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. Wang, Z. R., C. Haufler, K. M. Pryer & M. Kato. 2013. Cystopteridaceae. Pp. 257–266 *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.

CYSTOPTERIDACEAE

冷蕨科 leng jue ke

Wang Zhongren (王中仁)[1]; Christopher Haufler[2], Kathleen M. Pryer[3], Masahiro Kato[4]

Plants small to medium-sized, summer-green; rhizomes slender, creeping or ascending; costae articulate to rachis (in *Gymnocarpium*) or not so; lamina pinnate to 3(or 4)-pinnate-pinnatifid; veins free; sori orbicular or elongate, abaxial on veins, indusiate or exindusiate; indusia ovate-lanceolate, ovate, or orbicular, attached proximally to receptacle. $x = 40, 42$.

Four genera and more than 30 species: worldwide, mainly in the temperate and cold temperate zones and tropical mountains; four genera (one endemic) and 20 species (ten endemic) in China.

Wang Zhong-ren. 1999. *Acystopteris*, *Cystoathyrium*, *Cystopteris*, and *Gymnocarpium*. *In:* Chu Wei-ming, ed., Fl. Reipubl. Popularis Sin. 3(2): 38–74.

1a. Sori exindusiate ..... 1. *Gymnocarpium*
1b. Sori indusiate.
2a. Multicellular articulate hairs present on stipe and lamina; indusia small, often hidden under sporangia ..... 3. *Acystopteris*
2b. Multicellular articulate hairs absent from stipe and lamina; indusia visible.
3a. Lamina deltoid to lanceolate, base slightly narrowed or broadest part of lamina; spore wall echinate ..... 4. *Cystopteris*
3b. Lamina oblong-lanceolate, base gradually narrowed, spore wall with conical spines ..... 2. *Cystoathyrium*

1. GYMNOCARPIUM Newman, Phytologist 4: 371. 1851.

羽节蕨属 yu jie jue shu

Wang Zhongren (王中仁); Kathleen M. Pryer

Carpogymnia (H. P. Fuchs ex Janchen) Á. Löve & D. Löve; *Currania* Copeland; *Thelypteris* sect. *Carpogymnia* H. P. Fuchs ex Janchen.

Plants terrestrial, summer-green, small to medium-sized. Rhizomes long creeping, blackish brown, glabrate, clothed with brown, thin, broadly lanceolate or ovate-lanceolate scales at apices and stipe bases. Fronds distant; stipe thin, much longer than lamina, dark brown at base, upper part stramineous, U-shaped grooved adaxially; lamina simple-pinnatipartite to 3-pinnate-pinnatifid, deltoid-ovate to pentagonal-oval, base articulate to stipe apex, apex acuminate; pinnae stalked or sessile, articulate to rachis, basal pair not shortened. Veins free, pinnate in ultimate segments, lateral veins simple or occasionally forked, terminating at margin. Lamina herbaceous or thinly herbaceous, stipe apex, rachis, costae, and lamina ± with hyaline or pale yellow glands on surfaces, or glands absent. Sori oblong or orbicular, exindusiate, abaxial on veins, uniseriate along each side of costule or midrib. Spores bean-shaped, perispore surface rugate, folds lobed, foveolate or sometimes reticulate. $x = 40$.

Two sections, ten species, and several hybrids: temperate zone of the N Hemisphere (Asia, Europe, and North America) and subtropical mountains of Asia, occurring in forests; five species (two endemic) in China.

1a. Lamina pinnatifid; sori oblong ..... 1. *G. oyamense*
1b. Lamina 2- or 3-pinnate; sori smaller, orbicular.
2a. Rachis glandular abaxially.
3a. Stipe sparsely glandular, rachis base and costa base of basal 1–3 pairs of pinnae glandular; veins often forked ..... 2. *G. jessoense*
3b. Stipe apex, rachis, and costae densely glandular abaxially, other parts also glandular; veins usually simple ..... 3. *G. altaycum*
2b. Rachis glabrate, eglandulose.
4a. Lamina ovate-pentagonal or ternate, lowest pinnae nearly as large as rest of lamina, 2-pinnate-pinnatifid; basiscopic basal pinnules of lowest pinnae nearly as large as third pinnae; ultimate pinnules oblong, ± pinnatifid, or shallowly lobed ..... 4. *G. dryopteris*
4b. Lamina deltoid-ovate, lowest pinnae smaller than rest of lamina, 3-pinnate-pinnatifid; basiscopic basal pinnules of lowest pinnae nearly as large as fourth pinnae; ultimate pinnules narrowly oblong, usually entire ..... 5. *G. remotepinnatum*

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1. Gymnocarpium oyamense (Baker) Ching, Contrib. Biol. Lab. Sci. Soc. China, Bot. Ser. 9: 40. 1933.

东亚羽节蕨 dong ya yu jie jue

Polypodium oyamense Baker, J. Bot. 15: 366. 1877; *Aspidium krameri* (Franchet & Savatier) Christ; *Carpogymnia oyamensis* (Baker) Á. Löve & D. Löve; *Currania gracilipes* Copeland; *C. oyamensis* (Baker) Copeland; *C. oyamensis* var. *gracilipes* (Copeland) Tagawa; *Dryopteris gracilipes* (Copeland) C. Christensen; *D. gymnogrammoides* (Baker) C. Christensen; *D. oyamensis* (Baker) C. Christensen; *Gymnocarpium gracilipes* (Copeland) Ching; *G. oyamense* var. *gracilipes* (Copeland) W. C. Shieh; *Nephrodium gymnogrammoides* (Baker) Diels; *N. krameri* (Franchet & Savatier) Diels; *Phegopteris krameri* (Franchet & Savatier) Makino; *P. oyamensis* (Baker) Alderwerelt; *Polypodium gymnogrammoides* Baker; *P. krameri* Franchet & Savatier; *P. krameri* var. *incisum* Franchet & Savatier.

Rhizomes long creeping, 1.5–2(–3) mm in diam., clothed with red-brown, broadly lanceolate scales, glabrate when old. Fronds distant; fertile fronds (13–)25–45(–50) cm; stipe stramineous, shiny, (7–)12–25(–31) cm, 1.5–2 mm in diam., terete abaxially and grooved adaxially, scaly at base, upward glabrate, articulate to lamina at apex; lamina ovate-triangular, (7–)10–18(–22) × (4–)6–13(–20) cm, herbaceous, glabrate, base cordate, pinnatipartite 4–5 mm to rachis, apex acuminate; pinnae 6–9(–13) pairs, opposite, spreading, approximate, broadly lanceolate, falcate, base decurrent to narrow rachis wing, shallowly lobed to pinnatipartite, apex acute or acuminate; basal pair of pinnae descending, often broadly lanceolate, (2–)4–7(–10) × 1–1.8(–3) cm; second pair slightly longer than basal pinnae or subequal, spreading, shallowly lobed; pinna lobes obtuse-rounded, entire or crenate; veins pinnate, lateral veins (2–)4 or 5(–8) pairs, simple, slightly visible; rachis inserted obliquely and articulate to stipe; upper part of stipe, lower part of rachis, and bases of costae in lower pinnae sparsely pubescent with short glands, or glabrate. Sori oblong, medial on veins, biseriate along both sides of costules, exindusiate. Spore wall surface rugate, foveolate. 2*n* = 80, 160.

Damp areas in forests, on moss-covered rocks; 300–2900 m. Anhui, Chongqing, Gansu, Guizhou, Henan, Hubei, Hunan, Jiangxi, Shaanxi, Sichuan, Taiwan, Xizang, Yunnan, Zhejiang [NE India, Japan, Nepal, New Guinea, Philippines].

2. Gymnocarpium jessoense (Koidzumi) Koidzumi, Acta Phytotax. Geobot. 5: 40. 1936.

羽节蕨 yu jie jue

Dryopteris jessoensis Koidzumi, Bot. Mag. (Tokyo) 38: 104. 1924; *Aspidium dryopteris* (Linnaeus) Baumgarten var. *longulum* Christ; *Carpogymnia jessoensis* (Koidzumi) Á. Löve & D. Löve; *Dryopteris linnaeana* C. Christensen var. *jessoensis* (Koidzumi) C. Christensen; *Gymnocarpium longulum* (Christ) Kitagawa; *G. robertianum* (Hoffmann) Newman subsp. *longulum* (Christ) Toyokuni; *G. robertianum* var. *longulum* (Christ) H. Itô ex Nakai; *Lastrea jessoensis* (Koidzumi) Akasawa; *L. robertiana* (Hoffmann) Newman var. *longula* (Christ) Ohwi.

Rhizomes long creeping, apex clothed with brownish ovate-lanceolate scales; fronds distant, sometimes approximate. Fertile fronds (16–)20–50(–76) cm; stipe stramineous, (8–)15–32(–51) cm, up to 3.5 mm in diam., base sparsely scaly, upper part glabrate; lamina pinnate-pinnatifid or 2-pinnate-pinnatipartite, deltoid-ovate, (7–)15–20(–27) × (7–)14–22(–30) cm, herbaceous or papery, base rounded, apex acuminate; pinnae (3–)5–8 pairs, opposite, oblique, basal 1–4 pairs stalked, articulate to rachis; basal pinnae largest, narrowly triangular, (4–)8–15(–18) × 3–7(–11) cm at base, base subtruncate, with stalk (0.8–)1–2.5(–3.5) cm, slightly oblique, pinnate-pinnatifid or pinnate-pinnatipartite, apex acuminate; pinnules 5–8 pairs, deltoid-lanceolate, base subtruncate, apex acuminate, opposite or subopposite; basal one to several pairs articulate to costa, usually sessile, sometimes basal pair shortly stalked, 1–3(–12) mm; basal basiscopic pinnules longest, 1–5(–7) × (0.7–)1–2.3 cm, descending; pinnule segments 5–10 pairs, oblong to narrowly ovate, base free or adnate to narrow wing, margin crenate, apex rounded-obtuse; second basal pair of pinnae (2–)4–5(–7.5) cm apart from basal pair, narrowly triangular, much smaller than lowest pinnae, 4–8(–12) cm; third and upper pairs of pinnae broadly lanceolate, gradually smaller; veins pinnate in segment, veins usually forked, sometimes simple, very oblique, visible; stipe apex, rachis, and costae with hyaline or pale yellow short glands. Sori small, orbicular or oblong, abaxial on veins, submarginal, exindusiate. Spore wall surface rugate, foveolate. 2*n* = 80, 160.

Wet areas in forests, mountain slopes; 400–4000 m. Gansu, Guizhou, Hebei, Heilongjiang, Henan, Jilin, Liaoning, Nei Mongol, Ningxia, Qinghai, Shaanxi, Shanxi, Sichuan, Xinjiang, SE Xizang, NW Yunnan [Afghanistan, Bhutan, N India, Japan, Korea, Nepal, N Pakistan, E Russia; NW North America].

Treated as a pro parte synonym of *Gymnocarpium jessoense*, *G. disjunctum* (Ruprecht) Ching (Acta Phytotax. Sin. 10: 304. 1965; *Polypodium dryopteris* Linnaeus var. *disjunctum* Ruprecht, Distr. Crypt. Vasc. Ross. 52. 1845; *Carpogymnia disjuncta* (Ruprecht) Á. Löve & D. Löve; *G. dryopteris* (Linnaeus) Newman subsp. *disjunctum* (Ruprecht) Sarvela; *G. dryopteris* var. *disjunctum* (Ruprecht) Ching) is restricted to W North America (see Pryer & Haufler, Syst. Bot. 18: 150–172. 1993).

3. Gymnocarpium altaycum Chang Y. Yang, Fl. Xinjiang. 1: 304. 1992.

密腺羽节蕨 mi xian yu jie jue

Rhizomes long creeping, apex clothed with brownish ovate-lanceolate scales. Fronds distant; fertile fronds 18–40 cm; stipe stramineous, 11–25 cm, 0.5–1 mm in diam., base sparsely scaly, upper part glabrate; lamina 2-pinnate to 3-pinnatifid, deltoid-ovate, 7–13 × 4–8 cm, herbaceous or papery, base rounded, apex acuminate; pinnae 5–8 pairs, opposite, oblique, basal 3 or 4 pairs stalked, articulate to rachis, basal pair largest, narrowly triangular, 4.5–8.5 × 3–4.5 cm at base, base subtruncate, with stalk 6–13 cm, slightly oblique, pinnate, apex acuminate; pinnules 4–6 pairs, opposite or subopposite, deltoid-lanceolate or narrowly oblong, base broadly cuneate, basal 1 or 2 pairs articulate to costae, subsessile, apex acuminate; basal basiscopic pinnules longest, descending, 1.5–2.7 cm × 6–8 mm, pinnate or pinnatipartite; pinnule segments 5–7 pairs, oblong to narrowly ovate, separate or adnate at base, crenate, apex rounded-obtuse; second basal pair of pinnae 1.7–3.3 cm apart

from basal pinnae, narrowly triangular, much smaller than basal pinnae, 2–5.5 cm; third and upper pairs of pinnae broadly lanceolate, gradually smaller; veins pinnate in segment, simple, sometimes forked, oblique, visible; stipe (at least upper part), lower part of rachis, costae, and midribs pubescent with short glands. Sori small, orbicular or oblong, abaxial on veins, submarginal, exindusiate.

● Shaded places in forests, mountain slopes; 1500–2500 m. Qinghai, Xinjiang.

One of us (Pryer) notes that *Gymnocarpium robertianum* (Hoffmann) Newman (Phytologist 4: append. xxiv. 1851; *Polypodium robertianum* Hoffmann, Deutschl. Fl. 2: add. et emend. 10. 1795), which was treated as conspecific with *G. altaycum* in FRPS (3(2): 70–71. 1999), is glandular on both sides of the upper stipe, firm and stiff in texture, and moderately glandular on the adaxial as well as the abaxial surface, including on the laminae.

4. Gymnocarpium dryopteris (Linnaeus) Newman, Phytologist 4: append. xxiv. 1851.

欧洲羽节蕨 ou zhou yu jie jue

Polypodium dryopteris Linnaeus, Sp. Pl. 2: 1093. 1753; *Aspidium dryopteris* (Linnaeus) Baumgarten; *Carpogymnia dryopteris* (Linnaeus) Á. Löve & D. Löve; *Dryopteris linnaeana* C. Christensen; *Lastrea dryopteris* (Linnaeus) Bory.

Rhizomes slender, creeping, black, shiny, apex clothed with brown ovate-lanceolate scales. Fronds distant; fertile lamina (15–)20–30(–50) cm; stipe stramineous, 10–22(–35) cm, slender, with sparse scales at base; lamina nearly tripartite, usually 2-pinnate-pinnatifid, pentagonal-ovate or broadly ovate-triangular, 7–15(–20) cm long and wide, thinly herbaceous or submembranous, base broadly cuneate, apex acuminate; basal pair of pinnae nearly as large as other portion of lamina, narrowly triangular, (3.5–)5–9(–12) × 2.5–4(–7) cm, pinnate-pinnatifid, base subtruncate, with stalk (0.8–)1–1.5(–2.5) cm, portion of rachis between basal pinnae and central lamina ca. 3 cm; pinnules 5 or 6 pairs, oblong-lanceolate, 1.5–2(–4) × 0.5–2 cm, base rounded-cuneate, sessile, apex acute or acuminate, opposite or subopposite, spreading; largest pinnules with 6–10 pairs of segments, segments approximate, oblong to narrowly ovate, ca. 4 mm, lobed to narrow costular wing, entire to shallowly lobed at margin, rounded-obtuse at apex; second basal pair of pinnae 1.5–4 cm apart from basal pair, sometimes shortly stalked, upper pinnae sessile; veins pinnate in segment, simple, oblique, visible abaxially; rachis and costae slender, eglandular. Sori small, exindusiate, orbicular, abaxial on veins. Spore wall surface rugate, foveolate. 2*n* = 160.

Damp areas in coniferous forests; 300–2900 m. Heilongjiang, Jilin, Liaoning, Nei Mongol, Shaanxi, Shanxi, Xinjiang [Japan, Korea; Europe, North America].

American *Gymnocarpium dryopteris* is an allotetraploid species that arose following hybridization and polyploidization between *G. disjunctum* (Ruprecht) Ching and *G. appalachianum* Pryer & Haufler.

Sarvela noted that a specimen of *Gymnocarpium dryopteris* from Japan was indusiate; the indusia were reniform, ca. 0.5 mm in diam., hyaline, glabrate, erose at margin. It may be an example of atavism.

5. Gymnocarpium remotepinnatum (Hayata) Ching, Icon. Fil. Sin. 4: t. 172. 1937 [*"remote-pinnatum"*].

细裂羽节蕨 xi lie yu jie jue

Dryopteris remotepinnata Hayata, Suppl. Icon. Pl. Formosan. 6: 108. 1917, based on *D. remota* Hayata, J. Coll. Sci. Imp. Univ. Tokyo 30(1): 421. 1911, not (A. Braun) Hayek (1908); *Gymnocarpium remotum* Ching; *Thelypteris remotepinnata* (Hayata) Alston.

Rhizomes slender, creeping, with sparse brownish ovate-lanceolate scales. Fronds distant; fertile fronds 20–30 cm; stipe stramineous, (10–)12–20 cm, slender, fragile, sparsely scaly at base; lamina 3-pinnate or 3-pinnate-pinnatifid, triangular, 10–14 × 6–9 cm, thinly herbaceous, base subtruncate, apex acuminate; pinnae 5 or 6 pairs, opposite, basal 2 pairs shortly stalked, upper pinnae sessile, basal pinnae largest, narrowly triangular, 6–8 × 5–6 cm, base subtruncate, stalk 1–2.2 cm, articulate to rachis, 2-pinnate, apex acuminate, spreading; pinnules 5 or 6 pairs, opposite, oblong-lanceolate, 1.5–2 × ca. 1 cm, base broadly rounded, sessile, apex acuminate, spreading; pinnule segments or secondary pinnules narrowly oblong, separate or lobed to costular wings, entire but lobed on basiscopic side, apex rounded-obtuse; second basal pair of pinnae 2–3 cm apart from basal pinnae, smaller, ascending, oblong, falcate, base rounded and equilateral, sessile; upper pinnae gradually smaller than second basal pinnae; veins pinnate in segment, simple, very oblique, visible abaxially; lamina glabrate, abaxial surface of rachis and costae eglandular. Sori small, brown, orbicular, exindusiate, abaxial on veins. 2*n* = 80*.

● Coniferous forests, on rocks at forest margins; 2500–3400 m. Taiwan, NW Yunnan.

2. CYSTOATHYRIUM Ching, Acta Phytotax. Sin. 11: 22. 1966.

光叶蕨属 guang ye jue shu

Wang Zhongren (王中仁); Masahiro Kato

Plants evergreen, medium-sized. Rhizomes short, ascending, bearing remaining stipe bases and dense thick roots, clothed with dark brown ovate-lanceolate scales at apex. Fronds approximate; fertile fronds: rachis grooved adaxially, glabrate; lamina pinnate-pinnatifid; pinnae pinnatipartite, up to 30 pairs, subopposite, spreading, sessile, ca. 1 cm apart (lower pinnae more widely apart). Veinlets 3–5 pairs, simple but basal veins frequently forked, oblique, reaching margins of lobes. Sori orbicular, single per pinna lobe, abaxial on basal acroscopic veins, close to costae; indusia pale green, broadly ovate or orbicular, thinly membranous, fugacious, basiscopic to receptacle, inferior (i.e., hidden by sporangia), partly covering sori when young, hidden by sporangia at maturity, persistent; annulus consisting of 12 or 13 thick-walled cells. Spores dark brown, bean-shaped, perispore with dense conical spines.