

## EQUISETACEAE

木贼科 mu ze ke

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Plants perennial, homosporous, small to large, terrestrial, aquatic, or in shallow water. Rhizome creeping, sometimes erect or ascending, blackish brown, branched, with nodes; nodes with roots densely covered with trichomes or glabrous. Aerial stems annual or perennial, erect, monomorphic or dimorphic, green but lower nodes often blackish brown, terete, with nodes, hollow and with longitudinal canals in center, often with silica tubercles on epidermis, unbranched or with whorled branches; internodes with longitudinal ridges and grooves. Leaves reduced, scalelike, whorled; lower portion fused to form a collarlike sheath around base of internode; upper portion lobed. Strobili conelike, terminal on stem or branches, terete or ellipsoid, sometimes stalked; sporophylls whorled, peltate, hexagonal in surface view, imbricate, with 5–10 sporangia per sporophyll. Sporangia saclike, in whorls on abaxial side of sporophylls. Spores green, subglobose or globose, 35–70 µm in diam., each with 4 spirally curled, white filaments (elaters) that uncurl upon drying, without colpi, with thin and transparent perispores; perispores with granular ornamentation. Gametophytes growing at or near soil surface, green, disk- to cushion-shaped, irregularly lobed.  $x = 108$ .

One genus and ca. 15 species: cosmopolitan, except Antarctica; ten species in China.

Zhang Libing. 2004. Equisetaceae. In: Zhang Xianchun, ed., *Fl. Reipubl. Popularis Sin.* 6(3): 224–243.

### 1. EQUISETUM Linnaeus, Sp. Pl. 2: 1061. 1753.

木贼属 mu ze shu

*Allostelites* Börner; *Hippochaete* Milde; *Presla* Dulac.

Morphological characters and geographic distribution are the same as those of the family.

*Equisetum lyi* H. Léveillé (Bull. Herb. Boissier, sér. 2, 6: 506. 1906) was described from Guizhou (“Pin-Fa”). It could not be treated here because the current authors could not trace any specimens, including the type, which was stated in the protologue to be in the herbarium of the Académie internationale de géographie botanique.

- 1a. Aerial stems lasting more than one year; main stem often unbranched; stomata sunken, in one row; strobili mucronate apically; sheath teeth membranous, deciduous, light brown or gray (*E.* subg. *Hippochaete* (Milde) Baker).
  - 2a. Aerial stems irregularly undulate; main stem ca. 0.6 mm in diam., solid and without longitudinal canals in center, 7- or more ridged, with 3(–5) sheath teeth ..... 10. *E. scirpoides*
  - 2b. Aerial stems not irregularly undulate; main stem more than 1 mm in diam., hollow and with longitudinal canals in center, 6-ridged, with 6 or more sheath teeth.
    - 3a. Mature main stem branched in whorls; sheath tubes grayish white or slightly reddish brown at apex ..... 7. *E. ramosissimum*
    - 3b. Mature main stem unbranched or rarely branched but not in whorls; sheath tubes blackish brown at apex.
      - 4a. Main stem robust, 5–9 mm in diam. at middle, up to 1 m tall or taller; apices of sheath teeth falling off early; sheath teeth 2-ridged abaxially ..... 8. *E. hyemale*
      - 4b. Main stem slender, (1–)2–3(–4) mm in diam. at middle, 18–50 cm tall; sheath teeth persistent, 4-ridged abaxially ..... 9. *E. variegatum*
- 1b. Aerial stems lasting one year or less; main stem often branched in regular whorls; stomata located on surfaces of aerial branches, in several rows; strobili blunt apically; sheath teeth leathery, persistent, blackish brown or reddish brown (*E.* subg. *Equisetum*).
  - 5a. Aerial stems monomorphic, fertile stems same as sterile stems morphologically or young fertile stems slightly different from sterile branches.
    - 6a. Plants large; aerial branches 40–60 cm, main stem 3–6 mm in diam. at middle; internodes of lower 1–3 nodes of main stems reddish brown, lustrous; main stem not branched in whorls or branched in whorls but branches much thinner than main stem ..... 3. *E. fluviatile*
    - 6b. Plants small; aerial branches 10–30 cm, main stem 1–2 mm in diam. at middle; internodes of lower 1–3 nodes of main stems blackish brown, not lustrous; main stem branched in whorls.
      - 7a. Two sides of ridges of main stem and lateral branches with raised edges; upper main stem and lateral branches with 1 row of tubercles reaching apex of sheath teeth and a deep groove going through back of sheaths ..... 1. *E. diffusum*

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- 7b. Two sides of ridges of main stem and lateral branches rounded, with neither edges nor tubercles (but only laterally cut); groove shallow, going through back of sheaths ..... 2. *E. palustre*
- 5b. Aerial stems dimorphic, fertile stems without or with few shorter and finer whorled branches, obviously different from sterile branches.
- 8a. Main sterile branch plus lateral branches narrower than 10 cm; whorled lateral branches of sterile branch pointing upward and forming a 30° or smaller angle with main stem; lateral branches approximately half of main stem in diam.; main stem branched or unbranched below middle; fertile branch unbranched ... 6. *E. arvense*
- 8b. Main sterile branch plus lateral branches up to 20 cm wide; whorled lateral branches of sterile branch pointing laterally or slightly upward and forming a 45°–90° angle with main stem; lateral branches much thinner than half of main stem in diam.; main stem unbranched below middle; fertile branch eventually branched.
- 9a. Sheath teeth of sterile branch (2 or) 3–5-lobed; lobes ovate-deltoid, reddish brown, two sides of ridges often with bristlelike protuberances; sheath teeth of lateral branches open ..... 4. *E. sylvaticum*
- 9b. Sheath teeth of sterile branch 14–22-lobed; lobes narrowly deltoid, blackish brown at middle and light brown on margins, two sides of ridges often with tubercles; sheath teeth of lateral branches not open ..... 5. *E. pratense*

**1. *Equisetum diffusum*** D. Don, Prodr. Fl. Nepal. 19. 1825.

披散木贼 pi san mu ze

*Equisetum diffusum* var. *paucidentatum* C. N. Page; *E. mekongense* C. N. Page.

Plants small to medium-sized. Rhizome creeping, erect, or ascending, blackish brown, nodes and roots with dense long yellowish brown trichomes or glabrous. Aerial stems annual, monomorphic, 10–30(–70) cm tall, 1–2 mm in diam. at middle, much branched; internodes 1.5–6 cm, green but those of lower 1–3 nodes blackish brown, not lustrous. Main stem 4–10-ridged; each side of ridge raised and forming edges reaching lower sheath teeth; each edge with a row of tubercles reaching sheath teeth; sheath tubes long, narrow, grayish green in lower portion, blackish brown in upper portion, with a deep groove going through back of sheath; sheath teeth 5–10, blackish brown, lanceolate, leathery, caudate at apex, persistent. Lateral branches slender, rigid, terete, 4–8-ridged; each side of ridge with edges and tubercles; sheath teeth 4–6, grayish green, deltoid, leathery, persistent. Strobilus terete, 1–9 cm, 4–8 mm in diam., apex blunt; stalk prolonged when mature and 1–3 cm.

Under bushes, roadsides; sea level to 3400 m. Chongqing, Gansu, Guangxi, Guizhou, Hunan, Jiangsu, Sichuan, Xizang, Yunnan [Bhutan, NE India, Japan, Kashmir, Myanmar, Nepal, Pakistan, Vietnam].

*Equisetum* × *wallichianum* C. N. Page (Fern Gaz. 11: 34. 1975), possibly a hybrid between *E. diffusum* and *E. arvense*, was described from China (possibly W Sichuan) and is said to be distributed in India and Nepal.

**2. *Equisetum palustre*** Linnaeus, Sp. Pl. 2: 1061. 1753.

犬问荆 quan wen jing

*Equisetum palustre* f. *polystachion* (Weigel) Villars; *E. palustre* var. *polystachion* Weigel; *E. palustre* var. *szechuanense* C. N. Page.

Plants small to medium-sized. Rhizome erect or creeping, blackish brown, nodes and roots with long yellowish brown trichomes or glabrous. Aerial stem annual, monomorphic, with branches often clumped at base of aerial stems, 20–50(–60) cm tall, 1.5–2 mm in diam. at middle, green, but those of lower 1 or 2 nodes blackish brown, not lustrous; internodes 2–4 cm. Main

stem 4–7-ridged; ridges arc-shaped abaxially and glabrous or with small cross grains; sheath tubes long, narrow, lower portion grayish green, upper portion light brown; back of sheath with a shallow groove; sheath teeth 4–7, blackish brown, lanceolate, membranous at margin, acuminate at apex, persistent. Lateral branches robust, up to 20 cm, terete to complanate, 4–6-ridged, glabrous or with small pale cross grains; sheath teeth 4–6, grayish green, lanceolate, thinly leathery, persistent. Strobilus ellipsoid or terete, 0.6–2.5 cm, 4–6 mm in diam., apex blunt; stalk prolonged when mature, 0.8–1.2 cm.  $2n = 216$ .

Under bushes, roadsides; 200–4000 m. Chongqing, Gansu, Guizhou, Hebei, Heilongjiang, Henan, Hubei, Hunan, Jiangxi, Jilin, Liaoning, Nei Mongol, Ningxia, Qinghai, Shaanxi, Shanxi, Sichuan, Xinjiang, Xizang, Yunnan [Japan, Kashmir, Korea, Mongolia, N Pakistan, Russia; C and SW Asia, Europe, North America].

**3. *Equisetum fluviatile*** Linnaeus, Sp. Pl. 2: 1062. 1753.

溪木贼 xi mu ze

*Equisetum fluviatile* f. *limosum* (Linnaeus) Farwell; *E. fluviatile* var. *limosum* (Linnaeus) Satou; *E. fluviatile* f. *linnaeanum* (Döll) M. Broun; *E. heleocharis* Ehrhart; *E. heleocharis* f. *fluviatile* (Linnaeus) Ascherson & Graebner; *E. heleocharis* f. *limosum* (Linnaeus) Ascherson & Graebner; *E. limosum* Linnaeus; *E. limosum* f. *linnaeanum* Döll; *E. limosum* f. *verticillatum* Döll.

Plants large. Rhizome creeping or erect, castaneous, hollow in center, nodes with long castaneous adventitious roots; adventitious roots often with long yellowish trichomes. Aerial stem perennial, monomorphic, hollow in center, 40–60(–70) cm tall, 3–6 mm in diam. at middle, lower portion of main stem with 1–3 reddish brown internodes, lustrous, upper portion of main stem straw-colored or grayish green, without whorled branches or with shorter, more slender whorled branches in comparison with main stem; internodes 3–5 cm. Main stem 14–20-ridged; ridges arc-shaped abaxially and glabrous and with small light-colored cross grains; sheath tubes light brown, long, narrow, 1–1.2 cm; sheath teeth 14–20, blackish brown, lanceolate, thinly leathery, flat abaxially, without grooves, persistent. Lateral branches absent or present, if present then slender, 5–15 cm, 0.6–1 cm in diam., straw-colored or grayish green, 5–7-ridged; ridges arc-shaped abaxially and glabrous or with small

cross grains; sheath teeth 4–6, straw-colored or light brown, thinly leathery, persistent. Strobilus shortly clavate or ellipsoid, 1.2–2.5 cm, 0.6–1.2 cm in diam., apex blunt; stalk prolonged when mature and 1.2–2 cm.  $2n = 216$ .

Under bushes, river valleys, stream banks, roadsides; 500–3000 m. Chongqing, Gansu, Heilongjiang, Jilin, Nei Mongol, Sichuan, Xinjiang, Xizang [Japan, Korea, Mongolia, Russia; C and SW Asia, Europe, North America].

#### 4. *Equisetum sylvaticum* Linnaeus, Sp. Pl. 2: 1061. 1753.

林木贼 lin mu zei

*Equisetum capillare* Hoffmann; *E. sylvaticum* var. *capillare* (Hoffmann) Milde; *E. sylvaticum* f. *multiramosum* Fernald; *E. sylvaticum* var. *multiramosum* (Fernald) Wherry.

Plants large or medium-sized. Rhizome erect or creeping, blackish brown, nodes and roots with sparse long yellowish brown trichomes or glabrous. Aerial stem annual, dimorphic, fertile and sterile stems appearing simultaneously. Fertile stems reddish brown, sometimes straw-colored, 20–30 cm tall, 2–2.5 mm in diam. at middle, branched eventually, 10–14-ridged; ridges glabrous; internodes 3–4 cm; sheath tubes reddish brown on upper portion, straw-colored in lower portion, 1.1–1.5 cm, with 3 or 4 broad sheath teeth; sheath teeth reddish brown, ovate-deltoid, 0.5–1.1 mm, membranous, with shallow grooves abaxially. Fertile stems remaining alive after spores shed. Sterile stems grayish green, 30–70 cm, 2.5–5.5 mm in diam. at middle, well branched in whorls, unbranched below middle, main stem 10–16-ridged; ridges edged abaxially and with bristlelike protuberances on sides; each ridge often with a row of tubercles; internodes 4.5–6 cm; sheath tubes reddish brown on upper portion, grayish green on lower portion, ca. 6 mm, with 3 or 4 broad sheath teeth; sheath teeth reddish brown, ovate-deltoid, ca. 0.6 cm, membranous, persistent. Lateral branches slender, complanate, 3–8-ridged; ridges with spine-shaped protuberances or glabrous abaxially; sheath teeth open. Strobilus terete, 1.5–2.5 cm, 5–7 mm in diam., apex blunt; stalk prolonged when mature and 3–4.5 cm.  $2n = 216$ .

Forests; 200–1600 m. Heilongjiang, Jilin, Nei Mongol, Shandong, Xinjiang [Japan, Mongolia, Russia; C Asia, Europe, North America (including Greenland)].

#### 5. *Equisetum pratense* Ehrhart, Hannover. Mag. 22: 138. 1784.

草问荆 cao wen jing

*Equisetum umbrosum* J. G. F. Meyer ex Willdenow.

Plants medium-sized. Rhizome erect or creeping, blackish brown, nodes and roots with sparse long yellowish brown trichomes or glabrous. Aerial stem annual, dimorphic, fertile and sterile stems appearing simultaneously. Fertile stems straw-colored, 15–25 cm tall, 2–2.5 mm in diam. at middle, branched eventually, 10–14-ridged; ridges glabrous; sheath tubes grayish green, ca. 0.6 cm; internodes 2–3 cm; sheath teeth 10–14, light brown, lanceolate, 4–6 mm, membranous, with shallow grooves abaxially. Fertile stems remaining alive after spores shed. Sterile stems straw-colored or grayish green, 30–60 cm, 2–2.5 mm in diam. at middle, well branched in whorls, unbranched below

middle, main stem 14–22-ridged; ridges arc-shaped abaxially, each ridge often with a row of tubercles; internodes 2.2–2.8 cm; sheath tubes long, narrow, ca. 3 mm, lower portion grayish green, upper portion grayish green but with a light brown band; sheath abaxially 2-ridged; sheath teeth 14–22, light brown but with a blackish brown line, lanceolate, membranous, persistent. Lateral branches slender, complanate, with 3 or 4 narrow and tall ridges; ridges glabrous abaxially; sheath teeth not open. Strobilus ellipsoid-terete, 1–2.2 cm, 3–7 mm in diam., apex blunt; stalk prolonged when mature and 1.7–4.5 cm.  $2n = 216$ .

Forest margins, stream banks, roadsides; 500–2800 m. Gansu, Hebei, Heilongjiang, Henan, Hubei, Hunan, Jilin, Nei Mongol, Shaanxi, Shandong, Shanxi, Xinjiang [Japan, Mongolia, Russia; C Asia, Europe, North America].

#### 6. *Equisetum arvense* Linnaeus, Sp. Pl. 2: 1061. 1753.

问荆 wen jing

*Allostelites arvensis* (Linnaeus) Börner; *E. arvense* f. *arcticum* (Ruprecht) M. Broun; *E. arvense* var. *arcticum* Ruprecht; *E. arvense* f. *boreale* (Bongard) Klinge; *E. arvense* subsp. *boreale* (Bongard) Á. Löve; *E. arvense* var. *boreale* (Bongard) Ruprecht; *E. arvense* f. *campestre* (Schultz) Klinge; *E. arvense* var. *campestre* (Schultz) Ruprecht; *E. arvense* f. *ramulosum* (Ruprecht) Klinge; *E. arvense* subsp. *ramulosum* (Ruprecht) W. F. Rapp; *E. arvense* var. *ramulosum* Ruprecht; *E. boreale* Bongard; *E. calderi* B. Boivin; *E. campestre* Schultz; *E. saxicola* Suksdorf.

Plants small to medium-sized. Rhizome ascending, erect, or creeping, blackish brown, nodes and roots with sparse long yellowish brown trichomes or glabrous. Aerial stem annual, dimorphic. Fertile stems appearing in spring earlier than sterile branches, yellowish brown, 5–35 cm tall, 3–5 mm in diam. at middle, not whorled, ridges inconspicuous, with dense grooves, internodes 2–6 cm; sheath castaneous or pale yellow, ca. 0.8 cm, only upper portion of sheath abaxially with a shallow groove; sheath teeth 9–12, castaneous, narrowly deltoid, 4–7 mm. Fertile stems dying back after spores shed (ephemeral). Sterile stems green, up to 40 cm, middle portion of main stem 1.5–3 mm, multiple whorled, below middle portion of main stem branched; internodes 2–3 cm; ridges arc-shaped abaxially, without edges, with cross grains, without tubercles; sheath green, long, narrow; sheath teeth 5 or 6, deltoid, middle portion blackish brown, margin membranous, light brown, persistent. Lateral branches slender, flattened, with 3 or 4 narrow and tall ridges, ridges abaxially with cross grains; sheath teeth 3–5, green, lanceolate, margin membranous, persistent. Strobilus terete, 1.8–4 cm, 0.9–1 cm in diam., apex blunt; stalk prolonged when mature and 3–6 cm.  $2n = 216$ .

Forests, forest margins, under bushes, meadows, banks of rivers and streams, open fields; sea level to 3700 m. Anhui, Chongqing, Fujian, Gansu, Guizhou, Hebei, Heilongjiang, Henan, Hubei, Jiangsu, Jiangxi, Jilin, Liaoning, Nei Mongol, Ningxia, Qinghai, Shaanxi, Shandong, Shanxi, Sichuan, Xinjiang, Xizang, Yunnan, Zhejiang [W. Bhutan, N India, Japan, Korea, Mongolia, Nepal, Russia; C and SW Asia, Europe, North America (including Greenland)].

Morphologically, sterile stems of *Equisetum arvense* are similar to those of *E. palustre*, but the former has more abundant and slender and

longer lateral branches, which are 3- or 4-ridged and with cross grains abaxially or on ridges.

**7. *Equisetum ramosissimum*** Desfontaines, Fl. Atlant. 2: 398. 1799.

节节草 jie jie cao

Plants small to medium-sized. Rhizome erect, creeping, or ascending, blackish brown, nodes and roots with few to numerous long yellowish brown trichomes or glabrous. Aerial stem perennial, monomorphic, green, 20–60 cm tall, 1–7 mm in diam. at middle, lower portion of main stem often branched, tufted; internodes 2–10 cm; young whorled branches conspicuous or inconspicuous; main stem 5–20-ridged, ridges arc-shaped abaxially, with a row of tubercles or small light brown cross grains; sheath tubes narrow, up to 1 cm, lower portion grayish green, upper portion usually grayish brown; sheath teeth 5–22, grayish white to light or blackish brown, deltoid, base flat or arc-shaped, margin (sometimes upper part) membranous, caducous or persistent, with conspicuous or inconspicuous stomatal bands. Lateral branches hard, terete, 5–12-ridged; ridge glabrous or with 1 row of tubercles or small pale cross grains; sheath teeth 5–10, upper portion brown, lanceolate, leathery but membranous at margin, usually persistent. Strobilus shortly clavate or ellipsoid, 0.5–2.5 cm, 0.4–0.7 cm in diam. at middle, apex with small acute tip, sessile.  $2n = 216$ .

Forests, forest margins, under bushes, meadows, banks of rivers and streams; sea level to 3600 m. Anhui, Chongqing, Fujian, Gansu, Guangdong, Guangxi, Guizhou, Hainan, Hebei, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Jilin, Liaoning, Nei Mongol, Ningxia, Qinghai, Shaanxi, Shandong, Shanxi, Sichuan, Taiwan, Xinjiang, Xizang, Yunnan, Zhejiang [Afghanistan, Bangladesh, Bhutan, India, Indonesia, Japan, Kashmir, Korea, Laos, Malaysia, Mongolia, Myanmar, Nepal, New Guinea, Pakistan, Philippines, Russia, Singapore, Sri Lanka, Thailand, Vietnam; Africa, C and SW Asia, Europe, S Pacific islands; introduced in North America].

Reviewer Ralf Knapp notes that both subspecies of *Equisetum ramosissimum* are present in Taiwan but that the exact distribution (both regional and elevational) is currently insufficiently known. The highest known population in Taiwan is ca. 1650 m for subsp. *ramosissimum*, which on average appears to grow at higher elevations than subsp. *debile*.

- 1a. Young main stem obviously branched with branches clumped on underground stem or arranged in whorls on aerial stem; sheath teeth persistent, grayish white, sometimes brown, arc-shaped at base, with conspicuous stomatal bands ..... 7a. subsp. *ramosissimum*
- 1b. Young main stem not obviously branched; sheath teeth falling off early or persistent, blackish brown or light brown, flat at base and ridged laterally, with conspicuous or inconspicuous stomatal bands ..... 7b. subsp. *debile*

**7a. *Equisetum ramosissimum* subsp. *ramosissimum***

节节草(原亚种) jie jie cao (yuan ya zhong)

*Equisetum elongatum* Willdenow; *E. ramosissimum* var. *glaucum* Nakai; *E. ramosissimum* var. *japonicum* Milde; *E. ramosissimum* var. *taikankoense* Yamamoto; *E. ramosum*

Lamarck & Candolle; *E. sieboldii* Milde; *Hippochaete ramosissima* (Desfontaines) Milde ex Bruhin; *H. ramosissima* var. *japonica* (Milde) Satou.

Plants small to medium-sized. Rhizome erect, creeping, or ascending, blackish brown, nodes and roots with few long yellowish brown trichomes or glabrous. Aerial stem perennial, monomorphic, green, 20–60 cm tall, 1–3 mm in diam. at middle, lower portion of main stem often branched, tufted; internodes 2–6 cm. Main stem 5–14-ridged; ridges arc-shaped abaxially, with a row of tubercles or small light brown cross grains; sheaths narrow and up to 1 cm, lower portion grayish green, upper portion grayish brown; sheath teeth 5–12, deltoid, teeth of middle portion grayish white or few teeth blackish brown, arc-shaped abaxially, margin (sometimes upper part) membranous, persistent, with conspicuous stomatal bands on sheath teeth. Lateral branches hard, cylindrical, 5–8-ridged; ridge glabrous or with 1 row of tubercles or small pale cross grains; sheath teeth 5–8, teeth of upper portion brown, lanceolate, leathery but membranous at margin, persistent. Strobilus shortly clavate or ellipsoid, 0.5–2.5 cm, 0.4–0.7 cm in diam. at middle, apex with small acute tip, sessile.

Forests, forest margins, under bushes, meadows, banks of rivers and streams; 100–3600 m. Anhui, Chongqing, Fujian, Gansu, Guangdong, Guangxi, Guizhou, Hainan, Hebei, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Jilin, Liaoning, Nei Mongol, Ningxia, Qinghai, Shaanxi, Shandong, Shanxi, Sichuan, Taiwan, Xinjiang, Xizang, Yunnan, Zhejiang [Afghanistan, Bhutan, N India, Japan, Korea, Mongolia, Pakistan, Russia; Africa, C and SW Asia, Europe; introduced in North America (SE United States)].

**7b. *Equisetum ramosissimum* subsp. *debile*** (Roxburgh ex Vaucher) Hauke, Amer. Fern J. 52: 33. 1962.

笔管草 bi guan cao

*Equisetum debile* Roxburgh ex Vaucher, Mém. Soc. Phys. Genève 1: 387. 1822; *Hippochaete debilis* (Roxburgh ex Vaucher) Holub; *H. ramosissima* subsp. *debilis* (Roxburgh ex Vaucher) Á. Löve & D. Löve.

Plants medium-sized to large. Rhizome erect or creeping, blackish brown, nodes and roots with numerous long yellowish brown trichomes or glabrous. Aerial stem perennial, monomorphic, green, up to (or more than) 60 cm tall, 3–7 mm in diam. at middle, mature main stem often branched, but often only with few branches; internodes 3–10 cm. Main stem 10–20-ridged; ridges arc-shaped abaxially, with a row of tubercles or small light brown cross grains; sheaths short, lower portion green, upper portion slightly blackish brown; sheath teeth 10–22, narrowly deltoid, teeth on upper portion light brown, membranous, caducous or sometimes persistent, teeth on lower portion blackish brown, leathery, flattened, conspicuously edged laterally, stomatal bands on sheath teeth conspicuous or inconspicuous. Lateral branches hard, cylindrical, 8–12-ridged; ridges with tubercles or cross grains; sheath teeth 6–10, light brown, lanceolate, short, membranous, caducous or persistent. Strobilus shortly clavate or ellipsoid, 1–2.5 cm, 0.4–0.7 cm in diam. at middle, apex with small acute tip, sessile.

Forests, forest margins, under bushes, meadows, banks of rivers and streams; sea level to 3200 m. Anhui, Chongqing, Fujian, Gansu,

Guangdong, Guangxi, Guizhou, Hainan, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Shaanxi, Shandong, Sichuan, Taiwan, Xizang, Yunnan, Zhejiang [Bangladesh, India, Indonesia, Japan, Laos, Malaysia, Myanmar, Nepal, New Guinea, Philippines, Singapore, Thailand, Vietnam; S Pacific islands (Fiji, New Caledonia, New Hebrides)].

*Equisetum ramosissimum* subsp. *debile* is sometimes treated as a species. Based on the examination of a large number of specimens in China, we found that specimens from N, NE, and NW China are typical *E. ramosissimum*, but those from S, especially SW, China are between *E. ramosissimum* and *E. debile*. Therefore, *E. debile* is better treated as a subspecies.

### 8. *Equisetum hyemale* Linnaeus, Sp. Pl. 2: 1062. 1753.

木贼 mu ze

Plants large. Rhizome creeping or erect, blackish brown, nodes and roots with long yellowish brown trichomes. Aerial stem perennial, monomorphic, green, up to or more than 1 m tall, (3–)5–9 mm in diam. at middle, not branched or base with few erect lateral branches; internodes 5–8 cm. Aerial stem 16–22-ridged; ridges arc-shaped abaxially or nearly rectangular, without conspicuous tubercles or with 2 rows of tubercles; sheath 0.7–1.1 cm, blackish brown or both distal portion and base with a blackish brown band, or only distal portion with a blackish brown band; sheath teeth 16–22, lanceolate, small, 0.3–0.5 cm, teeth of distal portion light brown, membranous, aristate, caducous, teeth of lower portion blackish brown, abaxially 3- or 4-ridged at base, thinly leathery, persistent or falling off early with sheath tube. Strobilus ovate, 1–1.6 cm, 0.4–0.7 cm in diam., apex with small acute tip, sessile.  $2n = 216$ .

Forests, stream banks; 100–3000 m. Chongqing, Gansu, Hebei, Heilongjiang, Henan, Hubei, Jilin, Liaoning, Nei Mongol, Shaanxi, Sichuan, Xinjiang [Japan, Korea, Mongolia, Russia; C and SW Asia, Europe, Central and North America].

- 1a. Plants up to or more than 1 m tall;  
ridges with 2 rows of tubercles;  
sheath teeth 4-ridged abaxially ..... 8a. subsp. *hyemale*
- 1b. Plants up to 1.5 m tall; ridges without  
conspicuous tubercles; sheath teeth  
3-ridged abaxially ..... 8b. subsp. *affine*

### 8a. *Equisetum hyemale* subsp. *hyemale*

木贼(原亚种) mu ze (yuan ya zhong)

*Hippochaete hyemalis* (Linnaeus) Milde ex Bruhin.

Plants large. Rhizome creeping or erect, blackish brown, nodes and roots with long yellowish brown trichomes. Aerial stem perennial, monomorphic, green, up to or more than 1 m tall, (3–)5–9 mm in diam. at middle, not branched or base with few erect lateral branches; internodes 5–8 cm. Aerial stem 16–22-ridged; ridges arc-shaped abaxially or nearly rectangular, with 2 rows of tubercles; sheath 0.7–1 cm, blackish brown or both distal portion and base with a blackish brown band, or only distal portion with a blackish brown band; sheath teeth 16–22, lanceolate, small, 0.3–0.4 cm, teeth of distal portion light brown, membranous, aristate, caducous, teeth of lower portion blackish brown, thinly leathery, abaxially 4-ridged at base,

persistent or falling off early with sheath. Strobilus ovate, 1–1.5 cm, 0.4–0.7 cm in diam., apex with small acute tip, sessile.

Forests, stream banks; 100–3000 m. Chongqing, Gansu, Hebei, Heilongjiang, Henan, Hubei, Jilin, Liaoning, Nei Mongol, Shaanxi, Sichuan, Xinjiang [Japan, Korea, Mongolia, Russia; C and SW Asia, Europe].

### 8b. *Equisetum hyemale* subsp. *affine* (Engelmann) Calder & Roy L. Taylor, Canad. J. Bot. 43: 1387. 1965.

无瘤木贼 wu liu mu ze

*Equisetum robustum* A. Braun var. *affine* Engelmann, Amer. J. Sci. Arts 46: 88. 1844; *E. praealtum* Rafinesque; *E. robustum* A. Braun; *E. affine* (Engelmann) Rydberg; *E. hyemale* var. *affine* (Engelmann) A. A. Eaton; *E. hyemale* var. *komarovii* (Iljin) W. Wang; *E. hyemale* var. *robustum* (A. Braun) A. A. Eaton; *E. komarovii* Iljin; *E. praealtum* var. *affine* (Engelmann) M. Broun; *Hippochaete hyemalis* f. *affinis* (Engelmann) Satou; *H. hyemalis* var. *affinis* (Engelmann) S. X. Li & J. Z. Wang; *H. praealta* (Rafinesque) Farwell; *H. praealta* (Rafinesque) Farwell var. *affinis* (Engelmann) Farwell.

Plants large. Rhizome creeping or erect, blackish brown, nodes and roots with long yellowish brown trichomes. Aerial stem perennial, monomorphic, green, up to 1.5 m tall, 5–10 mm in diam. at middle, not branched or base with few erect lateral branches; internodes 6–9 cm. Aerial stem 16–22-ridged; ridges arc-shaped abaxially or nearly rectangular, without conspicuous tubercles; sheath 0.8–1.1 cm, blackish brown or both distal portion and base with a blackish brown band, or only distal portion with a blackish brown band; sheath teeth 16–22, lanceolate, small, 0.3–0.5 cm, teeth of distal portion light brown, membranous, aristate, caducous, teeth of lower portion blackish brown, thinly leathery, abaxially 3-ridged at base, persistent or falling off early with sheath. Strobilus ovate, 1.1–1.6 cm, 0.4–0.7 cm in diam., apex with small acute tip, sessile.

Forests; 700–1000 m. Heilongjiang [Russia (Far East); Central America (Guatemala, Mexico), North America].

### 9. *Equisetum variegatum* Schleicher ex F. Weber & D. Mohr, Bot. Taschenbuch, 60, 447. 1807.

斑纹木贼 ban wen mu ze

Plants small to medium-sized. Rhizome erect and creeping, blackish brown, nodes and roots with long yellowish brown trichomes. Aerial stem perennial, monomorphic, green, 10–20 cm tall, 1–1.5 mm in diam. at middle, not branched; internodes 1.5–4 cm. Aerial stem 6–8-ridged, ridge abaxially nearly rectangular or arc-shaped, middle portion with or without shallow grooves, with 1 row of tubercles on each side; sheath ca. 0.2 cm, green but distal and middle portion with a blackish brown band; sheath teeth 6–8, usually spreading, deltoid, ca. 0.1 cm, teeth of middle portion blackish brown, white at margin, membranous, abaxially 4-ridged at base, apex acute and shortly aristate, persistent. Strobilus ellipsoid, 0.5–0.8 cm, 0.2–0.4 cm in diam., apex with acute tip, sessile.  $2n = 216$ .

Forests, under bushes, valleys, meadows, roadsides; 100–3700 m. ?Jilin, Liaoning, Nei Mongol, Sichuan, Xinjiang [Japan, Mongolia, Russia; SW Asia, Europe, North America (including Greenland)].

- 1a. Plants up to 17 cm tall; sheath teeth open, white on margin ..... 9a. subsp. *variegatum*  
 1b. Plants up to 20 cm tall; sheath teeth curved inward, black on margin ..... 9b. subsp. *alaskanum*

**9a. *Equisetum variegatum* subsp. *variegatum***

斑纹木贼(原亚种) ban wen mu zei (yuan ya zhong)

*Equisetum hyemale* Linnaeus subsp. *variegatum* (Schleicher ex F. Weber & D. Mohr) A. Braun; *E. hyemale* var. *variegatum* (Schleicher ex F. Weber & D. Mohr) Newman; *E. reptans* Wahlenberg var. *variegatum* (Schleicher ex F. Weber & D. Mohr) Wahlenberg; *Hippochaete variegata* (Schleicher ex F. Weber & D. Mohr) Milde ex Bruhin.

Plants small to medium-sized. Rhizome erect and creeping, blackish brown, nodes and roots with long yellowish brown trichomes. Aerial stem perennial. Branches monomorphic, green, 10–17 cm tall, 1–1.3 mm in diam. at middle, not branched; internodes 1.5–4 cm. Aerial stem 6–8-ridged, ridge abaxially nearly rectangular or arc-shaped, middle portion with or without shallow grooves, with 1 row of tubercles on each side; sheath ca. 0.2 cm, green but distal and middle portion with a blackish brown band; sheath teeth 6–8, spreading, deltoid, ca. 0.1 cm, teeth of middle portion blackish brown, white at margin, membranous, abaxially 4-ridged at base, apex acute and shortly aristate, persistent. Strobilus ellipsoid, 0.5–0.7 cm, 0.2–0.3 cm in diam., apex with acute tip, sessile.

Forests, under bushes, valleys, roadsides; 1500–3700 m. ?Jilin, Nei Mongol, Sichuan, Xinjiang [Japan, Mongolia, Russia; SW Asia, Europe, North America (including Greenland)].

**9b. *Equisetum variegatum* subsp. *alaskanum*** (A. A. Eaton) Hultén, Acta Univ. Lund., 2, 37(1): 59. 1941.

阿拉斯加木贼 a la si jia mu zei

*Equisetum variegatum* var. *alaskanum* A. A. Eaton in Merriam, Harriman Alaska Exped. 5: 390. 1904; *E. alaskanum* (A. A. Eaton) J. P. Anderson; *Hippochaete hyemalis* (Linnaeus) Milde ex Bruhin var. *alaskana* (A. A. Eaton) Farwell; *H. variegata* subsp. *alaskana* (A. A. Eaton) Škoda.

Plants small to medium-sized. Rhizome erect and

creeping, blackish brown, nodes and roots with long yellowish brown trichomes. Aerial stem perennial, monomorphic, green, 15–20 cm tall, 1.2–1.5 mm in diam. at middle, not branched; internodes 2–4 cm. Aerial stem 6–8-ridged, ridge abaxially nearly rectangular or arc-shaped, middle portion with or without shallow grooves, with 1 row of tubercles on each side; sheath ca. 0.2 cm, green but distal and middle portion with a blackish brown band; sheath teeth 6–8, recurved, deltoid, ca. 0.1 cm, teeth of middle portion blackish brown, black at margin, membranous, abaxially with 4 longitudinal ridges at base, apex acute and shortly aristate, persistent. Strobilus ellipsoid, 0.6–0.8 cm, 0.2–0.4 cm in diam., apex with acute tip, sessile.

Meadows; ca. 100 m. Liaoning [NW North America (including Aleutian Islands)].

**10. *Equisetum scirpoides*** Michaux, Fl. Bor.-Amer. 2: 281. 1803.

蔺木贼 lin mu zei

*Equisetum hyemale* Linnaeus var. *tenellum* Liljebland; *E. tenellum* (Liljebland) A. A. Eaton; *Hippochaete scirpoides* (Michaux) Farwell.

Plants small. Rhizome erect and creeping, blackish brown, nodes and roots with long yellowish brown trichomes or glabrous. Aerial stems perennial, monomorphic, only branched at lower portion, tufted; main stem inconspicuous, 7- or more ridged; aerial stems irregularly undulate, 10–20 cm tall, ca. 0.6 mm in diam. at middle, solid and without longitudinal canals in center, green, but internodes of lower 1 or 2 nodes castaneous, lustrous; internodes 2–2.8 cm; branch 6-ridged; each ridge with 1 shallow longitudinal groove at middle and 2 edges on sides, each edge with 1 row of tooth-shaped protuberances; sheath blackish brown or upper portion blackish brown, lower portion green; sheath teeth 3(–5), broadly lanceolate, apex long aristate, teeth of middle portion blackish brown, margin light brown, membranous, persistent. Strobilus terete, small, ca. 5 × 1.5 mm, apex with acute tip, sessile.  $2n = 216$ .

Forests, grasslands; 500–2600 m. Nei Mongol, Xinjiang [Japan, Mongolia, Russia (European part, Far East, Siberia); N Europe, North America (including Greenland)].