Laboratories 4 & 5: Leptosporangiate Ferns

These two labs cover some of the major families of leptosporangiate ferns (see Lab #3 for a chart that distinguishes between eusporangiate and leptosporangiate ferns), sometimes called the “higher ferns” or “true ferns.” This is a group that contains 30-50 families and ~10,000 extant species. After the leptosporangiate fern labs you should be familiar with the common types of indusia (peltate, reniform, tubular, laterally attached, false, etc.), the two major categories of spores (trilete and monolete), annulus types (patch, apical, oblique, vertical, etc.), and other features that help distinguish the major groups of leptosporangiate ferns. See p. 87-92 in the Simpson text for more information.

PTERIDOPHYTES: Part II – Leptosporangiate Ferns

**Osmundaceae** – 3 genera, ~25 spp., temperate and tropical, terrestrial
Homosporous; **fertile and sterile fronds present (dimorphic fronds) or frond divided into sterile and fertile regions**; stipules often present at base of stipe; indusia lacking; no distinct or well-developed annulus; **many spores** per sporangium (>128), sporangia spherical; **spores green**, trilete

- *Osmunda*
- *Todea*

**Hymenophyllaceae** – 2-34 genera (depending on circumscription), ~600 spp., tropical, epiphytic or terrestrial
Homosporous; **leaves only one or two cell layers thick**; indusia present (cup-like or tubular); stomata lacking; **sori located at the margin of the leaves**; annulus oblique; **spores green**, trilete

- *Hymenophyllum*
- *Trichomanes*

**Schizaeaceae** – 4 genera, ~175 spp., tropical, terrestrial, commonly climbing vines
Homosporous; leaves indeterminate and climbing in *Lygodium*; **dichotomous branching and venation**; sporangia occur singly (i.e. not grouped into sori), marginal, **on stalks at blade tips or on pinnae lobes**; indusia absent (except in *Lygodium*); annulus apical; spores monolete

- *Lygodium*
- *Schizaea*

**Marsileaceae** – 3 genera, ~80 spp., tropical and temperate
**Heterosporous**; sori are enclosed within a **sporocarp** (microsporangia and megasporangia within the same sporocarp), which is stalked and arises from the rhizome or petiole; root-aquatic (often with floating leaves) or terrestrial; spores trilete

- *Marsilea*
- *Pilularia*
Salviniaceae – 2 genera, ~13 spp. tropical
  Heterosporous; sori are enclosed within a sporocarp (microsporangia and
  megasporangia in different sporocarps); in Salvinia, leaves in whorls of
  three, one of the three leaves resembles a submerged "root"; in Azolla, leaves
  divided into two lobes, one photosynthetic (with cavities that house the
  nitrogen-fixing cyanobacteria *Anabaena*), the other submersed and non-
  photosynthetic; all are free-floating aquatic, spores trilete
  *Salvinia*
  *Azolla*

* Families below this point have 64 or fewer spores per sporangium

Cyatheaceae – 4 genera, ~650 spp., tropical “Tree Ferns”
  Homosporous; generally arborescent; numerous scales and sometimes hairs
  present at leaf bases; indusia various or lacking, but not as in Dicksoniaceae;
  spores trilete
  *Cyathea*
  *Alsophila*

Dicksoniaceae – 6 genera, ~20 spp., tropical “Tree Ferns”
  Homosporous; arborescent; lacking scales but with hairs at leaf bases;
  indusium present, bivalvate, usually half composed by a reflexed portion of
  the margin (often colored differently), sometimes cup-shaped; spores trilete
  *Dicksonia*

Pteridaceae – ~40 genera, ~1000 spp., temperate to tropical, also in arid regions
  Homosporous; sporangia typically aggregated in lines along the veins or near
  the leaf margin; no indusium or a "false" indusium present, formed by
  reflexed margin; scales or glandular hairs often present; annulus typically
  vertical, interrupted; trilete spores; few spores per sporangium (usu. 32-64);
  spores dark in color (i.e. black, brown or gray), not green, trilete
  *Adiantum*
  *Cheilanthes*
  *Pellaea*

Aspleniaceae – ~8 genera, ~700 spp., temperate and tropical
  Homosporous; stems typically covered with scales; sporangia located on
  veins and are covered by laterally-attached indusia; sori usually linear,
  oblique to costa, typically open away from costa; spores monolete
  *Asplenium*

Blechnaceae – ~10 genera, ~300 spp., terrestrial or epipetric
  Homosporous; blades often reddish in color when young; sori linear, or
  clustered so as to form "chains", parallel to costa; indusia present, opening
  inward (i.e. toward the costa); spores monolete
  *Blechnum*
  *Woodwardia*
**Dryopteridaceae** – ~40 genera, ~1500 spp., temperate and tropical
Homosporous; **scales** present on stems; indusia usually present, **reniform** (kidney-shaped) or **peltate**, sometimes lacking or “acrostichoid” (spread densely over abaxial surface); sori generally not located along the leaf margin; leaves often highly dissected, **annulus vertical**, spores monolete

**Dryopteris**
**Polystichum**

**Polypodiaceae** - homosporous; **sori round** (sometimes elongate or acrostichoid) **and lacking an indusium**; annulus vertical and interrupted; net-like venation pattern; **leaves generally simple or pinnatifid**; plants often epiphytic, **annulus vertical**; spores monolete, usually yellow

**Lecanopteris**
**Polypodium**

<table>
<thead>
<tr>
<th>Family</th>
<th>Annulus</th>
<th>Indusium</th>
<th>Spore</th>
</tr>
</thead>
<tbody>
<tr>
<td>Osmundaceae</td>
<td>Patch/Not Distinct</td>
<td>None</td>
<td>Trilete, Green</td>
</tr>
<tr>
<td>Hymenophyllaceae</td>
<td>Oblique</td>
<td>Cup-Shaped or tubular</td>
<td>Trilete, Green</td>
</tr>
<tr>
<td>Schizaceae</td>
<td>Apical</td>
<td>None (except in <em>Lygodium</em>)</td>
<td>Monolete</td>
</tr>
<tr>
<td>Marsileaceae</td>
<td>N/A – In sporocarp</td>
<td>N/A</td>
<td>Trilete, Heterosporous</td>
</tr>
<tr>
<td>Salviniaeae</td>
<td>N/A – In sporocarp</td>
<td>N/A</td>
<td>Trilete, Heterosporous</td>
</tr>
<tr>
<td>Cyatheaceae</td>
<td>Oblique</td>
<td>Various (including lacking), but not as <em>Dicksoniaceae</em></td>
<td>Trilete</td>
</tr>
<tr>
<td>Dicksoniaceae</td>
<td>Oblique</td>
<td>Bivalvate or cup-shaped</td>
<td>Trilete</td>
</tr>
<tr>
<td>Pteridaceae</td>
<td>Vertical</td>
<td>False or none, (some acrostichoid)</td>
<td>Trilete</td>
</tr>
<tr>
<td>Aspleniaceae</td>
<td>Vertical</td>
<td>Laterally-attached, usually linear, typically opening away from costa</td>
<td>Monolete</td>
</tr>
<tr>
<td>Blechnaceae</td>
<td>Vertical</td>
<td>Laterally-attached, linear, opening towards costa</td>
<td>Monolete</td>
</tr>
<tr>
<td>Dryopteridaceae</td>
<td>Vertical</td>
<td>Reniform or peltate, occasionally laterally attached, (rarely lacking)</td>
<td>Monolete</td>
</tr>
<tr>
<td>Polypodiaceae</td>
<td>Vertical</td>
<td>None</td>
<td>Monolete</td>
</tr>
</tbody>
</table>
OSMUNDACEAE. OSMUNDA FAMILY

Fig. 46. OSMUNDACEAE. A. Osmunda cinnamomea: Aa, habit, much reduced; Ab, segments of fertile frond, x 3; Ac, sporangia, x 10. B. Osmunda Claytoniana: Ba, habit, much reduced; Bb, portion of frond with sterile (s) and fertile (f) segments, x ½. (From L. H. Bailey, Manual of cultivated plants, The Macmillan Company, 1949. Copyright 1924 and 1949 by Liberty H. Bailey.)

Hymenophyllaceae. Filmy Fern Family

Fig. 49. Hymenophyllaceae. Trichomanes Boschi: a, rhizome and fronds, x ½; b, fertile pinna, x 3; sporangium, x 50; d, fertile segment with sporangium and indusium, x 6.

Fig. 47. Schizaceae. Lygodium palmatum: a, plant, x ½; b, section of frond showing sterile (s) and fertile (f) pinnae, x ½; c, fertile segments, x 2; d, sporangia covered by indusium, x 5; e, sporangia with indusium cut and opened back, x 10. (From L. H. Bailey, Manual of cultivated plants, The Macmillan Company, 1949. Copyright 1924 and 1949 by Liberty H. Bailey.)

Fig. 53. Marsileaceae. Marsilea quadrifolia: a, portion of plant, x ½; b, sporocarps, c, germinating sporocarp, sorus pendent from gelatinous tissue, x 1½; d, sorus, seen from below, showing large megaspores surrounded by smaller microspores, x 8.

From Lawrence's Taxonomy of Vascular Plants
SORI, INDUSIA, AND FALSE INDUSIA

exindusiate sorus
round indusium (pellate)
kidney-shaped indusium (reniform)
linear sorus and indusium
sorus with cup-shaped indusium
linear sori near costa (pericostal)
marginal false indusia, long-linear
bivalvate indusium (involute)
conical (tubular) indusium (involute)
marginal false indusium, short
synangium

(figure from Palmer. 2003. Hawaii’s Ferns & Fern Allies)
MARSILEACEAE (*Marsilea quadrifolia*) extrusion of gelatinous cylinder (sorophore) to which sori are attached

Glossary: Leptosporangiate Ferns
Definitions from Simpson (2006), Plant Systematics

**abaxial:** the lower or outer surface of an organ – *syn.* dorsal

**acrostichoid:** having sporangia spread densely over the abaxial surface of a lamina

**adaxial:** the upper or inner surface of an organ – *syn.* ventral

**annulus:** a single row of specialized cells, having differentially thickened cell walls, on the outer rim of a leptosporangium, functioning in its dehiscence

**caudex** (*pl.* caudices or caudices): a short, thick, vertical or branched perennial stem, underground or at/near ground level – *e.g.* in Cyatheaceae and Dicksoniaceae

**circinate vernation:** the manner in which new fern fronds emerge (*i.e.* from a coiled fiddlehead)

**costa** (*pl.* costae): midrib

**crozier:** see fiddlehead

**exindusiate:** lacking an indusium

**false indusium:** an extension of the blade margin that overlaps the sorus of a leptosporangiate fern

**fiddlehead:** a leaf that is coiled during its development, characteristic of the leptosporangiate ferns (Polypodiales) and Marattiales – *syn.* crozier

**frond:** fern leaf

**indusium:** a flap of tissue that covers a sorus, found in some leptosporangiate ferns

**leptosporangium:** the sporangium of the leptosporangiate ferns (Polypodiales), characterized by developing from a single cell and having a single layer of cells making up the sporangium wall

**paraphysis** (*pl.* paraphyses): a sterile filament or hair borne among sporangia

**pinna** (*pl.* pinnae): the first discrete leaflets or blade divisions of a fern frond.

**pinnatifid:** pinnately lobed to divided

**pinnatisect:** pinnately divided, almost into discrete leaflets but confluent at the midrib

**pinnule:** the ultimate divisions or leaflets of a fern frond

**receptacle:** in ferns, the cushion of tissue bearing the sporangia (often exserted in Trichomanes)

**sorus** (*pl.* sori): a discrete cluster or aggregation of leptosporangia

**sporocarp:** the generally spherical reproductive structure of aquatic ferns, functioning in allowing the sporangia inside to remain dormant and resist desiccation for a long time

**stipe:** a leaf stalk in ferns – *syn.* petiole