This PDF version does not have an ISBN or ISSN and is not therefore effectively published (*Melbourne Code*, Art. 29.1). The printed version, however, was effectively published on 6 June 2013. Zhang, L. B. & K. Iwatsuki. 2013. Lycopodiaceae. Pp. 13–34 *in* Z. Y. Wu, P. H. Raven & D. Y. Hong, eds., Flora of China, Vol. 2–3 (Pteridophytes). Beijing: Science Press; St. Louis: Missouri Botanical Garden Press.

LYCOPODIACEAE

石松科 shi song ke

Zhang Libing (张丽兵)[1]; Kunio Iwatsuki[2]

Plants terrestrial, helophytic, or epiphytic, small to large. Main stems creeping, pendulous, climbing, or short and erect, mainly protostelic, rarely actinostelic or plectostelic, on substrate surface or subterranean, or forming stolons. Upright shoots once to multiple times dichotomously branched, conspicuously leafy; upper portion of stem and branchlets with or without bulbils. Lateral branches ascending or erect, dichotomously branched or nearly sympodially branched, rarely pseudomonopodially branched. Main stems and lateral branches rounded or flat in cross section. Leaves as microphylls, with 1 unbranched midrib, monomorphic, spirally arranged. Leaves on subterranean parts flat, appressed, not photosynthetic, and scalelike; leaves on aerial parts appressed, ascending or spreading, subulate, linear, lanceolate, ovate, or scalelike, not lustrous or lustrous, remote to dense and imbricate, papery, leathery, or thinly leathery, base truncate, margin entire or serrate. Strobili terminal on branchlets or main stem, abruptly becoming much smaller than or similar to sterile branches or branchlets in size, solitary, erect, nodding, or pendent, terete, sessile or stalked. Sporophylls homomorphic with or different from trophophylls, monomorphic or dimorphic, papery, margin toothed, membranous. Sporangia in axils of sporophylls, yellow, reniform, thick-walled, outer walls variously modified. Spores trilete, thick-walled, surfaces pitted to small-grooved, rugulose, or reticulate. Gametophytes subterranean or surficial. $x = 11, 13, 17, 23$.

Five genera and 360–400 species: cosmopolitan, with centers of diversity in the tropics; five genera and 66 species (28 endemic) in China.

Some pteridologists recognize a narrowly defined Lycopodiaceae s.s. and Huperziaceae with the latter comprising *Huperzia*, *Phlegmariurus*, and *Phylloglossum* Kunze, considering that the split between Huperziaceae and Lycopodiaceae s.s. has been dated to ca. 350 million years ago using plastid *rbcL* data (Wikström & Kenrick, Molec. Phylogen. Evol. 19: 177–186. 2001), an age much older than many extant fern families/orders. In spite of this, here Lycopodiaceae s.l. including Huperziaceae is recognized because of the sister relationship between Huperziaceae and Lycopodiaceae s.s.

In the Lycopodiaceae, sometimes *Lycopodiastrum* is subsumed under *Lycopodium*. However, the split between *Lycopodiastrum* and *Lycopodium* s.s. has been dated to the Permian Period (251–299 million years ago), much earlier than when extant species of *Lycopodium* s.s. started to diversify (Wikström & Kenrick, loc. cit.). Also, the morphology of *Lycopodiastrum* is distinct from *Lycopodium*. Therefore, *Lycopodiastrum* is recognized here.

Zhang Libing. 2004. Huperziaceae and Lycopodiaceae. *In:* Zhang Xianchun, ed., Fl. Reipubl. Popularis Sin. 6(3): 1–85.

1a. Horizontal stems absent, shoots clustered; roots usually in single basal clump; sporophylls very similar to vegetative trophophylls or smaller and paleate, usually not in obvious strobilus; spores pitted to small-grooved.
  2a. Plants normally shorter than 25(–32) cm, terrestrial or on rocks; stem erect or ascending; strobili homomorphic with sterile branches or branchlets; sporophylls homomorphic with trophophylls; leaves papery, serrate or entire on margin; upper portion of stem and branchlets often with bulbils; spore sides at equator concave with truncate angles ..... 1. *Huperzia*
  2b. Plants up to 100 cm tall, epiphytic; stem pendulous or ascending; strobili abruptly becoming much smaller than sterile branches or branchlets or rarely similar in size; sporophylls obviously different from or rarely almost homomorphic with trophophylls; leaves leathery or thinly leathery, entire on margin; upper portion of stem and branchlets often without bulbils; spore sides at equator convex with acute or blunt angles ..... 2. *Phlegmariurus*
1b. Horizontal stems present, upright shoot systems alternating along rhizome; roots emerging at intervals along horizontal stem; sporophylls very different from vegetative trophophylls, aggregated into upright or nodding or pendent strobili; spores reticulate or rugulate.
  3a. Aerial shoots climbing; strobili 6–26 per peduncle and terminal on multi-dichotomously branched peduncles ..... 5. *Lycopodiastrum*
  3b. Aerial shoots creeping or erect; strobili solitary or aggregated at apex of fertile branches.
    4a. Plants terrestrial; aerial shoots erect or creeping; strobili solitary or aggregated at apex of fertile branches ..... 3. *Lycopodium*
    4b. Plants helophytic; aerial shoots creeping; strobili solitary ..... 4. *Lycopodiella*

1. HUPERZIA Bernhardi, J. Bot. (Schrader) 1800(2): 126. 1801.

石杉属 shi shan shu

Plants terrestrial or on rocks, small to medium-sized. Stem erect or ascending, 3–32 cm, dichotomously branched, upper portion of stem and branchlets often with bulbils. Leaves linear or lanceolate, often papery, margin entire or serrate. Strobili homomorphic with sterile branches or branchlets. Sporophylls homomorphic with trophophylls but slightly smaller. Sporangia in axils of sporophylls of upper portion of stem or branchlets, reniform, dehiscent in 2 valves. Spore sides at equator concave with truncate angles.

[1] Missouri Botanical Garden, P.O. Box 299, Saint Louis, Missouri 63166-0299, U.S.A.; Chengdu Institute of Biology, Chinese Academy of Sciences, P.O. Box 416, Chengdu, Sichuan 610041, People's Republic of China.
[2] 815-29 Kamoshida, Aoba-ku, Yokohama 227-0033, Japan.

About 55 species: temperate and arctic zones; 27 species (18 endemic) in two sections in China.

1a. Leaf margins entire ..... 1. *H.* sect. *Huperzia*
1b. Leaf margins serrate or denticulate ..... 2. *H.* sect. *Serratae*

1. Huperzia sect. Huperzia

小杉兰组 xiao shan lan zu

Urostachys Herter.

Leaves entire on margin.

About 25 species: America, Asia, and Europe; 14 species (nine endemic) in China.

1a. Base of leaves obviously broadest part of leaf.
2a. Branches together with leaves 1.7–2 cm wide; leaves subulate, ca. 10 mm, falcate, reflexed at base ..... 5. *H. bucahwangensis*
2b. Branches together with leaves 0.5–1.4 cm wide; leaves lanceolate, linear, or subulate, 4–6 mm, straight or falcate, not reflexed at base.
3a. Leaves falcate, linear, up to 6 mm, ca. 0.8 mm wide at base ..... 4. *H. nanchuanensis*
3b. Leaves straight, lanceolate or subulate.
4a. Leaves sparse, lanceolate, ca. 1.2 mm wide at base, angled upward ..... 1. *H. chinensis*
4b. Leaves dense, linear-subulate or linear-triangular, 0.8–1 mm wide at base, variously angled.
5a. Leaves linear-subulate, ca. 0.8 mm wide at base, papery; longer and shorter leaves mixed on stem ..... 2. *H. miyoshiana*
5b. Leaves linear-triangular, ca. 1 mm wide at base, leathery; longer and shorter leaves in zones on stem ..... 3. *H. muscicola*
1b. Base of leaves narrower than broadest part of leaf or ± equal in width.
6a. Plants shorter than 10 cm, leaves shorter than 2–5(–6) mm; or plants up to 17 cm tall but leaves 1–2.2 mm.
7a. Leaves flat and straight on margin, even so abaxially, acuminate or acute toward apex.
8a. Plants smaller than 10 cm, leaves 2–5(–6) mm, ascending, acute toward apex ..... 6. *H. tibetica*
8b. Plants up to 17 cm tall, but leaves only 1–2.2 mm, reflexed, acuminate toward apex ..... 7. *H. rubicaulis*
7b. Leaves involute on margin, vaulted abaxially, acuminate toward apex.
9a. Leaves ascending and amplexicaul, ca. 1 mm wide ..... 8. *H. appressa*
9b. Leaves slightly reflexed, 0.5–0.7 mm wide ..... 9. *H. somae*
6b. Plants 7–25 cm tall, longest leaves ca. 8 mm or longer.
10a. Plants up to 25 cm tall; leaves narrowly elliptic-lanceolate, 1.5–1.8 mm wide, acute toward apex, papery ..... 14. *H. selago*
10b. Plants relatively small; leaves lanceolate or linear, narrower than 1.2(–1.4) mm, acuminate toward apex, thinly leathery or papery.
11a. Leaves papery, variously angled.
12a. Leaves lanceolate, ca. 1 mm wide ..... 10. *H. laipoensis*
12b. Leaves linear to subulate, obviously narrower than 1 mm ..... 11. *H. emeiensis*
11b. Leaves thinly leathery or papery, reflexed, descending, or ascending.
13a. Leaves subleathery, reflexed or slightly descending ..... 12. *H. quasipolytrichoides*
13b. Leaves papery, ascending ..... 13. *H. medogensis*

1. Huperzia chinensis (Herter ex Nessel) Ching, Acta Bot. Yunnan. 3: 304. 1981.

中华石杉 zhong hua shi shan

Urostachys chinensis Herter ex Nessel, Bärlappgewächse, 27. 1939, based on *Lycopodium chinense* Christ, Nuovo Giorn. Bot. Ital., n.s., 4: 101. 1897, not *L. sinense* Desvaux (1827); *Huperzia takingensis* Ching; *L. selago* Linnaeus subsp. *chinense* Hultén; *L. selago* var. *chinense* Ohwi.

Plants terrestrial. Stem erect or ascending, 10–16 cm, 1.2–2 mm in diam. at middle, together with leaves 1–1.3 cm wide, 2–4 times dichotomously branched, upper portion often with bulbils. Leaves sparse, attached at right angles with stem, not lustrous, lanceolate, not contracted toward base, widest at base, straight, 4–6 mm, ca. 1.2 mm wide at base, papery, glabrous on both surfaces, midrib indistinct, base truncate, decurrent, sessile, margin entire, straight and not crispate, apex acuminate. Sporophylls homomorphic with trophophylls; sporangia slightly visible on both sides of sporophylls, yellowish, reniform.

● Meadows, rock crevices; 2000–4200 m. Hubei, Shaanxi, Sichuan.

In the past, *Huperzia chinensis* was treated to include *H. miyoshiana* and *H. emeiensis* and other names.

2. Huperzia miyoshiana (Makino) Ching, Acta Bot. Yunnan. 3: 303. 1981.

东北石杉 dong bei shi shan

Lycopodium miyoshianum Makino, Bot. Mag. (Tokyo) 12:

36. 1898; *Huperzia miyoshiana* var. *coreana* (Hayata) Ching; *L. miyoshianum* var. *coreanum* Hayata; *L. selago* Linnaeus subsp. *miyoshianum* (Makino) Calder & Roy L. Taylor; *L. selago* var. *miyoshianum* (Makino) Makino; *L. tenuifolium* Herter; *Urostachys miyoshianus* (Makino) Herter ex Nessel.

Plants terrestrial. Stem erect or ascending, 10–18 cm, 1.5–2.5 mm in diam. at middle, together with leaves 0.7–0.9 cm wide, 2–4 times dichotomously branched, upper portion often with bulbils. Leaves dense, slightly angled upward or attached at right angles with stem, or slightly reflexed, lustrous, linear-subulate, not contracted toward base, widest at base, straight, 4–6 mm, ca. 0.8 mm wide at base, papery, both surfaces glabrous, midrib indistinct, base truncate, decurrent, sessile, margin entire, straight and not crispate, apex acuminate. Sporophylls homomorphic with trophophylls; sporangia visible on both sides of sporophylls, yellowish, reniform.

Wet places and/or among moss in forests; 1000–2200 m. Heilongjiang, Jilin [Japan, Korea; E North America].

Many pteridologists regarded *Huperzia miyoshiana* as a synonym of *H. chinensis*, but, more recently, most think that these two species differ in distribution and morphology.

"*Lycopodium chinense* Christ, Fl. URSS 1: 115. 1934" is probably a misapplied name for *Huperzia miyoshiana*.

The leaves of *Huperzia miyoshiana* differ from those of *H. chinensis* in being densely arranged and subulate.

3. Huperzia muscicola Ching ex W. M. Chu, Fl. Yunnan. 20: 718. 2006.

苔藓林石杉 tai xian lin shi shan

Plants terrestrial. Stem erect or ascending, 10–25 cm, up to 1.3 mm in diam. at middle, together with leaves 0.5–0.8 cm wide, 2 or 3 times dichotomously branched, upper portion often with a few bulbils. Leaves dense, slightly angled upward or attached at right angles with stem, or ± reflexed, lustrous, linear-triangular, not contracted toward base, widest at base, straight, 3–7 mm, longer and shorter leaves in zones on stem, ca. 1 mm wide at base, leathery, both surfaces glabrous, midrib indistinct, base truncate, decurrent, sessile, margin entire, straight and not crispate, apex acuminate. Sporophylls homomorphic with trophophylls; sporangia visible on both sides of sporophylls, grayish green or yellowish green, reniform.

● Among moss in elfin forests; 2000–2500 m. Yunnan (Ailao Shan, Laojun Shan).

4. Huperzia nanchuanensis (Ching & H. S. Kung) Ching & H. S. Kung, Acta Bot. Yunnan. 3: 302. 1981.

南川石杉 nan chuan shi shan

Lycopodium nanchuanense Ching & H. S. Kung, Acta Phytotax. Sin. 18: 235. 1980; *Huperzia hupehensis* Ching.

Plants terrestrial. Stem erect or ascending, 8–11 cm, 1–1.5 mm in diam. at middle, together with leaves 0.7–1 cm wide, 3–5 times dichotomously branched, upper portion often with bulbils. Leaves dense, attached at right angles with stem to slightly angled upward, not lustrous, linear, not contracted toward base, widest at base, falcate, 4–6 mm, ca. 0.8 mm wide at base, thinly papery, both surfaces glabrous, midrib indistinct, base truncate, decurrent, sessile, margin entire, straight and not crispate, apex acuminate. Sporophylls homomorphic with trophophylls; sporangia visible on both sides of sporophylls, yellowish, reniform.

● Wet places in forests or on tree trunks; 1700–2100 m. Chongqing, N and NE Guizhou, W Hubei, NE Yunnan (Yongshan, Zhenxiong).

The geographical distribution and the type locality (Xuan'en, Hubei) of *Huperzia hupehensis* are close to Nanchuan, Chongqing. Morphologically, there are no critical differences between *H. hupehensis* and *H. nanchuanensis*; thus, *H. hupehensis* is treated as a synonym of *H. nanchuanensis*.

The leaves of *Huperzia nanchuanensis* are linear and falcate.

5. Huperzia bucahwangensis Ching, Acta Bot. Yunnan. 3: 301. 1981.

曲尾石杉 qu wei shi shan

Plants terrestrial. Stem erect or ascending, 14–20 cm, 1.5–2 mm in diam. at middle, together with leaves 1.7–2 cm wide, 2–5 times dichotomously branched, upper portion often with bulbils. Leaves sparse, attached at right angles with stem, not lustrous, subulate, not contracted toward base, widest at base, falcate and bent upward, 0.9–1.1 cm, ca. 0.7 mm wide at base, thinly papery, both surfaces glabrous, midrib indistinct, base truncate, decurrent, sessile, margin entire, straight and not crispate, apex acuminate and with light-colored acute tip. Sporophylls homomorphic with trophophylls; sporangia obviously visible from outside of sporophylls, yellowish, reniform.

● Moss-covered shrubs in forests; 2300–2500 m. Yunnan.

The leaves of *Huperzia bucahwangensis* are subulate and falcate, like those of *Dicranum scoparium* Hedwig.

6. Huperzia tibetica (Ching) Ching, Acta Bot. Yunnan. 3: 304. 1981.

西藏石杉 xi zang shi shan

Lycopodium tibeticum Ching, Bull. Fan Mem. Inst. Biol., Bot. 10: 17. 1940.

Plants terrestrial. Stem erect or ascending, 2–10 cm, 1–3 mm in diam. at middle, together with leaves 5–8 mm wide, 1–3 times dichotomously branched, upper portion often with bulbils. Leaves sparse, or dense on some small individuals, angled upward or attached at right angles with stem, lustrous, lanceolate or narrowly elliptic, nearly as wide at base as middle, oblique upward, 2–5 mm, (0.8–)1–1.2 mm wide at middle, leathery to papery, abaxially arc-shaped, both surfaces glabrous, midrib indistinct, base truncate, decurrent, sessile, margin involute, straight and not crispate, entire, apex acute. Sporophylls homomorphic with trophophylls; sporangia not visible or visible on both sides of sporophylls, yellowish, reniform.

● Alpine wet meadows and wetlands; 2700–3300 m. NW Yunnan (Gongshan).

Despite its name, *Huperzia tibetica* does not occur in Xizang. Its leaves are sparsely arranged (especially in larger individuals), with margins straight and apex acute, differing from *H. appressa*.

7. Huperzia rubicaulis S. K. Wu & X. Cheng, Acta Phytotax. Sin. 23: 400. 1985.

红茎石杉 hong jing shi shan

Plants terrestrial. Stem erect or ascending, 10–17 cm, 1–3 mm in diam. at middle, together with leaves 5–8 mm wide, 1–3 times dichotomously branched, upper portion often with bulbils. Leaves sparse, or dense on some small individuals, angled upward or attached at right angles with stem, lustrous, lanceolate or narrowly elliptic, nearly as wide at base as middle, reflexed, 1–2.2 mm, 0.8–1 mm wide at middle, leathery to papery, abaxially arc-shaped, both surfaces glabrous, midrib indistinct, base truncate, decurrent, sessile, margin involute, straight and not crispate, entire, apex acuminate. Sporophylls homomorphic with trophophylls; sporangia not visible or visible on both sides of sporophylls, yellowish, reniform.

● Moss-covered rocks at forest margins; ca. 1500 m. NW Yunnan (Gongshan).

There is a similar name, *Huperzia rubricaulis* (Alderwerelt) Holub, in the genus.

Huperzia rubicaulis is similar to *H. tibetica*, but it is taller and has smaller and reflexed leaves.

8. Huperzia appressa (Desvaux) Á. Löve & D. Löve, Bot. Not. 114: 34. 1961.

伏贴石杉 fu tie shi shan

Lycopodium selago Linnaeus var. *appressum* Desvaux, Mém. Soc. Linn. Paris 6(2): 180. 1827; *Huperzia selago* (Linnaeus) Bernhardi ex Schrank & Martius subsp. *appressa* (Desvaux) D. Löve; *H. selago* var. *appressa* (Desvaux) Ching; *L. appressum* (Desvaux) Petrov (1930), not (Chapman) F. E. Lloyd & Underwood (1900); *L. selago* subsp. *appressum* (Desvaux) Hultén; *Urostachys selago* (Linnaeus) Herter f. *angustius* Christ ex Nessel [*"angustinus"*]; *U. selago* f. *reductus* Nessel; *U. selago* f. *reductus-angustius* Nessel [*"reductus-angustinus"*].

Plants terrestrial. Stem erect or ascending, 3–10 cm, 1–2 mm in diam. at middle, together with leaves 5–9 mm wide, 1 or 2 times dichotomously branched, upper portion often with bulbils. Leaves dense, angled upward or attached at right angles with stem, lustrous, lanceolate, base nearly as wide as middle, straight, 2–5 × 0.8–1.3 mm, leathery to papery, both surfaces glabrous, midrib indistinct abaxially, slightly distinct adaxially, base truncate, decurrent, sessile, margin straight and not crispate, entire, apex acute. Sporophylls homomorphic with trophophylls; sporangia not visible or visible on both sides of sporophylls, yellowish, reniform.

Alpine meadows, stone crevices; 2300–5000 m. Jilin, Shaanxi, Sichuan, Taiwan, Xizang, Yunnan [Asia, Europe, N North America].

Huperzia appressa is often treated as a variety, subspecies, form, or synonym of *H. selago*. However, Ji et al.'s (China J. Chin. Mat. Med. 32: 1971–1975. 2007) *matK* data show that *H. appressa* deserves to be treated at the specific rank.

The leaf margins of *Huperzia appressa* are involute, and the leaf apex is acuminate.

"Lycopodium selago f. *reductum"* and *"L. selago* f. *angustius"* (Christ, Boll. Soc. Bot. Ital. 1898: 184. 1898) belong here but are nomina nuda and were not therefore validly published (*Melbourne Code*, Art. 38.1(a)). These "formae" have sometimes been misinterpreted as a hyphenated forma: f. *reductum-angustius*.

9. Huperzia somae (Hayata) Ching, Acta Bot. Yunnan. 3: 301. 1981 [*"somai"*].

相马石杉 xiang ma shi shan

Lycopodium somae Hayata, Icon. Pl. Formosan. 5: 255. 1915 [*"somai"*]; *L. chinense* Christ var. *somae* (Hayata) Masamune; *L. selago* Linnaeus var. *somae* (Hayata) Masamune; *Urostachys somae* (Hayata) Herter ex Nessel.

Plants terrestrial. Stem erect or ascending, 4–8 cm, 0.5–0.8 mm in diam. at middle, together with leaves 5–8 mm wide, 2–4 times dichotomously branched, upper portion often with bulbils. Leaves sparse, attached at right angles with stem, angled upward or reflexed, lustrous, narrowly elliptic, not contracted toward base, widest at middle, straight to bent at 180°, 2–4 mm, 0.5–0.7 mm wide at middle, papery, both surfaces glabrous, midrib indistinct, base truncate, decurrent, sessile, margin straight and not crispate, entire, apex acute. Sporophylls homomorphic with trophophylls; sporangia visible on both sides of sporophylls, yellowish, reniform.

Banks of lakes, steep moss-covered slopes at roadsides, shaded places in forests; (600–)1600–2600(–3100) m. Taiwan [Japan, Philippines].

The leaves of *Huperzia somae* are elliptic-lanceolate, widest at the middle, and contracted toward the base.

10. Huperzia laipoensis Ching, Acta Bot. Yunnan. 3: 300. 1981.

雷波石杉 lei bo shi shan

Plants terrestrial. Stem erect or ascending, ca. 10 cm, ca. 2 mm in diam. at middle, together with leaves 1.6–2 cm wide, 2 or 3 times dichotomously branched, upper portion often with bulbils. Leaves sparse, pointing in various directions, not lustrous, lanceolate, nearly as wide at base as middle, slightly bent, 7–10 × ca. 1 mm, papery, both surfaces glabrous, midrib indistinct abaxially, slightly raised adaxially, base truncate, decurrent, sessile, margin straight, entire, apex acuminate. Sporophylls homomorphic with trophophylls; sporangia slightly visible, grayish green, reniform.

● Wet places or tree trunks in forests; 2300–2400 m. S Sichuan.

11. Huperzia emeiensis (Ching & H. S. Kung) Ching & H. S. Kung, Acta Bot. Yunnan. 3: 299. 1981.

峨眉石杉 e mei shi shan

Lycopodium emeiense Ching & H. S. Kung, Acta Phytotax. Sin. 18: 235. 1980.

Plants terrestrial. Stem erect or ascending, 6–12 cm, 1–1.5 mm in diam. at middle, together with leaves 1–1.5 cm wide, 2–4 times dichotomously branched, upper portion often with numerous bulbils. Leaves dense, reflexed, attached at right angles with stem or angled upward, not lustrous, linear-lanceolate, nearly as wide at base as middle, substraight, 6–11 × ca. 0.8

mm, papery, both surfaces glabrous, midrib indistinct, base truncate, decurrent, sessile, margin straight and not crispate, entire, apex acuminate. Sporophylls homomorphic with trophophylls; sporangia obviously visible or visible only on both sides of sporophylls, yellowish, reniform.

● Wet places in forests, shrubs in valleys, on rocks near streams or on tree trunks; 800–2800 m. Chongqing, N Guizhou, W Hubei, Hunan, Sichuan, NE Yunnan (Daguan, Suijiang, Yiliang).

The leaves of *Huperzia emeiensis* are straight and papery and angled in various directions apically.

12. Huperzia quasipolytrichoides (Hayata) Ching, Acta Bot. Yunnan. 3: 299. 1981.

金发石杉 jin fa shi shan

Plants terrestrial. Stem erect or ascending, 8–13 cm, 1.2–1.5 mm in diam. at middle, together with leaves 7–10 mm wide, 3–6 times dichotomously branched, upper portion often with numerous bulbils. Leaves dense, strongly reflexed or slightly angled downward, not lustrous, linear, nearly as wide at base as middle, conspicuously falcate, 5–9 × 0.7–0.8 mm, subleathery, both surfaces glabrous, midrib indistinct abaxially, slightly distinct adaxially, base truncate, decurrent, sessile, margin straight and not crispate, entire, apex acuminate. Sporophylls homomorphic with trophophylls; sporangia obviously visible from outside of sporophylls, yellowish or grayish green, reniform.

Alpine forests, moss-covered shrubs in forests. Anhui, Jiangxi, Taiwan [Japan].

Huperzia quasipolytrichoides can be divided into two varieties.

1a. Leaves strongly reflexed, conspicuously falcate ..... 12a. var. *quasipolytrichoides*
1b. Leaves slightly angled downward, straight ..... 12b. var. *rectifolia*

12a. Huperzia quasipolytrichoides var. **quasipolytrichoides**

金发石杉(原变种) jin fa shi shan (yuan bian zhong)

Lycopodium quasipolytrichoides Hayata, Icon. Pl. Formosan. 5: 252. 1915; *Huperzia reflexo-integra* (Hayata) Holub; *H. whangshanensis* Ching & P. S. Chiu; *L. reflexo-integrum* Hayata; *Urostachys quasipolytrichoides* (Hayata) Herter ex Nessel.

Stem 9–13 cm, 1.2–1.5 mm in diam. at middle, together with leaves 7–10 mm wide. Leaves strongly reflexed or slightly angled downward, conspicuously falcate, 6–9 × ca. 0.8 mm.

Cool-temperate to subalpine or alpine forests; 2600–3200 m (in Taiwan). Anhui (Huangshan), Taiwan [Japan].

The leaves of *Huperzia quasipolytrichoides* var. *quasipolytrichoides* are linear to narrowly lanceolate, falcate, and reflexed.

12b. Huperzia quasipolytrichoides var. **rectifolia** (J. F. Cheng) H. S. Kung & Li Bing Zhang, Acta Phytotax. Sin. 36: 528. 1998.

直叶金发石杉 zhi ye jin fa shi shan

Huperzia whangshanensis Ching & P. S. Chiu var. *rectifolia* J. F. Cheng, Fl. Jiangxi 1: 27, 505. 1993.

Stem 8–11 cm, 1.2–1.4 mm in diam. at middle, together with leaves 7–8 mm wide. Leaves slightly angled downward, straight, 5–8 × ca. 0.7 mm.

● Moss-covered shrubs in forests; ca. 100 m. Jiangxi (Xieshan).

Huperzia quasipolytrichoides var. *rectifolia* differs from the typical variety in having straight leaves.

13. Huperzia medogensis Ching & Y. X. Lin, Acta Phytotax. Sin. 22: 193. 1984.

墨脱石杉 mo tuo shi shan

Plants terrestrial. Stem erect or ascending, 7–13 cm, 2–3 mm in diam. at middle, together with leaves up to 5 mm wide, 2 or 3 times dichotomously branched, upper portion often with bulbils. Leaves dense, angled upward, lustrous, subulate, nearly as wide at base as middle, straight, ca. 8 × 1 mm, both surfaces glabrous, midrib indistinct, base truncate, decurrent, sessile, margin straight and not crispate, entire, apex acuminate. Sporophylls homomorphic with trophophylls; sporangia visible on both sides of sporophylls, yellowish, reniform.

● Tree trunks; ca. 1800 m. Xizang (Mêdog).

Huperzia medogensis is a dubious species. The type was not seen by us. The description above is based on the protologue.

14. Huperzia selago (Linnaeus) Bernhardi ex Schrank & Martius, Hort. Reg. Monac. 3. 1829.

小杉兰石杉 xiao shan lan shi shan

Lycopodium selago Linnaeus, Sp. Pl. 2: 1102. 1753; *L. abietiforme* S. F. Gray; *L. densum* Lamarck, nom. illeg. superfl.; *Mirmau selago* (Linnaeus) H. P. Fuchs; *Plananthus selago* (Linnaeus) P. Beauvois; *Urostachys selago* (Linnaeus) Herter.

Plants terrestrial. Stem erect or ascending, 16–25 cm, 2–3 mm in diam. at middle, together with leaves 11–16 mm wide, 3 or 4 times dichotomously branched, upper portion often with bulbils. Leaves dense, angled upward or attached at right angles with stem, lustrous, lanceolate, nearly as wide at base as middle, straight, 7–10 × 1.4–1.8 mm, leathery to papery, both surfaces glabrous, midrib indistinct abaxially, slightly distinct adaxially, base truncate, decurrent, sessile, margin straight and not crispate, entire, apex acute. Sporophylls homomorphic with trophophylls; sporangia not visible or visible on both sides of sporophylls, yellowish, reniform.

Alpine meadows, rock crevices, forests, stream banks; 1900–2300 m. Jilin, Xinjiang [America, Asia, Europe, Pacific islands].

The leaf margins of *Huperzia selago* are involute, and its leaf apex is acuminate.

2. Huperzia sect. **Serratae** (Rothmaler) Holub, Folia Geobot. Phytotax. 26: 92. 1991.

蛇足石杉组 she zu shi shan zu

Huperzia ser. *Serratae* Rothmaler, Repert. Spec. Nov. Regni Veg. 54: 59. 1944.

Leaves serrate or denticulate on margin.

About 30 species: America, Asia, and Europe; 13 species (nine endemic) in China.

1a. Leaves ovate to elliptic-lanceolate, evidently narrowed toward bases, serrate on margins.
2a. Leaves not crispate on margin ..... 15. *H. serrata*
2b. Leaves crispate on margin ..... 16. *H. crispata*
1b. Leaves subulate to lanceolate, narrowed toward bases or not, denticulate on margins.
3a. Visible teeth on almost every leaf margin.
4a. Leaves long and thin, falcate, ratio of length to width up to 25 ..... 19. *H. kangdingensis*
4b. Leaves relatively shorter and broader, straight, ratio of length to width smaller than 10.
5a. Plants up to 15 cm tall; upper leaves acuminate toward apex, papery, without clear midribs ..... 17. *H. sutchueniana*
5b. Plants up to 20 cm tall; upper leaves acute toward apex, thinly leathery, with clear midribs ..... 18. *H. liangshanica*
3b. Visible teeth absent from many leaf margins, with only some small teeth on upper margins of some leaves.
6a. Leaves not distinctly narrowed toward bases.
7a. Plants smaller than 8 cm; leaves ascending and amplexicaul ..... 27. *H. lajouensis*
7b. Plants up to 20 cm tall; leaves ascending but not amplexicaul.
8a. Leaves falcate, narrower than 1 mm ..... 25. *H. herteriana*
8b. Leaves straight, broader than 1–1.2 mm ..... 26. *H. lucidula*
6b. Leaves (at least leaves at base of plants) distinctly narrowed toward bases.
9a. Leaves at base of plants spatulate; plants smaller than 12 cm; leaves at upper parts of plants lanceolate ..... 23. *H. leishanensis*
9b. Leaves at base of plants not spatulate.
10a. Sporophylls much smaller than normal leaves; leaves acute toward apex, papery, lustrous ..... 24. *H. chishuiensis*
10b. Sporophylls not distinctly different from normal leaves.
11a. Plants 4–17 cm tall; leaves narrowly elliptic-lanceolate, acuminate toward apex, flat abaxially, thinly papery, not lustrous ..... 22. *H. kunmingensis*
11b. Plants usually less than 12 cm tall; leaves ovate-lanceolate or elliptic to oblong-lanceolate, acute toward apex, vaulted or flat abaxially, thinly leathery to leathery, lustrous.
12a. Plants 6–14 cm tall; leaves together with main stem 0.7–1.2 cm wide; leaves ovate-lanceolate, dense, reflexed or spreading, vaulted abaxially, 4–9 mm, 1.5–2 mm wide ..... 20. *H. delavayi*
12b. Plants 3.5–7 cm tall; leaves together with main stem 4–5 mm wide; leaves elliptic to oblong-lanceolate, sparse, strongly reflexed, flat abaxially, 1.5–3 mm, 0.7–1 mm wide ..... 21. *H. dixitiana*

15. Huperzia serrata (Thunberg) Trevisan, Atti Soc. Ital. Sci. Nat. 17: 247. 1875.

蛇足石杉 she zu shi shan

Lycopodium serratum Thunberg in Murray, Syst. Veg., ed. 14, 944. May–Jun 1784; *Huperzia myriophyllifolia* (Hayata) Holub [*"myriophylla"*]; *H. selago* (Linnaeus) Bernhardi ex Schrank & Martius var. *serrata* (Thunberg) Á. Löve & D. Löve; *H. serrata* f. *intermedia* (Nakai) Ching; *H. serrata* f. *longipetiolata* (Spring) Ching; *H. serrata* var. *longipetiolata* (Spring) H. M. Chang; *L. javanicum* Swartz; *L. serratum* var. *intermedium* Nakai; *L. serratum* var. *javanicum* (Swartz) Makino; *L. serratum* var. *longipetiolatum* Spring [*"longepetiolatum"*]; *L. serratum* var. *myriophyllifolium* Hayata; *L. serratum* var. *thunbergii* Makino; *Urostachys myriophyllifolius* (Hayata) Herter [*"myriophyllus"*]; *U. serratus* (Thunberg) Herter ex Nessel.

Plants terrestrial. Stem erect or ascending, 10–30 cm, 1.5–3.5 mm in diam. at middle, together with leaves 1.5–4 cm wide, 2–4 times dichotomously branched, upper portion often with bulbils. Leaves sparse, attached at right angles with stem, lustrous, narrowly elliptic, conspicuously contracted toward base, straight, 1–3 cm × 1–8 mm, thinly leathery, both surfaces glabrous, midrib conspicuously raised, base cuneate, decurrent, petiolate, margin straight and not crispate, irregularly toothed, apex acute or acuminate; teeth acute at apex, coarse or slightly small. Sporophylls homomorphic with trophophylls; sporangia visible on both sides of sporophylls, yellowish, reniform.

Forests, shrubs, roadsides; 300–2700 m. Throughout China except parts of N and NW China [Bhutan, Cambodia, India, Indonesia, Japan, Korea, Laos, Malaysia, Myanmar, Nepal, Philippines, Russia, Sri Lanka, Thailand, Vietnam; Australia, Central America, Pacific islands].

Although there are DNA data (Ji et al., J. Syst. Evol. 46: 213–219. 2008) showing that there is strong intraspecific variation at the molecular level, morphological differences at the intraspecific level are not well understood. More studies are needed.

The most distinguishing character of *Huperzia serrata* is its leaf margins with coarse teeth.

16. Huperzia crispata (Ching) Ching, Acta Bot. Yunnan. 3: 293. 1981.

皱边石杉 zhou bian shi shan

Lycopodium crispatum Ching, Acta Phytotax. Sin. 18: 236. 1980.

Plants terrestrial. Stem erect or ascending, 16–32 cm, 2–3.5 mm in diam. at middle, together with leaves 2–3.5 cm wide, 2–4 times dichotomously branched, upper portion often with bulbils. Leaves sparse, attached at right angles with stem, lustrous, narrowly elliptic or oblanceolate, conspicuously contracted toward base, straight, 1.2–2 cm × 2–3.5 mm, thinly leathery, both surfaces glabrous, midrib conspicuously raised, base cuneate, decurrent, petiolate, margin straight and crispate, irregularly toothed, apex acute; teeth acute at apex, coarse or slightly small. Sporophylls homomorphic with trophophylls; sporangia visible on both sides of sporophylls, yellowish, reniform.

● Wet places in forests; 900–2600 m. Chongqing, Guizhou, W Hubei, W Hunan, Jiangxi, Sichuan, NE Yunnan (Suijiang, Yiliang, Yongshan).

The leaf margins of *Huperzia crispata* are coarsely toothed, but they are also crispate, which is different from *H. serrata*.

17. Huperzia sutchueniana (Herter) Ching, Acta Bot. Yunnan. 3: 297. 1981.

四川石杉 si chuan shi shan

Lycopodium sutchuenianum Herter, Bot. Jahrb. Syst. 43(1, Beibl. 98): 43. 1909; *Huperzia minimadenta* J. F. Cheng; *L. serratum* Thunberg var. *alpestre* Christ; *Urostachys sutchuenianus* (Herter) Herter.

Plants terrestrial. Stem erect or ascending, 8–15(–18) cm, 1.2–3 mm in diam. at middle, together with leaves 1.5–1.7 cm wide, 2 or 3 times dichotomously branched, upper portion often with bulbils. Leaves dense, attached at right angles with stem, angled upward, or slightly reflexed, not lustrous, lanceolate, slightly contracted toward base, straight or falcate, 5–10 × 0.8–1 mm, leathery, both surfaces glabrous, midrib indistinct, base cuneate or subtruncate, decurrent, sessile, margin straight and not crispate, sparsely toothed, apex acuminate; teeth small, acute. Sporophylls homomorphic with trophophylls; sporangia visible on both sides of sporophylls, yellowish, reniform.

● Wet places in forests, shrubs, meadows, on rocks; 800–2000 m. Anhui, Chongqing, Guizhou, Hubei, Hunan, Jiangxi, Sichuan, Zhejiang.

The leaf margins of *Huperzia sutchueniana* are toothed, and its leaf apex is acuminate.

18. Huperzia liangshanica (H. S. Kung) Ching & H. S. Kung, Acta Bot. Yunnan. 3: 296. 1981.

凉山石杉 liang shan shi shan

Lycopodium liangshanicum H. S. Kung, Acta Bot. Yunnan. 2: 100. 1980.

Plants terrestrial. Stem erect or ascending, ca. 18 cm, 1.5–2.5 mm in diam. at middle, together with leaves 1.2–1.8 cm wide, 2 or 3 times dichotomously branched, upper portion often with bulbils. Leaves sparse, reflexed, lustrous, oblanceolate, indistinctly contracted toward base, straight, 7–9 × 1.5–2 mm, thinly leathery, both surfaces glabrous, midrib distinct, base cuneate, decurrent, petiolate, margins straight and not crispate, upper portions irregularly toothed, apex acute; teeth small, acute. Sporophylls homomorphic with trophophylls; sporangia visible on both sides of sporophylls, yellowish, reniform.

● Within moss layer in forests; ca. 2800 m. Sichuan (Leibo), ?Yunnan (Gongshan, Wenshan).

The leaves of *Huperzia liangshanica* are thinly leathery; its leaf apex is acute, and its leaf margins have shallow teeth.

19. Huperzia kangdingensis (Ching) Ching, Acta Bot. Yunnan. 3: 294. 1981.

康定石杉 kang ding shi shan

Lycopodium kangdingense Ching, Acta Phytotax. Sin. 18: 236. 1980; *Huperzia tahkuanensis* Ching.

Plants terrestrial. Stem erect or ascending, up to 27 cm, ca. 3 mm in diam. at middle, together with leaves 1.7–2.2 cm wide, 2 or 3 times dichotomously branched, upper portion often with bulbils. Leaves very reflexed or slightly reflexed, lustrous, linear-lanceolate, not contracted toward base, falcate, 8–15 × 0.5–0.9 mm, leathery, both surfaces glabrous, midrib indistinct abaxially, slightly raised adaxially and distinct, base subtruncate, decurrent, sessile, margin straight and not crispate, upper portion sparsely toothed, apex acuminate; teeth small, acute. Sporophylls homomorphic with trophophylls; sporangia visible on both sides of sporophylls, yellowish, reniform.

● Wet places in forests or on cliffs; 1300–2500 m. W Sichuan, NE Yunnan (Daguan).

20. Huperzia delavayi (Christ & Herter) Ching, Acta Bot. Yunnan. 3: 303. 1981.

苍山石杉 cang shan shi shan

Lycopodium delavayi Christ & Herter, Bot. Jahrb. Syst. 43(1, Beibl. 98): 41. 1909; *Urostachys delavayi* (Christ & Herter) Herter.

Plants terrestrial. Stem erect or ascending, 6–14 cm, ca. 2 mm in diam. at middle, together with leaves 0.7–1.2 cm wide, 2 or 3 times dichotomously branched, upper portion often with bulbils. Leaves dense, reflexed or attached at right angles with stem, lustrous, ovate-lanceolate, conspicuously contracted toward base, straight, 4–9 × 1.5–2 mm, leathery, both surfaces glabrous, midrib indistinct, base subcuneate, decurrent, sessile, margin straight and not crispate, upper portion inconspicuously toothed, apex acute. Sporophylls homomorphic with trophophylls; sporangia slightly visible or not visible from outside of sporophylls, yellowish, reniform.

● Wet soils under *Rhododendron* shrubs on slopes, among moss of shrubs, tree trunks, rocks, meadows; 2900–3800 m. ?W Sichuan (Kangding), S Xizang (Nyalam), W Yunnan (Gongshan, Lushui, Tengchong, Yangbi).

Very little about *Huperzia delavayi* is known, due to the brief description in the protologue and the shortage of material. The herbari-

um material of this species is often misidentified as *H. kunmingensis* and *H. herteriana*. In fact, the leaves of *H. delavayi* are ovate-lanceolate, acute apically, raised abaxially, leathery, and lustrous, which obviously differs from those of *H. kunmingensis*. The lower portion of the leaves of *H. delavayi* is conspicuously contracted, which is different from *H. herteriana*.

21. Huperzia dixitiana P. Mondal & R. K. Ghosh, Fern Gaz. 15(2): 72: 1995.

华西石杉 hua xi shi shan

Plants epilithic. Stem erect or ascending, 3.5–7 cm, ca. 1.5 mm in diam. at middle, together with leaves 4–5 mm wide, 1–5 times dichotomously branched, upper middle portion often with numerous bulbils. Leaves sparse, strongly reflexed, flat abaxially, lustrous, elliptic to oblong-lanceolate, sometimes upper portion involute, 1.5–3 mm, 0.7–1 mm wide at middle, thinly leathery, both surfaces glabrous, midrib indistinct, base slightly or not contracted, decurrent, sessile, margin not involute, upper portion often with acute small teeth or subentire, apex acute. Sporophylls homomorphic with trophophylls; sporangia in axils of upper sporophylls, slightly visible from outside of sporophylls, yellowish, reniform.

Alpine meadows; above 2000 m. W Sichuan, Xizang [India (Sikkim), Myanmar, Nepal].

Sichuan (Kangding) is the northernmost and westernmost distribution of *Huperzia dixitiana*.

Huperzia dixitiana is a small-sized *Huperzia*. It is similar to *H. selago*, but the upper portion of its leaves have acute small teeth.

22. Huperzia kunmingensis Ching, Acta Bot. Yunnan. 3: 297. 1981.

昆明石杉 kun ming shi shan

Plants terrestrial. Stem erect or ascending, 4–17 cm, 1.5–2 mm in diam. at middle, together with leaves ca. 1 cm wide, 2–4 times dichotomously branched, upper portion often with bulbils. Leaves dense or sparse, obliquely angled upward, nearly flat abaxially, not lustrous, narrowly elliptic-lanceolate, conspicuously contracted toward base, straight, 4–9 × 1.1–1.5 mm, thinly papery, both surfaces glabrous, midrib slightly raised abaxially, indistinct adaxially, base cuneate, decurrent, sessile, margin straight and not crispate, upper portion often with sparse small teeth or subentire, apex acuminate. Sporophylls homomorphic with trophophylls; sporangia slightly visible from outside of sporophylls, yellowish, reniform.

● Streamsides in valleys; 1200–2100 m. Guangxi, W Guizhou (Panxian), Yunnan (Kunming, Malong, Pingbian).

The leaves of *Huperzia kunmingensis* are elliptic-lanceolate, acuminate apically, flat abaxially, thinly papery, and not lustrous.

23. Huperzia leishanensis X. Y. Wang, Bull. Bot. Res., Harbin 14: 355: 1994.

雷山石杉 lei shan shi shan

Plants terrestrial. Stem erect or ascending, 3–9 cm, ca. 1.5 mm in diam. at middle, together with leaves 0.8–1.2 cm wide, 2 or 3 times dichotomously branched, upper portion with bulbils. Leaves dense, obliquely angled upward, arc-shaped to slightly flat abaxially, not lustrous, lanceolate (but basal leaves spatulate), conspicuously contracted toward base, slightly falcate, 5–10 × 1–1.5 mm (basal leaves up to 2.5 mm wide), papery, both surfaces glabrous, midrib indistinct, base cuneate, decurrent, sessile, margin straight and not crispate, upper portion with sparse teeth, apex acuminate (basal leaves acute at apex). Sporophylls homomorphic with trophophylls; sporangia visible on both sides of sporophylls, yellowish green, reniform.

● Wet soils under shrubs; 1400–2100 m. Guizhou (Leigong Shan), Sichuan (Gulin), Yunnan (Funing).

The basal leaves of *Huperzia leishanensis* are spatulate.

24. Huperzia chishuiensis X. Y. Wang & P. S. Wang, Bull. Bot. Res., Harbin 16: 417. 1996.

赤水石杉 chi shui shi shan

Plants terrestrial. Stem erect or ascending, 8–16 cm, ca. 1 mm in diam. at middle, together with leaves 1.5–2 cm wide, 1 or 2 times dichotomously branched, upper portion often with bulbils. Leaves dense, attached at right angles with stem, nearly flat abaxially, lustrous, narrowly elliptic-lanceolate, conspicuously contracted toward base, straight, 6–7 × 0.7–1.8 mm, papery, both surfaces glabrous, midrib indistinct, base cuneate, decurrent, petiolate, margin straight and not crispate, upper portion with indistinct sparse teeth, apex acute. Sporophylls ± homomorphic with trophophylls, but much smaller; sporangia visible on both sides of sporophylls, yellowish green, reniform.

● Wet soils among moss under shrubs; 1400–1500 m. N Guizhou.

The leaves of *Huperzia chishuiensis* are dimorphic with the sporophylls being much smaller than the trophophylls, acute apically, papery, and lustrous.

25. Huperzia herteriana (Kümmerle) T. Sen & U. Sen, Fern Gaz. 11: 415. 1978.

锡金石杉 xi jin shi shan

Lycopodium herterianum Kümmerle, Magyar Bot. Lapok 26: 99. 1927; *Huperzia kamaensis* Ching; *H. maerhkangensis* Ching; *H. multidichotoma* Ching; *H. obscuredenticulata* Ching; *L. sikkimense* Herter (1909), not Müller (Halle) (1861); *Urostachys herterianus* (Kümmerle) Herter; *U. sikkimensis* Herter ex Nessel.

Plants terrestrial. Stem erect or ascending, 4–19 cm, 1.5–2.5 mm in diam. at middle, together with leaves 1–1.5 cm wide, 2–4 times dichotomously branched, upper portion with bulbils. Leaves dense, reflexed, lustrous, oblanceolate, not conspicuously contracted toward base, falcate, 5–9 × < 1 mm, thinly leathery, both surfaces glabrous, midrib indistinct, base cuneate, decurrent, sessile, margin straight and not crispate, upper portion with erose small teeth or entire, apex acute or acuminate. Sporophylls homomorphic with trophophylls; sporangia visible on both sides of sporophylls, yellowish, reniform.

Wet places in forests, moss-covered shrubs; 2000–3900 m. Guizhou (Leigong Shan), W Sichuan, S and SE Xizang, Yunnan (Gongshan) [Bhutan, NE India, Nepal].

This is a typical Sino-Himalayan *Huperzia*. Its leaves are falcate and lustrous.

26. Huperzia lucidula (Michaux) Trevisan, Atti Soc. Ital. Sci. Nat. 17: 248. 1875.

亮叶石杉 liang ye shi shan

Lycopodium lucidulum Michaux, Fl. Bor.-Amer. 2: 224. 1803; *Huperzia lucidula* var. *asiatica* Ching; *Urostachys lucidulus* (Michaux) Herter ex Nessel.

Plants terrestrial. Stem erect or ascending, 12–15 cm, ca. 2.5 mm in diam. at middle, together with leaves 0.9–1.4 cm wide, 2 or 3 times dichotomously branched, upper portion often with bulbils. Leaves dense, reflexed, lustrous, lanceolate, slightly contracted toward base, straight, 5–9 × > 1.2 mm, thinly papery, both surfaces glabrous, midrib distinct only abaxially, indistinct adaxially, base cuneate, decurrent, sessile, margin straight and not crispate, upper portion with sparse acute teeth, apex acute or acuminate. Sporophylls homomorphic with trophophylls; sporangia visible because of reflexed sporophylls, yellowish, reniform.

Mossy places in forests; below 1800 m. Jilin [North America].

Based on the protologue, the major difference between *Huperzia lucidula* var. *asiatica* and the typical variety is that var. *asiatica* has reflexed leaves. But based on examinations of North American material by one of us (Zhang), there are no reliable differences between the two varieties and thus they should be merged.

27. Huperzia lajouensis Ching, Acta Bot. Yunnan. 3: 305. 1981.

拉觉石杉 la jue shi shan

Plants terrestrial. Stem erect or ascending, up to 8 cm, ca. 1.5 mm in diam. at middle, together with leaves 0.5–1 cm wide, 2 or 3 times dichotomously branched, upper portion often with bulbils. Leaves dense, reflexed, angled upward and amplexicaul, lustrous, lanceolate, slightly contracted toward base, straight, 4–7 × ca. 1 mm, thinly papery, both surfaces glabrous, midrib distinct abaxially, indistinct adaxially, base cuneate, decurrent, sessile, margin straight and not crispate, distal margins with sparse teeth, apex acute or acuminate. Sporophylls homomorphic with trophophylls; sporangia visible because of reflexed sporophylls, yellowish, reniform.

● Wetlands; 3400–4000 m. Xizang (Zayü).

Huperzia lajouensis was classified into *H.* sect. *Huperzia* by Ching (Acta Bot. Yunnan. 3: 305. 1981). In fact, the distal portion of the leaves of this species is sparsely denticulate. This also distinguishes this species from *H. tibetica*.

2. PHLEGMARIURUS (Herter) Holub, Preslia 36: 17, 21. 1964.

马尾杉属 ma wei shan shu

Lycopodium sect. *Phlegmariurus* Herter, Bot. Jahrb. Syst. 43(1, Beibl. 98): 30. 1909.

Plants epiphytic, medium-sized. Mature stem pendulous or ascending, 15–100 cm, multiple times dichotomously branched, upper portion of stem and branchlets often without bulbils. Leaves lustrous or not lustrous, lanceolate, ovate, or scalelike, leathery or thinly leathery, margin entire. Strobili abruptly becoming much smaller than sterile branches or branchlets or rarely similar in size. Sporophylls and trophophylls dimorphic or almost homomorphic. Sporangia in axils of sporophylls of upper portion of stem or branchlets, reniform, dehiscing from 2 valves. Spore sides at equator concave with acute or blunt angles.

About 250 species: tropics extending to subtropics; 22 species (eight endemic) in three sections in China.

1a. Mature branches pendulous; branches and leaves cordlike, 2–5 mm in diam.; leaves up to 8 mm, ca. 4 mm wide, hard, imbricate, raised abaxially and/or keeled ..... 3. *P.* sect. *Carinaturus*
1b. Mature branches pendulous or suberect; branches and leaves flat or nearly flat; leaves normally larger, flat abaxially.
2a. Mature branches pendulous; leaves dimorphic, strobili linear ..... 1. *P.* sect. *Phlegmariurus*
2b. Mature branches suberect; sporophylls homomorphic with trophophylls or gradually smaller toward rachis apex, strobili not linear ..... 2. *P.* sect. *Huperzioides*

1. Phlegmariurus sect. Phlegmariurus

马尾杉组 ma wei shan zu

Mature branches pendulous. Leaves dimorphic. Strobili linear.

About 70 species: Old World tropics, including Africa and extending to Australia and Central and South America; three species (one endemic) in China.

1a. Stems 4–6 times dichotomously branched; trophophylls ovate-triangular, cordate or subcordate at base, conspicuously stipitate ..... 1. *P. phlegmaria*
1b. Trophophylls ovate or broadly lanceolate, rounded or cuneate at base, stipitate or not.
2a. Stems soft and pendulous, 6–10 times dichotomously branched; trophophylls ovate, rounded at base, shortly stipitate ..... 2. *P. salvinioides*
2b. Stems erect or slightly pendulous, 1–3 times dichotomously branched; trophophylls broadly lanceolate, cuneate at base, decurrent, sessile ..... 3. *P. guangdongensis*

1. Phlegmariurus phlegmaria (Linnaeus) Holub, Preslia 36: 21. 1964.

马尾杉 ma wei shan

Lycopodium phlegmaria Linnaeus, Sp. Pl. 2: 1101. 1753; *Huperzia phlegmaria* (Linnaeus) Rothmaler; *Lepidotis phlegmaria* (Linnaeus) P. Beauvois; *Lycopodium filiforme* Wallich ex Roxburgh (1844), not Swartz (1801); *Urostachys phlegmaria* (Linnaeus) Herter ex Nessel.

Lycophytes, medium-sized. Stems caespitose, slender and pendulous, 4–6 times dichotomously branched, 20–40 cm, main stems ca. 3 mm in diam., stem together with leaves flat or nearly flat, not cordlike. Leaves conspicuously dimorphic. Trophophylls obliquely spreading, not lustrous, ovate-triangular, 5–10 × 3–5 mm, leathery, abaxially flat, midrib distinct, base cordate or subcordate, decurrent, conspicuously and shortly stipitate, margin entire, apex acuminate. Strobili terminal on branches, linear, 9–14 cm. Sporophylls sparsely arranged, ovate, ca. 1.2 × 1 mm, midrib distinct, margin entire, apex acute. Sporangia yellowish, reniform, vertically bisected.

Epiphytic on tree trunks or rocks in forests; 100–2400 m. Guangdong, Guangxi, Hainan, Taiwan, Yunnan [Cambodia, India, Japan, Laos, Nepal, Thailand, Vietnam; Pacific islands, Paleotropics, South America].

The strobili of *Phlegmariurus phlegmaria* are pendulous, cordlike, or like horsetail plants. Moreover, the base of its trophophylls is cordate or subcordate and shortly stipitate.

2. Phlegmariurus salvinioides (Herter) Ching, Acta Bot. Yunnan. 4: 122. 1982.

柔软马尾杉 rou ruan ma wei shan

Urostachys salvinioides Herter, Philipp. J. Sci. 22: 67. 1923; *Huperzia salvinioides* (Herter) Holub; *Lycopodium salvinioides* (Herter) Tagawa; *U. formosanus* Herter ex Nessel.

Lycophytes, medium-sized. Stems caespitose, slender and pendulous, 6–10 times forked, 20–40 cm, main stems ca. 3 mm in diam., stem together with leaves flat or nearly flat, not cordlike. Leaves conspicuously dimorphic. Trophophylls obliquely spreading, not lustrous, ovate, 5–10 × 3–5 mm, leathery, abaxially flat, midrib distinct, base rounded, decurrent, shortly stipitate, margin entire, apex acuminate. Strobili terminal on branches, linear, 10–15 cm. Sporophylls sparsely arranged, ovate, ca. 1 × 0.7 mm, midrib distinct, base rounded, margin entire, apex acute. Sporangia yellowish, reniform, vertically bisected.

Epiphytic on tree trunks; 200–800 m. E and S Taiwan [Japan, Philippines].

The trophophylls of *Phlegmariurus salvinioides* are ovate, rounded at the base, and shortly stipitate.

3. Phlegmariurus guangdongensis Ching, Acta Bot. Yunnan. 4: 123. 1982.

广东马尾杉 guang dong ma wei shan

Huperzia guangdongensis (Ching) Holub.

Lycophytes, medium-sized. Stems caespitose, erect, or slightly pendulous, 1–3 times dichotomously branched, 23–36 cm, main stems ca. 4 mm in diam., stem together with leaves flat or nearly flat, not cordlike. Leaves conspicuously dimorphic. Trophophylls obliquely spreading, not lustrous, broadly lanceolate, 6–9 × ca. 4 mm, leathery, abaxially flat, midrib distinct, base cuneate, decurrent, sessile, margin entire, apex acuminate. Strobili terminal on branches, linear, 8–14 cm. Sporophylls sparsely arranged, ovate, ca. 1.2 × 0.8 mm, midrib distinct, margin entire, apex acute. Sporangia yellowish, reniform, vertically bisected.

● Epiphytic on tree trunks or rocky cliffs in forests; 400–1000 m. Guangdong, Hainan.

The trophophylls of *Phlegmariurus guangdongensis* are broadly lanceolate, cuneate at base, and sessile.

2. Phlegmariurus sect. **Huperzioides** H. S. Kung & Li Bing Zhang, Acta Phytotax. Sin. 37: 42. 1999.

拟石杉马尾杉组 ni shi shan ma wei shan zu

Mature branches suberect; branches and leaves flat or nearly flat. Leaves not imbricate, flat abaxially. Sporophylls homomorphic with trophophylls or gradually smaller toward rachis apex. Strobili not linear.

About 100 species: tropics and subtropics; 14 species (six endemic) in China.

1a. Plants robust, up to 1 m tall; leaves lanceolate, thinly leathery, angled straight with rachis or angled slightly upward ..... 17. *P. squarrosus*
1b. Plants relatively thin, much shorter than 1 m; leaves of various shapes, textures, and pointing in various directions; strobili not columniform and thin, or without distinct strobili; sporophylls sparse.
2a. Stems 10–15 cm; leaves narrowly lanceolate, without stipes, sharp at apex ..... 16. *P. nylamensis*
2b. Stems normally more than 20 cm; leaves linear to ovate, with or without stipes.
3a. Leaves linear.
4a. Plants 60–75 cm; leaves ca. 1.2 cm × 2 mm ..... 6. *P. cunninghamioides*
4b. Plants 15–50 cm; leaves 0.8–1.1 cm × 0.5–1.5 mm.
5a. Leaves ascending and amplexicaul; branches plus leaves ca. 6 mm wide; stems 15–50 cm, main stems ca. 4 mm in diam. ..... 4. *P. pulcherrimus*
5b. Leaves only slightly ascending and not amplexicaul; branches plus leaves ca. 10 mm wide; stems 10–25 cm, main stems 1–2 mm in diam. ..... 5. *P. taiwanensis*

3b. Leaves lanceolate to ovate.
6a. Leaves ovate, subcordate at base; leaves at middle of plants ca. 7 × 5 mm, large ..... 15. *P. ovatifolius*
6b. Leaves elliptic-lanceolate or lanceolate, not cordate at base.
7a. Leaves lanceolate, without stipes, sharp at apex; leaves at middle of plants normally 1.5–2 mm wide.
8a. Leaves papery, sparse, midrib not raised abaxially ..... 13. *P. mingcheensis*
8b. Leaves thinly leathery, denser, midrib raised abaxially ..... 14. *P. cryptomerianus*
7b. Leaves elliptic or elliptic-lanceolate, with or without stipes, acuminate, acute, or obtuse toward apex; leaves at middle of plants normally over 2 mm wide or smaller but with stipes.
9a. Leaves (at least leaves near bases of plants) amplexicaul, elliptic-lanceolate, without stipes, not lustrous ..... 12. *P. fordii*
9b. Leaves angled straight or upward, elliptic or elliptic-lanceolate, with distinct or indistinct stipes, lustrous or not lustrous.
10a. Leaves elliptic or elliptic-lanceolate, with obvious stipes, lustrous.
11a. Leaves elliptic-lanceolate; leaves at middle of plants normally narrower than 2 mm wide ..... 7. *P. petiolatus*
11b. Leaves elliptic (obtuse at apex); leaves at middle of plants more than 2.5–4 mm wide ..... 8. *P. austrosinicus*
10b. Mature leaves without clear stipes, lustrous or not lustrous.
12a. Leaves elliptic, straight or slightly angled upward, not lustrous ..... 11. *P. henryi*
12b. Leaves elliptic-lanceolate, much or slightly angled upward, lustrous.
13a. Leaves obtuse at apex, more than 6 mm wide ..... 9. *P. hamiltonii*
13b. Leaves sharp at apex, 3–4 mm wide ..... 10. *P. shangsiensis*

4. Phlegmariurus pulcherrimus (Wallich ex Hooker & Greville) Á. Löve & D. Löve, Taxon 26: 324. 1977.

美丽马尾杉 mei li ma wei shan

Lycopodium pulcherrimum Wallich ex Hooker & Greville, Icon. Filic. 1: 38. 1827; *Huperzia pulcherrima* (Wallich ex Hooker & Greville) Pichi Sermolli; *H. setacea* Trevisan; *L. setaceum* Buchanan-Hamilton ex D. Don (1825), not Lamarck (1789); *Urostachys pulcherrimus* (Wallich ex Hooker & Greville) Herter ex Nessel; *U. setaceus* Herter ex Nessel.

Lycophytes, medium-sized. Stems caespitose, mature branches pendulous, 1 to several times forked, 15–50 cm, main stems ca. 4 mm in diam., stem together with leaves ca. 6 mm wide. Leaves basally twisted and forming 2 rows. Trophophylls oblique upward and amplexicaul, not lustrous, linear, 0.8–1.1 cm × 0.5–1.5 mm, leathery, midrib distinct, base cuneate, decurrent, sessile, margin entire, apex acuminate. Strobili thinner than sterile part, not columniform, terminal on branches. Sporophylls sparsely arranged, linear, 6–9 × ca. 1 mm, midrib distinct, base cuneate, margin entire, apex acute. Sporangia yellowish, reniform, vertically bisected.

Epiphytic on tree trunks in forests; 1100–1900 m. S Xizang (Mêdog), W Yunnan (Gongshan, Lushui, Yingjiang) [Bhutan, India, Nepal].

Phlegmariurus pulcherrimus is a typical Sino-Himalayan species. In China, it only occurs in S Xizang and W Yunnan, not in S or E China. There are mistakes about its distribution in China in some references. Sometimes, it is misidentified as *P. cryptomerianus*. It is questionable whether this species occurs in Thailand and Vietnam as reported by Ching (Acta Bot. Yunnan. 4: 124. 1982).

This species is similar to *Phlegmariurus mingcheensis*, the latter occurs in E, S, and SW China. The leaves of this species are linear, dense, ascending, and amplexicaul.

5. Phlegmariurus taiwanensis (C. M. Kuo) Li Bing Zhang, Fl. Reipubl. Popularis Sin. 6(3): 38. 2004.

台湾马尾杉 tai wan ma wei shan

Lycopodium taiwanense C. M. Kuo, Taiwania 30: 51. 1985; *Huperzia formosana* Holub; *H. taiwanense* (C. M. Kuo) C. M. Kuo.

Lycophytes, medium-sized. Stems caespitose, mature branches pendulous, 1 to several times forked, 10–25 cm, main stems 1–2 mm in diam., stem together with leaves ca. 10 mm wide. Leaves basally twisted and forming 2 rows. Trophophylls obliquely spreading but not amplexicaul, not lustrous, linear, 0.8–1.1 cm × 0.5–1.5 mm, leathery, midrib distinct, base cuneate, decurrent, sessile, margin entire, apex acuminate. Strobili thinner than sterile part, not columniform, terminal on branches. Sporophylls sparsely arranged, linear, 6–9 × ca. 1 mm, midrib distinct, base cuneate, margin entire, apex acute. Sporangia yellowish, reniform, vertically bisected.

● Epiphytic on tree trunks or rocks in forests; 1800–2500 m. Taiwan.

"*Phlegmariurus taiwanensis* Ching" (Acta Bot. Yunnan. 4: 124. 1982) was not validly published because no Latin description or diagnosis, or reference to such, was provided (*Melbourne Code*, Art. 39.1); in addition, the combination "*Huperzia taiwanensis* (Ching) Holub" was not validly published.

This species is similar to *Phlegmariurus pulcherrimus*, but it is smaller, its branches are very slender, and its leaves are not amplexicaul.

6. Phlegmariurus cunninghamioides (Hayata) Ching, Acta Bot. Yunnan. 4: 125. 1982.

杉形马尾杉 shan xing ma wei shan

Lycopodium cunninghamioides Hayata, Icon. Pl. Formosan. 4: 131. 1914; *Huperzia cunninghamioides* (Hayata) Holub; *Urostachys cunninghamioides* (Hayata) Herter ex Nessel.

Lycophytes, medium-sized. Stems caespitose, mature branches pendulous, 1 to several times forked, 60–75 cm, main stems 7–8 mm in diam., stem together with leaves 2.5–3 cm wide. Leaves basally twisted and forming 2 rows. Trophophylls oblique upward and amplexicaul, not lustrous, linear, ca. 1.2 cm × 2 mm, leathery, midrib distinct, base cuneate, decurrent, sessile, margin entire, apex acuminate. Strobili thinner than sterile part, not columniform, terminal on branches. Sporophylls sparsely arranged, linear, 6–9 × ca. 1 mm, midrib distinct, base cuneate, margin entire, apex acute. Sporangia yellowish, reniform, vertically bisected.

Epiphytic on tree trunks in forests; 400–1200 m. Taiwan [Japan].

Phlegmariurus cunninghamioides is similar to *P. pulcherrimus*, but it is larger and its leaves are longer and wider.

7. Phlegmariurus petiolatus (C. B. Clarke) H. S. Kung & Li Bing Zhang, Acta Phytotax. Sin. 37: 45. 1999.

有柄马尾杉 you bing ma wei shan

Lycopodium hamiltonii Sprengel ex Greville & Hooker var. *petiolatum* C. B. Clarke, Trans. Linn. Soc. London, Bot. 1: 593. 1880; *Huperzia petiolata* (C. B. Clarke) R. D. Dixit; *L. petiolatum* (C. B. Clarke) Baker; *Phlegmariurus hamiltonii* (Sprengel ex Greville & Hooker) Li Bing Zhang var. *petiolatus* (C. B. Clarke) Ching; *Urostachys hamiltonii* (Sprengel ex Greville & Hooker) Herter ex Nessel var. *petiolatus* (C. B. Clarke) Herter ex Nessel; *U. petiolatus* (C. B. Clarke) Herter ex Nessel.

Lycophytes, medium-sized. Stems caespitose, mature branches pendulous, 2 to several times forked, 20–75 cm, main stems ca. 5 mm in diam., stem together with leaves 2.8–3.5 cm wide. Trophophylls attached at right angles with stem or pointing upward, lustrous, elliptic-lanceolate, ca. 1.2 cm, less than 2 mm wide at middle, leathery, midrib distinct, base cuneate, decurrent, conspicuously stipitate, margin entire, apex acuminate. Strobili slightly thinner than sterile part, not columniform, terminal on branches. Sporophylls sparsely arranged, elliptic-lanceolate, 6–9 × ca. 1 mm, midrib distinct, base cuneate, margin entire, apex acute. Sporangia yellowish, reniform, vertically bisected.

Epiphytic on tree trunks or rocks by rivers and roadsides in forests or terrestrial; 600–2500 m. Chongqing, Fujian, Guangdong, Guangxi, Guizhou (Chishui), Hainan, Hunan, Sichuan, Yunnan (Yimen, Yingjiang) [India].

Phlegmariurus petiolatus differs from the American *P. taxifolius* (Swartz) Á. Löve & D. Löve. The two should not be treated as conspecific.

The leaves of this species are elliptic-lanceolate and conspicuously stipitate.

8. Phlegmariurus austrosinicus (Ching) Li Bing Zhang, Fl. Reipubl. Popularis Sin. 6(3): 42. 2004.

华南马尾杉 hua nan ma wei shan

Huperzia austrosinica Ching, Acta Bot. Yunnan. 3: 298. 1981.

Lycophytes, medium-sized. Stems caespitose, mature branches pendulous, 2 to several times forked, 20–70 cm, main stems ca. 5 mm in diam., stem together with leaves 2.5–3.3 cm wide. Trophophylls attached at right angles with stem or pointing upward, lustrous, elliptic, ca. 14 cm, more than 2.5–4 mm wide at middle, leathery, midrib distinct, base cuneate, decurrent, conspicuously stipitate, margin entire, apex obtuse. Strobili slightly thinner than sterile part, not columniform, terminal on branches. Sporophylls sparsely arranged, elliptic-lanceolate, 7–11 × ca. 1.2 mm, midrib distinct, base cuneate, margin entire, apex acute. Sporangia yellowish, reniform, vertically bisected.

● Epiphytic on rocks in forests; 700–2000 m. Guangdong, Guangxi, Guizhou, Jiangxi, Sichuan, Yunnan.

Phlegmariurus austrosinicus is very similar to *P. petiolatus*, but its leaves are elliptic and wider.

9. Phlegmariurus hamiltonii (Sprengel ex Greville & Hooker) Li Bing Zhang, Fl. Reipubl. Popularis Sin. 6(3): 42. 2004.

喜马拉雅石杉 xi ma la ya shi shan

Lycopodium hamiltonii Sprengel ex Greville & Hooker, Bot. Misc. 2: 366. 1831, based on *L. obtusifolium* Buchanan-Hamilton ex D. Don, Prodr. Fl. Nepal. 18. 1825, not Swartz (1806); *Huperzia aloifolia* (Wallich ex Greville & Hooker) Trevisan; *H. hamiltonii* (Sprengel ex Greville & Hooker) Trevisan; *L. aloifolium* Wallich ex Greville & Hooker; *L. empetrifolium* Dalzell; *Urostachys aloifolius* (Wallich ex Greville & Hooker) Herter ex Nessel; *U. hamiltonii* (Sprengel ex Greville & Hooker) Herter ex Nessel.

Lycophytes, medium-sized. Stems caespitose, mature branches pendulous, 2 to several times forked, 20–80 cm, main stems ca. 6 mm in diam., stem together with leaves 2.8–3.5 cm wide. Trophophylls much or slightly angled upward, elliptic-lanceolate, ca. 1.6 cm, more than 6 mm wide, base cuneate, decurrent, mature leaves inconspicuously stipitate, lustrous, leathery, midrib distinct, margin entire, apex obtuse. Strobili slightly thinner than sterile part, not columniform, terminal on branches. Sporophylls sparsely arranged, elliptic-lanceolate, 9–13 × ca. 1.5 mm, midrib distinct, base cuneate, margin entire, apex blunt. Sporangia yellowish, reniform, vertically bisected.

Epiphytic on tree trunks or rocks in broad-leaved evergreen forests; 700–2300 m. W Yunnan (Ximeng, Yongde) [Bhutan, India, N Myanmar, Nepal].

Historically, the distribution of *Phlegmariurus hamiltonii* was widely reported from the Himalaya to SW, S, and E China and SE Asia (e.g., Cambodia, Japan, Laos, Malaysia, Thailand, Vietnam). In fact, it is only a Sino-Himalayan species, so all other distributions are based upon misidentifications.

The description of the spore morphology of "*Lycopodium hamiltonii* Sprengel" in Sporae Pterid. Sin. (39–40. 1976) is not that of this species.

The leaves of this species are elliptic-lanceolate, strongly angled upward, sessile, and lustrous.

10. Phlegmariurus shangsiensis C. Y. Yang, Acta Phytotax. Sin. 22: 87. 1984.

上思马尾杉 shang si ma wei shan

Huperzia shangsiensis (C. Y. Yang) Holub.

Lycophytes, medium-sized. Stems caespitose, mature branches pendulous, 2 to several times forked, 20–70 cm, main stems ca. 6 mm in diam., stem together with leaves 2.6–3.2 cm wide. Trophophylls much or slightly angled upward, elliptic-lanceolate, ca. 1.4 cm × 3–4 mm, base cuneate, decurrent, mature leaves inconspicuously stipitate, lustrous, leathery, midrib distinct, margin entire, apex acute. Strobili slightly thinner than sterile part, not columniform, terminal on branches. Sporophylls sparsely arranged, elliptic-lanceolate, 7–10 × ca. 1.3 mm, midrib distinct, base cuneate, margin entire, apex acute. Sporangia yellowish, reniform, vertically bisected.

● Epiphytic on rocks in forests; ca. 1300 m. Guangxi (Shangsi, Shiwandashan).

The leaves of *Phlegmariurus shangsiensis* are elliptic-lanceolate, acute apically, and lustrous.

11. Phlegmariurus henryi (Baker) Ching, Acta Bot. Yunnan. 4: 125. 1982.

椭圆叶马尾杉 tuo yuan ye ma wei shan

Lycopodium henryi Baker, Bull. Misc. Inform. Kew 1906: 15. 1906; *Huperzia henryi* (Baker) Holub; *Urostachys henryi* (Baker) Herter.

Lycophytes, medium-sized. Stems caespitose, mature branches pendulous, 2 to several times forked, 18–72 cm, main stems ca. 5 mm in diam., stem together with leaves 2.3–3 cm wide. Trophophylls attached at right angles with stem or slightly angled upward, not lustrous, elliptic, ca. 1.3 cm × 3–4 mm, leathery, midrib distinct, base cuneate, decurrent, mature leaves inconspicuously stipitate, margin entire, apex acute. Strobili terminal on branches, slightly thinner than sterile part, not columniform. Sporophylls sparsely arranged, elliptic, 7–11 × ca. 1.2 mm, midrib distinct, base cuneate, margin entire, apex acute. Sporangia yellowish, reniform, vertically bisected.

Epiphytic on tree trunks in forests or in shrubs on mountain summits; 700–3100 m. Guangxi, Yunnan [N Vietnam].

The leaves of *Phlegmariurus henryi* are elliptic, attached at right angles with the stem, inconspicuously stipitate, and not lustrous.

12. Phlegmariurus fordii (Baker) Ching, Acta Bot. Yunnan. 4: 126. 1982.

福氏马尾杉 fu shi ma wei shan

Lycopodium fordii Baker, Handb. Fern Allies, 17. 1887; *Huperzia fordii* (Baker) R. D. Dixit; *H. juniperistachya* (Hayata) Holub; *L. juniperistachyum* Hayata; *L. poissonii* Herter; *L. subdistichum* Makino; *Phlegmariurus longyangensis* C. Y. Ma; *P. nanus* C. Y. Ma; *P. yandongensis* Ching & C. F. Zhang; *Urostachys fordii* (Baker) Herter ex Nessel; *U. juniperistachys* (Hayata) Herter ex Nessel; *U. poissonii* (Herter) Herter ex Nessel; *U. subdistichus* (Makino) Herter ex Nessel.

Lycophytes, medium-sized. Stems caespitose, mature branches pendulous, 1 to several times forked, 20–30 cm, stem together with leaves 1.2–2 cm wide. Leaves basally twisted and forming 2 rows. Trophophylls (at least basal leaves) amplexicaul, not lustrous, elliptic-lanceolate, 1–1.5 cm × 3–4 mm, leathery, midrib distinct, base rounded-cuneate, decurrent, sessile, margin entire, apex acuminate. Strobili slightly thinner than sterile part, terminal on branches. Sporophylls lanceolate or elliptic, 4–6 × ca. 1 mm, midrib distinct, base cuneate, margin entire, apex blunt. Sporangia yellowish, reniform, vertically bisected.

Epiphytic in shaded places in bamboo forests, cliffs in valleys, on rocks in shrubs or forests; 100–1700 m. Fujian, Guangdong, Guangxi, Guizhou, Hainan, S Hunan, S Jiangxi, Taiwan, Yunnan (Cangyuan, Jinghong, Menghai, Menglian), Zhejiang [India (E Himalaya), Japan].

Japanese botanists (e.g., Nakaike, New Fl. Japan, 22. 1982; K. Iwatsuki, Ferns Fern Allies Jap. 46. pl. 4: 4. 1992) merged *Phlegmariurus fordii* with *Lycopodium hamiltonii* (here, *P. hamiltonii*). However, *P. fordii* has amplexicaul, non-lustrous leaves and is a Himalayan-Sino-Japanese species, while *P. hamiltonii* has lustrous leaves angled upward and is a Sino(W Yunnan)-Himalayan species.

The amplexicaul leaves are the most important character of *Phlegmariurus fordii*.

13. Phlegmariurus mingcheensis Ching, Acta Bot. Yunnan. 4: 125. May 1982.

闽浙马尾杉 min zhe ma wei shan

Huperzia mingcheensis (Ching) Holub; *Lycopodium mingcheense* Ching [*"minchegense"*]; *Phlegmariurus mingcheensis* (Ching) Li Bing Zhang (2004), not Ching (1982) [*"minchegense"*]; *P. mingcheensis* var. *angustifolius* C. Y. Ma; *P. mingjoui* X. C. Zhang, nom. illeg. superfl.

Lycophytes, medium-sized. Stems caespitose, mature branches erect or slightly pendulous, 1 to several times forked, 17–33 cm, stem together with leaves 1.5–2 cm wide at middle. Trophophylls sparse, not lustrous, lanceolate, 1.1–1.5 cm × 1.5–2.5 mm, papery, midrib distinct, base cuneate, decurrent, sessile, margin entire, apex acute. Strobili slightly thinner than sterile part, terminal on branches. Sporophylls lanceolate, 8–13 × ca. 0.8 mm, midrib distinct, base cuneate, margin entire, apex acute. Sporangia yellowish, reniform, vertically bisected.

● Epiphytic on tree trunks and cliffs in forests, or terrestrial; 100–1600 m. Anhui, Chongqing, Fujian, Guangdong, Guangxi, Hainan, Hunan, Jiangxi, Sichuan, Zhejiang.

In 1982, Ching twice described the same lycophyte species under the names *Lycopodium mingcheense* (Fl. Fujian. 1: 619. Apr 1982; the original "*minchegense*" spelling being a correctable error) and *Phlegmariurus mingcheensis*. *Phlegmariurus mingcheensis* cannot be taken as a combination based on *L. mingcheense* because in the original publication a different holotype was indicated and the name *L. mingcheense* was not mentioned. The correct names for this species in *Huperzia*, *Lycopodium*, and *Phlegmariurus* are *Huperzia mingcheensis* (Ching) Holub (basionym: *Phlegmariurus mingcheensis*), *Lycopodium mingcheense* Ching, and *Phlegmariurus mingcheensis* Ching, respectively. The lectotypification of the name *Lycopodium mingcheense* using *P. S. Chiu 2069* (PE) by Xiang et al. (Taxon 52: 857–858. 2003) was redundant since this specimen was clearly indicated as the holotype in Ching's original publication. The replacement name *Phlegmariurus mingjoui* (X. C. Zhang, Higher Pl. China 2: 20. 2008) is an illegitimate superfluous name (see Li Bing Zhang, Taxon 61: 665–666. 2012).

This species is similar to *Phlegmariurus petiolatus*, but its leaves are lanceolate (not elliptic-lanceolate) and sessile.

14. Phlegmariurus cryptomerianus (Maximowicz) Ching ex H. S. Kung & Li Bing Zhang, Acta Phytotax. Sin. 37: 51. 1999.

柳杉叶马尾杉 liu shan ye ma wei shan

Lycopodium cryptomerianum Maximowicz, Bull. Acad. Imp. Sci. Saint-Pétersbourg 15: 231. 1870; *Huperzia cryptomeriana* (Maximowicz) R. D. Dixit; *Urostachys coreanus* (Herter ex Nessel) Herter; *U. cryptomerianus* (Maximowicz) Herter ex Nessel; *U. cryptomerianus* var. *coreanus* Herter ex Nessel.

Lycophytes, medium-sized. Stems caespitose, mature branches erect or slightly pendulous, 1–4 times dichotomously branched, 20–25 cm, stem together with leaves 2.5–3 cm wide at middle. Leaves spreading. Trophophylls sparse, lustrous, lanceolate, 1.4–2.5 cm × 1.5–2.5 mm, thinly leathery, midrib raised abaxially and distinct, base cuneate, decurrent, sessile, margin entire, apex acute. Strobili slightly thinner than sterile part, terminal on branches. Sporophylls lanceolate, 1–2 cm × ca. 1.5 mm, base cuneate, margin entire, apex acute. Sporangia yellowish, reniform, vertically bisected.

Epiphytic on tree trunks or on rocks in forests, or terrestrial; 400–800 m. Taiwan, Zhejiang [India, Japan, Korea, Philippines].

Phlegmariurus cryptomerianus has been widely misidentified in China as *P. pulcherrimus*.

This species was previously transferred from *Lycopodium* to *Phlegmariurus* in Fl. Anhui (1: 21. 1985) and Fl. Zhejiang (1: 3. 1993), but those combinations were not validly published because the basionym was not indicated (*Melbourne Code*, Art. 41.5).

This species is similar to *Phlegmariurus mingcheensis*, but the texture of its leaves is slightly thicker and its midrib is raised abaxially.

15. Phlegmariurus ovatifolius (Ching) W. M. Chu ex H. S. Kung & Li Bing Zhang, Acta Phytotax. Sin. 37: 52. 1999.

卵叶马尾杉 luan ye ma wei shan

Huperzia ovatifolia Ching, Acta Bot. Yunnan. 3: 298. 1981.

Lycophytes, medium-sized. Stems caespitose, mature branches pendulous, 2 to several times forked, 18–72 cm, main stems ca. 4 mm in diam., stem together with leaves 2.5–3.5 cm wide. Trophophylls attached at right angles with stem or slightly angled upward, ovate, leaves at middle part ca. 7 mm × 5 mm, base cordate, mature leaves shortly stipitate, lustrous, leathery, midrib distinct, margin entire, apex acute. Strobili terminal on branches, slightly thinner than sterile part, not columniform. Sporophylls sparsely arranged, ovate, ca. 5 × 3 mm, midrib distinct, base subcordate, margin entire, apex acute. Sporangia yellowish, reniform, vertically bisected.

● Epiphytic on rocks in forests; ca. 500 m. S Yunnan (Jinping, Ximeng, Zhenkang).

The leaves of *Phlegmariurus ovatifolius* are ovate, which is unique in the genus.

16. Phlegmariurus nylamensis (Ching & S. K. Wu) H. S. Kung & Li Bing Zhang, Acta Phytotax. Sin. 37: 52. 1999.

聂拉木马尾杉 nie la mu ma wei shan

Huperzia nylamensis Ching & S. K. Wu, Acta Bot. Yunnan. 3: 305. 1981.

Lycophytes, small. Stems caespitose, mature branches erect or slightly pendulous, 1–4 times forked, 10–15 cm, stem together with leaves 1.8–2.2 cm wide at middle. Trophophylls sparse, slightly angled upward, lustrous, narrowly lanceolate, 1–2.2 cm × 1–1.5 mm, leathery, midrib distinct, base cuneate, decurrent, sessile, margin entire, apex acute. Strobili terminal on branches, slightly thinner than sterile part. Sporophylls narrowly lanceolate, 0.7–1.2 cm × ca. 1 mm, base cuneate, margin entire, apex acute. Sporangia yellowish, reniform, vertically bisected.

● Epiphytic on rocks in forests; 1800–2000 m. S Xizang.

Phlegmariurus nylamensis is a small member of the genus. It has small, narrowly lanceolate leaves with an acute apex.

17. Phlegmariurus squarrosus (G. Forster) Á. Löve & D. Löve, Taxon 26: 324. 1977.

粗糙马尾杉 cu cao ma wei shan

Lycopodium squarrosum G. Forster, Fl. Ins. Austr. 86. 1786; *Huperzia squarrosa* (G. Forster) Trevisan; *L. forsteri* Poiret, nom. illeg. superfl.; *L. pseudosquarrosum* Pampanini; *L. remoganense* Hayata; *Plananthus squarrosus* (G. Forster) P. Beauvois; *Urostachys madagascariensis* (Desvaux ex Nessel) Herter; *U. squarrosus* (G. Forster) Herter; *U. squarrosus* f. *madagascariensis* Desvaux ex Nessel.

Lycophytes, large, epiphytic. Stems caespitose, robust, mature branches pendulous, 1 to several times forked, 25–100 cm, main stems 3–7 mm, stem together with leaves 2.5–3 cm wide at middle. Trophophylls lustrous, lanceolate, attached at right angles or slightly angled upward, 1.1–1.5 cm × 1–2 mm, thinly leathery, midrib distinct, base cuneate, decurrent, sessile, margin entire, apex acute. Strobili terminal on branches, slightly thinner than sterile part, columniform. Sporophylls densely arranged, ovate-lanceolate, 8–15 × ca. 0.9 mm, midrib distinct, base cuneate, margin entire, apex acute. Sporangia yellowish, reniform, vertically bisected.

Epiphytic on tree trunks in forests or terrestrial; 400–1900 m. NW and W Guangxi, Taiwan, S Xizang, Yunnan [Bangladesh, Bhutan, Cambodia, India, Laos, Malaysia, Myanmar, Nepal, Philippines, Sri Lanka, Thailand; Madagascar, Pacific islands].

Phlegmariurus squarrosus is the largest species of the genus in China; both branches and sporangia are robust, and its sporophylls are ovate-lanceolate.

3. Phlegmariurus sect. **Carinaturus** (Herter) H. S. Kung & Li Bing Zhang, Acta Phytotax. Sin. 38: 23. 2000.

龙骨马尾杉组 long gu ma wei shan zu

Lycopodium sect. *Carinaturus* Herter, Bot. Jahrb. Syst. 43(1, Beibl. 98): 30. 1909.

Mature branches pendulous. Branches together with leaves ropelike. Leaves small, rigid, leathery, imbricate, raised or carinate abaxially.

About 80 species: Bhutan, S China, India, Japan, Korea, and Old World tropics, extending to Australia and the New World; five species (one endemic) in China.

1a. Trophophylls needlelike, substraight and excurved at apex, up to 8 mm; strobili ca. 3 mm in diam.; sporangia not visible from outside of sporophylls ..... 22. *P. carinatus*
1b. Trophophylls not needlelike, incurved at apex, shorter than 5 mm; strobili 1.5–2.5 mm in diam.; sporangia visible from outside of sporophylls.
2a. Trophophylls of upper portion of plant ovate-lanceolate or elliptic, acute or subacute at apex; sporophylls ovate.
3a. Trophophylls elliptic, subacute and slightly incurved at apex; sporophylls obtuse and without mucro at apex ..... 18. *P. sieboldii*
3b. Trophophylls ovate-lanceolate, acute and strongly incurved at apex; sporophylls acute and with mucro at apex ..... 19. *P. yunnanensis*
2b. Trophophylls of upper portion of plant lanceolate, acuminate at apex; sporophylls ovate or lanceolate.
4a. Branches slender, tertiary branches together with leaves ca. 2 mm in diam., lateral branches equal in length; sporophylls ovate and lanceolate, caudate or mucronate at apex ..... 20. *P. fargesii*
4b. Branches stout, tertiary branches together with leaves more than 2.5 mm in diam., lateral branches unequal in length; sporophylls ovate only, mucronate at apex ..... 21. *P. cancellatus*

18. Phlegmariurus sieboldii (Miquel) Ching, Acta Bot. Yunnan. 4: 121. 1982.

鳞叶马尾杉 lin ye ma wei shan

Lycopodium sieboldii Miquel, Ann. Mus. Bot. Lugduno-Batavi 3: 184. 1867; *Huperzia sieboldii* (Miquel) Holub; *Urostachys sieboldii* (Miquel) Herter ex Nessel.

Lycophytes, medium-sized. Stems caespitose, mature branches pendulous, 1 to several times forked, 30–45 cm, stem together with leaves cordlike, 2–5 mm wide at middle. Leaves twisted and forming 2 rows. Trophophylls dense, adnate to branches, slightly incurved, lustrous, elliptic, less than 5 mm, ca. 3 mm wide, midrib indistinct, hard, raised abaxially, base cuneate, decurrent, sessile, margin entire, apex subacute. Strobili terminal on branches, 1.5–2.5 mm in diam. Sporophylls ovate, midrib indistinct, base cuneate, margin entire, apex blunt without mucro. Sporangia visible from outside of sporophylls, yellowish, reniform, vertically bisected.

Epiphytic on tree trunks in forests; 400–1400 m. Taiwan [Japan, Korea].

Phlegmariurus sieboldii has elliptic trophophylls and apically blunt sporophylls.

19. Phlegmariurus yunnanensis Ching, Acta Bot. Yunnan. 4: 121. 1982.

云南马尾杉 yun nan ma wei shan

Huperzia yunnanensis (Ching) Holub.

Lycophytes, medium-sized. Stems caespitose, mature branches pendulous, 1 to several times forked, 32–47 cm, stem together with leaves cordlike, 2–5 mm wide at middle. Leaves twisted and forming 2 rows. Trophophylls dense, those of upper middle portion of plant ovate-lanceolate, less than 5 mm, ca. 3 mm wide, adnate to branches, much incurved, lustrous, midrib indistinct, hard, raised abaxially, base cuneate, decurrent, sessile, margin entire, apex acute. Strobili terminal on branches, 1.5–2.5 mm in diam. Sporophylls ovate, midrib indistinct, base cuneate, margin entire, apex acute with mucro. Sporangia exposed to outside of sporophylls, yellowish, reniform, vertically bisected.

● Epiphytic on tree trunks in forests; 1500–2600 m. Yunnan (Gongshan, Hekou, Yangbi).

Phlegmariurus yunnanensis may be a geographical substitute of *P. sieboldii*. Its trophophylls are ovate-lanceolate, and its sporophylls have an acute apex.

20. Phlegmariurus fargesii (Herter) Ching, Acta Bot. Yunnan. 4: 120. 1982.

金丝条马尾杉 jin si tiao ma wei shan

Lycopodium fargesii Herter, Bot. Jahrb. Syst. 43(1, Beibl. 98): 48. 1909; *Huperzia fargesii* (Herter) Holub; *L. christensenianum* Christ & Herter; *L. fargesii* var. *gracile* Tagawa; *L. fauriei* Rosenstock; *L. quasiprimaevum* Koidzumi; *L. tereticaule* Hayata; *Urostachys christensenianus* (Christ & Herter) Herter ex Nessel; *U. fargesii* (Herter) Herter ex Nessel; *U. fauriei* (Rosenstock) Herter; *U. tereticaulis* (Hayata) Herter ex Nessel.

Lycophytes, medium-sized. Stems caespitose, mature branches pendulous, 1 to several times forked, 30–52 cm, branches thin, stem together with leaves cordlike, tertiary branches with leaves ca. 2 mm in diam., lateral branches equal. Leaves twisted and forming 2 rows. Trophophylls dense, adnate to branches, much incurved, those of upper middle portion of plant lanceolate, less than 5 mm, ca. 3 mm wide, lustrous, midrib indistinct, hard, raised abaxially, base cuneate, decurrent, sessile, margin entire, apex acuminate. Strobili terminal on branches, 1.5–2.3 mm in diam. Sporophylls ovate and lanceolate, midrib indistinct, base cuneate, margin entire, apex with long tip or mucro. Sporangia exposed to outside of sporophylls, yellowish, reniform, vertically bisected.

Epiphytic on tree trunks in forests; 100–1900 m. Chongqing, Guangxi, Sichuan, Taiwan, Yunnan (Guangnan, Maguan, Malipo, Xichou) [Japan].

Lateral branches of *Phlegmariurus fargesii* are equal in length, and its sporophylls are dimorphic and either ovate or lanceolate.

21. Phlegmariurus cancellatus (Spring) Ching, Acta Bot. Yunnan. 4: 122. 1982.

网络马尾杉 wang luo ma wei shan

Lycopodium cancellatum Spring, Mém. Acad. Roy. Sci. Belgique 24: 27. 1849; *Huperzia cancellata* (Spring) Trevisan; *Phlegmariurus cancellatus* var. *minor* Ching; *Urostachys cancellatus* (Spring) Herter ex Nessel.

Lycophytes, medium-sized. Stems caespitose, mature branches pendulous, 1 to several times forked, 31–49 cm, branches slightly robust, stem together with leaves cordlike, tertiary branches with leaves more than 2.5 mm in diam., lateral branches unequal. Leaves twisted and forming 2 rows. Trophophylls dense, those of upper middle portion of plant lanceolate, less than 5 mm, ca. 3 mm wide, adnate to branches, much incurved, lustrous, base cuneate, decurrent, sessile, midrib indistinct, raised abaxially, hard, margin entire, apex acuminate. Strobili terminal on branches, 1.5–2.3 mm in diam. Sporophylls ovate, base cuneate, midrib indistinct, margin entire, apex acute, with mucro. Sporangia exposed to outside of sporophylls, yellowish, reniform, vertically bisected.

Epiphytic on tree trunks in forests; 1800–2300 m. Xizang [Bhutan, India].

Phlegmariurus cancellatus is similar to *P. fargesii*, but its lateral branches are unequal in length and its sporophylls are only ovate.

22. Phlegmariurus carinatus (Desvaux ex Poiret) Ching, Acta Bot. Yunnan. 4: 120. 1982.

龙骨马尾杉 long gu ma wei shan

Lycopodium carinatum Desvaux ex Poiret in Lamarck, Encycl., Suppl. 3: 555. 1814; *Huperzia carinata* (Desvaux ex Poiret) Trevisan; *H. laxa* (C. Presl) U. Sen & T. Sen; *L. acrostachyum* Hooker & Greville; *L. carinatum* var. *minus* Tagawa; *L. flagellaria* Bory; *L. laxum* C. Presl; *L. pendulum* Roxburgh; *Urostachys carinatus* (Desvaux ex Poiret) Herter ex Nessel.

Lycophytes, medium-sized. Stems caespitose, mature branches pendulous, 1 to several times forked, 31–49 cm, branches slightly robust, stem together with leaves cordlike, tertiary branches with leaves more than 2.5 mm in diam., lateral branches unequal. Leaves twisted and forming 2 rows. Trophophylls dense, adnate to branches, much incurved, lustrous, acicular, up to 8 × 4 mm, midrib indistinct, hard, raised abaxially and keeled, base cuneate, decurrent, sessile, margin entire, apex acuminate, substraight, opening outside. Strobili terminal on branches, ca. 3 mm in diam. Sporophylls ovate, midrib indistinct, base cuneate, margin entire, apex acute, with mucro. Sporangia hidden inside of sporophylls, indistinct, yellowish, reniform, vertically bisected.

Epiphytic on tree trunks or rocks in dense forests of ridges, valleys, hills; 200–2300 m. Guangdong, Guangxi, Hainan, Taiwan, Yunnan (Hekou) [Cambodia, India, Japan, Laos, Malaysia, Philippines, Singapore, Thailand, Vietnam; Pacific islands].

The trophophylls of *Phlegmariurus carinatus* are acicular, and its sporangia are hidden inside of its sporophylls; these characters are conspicuously different from other heterophyllous species in the genus.

3. LYCOPODIUM Linnaeus, Sp. Pl. 2: 1100. 1753.

石松属 shi song shu

Diphasiastrum Holub; *Palhinhaea* Franco & Vasconcellos.

Plants small to large. Main stems creeping or erect, sparsely or densely leafy. Lateral branches ascending or erect, once to multiple times dichotomously branched, terete, complanate or subcomplanate. Leaves on lateral branches and branchlets spirally arranged, subulate, triangular, lanceolate, or linear, papery to leathery, midrib indistinct, base cuneate, decurrent, adnate, sessile, margin entire or toothed, apex acuminate. Strobili solitary or aggregated, erect or nodding, terete, sessile or stalked. Sporophylls different from trophophylls, ovate or broadly lanceolate, imbricate, margin membranous and irregularly toothed, apex caudate.

About 40–50 species: widely distributed in temperate and tropical climates and tropical mountains; 14 species (two endemic) in China.

The following taxon is excluded from the present treatment, pending further research: *Lycopodium clavatum* Linnaeus var. *divaricatum* Raciborski (Bull. Inst. Bot. Buitenzorg 1: 244. 1898), described from Jiangxi (Pingxiang).

1a. Branchlets ± complanate.
  2a. Branchlets obviously complanate; every fertile branch with (1–)3–12 strobili.
    3a. Stolons completely or mostly subterranean; leaves on stolon spatulate or ovate, membranous or thickly membranous, grayish brown or dark brown; sterile branchlets light green or grayish green abaxially; every fertile branch with (1–)3–5(or 6) strobili ..... 10. *L. complanatum*
    3b. Stolons above ground; leaves on stolon subulate, nearly leathery, green; young sterile branchlets gray abaxially; every fertile branch with (4–)8–12 strobili ..... 11. *L. multispicatum*
  2b. Branchlets complanate or subcylindric; every fertile branch with 1–3 strobili.
    4a. Branchlets plus leaves complanate and dorsiventral; sterile leaves scalelike, leathery, adnate to branchlets; strobili binate ..... 12. *L. alpinum*
    4b. Branchlets plus leaves complanate or subcylindric; sterile leaves subulate or linear-lanceolate to lanceolate, papery, not or slightly adnate to branchlets; strobili solitary or 3 per fertile branchlet.
      5a. Branchlets plus leaves subcylindric and not dorsiventral; sterile leaves linear-lanceolate to lanceolate, acute at apex; strobili solitary ..... 13. *L. veitchii*
      5b. Branchlets plus leaves complanate and dorsiventral; sterile leaves subulate, aciculate at apex; strobili 3 per fertile branchlet ..... 14. *L. yueshanense*

1b. Branchlets cylindric.
6a. Strobili pendulous.
7a. Leaves subulate to linear, 3–5 × ca. 0.4 mm, straight or slightly bent upward, papery ..... 8. *L. cernuum*
7b. Leaves subulate, 2–3 × 0.5–0.8 mm, falcate, thickly papery to leathery ..... 9. *L. hainanense*
6b. Strobili erect.
8a. Stems erect.
9a. Lateral branches mostly attached at a right angle with main branch or angled downward, whole branches forming a semi-orbicular shape ..... 1. *L. obscurum*
9b. Lateral branches mostly angled upward, whole branches forming a terete shape ..... 2. *L. verticale*
8b. Stems creeping.
10a. Every fertile branch with 2–6(–8) strobili; strobili not solitary, with stipes.
11a. Main branches 2 or 3 times dichotomously branched; leaves linear to linear-lanceolate, thin and soft; every fertile branch with (3 or)4–8 strobili at different positions of branch; strobili 2–8 cm, with long stipes; sporophylls 2.5–3.5 × ca. 2 mm, with long arista at top ..... 6. *L. japonicum*
11b. Main branches 1 or 2 times dichotomously branched; leaves lanceolate, thick and hard; every fertile branch with 2(or 3) strobili at equal positions of branch; strobili 3.5–4.5 cm, almost without stipes or with short stipes; sporophylls ca. 1.5 × 1.3 mm, with short arista at top ..... 7. *L. clavatum*
10b. Strobili solitary and without stipes.
12a. Leaves denticulate on margin ..... 3. *L. annotinum*
12b. Leaves entire on margin.
13a. Leaves acerose, ascending; sporophylls papery, with broader membranous transparent erose margins ..... 4. *L. neopungens*
13b. Leaves lanceolate, angled upward and amplexicaul; sporophylls thinly leathery, with very narrow membranous transparent margins ..... 5. *L. zonatum*

1. Lycopodium obscurum Linnaeus, Sp. Pl. 2: 1102. 1753.

玉柏 yu bai

Lycopodium obscurum var. *japonicum* Thunberg.

Stolons subterranean, slender and creeping, brownish yellow, glabrous or with few leaves; lateral branches erect, 18–50 cm tall, lower part not branched, distal part forked; branches dense, slightly complanate, whole branches forming a flabellate, semi-orbicular, or terete shape. Leaves spirally arranged, slightly sparse, ascending or nearly spreading, linear-lanceolate, 3–4 × ca. 0.6 mm, leathery, midrib slightly conspicuous, base cuneate, decurrent, sessile, margin entire, apex acuminate, with short acute tip. Strobili solitary, terminal on branchlets, erect, terete, sessile, 2–3 cm × 4–5 mm; sporophylls broadly ovate, ca. 3 × 2 mm, papery, margin membranous, with erose teeth, apex acute. Sporangia borne in axils of sporophylls, enclosed.

Stone crevices or moss layer in canopy gaps of *Betula*, *Larix*, *Picea*, and *Pinus* forests. Heilongjiang, Jilin, Liaoning [Japan, Korea, Russia; North America].

2. Lycopodium verticale Li Bing Zhang, **sp. nov.**

笔直石松 bi zhi shi song

Type: China. Sichuan: Leibo County, Xining, Wayaoping, on rock under bushes, 3 Aug 1978, *Xian-Xu Kong (H. S. Kung) 5642* (holotype, CDBI-302; isotype, CDBI-303).

Lycopodium verticale is most similar to *L. obscurum* but differs by its lateral branches mostly angled upward and its whole branches forming a terete shape.

Stolons subterranean, slender and creeping, brownish yellow, glabrous or with few leaves; lateral branches ascending, 15–50 cm tall, lower part not branched, distal part forked; branches dense, whole branches forming a terete shape. Leaves spirally arranged, slightly sparse, ascending or nearly spreading, linear-lanceolate, 3–4 × ca. 0.6 mm, leathery, midrib slightly conspicuous, base cuneate, decurrent, sessile, margin entire, apex acuminate, with short acute tip. Strobili solitary, terminal on branchlets, erect, terete, sessile, 2–3 cm × 4–5 mm; sporophylls broadly ovate, ca. 3 × 2 mm, papery, margin membranous, with erose teeth, apex acute. Sporangia borne in axils of sporophylls, enclosed.

Among grasses, under shrubs in coniferous and broad-leaved mixed forests, wet places on cliffs; 1000–3000 m. Anhui, Chongqing, Guizhou, Hubei, Hunan, Jiangxi, Shaanxi (Qin Ling), Shanxi, Sichuan, Taiwan, E Xizang, NE Yunnan, Zhejiang [Japan].

The treatment of this taxon has been controversial; some treat it as a variety, some as a form (*Lycopodium dendroideum* Michaux f. *strictum* Milde, Fil. Europ. 254. 1867; *L. obscurum* f. *strictum* (Milde) Nakai ex H. Hara), while others do not recognize it at all. Compared with *L. obscurum*, it is smaller with erect branches, and it occurs in different regions. It is better to be treated as a species.

A similar European species, *Lycopodium juniperoideum* Swartz, does not occur in China. The relationships among *L. juniperoideum*, *L. obscurum*, and *L. verticale* are unclear.

3. Lycopodium annotinum Linnaeus, Sp. Pl. 2: 1103. 1753.

多穗石松 duo sui shi song

Lepidotis annotina (Linnaeus) P. Beauvois; *Lycopodium bryophyllum* C. Presl; *Spinulum annotinum* (Linnaeus) A. Haines.

Stolons slender and creeping, up to 2 m, green, with sparse leaves; lateral branches ascending, 8–20 cm tall, 1–3 times forked, sparse, terete, stem together with leaves 10–15 mm in diam. Leaves spirally arranged, dense, spreading or nearly

spreading, lanceolate, 4–8 × 1–1.5 mm, leathery, without transparent hairs, midrib indistinct abaxially, visible adaxially, base cuneate, decurrent, sessile, margin toothed (margins of leaves of aerial shoots subentire), apex acuminate. Strobili solitary, terminal on branchlets, erect, terete, sessile, 2.5–4 cm × ca. 5 mm; sporophylls broadly ovate, ca. 3 × 2 mm, papery, margin membranous, erose, apex acute. Sporangia enclosed.

Coniferous forests, mixed forests, bamboo forests; 700–3700 m. Chongqing, Gansu, Heilongjiang, Hubei, Jilin, Liaoning, Shaanxi, Sichuan, Taiwan [Bhutan, NE India, Japan, Korea, Nepal, Russia; Europe, North America].

Lycopodium annotinum is the most common species in the genus. Its leaves are lanceolate with toothed margins.

4. Lycopodium neopungens H. S. Kung & Li Bing Zhang, Acta Phytotax. Sin. 38: 268. 2000.

新锐叶石松 xin rui ye shi song

Lycopodium pungens Bachelot de la Pylaie ex Iljin, Fl. URSS 1: 117. 1934, not Alderwerelt (1915).

Stolons slender and creeping, up to 1.4 m, green, with sparse leaves; lateral branches ascending, 8–17 cm tall, 1–3 times forked, sparse, whole branches terete, stem together with leaves 8–12 mm in diam. Leaves spirally arranged, dense, angled upward, acicular, 3–6 × 0.7–1.3 mm, leathery, without transparent hairs, midrib indistinct abaxially, visible adaxially, base cuneate, decurrent, sessile, margin entire, apex acuminate. Strobili solitary, terminal on branchlets, erect, terete, sessile, 2–3.3 cm × ca. 4 mm; sporophylls broadly ovate, ca. 3 × 2 mm, papery, with broad membranous transparent erose margin, apex acute. Sporangia enclosed.

Forests, forest margins; ca. 1000 m. Heilongjiang [Russia; North America].

Lycopodium canadense Nessel (Revista Sudamer. Bot. 6(5–6): 169. 1940) is possibly conspecific with *L. neopungens*. More studies are needed.

Lycopodium neopungens is similar to *L. annotinum* but is smaller with smaller leaves and entire leaf margins.

5. Lycopodium zonatum Ching, Acta Bot. Yunnan. 4: 218. 1982.

成层石松 cheng ceng shi song

Lycopodium alticola Ching; *L. annotinum* Linnaeus var. *acicularis* Christ; *L. annotinum* f. *brevifolium* Christ.

Stolons slender and creeping, up to 1.8 m, green, with sparse leaves; lateral branches ascending, 8–15 cm tall, 1–3 times forked, sparse, whole branches terete, stem together with leaves 7–11 mm in diam. Leaves spirally arranged, dense, angled upward and amplexicaul, lanceolate, 3.5–5 × 0.6–1.2 mm, leathery, midrib indistinct abaxially, visible adaxially, without transparent hairs, base cuneate, decurrent, sessile, margin entire, apex acuminate. Strobili solitary, terminal on branchlets, erect, terete, sessile, 2–3 cm × ca. 4 mm; sporophylls broadly ovate, ca. 3 × 2 mm, thinly leathery, with only narrow transparent membranous margin, apex acute. Sporangia enclosed.

● Shaanxi, Sichuan, Xizang, Yunnan [?India].

Because there are no critical differences in the morphology and habitat between *Lycopodium alticola* and *L. zonatum*, the former is here treated as a synonym of the latter.

Lycopodium zonatum seems to be an ecological substitute of *L. annotinum* in W alpine areas.

This species is small, and its leaves are densely arranged, strongly ascending, with entire margins.

6. Lycopodium japonicum Thunberg in Murray, Syst. Veg., ed. 14, 944. May–Jun 1784.

石松 shi song

Lycopodium centrochinense Ching; *L. clavatum* Linnaeus var. *nipponicum* Nakai; *L. clavatum* var. *wallichianum* Spring; *L. interjectum* Ching & H. S. Kung; *L. kinabaluense* Ching; *L. pseudoclavatum* Ching; *L. pseudoclavatum* var. *yunnanense* Ching; *L. simulans* Ching & H. S. Kung; *L. taliense* Ching; *Stachygynandrum japonicum* (Thunberg) P. Beauvois.

Stolons borne on ground, slender and creeping, 2 or 3 times forked, green, with sparse leaves; lateral branches erect, up to 40 cm tall, multiple times dichotomous, sparse, flattened (young branches terete), stem together with leaves 5–10 mm in diam. Leaves spirally arranged, dense, angled upward, lanceolate or linear-lanceolate, 4–8 × 0.3–0.6 mm, herbaceous, with transparent hairs, midrib indistinct, base cuneate, decurrent, sessile, margin entire, apex acuminate. Strobili (3 or)4–8 together on a peduncle, bracts of peduncle spirally arranged, sparse, thinly herbaceous, leaflike; strobili bearing different lengths of pedicels, erect, terete, 2–8 cm × 5–6 mm, pedicels 1–5 cm; sporophyll broadly ovate, 2.5–3.5 × ca. 2 mm, thinly leathery or papery, erose, with only narrow transparent membranous erose margin, apex acute, with long aristate tip. Sporangia slightly exposed.

Forests, shrubs, grassy slopes, roadsides, on rocks; 100–3300 m. Throughout China except N and NE China [Bhutan, Cambodia, India, Japan, Laos, Myanmar, Nepal, Vietnam; other countries of S Asia].

The angles between branches and stems of *Lycopodium japonicum* are an unreliable character. The leaf shapes can vary too from one population to another depending upon the habitat. Thus, *L. centrochinense*, *L. interjectum*, *L. kinabaluense*, *L. pseudoclavatum* var. *yunnanense*, *L. simulans*, and *L. taliense* should be merged into *L. japonicum*.

Lycopodium japonicum, occurring in E and S Asia, is often misidentified as the European *L. clavatum* Linnaeus (e.g., Nakaike, New Fl. Japan, 17. 1982; J. L. Tsai & W. C. Shieh, Fl. Taiwan, ed. 2, 1: 31. 1994).

Lycopodium japonicum has entire leaves, and each of its fertile branches has 3–8 strobili with pedicels of different lengths.

7. Lycopodium clavatum Linnaeus, Sp. Pl. 2: 1101. 1753.

东北石松 dong bei shi song

Lycopodium aristatum Humboldt & Bonpland ex Willdenow var. *robustius* Greville & Hooker; *L. clavatum* var. *asiaticum* Ching; *L. clavatum* var. *robustius* (Greville & Hooker) Nakai.

Stolons subterranean, slender and creeping, 1 or 2 times forked, green, with sparse entire leaves; lateral branches erect, 20–25 cm tall, 3–5 times forked, sparse, flattened (young branches terete), stem together with leaves 9–12 mm in diam. Leaves spirally arranged, dense, angled upward, lanceolate, 4–6 × ca. 1 mm, leathery, with transparent hairs, midrib visible on both surfaces, base cuneate, decurrent, sessile, margin entire, apex acuminate. Strobili 2(or 3) together on a peduncle, peduncle up to 12 cm, bracts of peduncle spirally arranged, sparse, herbaceous, narrowly lanceolate; strobili erect, terete, 3.5–4.5 cm × ca. 4 mm, subsessile or with short, equally long pedicels; sporophyll broadly ovate, ca. 1.5 × 1.3 mm, papery, margin membranous, erose, apex acute, with short acute tip. Sporangia slightly exposed.

Coniferous forests, among dry moss; 700–1800 m. Heilongjiang, Jilin, Liaoning, Nei Mongol [Japan, Korea; North and South America].

Lycopodium clavatum differs from *L. japonicum* in its fertile branches each bearing 2(or 3) strobili with equal pedicels.

8. Lycopodium cernuum Linnaeus, Sp. Pl. 2: 1103. 1753.

垂穗石松 chui sui shi song

Lepidotis cernua (Linnaeus) P. Beauvois; *Lycopodiella cernua* (Linnaeus) Pichi Sermolli; *Lycopodium cernuum* f. *sikkimense* (Müller (Halle)) H. S. Kung; *L. cernuum* var. *sikkimense* (Müller (Halle)) C. B. Clarke; *L. sikkimense* Müller (Halle); *Palhinhaea cernua* (Linnaeus) Vasconcellos & Franco; *P. cernua* f. *sikkimensis* (Müller (Halle)) H. S. Kung; *P. cernua* var. *sikkimensis* (Müller (Halle)) Ching; *P. lufengensis* C. Y. Yang.

Plants medium-sized to large; aerial shoots erect, up to 60 cm tall, terete, 1.5–2.5 mm in diam. at middle, glabrous, dichotomously branched with well-differentiated lateral branchlets much branched; leaves of aerial shoots spirally arranged, sparse, subulate to linear, ca. 4 × 0.3 mm, straight or slightly involute, papery, midrib indistinct, base rounded, decurrent, sessile, margin entire, apex acuminate. Lateral branches ascending, dichotomously branched with well-differentiated lateral branchlets much branched, pubescent or glabrous; leaves of lateral branches and branchlets spirally arranged, dense, slightly bent upward, subulate to linear, 3–5 × ca. 0.4 mm, papery, longitudinally furrowed on surface, glabrous, midrib indistinct, base decurrent, sessile, margin entire, apex acuminate. Strobilus solitary, terminal on small branches, often pendulous when mature, pale yellow, shortly terete, 3–10 × 2–2.5 mm, sessile; sporophyll ovate-rhombic, imbricate, ca. 0.6 × 0.8 mm, margin membranous, with irregular teeth, apex acute, caudate. Sporangia enclosed.

Forests, forest margins, shaded places in shrubs or beside rocks; 100–2300(–2800?) m. Chongqing, Fujian, Guangdong, Guangxi, Guizhou, Hainan, Hunan, Jiangxi, Sichuan, Taiwan, Xizang, Yunnan, Zhejiang [tropical and subtropical areas of Asia, Central and South America, Pacific islands].

Branches of this species are hairy or glabrous; if hairy then the quantity of hairs is variable. This species can be divided into two forms based on indumentum: *Lycopodium cernuum* f. *cernuum* (branches without hairs) and *L. cernuum* f. *sikkimense* (branches with hairs). *Lycopodium cernuum* f. *sikkimense* has a more southern distribution than the typical form. In Sichuan, the typical form is more common, while this form is more common in Yunnan.

A form with ciliate sterile leaves is recognized as *Palhinhaea cernua* f. *ciliatomarginata* W. M. Chu (Fl. Yunnan. 20: 30. 2006).

9. Lycopodium hainanense (C. Y. Yang) Li Bing Zhang, **comb. nov.**

海南垂穗石松 hai nan chui sui shi song

Basionym: *Palhinhaea hainanensis* C. Y. Yang, Bull. Bot. Res., Harbin 2(4): 141. 1982; *P. hainanensis* f. *glabra* H. S. Kung & Li Bing Zhang.

Plants medium-sized to large, terrestrial; aerial shoots erect, up to 30–150 cm tall, terete, middle part 2–3.5 mm in diam., dichotomously branched with well-differentiated lateral branchlets much branched; leaves of aerial shoots spirally arranged, sparse, subulate, ca. 3 × 0.5 mm, thinly herbaceous, midrib indistinct, base rounded, decurrent, sessile, margin entire, straight or slightly involute, apex acuminate. Lateral branches ascending, dichotomously branched with well-differentiated lateral branchlets much branched, pubescent or glabrous; leaves of lateral branches and branchlets spirally arranged, dense, strongly bent upward, subulate, not narrowed toward base, falcate, 2–3 × 0.5–0.8 mm, thickly herbaceous to leathery, with 1–3 longitudinal furrows on surface, glabrous or shortly pubescent, midrib indistinct, base robust, decurrent, sessile, margin entire, apex acuminate. Strobilus solitary, terminal on small branches, often pendulous or slightly pendulous, pale yellow, shortly terete, 3–5 × 2–2.5 mm, sessile; sporophylls ovate-rhombic, imbricate, ca. 0.6 × 0.8 mm, margin membranous, with irregular teeth, apex acute, caudate. Sporangia enclosed.

Forests; 100–300 m. Hainan [Indonesia, Vietnam].

In comparison with leaves of *Lycopodium cernuum*, those of *L. hainanense* are broader and shorter, more strongly falcate, with thicker texture.

Branches of *Lycopodium hainanense* are pubescent or glabrous.

10. Lycopodium complanatum Linnaeus, Sp. Pl. 2: 1104. 1753.

扁枝石松 bian zhi shi song

Diphasiastrum complanatum (Linnaeus) Holub; *D. complanatum* var. *anceps* Ascherson; *D. wilceae* Ivanenko; *Diphasium anceps* Á. Löve & D. Löve; *D. complanatum* (Linnaeus) Rothmaler; *Lepidotis complanata* (Linnaeus) P. Beauvois; *Lycopodium anceps* Wallroth (1840), not C. Presl (1825); *L. wilceae* X. C. Zhang; *Stachygynandrum complanatum* (Linnaeus) C. Presl.

Plants small to medium-sized, terrestrial; stolons completely or mostly subterranean; leaves on stolon spatulate or ovate, membranous or thickly membranous, grayish brown or dark brown; aerial shoots creeping, up to 100 cm. Lateral branches suberect, up to 15 cm tall, dichotomously branched with well-differentiated lateral branchlets much branched, branchlets obviously flattened; sterile branchlets light green or grayish green abaxially. Leaves arranged in 4 rows, dense, triangular, 1–2 × ca. 1 mm, herbaceous, midrib indistinct, base

appressed on branches, sessile, margin slightly involute, entire, apex acute. Strobili (1–)3–5(or 6), terminal on peduncles (10–20 cm), pale yellow, terete, 1.5–3 cm; sporophylls broadly ovate, imbricate, ca. 2.5 × 1.5 mm, margin membranous, with irregular teeth, apex acute, caudate. Sporangia enclosed.

Forests, shrubs, grasslands of mountain slopes; 700–2900 m. Anhui, Guangdong, Guangxi, Guizhou, Hainan, Hubei, Hunan, Jiangxi, Sichuan, Xinjiang, Xizang, Yunnan, Zhejiang [widespread in temperate and subtropical regions].

Diphasiastrum wilceae, described from Sichuan and with additional distribution in Guangdong, Guizhou, Taiwan, and Yunnan, is provisionally treated as a synonym of *Lycopodium complanatum* considering the wide distribution and morphological variation of the latter.

11. Lycopodium multispicatum J. H. Wilce, Nova Hedwigia 3: 103. 1961.

灰白扁枝石松 hui bai bian zhi shi song

Diphasiastrum complanatum (Linnaeus) Holub var. *glaucum* Ching; *D. multispicatum* (J. H. Wilce) Holub; *Diphasium multispicatum* (J. H. Wilce) Rothmaler.

Plants small to medium-sized, terrestrial; stolons above ground; leaves on stolon subulate, nearly leathery, green; aerial shoots creeping, 50–80 cm. Lateral branches suberect, 6–10 cm tall, dichotomously branched with well-differentiated lateral branchlets much branched, branchlets obviously flattened; young sterile branchlets grayish white abaxially. Leaves arranged in 4 rows, dense, triangular, 1–2 × ca. 1 mm, herbaceous, midrib indistinct, base appressed on branches, sessile, margin slightly involute, entire, apex acute. Strobili (4–)8–12, terminal on peduncles (6–15 cm), pale yellow, terete, 1.2–2.5 cm; sporophylls broadly ovate, imbricate, ca. 2.5 × 1.5 mm, margin membranous, with irregular teeth, apex acute, caudate. Sporangia enclosed.

Forests, forest margins; 1300–2100 m. Guangdong, Guangxi, Taiwan, Xizang, S Yunnan [Philippines, Thailand, Vietnam].

This species is sometimes treated as a variety, i.e., *Diphasiastrum complanatum* var. *glaucum* (see FRPS 5(2): 79. 2001).

12. Lycopodium alpinum Linnaeus, Sp. Pl. 2: 1104. 1753.

高山扁枝石松 gao shan bian zhi shi song

Diphasiastrum alpinum (Linnaeus) Holub; *D. alpinum* var. *planiramulosum* (Takeda) Li & J. Z. Wang; *Diphasium alpinum* (Linnaeus) Rothmaler; *Lepidotis alpina* (Linnaeus) P. Beauvois; *Lycopodium alpinum* var. *planiramulosum* Takeda; *Stachygynandrum alpinum* (Linnaeus) C. Presl.

Plants small to medium-sized, terrestrial; aerial shoots creeping, 30–70 cm. Lateral branches suberect, 6–10 cm tall, dichotomously branched with well-differentiated lateral branchlets much branched, branchlets flattened, dorsiventral. Leaves spirally arranged, dense, scalelike, strongly adnate to branchlets making branchlets cordlike, 0.7–1.5 × ca. 0.8 mm, herbaceous, midrib indistinct, base adnate to branches, sessile, margin slightly involute, entire, apex acute. Strobili 2, terminal on short peduncle, pale yellow, terete, 1.1–2.5 cm; sporophylls broadly ovate, imbricate, ca. 2 × 1.2 mm, margin membranous, with irregular teeth, apex acute, caudate. Sporangia enclosed.

Alpine tundra regions, under small shrubs, mixed forests, on rocks; 1700–2400 m. Heilongjiang, Jilin [India, Japan, Korea, Mongolia, Russia (Siberia), Sri Lanka; Europe, North America].

13. Lycopodium veitchii Christ, Bull. Acad. Int. Géogr. Bot. 16: 141. 1905.

矮小扁枝石松 ai xiao bian zhi shi song

Diphasiastrum veitchii (Christ) Holub; *Lycopodium alpinum* Linnaeus var. *transmorrisonense* Hayata; *L. malacophyllum* Handel-Mazzetti; *L. sitchense* Ruprecht var. *veitchii* (Christ) Takeda.

Plants small to medium-sized, terrestrial; aerial shoots creeping, 40–70 cm. Lateral branches suberect, 5–7 cm tall, dichotomously branched with well-differentiated lateral branchlets much branched, small stem together with leaves terete, not dorsiventral. Leaves spirally arranged, dense, linear-lanceolate to lanceolate, 2–4 × 0.6–1 mm, herbaceous, base not adnate to branchlets, sessile, margin slightly involute, entire, apex acuminate. Strobili solitary, terminal on peduncles (2–4 cm), pale yellow, terete, 2–3 cm; sporophyll broadly ovate, imbricate, ca. 4 × 2 mm, margin membranous, with irregular teeth, apex long acuminate. Sporangia enclosed.

Alpine slopes, forest margins; 2600–4000 m. W Hubei, W Sichuan, Taiwan, Xizang, NW Yunnan [Bhutan, India, Myanmar, Nepal].

14. Lycopodium yueshanense C. M. Kuo, Taiwania 30: 52. 1985.

玉山扁枝石松 yu shan bian zhi shi song

Diphasiastrum yueshanense (C. M. Kuo) Holub.

Plants small to medium-sized, terrestrial; aerial shoots creeping, 40–65 cm. Lateral branches suberect, 5–6 cm tall, dichotomously branched with well-differentiated lateral branchlets much branched, small stem together with leaves flattened, complanate and dorsiventral. Sterile leaves spirally arranged, dense, subulate, 2–4 mm, 0.6–1 mm wide at base, herbaceous, base slightly adnate to branchlets, sessile, margin slightly involute, entire, apex aciculate. Strobili (1–)3 per fertile branchlet, terminal on peduncles (2–4 cm), pale yellow, terete, 2–3 cm; sporophyll broadly ovate, imbricate, ca. 4 × 2 mm, margin membranous, with irregular teeth, apex long acuminate. Sporangia enclosed.

● Alpine grasslands; 2700–3200 m. Taiwan.

4. LYCOPODIELLA Holub, Preslia 36: 20, 22. 1964.

小石松属 xiao shi song shu

Pseudolycopodiella Holub.

Plants helophytic, small. Aerial shoots creeping, unbranched or dichotomously branched, terete, sparsely leafy. Leaves

spirally arranged, dimorphic or monomorphic, lanceolate, linear, or scalelike, papery, midrib indistinct, base cuneate, decurrent, sessile, margin entire, apex acuminate. Strobili solitary, erect, terete, stalked. Sporophylls different from trophophylls, dimorphic or monomorphic, subulate to lanceolate, imbricate, margin membranous and irregularly toothed, apex acute, acuminate, or obtuse. Sporangia yellow, reniform.

About 18–25(–40) species: cosmopolitan, with centers of diversity in New World tropics and New Guinea; two species in China.

1a. Bracts dense, similar size to leaves; sporophylls dimorphic, linear-lanceolate and broadly lanceolate ..... 1. *L. inundata*
1b. Bracts sparse, obviously smaller than leaves; sporophylls monomorphic, ovate ..... 2. *L. caroliniana*

1. Lycopodiella inundata (Linnaeus) Holub, Preslia 36: 21. 1964.

小石松 xiao shi song

Lycopodium inundatum Linnaeus, Sp. Pl. 2: 1102. 1753; *Lepidotis inundata* (Linnaeus) Opiz; *Plananthus inundatus* (Linnaeus) P. Beauvois.

Plants of marshes and wetlands. Aerial shoots creeping, 5–20 cm, simple or multiple times dichotomous, 1–2 mm in diam., stem together with leaves 5–8 mm wide. Leaves spirally arranged, sparser on creeping side of stem, dense, ascending, yellowish green, not lustrous, lanceolate to linear, bent, 4–7 × 0.5–1.1 mm, papery, both surfaces glabrous, midrib indistinct, base not narrowed, decurrent, sessile, margin entire, apex acuminate. Peduncles solitary, erect, 3–8 cm tall, together with bracts 4–10 mm wide; bracts dense, linear or linear-lanceolate; strobilus yellowish green, terete, 1–5 cm × 5–7 mm; sporophylls dimorphic, yellowish green, linear-lanceolate and lanceolate, imbricate, 2–5 × 0.5–1.2 mm, papery, margin entire, apex acuminate or blunt. Sporangia enclosed or slightly exposed, subspherical, ca. 0.5 mm in diam., apex acuminate.

Bogs, marshes, swamps; 400–1000 m. Fujian [Japan, Russia; Europe, North America].

2. Lycopodiella caroliniana (Linnaeus) Pichi Sermolli, Webbia 23(1): 165. 1968.

卡罗利小石松 ka luo li xiao shi song

Lycopodium carolinianum Linnaeus, Sp. Pl. 2: 1101. 1753; *Lepidotis caroliniana* (Linnaeus) P. Beauvois; *L. repens* P. Beauvois; *Lycopodium repens* (P. Beauvois) Swartz; *L. subinundatum* Tagawa; *Pseudolycopodiella caroliniana* (Linnaeus) Holub.

Plants of marshes or wetlands. Aerial shoots creeping, 10–30 cm, forked, 2–5 mm in diam., stem together with leaves 7–12 mm wide. Leaves spirally arranged, sparser on creeping side of stem, dense, ascending, yellowish green, not lustrous, lanceolate, slightly bent at base, 5–10 × 1–2 mm, papery, both surfaces crimped, midrib indistinct, base not narrowed, decurrent, sessile, margin entire, apex acuminate. Peduncles solitary, erect, 8–15 cm tall, 10–15 mm wide; bracts sparse, subulate to lanceolate, obviously smaller than leaves of creeping stems, 3–5 × ca. 1 mm, papery, margin entire, apex acuminate, with long acute tip; strobilus yellow, terete, 2.5–5 cm, 3–4 mm in diam. (excluding sporophylls); sporophylls monomorphic, yellow, broadly ovate, imbricate, 4–5 mm, 2–2.5 mm wide at base, leathery, margin membranous, with irregular blunt teeth, apex acute, caudate. Sporangia enclosed, reniform, ca. 1.2 mm in diam.

Marshes, wetlands on hillsides; 1000–1500 m. Fujian, Guangdong, Hunan [India, Japan, Sri Lanka; Africa, America].

Yizhang, Hunan, is the northernmost distribution limit of this species in China.

5. LYCOPODIASTRUM Holub ex R. D. Dixit, J. Bombay Nat. Hist. Soc. 77: 540. 1981.

藤石松属 teng shi song shu

Plants large, terrestrial. Rhizome long and creeping, aerial shoots woody and vinelike, terete, with sparse leaves. Sterile branches soft, yellowish green, terete, dichotomously branched with well-differentiated lateral branchlets much branched; leaves spirally arranged, but leaf base twisted and making branchlets complanate, dense, ascending, subulate, herbaceous. Fertile branches soft, reddish brown, branchlets flattened, dichotomously branched with well-differentiated lateral branchlets; leaves spirally arranged, sparse, appressed, scalelike; bracts similar to leaves on aerial shoots but smaller; strobili 6–26 per peduncle and terminal on multi-dichotomously branched peduncles forming a cone shape, with erect peduncles and pedicels, bent, reddish brown; sporophylls broadly ovate, imbricate, thickly membranous, with irregular teeth on margin, apex acute, with membranous long awn. Sporangia borne in axils of sporophylls, enclosed, yellow, reniform.

One species: widely distributed in tropics and subtropics of Asia extending eastward to Papua New Guinea.

1. Lycopodiastrum casuarinoides (Spring) Holub ex R. D. Dixit, J. Bombay Nat. Hist. Soc. 77: 541. 1981.

藤石松 teng shi song

Lycopodium casuarinoides Spring, Monogr. Lycopod. 1: 94. 1842; *Lepidotis casuarinoides* (Spring) Rothmaler.

Plants large, terrestrial. Rhizome long and creeping, aerial shoots woody and vinelike, up to several meters, terete, ca. 2 mm in diam., with sparse leaves; leaves spirally arranged, adnate, ovate-lanceolate to subulate, 1.5–3 × ca. 0.5 mm, base raised, arc-shaped, sessile, apex acuminate, with 1 membranous long awn 2–5 mm, sometimes awns deciduous. Sterile branches soft, yellowish green, terete, together with leaves ca. 4 mm wide, dichotomously branched with well-differentiated lateral branchlets much branched; leaves spirally arranged, but leaf

base twisted and making branchlets complanate, dense, ascending, not lustrous, subulate, angled upward, 2–3 × ca. 0.5 mm, abaxially arc-shaped, concave adaxially, midrib indistinct, herbaceous, base decurrent, sessile, margin entire, apex acuminate, long aristate. Fertile branches soft, reddish brown, branchlets flattened, dichotomously branched with well-differentiated lateral branchlets; leaves spirally arranged, sparse, appressed, scalelike, ca. 0.8 × 0.3 mm, base decurrent, sessile, margin entire, apex acuminate, aristate; bracts similar to leaves on aerial shoots but smaller; strobili 6–26 per peduncle and terminal on multi-dichotomously branched peduncles forming a cone shape, with erect peduncles and pedicels, bent, reddish brown, 1–4 cm × 2–3 mm; sporophylls broadly ovate, imbricate, 2–3 × ca. 1.5 mm, thickly membranous, with irregular teeth on margin, apex acute, with membranous long awn. Sporangia borne in axils of sporophylls, enclosed, yellow, reniform.

Forests, forest margins, shrubs, riverbanks; 100–3100 m. Chongqing, Fujian, Guangdong, Guangxi, Guizhou, Hubei, Hunan, Jiangxi, Sichuan, Taiwan, Xizang, Yunnan, Zhejiang [tropical and subtropical regions of Asia: Bhutan, India, Japan, Nepal, and SE Asia extending to Papua New Guinea].