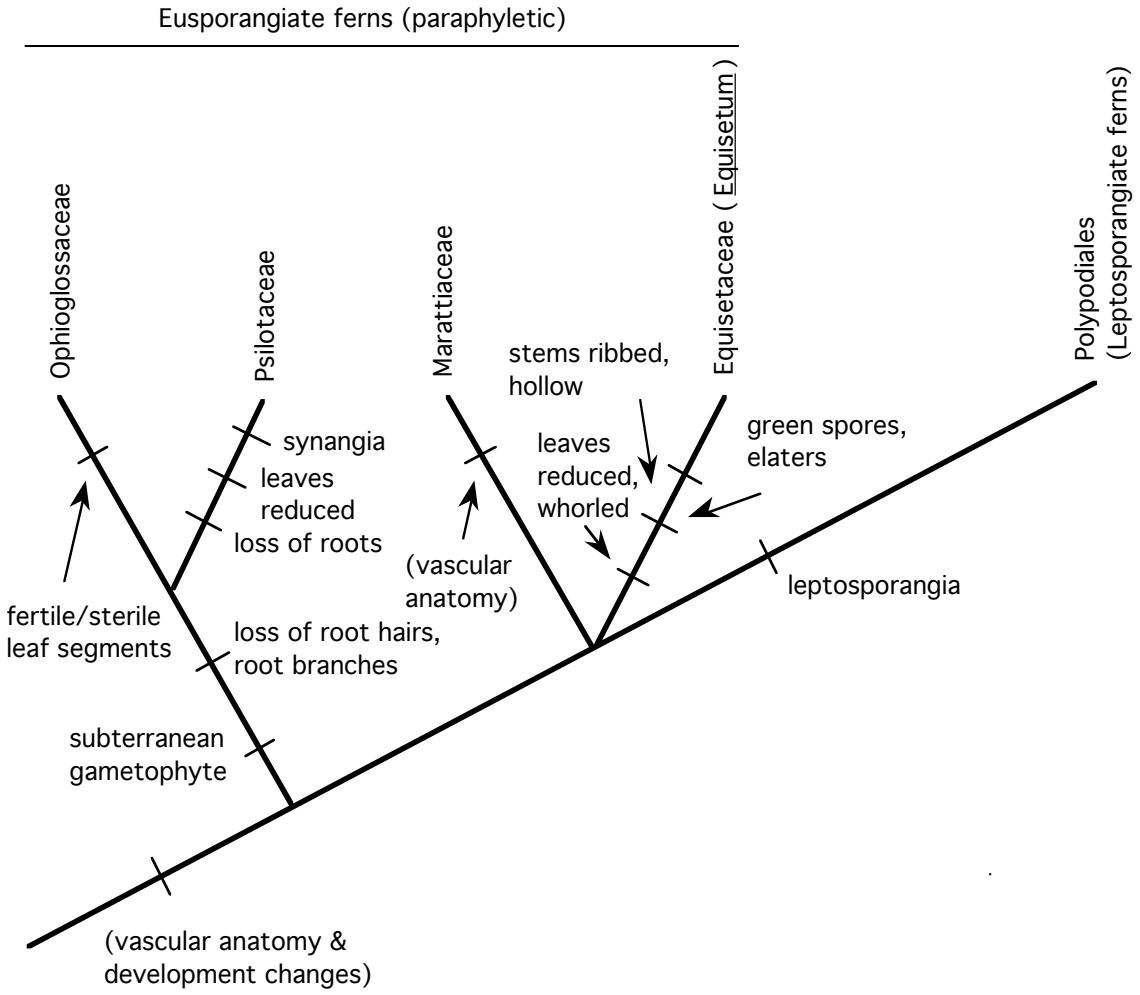


Polypodiales = Leptosporangiate ferns (lepto = delicate or narrow)

Polypodiales (approx. 12,000 species)
The vast majority of ferns (~3% of tracheophytes); treated in 25-50 families
A well-supported monophyletic group.
Worldwide in distribution; most diverse in tropics (where high humidity; equable climate year-round and through time).
Ancient (date back to Paleozoic) but most modern fern diversity ("higher leptosporangiate ferns") arose much more recently, at same time that flowering plants diversified, in late Mesozoic (beginning around 130 million years ago). Possibly the environments created by flowering plants were important for success of most modern ferns.

Some diagnostic (synapomorphic) characteristics of leptosporangiate ferns
Reduction in size of sporangia; entire sporangium develops from 1 initial cell (eusporangia are larger and develop from several initial cells)

Reduction in sporangial wall to 1 cell layer (eusporangia with wall >1 cell layer thick)
Reduction in number of spores/sporangium; <1000, often <100 (>1000 in eusporangia of homosporous ferns)
Evolution of annulus -- specialized set of cells with thickened radial and inner walls involved in sporangial dehiscence and often catapult-like release of spores.
Evolution of sporangial stalk

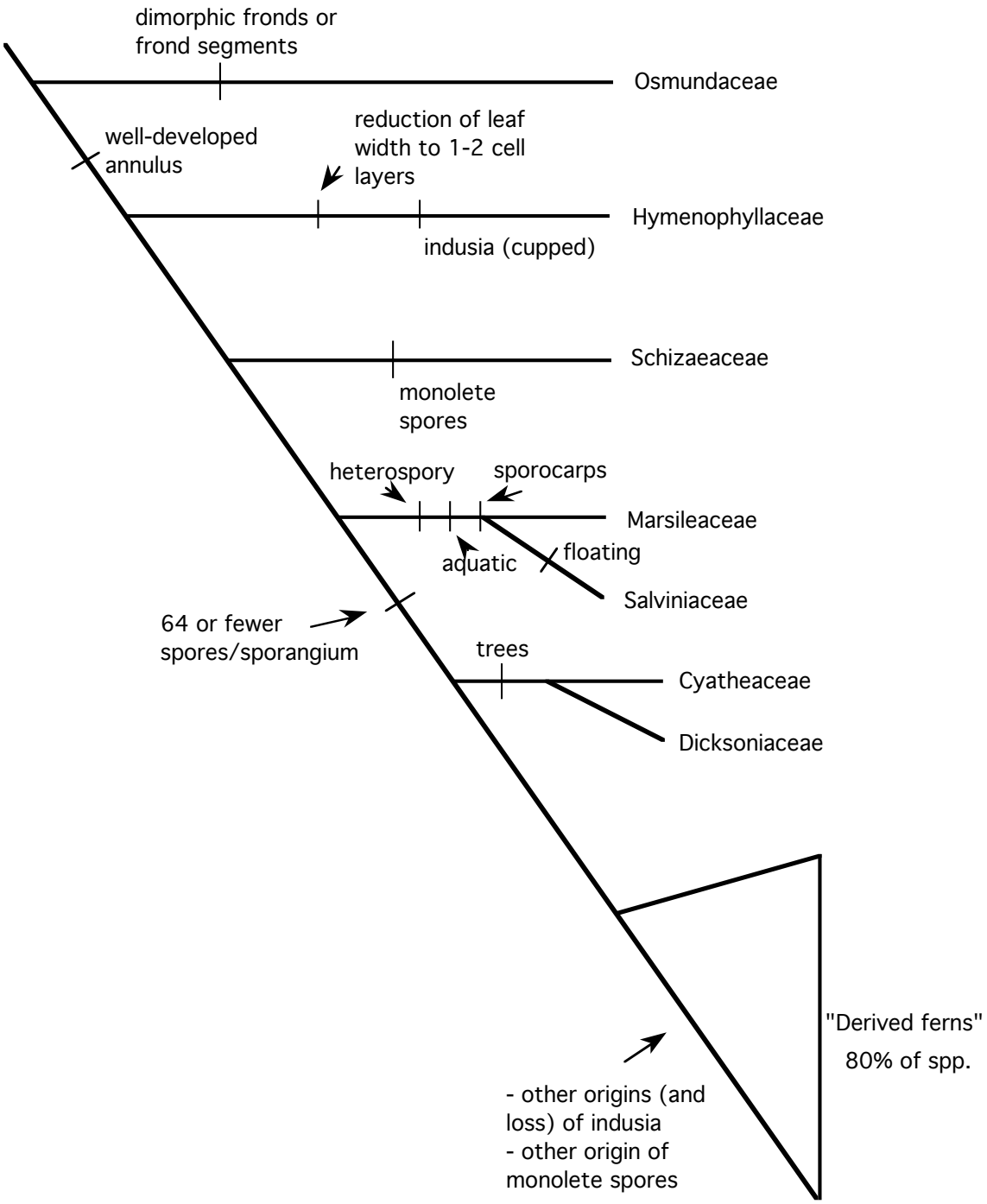
Type of annulus differs among leptosporangiate fern families; good diagnostic characteristics for different groups.

As annulus cells dry, the outer walls collapse, water cohesion places tension on cells outside annulus, sporangium cracks open, recoils, and flings spores away.

Other features of leptosporangiate ferns
Circinate vernation (leaves coiled in bud; unroll as emerging); plesiomorphic (also in Marattiaceae)
Sporangia often organized into clusters called sori (singular, sorus) on abaxial (under-) surface of leaves, sometimes shielded by outgrowth of abaxial surface of leaf called an indusium (plural, indusia). Indusium dries and shrivels at time of sporangial dehiscence (doesn't interfere with dispersal of spores). These features evolved after onset of diversification of modern leptosporangiate ferns (indusia appear to have evolved repeatedly; homoplastic)
Gametophytes free-living, often heart-shaped, green, lying flat on ground, bisexual (most leptosporangiate ferns are homosporous)
Chromosome numbers often high, possibly from extensive hybridization and polyploidy.

Evolutionary trends in leptosporangiate ferns based on phylogenetic relationships
Heterospory derived in water ferns; evolution of sporocarp, which germinates to exude gelatinous sporophore, with numerous megasporangia and microsporangia
Tree ferns monophyletic and derived from herbaceous ancestors
Net-like (reticulate) venation of leaves derived from dichotomous leaf venation
Simple, entire leaves derived from dissected or compound ancestral condition
Scales (>1 cell layer wide) derived from hairs (1 cell layer wide)
Sori on underside of leaves derived; sori at leaf margins ancestral
Indusia derived (naked sori ancestral); evolved multiple times (& very diverse in form)
Monolete spores derived (trilete spores ancestral); evolved multiple times

Relationships among major lineages on next page


dimorphic fronds or
frond segments
Osmundaceae
well-developed
annulus
reduction of leaf
width to 1-2 cell
layers
Hymenophyllaceae
indusia (cupped)
Schizaeaceae
monolete
spores
heterospory
sporocarps
Marsileaceae
aquatic
floating
Salviniaceae
64 or fewer
spores/sporangium
trees
Cyatheaceae
Dicksoniaceae
"Derived ferns"
80% of spp.
- other origins (and
loss) of indusia
- other origin of
monolete spores