A family of 10-15 genera and about 400 species. Lycopodiaceae, along with Selaginellaceae and Isoetaceae, have now been shown to be only distantly related to other extant pteridophytes and seed plants (Pryer et al. 2001). The division of North American Lycopodium into three or more genera has been strongly advocated by Wagner & Beitel (1992), Wagner & Beitel in FNA (1993), Haines (2003a), and nearly all other recent authors. The traditionally broad Lycopodium appears to include a number of natural groups which are strikingly different from one another and have constituted separate lineages for tens to hundreds of millions of years. These natural groups are separable by numerous morphological, developmental, and anatomical characters, karyotype, and inability to hybridize. Wagner & Beitel (1992) divide Lycopodium (sensu latissimo) of our area into six genera in three subfamilies, as follows: Huperzia in Subfamily Huperzioideae, Lycopodium and Diphasiastrum in Subfamily Lycopodiioideae, and Lycopodiella, Palhinhaea, and Pseudolycopodiella in Subfamily Lycopodielloideae. Haines (2003a) further divides Lycopodium (sensu lato) into three genera: Dendrolycopodium, Spinulum, and Lycopodium (sensu stricto). The reasoning behind this division is very strong, and it is here followed. Profound differences in anatomy, morphology, reproduction, gametophyte morphology, and karyotype support this separation. The chromosome numbers of our genera: Dendrolycopodium (x=34), Diphasiastrum (x=23), Huperzia (x=67, 68), Lycopodiella (x=78), Lycopodium (x=34), Palhinhaea (x=55), Pseudolycopodiella (x=35), and Spinulum (x=34). Øllgaard in Kramer & Green (1990) and Wikström & Kenrick (2000) follow a somewhat broader coarse, recognizing three genera for our species (corresponding to the subfamilies of Wagner & Beitel 1992), and recognizing as sections the genera of Wagner & Beitel (1992). Øllgaard states that the "genera are very distinct, and also the sections within Lycopodiella and Lycopodium seem to represent ancient, independent evolutionary lines." Wikström & Kenrick (2000, 2001) suggest that the phylogenetic separation of Lycopodium (including Diphasiastrum) and Lycopodiella (including Pseudolycopodiella and Palhinhaea) occurred at least as long ago as the early Jurassic (208 million years before present), and the divergence of Huperzia from Lycopodium and Lycopodiella still longer ago. Based on this deep division between Huperzia and the other genera, some authors additionally advocate the recognition of Huperzia in a separate family, Huperziaceae, a suggestion which is by no means outlandish (though not followed here). References: Lellinger (1985); Mickel (1979); Wagner and Beitel (1992); Beitel (1979); Snyder & Bruce (1986); Wagner & Beitel in FNA (1993b); Øllgaard in Kramer & Green (1990); Wikström & Kenrick (2000, 2001); Øllgaard (1987); Haines (2003a). Key based in part on Haines (2003a).

1. Leafy stems erect, simple or dichotomously branched, the ultimate branches vertically oriented; sporophylls like the sterile leaves or only slightly reduced, in annual bands along the stem; vegetative reproduction by leafy gemmae near the stem apex; [subfamily Huperzioideae]....

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1. Huperzia

1. Leafy stems prostrate or erect, if erect then generally branched, the ultimate branches spreading (horizontal) or ascending; sporophylls differing from sterile leaves, either broader and shorter, or more spreading, aggregated into terminal cones; lacking vegetative reproduction by gemmae.
2. Leaves herbaceous, pale or yellow-green, dull, deciduous; principal leafy stems creeping (except erect and repeatedly branched in Palhinhaea); rhizome dying back annually to an underground vegetative
A genus of about 10-15 species, north temperate and arctic (and tropical mountains of Asia). Within the Lycopodiaceae, *Huperzia* has "an isolated position", basal to the remainder of the family, and is sometimes separated in a separate family, the Huperziaceae (Haines 2003a). References: Wagner & Beitel in FNA (1993b); Haines (2003a)=Z; Øllgaard in Kramer & Green (1990); Wikström & Kenrick (2000).

**Identification notes:** Several hybrids are known from our area; they usually occur in intermediate habitats (such as in thin soil at the base of cliffs) and generally are found in proximity to both parents, but sometimes occur in the absence of one or both parents. Hybrids can be recognized by their intermediate morphology. In addition, *Huperzia selago* (Linnaeus) Bernhardi ex Martius & Schrank, Northern
Firmoss, is circumboreal, ranging south in North America to NY, New England, and the Great Lakes region, and disjunct to OH. It could easily occur as a disjunct in our area, and should be sought in the high mountains.

1 Leaves oblanceolate, the apical portion toothed with 1-8 large, irregular teeth; leaves 6-15 mm long, 1.0-2.5 mm wide; stomates on lower leaf surface only (visible at 10×, or preferably 20-40×, magnification); spores 23-29 μm in diameter; [mainly of forest soils] H. lucidula

1 Leaves lanceolate (awl-shaped), margins not toothed, or minutely toothed in the apical portion only with 1-3 low teeth; leaves 3-9 mm long, 0.6-1.3 mm wide; stomates on both leaf surfaces (visible at 10×, or preferably 20-40×, magnification); spores 29-38 μm in diameter; [mainly of rock outcrops].

2 Leaves spreading, (3-) 5-9 mm long, ca. 1 mm wide, usually sparsely toothed; stomates relatively few on the upper leaf surface (1-25 on each side of midrib); [of outcrops at low to medium elevations] H. porophila

2 Leaves ascending to spreading, 2-7.5 mm long, 0.6-0.8 (-1.0) mm wide, not toothed (though sometimes with minute, single cell bumps); stomates relatively many on the upper leaf surface (30-90 on each side of midrib); [of high to medium elevations].

3 Leaves dimorphic, those at the base longer and spreading wider from the shoot axis than those from the apical portion of the plant; gemma-bearing branches borne throughout the apical portion of mature shoots; lateral leaves of gemmae 0.5-1.1 mm wide

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Huperzia appressa (Desvaux) A. Löve & D. Löve, Appalachian Firmoss. Rock outcrops at high elevations (very rarely at middle elevations), rarely also in seepage or along banks of small streams at high elevations, and in fens (on hummocks). June-August. N. QC and NL (Newfoundland) west to ON, MI, and MN and south along the Appalachians to w. NC, e. TN, and ne. GA. This species was named in 1992 as H. appalachiana (Beitel & Mickel 1992), but H. appressa (Desvaux) A. Löve & D. Löve is an older combination that applies to the same species (Haines 2003a). Though morphologically only subtly differentiated from the circumboreal H. selago (for distinctions see Beitel & Mickel 1992; Brunton, Wagner, & Beitel 1992; Haines 2003a), the case for the distinctness of H. appressa is confirmed by the production of sterile (abortive-spored) hybrids where it co-occurs with H. selago. [= Z; = H. appalachiana Beitel & Mickel – FNA, K; < Lycopodium selago Linnaeus – RAB, S, W; > < Lycopodium selago Linnaeus var. appressum (Desvaux) Petrovic – C, F; << Lycopodium selago var. selago – C, G]

Huperzia ×bartleyi (Cusick) Kartesz & Gandhi [H. lucidula × porophila]. Rock outcrops. Reported for NC by Waterway (1986). This hybrid can be told from its parents by the presence of stomates on both surfaces of the leaf (unlike H. lucidula), but their marked lower density on the upper surface (unlike H. porophila). [= K, Z]


Huperzia ×protoporophila A. Haines [H. appressa × lucidula]. Rock outcrops and cliff bases. Known from Chimney Rock Park, Rutherford County, NC (the lowest elevation occurrence of H. appressa in NC) and from Roan Mountain, Mitchell County, NC, and Grandfather Mountain, Avery County, NC. Expected at other cliff bases where the two parents are in proximity. This hybrid can be told from its parents by the presence of stomates on both surfaces of the leaf (unlike H. lucidula), but their marked lower density on the upper surface (unlike H. appressa). An additional useful character is the distribution of gemma-bearing branches: those of Huperzia appressa are abundantly distributed throughout the apical portion of mature plants, while those of the hybrid are confined to 1 or 2 pseudowhors at the apex of annual growth (i.e., there are large gaps between the pseudowhors of gemma-bearing branches). 

2. Lycopodiella Holub 1964 (Bog Clubmoss)

A genus of about 15-20 species, temperate and tropical. Additional research on this genus in our area is needed. Two fertile tetraploid species were recently named from MI (Bruce, Wagner, & Beitel 1991), and additional cryptic or semicryptic species may be found in the Southeastern Coastal Plain. This group is variously treated as genus Lycopodiella, or as Lycopodiella section Lycopodiella (Øllgaard in Kramer & Green 1990, Wikström & Kenrick 2000). References: Wagner & Beitel in FNA (1993b); Øllgaard in Kramer & Green (1990); Wikström & Kenrick (2000); Haines (2002a, 2003a, 2003b)=Z. [also see Pseudolycopodiella]

Identification notes: Species of this genus are difficult to identify. They often grow together; it is not uncommon to find two or more species at a single site in the Coastal Plain. Hybrids occur. Juvenile plants, resprouting in spring or after fire, are especially difficult to identify. In contrast to the other species, Pseudolycopodiella caroliniana and, to a lesser degree, L. prostrata, are dorsiventrally flattened (or apparently distichous), but it seems that juvenile sprouts of all species are somewhat flattened.

1 Leaves of the horizontal shoots entire (rarely those toward the shoot apex with a few teeth); horizontal shoots, excluding the leaves, 0.5-0.9 (-1.0) mm in diameter; each horizontal shoot segment commonly producing a single upright shoot; [in our area, a plant of the Mountains] ..............

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L. inundata

1 Leaves of the horizontal shoots toothed (except when inundated); horizontal shoots, excluding the leaves, 1.5-5.0 mm in diameter; each horizontal shoot segment producing 2-6 upright shoots; [collectively primarily of the Coastal Plain, with some disjunctions inland into the Piedmont and Mountains].

2 Fertile leaves (sporophylls) 2.9-5.0 (-5.2) mm long, appressed at maturity, entire or with short teeth < 0.3 mm long; strobili 3-6 mm in diameter at maturity.......................L. appressa

2 Fertile leaves (sporophylls) 5.5-9 mm long, spreading, with 1-8 teeth per margin, some or all of the teeth exceeding 0.3 mm in length; strobili 10-20 mm in diameter at maturity.

3 Prostrate stems arching, not in contact with the ground (and rooting) all along their length, 8-11 mm wide (including leaves), the stem (stripped of leaves) 2-4 mm in diameter; leaves of the prostrate
stem of one size and shape, spreading to ascending, 5-7 mm long, 0.5-0.7 mm wide; erect stems many, equally spaced along the prostrate stems, progressively shorter and sterile toward the apex of the prostrate stems .......................................................... L. alopecuroides

3 Prostrate stems creeping, in contact with the ground (and rooting) all along their length, 12-19 mm wide (including leaves), the stem (stripped of leaves) 1-2.2 mm in diameter; leaves of the prostrate stems dimorphic, spreading to reflexed, the upper leaves smaller (4-5 mm long, 0.4-0.6 mm wide) than the lateral leaves (7-8 mm long, 0.7-1.8 mm wide); erect stems few, clustered well behind the apex of the prostrate stems, mostly fertile and subequal in length. L. prostrata

Lycopodiella alopecuroides (Linnaeus) Cranfill, Foxtail Clubmoss. Savannas, seepages, and other wet, sandy sites. July-September. Primarily Southeastern Coastal Plain: se. MA south to FL and west to e. TX, and disjunct in the Cumberland Plateau of KY, TN, and VA, the Allegheny Mountains of WV (Morton et al. 2004), the e. Highland Rim of TN, and in ME (Haines 2001); s. Mexico south through Central America to n. South America; Cuba. [= FNA, K, Pa, WH3, Z; < Lycopodium alopecuroides Linnaeus – RAB; = Lycopodium alopecuroides Linnaeus – C, F, G, Md, S, W]


Lycopodiella inundata (Linnaeus) Holub, Northern Bog Clubmoss. Gravelly or sandy seepage areas, bogs. July-September. A circumboreal species, ranging south in the Appalachians to NC, where it was first found in 1986 (Weakley, in prep.). [= FNA, K, Pa, Z; = Lycopodium inundatum Linnaeus – C, Md, W, WV; = Lycopodium inundatum var. inundatum – F, G]


All pairwise combinations of sympatric species form fertile hybrids (only L. inundata and L. prostrata are entirely allopatric and not known to hybridize). The following hybrids should be expected where the parents grow together.

Lycopodiella alopecuroides × appressa. [= Lycopodiella ×copelandii (Eiger) Cranfill – K, WH3, Z; Lycopodium ×copelandii Eiger]


Lycopodiella alopecuroides × prostrata. [= Lycopodiella ×brucei Cranfill – K, WH3; = Lycopodium ×brucei (Cranfill) Lellinger]


Lycopodiella appressa × prostrata.
3. Pseudolycopodiella Holub 1983 (Carolina Bog Clubmoss)

A genus of about 12 species, sub-cosmopolitan. This group has often been treated as section of *Lycopodium* (or of *Lycopodiella*); it appears to warrant status as a genus separate from *Lycopodiella*. In addition to the morphologic distinctions, this species has considerable anatomical differences, a different base chromosome number than the four species of *Lycopodiella* (*x* = 35 vs. *x* = 78), and does not hybridize with *Lycopodiella* (Wagner & Beitel 1992). Øllgaard in Kramer & Green (1990) and Wikström & Kenrick (2000) retain it as *Lycopodiella* section *Carolinianae*. References: Wagner & Beitel in FNA (1993b); Haines (2003a)=Z; Øllgaard in Kramer & Green (1990); Wikström & Kenrick (2000).

**Pseudolycopodiella caroliniana** (Linnaeus) Holub, Carolina Bog Clubmoss, Slender Clubmoss. Savannas, seepages. July-September. This species occurs in se. North America, the West Indies, and is widespread in the Southern Hemisphere; in North America, it ranges from MA south to s. FL and west to e. TX. [= FNA, Z; = *Lycopodium carolinianum* Linnaeus – C, F, G, Md, RAB, S; > *Lycopodiella caroliniana* (Linnaeus) Pichi Sermolli var. caroliniana – K; = *Lycopodiella caroliniana* (Linnaeus) Pichi Sermolli – WH3]


A genus of 10-15 species, tropical and subtropical. This group is variously treated as the genus *Palhinhaea* or as *Lycopodiella* section *Campylostachys* (Øllgaard in Kramer & Green 1990, Wikström & Kenrick 2000). References: Wagner & Beitel in FNA (1993b); Øllgaard in Kramer & Green (1990); Wikström & Kenrick (2000).

**Palhinhaea cernua** (Linnaeus) Vasconcellos & Franco, Nodding Clubmoss, Staghorn Clubmoss. Wet savannas, ditches and other disturbed moist areas. This species is pantropical, occurring in both the Neotropics and the Paleotropics. Some of its occurrences in our area may be adventive. [= FNA; > *Lycopodiella cernua* (Linnaeus) Pichi Sermolli var. cernua – K; = *Lycopodium cernuum* Linnaeus – S; = *Lycopodiella cernua* (Linnaeus) Pichi Sermolli – WH3]

5. Dendrolycopodium A. Haines 2003 (Tree-clubmoss)

A genus of 4 species, temperate and subarctic. Haines (2003a) makes the case for this genus as distinct from *Lycopodium s.s.* and other relatives. References: Wagner & Beitel in FNA (1993b); Wagner, Beitel, & Moran (1989); Hickey (1977); Øllgaard in Kramer & Green (1990); Haines (2003a)=Z.

1 Leaves of the main vertical axis spreading (30-90° angle to stem) in the vicinity of the lower lateral branches, prickly to the touch; branchlets round in cross-section, the 6 ranks of leaves (2 lateral ranks, 2 adaxial ranks, and 2 abaxial ranks) equal in length and spreading to ascending....
**Dendrolycopodium dendroideum** (Michaux) A. Haines, Tree Ground-pine, Round-branch Clubmoss, Prickly Tree-clubmoss. Openings, grassy balds, high elevation spruce-fir and northern hardwood forests. July-September. The northernmost of the *L. obscurum* complex, ranging from n. QC and NL (Newfoundland) west to AK, south to s. NJ, w. NC, MO, MN, SD, CO, MT, ID, and WA; also in Asia. [= Z; *Lycopodium obscurum* var. *dendroideum* (Michaux) D.C. Eaton – RAB, F, G, Md, WV; = *Lycopodium dendroideum* Michaux – FNA, K, Pa, W; < *L. obscurum* – C]


**Dendrolycopodium obscurum** (Linnaeus) A. Haines, Common Ground-pine, Flat-branched Tree-clubmoss. Acidic forests. July-September. NS and NB west to MI and WI, south to n. GA, ne. AL, s. IN, n. IL, and c. MN. [= Z; = *Lycopodium obscurum* Linnaeus – FNA, K, Pa; = *Lycopodium obscurum* var. *obscurum* – F, G, Md, RAB, W, WV; < *L. obscurum* – C, S]

6. **Diphasiastrum** Holub 1975 (Flat-branched Clubmoss, Running Cedar)


1 Foliage dark green, not glaucous; horizontal branchlets 2-4 mm wide (including the leaves); branchlets without conspicuous annual constrictions; rhizomes 0-1 cm deep (which can be determined by pulling up a single upright shoot – the depth to rhizome is approximately the length of the white portion of the vertical stem); abaxial rank of leaves shorter than lateral ranks (thus the branchlets flat in cross-section)
D. digitatum
Foliage blue-green, glaucous; horizontal branchlets 1-2 mm wide (including the leaves); branchlets with conspicuous annual constrictions; rhizomes (1-) 5-12 cm deep; abaxial rank of leaves as long as lateral ranks (thus the branchlets more-or-less square in cross-section)

D. tristachyum

Hydrocotyle bonariensis Lamarck, Dune Pennywort. Beaches, dunes, and moist sandy areas. April-September. Widespread in South and Central America, north in North America to the Southeastern Coastal Plain, se. VA to s. FL and TX. [= RAB, GW, K, MC, S, WH]


Kalopanax Miquel 1863 (Castor Aralia)
**Araliaceae**


Panax Linnaeus 1753 (Ginseng)


* Panax quinquefolius* Linnaeus, Ginseng, Sang, American Ginseng. Cove forests, mesic hardwood forests, generally in nutrient-rich forests though tending to avoid the richest coves. May-June; August-October. ME and QC west to MN and SD, south to e. VA, e. NC, nc. SC, sw. GA, s. AL, s. MS, e. LA, and OK. *P. quinquefolius* is gathered in quantity throughout its range for the herbal trade; most of the North American harvest is shipped to China, where it is prized for medicinal uses. Dried roots command prices in excess of $1000 per kilogram; in our area, "sang" is a multimillion dollar industry. Formerly abundant and occurring in large populations, *P. quinquefolius* has been reduced in most of its range to small populations of scattered individuals, a classic example of a "predator-prey" relationship. Collection and trade in ginseng is monitored and regulated in most states. In NC, it is illegal for ginseng dealers to buy ginseng from collectors before September; this allows the plants to mature fruits prior to collection. Schlessman (1985) discusses the floral biology of *P. quinquefolius*. [= F, K, Pa, W, WV, Y, Z; = *P. quinquefolium* – RAB, C, G, S, orthographic variant]

* Panax trifolius* Linnaeus, Dwarf Ginseng. Cove forests, bottomland forests, other nutrient-rich forests. April-June; August-October. NS and QC west to MN, south to PA, e. VA, c. NC, nc. GA, ec. TN, IN, and IA. [= F, K, Pa, W, WV, Y, Z; = *P. trifolium* – RAB, C, G, S, orthographic variant]

Tetrapanax (K. Koch) K. Koch 1859 (Ricepaper-plant)

A monotypic genus, a robust herb or shrub, of China.

* Tetrapanax papyriferus* (Hooker) K. Koch, Ricepaper-plant. Disturbed forests; native of Asia. [= K, WH; = *T. papyrifer*, orthographic variant]
ARALIACEAE Lindley 1836 or UMBELLIFERAE A.L. de Jussieu 1789 (Carrot Family) [in APIALES]

A family of about 445 genera and about 3540 species of herbs (rarely shrubs or trees), cosmopolitan, but especially north temperate. Hydrocotyle is more closely related to Araliaceae, and has been transferred there (Chandler & Plunkett 2004). References: Mathias & Constance (1945)=MC. [also see ARALIACEAE]

**Identification notes:** The Apiaceae is an easy family to recognize (with some exceptions). These are herbs, typically with a clasping petiole base and often a variously (and often highly) compound leaf, either 1-5× pinnately, palmately, pinnately-ternately, or ternately compound (less commonly simple or phyllodial). The inflorescence is typically a simple or compound umbel (sometimes subcapitate or truly modified into a head) with numerous small flowers. Subtending the inflorescence is (usually) an involucre of individual bracts. If the umbel is compound, rays support umbellets, each of which may be subtended by an involucel of individual bractlets. The ovary is 2-carpellate, with 2 styles at the summit, these often swollen at the base into a stylopodium capping the ovary. The fruit develops into 2 mericarps, united by their faces at the commissure; each mericarp may be terete, flattened dorsally (parallel to the commissure, the commissure therefore broad), or flattened laterally (perpendicular to the commissure, the commissure therefore narrow). Each mericarp has 5 primary ribs, one down the back (the dorsal rib), 2 near each edge near the commissure (the lateral ribs or lateral wings), and 2 in-between (the intermediate ribs). The ribs may be thin and filiform in ×-section, corky, or winged, and they (or the entire outer surface of the mericarp) may also be ornamented with hairs, spines, uncinate prickles, etc.

1 Principal leaves either all simple (though sometimes palmately or pinnately lobed) or those that are basally disposed simple (those on the upper stem sometimes compound) .. **Key A**
1 Principal leaves all variously compound (small bracteal leaves on the upper stem sometimes reduced and simple).
2 Leaves 1-palmately or 1-pinnately compound (all leaflets attached to the summit of the petiole or to the primary inflorescence rachis).
3 Leaves 1-palmately compound, all of the 3-7 leaflets attached to the summit of the petiole **Key B**
3 Leaves 1-pinnately compound, all of the 3-13 leaflets attached to a primary inflorescence rachis

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**Key C**
2 Leaves 2-5× compound.
4 Leaves 2-4× pinnately or pinnately-ternately compound, the ultimate segments consisting of relatively few (usually < 25), discreet, typically broad (elliptic, ovate, or lanceolate) leaflets

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**Key D**
4 Leaves 2-5× pinnately or pinnately-ternately decompound, the ultimate segments either linear (and then flat or angled in ×-section) or broader, but then very many (> 50) and often imperfectly separated from one another .......................................................... **Key E**