

**INTRODUCTION 7**

What Are Ferns, Spikemosses, Clubmosses, and Quillworts? 7

What's Included: Ferns, Spikemosses, Clubmosses, and Quillworts of Eastern North America 10

How to Use This Book 13

**IDENTIFYING FERNS AND LYCOPHYTES 16**

Lycophyte Morphology and Identification 16

Fern Morphology and Identification 22

**GLOSSARY 27**

**KEY TO PTERIDOPHYTE GENERA OF EASTERN NORTH AMERICA 32**

**LYCOPHYTES—Descriptions of Genera and Species 41**

*Dendrolycopodium* 42

*Isoetes* 59

*Palhinhaea* 90

*Spinulum* 111

*Diphasiastrum* 47

*Lycopodiella* 79

*Pseudolycopodiella* 92

*Huperzia* 53

*Lycopodium* 86

*Selaginella* 94

**FERNS—Descriptions of Genera and Species 113**

*Acrostichum* 114

*Coryphopteris* 230

*Lygodium* 328

*Pilularia* 421

*Actinostachys* 118

*Crepidomanes* 232

*Macrothelypteris* 333

*Pityrogramma* 423

*Adiantum* 120

*Cryptogramma* 234

*Marsilea* 335

*Platycterium* 427

*Amauropelta* 130

*Ctenitis* 237

*Matteuccia* 343

*Pleopeltis* 429

*Amblovenatum* 134

*Cyclosorus* 240

*Meniscium* 345

*Polypodium* 432

*Anchistea* 136

*Cyrtomium* 242

*Microgramma* 348

*Polystichum* 435

*Anemia* 138

*Cystopteris* 245

*Microsorium* 350

*Psilotum* 440

*Arachniodes* 142

*Dennstaedtia* 254

*Moranopteris* 352

*Pteridium* 442

*Argyrochosma* 144

*Deparia* 257

*Myriopteris* 353

*Pteris* 445

*Aspidotis* 145

*Dicranopteris* 260

*Nephrolepis* 361

*Rumohra* 453

*Asplenium* 146

*Didymoglossum* 262

*Odontosoria* 371

*Salvinia* 455

*Astrolepis* 180

*Diplazium* 266

*Onoclea* 373

*Sceptridium* 458

*Athyrium* 183

*Dryopteris* 269

*Ophioderma* 375

*Schizaea* 467

*Azolla* 187

*Equisetum* 289

*Ophioglossum* 377

*Tectaria* 469

*Blechnum* 191

*Goniopteris* 303

*Osmunda* 386

*Telmatoblechnum* 473

*Botrychium* 193

*Gymnocarpium* 309

*Osmundastrum* 388

*Thelypteris* 475

*Botrypus* 213

*Homalosorus* 315

*Pecluma* 390

*Trichomanes* 477

*Campyloneurum* 215

*Hymenophyllum* 317

*Pelazoneuron* 395

*Vandenboschia* 479

*Ceratopteris* 219

*Hypolepis* 320

*Pellaea* 402

*Vittaria* 481

*Cheiroglossa* 223

*Leptogramma* 322

*Phegopteris* 408

*Woodsia* 486

*Christella* 225

*Lomariopsis* 324

*Phlebodium* 414

*Claytasmunda* 228

*Lorinseria* 326

*Physematum* 416

**CHECKLISTS OF FERN AND LYCOPHYTE SPECIES IN EASTERN NORTH AMERICA 491**

**ACKNOWLEDGMENTS 501**

**FURTHER READING AND REFERENCES 502**

**ISOETES IMAGE CREDITS 505**

**INDEX TO SCIENTIFIC NAMES 507**

**INDEX TO COMMON NAMES 519**

- 96b Tan scales are present on the lower leaf surface, along the pinna midveins; the upper leaf surface is smooth or sparsely hairy, with hairs shorter than 0.2mm ..... *Cyclosorus* ■■■
- 95b The lowest veins of adjacent pinnules, in at least a few places, come together right at the sinus, or reach the margin above the sinus ..... 97
- 97a Yellowish glands are present on the lower surface of the leaf (especially along the veins and at the pinnule tips) ..... *Amblovenatum* ■■■
- 97b No yellowish glands are present on the lower surface of the leaf ..... *Pelazoneuron* ■■■
- 91b The pinnule midveins, lateral veins, and blade tissue do not have a sparse to dense covering of transparent, needlelike or starlike hairs ..... 98
- 98a Leaves are 1-pinnate and the leaf tip always remains curled in a tiny fiddlehead ..... *Nephrolepis* ■■■
- 98b Leaves are variously divided and the leaf tip unfurls completely, not remaining as a fiddlehead ..... 99
- 99a Lateral veins are distinctly reticulate and anastomosing, forming networks of small polygons ..... 100
- 100a Leaves are tough and leathery and strongly 1-pinnate; pinnae have long tips that usually curve upward toward the leaf tip ..... *Cyrtomium* ■■■
- 100b Leaves are not particularly leathery and are lobed to pinnatifid or 1-pinnate; pinna tips are not long and drawn out ..... *Tectaria* ■■■
- 99b Lateral veins are free or form networks only occasionally ..... 101
- 101a Sori are round and indusia are attached at their center, like an umbrella (peltate) ..... 102
- 102a Leaves are 1-pinnate or 2-pinnate and form vaselike clusters ..... *Polystichum* (remaining species) ■■■■
- 102b Leaves are 2-pinnate to 3-pinnate and spread out along long-creeping stems ..... *Rumohra* ■■■
- 101b Sori are kidney shaped and indusia are attached at 1 edge ..... 103
- 103a Leaves are variegated in color, the pinnae yellow to light green at the center and darkening toward the margins; indusia may appear round or peltate but are attached along 1 edge ..... *Arachniodes* ■■■
- 103a Leaves are not variegated and are uniform in color; indusia are usually clearly attached along 1 edge and do not appear peltate ..... *Dryopteris* (remaining species) ■■■■



© Copyright, Princeton University Press. No part of this book may be distributed, posted, or reproduced in any form by digital or mechanical means without prior written permission of the publisher.

# LYCOPHYTES

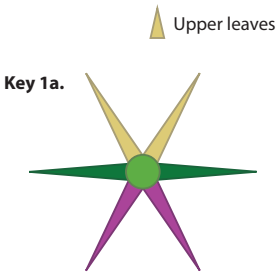
DESCRIPTIONS OF  
GENERA AND SPECIES

## FAMILY: LYCOPODIACEAE

*Dendrolycopodium* is a genus of lycophytes known as the tree clubmosses, and this common name references an easily recognizable aspect of their appearance: they strongly resemble small pine trees. The members of this genus were historically included in *Lycopodium*, the clubmoss genus (p. 86), which explains the remainder of the common name. *Lycopodium* has been broken up in recent years into several smaller genera, and *Dendrolycopodium* is perhaps the most readily distinguishable of these, based on its unique miniature tree-like morphology. Globally there are 4 or 5 species in the genus, all in mountainous, temperate, and/or boreal regions of the Northern Hemisphere, and we have 3 species in our flora. The lateral branches of *Dendrolycopodium* usually have whorls of leaves in sets of 6, and the arrangement and relative size of these leaves are useful characters for distinguishing the 3 species (see figure below). Base chromosome number ( $x$ ) = 34.

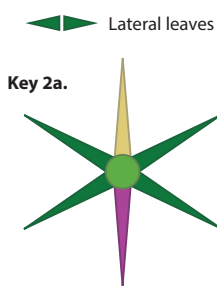
### KEY TO THE SPECIES OF *DENDROLYCOPIDIUM* IN OUR FLORA:

- 1a The leaves on the main upright shoot axes are spaced widely apart and spread outward, sometimes nearly horizontally; the lateral shoots have 2 leaves on the top surface pointing upward, 2 on the lower surface pointing downward, and 1 on each side pointing outward ..... *Dendrolycopodium dendroideum*
- 1b The leaves on the main upright shoot axes are close together and are pressed more or less against the axis, pointing strongly upward; the lateral shoots have 1 leaf on the top surface pointing upward, 1 leaf on the lower surface pointing downward, and 2 leaves on each side pointing outward ..... 2
- 2a The lateral shoots are round in cross section; the lateral leaves of the lateral shoots are not twisted and are all more or less the same length ..... *Dendrolycopodium hickeyi*
- 2b The lateral shoots are flat in cross section; the lateral leaves of the lateral shoots are somewhat twisted, so that the side of the leaf points upward; the leaves pointing downward from the lower surfaces of the lateral shoots are shorter than the other leaves ..... *Dendrolycopodium obscurum*



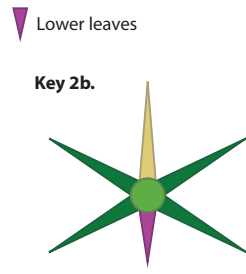
*Dendrolycopodium dendroideum*

Two upper leaves, two lower leaves, one lateral leaf on each side; all leaves are the same size; the branch is round in cross section



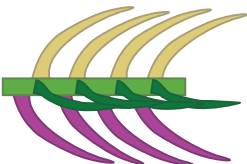
*Dendrolycopodium hickeyi*

One upper leaf, one lower leaf, two lateral leaves on each side; all leaves are the same size; the branch is round in cross section



*Dendrolycopodium obscurum*

One upper leaf, one lower leaf, two lateral leaves on each side; the lower leaf is shorter; the branch is flat in cross section



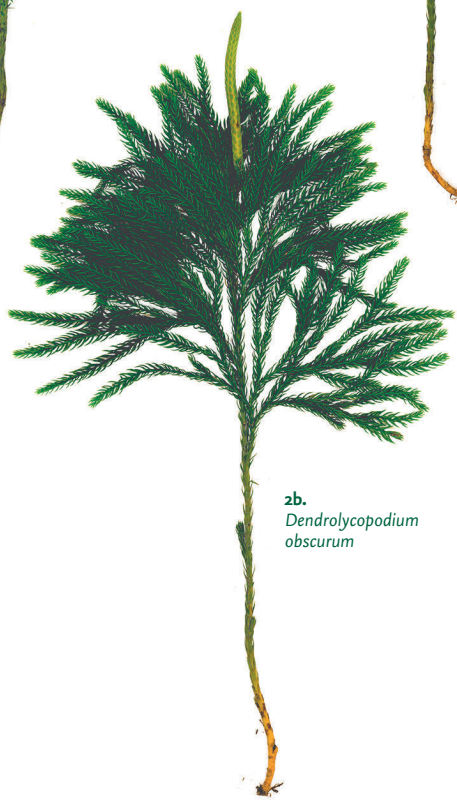




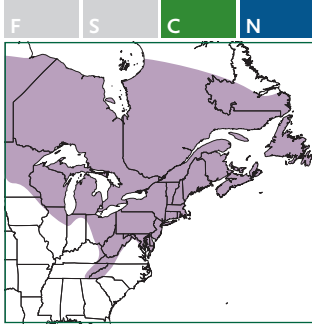
1a.  
*Dendrolycopodium*  
*dendroideum*



2a.  
*Dendrolycopodium*  
*hickeyi*



2b.  
*Dendrolycopodium*  
*obscurum*



## *Dendrolycopodium dendroideum*

**COMMON NAME(S)** Northern tree clubmoss, prickly tree clubmoss

**NOTABLE SYNONYMS** *Lycopodium dendroideum*

**STATUS** Native, somewhat common

**HABITAT/DISTRIBUTION** Dry forests and shrubby habitats; also occurs in western North America and Asia

**Plants** are terrestrial. **Stems** are belowground and long creeping. **Shoots** are erect and treelike, up to 26cm tall, with a central axis and numerous lateral side shoots that branch further. **Leaves** on the main upright shoot axes are up to 4mm long and 1mm wide, are spaced widely apart, and spread outward, sometimes nearly horizontally. The horizontal **branches** are round in cross section, with more or less obvious annual growth constrictions, and with leaves up to 3.5mm long and 1.2mm wide that spread slightly outward before pointing toward the shoot tip. The branches have 2 leaves on the top surface pointing upward, 2 on the lower surface pointing downward, and 1 lateral leaf on each side pointing outward. All leaves are roughly the same length, and none of the leaves are twisted. **Margins** are entire, and leaves are linear and pointed but do not have a hairlike tip. **Strobili** are up to 55mm long and sit directly atop the leaf portion of the upright shoots, with 1–7 strobili per shoot.  $2n=68$  (diploid).



**A.** Plants of *Dendrolycopodium dendroideum*.

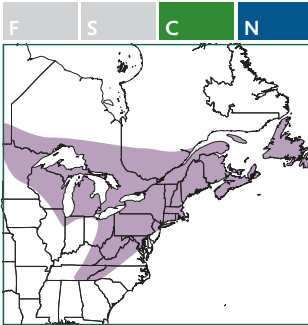
**B.** Main shoot axis showing widely spaced, spreading leaves.

**C.** Lateral branches.

**D.** Strobili.







## *Dendrolycopodium hickeyi*

COMMON NAME(S) Hickey's tree clubmoss

NOTABLE SYNONYMS *Lycopodium hickeyi*

STATUS Native (endemic to North America), somewhat common

HABITAT/DISTRIBUTION Forests and shrubby habitats; also occurs in western North America

**Plants** are terrestrial. **Stems** are belowground and long creeping. **Shoots** are erect and treelike, up to 16cm tall, with a central axis and numerous lateral side shoots that branch further. **Leaves** on the main upright shoot axes are up to 4.5mm long and 0.6mm wide and are close together and pressed more or less against the axis, pointing strongly upward. The horizontal **branches** are round in cross section, with more or less obvious annual growth constrictions, and with leaves up to 5mm long and 1mm wide that spread slightly outward before pointing toward the shoot tip. The branches have 1 leaf on the top surface pointing upward, 1 leaf on the lower surface pointing downward, and 2 lateral leaves on each side pointing outward. All leaves are roughly the same length, and none of the leaves are twisted. **Margins** are entire, and leaves are linear and pointed but do not have a hairlike tip. **Strobili** are up to 65mm long and sit directly atop the leaf portion of the upright shoots, with 1–7 strobili per shoot.  $2n=68$  (diploid).

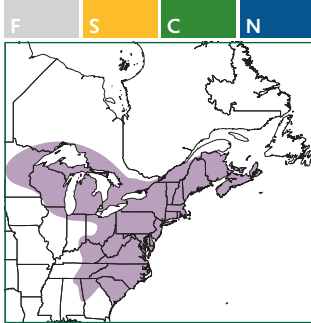


A & B. Plants of *Dendrolycopodium hickeyi*.

C. Plants showing lateral branches that are round in cross-section.

D. Strobili.





## *Dendrolycopodium obscurum*

**COMMON NAME(S)** Flat-branched tree clubmoss

**NOTABLE SYNONYMS** *Lycopodium obscurum*

**STATUS** Native (endemic to eastern North America), common

**HABITAT/DISTRIBUTION** Forests and shrubby habitats

**Plants** are terrestrial. **Stems** are belowground and long creeping. **Shoots** are erect and treelike, up to 21cm tall, with a central axis and numerous lateral side shoots that branch further. **Leaves** on the main upright shoot axes are up to 4.5mm long and 0.7mm wide and are close together and pressed more or less against the axis, pointing strongly upward. The horizontal **branches** are flat in cross section, with more or less obvious annual growth constrictions, and with leaves up to 5.5mm long and 1.2mm wide that spread slightly outward before pointing toward the shoot tip. The branches have 1 leaf on the top surface pointing upward, 1 leaf on the lower surface pointing downward, and 2 lateral leaves on each side pointing outward. The downward-pointing leaves on the lower surface are distinctly shorter and give the branch its flattened appearance. The outward-pointing lateral leaves are somewhat twisted, so that the top surfaces of the leaves point upward instead of outward. **Margins** are entire, and leaves are linear and pointed but do not have a hairlike tip. **Strobili** are up to 60mm long and sit directly atop the leaf portion of the upright shoots, with 1–6 strobili per shoot.  $2n=68$  (diploid).



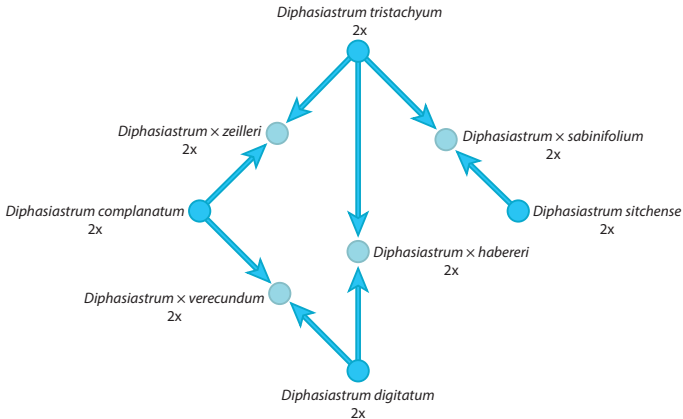
**B.** Lateral branches appear flat in cross section.

**C.** Side view of flattened lateral branches.

**A.** Plants of *Dendrolycopodium obscurum*.

## FAMILY: LYCOPODIACEAE

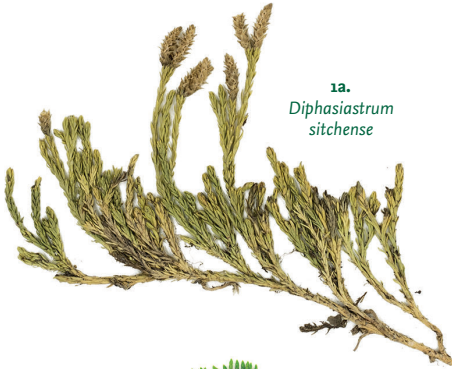
*Diphasiastrum* is a genus of lycophytes commonly known as ground-pines, ground-cedars, or running-pines for their resemblance to miniature conifer trees. They have minute, scalelike leaves and distinctive fan-shaped branches that set them apart from other, closely related and morphologically similar genera. Globally there are 16 species recognized in *Diphasiastrum*, and 4 occur in our flora. The group is known worldwide for its ability to produce hybrids, many of which are fertile and can be locally abundant (see figure below). Base chromosome number ( $x$ ) = 23.



Relationships among *Diphasiastrum* species in eastern North America. Darker blue circles are diploid parental taxa ( $2x$ ), and arrows show the direction of their parental contributions to fertile diploid (also  $2x$ ) hybrids (lighter blue circles). For more information about interpreting these figures, see p. 12.

### KEY TO THE SPECIES OF *DIPHASIASTRUM* IN OUR FLORA:

- 1a The upright shoots are mostly less than 12cm tall; the strobili are mostly unstalked, sitting directly atop the leafy part of the shoot ..... *Diphasiastrum sitchense*
- 1b The upright shoots are mostly more than 12cm tall; the strobili are mostly stalked, sitting atop long peduncles ..... 2
  - 2a The tip-most branchlets are 4-sided and nearly square in cross section; leaves and plants are usually somewhat bluish or grayish green; the leaves on the tops, sides, and bottoms of the branches are more or less all equal in size ..... *Diphasiastrum tristachyum*
  - 2b The tip-most branchlets are flat in cross section; leaves and plants are bright to dark green; the leaves on the bottoms of the branches are much smaller than those on the tops and sides ..... 3
    - 3a Branching is irregular; annual growth constrictions are usually apparent along the branches; strobili are mostly 10–25mm long and sit at the tips of relatively thin peduncles ..... *Diphasiastrum complanatum* subsp. *complanatum*
    - 3b Branching is regular and fanlike; annual growth constrictions are not present; strobili are mostly 20–40mm long and sit at the tips of relatively thick, stout peduncles ..... *Diphasiastrum digitatum*



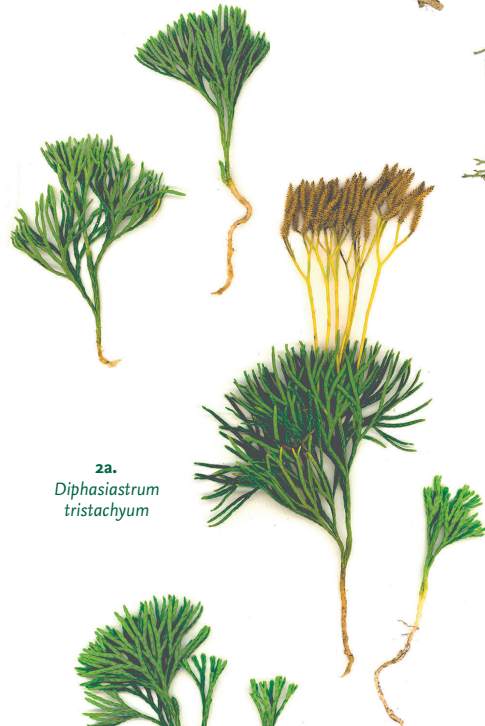
1a.  
*Diphasiastrum*  
*sitchense*

IMAGE COURTESY OF THE C. V. STARR VIRTUAL HERBARIUM  
OF THE NEW YORK BOTANICAL GARDEN (NY 02705320).



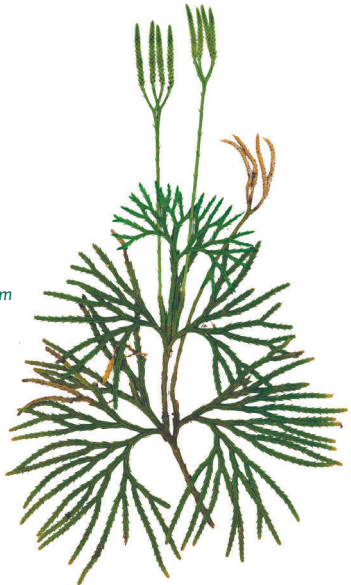
3a.  
*Diphasiastrum*  
*complanatum* subsp.  
*complanatum*

IMAGE COURTESY OF THE C. V. STARR VIRTUAL HERBARIUM  
OF THE NEW YORK BOTANICAL GARDEN (NY 02578510).

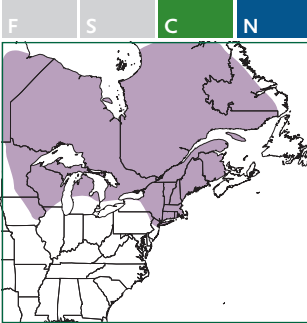


2a.  
*Diphasiastrum*  
*tristachyum*

3b.  
*Diphasiastrum*  
*digitatum*







### *Diphasiastrum complanatum* subsp. *complanatum*

**COMMON NAME(S)** Northern ground-cedar, northern running-pine

**NOTABLE SYNONYMS** *Lycopodium complanatum*

**STATUS** Native, somewhat common

**HABITAT/DISTRIBUTION** Dry, open forests and slopes; also occurs in Greenland, Europe, and Asia (a second subspecies, *D. complanatum* subsp. *montellii*, has been described from Europe)

**Plants** are terrestrial and can form large colonies. **Stems** are horizontal and long creeping, sitting against the substrate or underneath litter, with small, linear, appressed leaves. **Upright shoots** are up to 44cm tall, with an erect central axis that has small, pointed, appressed leaves up to 3.2mm long and 1.1mm wide. Horizontal **branches** are up to 4.4mm wide including the leaves, bright to dark green, flat in cross section, and irregularly branched, with conspicuous annual growth constrictions. Leaves on the branches are pressed against the branch for at least half their length, making the branches themselves appear green. Leaves are linear to lanceolate, with pointed tips that spread away from the branch axis. The leaves on the upper surface of the branches are up to 2mm long and 1.2mm wide; the lateral leaves are up to 7.3mm long and 2.1mm wide; and the leaves on the underside of the branches are the smallest, up to 1.5mm long and 0.9mm wide. **Peduncles** are up to 8.5cm long and slender, with minute leaves, and 1 or 2 strobili per peduncle, at the ends of short stalks. **Strobili** are up to 25mm long and do not end in sterile tips.  $2n=46$  (diploid).



A



B

A. Plants of *Diphasiastrum complanatum* subsp. *complanatum*.

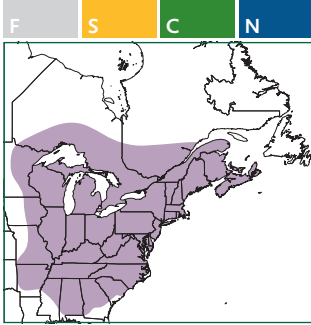
B. Branches with appressed leaves and annual growth constrictions.

C. Young plants with bright green new foliage.

C







## *Diphasiastrum digitatum*

**COMMON NAME(S)** Southern ground-cedar, southern running-pine

**NOTABLE SYNONYMS** *Lycopodium digitatum*

**STATUS** Native (endemic to eastern North America), common

**HABITAT/DISTRIBUTION** Forested and shrubby habitats, sometimes open meadows

**Plants** are terrestrial and can form large colonies. **Stems** are horizontal and long creeping, sitting against the substrate or underneath litter, with small, linear, appressed leaves. **Upright shoots** are up to 50cm tall, with an erect central axis that has small, pointed, appressed leaves up to 3.5mm long and 1mm wide. Horizontal **branches** are up to 3.9mm wide including the leaves, bright to dark green, flat in cross section, and irregularly branched, without conspicuous annual growth constrictions. Leaves on the branches are pressed against the branch for at least half their length, making the branches themselves appear green. Leaves are linear to lanceolate, with pointed tips that spread away from the branch axis. The leaves on the upper surface of the branches are up to 1.5mm long and 0.9mm wide; the lateral leaves are up to 5.5mm long and 2mm wide; and the leaves on the underside of the branches are the smallest, up to 1mm long and 0.7mm wide. **Peduncles** are up to 12.5cm long, thick and stout, with minute leaves, and 2–4 strobili per peduncle, at the ends of short, branched stalks. **Strobili** are up to 40mm long and may end in sterile tips up to 11mm long.  $2n=46$  (diploid).



- A. A colony of *Diphasiastrum digitatum*.  
 B. Fertile plants.  
 C. Close-up of strobili.  
 D. Dichotomous branching.  
 E. Strobili that have released their spores.



## *Diphasiastrum sitchense*

COMMON NAME(S) Sitka clubmoss

NOTABLE SYNONYMS *Lycopodium sitchense*

STATUS Native, uncommon

HABITAT/DISTRIBUTION Open meadows, conifer forests, rocky areas above tree line; also occurs in western North America and Asia

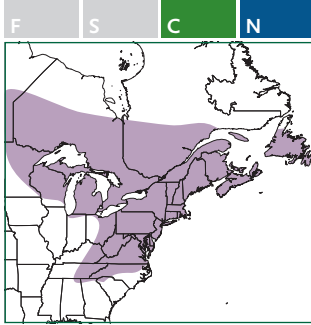
**Plants** are terrestrial and can form large colonies. **Stems** are horizontal and long creeping, sitting against the substrate or underneath litter, with small, linear, appressed leaves. **Upright shoots** are mostly 12cm tall or less but can be up to 17.5cm tall, branch near the base, do not have a clear central axis, and have small, linear, appressed leaves. Horizontal **branches** are up to 2.5mm wide including the leaves, bright to dark green, round in cross section, and irregularly branched, with annual growth constrictions, but these are not obvious. Leaves on the branches are pressed against the branch for less than half their length, with the tips spreading outward, and leaves are arranged in pseudowhorls of 2 and 3 leaves. Leaves are all alike in size, up to 5.6mm long and 0.9mm wide, with sharply pointed tips. **Peduncles** are absent, or if present are up to 1cm long at most. **Strobili** are up to 38mm long and do not have stalks, instead sitting directly atop the leafy portion of the shoot.  $2n=46$  (diploid).



- A. A colony of *Diphasiastrum sitchense*.  
B. Fertile plants.  
C. Immature strobili.  
D. Mature stems with dehiscent strobili.

PHOTOGRAPHS A & C BY NOLAN EXE  
PHOTOGRAPHS B & D BY GREG RAND





## *Diphasiastrum tristachyum*

COMMON NAME(S) Blue ground-cedar

NOTABLE SYNONYMS *Lycopodium tristachyum*

STATUS Native, uncommon

HABITAT/DISTRIBUTION Open forests and rocky areas, on acidic soils; also occurs in Europe and Asia

**Plants** are terrestrial and can form large colonies. **Stems** are horizontal and long creeping and are typically buried in the soil, with small, linear, appressed leaves. **Upright shoots** cluster together and are up to 36cm tall, with an erect central axis that has small, pointed, appressed leaves up to 3.4mm long and 1mm wide. Horizontal **branches** are up to 2.2mm wide including the leaves, bluish or grayish green, quadrangular in cross section, and irregularly branched, with conspicuous annual growth constrictions. Leaves on the branches are pressed against the branch for at least half their length, making the branches themselves appear green. Leaves are linear or needlelike, with pointed tips that spread away from the branch axis. The leaves on the upper surface of the branches are up to 1.7mm long and 0.9mm wide; the lateral leaves are up to 7.2mm long and 2mm wide; and the leaves on the underside of the branches are similar to those on top, up to 2mm long and 0.7mm wide. **Peduncles** are up to 15cm long, slender, with minute leaves, and 2–4 strobili per peduncle, at the ends of short, branched stalks. **Strobili** are up to 28mm long and do not end in sterile tips.  $2n=46$  (diploid).



**A.** A colony of *Diphasiastrum tristachyum*.

**B.** Plants with prominent central axis.

**C.** Branches with appressed leaves.

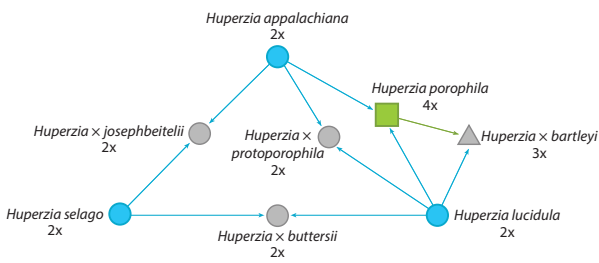
**D.** Strobili that have released their spores.

## FAMILY: LYCOPODIACEAE

*Huperzia* is a lycophyte genus whose species can typically be found in the northern part of our region (though a few also occur in the south). The common name of the genus, temperate firmosses, refers to their similarity to miniature fir trees and their occurrence only in the temperate zone. The association with mosses predates our modern understanding of relationships among land plants (see p. 7). *Huperzia* species are similar in appearance to some other members of Lycopodiaceae, especially *Spinulum* (p. 111), but can easily be distinguished by not having well-defined strobili; their spore-bearing leaves are located at the tips of the shoots, but they resemble the sterile leaves and you must look closely to discern the sporangia tucked in at the leaf bases. Gemmae (small vegetative propagules) are common in some species and are unique to this genus of lycophytes. They may occur either throughout the shoots, or in 1 or more whorls near the shoot tip. Three of the *Huperzia* species in our eastern flora are diploids and 1 is a tetraploid, and several sterile hybrids are known to form from crosses between them (see figure below). Base chromosome number (x) = 67, 68.



RIGHT: Shoots of *Huperzia porophila* with gemmae (toward the bottom of the left shoot and the middle of the right one). PHOTOGRAPH BY ALAN CRESSLER

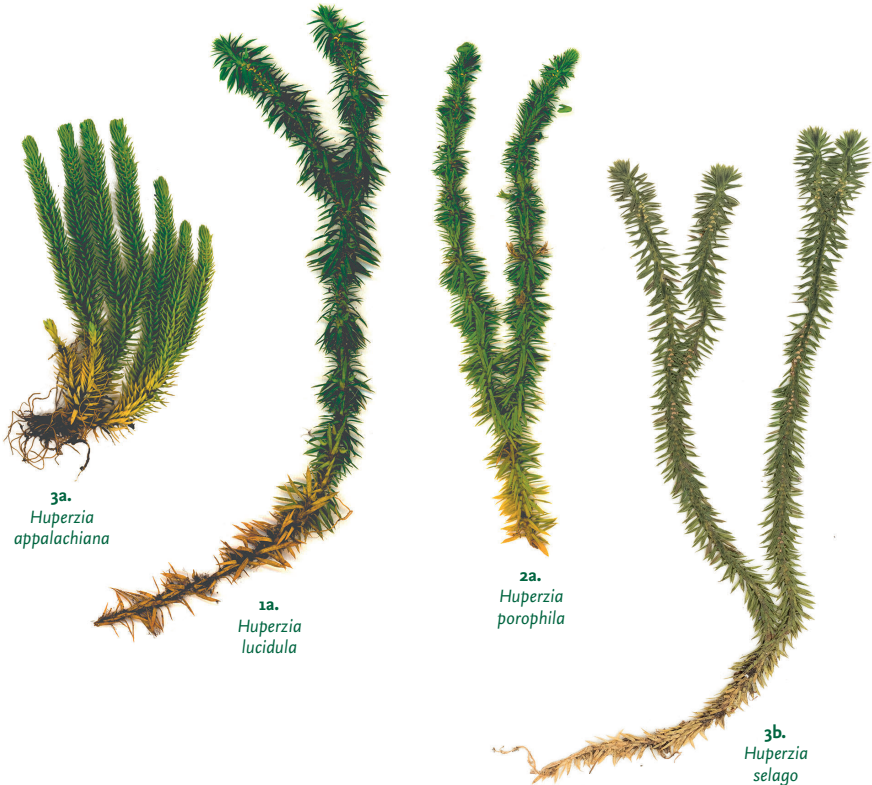


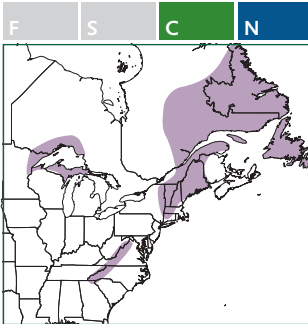
LEFT: Relationships among *Huperzia* species in eastern North America. Blue circles are fertile diploids (2x), the green square is a fertile allotetraploid (4x), and the gray circles and triangle are sterile diploid and triploid hybrids, respectively. Arrows show the direction of genetic contribution from parental toward offspring taxa. For more information about interpreting these figures, see p. 12.



KEY TO THE SPECIES OF *HUPERZIA* IN OUR FLORA:

- 1a Leaves are widest above the middle, with an obovate overall shape; leaves spread away from the shoot axis and have at least a few distinct teeth along the margins; annual growth constrictions are conspicuous ..... *Huperzia lucidula*
- 1b Leaves are widest at the base, with a lancelike overall shape; leaves point upward and have no teeth or only a few small teeth; annual growth constrictions are indistinct or absent ..... 2
- 2a Leaves are lanceolate but the sides are parallel for most of the leaf length; stomata are present on both surfaces of the leaf (hand lens required for viewing), but fewer than 50 are present on the upper leaf surface ..... *Huperzia porophila*
- 2b Leaves are lanceolate to ovate or triangular; stomata are present on both surfaces of the leaf, but more than 60 are present on the upper surface ..... 3
- 3a The sterile leaves are of 2 kinds, with those near the base of the shoots much longer and more spreading than those farther up; gemmae can be found throughout the shoots ..... *Huperzia appalachiana*
- 3b The sterile leaves are all alike; gemmae occur in only a single whorl near the shoot tip ..... *Huperzia selago*





## *Huperzia appalachiana*

COMMON NAME(S) Mountain firmoss

NOTABLE SYNONYMS *Huperzia appressa*, *Huperzia selago* subsp. *appressa*, *Lycopodium selago* subsp. *appressum*

STATUS Native, uncommon

HABITAT/DISTRIBUTION Typically on damp but exposed, rocky cliffs or talus slopes, occasionally on thin soils; also occurs in Greenland

**Plants** are terrestrial. **Stems** are compact and erect. **Shoots** are erect, up to 10cm tall, and often form clusters. If shoots branch, they do so dichotomously. Annual growth constrictions are typically not distinct. **Leaves** at the base of the shoots are distinctly larger and more spreading than those farther up the shoot, which are more closely pressed against the shoot. Leaves are up to 6mm long and widest at their base (lanceolate in overall shape to ovate or even triangular) and have entire **margins** with no teeth. Stomata are present on both surfaces and are numerous (more than 60) on the upper surface. **Sporangia** occur on the upper surfaces of the tip-most leaves, tucked in at the leaf bases. **Gemmae** occur throughout the shoots.  $2n=134$  (diploid).



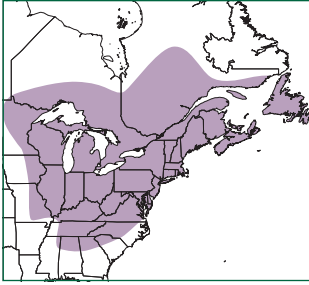
A. A colony of *Huperzia appalachiana*.

B. Plants.

C. Fertile leaves and gemmae.



F S C N



## *Huperzia lucidula*

COMMON NAME(S) Shining firmoss

NOTABLE SYNONYMS *Lycopodium lucidulum*

STATUS Native (endemic to North America), common

HABITAT/DISTRIBUTION Shady conifer or hardwood forests; also occurs sporadically farther west in the U.S. and Canada

**Plants** are terrestrial. **Stems** are compact and erect. **Shoots** are erect, up to 20cm tall, and often form clusters. If shoots branch, they do so dichotomously. Annual growth constrictions are distinct along the shoots. **Leaves** are similar in size and shape along the length of the shoot. Leaves are up to 12mm long and widest above the middle of the leaf (obovate in overall shape) and have distinctly toothy **margins**. Stomata are visible only on the bottom surface of the leaf. **Sporangia** occur on the upper surfaces of the tip-most leaves, tucked in at the leaf bases. **Gemmae** occur in a single whorl toward the shoot tip.  $2n=134$  (diploid).



A. Plants of *Huperzia lucidula*.

B. A shoot with dichotomous branching.



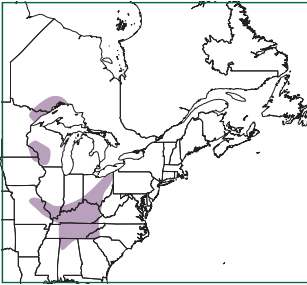
C. Fertile section of the stem.

D. Fertile leaves with sporangia.

E. Shoot tip with gemmae.







## *Huperzia porophila*

COMMON NAME(S) Rock firmoss

NOTABLE SYNONYMS *Lycopodium porophilum*

STATUS Native (endemic to eastern North America), uncommon

HABITAT/DISTRIBUTION Typically in rocky woods on damp, shaded (or occasionally more exposed) sandstone substrates

**Plants** are terrestrial. **Stems** are compact and erect. **Shoots** are erect, up to 15cm tall, and often form clusters. If shoots branch, they do so dichotomously. Annual growth constrictions are typically not distinct. **Leaves** are similar in size and shape along the length of the shoot. Leaves are up to 8mm long and widest at their base (lanceolate in overall shape), but the sides are parallel for most of the leaf length. Leaves have nearly entire **margins** with no or only a few small teeth. Stomata are present on both surfaces but are sparse (fewer than 50) on the upper surface. **Sporangia** occur on the upper surfaces of the tip-most leaves, tucked in at the leaf bases. **Gemmae** occur in 1–3 whorls toward the tips of the shoots.  $2n=268$  (tetraploid).



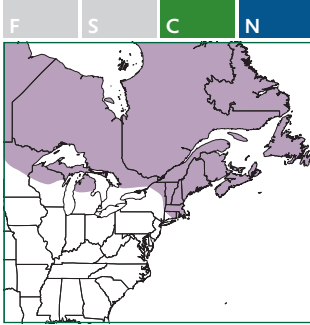
A. Fertile plants of *Huperzia porophila*.



B. Fertile section of stem, with gemmae.



C. Lower surfaces of leaves, with stomata (small white dots).



## *Huperzia selago*

COMMON NAME(S) Northern firmoss

NOTABLE SYNONYMS *Lycopodium selago*

STATUS Native, uncommon

HABITAT/DISTRIBUTION Damp habitats including swamps, conifer woods, and along streams, moist cliffs, and old trails; also occurs in western North America, Europe, and Asia

**Plants** are terrestrial. **Stems** are compact and erect. **Shoots** are erect, up to 15cm tall, and often form clusters. If shoots branch, they do so dichotomously. Annual growth constrictions are typically not distinct. **Leaves** are similar in size and shape along the length of the shoot. Leaves are up to 8mm long and are widest at their base (lanceolate in overall shape to ovate or even triangular). Leaves have nearly entire **margins** with no or only a few small teeth. Stomata are present on both surfaces and are numerous (more than 60) on the upper surface. **Sporangia** occur on the upper surfaces of the tip-most leaves, tucked in at the leaf bases. **Gemmae** occur in a single whorl toward the shoot tip.  $2n=134$  (diploid).



A. Plants of *Huperzia selago*.



B. Fertile section of stem, with gemmae.



C. Top-down view showing gemmae.

ALL PHOTOGRAPHS BY NATE MARTINEAU



## FAMILY: ISOETACEAE

*Isoetes* is a genus of lycophytes commonly known as quillworts or Merlin's grasses. This is perhaps the most intriguing and enigmatic group of plants in our fern and lycophyte flora; the members of this genus are unique in their appearance and lifestyle, in ways that lead to their being easily overlooked in nature. All *Isoetes* species are perennials and associate closely with water. Many species are fully submerged aquatics, while others are emergent but rooted in permanent water, and still others are only seasonally inundated, occurring in ephemeral water bodies and becoming essentially terrestrial once these waters have receded or dried up. The vast majority of the 200+ quillwort species known worldwide require acidic or at least circumneutral substrates; very few can tolerate limy or nutrient-rich soils. The ability of most *Isoetes* to grow in these relatively sterile conditions may reduce competition from other plants, but it also greatly limits the possible geographic extent of their occurrence in eastern North America.

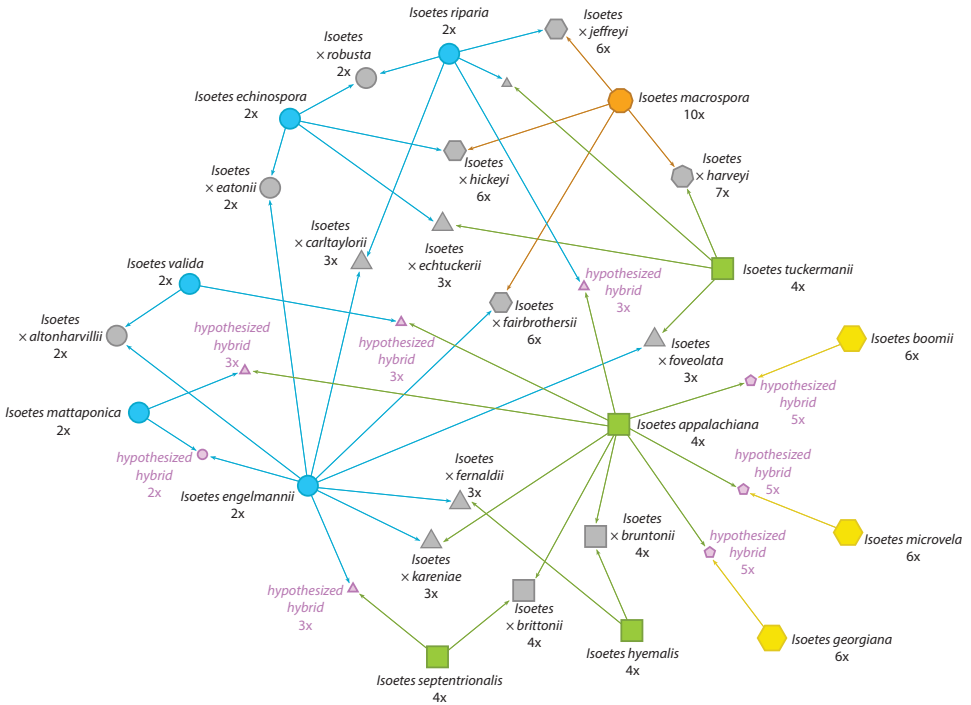
Quillworts in our region can be categorized within three distinct groupings of habitat and seasonality: 1) rock outcrop, posted and ephemeral meadow species, which have the shortest growing season, appearing in late winter to early spring but becoming dormant and usually invisible aboveground by early summer; 2) woodland swamp species that develop in late spring and are evident aboveground into late summer or early fall; and 3) fully aquatic species that develop in mid to late summer, mature well into autumn, and often remain evident until freeze-up. Their aquatic nature makes it unlikely that you will encounter these plants on the average hike; often they will be found only by a targeted search. Despite an inconspicuous overall appearance (most quillworts look like a tuft of grass or an upright bundle of pine needles), the unique morphological features of their appearance and structure will become clear upon closer inspection (see the *Isoetes* section in the description of lycophyte morphology on p. 20).

In addition to their distinctive appearance and watery habit, *Isoetes* species are noteworthy for several additional reasons. First, unlike most plants, they absorb CO<sub>2</sub> through their roots and expel oxygen into the soil. A red color is often evident in the substrate around the roots of many aquatic quillworts, and it is literally rust, caused by oxidation. They also employ CAM photosynthesis, an alternative photosynthetic pathway to the one employed by most plants, which is particularly interesting in *Isoetes* because CAM photosynthesis is typically seen in plants adapted to arid and desert habitats. The CAM process is especially useful for plants growing where photosynthetic productivity is limited by environmental stress (e.g., in deserts) or sterility (e.g., nutrient-poor, aquatic habitats).

Quillworts are extremely prone to hybridization and polyploidy, and this has been the primary route for the formation of new species in our region. Ploidy—the number of sets of chromosomes in an organism—has provided critical insights into the classification, taxonomy, and relationships of quillworts. The genus may have the most complicated network of interspecies hybridization of any group in the North American pteridophyte flora (see figure below), and over a dozen sterile hybrids involving eastern North American species have been formally described. New hybrids continue to be identified regularly, as do sexual species, and it seems likely that significant diversity still remains to be discovered. The base number of chromosomes in the genus is 11, and all distinct North American species of *Isoetes* have even ploidal levels (e.g., a diploid will have 2n=22 chromosomes, a tetraploid 2n=44 chromosomes, etc.). Odd-numbered sets of chromosomes reflect hybrids between parents of different ploidal levels (e.g., a triploid with 2n=33 or a pentaploid with 2n=55), and these are always sterile (though even-numbered fertile hybrids, between parents at the same ploidal level, are also known). Hybrid plants are most often first detected by their aborted, sterile megaspores, which vary in appearance and size, with a mix of ornamentation

features from both parental taxa. All members of the family Isoetaceae are heterosporous, with separate female megaspores and male microspores.

Finally, it is worth mentioning that the name of this genus can be spelled legitimately in two ways: *Isoetes* and *Isoëtes* are both technically correct and acceptable spellings. The former is used here for simplicity. Base chromosome number ( $x$ ) = 11.



Relationships among *Isoetes* species in eastern North America. Blue circles are fertile diploids (2x), green squares are fertile allotetraploids (4x), yellow hexagons are fertile allohexaploids (6x), and the orange dodecagon is a fertile dodecaploid (10x). Gray circles, triangles, squares, and hexagons are sterile diploids, triploids, tetraploids, and hexaploids, respectively. Purple shapes are hypothesized hybrids that have not yet been found in nature. Large shapes are named taxa, and small shapes are as yet unnamed. Arrows show the direction of genetic contribution from parental toward offspring taxa. For more information about interpreting these figures, see p. 12.

OPPOSITE PAGE:

- A. *Isoetes georgiana* growing in a slow-moving forest stream.
- B. *Isoetes engelmanni* growing in a forest pool.
- C. *Isoetes butleri* growing in a grassy swale that is seasonally flooded.
- D. *Isoetes flaccida* growing in a cypress dome in the Everglades.
- E. Leaves of *Isoetes flaccida*.
- F. Outside of a leaf base of *Isoetes engelmanni*.
- G. Sporangium of *Isoetes engelmanni*, with its outline visible (the velum has been removed).
- H. Leaf base of *Isoetes flaccida* with ligule still attached.





A



B



C



D



E



F



G



H

## KEY TO THE SPECIES OF *ISOETES* IN OUR FLORA:

A combination of features can be used to arrive at credible field identifications of quillworts, but most of them cannot be identified by the unaided eye. The examination of megaspore ornamentation at 15× (preferably 30×) magnification is usually essential, in concert with leaf features (especially velum coverage) and attributes such as plant form, phenology, and site ecology. In order to provide reliable information about ornamentation pattern and spore size, megaspores must be mature (appearing pure white in all but a few species, and never yellow and/or glassy). Spores retained in the soil around the roots from previous growing seasons can often provide the mature material needed for identification.

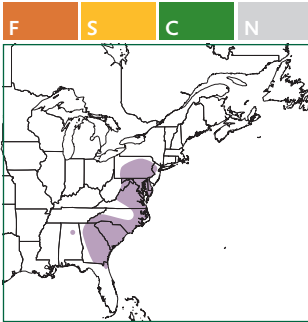
- 1a** Megaspores from the same plant are variable in shape and size and/or exhibit more than one ornamentation pattern (i.e., they are abortive and not viable); individual plants are often substantially larger than associates (i.e., they display hybrid vigor) ..... various sterile hybrid species
- 1b** Megaspores from the same plant are uniform in shape, size, and ornamentation; all plants are approximately the same size ..... 2
- 2a** Plants are terrestrial or occur in seasonally flooded or ephemeral soils, swales, or pools, or on and around rock outcrops (note that plants may be in flowing water early in the season but typically end up on soil later, when the water recedes) ..... 3
- 3a** The velum covers 70–100% of the sporangium; megaspores are gray to black; plants are tiny (< 7cm tall) and occur only on isolated granite outcrops (Georgia and South Carolina) ..... 4
- 4a** Plants are up to 5–7cm tall and grow individually; corms are globose; megaspores are densely ornamented with tubercles ..... *Isoetes melanospora*
- 4b** Plants are up to 3–4cm tall and grow in dense mats; corms are elongated; megaspores are somewhat wrinkled or unornamented ..... *Isoetes tegetiformans*
- 3b** The velum covers less than 70% of the sporangium; megaspores are white; plants are substantially larger (8–30cm tall) and variously distributed ..... 5
- 5a** Plants occur on basic substrates (e.g., calcareous, limestone-derived soils); megaspores are generally more than 525µm in diameter ..... *Isoetes butleri*
- 5b** Plants occur on acidic or circumneutral substrates (e.g., noncalcareous soils); megaspores are mostly less than 500µm in diameter ..... 6
- 6a** The velum covers approximately 40% of the sporangium; megaspore ornamentation is of low, broad walls forming a broken-reticulate pattern; plants are confined to the coastal plain (Georgia) ..... *Isoetes junciformis*
- 6b** The velum covers less than 25% of the sporangium; megaspore ornamentation is of a granular to tubercular (rarely obscurely reticulate) pattern; plants are variously distributed ..... 7
- 7a** Leaves are loosely reflexed to sprawling; megaspores average more than 465µm in diameter, with a dense pattern of low, rugulate (wrinkled) ornamentation; plants are rare and found only in the eastern Piedmont ..... *Isoetes virginica*
- 7b** Leaves are stiffly erect to reflexed, or may be erect when immature but sprawling as they mature; megaspores average less than 450µm in diameter, with obscurely granular or tuberculate ornamentation ..... 8
- 8a** Plants typically have 35–40 leaves; leaves are 1.5–2.0mm wide and 15–30cm long; the velum covers 5–20% of the sporangium; megaspore ornamentation is plain to densely low tuberculate; plants occur in shaded deciduous swamps ..... *Isoetes melanopoda*
- 8b** Plants typically have 20–30 leaves; leaves are 1.0–1.5mm wide and typically less than 15cm long; the velum covers less than 10% of the sporangium; megaspore ornamentation is tuberculate to wrinkled; plants occur in ephemeral pools on open bedrock outcrops ..... 9
- 9a** Mature megaspores average 455µm in diameter, and ornamentation is sparsely wrinkled to short walled or densely tuberculate; plants are found on granite (or rarely sandstone) outcrops ..... *Isoetes piedmontana*



9b	Mature megaspores average 475µm in diameter, and ornamentation is typically wrinkled to low tuberculate; plants are found on granite outcrops in the western Piedmont (Alabama) .....	<i>Isoetes graniticola</i>
2b	Plants are aquatic, either submerged or emergent, in permanent water bodies or in persistently extremely wet soils .....	10
10a	Plants are in tidal freshwater marsh habitats; megaspores are less than 350µm in diameter; plants occur on the coastal plain (eastern Virginia) .....	<i>Isoetes mattaponica</i>
10b	Plants are in various freshwater habitats; megaspores are more than 400µm in diameter; plants are variously distributed .....	11
11a	Megaspore ornamentation is a dense, uniform pattern of thin, sharp spines .....	<i>Isoetes echinospora</i> subsp. <i>muricata</i>
11b	Megaspore ornamentation is of various patterns other than exclusively spiny .....	12
12a	Megaspores average more than 575µm in diameter .....	13
13a	Plants occur in deep lakes or fast-flowing rivers; the velum typically covers less than 30% of the sporangium; leaves are 6–20cm long .....	14
14a	Plants occur in fast-flowing water; the walls of the megaspore ornamentation are thick and even in height, forming an uncongested, evenly reticulate pattern; plants occur in the southern Appalachian Mountains (Tennessee) .....	<i>Isoetes tennesseensis</i>
14b	Plants occur in deep or slow-flowing water; the walls of the megaspore ornamentation are thin to moderately thick and uneven in height, forming a congested, unevenly reticulate pattern; plants are widespread in northern lakes .....	<i>Isoetes macrospora</i>
13b	Plants occur in slow-moving stream channels in deciduous swamp forests; the velum covers more than 30% of the sporangium; leaves are 20–45cm long .....	15
15a	The walls of the megaspore ornamentation are thick, and the pattern is open and uncongested; the velum covers ca. 60% of the sporangium; plants occur on the coastal plain (southern Georgia) .....	<i>Isoetes georgiana</i>
15b	The walls of the megaspore ornamentation are thin to somewhat thick, and the pattern is congested; the velum covers ca. 30% of the sporangium; plants are somewhat widespread but in localized populations in the southeast .....	<i>Isoetes boomii</i>
12b	Megaspores average less than 575µm in diameter .....	16
16a	The velum covers more than 40% of the sporangium .....	17
17a	The velum covers more than 80% (up to 100%) of the sporangium .....	18
18a	The leaves are dark green and rigid; plants occur in northern New England and the Canadian Maritimes .....	<i>Isoetes prototypus</i>
18b	The leaves are bright green and flexible; plants occur in the extreme southeast .....	<i>Isoetes flaccida</i>
17b	The velum covers less than 70% (typically 50–60%) of the sporangium .....	19
19a	Plants are large (20–35cm tall); leaves are broad and often distinctively yellow green; megaspore ornamentation is tall and ragged reticulate; plants are early emergent (May–June) in woodland seepage areas (rarely fully aquatic) and are widely distributed in the south and southeast .....	<i>Isoetes valida</i>
19b	Plants are small (ca. 10cm tall); leaves are narrow and uniformly green; megaspore ornamentation is obscurely wrinkled; plants are permanently aquatic and are known from a single lake in the northern Appalachian Mountains (Vermont) .....	<i>Isoetes viridimontana</i>
16b	The velum covers less than 40% of the sporangium .....	20
20a	The megaspores are typically less than 500µm in diameter .....	21

- 21a Leaves are bright green and flexible; megaspore ornamentation is evenly, uniformly reticulate; plants are widely distributed in the eastern U.S. .... *Isoetes engelmannii*
- 21b Leaves are dull gray green and mostly erect; megaspore ornamentation is densely broken reticulate to almost spiny; plants are confined to freshwater tidal marshes in eastern Canada (Québec) ..... *Isoetes laurentiana*
- 20b The megaspores are typically more than 525µm in diameter ..... 22
- 22a Leaves are narrow (mostly less than 2mm wide) and typically dark green to olive green (or reddish); megaspore walls form a moderately to densely congested or almost spiny ornamentation pattern, usually with a distinct, densely spiny band below the equatorial ridge (except in *I. septentrionalis*) ..... 23
- 23a Leaves are olive green to reddish brown; megaspore ornamentation is reticulate, with walls either tall and narrow or low and broad, and an equatorial band that is either densely papillate (with numerous very small, smooth projections) or broad and plain ..... *Isoetes tuckermanii*
- 23b Leaves are dark green to olive green; megaspore ornamentation is moderately to densely congested, with walls typically in a cristate or almost spiny pattern, and an equatorial band that is narrow and spiny, or absent ..... 24
- 24a The vellum covers 10–20% of the sporangium; leaves are relatively narrow (1–1.5mm wide) and 20–45cm long; megaspore walls are in a uniformly, moderately congested, almost spiny pattern ..... *Isoetes hyemalis*
- 24b The velum covers 25–40% of the sporangium; leaves are relatively broad (1.5–2mm wide) and 10–25cm long; megaspore walls are short and branching, in a dense to open, cristate pattern ..... 25
- 25a Megaspore walls are in a densely crowded, congested ornamentation pattern, with an equatorial band of obscure to conspicuous spines; plants occur in the coastal plain, often in emergent, tidal beach habitats ..... *Isoetes riparia*
- 25b Megaspore walls are in a dispersed, somewhat broken, network-forming ornamentation pattern, with no equatorial band; plants occur in freshwater habitats ..... *Isoetes septentrionalis*
- 22b Leaves are broad (ca. 2mm wide or sometimes wider) and bright to dark green; megaspore ornamentation is a moderately reticulate pattern of walls with no or a few short, stand-alone tubercles; the equatorial band is absent or only obscurely spiny below the equatorial ridge ..... 26
- 26a The megaspore ornamentation pattern is of irregularly reticulate, long, interconnected and short, stand-alone walls; the velum covers ca. 30% of the sporangium; plants are usually deeply rooted, growing in clay or clayey sand; plants occur in the southern coastal plain ..... *Isoetes louisianensis*
- 26b The megaspore ornamentation pattern is typically of regularly reticulate, mostly interconnected walls and only a few or no isolated, shorter walls; the velum usually covers 10–25% of the sporangium; plants are usually shallowly rooted, growing in sandy or silty-sandy soils ..... 27
- 27a The velum covers 20–25% of the sporangium; megaspores are 525–550µm in diameter, with a broadly reticulate ornamentation pattern; plants are widespread ..... *Isoetes appalachiana*
- 27b The velum covers ca. 10% of the sporangium; megaspores are 530–590µm in diameter, with a congested and densely reticulate ornamentation pattern; plants occur in the coastal plain (North Carolina) ..... *Isoetes microvela*





### *Isoetes appalachiana*

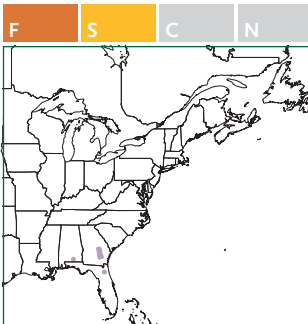
**COMMON NAME(S)** Appalachian quillwort

**NOTABLE SYNONYM(S)** *Isoetes engelmannii* var. *georgiana*

**STATUS** Native (endemic to eastern North America), somewhat common

**HABITAT/DISTRIBUTION** A variety of aquatic and seasonally emergent habitats, including swampy forests and the shores of clear, flowing rivers and pools; widespread in the eastern and southeastern U.S.

**Plants** are submerged and amphibious (tolerant of fluctuating water levels). **Leaves** are erect to reflexed, 25–30cm long, 1–2mm wide, and dull olive green, with bases that are whitish green to pale brownish green. The **velum** covers 20% (rarely up to 40%) of the sporangium. **Megaspores** are 525–550 (average 535)  $\mu\text{m}$  in diameter. Ornamentation is in a ragged-reticulate pattern with variably tall and irregularly connected walls; a dense but obscure equatorial band of short spines is often present.  $2n=44$  (tetraploid).



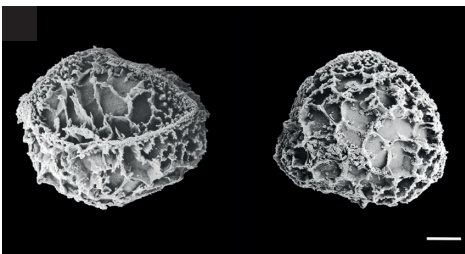
### *Isoetes boomii*

**COMMON NAME(S)** Boom's quillwort, swamp quillwort

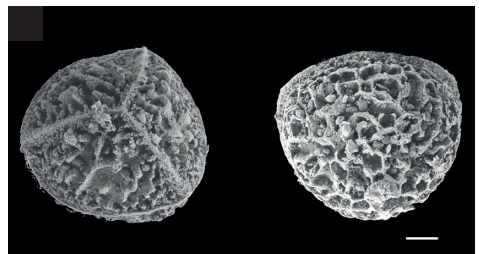
**STATUS** Native (endemic to eastern North America), rare

**HABITAT/DISTRIBUTION** Shallow, permanently flowing streams in swamps; known from only a handful of locations in the southern U.S.

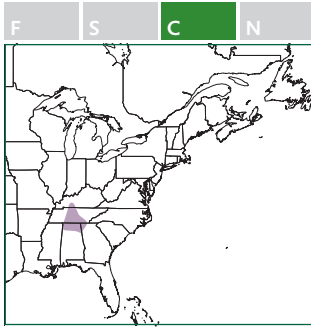
**Plants** are submerged to uncommonly emergent. **Leaves** are flexible and pliant, up to 45cm long, and bright green, with pale bases. The **velum** covers ca. 30% of the sporangium. **Megaspores** are 460–610 $\mu\text{m}$  in diameter. Ornamentation is in a congested, cristate to reticulate pattern with moderately thick, interconnecting walls.  $2n=66$  (hexaploid).



Megaspores of *Isoetes appalachiana*. Left: lateral view; right: distal view. Scale bar 100 $\mu\text{m}$ .



Megaspores of *Isoetes boomii*. Left: proximal view; right: distal view.

*Isoetes butleri*

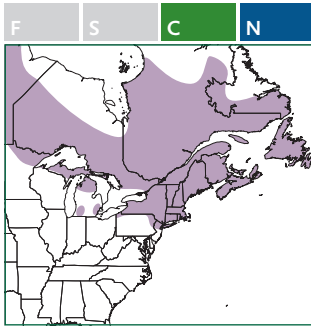
**COMMON NAME(S)** Butler's quillwort, limestone quillwort

**STATUS** Native (endemic to eastern North America), locally uncommon

**HABITAT/DISTRIBUTION** The only North American quillwort known from calcareous substrates, in seasonally wet glades and wet prairies; scattered in the central-southern U.S.

**Plants** are emergent to terrestrial, in seasonally damp soils in early spring, but become fully terrestrial as water recedes.

**Leaves** are erect but flexible, up to 15cm long (sometimes longer), and dull gray green to green, with pale bases. The **velum** covers less than 25% of the sporangium. **Megaspores** are 480–650µm in diameter. Ornamentation is obscurely tuberculate on a fibrose surface, with an obscure equatorial ridge. 2n=22 (diploid).

*Isoetes echinospora* subsp. *muricata*

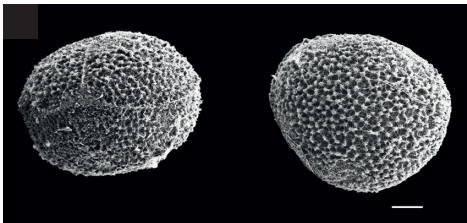
**COMMON NAME(S)** Spiny-spored quillwort

**STATUS** Native, somewhat common

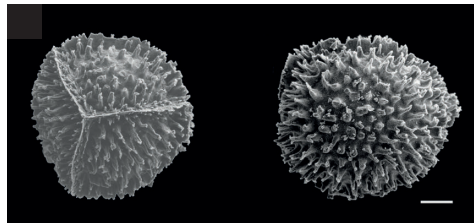
**HABITAT/DISTRIBUTION** Cool, noncalcareous, oligotrophic (i.e., oxygen-rich) lakes and ponds; also occurs in the western U.S. and Canada, and Greenland (a second subspecies, *I. echinospora* subsp. *echinospora*, occurs in Europe and Asia)

**Plants** are submerged to occasionally emergent late in the season. **Leaves** are pliant, up to 15cm long (rarely 25cm or

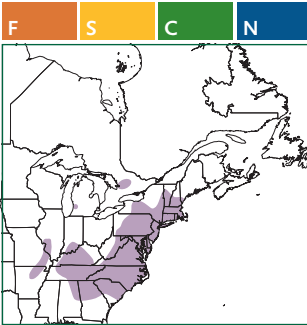
longer), and bright green to brownish green, with pale bases. The **velum** covers less than 50% of the sporangium. **Megaspores** are 450–500µm in diameter (rarely up to 550µm). Ornamentation is uniformly of thin, sharp spines. 2n=22 (diploid).



Megaspores of *Isoetes butleri*. Left: lateral view; right: distal view. Scale bar 100µm.



Megaspores of *Isoetes echinospora* subsp. *muricata*. Left: proximal view; right: distal view. Scale bar 100µm.



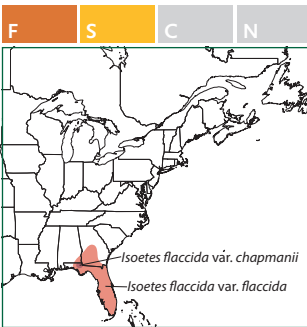
### *Isoetes engelmannii*

COMMON NAME(S) Engelmann's quillwort

STATUS Native (endemic to eastern North America), formerly common but much reduced in recent decades, especially in New England, because of habitat degradation

HABITAT/DISTRIBUTION Shallow, cool, freshwater streams, lakes, ponds, and ditches; widely distributed in the east

**Plants** are submerged to emergent. **Leaves** are pliant, up to 25cm long (rarely up to 40cm), and bright green, with pale bases. The **velum** typically covers 5–10% (rarely up to 20%) of the sporangium. **Megaspores** are 400–480 $\mu$ m (rarely up to 500 $\mu$ m) in diameter. Ornamentation pattern is of tall, connected, evenly reticulate walls that are continuous to the equatorial ridge.  $2n=22$  (diploid).



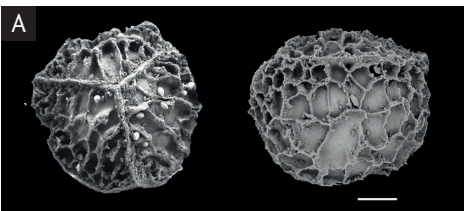
### *Isoetes flaccida*, including varieties *flaccida* and *chapmanii*

COMMON NAME(S) Florida quillwort

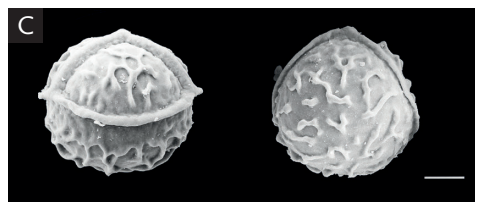
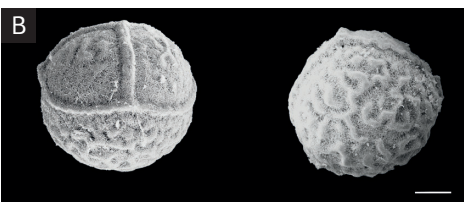
STATUS Native (endemic to eastern North America), rare

HABITAT/DISTRIBUTION Shallow waters, usually at the edges of marshes, ponds, lakes, streams, and ditches; *I. flaccida* var. *chapmanii* is known only from Jackson County, Florida, while *I. flaccida* var. *flaccida* is more widely distributed, throughout the Florida peninsula and into southernmost Georgia and Alabama

**Plants** are submerged to emergent. **Leaves** are pliant, up to 60cm long, bright green, and 1.25–1.5mm (var. *chapmanii*) or ca. 1mm (var. *flaccida*) wide. The **velum** covers the entire sporangium. **Megaspores** are ca. 500 $\mu$ m (var. *chapmanii*) or less than 450 $\mu$ m (var. *flaccida*) in diameter. Ornamentation is dense with small tubercles (var. *chapmanii*) or more dispersed with broad tubercles and/or loosely interconnected mounds (var. *flaccida*).  $2n=22$  (diploid).



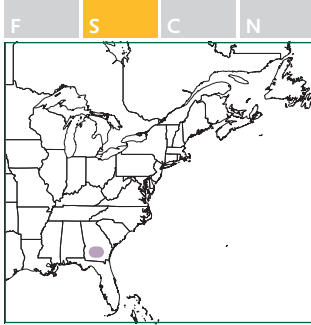
A. Megaspores of *Isoetes engelmannii*. Left: proximal view (note microspores on the megaspore surface); right: distal view. Scale bar 100 $\mu$ m.



B. Megaspores of *Isoetes flaccida* var. *chapmanii*. Left: lateral view; right: distal view. Scale bar 100 $\mu$ m.

C. Megaspores of *Isoetes flaccida* var. *flaccida*. Left: lateral view; right: distal view. Scale bar 100 $\mu$ m.

IMAGES COURTESY OF DANIEL BRUNTON; SEE P. 505 FOR SPECIMEN SOURCE INFORMATION



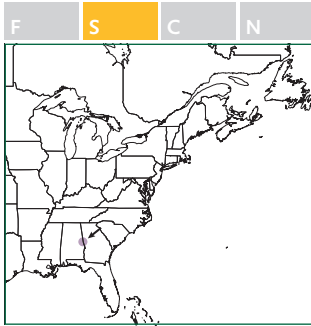
### *Isoetes georgiana*

**COMMON NAME(S)** Georgia quillwort

**STATUS** Native (endemic to eastern North America), rare

**HABITAT/DISTRIBUTION** Ephemeral streams in deciduous swamp forests; known only from several small watersheds on the Gulf of Mexico coastal plain in Georgia

**Plants** are submerged to emergent. **Leaves** are pliant, up to 40cm long, and olive green, with pale bases. The **velum** covers 55–60% of the sporangium. **Megaspores** are 450–650 (average 625)  $\mu\text{m}$  in diameter. Ornamentation pattern is open and uncongested, with thick, loosely connected or isolated walls.  $2n=66$  (hexaploid).



### *Isoetes graniticola*

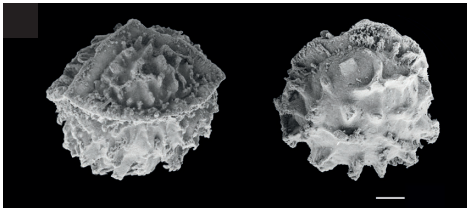
**COMMON NAME(S)** Flat rock quillwort

**NOTABLE SYNONYMS** *Isoetes piedmontana*, in part

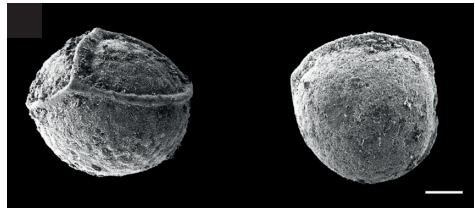
**STATUS** Native (endemic to eastern North America), rare

**HABITAT/DISTRIBUTION** Shallow, ephemeral pools on flat granite outcrops; known from only a few locations in east-central Alabama

**Plants** are emergent to terrestrial, in seasonally damp soils, but become fully terrestrial as water recedes. **Leaves** are stiffly erect to broadly arching, up to 10cm long and 1.0–1.5mm wide, and dull brownish green, with whitish-green to blackish-brown bases. The **velum** covers less than 10% of the sporangium. **Megaspores** are 450–525 (average 475)  $\mu\text{m}$  in diameter. Ornamentation pattern is smooth or wrinkled to low tuberculate, with low, wide walls, and no distinct equatorial band.  $2n=44$  (tetraploid).

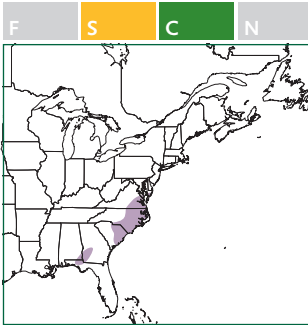


Megaspores of *Isoetes georgiana*. Left: lateral view; right: distal view. Scale bar 100 $\mu\text{m}$ .



Megaspores of *Isoetes graniticola*. Left: lateral view; right: distal view. Scale bar 100 $\mu\text{m}$ .





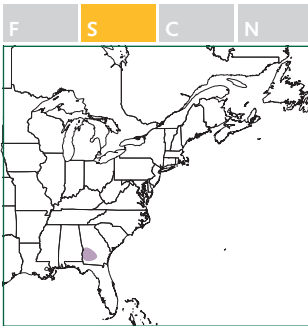
### *Isoetes hyemalis*

COMMON NAME(S) Winter quillwort

STATUS Native (endemic to eastern North America), uncommon and local

HABITAT/DISTRIBUTION Shaded forest streams; widely scattered from the lower Piedmont of Virginia and North Carolina to the Gulf of Mexico coastal plain in southern Georgia and Alabama

**Plants** are submerged and amphibious (tolerant of seasonally fluctuating water levels). **Leaves** are wiry, 20–45cm long at maturity and 1–1.5mm wide, bright green when young but becoming dark green to dark brownish green with age, with pale bases. The **velum** covers 10–20% of the sporangium. **Megaspores** are 400–580 (average 525)  $\mu\text{m}$  in diameter. Ornamentation is of tall walls with irregular crests in a congested, somewhat reticulate pattern, with thin tubercles and a spiny equatorial band.  $2n=44$  (tetraploid).



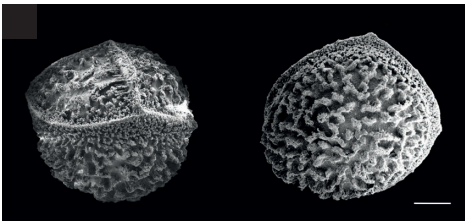
### *Isoetes junciformis*

COMMON NAME(S) Rush quillwort

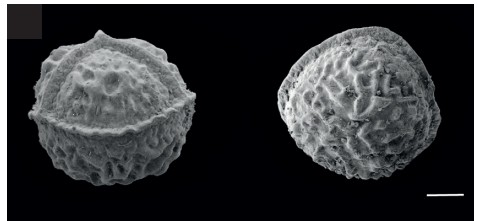
STATUS Native (endemic to eastern North America), rare

HABITAT/DISTRIBUTION Open swales along the margins of deciduous swamp forest; known from only a few locations (some of which have been lost, either to human activity or natural successional processes) on the Gulf of Mexico coastal plain in Georgia

**Plants** are seasonally flooded and then emergent in saturated soils, becoming fully terrestrial as water recedes. **Leaves** are erect, 35–40cm long at maturity, and dull, pale green to grayish green, with pale to white bases that may have a light pinkish-purple cast, especially in young leaves. The **velum** covers ca. 40% of the sporangium, and the surface of the sporangium is whitish with brown streaks. **Megaspores** average 460 $\mu\text{m}$  in diameter. Ornamentation is in a prominent, ragged-reticulate pattern of low, broad, smooth-topped walls.  $2n=44$  (tetraploid).

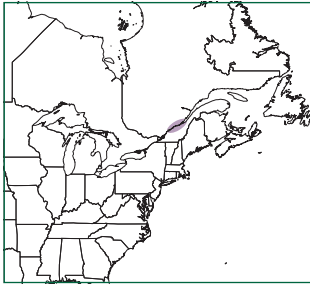


Megaspores of *Isoetes hyemalis*. Left: lateral view; right: distal view. Scale bar 100 $\mu\text{m}$ .



Megaspores of *Isoetes junciformis*. Left: lateral view; right: distal view. Scale bar 100 $\mu\text{m}$ .

F S C N



### *Isoetes laurentiana*

**COMMON NAME(S)** St. Lawrence quillwort

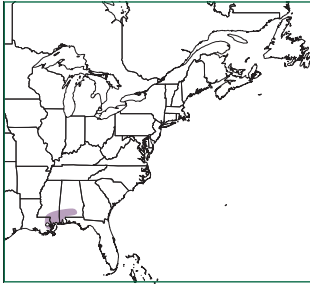
**NOTABLE SYNONYM(S)** *Isoetes tuckermanii*, in part

**STATUS** Native (endemic to eastern North America), rare but locally abundant

**HABITAT/DISTRIBUTION** Known only from freshwater tidal marshes along the St. Lawrence River in Québec

**Plants** are amphibious (tolerant of twice-daily emergence from tidally fluctuating fresh water). **Leaves** are erect to arching, up to 12cm long, and dull gray green, with paler bases that have a brownish cast. The **velum** covers up to 25% of the sporangium. **Megaspores** average 460µm in diameter. Ornamentation is of densely broken-reticulate to almost spiny and ragged-crested walls, with a very narrow equatorial band of fine spines.  $2n=44$  (tetraploid).

F S C N



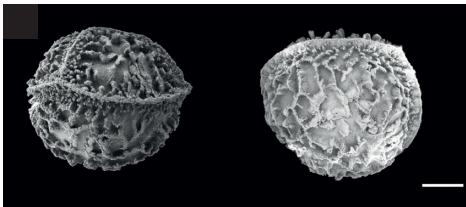
### *Isoetes louisianensis*

**COMMON NAME(S)** Louisiana quillwort

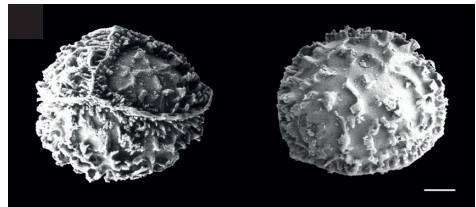
**STATUS** Native (endemic to eastern North America), rare

**HABITAT/DISTRIBUTION** Forest creeks with clay or clayey sand; on the Gulf of Mexico coastal plain between Alabama and Louisiana

**Plants** are submerged to emergent and typically deeply rooted. **Leaves** are pliant, up to 40cm long, and bright green, with paler bases. The **velum** covers ca. 30% of the sporangium (sometimes more). **Megaspores** average 500–550µm in diameter (rarely up to 600µm). Ornamentation pattern is irregularly reticulate, with both long, interconnected and short, stand-alone walls; the lower side of the equatorial ridge is typically obscurely, coarsely spiny.  $2n=44$  (tetraploid).



Megaspores of *Isoetes laurentiana*. Left: lateral view; right: distal view. Scale bar 100µm.



Megaspores of *Isoetes louisianensis*. Left: lateral view; right: distal view. Scale bar 100µm.

## INDEX TO SCIENTIFIC NAMES

**Bold italics** currently accepted species names

*Italics*: synonyms of species names

**Page numbers in bold**: the main entry for that genus or species

### A

*Acrostichum* 36, **114–117**, 435

*Acrostichum aureum* 114, 115, **116**, 493

*Acrostichum danaeifolium* 114, 115, **117**, 493

*Actinostachys* 34, **118–119**, 467

*Actinostachys pennula* 118, **119**, 467, 493

*Adiantum* 10, 37, **120–129**

*Adiantum aleuticum* 122, **123**, 493

*Adiantum anceps* 121, **124**, 493

*Adiantum capillus-veneris* 121, **125**, 493

*Adiantum caudatum* 10

*Adiantum hispidulum* 10

*Adiantum melanoleucum* 121, **126**, 493

*Adiantum pedatum* 122, **127**, 493

*Adiantum tenerum* 121, 122, **128**, 493

*Adiantum trapeziforme* 10

*Adiantum villosum* 10

*Adiantum viridimontanum* 122, **129**, 493

*Amauropelta* 25, 39, **130–133**, 230, 475

*Amauropelta noveboracensis* 130, **131**, 230, 493

*Amauropelta resinifera* 130, **132**, 493

*Amauropelta sancta* 25, 130, **133**, 493

*Amblovenatum* 40, **134–135**, 475

*Amblovenatum opulentum* 134, **135**, 493

*Amphineuron* 135

*Amphineuron opulentum* (*Amblovenatum opulentum*)  
135

*Anchistea* 37, **136–137**, 191, 326

*Anchistea virginica* 136, **137**, 326, 493

*Anemia* 34, 35, 36, **138–141**

*Anemia adiantifolia* 138, 139, **140**, 493

*Anemia wrightii* 36, 138, 139, **141**, 493

*Anemiaceae* 11, 138

*Anisocampium* 186

*Anisocampium niponicum* (*Athyrium niponicum*) 186

*Arachniodes* 23, 40, **142–143**

*Arachniodes simplicior* 23, 142, **143**, 493

*Argyrochosma* 37, **144**, 402

*Argyrochosma dealbata* **144**, 493

*Aspidotis* 37, **145**

*Aspidotis densa* **145**, 493

*Aspleniaceae* 11, 146, 315

*Asplenium* 12, 25, 34, 37, **146–179**

*Asplenium* × *alternifolium* 147, 148, 152, 153

*Asplenium* × *biscayneanum* 147, 148, 155

*Asplenium* × *boydstoniae* 147

*Asplenium* × *clermontae* 147

*Asplenium* × *curtissii* 147, 148, 155, 156

*Asplenium* × *ebenoides* 147, 148, 150, 151

*Asplenium* × *gravesii* 147, 148, 151

*Asplenium* × *herbwagneri* 147

*Asplenium* × *heteroresiliens* 147, 148, 153, 155

*Asplenium* × *inexpectatum* 147

*Asplenium* × *kentuckiense* 147, 149, 151

*Asplenium* × *morganii* 147

*Asplenium* × *shawneense* 147

*Asplenium* × *trudellii* 147, 149, 151

*Asplenium* × *virginicum* 147

*Asplenium* × *wherryi* 147

*Asplenium abscissum* 147, 152, 153, **158**, 493

*Asplenium auritum* 25, 152, 153, **159**, 493

*Asplenium bradleyi* 147, 150, 151, **160**, 493

*Asplenium cristatum* 155, 157, **161**, 493

*Asplenium dentatum* subsp. *barbadense* 162

*Asplenium dentatum* subsp. *dentatum* 147, 152, 153,  
**162**, 493

*Asplenium erosum* (*Asplenium erosum*) 159

*Asplenium heterochroum* 147, 153, 154, **163**, 493

*Asplenium monanthes* 153, 154, **164**, 493

*Asplenium montanum* 147, 155, 156, **165**, 493

*Asplenium nidus* 175

*Asplenium pinnatifidum* 147, 150, 151, **166**, 493

*Asplenium platyneuron* 147, 152, 153, **167**, 493

*Asplenium plenum* 147, 155, 157, **168**, 493

- Asplenium pumilum* 151, **169**, 493  
*Asplenium quadrivalens* (*Asplenium trichomanes* subsp. *quadrivalens*) 176  
*Asplenium resiliens* 147, 153, 154, **170**, 493  
*Asplenium rhizophyllum* 34, 147, 149, 150, **171**, 493  
*Asplenium ruta-muraria* var. *cryptolepis* 147, 155, **172**, 494  
*Asplenium scolopendrium* var. *americanum* 34, 149, 150, **173**, 494  
*Asplenium septentrionale* subsp. *caucasicum* 174  
*Asplenium septentrionale* subsp. *rehmanii* 174  
*Asplenium septentrionale* subsp. *septentrionale* 34, 147, 149, 150, **174**, 494  
*Asplenium serratum* 34, 149, **175**, 494  
*Asplenium trichomanes* 147, 153, 154, **176**, 494  
*Asplenium trichomanes* subsp. *quadrivalens* **176**  
*Asplenium trichomanes* subsp. *trichomanes* **176**  
*Asplenium trichomanes-dentatum* (*Asplenium dentatum* subsp. *dentatum*) 162  
*Asplenium trichomanes-ramosum* (*Asplenium viride*) 179  
*Asplenium tutwilerae* 147, 150, 151, **177**, 494  
*Asplenium verecundum* 147, 155, 157, **178**, 494  
*Asplenium viride* 153, **179**, 494
- Astrolepis* 37, **180–182**  
*Astrolepis cochisensis* 180  
*Astrolepis integerrima* 180, **181**, 494  
*Astrolepis sinuata* 180, **182**, 494
- Athyriaceae 11, 183, 257, 266, 315
- Athyrium* 10, 37, 146, **183–186**  
*Athyrium angustum* 183, **184**, 494  
*Athyrium americanum* 10  
*Athyrium asplenioides* 183, **185**, 494  
*Athyrium filix-femina* 184, 185  
*Athyrium filix-femina* var. *angustum* (*Athyrium angustum*) 184  
*Athyrium filix-femina* var. *asplenioides* (*Athyrium asplenioides*) 185  
*Athyrium niponicum* 183, **186**, 494
- Azolla* 32, **187–190**, 219, 335, 421, 455  
*Azolla caroliniana* (*Azolla cristata*) 189  
*Azolla cristata* 187, 188, **189**, 494  
*Azolla filiculoides* 187
- Azolla mexicana* 187, **189**, 494  
*Azolla microphylla* (*Azolla mexicana*) 189  
*Azolla pinnata* subsp. *africana* 190  
*Azolla pinnata* subsp. *asiatica* 190  
*Azolla pinnata* subsp. *pinnata* 187, **190**, 494
- ## B
- Blechnaceae 11, 136, 191, 326, 473
- Blechnum* 37, **191–192**, 473, 474  
*Blechnum appendiculatum* 191, **192**, 473, 494  
*Blechnum occidentale* var. *minus* (*Blechnum appendiculatum*) 192  
*Blechnum serrulatum* (*Telmatoblechnum serrulatum*) 474
- Botrychium* 10, 35, **193–212**, 213, 214, 377, 458, 460, 461, 462, 463, 464, 465, 466, 501  
*Botrychium acuminatum* (*Botrychium matricariifolium*) 204  
*Botrychium angustisegmentum* 194, 195, **199**, 494  
*Botrychium ascendens* 194, 198, **200**, 494  
*Botrychium biternatum* (*Sceptridium biternatum*) 460  
*Botrychium campestre* 194, 196, **201**, 494  
*Botrychium crenulatum* 194, 196, 197, **202**, 494  
*Botrychium cuneatum* (*Sceptridium dissectum*) 461  
*Botrychium dissectum* (*Sceptridium dissectum*) 461  
*Botrychium farrarii* 194  
*Botrychium gallicomontanum* 194, 196, 197, **203**, 494  
*Botrychium jenmanii* (*Sceptridium jenmanii*) 462  
*Botrychium lanceolatum* subsp. *angustisegmentum* (*Botrychium angustisegmentum*) 199  
*Botrychium lunaria* (*Botrychium neolunaria*) 208  
*Botrychium lunaria* var. *crenulatum* (*Botrychium crenulatum*) 202  
*Botrychium lunaria* var. *matricariifolium* (*Botrychium matricariifolium*) 204  
*Botrychium lunaria* var. *minganense* (*Botrychium minganense*) 206  
*Botrychium lunarioides* (*Sceptridium lunarioides*) 463  
*Botrychium matricariifolium* 194, 195, **204**, 494  
*Botrychium michiganense* 194, 195, **205**, 494  
*Botrychium minganense* 194, 197, 198, **206**, 494



- Botrychium mormo** 194, 195, 207, 494  
*Botrychium multifidum* (*Sceptridium multifidum*) 464  
**Botrychium neolunaria** 194, 196, 197, 208, 494  
*Botrychium oneidense* (*Sceptridium oneidense*) 465  
**Botrychium pallidum** 193, 194, 195, 197, 209, 494  
*Botrychium rugulosum* (*Sceptridium rugulosum*) 466  
**Botrychium simplex** var. *compositum* 210  
**Botrychium simplex** var. *simplex* 194, 195, 210, 494  
*Botrychium simplex* var. *tenebrosum* (**Botrychium tenebrosum**) 212  
**Botrychium spathulatum** 194, 198, 211, 494  
**Botrychium tenebrosum** 212, 494  
*Botrychium virginianum* (**Botrypus virginianus**) 214  
**Botrypus** 23, 35, 193, 213–214, 458  
**Botrypus virginianus** 23, 193, 213, 214, 494  
*Bryodesma* 94, 98, 100, 102, 106, 108  
*Bryodesma acanthonota* (*Selaginella acanthonota*) 98  
*Bryodesma arenicola* subsp. *acanthonota* (*Selaginella acanthonota*) 98  
*Bryodesma arenicola* (*Selaginella arenicola*) 100  
*Bryodesma arenicola* subsp. *riddellii* (*Selaginella corallina*) 102  
*Bryodesma rupestre* (*Selaginella rupestris*) 106  
*Bryodesma tortipilum* (*Selaginella tortipila*) 108
- C**
- Campyloneurum* 34, 215–218  
**Campyloneurum angustifolium** 215, 216, 494  
**Campyloneurum costatum** 215, 217, 494  
**Campyloneurum phyllitidis** 215, 218, 495  
*Ceratopteris* 32, 219–222, 234, 421  
**Ceratopteris pteridoides** 219, 220, 495  
**Ceratopteris richardii** 219, 221, 495  
**Ceratopteris thalictroides** subsp. *thalictroides* 219, 222, 495  
*Cheilanthes* 181, 182, 353, 355, 356, 357, 358, 359, 360, 406  
*Cheilanthes alabamensis* (*Myriopteris alabamensis*) 355  
*Cheilanthes eatonii* (*Myriopteris rufa*) 359  
*Cheilanthes feei* (*Myriopteris gracilis*) 356  
*Cheilanthes integerrima* (*Astrolepis integerrima*) 181  
*Cheilanthes lanosa* (*Myriopteris lanosa*) 357  
*Cheilanthes microphylla* (*Myriopteris microphylla*) 358  
*Cheilanthes sinuata* (*Astrolepis sinuata*) 182  
*Cheilanthes tomentosa* (*Myriopteris tomentosa*) 360  
*Cheilanthes viridis* (*Pellaea viridis*) 406  
*Cheiroglossa* 35, 193, 223–224, 375  
**Cheiroglossa palmata** 223, 224, 375, 495  
*Christella* 39, 225–227, 395, 475  
**Christella dentata** 225, 226, 495  
**Christella hispidula** 225, 227, 495  
*Christella hispidula* var. *versicolor* 227  
Cibotiaceae 11  
*Claytosmunda* 36, 228–229, 386, 388  
**Claytosmunda claytoniana** 386, 388, 228, 229, 495  
*Coryphopteris* 39, 230–231, 475  
**Coryphopteris simulata** 230, 231, 495  
*Crepidomanes* 26, 32, 232–233, 317, 477, 479, 481  
**Crepidomanes intricatum** 26, 232, 233, 481, 495  
*Cryptogramma* 35, 234–236  
**Cryptogramma acrostichoides** 234, 235, 495  
**Cryptogramma stelleri** 234, 236, 495  
*Ctenitis* 39, 237–239  
**Ctenitis sloanei** 39, 237, 238, 495  
**Ctenitis submarginalis** 39, 237, 239, 495  
Culcitaceae 11  
Cyatheaceae 11  
*Cyclosorus* 40, 240–241, 475  
**Cyclosorus interruptus** 240, 241, 495  
×*Cystocarpium* 245, 309  
×*Cystocarpium roskamianum* 245, 309  
Cystodiaceae 11  
*Cyrtomium* 23, 25, 40, 242–244  
**Cyrtomium falcatum** subsp. *australe* 243  
**Cyrtomium falcatum** subsp. *falcatum* 23, 25, 242, 243, 495  
**Cyrtomium falcatum** subsp. *littorale* 243  
**Cyrtomium fortunei** 242, 244, 495  
Cystopteridaceae 11, 245  
*Cystopteris* 26, 38, 245–253, 309  
**Cystopteris** × *illinoensis* 245  
**Cystopteris** × *wagneri* 245

- Cystopteris bulbifera* 245, 246, 247, **248**, 495  
*Cystopteris fragilis* 245, 246, 247, **249**, 309, 495  
*Cystopteris "hemifragilis"* 245  
*Cystopteris laurentiana* 245, 246, 247, **250**, 495  
*Cystopteris protrusa* 245, 246, 247, **251**, 495  
*Cystopteris reevesiana* 245  
*Cystopteris tennesseensis* 26, 245, 246, 247, **252**, 495  
*Cystopteris tenuis* 245, 246, 247, **253**, 495
- D**
- Davalliaceae 11
- Dendrolycopodium* 33, **42–46**, 86, 111  
*Dendrolycopodium dendroideum* 42, 43, **44**, 491  
*Dendrolycopodium hickeyi* 42, 43, **45**, 491  
*Dendrolycopodium obscurum* 42, 43, **46**, 491
- Dennstaedtia* 36, **254–256**  
*Dennstaedtia bipinnata* 254, **255**, 495  
*Dennstaedtia punctilobula* 254, **256**, 495
- Dennstaedtiaceae 11, 254, 320, 442
- Deparia* 38, 146, **257–259**  
*Deparia acrostichoides* 257, **258**, 495  
*Deparia petersenii* 257, **259**, 495
- Desmophlebiaceae 11
- Dicksoniaceae 11
- Dicranopteris* 34, **260–261**  
*Dicranopteris flexuosa* 260, **261**, 495
- Didymochlaenaceae 11
- Didymoglossum* 12, 14, 34, **262–265**, 317, 477, 479  
*Didymoglossum krausii* 262, **263**, 495  
*Didymoglossum lineolatum* 12  
*Didymoglossum membranaceum* 12  
*Didymoglossum petersii* 262, **264**, 495  
*Didymoglossum punctatum* subsp. *floridanum* 262, **265**, 495
- Diphasiastrum* 10, 18, 33, **47–52**  
*Diphasiastrum* × *habereri* 47  
*Diphasiastrum* × *sabinifolium* 47  
*Diphasiastrum* × *verecundum* 47  
*Diphasiastrum* × *zeilleri* 47  
*Diphasiastrum alpinum* 10  
*Diphasiastrum complanatum* subsp. *complanatum* 47, 48, **49**, 491  
*Diphasiastrum complanatum* subsp. *montellii* 49
- Diphasiastrum digitatum* 18, 47, 48, **50**, 491  
*Diphasiastrum sitchense* 47, 48, **51**, 491  
*Diphasiastrum tristachyum* 47, 48, **52**, 491
- Diplaziopsidaceae 11, 315
- Diplaziopsis* 316  
*Diplaziopsis pycnocarpos* (*Homalosorus pycnocarpos*) 316
- Diplazium* 38, 146, **266–268**, 315, 316  
*Diplazium esculentum* 38, 266, **267**, 495  
*Diplazium lonchophyllum* 38, 266, **268**, 495  
*Diplazium pycnocarpon* (*Homalosorus pycnocarpos*) 315, 316
- Dipteridaceae 11
- Dryopteridaceae 11, 142, 237, 242, 269, 435, 453
- Dryopteris* 12, 23, 36, 40, **269–288**, 435  
*Dryopteris* × *algonquinensis* 270  
*Dryopteris* × *australis* 269, 270, 271  
*Dryopteris* × *benedictii* 270  
*Dryopteris* × *boottii* 269, 270, 271, 274  
*Dryopteris* × *brathaica* 270  
*Dryopteris* × *burgessii* 270  
*Dryopteris* × *correllii* 270  
*Dryopteris* × *dowellii* 270  
*Dryopteris* × *leedsii* 270, 271  
*Dryopteris* × *mickelii* 270  
*Dryopteris* × *montgomeryi* 270  
*Dryopteris* × *neowherryi* 270, 271  
*Dryopteris* × *pittsfordensis* 271  
*Dryopteris* × *separabilis* 271  
*Dryopteris* × *slossoniae* 271  
*Dryopteris* × *triploidea* 269, 271, 272  
*Dryopteris* × *uliginosa* 269, 271  
*Dryopteris campyloptera* 270, 272, 273, **276**, 495  
*Dryopteris carthusiana* 269, 270, 272, 273, **277**, 496  
*Dryopteris celsa* 270, 274, 275, **278**, 496  
*Dryopteris clintoniana* 36, 269, 270, 274, 275, **279**, 496  
*Dryopteris cristata* 23, 36, 269, 270, 274, **280**, 496  
*Dryopteris erythrosora* 274, 275, **281**, 496  
*Dryopteris expansa* 270, 272, 273, **282**, 496  
*Dryopteris filix-mas* subsp. *brittonii* 270, 272, 274, **283**, 496  
*Dryopteris filix-mas* subsp. *filix-mas* 283

- Dryopteris fragrans* 269, 270, 272, 273, **284**, 496  
*Dryopteris goldiana* 269, 270, 274, 275, **285**, 435, 496  
*Dryopteris goldieana* (*Dryopteris goldiana*) 285  
*Dryopteris intermedia* subsp. *azorica* 286  
*Dryopteris intermedia* subsp. *intermedia* 269, 270, 272, 273, **286**, 496  
*Dryopteris intermedia* subsp. *maderensis* 286  
*Dryopteris ludoviciana* 36, 269, 270, 272, 274, **287**, 496  
*Dryopteris marginalis* 269, 270, 272, 273, **288**, 496  
*Dryopteris "semicristata"* 270  
×*Dryostichum* 269, 435  
×*Dryostichum singulare* 269, 435

## E

Equisetaceae 11, 289

*Equisetum* 7, 8, 10, 22, 25, 31, 32, **289–302**

*Equisetum* × *ferrissii* 289

*Equisetum* × *litorale* 289

*Equisetum* × *nelsonii* 289

*Equisetum* × *trachyodon* 289

*Equisetum arvense* subsp. *arvense* 289, 290, 291, 292, **294**, 496

*Equisetum fluviatile* 8, 289, 290, 291, 292, **295**, 496

*Equisetum hyemale* subsp. *affine* 289, 290, 291, **296**, 496

*Equisetum hyemale* subsp. *hyemale* 296

*Equisetum laevigatum* 289, 290, 293, **297**, 496

*Equisetum palustre* 290, 291, **298**, 496

*Equisetum pratense* 290, 291, 292, **299**, 496

*Equisetum ramosissimum* 10

*Equisetum scirpoides* 290, 291, 293, **300**, 496

*Equisetum sylvaticum* 290, 291, 292, **301**, 496

*Equisetum variegatum* subsp. *alaskanum* 302

*Equisetum variegatum* subsp. *variegatum* 289, 290, 291, 293, **302**, 496

## G

Gleicheniaceae 11, 260

*Goniopteris* 39, **303–308**, 475

*Goniopteris domingensis* 303, 304, **305**, 496

*Goniopteris reptans* 303, 304, **306**, 496

*Goniopteris sclerophylla* 303, 304, **307**, 496

*Goniopteris tetragona* 303, 304, **308**, 496

*Grammitis* 352

*Grammitis nimbata* (*Moranopteris nimbata*) 352

*Gymnocarpium* 38, 245, **309–314**

*Gymnocarpium* × *achriosporum* 309

*Gymnocarpium* × *brittonianum* 309

*Gymnocarpium* × *heterosporum* 309

*Gymnocarpium* × *intermedium* 309

*Gymnocarpium appalachianum* 309, 310, **311**, 496

*Gymnocarpium continentale* 309, 310, **312**, 496

*Gymnocarpium disjunctum* 309

*Gymnocarpium dryopteris* 309, 310, **313**, 496

*Gymnocarpium jessoense* subsp. *parvulum* (*Gymnocarpium continentale*) 312

*Gymnocarpium robertianum* 309, 310, **314**, 496

## H

Hemidictyaceae 11

*Holubiella* 463

*Holubiella lunarioides* (*Sceptridium lunarioides*) 463

*Homalosorus* 38, 146, **315–316**

*Homalosorus pycnocarpos* 315, **316**, 496

*Huperzia* 10, 16, 17, 18, 33, **53–58**, 111

*Huperzia* × *bartleyi* 53

*Huperzia* × *battersii* 53

*Huperzia* × *josephbeitelii* 53

*Huperzia* × *protoporophila* 53

*Huperzia appalachiana* 53, 54, **55**, 491

*Huperzia appressa* (*Huperzia appalachiana*) 55

*Huperzia lucidula* 18, 53, 54, **56**, 491

*Huperzia miyoshiana* 10

*Huperzia porophila* 17, 53, 54, **57**, 491

*Huperzia selago* 53, 54, **58**, 491

*Huperzia selago* subsp. *appressa* (*Huperzia appalachiana*) 55

Hymenophyllaceae 11, 232, 262, 317, 477, 479

*Hymenophyllum* 25, 34, 232, **317–319**, 477, 479

*Hymenophyllum tayloriae* 232, 317, **318**, 496

*Hymenophyllum tunbrigense* 317, **319**, 496

Hypodematiaceae 11

*Hypolepis* 36, 254, **320–321**

*Hypolepis barringtonii* 254, 320, **321**, 496

*Hypolepis repens* (*Hypolepis barringtonii*) 320, 321



- I**
- Isoetaceae 7, 8, 11, 16, 20, 59
- Isoetes* 8, 10, 12, 20, 21, 32, **59–78**, 501
- Isoetes* × *altonharvillii* 60
- Isoetes* × *brittonii* 60
- Isoetes* × *bruntonii* 60
- Isoetes* × *carltaylorii* 60
- Isoetes* × *eatonii* 60
- Isoetes* × *echtuckeri* 60i
- Isoetes* × *fairbrothersii* 60
- Isoetes* × *fernaldii* 60
- Isoetes* × *foveolata* 60
- Isoetes* × *harveyi* 60
- Isoetes* × *hickeyi* 60
- Isoetes* × *jeffreyi* 60
- Isoetes* × *kareniae* 60
- Isoetes* × *robusta* 60
- Isoetes appalachiana* 60, 64, **65**, 491
- Isoetes boomii* 60, 63, **65**, 491
- Isoetes butleri* 20, 21, 60, 62, **66**, 491
- Isoetes caroliniana* (*Isoetes valida*) 77
- Isoetes echinospora* subsp. *echinospora* 66
- Isoetes echinospora* subsp. *muricata* 21, 60, 63, **66**, 491
- Isoetes engelmannii* 8, 21, 60, 64, 65, **67**, 491
- Isoetes engelmannii* var. *georgiana* (*Isoetes appalachiana*) 65
- Isoetes flaccida* 20, 21, 60, 63, **67**, 491
- Isoetes flaccida* var. *chapmanii* **67**, 491
- Isoetes flaccida* var. *flaccida* **67**, 491
- Isoetes georgiana* 20, 21, 60, 63, **68**, 491
- Isoetes graniticola* 63, **68**, 491
- Isoetes hyemalis* 60, 64, **69**, 491
- Isoetes junciformis* 62, **69**, 491
- Isoetes lacustris* (*Isoetes macrospora*) 71
- Isoetes laurentiana* 64, **70**, 491
- Isoetes louisianensis* 64, **70**, 491
- Isoetes macrospora* 60, 63, **71**, 76, 491
- Isoetes mattaponica* 60, 63, **71**, 491
- Isoetes melanopoda* 21, 62, **72**, 491
- Isoetes melanopoda* subsp. *melanopoda* **72**, 491
- Isoetes melanopoda* subsp. *silvatica* 21, **72**, 491
- Isoetes melanospora* 62, **72**, 491
- Isoetes microvela* 60, 64, **73**, 491
- Isoetes piedmontana* 62, 68, **73**, 491
- Isoetes prototypus* 63, **74**, 75, 491
- Isoetes riparia* 60, 64, **74**, 75, 491
- Isoetes riparia* var. *reticulata* **74**, 75, 491
- Isoetes riparia* var. *riparia* **74**, 75, 491
- Isoetes saccharata* (*Isoetes riparia*) 74
- Isoetes septentrionalis* 60, 64, **75**, 492
- Isoetes tegetiformans* 21, 62, **75**, 492
- Isoetes tennesseensis* 63, **76**, 492
- Isoetes tuckermanii* 21, 60, 64, 70, **76**, 77, 492
- Isoetes tuckermanii* subsp. *acadiensis* **76**, 77, 492
- Isoetes tuckermanii* subsp. *tuckermanii* 21, **76**, 77, 492
- Isoetes valida* 60, 63, **77**, 492
- Isoetes virginica* 62, 73, **78**, 492
- Isoetes virginica* var. *piedmontana* (*Isoetes piedmontana*) 73
- Isoetes viridimontana* 63, **78**, 492
- L**
- Leptogramma* 39, **322–323**, 475
- Leptogramma burksiorum* 322, **323**, 496
- Lindsaeaceae 11, 371
- Lomariopsidaceae 11, 324
- Lomariopsis* 34, 36, 232, **324–325**
- Lomariopsis kunzeana* 232, 324, **325**, 497
- Lonchitidaceae 11
- Lorinseria* 35, 191, **326–327**
- Lorinseria areolata* 326, **327**, 497
- Loxsomataceae 11
- Lycopodiaceae 7, 8, 11, 16, 17, 18, 42, 47, 53, 79, 86, 90, 92, 111
- Lycopodiella* 8, 33, **79–85**, 90, 91, 92, 93, 468
- Lycopodiella* × *brucei* 79
- Lycopodiella* × *copelandii* 79
- Lycopodiella* × *gilmanii* 79
- Lycopodiella* × *robusta* 79
- Lycopodiella alopecuroides* 79, 80, **81**, 468, 492
- Lycopodiella appressa* 79, 80, **82**, 492
- Lycopodiella caroliniana* (*Pseudolycopodiella caroliniana*) 93
- Lycopodiella cernua* (*Palhinhaea cernua*) 91

- Lycopodiella inundata* 8, 79, 80, **83**, 492  
*Lycopodiella margueritae* 79  
*Lycopodiella prostrata* 79, 80, **84**, 492  
*Lycopodiella subappressa* 79, 80, **85**, 492  
*Lycopodioides* 94, 97, 99, 101, 103, 104, 105, 109, 110  
*Lycopodioides apodum* (*Selaginella apoda*) 99  
*Lycopodioides braunii* (*Selaginella braunii*) 101  
*Lycopodioides eatonii* (*Selaginella eatonii*) 103  
*Lycopodioides eclipses* (*Selaginella eclipses*) 104  
*Lycopodioides ludovicianum* (*Selaginella ludoviciana*) 105  
*Lycopodioides uncinatum* (*Selaginella uncinata*) 109  
*Lycopodioides willdenowii* (*Selaginella willdenowii*) 110  
*Lycopodium* 16, 17, 33, 42, 44, 45, 46, 49, 50, 51, 52, 55, 56, 57, 58, 79, 81, 82, 83, 84, **86–89**, 93, 111, 112  
*Lycopodium alopecuroides* (*Lycopodiella alopecuroides*) 81  
*Lycopodium annotinum* (*Spinulum annotinum*) 112  
*Lycopodium appressum* (*Lycopodiella appressa*) 82  
*Lycopodium carolinianum* (*Pseudolycopodiella caroliniana*) 93  
*Lycopodium clavatum* subsp. *clavatum* 17, 86, 87, **88**, 492  
*Lycopodium clavatum* subsp. *contiguum* 88  
*Lycopodium complanatum* (*Diphasiastrum complanatum* subsp. *complanatum*) 49  
*Lycopodium dendroideum* (*Dendrolycopodium dendroideum*) 44  
*Lycopodium digitatum* (*Diphasiastrum digitatum*) 50  
*Lycopodium hickeyi* (*Dendrolycopodium hickeyi*) 45  
*Lycopodium inundatum* (*Lycopodiella inundata*) 83  
*Lycopodium inundatum* var. *appressum* (*Lycopodiella appressa*) 82  
*Lycopodium lagopus* 86, 87, **89**, 492  
*Lycopodium lucidulum* (*Huperzia lucidula*) 56  
*Lycopodium obscurum* (*Dendrolycopodium obscurum*) 46  
*Lycopodium porophilum* (*Huperzia porophila*) 57  
*Lycopodium prostratum* (*Lycopodiella prostrata*) 84  
*Lycopodium selago* (*Huperzia selago*) 58  
*Lycopodium selago* subsp. *appressum* (*Huperzia appalachiana*) 55  
*Lycopodium sitchense* (*Diphasiastrum sitchense*) 51  
*Lycopodium tristachyum* (*Diphasiastrum tristachyum*) 52  
Lygodiaceae 11, 328  
Lygodium 34, **328–332**, 348  
*Lygodium japonicum* 328, 329, **330**, 497  
*Lygodium microphyllum* 328, 329, **331**, 497  
*Lygodium palmatum* 328, 329, **332**, 497
- ## M
- Macrothelypteris* 38, 39, 237, **333–334**  
*Macrothelypteris torresiana* 333, **334**, 497  
Marattiaceae 11  
Marsilea 28, 31, 32, 187, 219, **335–342**, 421, 455  
*Marsilea hirsuta* 335, 336, **337**, 497  
*Marsilea macropoda* 335, 336, **337**, 497  
*Marsilea minuta* 335, **338**, 497  
*Marsilea mutica* 335, 336, **339**, 497  
*Marsilea oligospora* 335, 336, **340**, 497  
*Marsilea quadrifolia* 335, 336, **340**, 497  
*Marsilea vestita* 335, **342**, 497  
Marsileaceae 11, 187, 335, 421, 455  
Matoniaceae 11  
Matteuccia 35, **343–344**, 388  
*Matteuccia pensylvanica* (*Matteuccia struthiopteris* var. *pensylvanica*) 344  
*Matteuccia struthiopteris* var. *pensylvanica* 343, **344**, 388, 497  
*Matteuccia struthiopteris* var. *struthiopteris* 344  
Maxonia 12  
*Maxonia apiifolia* var. *apiifolia* 12  
Meniscium 25, 39, **345–347**, 475  
*Meniscium reticulatum* 25, 345, **346**, 497  
*Meniscium serratum* 345, **347**, 497  
Metaxyaceae 11  
Microgramma 34, 215, **348–349**  
*Microgramma heterophylla* 348, **349**, 497  
Micropolypodium 352  
*Micropolypodium nimbatum* (*Moranopteris nimbata*) 352  
Microsorium 39, **350–351**, 414  
*Microsorium grossum* 350, **351**, 414, 497

- Microsorium scolopendria* (*Microsorium grossum*) 351  
 Moranopteris 38, 215, 232, **352**  
*Moranopteris nimbata* 232, **352**, 497  
 Mucura 255  
*Mucura bipinnata* (*Dennstaedtia bipinnata*) 255  
 Myriopteris 37, **353–360**  
*Myriopteris alabamensis* 353, 354, **355**, 497  
*Myriopteris gracilis* 353, 354, **356**, 497  
*Myriopteris lanosa* 353, 354, **357**, 497  
*Myriopteris microphylla* 353, 354, **358**, 497  
*Myriopteris rufa* 353, 354, **359**, 497  
*Myriopteris tomentosa* 353, 354, **360**, 497

## N

- Nephrolepidaceae 11  
 Nephrolepis 40, **361–370**  
*Nephrolepis* × *averyi* 361, 362, 363, **364**, 497  
*Nephrolepis biserrata* 362, 363, 364, **365**, 497  
*Nephrolepis brownii* 361, 362, **366**, 497  
*Nephrolepis cordifolia* 361, 362, 363, **367**, 497  
*Nephrolepis exaltata* 361, 362, 363, 364, **368**, 497  
*Nephrolepis falcata* 362, **369**, 497  
*Nephrolepis hirsutula* 362, **370**, 497  
*Nephrolepis multiflora* (*Nephrolepis brownii*) 366  
 Notholaena 181, 182  
*Notholaena integerrima* (*Astrolepis integerrima*) 181  
*Notholaena sinuata* (*Astrolepis sinuata*) 182

## O

- Odontosoria 36, **371–372**, 440  
*Odontosoria clavata* 371, **372**, 440, 497  
 Oleandraceae 11  
 Onoclea 35, 343, **373–374**  
*Onoclea sensibilis* 343, 373, **374**, 497  
 Onocleaceae 11, 343, 373  
 Ophioderma 35, 193, 223, 224, **375–376**  
*Ophioderma palmatum* (*Cheiroglossa palmata*) 224  
*Ophioderma pendulum* 223, 375, **376**, 498  
 Ophioglossaceae 11, 25, 31, 34, 193, 213, 223, 375, 377, 458  
 Ophioglossum 33, 34, 35, 193, 223, 224, 376, **377–385**, 458  
*Ophioglossum crotalophoroides* 378, 379, **380**, 498

- Ophioglossum engelmannii* 378, 379, **381**, 498  
*Ophioglossum nudicaule* 378, 379, **382**, 498  
*Ophioglossum palmatum* (*Cheiroglossa palmata*) 224  
*Ophioglossum pendulum* (*Ophioderma pendulum*) 376  
*Ophioglossum petiolatum* 378, 379, **383**, 498  
*Ophioglossum pusillum* 378, 379, **384**, 498  
*Ophioglossum pycnostichum* 378, 379, **385**, 498  
*Ophioglossum reticulatum* (*Ophioglossum petiolatum*) 383  
*Ophioglossum vulgatum* (*Ophioglossum pycnostichum*) 385  
*Ophioglossum vulgatum* var. *pycnostichum* (*Ophioglossum pycnostichum*) 385  
 Oreopteris 10  
*Oreopteris quelpartensis* 10  
 Osmunda 36, 228, 229, **386–387**, 388, 389  
*Osmunda* × *ruggii* (×*Osmunimunda ruggii*) 228, 386  
*Osmunda cinnamomea* (*Osmundastrum cinnamomeum* subsp. *cinnamomeum*) 389  
*Osmunda claytoniana* (*Claytosmunda claytoniana*) 229  
*Osmunda regalis* (*Osmunda spectabilis*) 386, 387  
*Osmunda regalis* var. *spectabilis* (*Osmunda spectabilis*) 387  
*Osmunda spectabilis* 228, 386, **387**, 498  
 Osmundaceae 11, 228, 386, 388  
 Osmundastrum 35, 228, 229, 386, **388–389**  
*Osmundastrum cinnamomeum* subsp. *asiaticum* 389  
*Osmundastrum cinnamomeum* subsp. *cinnamomeum* 228, 229, 386, 388, **389**, 498  
 ×*Osmunimunda* 228, 336  
 ×*Osmunimunda ruggii* 228, 336

## P

- Palhinhaea 33, **90–91**  
*Palhinhaea cernua* 90, **91**, 492  
 Parathelypteris 131, 231  
*Parathelypteris noveboracensis* (*Amauropelta noveboracensis*) 131  
*Parathelypteris simulata* (*Coryphopteris simulata*) 231



- Pecluma* 8, 23, 39, **390–394**  
*Pecluma bourgeauana* 390, 391, **392**, 498  
*Pecluma dispersa* 8, 390, 391, **393**, 498  
*Pecluma plumula* 23, 390, 391, **394**, 498  
*Pecluma ptilodon* var. *caespitosa* (*Pecluma bourgeauana*) 392  
*Pecluma ptilota* var. *bourgeauana* (*Pecluma bourgeauana*) 392  
*Pecluma ptilota* var. *caespitosa* (*Pecluma bourgeauana*) 392  
*Pecluma ptilotos* var. *bourgeauana* (*Pecluma bourgeauana*) 392
- Pelazoneuron* 23, 40, **395–401**, 475  
*Pelazoneuron abruptum* var. *grande* 395, 396, **397**, 498  
*Pelazoneuron abruptum* var. *pallescens* 397  
*Pelazoneuron augescens* 395, 396, **398**, 498  
*Pelazoneuron kunthii* 23, 395, 396, **399**, 498  
*Pelazoneuron ovatum* 395, 396, **400**, 498  
*Pelazoneuron patens* 395, **401**, 498
- Pellaea* 37, 144, **402–407**  
*Pellaea atropurpurea* 402, 403, **404**, 498  
*Pellaea glabella* subsp. *glabella* 402, 403, **405**, 498  
*Pellaea viridis* 402, 403, **406**, 498  
*Pellaea wrightiana* 402, 403, **407**, 498
- Phegopteris* 39, **408–413**  
*Phegopteris connectilis* 408, 409, **410**, 498  
*Phegopteris excelsior* 408, 409, **411**, 498  
*Phegopteris hexagonoptera* 408, 409, **412**, 498  
*Phegopteris taiwaniana* 408, 409, **413**, 498
- Phlebodium* 38, 215, 350, **414–415**  
*Phlebodium aureum* 350, 414, **415**, 498
- Phlegmariurus* 12  
*Phlegmariurus dichotomous* 12
- Phyllitis* 173  
*Phyllitis scolopendrium* var. *americanum* (*Asplenium scolopendrium* var. *americanum*) 173
- Phymatosorus* 351  
*Phymatosorus grossus* (*Microsorium grossum*) 351
- Physematium* 38, **416–420**, 486  
*Physematium* × *maxonii* 416  
*Physematium obtusum* subsp. *obtusum* 416, **417**, 498
- Physematium oreganum* 416, 418  
*Physematium oreganum* subsp. *cathcartianum* 416, **418**, 486, 498  
*Physematium scopulinum* subsp. *appalachianum* 416, **419**, 498  
*Physematium scopulinum* subsp. *laurentianum* 416, **420**, 498
- Pilularia* 32, 187, 219, 335, **421–422**, 455  
*Pilularia americana* 421, **422**, 498
- Pityrogramma* 36, **423–426**  
*Pityrogramma calomelanos* var. *calomelanos* 423, 424, **425**, 498  
*Pityrogramma trifoliata* 423, 424, **426**, 498
- Plagiogyriaceae 11
- Platycterium* 25, 36, **427–428**  
*Platycterium bifurcatum* 25, 427, **428**, 498
- Pleopeltis* 12, 22, 38, **429–431**, 432  
*Pleopeltis astrolepis* 12  
*Pleopeltis marginata* 12  
*Pleopeltis michauxiana* 22, 429, **430**, 432, 499  
*Pleopeltis polypodioides* 429, **431**, 499  
*Pleopeltis polypodioides* var. *michauxiana* (*Pleopeltis michauxiana*) 430
- Polypodiaceae 11, 215, 348, 350, 352, 390, 414, 427, 429, 432
- Polypodium* 12, 38, 351, 392, 429, 430, 431, **432–434**  
*Polypodium* × *incognitum* 432  
*Polypodium appalachianum* 432, **433**, 499  
*Polypodium aureum* (*Phlebodium aureum*) 415  
*Polypodium grossum* (*Microsorium grossum*) 351  
*Polypodium polypodioides* (*Pleopeltis polypodioides*) 431  
*Polypodium polypodioides* var. *michauxianum* (*Pleopeltis michauxiana*) 430  
*Polypodium ptilodon* (*Pecluma ptilodon* var. *bourgeauana*) 392  
*Polypodium triseriale* (*Serpocaulon triseriale*) 12  
*Polypodium virginianum* 432, **434**, 499
- Polystichum* 10, 36, 40, 269, **435–439**  
*Polystichum* × *potteri* 435, 436  
*Polystichum* × *hagenahii* 435  
*Polystichum* × *meyeri* 435  
*Polystichum acrostichoides* 36, 435, 436, **437**, 499

- Polystichum braunii* 435, 436, **438**, 499  
*Polystichum lonchitis* 269, 435, 436, **439**, 499  
*Polystichum scopulinum* 10  
*Pseudolycopodiella* 33, **92–93**  
*Pseudolycopodiella caroliniana* 92, **93**, 492  
Psilotaceae 11, 440  
*Psilotum* 7, 8, 25, 32, 371, **440–441**  
*Psilotum nudum* 7, 8, 25, 371, 440, **441**, 499  
Pteridaceae 11, 114, 120, 144, 145, 180, 219, 234, 353, 402, 423, 445, 481  
*Pteridium* 22, 25, 37, **442–444**  
*Pteridium aquilinum* 22, 442, **443**, 499  
*Pteridium aquilinum* var. *caudatum* (*Pteridium caudatum*) 444  
*Pteridium aquilinum* var. *latiusculum* 442, **443**, 499  
*Pteridium aquilinum* var. *pseudocaudatum* 442, **443**, 499  
*Pteridium caudatum* 25, 442, **444**, 499  
*Pteris* 10, 25, 37, **445–452**  
*Pteris* × *delchampsii* 445  
*Pteris bahamensis* 445, 446, **447**, 499  
*Pteris cretica* 445, 446, **448**, 499  
*Pteris cretica* var. *albolineata* (*Pteris parkeri*) 450  
*Pteris grandifolia* 10  
*Pteris multifida* 445, 446, **449**, 499  
*Pteris parkeri* 445, 446, **450**, 499  
*Pteris plumula* 10  
*Pteris quadriaurita* 10  
*Pteris tripartita* 445, 446, **451**, 499  
*Pteris vittata* 25, 445, 446, **452**, 499
- R**  
*Regnellidium* 187, 335, 455  
Rhachidosoraceae 11  
*Rumohra* 40, **453–454**  
*Rumohra adiantiformis* 453, **454**, 499
- S**  
Saccolomataceae 11  
*Salvinia* 32, 187, 219, 335, 421, **455–457**  
*Salvinia minima* 455, **456**, 499  
*Salvinia molesta* 455, **457**, 499  
*Salvinia rotundifolia* (*Salvinia minima*) 456  
Salviniaceae 11, 187, 455  
*Sceptridium* 25, 35, 193, 213, **458–466**  
*Sceptridium biternatum* 458, 459, **460**, 499  
*Sceptridium dissectum* 25, 458, 459, **461**, 499  
*Sceptridium jenmanii* 458, 459, **462**, 499  
*Sceptridium lunarioides* 458, 459, **463**, 499  
*Sceptridium multifidum* 458, 459, **464**, 499  
*Sceptridium oneidense* 458, 459, **465**, 499  
*Sceptridium rugulosum* 458, 459, **466**, 499  
*Schizaea* 34, 118, **467–468**  
*Schizaea pusilla* 118, 467, **468**, 499  
Schizaeaceae 11, 118, 467  
*Selaginella* 8, 10, 19, 30, 33, **94–110**  
*Selaginella acanthonota* 19, 95, 97, **98**, 492  
*Selaginella apoda* 96, 97, **99**, 492  
*Selaginella apoda* var. *ludoviciana* (*Selaginella ludoviciana*) 105  
*Selaginella arenicola* 95, 97, **100**, 492  
*Selaginella arenicola* subsp. *riddellii* (*Selaginella corallina*) 102  
*Selaginella arenicola* var. *riddellii* (*Selaginella corallina*) 102  
*Selaginella armata* var. *eatonii* (*Selaginella eatonii*) 103  
*Selaginella braunii* 96, 97, **101**, 492  
*Selaginella corallina* 95, 97, **102**, 492  
*Selaginella eatonii* 97, **103**, 492  
*Selaginella eclipses* 96, 97, **104**, 492  
*Selaginella kraussiana* 10  
*Selaginella ludoviciana* 96, 97, **105**, 492  
*Selaginella rupestris* 8, 94, 95, **106**, 492  
*Selaginella selaginoides* 94, 95, **107**, 492  
*Selaginella tortipila* 94, 95, **108**, 492  
*Selaginella uncinata* 19, 96, 97, **109**, 492  
*Selaginella willdenowii* 19, 96, 97, **110**, 492  
Selaginellaceae 7, 8, 11, 16, 18, 19, 94  
*Serpocaulon* 12  
*Serpocaulon triseriale* 12  
*Sitobolium* 256  
*Sitobolium punctilobulum* (*Dennstaedtia punctilobula*) 256  
*Sphenomeris* 372  
*Sphenomeris clavata* (*Odontosoria clavata*) 372

- Spinulum* 17, 33, 53, 86, **111–112**  
*Spinulum annotinum* 17, 111, **112**, 492  
*Spinulum canadense* 111
- Stegnogramma* 323  
*Stegnogramma burksiorum* (**Leptogramma burksiorum**) 323
- Stenochlaena* 10  
*Stenochlaena tenuifolia* 10
- T**
- Tectaria* 12, 40, **469–472**  
*Tectaria coriandrifolia* 12  
*Tectaria fimbriata* 469, **470**, 499  
*Tectaria heracleifolia* 469, **471**, 499  
*Tectaria incisa* 469, **472**, 499
- Tectariaceae 11, 469
- Telmatoblechnum* 37, 191, **473–474**  
*Telmatoblechnum serrulatum* 191, 473, **474**, 499
- Thelypteridaceae 11, 130, 134, 225, 230, 240, 303, 322, 333, 345, 395, 408, 475
- Thelypteris* 39, 130, 131, 132, 133, 134, 135, 225, 226, 227, 230, 231, 240, 241, 303, 305, 306, 307, 308, 322, 323, 345, 346, 347, 395, 397, 398, 399, 400, 401, **475–476**  
*Thelypteris augescens* (**Pelazoneuron augescens**) 398  
*Thelypteris dentata* (**Christella dentata**) 226  
*Thelypteris grandis* var. *grandis* (**Pelazoneuron abruptum** var. **grande**) 397  
*Thelypteris guadalupensis* (**Goniopteris domingensis**) 305  
*Thelypteris hispidula* var. *versicolor* (**Christella hispidula**) 227  
*Thelypteris interrupta* (**Cyclosorus interruptus**) 241  
*Thelypteris kunthii* (**Pelazoneuron kunthii**) 399  
*Thelypteris noveboracensis* (**Amauropelta noveboracensis**) 131  
*Thelypteris opulenta* (**Amblovenatum opulentum**) 135  
*Thelypteris ovata* (**Pelazoneuron ovatum**) 400  
**Thelypteris palustris** 230, 475, **476**, 499  
*Thelypteris patens* var. *patens* (**Pelazoneuron patens**) 401  
*Thelypteris pilosa* var. *alabamensis* (**Leptogramma burksiorum**) 323
- Thelypteris reptans* (**Goniopteris reptans**) 306  
*Thelypteris resinifera* (**Amauropelta resinifera**) 132  
*Thelypteris reticulata* (**Meniscium reticulatum**) 346  
*Thelypteris sancta* (**Amauropelta sancta**) 133  
*Thelypteris sclerophylla* (**Goniopteris sclerophylla**) 307  
*Thelypteris serrata* (**Meniscium serratum**) 347  
*Thelypteris simulata* (**Coryphopteris simulata**) 231  
*Thelypteris tetragona* (**Goniopteris tetragona**) 308
- Thyrsopteridaceae 11
- Trichomanes* 12, 34, 233, 262, 263, 264, 265, 317, **477–478**, 479, 480  
*Trichomanes boschianum* (**Vandenboschia boschiana**) 479, 480  
**Trichomanes holopterum** 477, **478**, 499  
*Trichomanes intricatum* (**Crepidomanes intricatum**) 233  
*Trichomanes krausii* (**Didymoglossum krausii**) 263  
*Trichomanes lineolatum* (**Didymoglossum lineolatum**) 12  
*Trichomanes membranaceum* (**Didymoglossum membranaceum**) 12  
*Trichomanes petersii* (**Didymoglossum petersii**) 264  
*Trichomanes punctatum* subsp. *floridanum* (**Didymoglossum punctatum** subsp. **floridanum**) 265
- V**
- Vandenboschia* 34, 317, 477, **479–480**  
**Vandenboschia boschiana** 479, **480**, 500
- Vittaria* 26, 32, 33, 232, 376, **481–485**  
**Vittaria appalachiana** 26, 32, 232, 481, 482, **483**, 500  
**Vittaria graminifolia** 481, 482, **484**, 500  
**Vittaria lineata** 376, 481, 482, **485**, 500
- W**
- Woodsia* 38, 416, 417, 418, 419, 420, **486–490**  
*Woodsia* × *abbeae* (×**Woodsimatium abbeae**) 486  
**Woodsia** × *gracilis* 486  
*Woodsia* × *maxonii* (**Physematium** × **maxonii**) 416, 486  
**Woodsia** × *tryonis* 486



- Woodsia alpina*** 486, 487, **488**, 500
- Woodsia appalachiana* (***Physematium scopulinum*** subsp. ***appalachianum***) 419
- Woodsia glabella*** 486, 487, **489**, 500
- Woodsia ilvensis*** 416, 486, 487, **490**, 500
- Woodsia obtusa* subsp. *obtusa* (***Physematium obtusum*** subsp. ***obtusum***) 417
- Woodsia oregana* subsp. *cathcartiana* (***Physematium oreganum*** subsp. ***cathcartianum***) 418
- Woodsia scopulina* subsp. *appalachiana* (***Physematium scopulinum*** subsp. ***appalachianum***) 419
- Woodsia scopulina* subsp. *laurentiana* (***Physematium scopulinum*** subsp. ***laurentianum***) 420
- Woodsiaceae 11, 416, 486
- ×*Woodsimatium* 416, 486
- ×***Woodsimatium abbeae*** 416, 486
- Woodwardia* 136, 137, 326, 327
- Woodwardia areolata* (***Lorinseria areolata***) 327
- Woodwardia virginica* (***Anchistea virginica***) 136, 137

## INDEX TO COMMON NAMES

A note on common names: Because there are no rules governing the creation or application of common names, they can be extremely confusing, and are not nearly as useful or precise as the Latin binomials that are the “official” names for species. Multiple species can share the same common name, and individual species often have multiple common names, as the index below shows. Especially misleading are the common names for species that reference what were historically assumed to be their relationships or generic affinities, when those species are recognized today as belonging to a different group. For example, the two species of *Deparia* in our flora, *D. acrostichoides* and *D. petersenii*, each have a common name that includes the term “spleenwort”. This is a relic of their historical inclusion in *Asplenium*, the genus commonly called the spleenworts. While both of these species are now recognized as belonging to the genus *Deparia*, their old common names persist.

### A

#### Adder's-tongue

Bulbous adder's-tongue (*Ophioglossum crotalophoroides*) 380

Limestone adder's-tongue (*Ophioglossum engelmannii*) 381

Northern adder's-tongue (*Ophioglossum pusillum*) 384

Old World adder's-tongue (*Ophioderma pendulum*) 376

Slender adder's-tongue (*Ophioglossum nudicaule*) 382

Southern adder's-tongue (*Ophioglossum pycnostichum*) 385

Stalked adder's-tongue (*Ophioglossum petiolatum*) 383

**Alabama streak-sorus fern** (*Leptogramma burksiorum*) 323

**American bird's-nest fern** (*Asplenium serratum*) 175

**American hart's-tongue fern** (*Asplenium scolopendrium* var. *americanum*) 173

**American pillwort** (*Pilularia americana*) 422

**American royal fern** (*Osmunda spectabilis*) 387

**Appalachian gametophyte** (*Vittaria appalachiana*) 483

**Autumn fern** (*Dryopteris erythrosora*) 281

### B

**Bear's foot fern** (*Phlebodium aureum*) 415

#### Beech fern

Broad beech fern (*Phegopteris hexagonoptera*) 412

Narrow beech fern (*Phegopteris connectilis*) 410

Northern beech fern (*Phegopteris connectilis*) 410

Southern beech fern (*Phegopteris hexagonoptera*) 412

Taiwanese beech fern (*Phegopteris taiwaniana*) 413

Tall beech fern (*Phegopteris excelsior*) 411

Tetraploid beech fern (*Phegopteris excelsior*) 411

**Bipinnate cuplet fern** (*Dennstaedtia bipinnata*) 255

#### Bladder fern

Brittle bladder fern (*Cystopteris fragilis*) 249

Bulblet bladder fern (*Cystopteris bulbifera*) 248

Illinois bladderfern (*Cystopteris* × *illinoensis*) 245

Laurentian bladder fern (*Cystopteris laurentiana*) 250

Lowland bladder fern (*Cystopteris protrusa*) 251

Southern bladder fern (*Cystopteris protrusa*) 251

St. Lawrence bladder fern (*Cystopteris laurentiana*) 250

Tennessee bladder fern (*Cystopteris tennesseensis*) 252

Upland brittle bladder fern (*Cystopteris tenuis*) 253

Wagner's bladderfern (*Cystopteris* × *wagneri*) 245

**Bog fern** (*Coryphopteris simulata*) 231

#### Bracken

Bracken (*Pteridium aquilinum*) 443

Bracken fern (*Pteridium aquilinum*) 443

Eastern bracken (*Pteridium aquilinum*) 443

Lacy bracken (*Pteridium caudatum*) 444

Southern bracken (*Pteridium caudatum*) 444

**Brake/brake fern**

- Bahama ladder brake (*Pteris bahamensis*) 447  
 Chinese ladder brake (*Pteris vittata*) 452  
 Cretan brake (*Pteris cretica*) 448  
 Delchamps' ladder brake (*Pteris* × *delchampsii*) 445  
 Giant brake (*Pteris tripartita*) 451  
 Spider brake (*Pteris multifida*) 449  
 White-lined Cretan brake (*Pteris parkeri*) 450

**Bristle fern**

- Appalachian bristle fern (*Vandenboschia boschiana*) 480  
 Dwarf bristle fern (*Didymoglossum petersii*) 264  
 Entire-winged bristle fern (*Trichomanes holopterum*) 478  
 Florida bristle fern (*Didymoglossum punctatum* subsp. *floridanum*) 265  
 Kraus's bristle fern (*Didymoglossum krausii*) 263  
 Peters' bristle fern (*Didymoglossum petersii*) 264  
 Treemoss bristle fern (*Didymoglossum krausii*) 263

**Brittle fern** (*Cystopteris fragilis*) 249**C****C-Fern** (*Ceratopteris richardii*) 221**Christmas fern** (*Polystichum acrostichoides*) 437**Cinnamon fern** (*Osmundastrum cinnamomeum* subsp. *cinnamomeum*) 389**Cliff brake**

- Green cliff brake (*Pellaea viridis*) 406  
 Purple-stem cliff brake (*Pellaea atropurpurea*) 404  
 Slender cliff brake (*Cryptogramma stelleri*) 236  
 Smooth cliff brake (*Pellaea glabella* subsp. *glabella*) 405  
 Wright's cliff brake (*Pellaea wrightiana*) 407

**Cliff fern**

- Alpine cliff fern (*Woodsia alpina*) 488  
 Appalachian cliff fern (*Physematium scopulinum* subsp. *appalachianum*) 419  
 Blunt-lobed cliff fern (*Physematium obtusum* subsp. *obtusum*) 417  
 Mountain cliff fern (*Physematium scopulinum* subsp. *laurentianum*) 420  
 Oregon cliff fern (*Physematium oreganum* subsp. *cathcartianum*) 418

- Rocky Mountain cliff fern (*Physematium scopulinum* subsp. *laurentianum*) 420  
 Rusty cliff fern (*Woodsia ilvensis*) 490  
 Smooth cliff fern (*Woodsia glabella*) 489

**Climbing fern**

- American climbing fern (*Lygodium palmatum*) 332  
 Japanese climbing fern (*Lygodium japonicum*) 330  
 Old World climbing fern (*Lygodium microphyllum*) 331  
 Small-Leaved climbing fern (*Lygodium microphyllum*) 331

**Climbing vine fern** (*Microgramma heterophylla*) 349**Cloak fern**

- Hybrid cloak fern (*Astrolepis integerrima*) 181  
 Powdery false cloak fern (*Argyrochosma dealbata*) 144  
 Wavy climbing fern (*Astrolepis sinuata*) 182  
 Wavy scaly climbing fern (*Astrolepis sinuata*) 182

**Clubmoss** 7, 8, 16, 42

- Appressed bog clubmoss (*Lycopodiella appressa*) 82  
 Bog clubmoss (*Pseudolycopodiella caroliniana*) 93  
 Bristly clubmoss (*Spinulum annotinum*) 111  
 Bruce's clubmoss (*Lycopodiella* × *brucei*) 79  
 Butters' clubmoss (*Huperzia* × *buttersii*) 53  
 Common clubmoss (*Lycopodium clavatum* subsp. *clavatum*) 88  
 Copeland's clubmoss (*Lycopodiella* × *copelandii*) 79  
 Flat-branched tree clubmoss (*Dendrolycopodium obscurum*) 46  
 Foxtail bog clubmoss (*Lycopodiella alopecuroides*) 81  
 Gilman's bog clubmoss (*Lycopodiella* × *gilmanii*) 79  
 Hickey's tree clubmoss (*Dendrolycopodium hickeyi*) 45  
 Nodding clubmoss (*Palhinhaea cernua*) 91  
 Northern appressed clubmoss (*Lycopodiella subappressa*) 85  
 Northern tree clubmoss (*Dendrolycopodium dendroideum*) 44  
 Northern bog clubmoss (*Lycopodiella inundata*) 83  
 One-cone clubmoss (*Lycopodium lagopus*) 89



- Prickly tree clubmoss (*Dendrolycopodium dendroideum*) 44  
Prostrate bog clubmoss (*Lycopodiella prostrata*) 84  
Robust clubmoss (*Lycopodiella* × *robusta*) 79  
Slender clubmoss (*Pseudolycopodiella caroliniana*) 93  
Stag's horn clubmoss (*Lycopodium clavatum* subsp. *clavatum*) 88  
Staghorn clubmoss (*Palhinhaea cernua*) 91
- Comb fern**  
Brown-hair comb fern (*Ctenitis submarginalis*) 239  
Red-hair comb fern (*Ctenitis sloanei*) 238
- Common staghorn fern** (*Platynerium bifurcatum*) 428
- Creeping bramble fern** (*Hypolepis barringtonii*) 321
- Cuplet fern** (*Dennstaedtia bipinnata*) 255
- Curly Grass fern** (*Schizaea pusilla*) 468
- D**
- Dense lace fern** (*Aspidotis densa*) 145
- Dentate midsorus fern** (*Telmatoblechnum serrulatum*) 474
- Downy shield fern** (*Christella dentata*) 226
- Dwarf staghorn** (*Cheiroglossa palmata*) 224
- E**
- Elkhorn fern** (*Platynerium bifurcatum*) 428
- F**
- Flakelet fern** (*Hypolepis barringtonii*) 321
- Filmy fern**  
Appalachian filmy fern (*Vandenboschia boschiana*) 480  
Taylor's filmy fern (*Hymenophyllum tayloriae*) 318  
Tunbridge filmy fern (*Hymenophyllum tunbrigense*) 319
- Firmoss** 7, 53  
Bartley's firmoss (*Huperzia* × *bartleyi*) 53  
Beitel's firmoss (*Huperzia* × *josephbeiteli*) 53  
Hybrid rock firmoss (*Huperzia* × *protoporphila*) 53  
Mountain firmoss (*Huperzia appalachiana*) 55  
Northern firmoss (*Huperzia selago*) 58  
Rock firmoss (*Huperzia porophila*) 57  
Shining firmoss (*Huperzia lucidula*) 56
- Floating antler fern** (*Ceratopteris pteridoides*) 220
- Floating fern** (*Salvinia minima*) 456
- Florida tree fern** (*Ctenitis sloanei*) 238
- Forked fern** (*Dicranopteris flexuosa*) 261
- Fragile fern** (*Cystopteris fragilis*) 249
- G**
- Giant salvinia** (*Salvinia molesta*) 457
- Glade fern**  
Glade fern (*Homalosorus pycnocarpos*) 316  
Narrow-leaved glade fern (*Homalosorus pycnocarpos*) 316  
Silvery glade fern (*Deparia acrostichoides*) 258
- Goldenrod fern** (*Pityrogramma trifoliata*) 426
- Goldfoot fern** (*Phlebodium aureum*) 415
- Grape fern** 25  
Alabama grape fern (*Sceptridium jenmanii*) 462  
Blunt-leaved grape fern (*Sceptridium oneidense*) 465  
Common grape fern (*Botrypus virginianus*) 214  
Cut-leaf grape fern (*Sceptridium dissectum*) 461  
Dissected grape fern (*Sceptridium dissectum*) 461  
Leathery grape fern (*Sceptridium multifidum*) 464  
Prostrate grape fern (*Sceptridium lunarioides*) 463  
Southern grape fern (*Sceptridium biternatum*) 460  
Sparse-leaved grape fern (*Sceptridium biternatum*) 460  
St. Lawrence grape fern (*Sceptridium rugulosum*) 466  
Ternate grape fern (*Sceptridium rugulosum*) 466  
Winter grape fern (*Sceptridium lunarioides*) 463
- Grass fern** (*Vittaria graminifolia*) 484
- Ground-cedar** 7, 47  
Blue ground-cedar (*Diphasiastrum tristachyum*) 52  
Haberer's ground-cedar (*Diphasiastrum* × *habereri*) 47  
Juniper-leaved ground-cedar (*Diphasiastrum* × *sabinifolium*) 47  
Modest ground-cedar (*Diphasiastrum* × *verecundum*) 47  
Northern ground-cedar (*Diphasiastrum complanatum* subsp. *complanatum*) 49  
Southern ground-cedar (*Diphasiastrum digitatum*) 50  
Zeiller's ground-cedar (*Diphasiastrum* × *zeilleri*) 47

**H****Halberd fern**

- Broad halberd fern (*Tectaria heracleifolia*) 471
- Incised halberd fern (*Tectaria incisa*) 472
- Least halberd fern (*Tectaria fimbriata*) 470

**Hammock fern** (*Blechnum appendiculatum*) 192**Hand fern** (*Cheiroglossa palmata*) 224**Hand tongue** (*Cheiroglossa palmata*) 224**Hartford fern** (*Lygodium palmatum*) 332**Hay-scented fern** (*Dennstaedtia punctilobula*) 256**Holly fern**

- Asian holly fern (*Cyrtomium falcatum* subsp. *falcatum*) 243
- Braun's holly fern (*Polystichum braunii*) 438
- Climbing holly fern (*Lomariopsis kunzeana*) 325
- East Indian holly fern (*Arachniodes simplicior*) 143
- Fortune's holly fern (*Cyrtomium fortunei*) 244
- Hagenah's holly fern (*Polystichum* × *hagenahii*) 435
- Holly fern (*Cyrtomium falcatum* subsp. *falcatum*) 243
- Holly fern (*Lomariopsis kunzeana*) 325
- Holly fern (*Polystichum lonchitis*) 439
- Meyer's holly fern (*Polystichum* × *meyeri*) 435
- Potter's holly fern (*Polystichum* × *potteri*) 435

**Holly vine fern** (*Lomariopsis kunzeana*) 325**Horsetail** 7, 8, 22, 25

- Common horsetail (*Equisetum arvense* subsp. *arvense*) 294
- Ferriss' horsetail (*Equisetum* × *ferrissii*) 289
- Field horsetail (*Equisetum arvense* subsp. *arvense*) 294
- Littoral horsetail (*Equisetum* × *litorale*) 289
- Mackay's horsetail (*Equisetum* × *trachyodon*) 289
- Marsh horsetail (*Equisetum palustre*) 298
- Meadow horsetail (*Equisetum pratense*) 299
- Nelson's horsetail (*Equisetum* × *nelsonii*) 289
- River horsetail (*Equisetum fluviatile*) 295
- Woodland horsetail (*Equisetum sylvaticum*) 301

**Huguenot fern** (*Pteris multifida*) 449**I****Interrupted fern** (*Claytosmunda claytoniana*) 229**J****Japanese painted fern** (*Athyrium niponicum*) 186**K****Kariba weed** (*Salvinia molesta*) 457**L****Lady fern**

- Japanese lady fern (*Deparia petersenii*) 259
- Lady fern (Genus *Athyrium*) 183
- Lowland lady fern (*Athyrium asplenoides*) 185
- Narrow lady fern (*Athyrium angustum*) 184
- Northern lady fern (*Athyrium angustum*) 184
- Southern lady fern (*Athyrium asplenoides*) 185

**Lance-leaf twin-sorus fern** (*Diplazium lonchophyllum*) 268**Lattice-vein fern**

- Dentate lattice-vein fern (*Meniscium serratum*) 347
- Lattice-vein fern (*Meniscium reticulatum*) 346
- Toothed lattice-vein fern (*Meniscium serratum*) 347

**Leather fern**

- Coast leather fern (*Acrostichum aureum*) 116
- Giant leather fern (*Acrostichum danaeifolium*) 117
- Golden leather fern (*Acrostichum aureum*) 116
- Inland leather fern (*Acrostichum danaeifolium*) 117
- Leather fern (*Acrostichum aureum*) 116
- Leather fern (*Rumohra adiantiformis*) 454

**Lip fern**

- Alabama lip fern (*Myriopteris alabamensis*) 355
- Eaton's lip fern (*Myriopteris rufa*) 359
- Hairy lip fern (*Myriopteris lanosa*) 357
- Slender lip fern (*Myriopteris gracilis*) 356
- Smooth lip fern (*Myriopteris alabamensis*) 355
- Southern lip fern (*Myriopteris tomophylla*) 358
- Wooly lip fern (*Myriopteris tomentosa*) 360

**Log fern** (*Dryopteris celsa*) 278**M****Mackay's brittle fern** (*Cystopteris tenuis*) 253**Maiden fern**

- Abrupt-Tip maiden fern (*Pelazoneuron augescens*) 398

Alabama maiden fern (*Leptogramma burksiorum*) 323  
Caribbean maiden fern (*Amauropelta sancta*) 133  
Downy maiden fern (*Christella dentata*) 226  
Glandular maiden fern (*Amauropelta resinifera*) 132  
Grid-scale maiden fern (*Pelazoneuron patens*) 401  
Guadeloupe maiden fern (*Goniopteris domingensis*) 305  
Jeweled maiden fern (*Amblovenatum opulentum*) 135  
Mariana maiden fern (*Macrothelypteris torresiana*) 334  
Rough hairy maiden fern (*Christella hispidula*) 227  
Southern maiden fern (*Pelazoneuron kunthii*) 399  
Stately maiden fern (*Pelazoneuron abruptum* var. *grande*) 397  
Variable maiden fern (*Christella hispidula*) 227  
Wax-dot maiden fern (*Amauropelta resinifera*) 132  
Widespread maiden fern (*Pelazoneuron kunthii*) 399

#### Maidenhair

Aleutian maidenhair (*Adiantum aleuticum*) 123  
Brittle maidenhair (*Adiantum tenerum*) 128  
Common maidenhair (*Adiantum capillus-veneris*) 125  
Double-Edge maidenhair (*Adiantum anceps*) 124  
Fragrant maidenhair (*Adiantum melanoleucum*) 126  
Green Mountain maidenhair (*Adiantum viridimontanum*) 129  
Northern maidenhair (*Adiantum pedatum*) 127  
Southern maidenhair (*Adiantum capillus-veneris*) 125  
Western maidenhair (*Adiantum aleuticum*) 123

**Maidenhair pineland fern** (*Anemia adiantifolia*) 140

**Male fern** (*Dryopteris filix-mas* subsp. *brittonii*) 283

#### Marsh fern

Marsh fern (*Telmatoblechnum serrulatum*) 474  
Marsh fern (*Thelypteris palustris*) 476  
Ovate marsh fern (*Pelazoneuron ovatum*) 400

**Massachusetts fern** (*Coryphopteris simulata*) 231

**Merlin's grass** (*Isoetes*) 59

#### Mosquito fern

Carolina mosquito fern (*Azolla cristata*) 189

Crested mosquito fern (*Azolla cristata*) 189  
Eastern mosquito fern (*Azolla cristata*) 189  
Feathered mosquito fern (*Azolla pinnata* subsp. *pinnata*) 190  
Mexican mosquito fern (*Azolla mexicana*) 189  
Mosquito fern (*Azolla cristata*) 189

#### Moonwort

American moonwort (*Botrychium neolunaria*) 208  
Dainty moonwort (*Botrychium crenulatum*) 202  
Daisy-leaf moonwort (*Botrychium matricariifolium*) 204  
Frenchman's Bluff moonwort (*Botrychium gallicomontanum*) 203  
Least moonwort (*Botrychium simplex* var. *simplex*) 210  
Little goblin moonwort (*Botrychium mormo*) 207  
Michigan moonwort (*Botrychium michiganense*) 205  
Mingan moonwort (*Botrychium minganense*) 206  
Mischievous moonwort (*Botrychium tenebrosum*) 212  
Narrow triangle moonwort (*Botrychium angustisegmentum*) 199  
Pale moonwort (*Botrychium pallidum*) 209  
Prairie moonwort (*Botrychium campestre*) 201  
Spatulate moonwort (*Botrychium spatulatum*) 211  
Upswept moonwort (*Botrychium ascendens*) 200

## N

**Nardoo** (*Marsilea mutica*) 339

**Netted chain fern** (*Lorinseria areolata*) 327

**New World midSORUS fern** (*Blechnum appendiculatum*) 192

**New York fern** (*Amauropelta noveboracensis*) 131

## O

#### Oak fern

Appalachian oak fern (*Gymnocarpium appalachianum*) 311  
Asian oak fern (*Gymnocarpium continentale*) 312  
Britton's oak fern (*Gymnocarpium* × *brittonianum*) 309  
Intermediate oak fern (*Gymnocarpium* × *intermedium*) 309



- Limestone oak fern (*Gymnocarpium robertianum*) 314
- Nahanni oak fern (*Gymnocarpium continentale*) 312
- Northern oak fern (*Gymnocarpium dryopteris*) 313
- Tetraploid hybrid oak fern (*Gymnocarpium* × *achriosporum*) 309
- Ostrich fern** (*Matteuccia struthiopteris* var. *pennsylvanica*) 344
- P**
- Pine fern** (*Anemia adiantifolia*) 140
- Parsley fern**
- American parsley fern (*Cryptogramma acrostichoides*) 235
- Slender parsley fern (*Cryptogramma stelleri*) 236
- Polypody**
- Appalachian polypody (*Polypodium appalachianum*) 433
- Comb polypody (*Pecluma bourgeauana*) 392
- Dwarf polypody (*Moranopteris nimbata*) 352
- Eastern hybrid polypody (*Polypodium* × *incognitum*) 432
- Golden polypody (*Phlebodium aureum*) 415
- Gray's polypody (*Pleopeltis michauxiana*) 430
- Plume polypody (*Pecluma plumula*) 394
- Rock polypody (*Polypodium virginianum*) 434
- Scaly polypody (*Pleopeltis michauxiana*) 430
- Swamp plume polypody (*Pecluma bourgeauana*) 392
- West Indian dwarf polypody (*Moranopteris nimbata*) 352
- Widespread polypody (*Pecluma dispersa*) 393
- Prickly mountain-moss** (*Selaginella selaginoides*) 107
- Q**
- Quillwort** 7, 8, 13, 16, 20, 28
- Appalachian quillwort (*Isoetes appalachiana*) 65
- Black-spored quillwort (*Isoetes melanospora*) 72
- Boom's quillwort (*Isoetes boomii*) 65
- Butler's quillwort (*Isoetes butleri*) 66
- Carolina quillwort (*Isoetes valida*) 77
- Chesapeake quillwort (*Isoetes mattaponica*) 71
- Eastern black-footed quillwort (*Isoetes melanopoda*) 72
- Engelmann's quillwort (*Isoetes engelmannii*) 67
- Flat rock quillwort (*Isoetes graniticola*) 68
- Florida quillwort (*Isoetes flaccida*) 67
- Georgia quillwort (*Isoetes georgiana*) 68
- Green Mountain quillwort (*Isoetes viridimontana*) 78
- Lake quillwort (*Isoetes macrospora*) 71
- Limestone quillwort (*Isoetes butleri*) 66
- Louisiana quillwort (*Isoetes louisianensis*) 70
- Mat-forming quillwort (*Isoetes tegetiformans*) 75
- Northern quillwort (*Isoetes septentrionalis*) 75
- Piedmont quillwort (*Isoetes piedmontana*) 73
- Prototype quillwort (*Isoetes prototypus*) 74
- Rush quillwort (*Isoetes junciformis*) 69
- Shore quillwort (*Isoetes riparia*) 74
- Short-veiled quillwort (*Isoetes microvela*) 73
- Spiny-spored quillwort (*Isoetes echinospora* subsp. *muricata*) 66
- St. Lawrence quillwort (*Isoetes laurentiana*) 70
- Strong quillwort (*Isoetes valida*) 77
- Swamp quillwort (*Isoetes boomii*) 65
- Tennessee quillwort (*Isoetes tennesseensis*) 76
- True quillwort (*Isoetes valida*) 77
- Tuckerman's quillwort (*Isoetes tuckermanii*) 76
- Virginia quillwort (*Isoetes virginica*) 78
- Winter quillwort (*Isoetes hyemalis*) 69
- Woodland quillwort (*Isoetes melanopoda*) 72
- R**
- Rattlesnake fern** (*Botrypus virginianus*) 25, 214
- Ray fern** (*Actinostachys pennula*) 119
- Ray spiked fern** (*Actinostachys pennula*) 119
- Resurrection fern**
- Resurrection fern (*Pleopeltis michauxiana*) 430
- Tropical resurrection fern (*Pleopeltis polypodioides*) 431
- Ribbon fern** (*Ophioderma pendulum*) 376
- Rockbrake**
- American rockbrake (*Cryptogramma acrostichoides*) 235
- Fragile rockbrake (*Cryptogramma stelleri*) 236

- Slender rockbrake (*Cryptogramma stelleri*) 236  
Steller's rockbrake (*Cryptogramma stelleri*) 236  
**Rock cap fern** (*Polypodium appalachianum*) 433  
**Royal fern** (*Osmunda spectabilis*) 387  
**Rugg's Osmunda** ( $\times$ *Osmunimunda ruggii*) 228, 336  
**Running-pine** 47  
    Northern running-pine (*Diphasiastrum complanatum* subsp. *complanatum*) 49  
    Southern running-pine (*Diphasiastrum digitatum*) 50
- S**
- Savinleaf ground-pine** (*Diphasiastrum*  $\times$  *sabinifolium*) 47  
**Scouring rush**  
    Common scouring rush (*Equisetum hyemale* subsp. *affine*) 296  
    Dwarf scouring rush (*Equisetum scirpoides*) 300  
    Smooth scouring rush (*Equisetum laevigatum*) 297  
    Variegated scouring rush (*Equisetum variegatum* subsp. *variegatum*) 302  
**Sensitive fern** (*Onoclea sensibilis*) 374  
**Serpent fern** (*Microsorium grossum*) 351  
**Serpentine fern** (*Aspidotis densa*) 145  
**Shield fern**  
    Southern shield fern (*Dryopteris ludoviciana*) 287  
    St. John's shield fern (*Christella hispidula*) 227  
    Swamp shield fern (*Cyclosorus interruptus*) 241  
**Shoestring fern** (*Vittaria lineata*) 485  
**Short-fruit nardoo** (*Marsilea hirsuta*) 337  
**Silverback fern** (*Pityrogramma calomelanos* var. *calomelanos*) 425  
**Single-sorus fern** (*Asplenium monanthes*) 164  
**Sinkhole fern** (*Blechnum appendiculatum*) 192  
**Sitka clubmoss** (*Diphasiastrum sitchense*) 51  
**Spikemoss** 7, 8, 16, 94  
    Blue spikemoss (*Selaginella uncinata*) 109  
    Braun's spikemoss (*Selaginella braunii*) 101  
    Buck's meadow spikemoss (*Selaginella eclipes*) 104  
    Dwarf spikemoss (*Selaginella rupestris*) 106  
    Eaton's spikemoss (*Selaginella eatonii*) 103  
    Gulf spikemoss (*Selaginella ludoviciana*) 105  
    Hidden spikemoss (*Selaginella eclipes*) 104  
    Louisiana spikemoss (*Selaginella ludoviciana*) 105  
    Meadow spikemoss (*Selaginella apoda*) 99  
    Northern spikemoss (*Selaginella selaginoides*) 107  
    Peacock spikemoss (*Selaginella uncinata*) 109  
    Riddell's spikemoss (*Selaginella corallina*) 102  
    Rock spikemoss (*Selaginella rupestris*) 106  
    Sand spikemoss (*Selaginella arenicola*) 100  
    Sandy spikemoss (*Selaginella acanthonota*) 98  
    Spiny spikemoss (*Selaginella acanthonota*) 98  
    Twisted-hair spikemoss (*Selaginella tortipila*) 108  
    Vine spikemoss (*Selaginella willdenowii*) 110  
**Spleenwort** 146  
    Abscised spleenwort (*Asplenium abscissum*) 158  
    Alternate-leaved spleenwort (*Asplenium*  $\times$  *alternifolium*) 147, 148, 152, 153  
    Auricled spleenwort (*Asplenium auritum*) 159  
    Biscayne spleenwort (*Asplenium*  $\times$  *biscayneanum*) 147, 148, 155  
    Black-stemmed spleenwort (*Asplenium resiliens*) 170  
    Bradley's spleenwort (*Asplenium bradleyi*) 160  
    Boydston's spleenwort (*Asplenium*  $\times$  *boydstoniae*) 147  
    Crested spleenwort (*Asplenium cristatum*) 161  
    Curtiss's spleenwort (*Asplenium*  $\times$  *curtissii*) 147, 148, 155, 156  
    Cutleaf spleenwort (*Asplenium abscissum*) 158  
    Delicate spleenwort (*Asplenium verecundum*) 178  
    Eared spleenwort (*Asplenium auritum*) 159  
    Ebony spleenwort (*Asplenium platyneuron*) 167  
    Forked spleenwort (*Asplenium septentrionale* subsp. *septentrionale*) 174  
    Graves's spleenwort (*Asplenium*  $\times$  *gravesii*) 147, 148, 151  
    Green spleenwort (*Asplenium viride*) 179  
    Hairy spleenwort (*Asplenium pumilum*) 169  
    Hemlock spleenwort (*Asplenium cristatum*) 161  
    Herb's spleenwort (*Asplenium*  $\times$  *herbwagneri*) 147  
    Japanese false spleenwort (*Deparia petersenii*) 259  
    Kentucky spleenwort (*Asplenium*  $\times$  *kentuckiense*) 147, 149, 151  
    Lobed spleenwort (*Asplenium pinnatifidum*) 166  
    Maidenhair spleenwort (*Asplenium trichomanes*) 176

- Modest spleenwort (*Asplenium verecundum*) 178  
 Morgan's spleenwort (*Asplenium* × *morganii*) 147  
 Morzenti's spleenwort (*Asplenium* × *heteroresiliens*) 147, 148, 153, 155  
 Mountain spleenwort (*Asplenium montanum*) 165  
 Narrow-leaved spleenwort (*Homalosorus pycnocarpus*) 316  
 Parsley spleenwort (*Asplenium cristatum*) 161  
 Ruffled spleenwort (*Asplenium plenum*) 168  
 Scott's fertile spleenwort (*Asplenium tutwilerae*) 177  
 Scott's spleenwort (*Asplenium* × *ebenooides*) 147, 148, 150, 151  
 Shawnee spleenwort (*Asplenium* × *shawneense*) 147  
 Silvery spleenwort (*Deparia acrostichoides*) 258  
 Toothed spleenwort (*Asplenium dentatum* subsp. *dentatum*) 162  
 Triangle spleenwort (*Asplenium pumilum*) 169  
 Trudell's spleenwort (*Asplenium* × *trudellii*) 147, 149, 151  
 Tutwiler's spleenwort (*Asplenium tutwilerae*) 177  
 Varicolored spleenwort (*Asplenium heterochroum*) 163  
 Virginia spleenwort (*Asplenium* × *virginicum*) 147  
 Wherry's spleenwort (*Asplenium* × *wherryi*) 147
- Spready tri-vein fern** (*Cyclosorus interruptus*) 241
- Star-hair fern**  
 Creeping star-hair fern (*Goniopteris reptans*) 306  
 Free-tip star-hair fern (*Goniopteris tetragona*) 308  
 Stiff star-hair fern (*Goniopteris sclerophylla*) 307
- Strap fern**  
 Long strap fern (*Campyloneurum phyllitidis*) 218  
 Narrow strap fern (*Campyloneurum angustifolium*) 216  
 Tailed strap fern (*Campyloneurum costatum*) 217
- Swamp fern** (*Telmatoblechnum serrulatum*) 474
- Sword fern**  
 Asian sword fern (*Nephrolepis brownii*) 366  
 Avery's sword fern (*Nephrolepis* × *averyi*) 364  
 Fishtail sword fern (*Nephrolepis falcata*) 369  
 Giant sword fern (*Nephrolepis biserrata*) 365  
 Rough sword fern (*Nephrolepis hirsutula*) 370  
 Scaly sword fern (*Nephrolepis hirsutula*) 370  
 Sword fern (*Nephrolepis exaltata*) 368  
 Tuberous sword fern (*Nephrolepis cordifolia*) 367
- T**
- Tapering tri-vein fern** (*Christella dentata*) 226  
**Torres's fern** (*Macrothelypteris torresiana*) 334  
**Tropical curly-grass fern** (*Actinostachys pennula*) 119
- V**
- Vegetable fern** (*Diplazium esculentum*) 267  
**Venus' hair fern** (*Adiantum capillus-veneris*) 125  
**Virginia chain fern** (*Anchistea virginica*) 137
- W**
- Walking fern** (*Asplenium rhizophyllum*) 171  
**Wall rue** (*Asplenium ruta-muraria* var. *cryptolepis*) 172  
**Wart fern** (*Microsorium grossum*) 351
- Water clover**  
 Bigfoot water clover (*Marsilea macropoda*) 337  
 Bristly water clover (*Marsilea hirsuta*) 337  
 European water clover (*Marsilea quadrifolia*) 340  
 Hairy water clover (*Marsilea vestita*) 342  
 Small water clover (*Marsilea minuta*) 338  
 Tropical water clover (*Marsilea oligospora*) 340
- Water fern**  
 Floating water fern (*Ceratopteris pteridoides*) 220  
 Triangle water fern (*Ceratopteris richardii*) 221
- Water hornfern** (*Ceratopteris thalictroides* subsp. *thalictroides*) 222
- Water Spangles** (*Salvinia minima*) 456
- Water Sprite** (*Ceratopteris thalictroides* subsp. *thalictroides*) 222
- Water velvet** (*Azolla cristata*) 189
- Wedgelet fern** (*Odontosoria clavata*) 372
- Weft fern** (*Crepidomanes intricatum*) 233
- Whisk fern** (*Psilotum nudum*) 7, 8, 25, 371, 441
- Wild Boston fern** (*Nephrolepis exaltata*) 368
- Willdenow's fern** (*Cyclosorus interruptus*) 241
- Wood fern/woodfern**  
 Algonquin wood fern (*Dryopteris* × *algonquinensis*) 270  
 Benedict's wood fern (*Dryopteris* × *benedictii*) 270



- Boott's wood fern (*Dryopteris* × *boottii*) 269, 270, 271, 274
- Brathay wood fern (*Dryopteris* × *brathaica*) 270
- Burgess' wood fern (*Dryopteris* × *burgessii*) 270
- Clinton's wood fern (*Dryopteris clintoniana*) 279
- Correll's hybrid wood fern (*Dryopteris* × *correllii*) 270
- Crested wood fern (*Dryopteris cristata*) 280
- Dixie wood fern (*Dryopteris* × *australis*) 269, 270, 271
- Dowell's wood fern (*Dryopteris* × *dowellii*) 270
- Evergreen wood fern (*Dryopteris intermedia* subsp. *intermedia*) 286
- Fragrant wood fern (*Dryopteris fragrans*) 284
- Goldie's wood fern (*Dryopteris goldiana*) 285
- Leeds' wood fern (*Dryopteris* × *leedsii*) 270, 271
- Marginal wood fern (*Dryopteris marginalis*) 288
- Marsh wood fern (*Dryopteris* × *uliginosa*) 269, 271
- Mickell's wood fern (*Dryopteris* × *mickelii*) 270
- Montgomery's wood fern (*Dryopteris* × *montgomeryi*) 270
- Mountain wood fern (*Dryopteris campyloptera*) 276
- Northern wood fern (*Dryopteris expansa*) 282
- Pittsford's wood fern (*Dryopteris* × *pittsfordensis*) 271
- Separate wood fern (*Dryopteris* × *separabilis*) 271
- Slosson's wood fern (*Dryopteris* × *slossoniae*) 271
- Southern wood fern (*Dryopteris ludoviciana*) 287
- Spinulose wood fern (*Dryopteris carthusiana*) 277
- Spreading wood fern (*Dryopteris expansa*) 282
- Toothed wood fern (*Dryopteris carthusiana*) 277
- Triploid wood fern (*Dryopteris* × *triploidea*) 269, 271, 272
- Wherry's wood fern (*Dryopteris* × *neowherryi*) 270, 271
- Woodsia**
- Abbe's woodsia (×*Woodsiamatium abbeae*) 416, 486
- Slender woodsia (*Woodsia* × *gracilis*) 486
- Maxon's woodsia (*Physematium* × *maxonii*) 416
- Tryon's woodsia (*Woodsia* × *tryonis*) 486
- Wright's pineland fern** (*Anemia wrightii*) 141