

## Dichotomous Key to Fern Allies of Wisconsin

(Compiled by Tim Gerber/UW-La Crosse)

Twenty-nine species (excluding hybrids) make up the Fern Ally flora of Wisconsin (Wetter et. al., 2001). This key includes only native species. No exotic fern allies are found growing in the wild in WI. This key relies on features found in Flora of North America (1993) and Gleason & Cronquist (1991); nomenclature follows Wetter et al. (2001). Groups of fern allies included here are Quillworts (*Isoetes*), Horsetails and Scouring Rushes (*Equisetum*), Club-mosses (*Diphasiastrum*, *Huperzia*, *Lycopodiella*, and *Lycopodium*); and Spike-mosses (*Selaginella*). Wetland indicator status for those species indicated follows USFWS (1988), Region 3. [Note: This document should not be used to officially determine or assign a wetland indicator status.]

1	Leaves grass-like, blade not expanded/ spore-bearing structures imbedded in leaf bases or on short stalks 1 – 2 mm at leaf bases, at or below ground level// aquatic, semi-aquatic, or vernal wet habitats.  <i>(Isoetes)</i>	2
1	Leaves (microphylls) inconspicuous scales or needles < 2 cm, all leaves with single unbranched vein/ spore-bearing structures (sporangium) aggregated in cone-like terminal structures (strobilus) above ground// wet to terrestrial habitats.  <i>(Equisetum, Club-mosses, Selaginella)</i>	3
2(1)	Megaspores texture with small spines (echinate)/ plants aquatic, occasionally emergent. <b>OBL</b>	<i>Isoetes echinospora</i>
2	Megaspores texture not echinate/ plants submerged aquatics. <b>OBL</b>	<i>Isoetes lacustris</i>
3(1)	Stems (and branches, if any) jointed, usually fluted, hollow, often rough from silica deposited in cells/ leaves borne in whorls at each node, fused at base to form sheath but with free tips that may be caduceus// sporangia aggregated into terminal strobili with polygonal sections.  <i>(Equisetum)</i>	4
3	Stems and branches not jointed, not fluted or hollow/ leaves spirally or oppositely arranged// sporangia variously arranged.  <i>(Club-mosses, Selaginella)</i>	12

4(3)	Aerial stems persisting only 1 year or less, $\pm$ (usually with) regular whorls of branches/ stomates on surface, scattered or in bands// cone apex rounded. <b>(Horsetails)</b>	5
4	Aerial stems persisting more than a year (except some <i>E. laevigatum</i> , usually unbranched or with scattered branches/ stomates sunken, in single lines// cone apex pointed (except in some <i>E. laevigatum</i> ). <b>(Scouring Rushes)</b>	9
5(4)	Aerial stems green/ fertile and sterile stems alike or If aerial stem branches present, then first internode of each hollow branch shorter than subtending stem sheath/ branch ridges and valleys rounded.	6
5	Aerial stems not green/ fertile and sterile stems unlike If aerial stem branches present, then first internode of each branch equal to or longer than subtending stem sheath/ branch valleys channeled.	7
6(5)	Sheaths square in face view, teeth $> 11$ per sheath, often black throughout or with narrow white margins, 2 – 3 mm. <b>OBL</b>	<i>Equisetum fluviatile</i>
6	Sheaths elongate in face view, teeth $< 11$ per sheath, with prominent white margins and dark centers, 2 – 5 mm. <b>FACW</b>	<i>Equisetum palustre</i>
7(5)	Sheath teeth reddish, papery, coherent into 3 – 4 large groups If aerial stem branches present, then branches also branched. <b>FACW</b>	<i>Equisetum sylvaticum</i>
7	Sheath teeth black or brown, firm, separate or coherent in $> 4$ small groups. If aerial stem branches present, then branches unbranched.	8
8(4)	Aerial stems with stomates, persistent, becoming green and branched.	<i>Equisetum pratense</i>
8	Aerial stems lacking stomates, dying back after spores shed. <b>FAC</b>	<i>Equisetum arvense</i>
9(5)	Sheaths dark-girdled at most nodes of stem/ teeth $14 \leq$ per sheath, usually shed/ articulation line visible. <b>FACW-</b>	<i>Equisetum hyemale</i>
9	Sheaths green or obscurely girdled at nodes near base of stem/ teeth $32 \leq$ per sheath, usually persistent but shed in some spp./ articulation line lacking.	10
10(9)	Teeth 3 – 32 per sheath/ stem ridges same number as teeth// aerial stems erect and straight.	11
10	Teeth 3 per sheath/ stem ridges 6// aerial stems inclined and tortuous. <b>FAC+</b>	<i>Equisetum scirpoides</i>
11(10)	Sheath teeth usually shed/ cone apex rounded to apiculate with blunt tip// stem ridges flattened or $\pm$ convex. <b>FACW</b>	<i>Equisetum laevigatum</i>
11	Sheath teeth usually persistent throughout/ cone apex sharply apiculate with blunt tip// stem ridges minutely grooved. <b>FACW</b>	<i>Equisetum variegatum</i>

12(3)	Sporangia borne singly in leaf axils, the leaves unmodified or modified and aggregated in cylindrical strobili mostly 3 – 25 mm wide at branch tips/ spores of 1 size (homosporous), < 50µm in diameter. <b>(Club-mosses)</b>	13
12	Sporangia commonly borne in flattened or 4-sided strobili 1 – 2.5 (3.5) mm wide at branch tips (except Selaginella selaginoides with cylindrical strobili 4 – 6 mm wide)/ spores of 2 sizes (heterosporous), megaspore > 300µm in diameter, borne singly or in groups to 4, and minute microspores in mass. <b>(Selaginella)</b>	26
13(12)	Horizontal stems absent/ upright parts of shoots clustered// roots traveling in stem cortex some distance before emerging/// sporangia borne in axils of unmodified leaves//// spores pitted to small-grooved.	14
13	Horizontal stems present/ upright parts of shoots alternating along rhizome// roots emerging where they originate/// sporangia borne in axils of highly modified, reduced sporophylls aggregated into upright or nodding or pendent strobili//// spores reticulate or regulate.	17
14(13)	Leaves narrowly obovate, teeth 1 – 8 irregular/ stomates abaxial// spores (23) 24 – 26 (29) µm. <b>FAC+</b>	<i>Huperzia lucidula</i>
14	Leaves lanceolate or oblanceolate, entire or with 1 – 3 low teeth/ stomata on both surfaces// spores 25 – 41 µm.	15
15(14)	Largest leaves lanceolate with sides nearly parallel much of the length/ stomates 1 – 25 per ½ leaf on adaxial surface. <b>FACU-</b>	<i>Huperzia porophila</i>
15	Largest leaves lanceolate to ovate or nearly triangular and widest at base or sides nearly parallel much of the length/ stomates > 30 per ½ leaf on adaxial surface.	16
16(15)	Shoots weak with annual constrictions/ gemmiferous branchlets and gemmae formed in 1 pseudowhorl at end of annual growth. <b>FACU-</b>	<i>Huperzia selago</i>
16	Shoots without annual constrictions/ gemmiferous branchlets and gemmae formed in 1 – 3 pseudowhorl at end of annual growth or throughout mature shoots.	<i>Huperzia appalachiana</i>
17(13)	Strobili borne on leafy peduncles with crowded unmodified leaves// spores rugulate/// gametophytes on substrate surface, photosynthetic, mainly wetlands.	18
17	Strobili borne on distinct peduncles or sessile/ peduncles, if present, bearing remote, reduced leaves// spores reticulate/// gametophytes subterranean, non-photosynthetic, mainly dry uplands.	19
18	Fertile shoots mostly 3.5 – 6 cm/ sporophylls spreading// mainly north of 45° N latitude and high in mountains southward. <b>OBL</b>	<i>Lycopodiella inundata</i>
18	Fertile shoots mostly 4 – 45 cm but mostly 8 – 35 cm/ sporophylls spreading or appressed// mainly south of 45° N latitude at low elevations.	<i>Lycopodiella margueritae</i>

19(17)	Ultimate shoots (including leaves) 5 – 12 mm diam., rounded (flattened in <i>L. obscurum</i> )/ leaves 6-ranked or more, not imbricate// peduncles if present, falsely appearing to have 1 main branch and alternate/// gametophytes disc-shaped.	20
19	Ultimate shoots (including leaves) 2 – 6 mm diam., quadrate to flattened (except in <i>D. stichensis</i> which is rounded-branched)/ leaves 4 – 5-ranked, mostly imbricate (except in <i>D. stichensis</i> )// peduncles, if present, dichotomously branched and alternate/// gametophytes carrot-shaped.	25
20(19)	Strobili pedunculate/ upright shoots with 2 – 5 branches, not treelike// leaves with hair tips 1 – 4 mm (these may fall off early, but remain at shoot apices) ( <i>L. clavatum</i> group).	21
20	Strobili sessile/ upright shoots either unbranched or much branched to produce treelike habit// leaves lacking hair tips.	22
21(20)	Strobili mostly solitary on peduncle, if paired then nearly lacking pedicels/ leaves 3 – 5 mm, ascending to appressed; branches 2 – 3(-4), mostly upright.	<i>Lycopodium lagopus</i>
21	Strobili 2 – 5, borne on loosely alternate pedicels, 0.5 – 0.8 cm; leaves 4 – 6 mm, spreading to somewhat ascending/ branches 3 – 6, mostly oblique or spreading. <b>FAC</b>	<i>Lycopodium clavatum</i>
22(20)	Strobili single at top of upright shoot/ shoot unbranched or branched 1 – 2 times// horizontal stems on substrate surface ( <i>L. annotinum</i> group). <b>FAC</b>	<i>Lycopodium annotinum</i>
22	Strobili 1 – 7 at top of many-branched shoot/ shoot upright, treelike shoot// horizontal stems subterranean ( <i>L. dendroideum</i> group).	23
23(22)	Lateral shoots flat in cross section, leaves unequal in size, lateral leaves spreading and twisted, adaxial surfaces facing upward, proximal leaves much reduced/ leaves on main axis dark green, tightly appressed. <b>FACU</b>	<i>Lycopodium obscurum</i>
23	Lateral shoots round in cross section, leaves equal in size, none twisted, adaxial leaf surfaces all facing stem, proximal leaves not reduced/ leaves on main axis light or dark green, spreading or appressed.	24
24(23)	Leaf ranks 1 on upper side of lateral branch, 2 on each side, and 1 on underside/ leaves of main axis below branches dark green, tightly appressed, soft to touch.	<i>Lycopodium hickeyi</i>
24	Leaf ranks 2 on top of lateral branch, 1 on each side, and 2 on underside/ leaves of main axis below branches pale green, spreading, prickly to touch. <b>FAC</b>	<i>Lycopodium dendroideum</i>

25(19)	Ultimate branchlets cordlike, nearly square in cross section, usually bluish glaucous/ underside leaves approximately equal in size to lateral and upper side leaves.	<i>Diphasiastrum tristachyum</i>
25	Ultimate branchlets narrowly bladelike, flat in cross section, usually green/ underside leaves much smaller than lateral and upper side leaves.	26
26(25)	Branchlets irregular, with conspicuous annual bud constrictions/ peduncles, if present, regularly forked// strobili mostly 15 – 25 mm, lacking sterile tips. <b>FACU+</b>	<i>Diphasiastrum complanatum</i>
26	Branchlets very regularly fan-shaped, lacking conspicuous annual bud constrictions/ peduncles mostly branching abruptly at base to produce false whorl of strobili// strobili mostly 20 – 35 mm, many with sterile tips.	<i>Diphasiastrum digitatum</i>
27(12)	Leaves on aerial stems dimorphic, arranged in 4 ranks (2 median, 2 lateral), axillary leaves present at branching points/ rhizomes present.	<i>Selaginella eclipses</i>
27	Leaves on aerial stems monomorphic, not in distinct ranks, axillary leaves absent at branching points/ rhizomes present or absent.	28
28(27)	Leaves thin, soft, margins short-spiny/ stomates throughout abaxial leaf surface/ Strobili cylindric, sporophylls spreading// rhizophores absent. <b>FACW+</b>	<i>Selaginella selaginoides</i>
28	Leaves thick or fleshy (seldom thin), firm, margins not spiny/ stomates in abaxial groove/ Strobili cylindric, sporophylls spreading// rhizophores present.	<i>Selaginella rupestris</i>

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