensis* (Franchet) E. Pritzel; *T. yunnanensis* subsp. *dura* (Downie) E. Murray.

Trees to 40 m tall; trunk to 2.7 m d.b.h.; bark brownish gray or gray-brown, thick, longitudinally fissured; crown pyramidal; branchlets initially yellowish or reddish brown, turning light brown or dark gray in 2nd or 3rd year, ridged and grooved, brown lanate. Leaves pectinately arranged, linear, rarely narrowly linear-lanceolate, 1–2.4(–3.5) cm × 1.5–3 mm, grooved adaxially, abaxial stomatal bands white, distal margin entire or serrulate, apex obtuse, entire or occasionally emarginate. Seed cones light green, maturing light brown, ovoid or narrowly so, 1.5–3 × 1–2 cm. Seed scales obovate-orbicular, 1–1.4 × 0.7–1.2 cm, base only slightly convex, distal part slightly recurved, very thin, smooth. Bracts cuneate-rhombic, margin denticulate, apex 2-lobed. Seeds obliquely ovoid or narrowly ovoid, 0.8–1.2 cm including wing. Pollination Apr–May, seed maturity Oct–Nov.

Mountain slopes, river basins; 2300–3500 m. Sichuan, S Xizang, N and W Yunnan [Bhutan, N India, N Myanmar, Nepal, Sikkim, N Vietnam].

The timber is used for construction and furniture.

**3. *Tsuga oblongisquamata*** (W. C. Cheng & L. K. Fu) L. K. Fu & Nan Li, Novon 7: 263. 1997.

矩鳞铁杉 ju lin tie shan

*Tsuga chinensis* (Franchet) E. Pritzel var. *oblongisquamata* W. C. Cheng & L. K. Fu in W. C. Cheng & al., Acta Phytotax. Sin. 13(4): 83. 1975.

Branchlets brownish yellow or brown, relatively stout, 1.5–2 mm in diam. Leaves without white bands of stomata, margin entire, apex rounded or slightly emarginate. Seed cones narrowly ovoid or ovoid-cylindric, 2–3 × 1.5–2.5 cm. Seed scales loosely overlapping, narrowly orbicular, ca. 2 × as long as wide, exposed part glabrous. Bracts without cusp at apex.

• Valleys, river basins; 2600–3200 m. S Gansu, W Hubei, N and W Sichuan.

Closely related to *Tsuga chinensis* and perhaps better treated as a variety of that species.

**4. *Tsuga chinensis*** (Franchet) E. Pritzel, Bot. Jahrb. Syst. 29: 217. 1900.

铁杉 tie shan

Trees to 50 m tall; trunk to 1.6 m d.b.h.; bark dark gray, longitudinally fissured, flaking; crown pyramidal; branchlets brown-yellow or grayish yellow initially, turning grayish yellow, gray, or brownish gray in 2nd or 3rd year, slender, pubescent; winter bud scales appressed or keeled at base of branchlets. Leaves pectinately arranged, linear, 1.2–2.7 cm × 2–3 mm, abaxial stomatal bands grayish green, margin entire, apex obtuse, entire or emarginate. Seed cones light green, maturing pale gray-yellow or pale brown, ovoid-globose to cylindric or obovoid-oblong, 1.5–4 × 1.2–2.5 cm. Seed scales at middle of cones densely arranged, square-orbicular, pentagonal-ovate, or compressed orbicular, 0.9–1.2 × 0.8–1.1 cm, apex rounded or nearly truncate. Bracts cuneate-obovate or obtriangular, apex erose. Seeds 7–9 mm including obliquely ovate wing. Pollination Apr, seed maturity Oct.

• Mountains, mixed forests, valleys, river basins; 1000–3500 m. Anhui, Fujian, S Gansu, Guangdong, Guangxi, N Guizhou, W Henan, W Hubei, Hunan, Jiangxi, S Shaanxi, Sichuan, Taiwan, Xizang, Yunnan, Zhejiang.

The timber is used for construction, aircraft, furniture, and in mines. The bark is used for producing tannin, the trunk for resin, and the roots, trunk, and branches for aromatic oils.

- 1a. Branchlets gray or yellow-gray, ca. 1 mm in diam.; seed cones ovoid, 1.5–2.5 × 1.2–1.6 cm.
  - 2a. Seed scales pentagonal-ovate, subsquare, or suborbicular ..... 4a. var. *chinensis*
  - 2b. Seed scales compressed orbicular or nearly semiorbicular ..... 4b. var. *formosana*
- 1b. Branchlets brownish yellow or brown, 1.5–2 mm in diam.; seed cones ovoid-globose, narrowly ovoid, ovoid-cylindric, or shortly cylindric, 2–4 × 1.5–3 cm.
  - 3a. Seed cones ovoid-globose, 2–2.5 × 1.8–2 cm; seed scales almost square, exposed part smooth, shining ... 4c. var. *patens*
  - 3b. Seed cones narrowly ovoid, ovoid-cylindric, or shortly cylindric, (2–)2.5–4 × 1.5–3 cm; seed scales narrowly ovate, oblong, or square-orbicular, exposed part striate and glabrous, or pubescent.
    - 4a. Seed cones slender, narrowly ovoid or ovoid-cylindric; seed

scales narrowly ovate or oblong, exposed part striate, glabrous, margin thickened ..... 4d. var. *forrestii*

4b. Seed cones stout, shortly cylindrical; seed scales square-orbicular, exposed part pubescent, margin not thickened

..... 4e. var. *robusta*

**4a. *Tsuga chinensis* var. *chinensis***

铁杉(原变种) tie shan (yuan bian zhong)

*Abies chinensis* Franchet, J. Bot. (Morot) 13: 259. 1899; *Tsuga chinensis* var. *tchekiangensis* (Flous) W. C. Cheng & L. K. Fu; *T. dumosa* (D. Don) Eichler var. *chinensis* (Franchet) E. Pritzl; *T. tchekiangensis* Flous.

Branchlets gray or yellow-gray, ca. 1 mm in diam. Seed cones ovoid, 1.5–2.5 × 1.2–1.6 cm. Seed scales pentagonal-ovate, subsquare, or suborbicular.

• Mountains, river basins; 1000–3200 m. Anhui, Fujian, S Gansu, Guangdong, Guangxi, NW Guizhou, W Henan, W Hubei, Hunan, Jiangxi, S Shaanxi, Sichuan, Xizang, Yunnan, Zhejiang.

**4b. *Tsuga chinensis* var. *formosana*** (Hayata) H. L. Li & H. Keng, *Taiwania* 5: 64. 1954.

台湾铁杉 tai wan tie shan

*Tsuga formosana* Hayata, Gard. Chron., ser. 3, 43: 194. 1908; *T. chinensis* var. *daibuensis* S. S. Ying.

Branchlets gray or yellow-gray, ca. 1 mm in diam. Seed cones ovoid, 1.5–2.5 × 1.2–1.6 cm. Seed scales compressed orbicular or almost semiorbicular.

• Mountains; 2000–3500 m. Taiwan.

**4c. *Tsuga chinensis* var. *patens*** (Downie) L. K. Fu & Nan Li, *Novon* 7: 263. 1997.

长阳铁杉 chang yang tie shan

*Tsuga patens* Downie, Notes Roy. Bot. Gard. Edinburgh 14: 16. 1923; *T. chinensis* subsp. *patens* (Downie) E. Murray.

Branchlets brownish yellow or brown, 1.5–2 mm in diam. Seed cones ovoid-globose, 2–2.5 × 1.8–2 cm. Seed scales almost square, thick, exposed part smooth and shining.

• Mountains; 2000–2300 m. W Hubei (Changyang Xian).

**4d. *Tsuga chinensis* var. *forrestii*** (Downie) Silba, *Phytologia* 68: 72. 1990.

丽江铁杉 li jiang tie shan

*Tsuga forrestii* Downie, Notes Roy. Bot. Gard. Edinburgh 14: 18. 1923.

Branchlets brownish yellow or brown, 1.5–2 mm in diam. Seed cones narrowly ovoid or ovoid-cylindric, (2–)2.5–4 × 1.5–3 cm. Seed scales narrowly ovate or oblong, exposed part striate, glabrous, margin thickened.

• Mountains, valleys, mixed forests; 2000–3000 m. NE Guizhou (Jiangkou: Fanjing Shan), SW Sichuan, NW Yunnan.

A vulnerable plant.

**4e. *Tsuga chinensis* var. *robusta*** W. C. Cheng & L. K. Fu in W. C. Cheng & al., *Acta Phytotax. Sin.* 13(4): 83. 1975.

大果铁杉 da guo tie shan

Branchlets brownish yellow or brown, 1.5–2 mm in diam. Seed cones ovoid-cylindric or narrowly ovoid, 2–4 × 1.5–2.5 cm. Seed scales square-orbicular, exposed part pubescent. Bracts cuspidate at apex.

• Mountains; ca. 1800 m. W Hubei (Badong Xian), W Sichuan (Yalong Jiang valley).

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