

## **BIOLOGY 322: FERNS & LYCOPHYTES: DIVERSITY & BIOLOGY**

**INSTRUCTOR:** Michael W. Hawkes, BioSc. Rm. 2526, Ph. 604-822-5430,  
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**TIME & PLACE:** Tue. & Thurs. 9:00 a.m.-11:50; BioSc. Rm. 3009 (both lecture & lab)

*“My sense of a prehistoric world, of immense spans of time, was first stimulated by ferns and fossil ferns.”*

- Oliver Sacks, 2002: 9. *Oaxaca Journal*

### **COURSE SYNOPSIS: Lecture & Lab**

Biology 322 will investigate the natural history and biology of spore-bearing vascular plants (both living and extinct). Starting with the transition to land by a charophycean green algal ancestor, we will re-evaluate extinct plants of the primary terrestrial radiation – the rhyniophytes, zosterophyllophytes, and trimerophytes – in light of recent advances in our understanding of these groups. Both major clades of living vascular plants contain spore-bearing taxa:

1. Lycophytes (all taxa are spore-bearing), and 2. Euphyllophytes (spore-bearing taxa and seed-bearing taxa [spermatophytes]). Spore-bearing members of the euphyllophytes are treated as a more broadly circumscribed ‘ferns’ (monilophytes) with 5 major lineages: whisk ferns, ophioglossoid ferns, horsetails, marattioid ferns, and leptosporangiate ferns.

We will examine key morphological, anatomical, reproductive, ecological and biogeographic features of representatives from the main lineages. Other aspects of fern and lycophyte biology that will be discussed include reproductive biology and population genetics, physiology, biochemistry, and uses. In addition to lab investigation, which emphasizes morphological and reproductive diversity, there will be a field trip to study native ferns in habitat. We will use a taxon-based framework to look at all levels of organization, from molecules to ecosystems (see paper by Wilson, 1989\*).

### **OBJECTIVES:**

- To give the student an integrated picture, from an organismal perspective, of the spore-bearing vascular plants (both living and extinct)
- To raise awareness of the significance of spore-bearing vasculars in the evolutionary history of land plants and their important contributions to past and present ecosystems.

*“...we therefore prefer to use the terms **monilophytes** (or quite simply, a more inclusive, **ferns**) and **lycophytes**, which specify clade membership, to the terms “pteridophytes” and “ferns and fern allies” that unite paraphyletic assemblages of plants.”*

- Pryer et al., 2004

**DISTRIBUTION OF GRADES:**

Mid-term lecture exam	20% (Thurs. 9 Feb)
Mid-term lab exam	25% (Tue. 21 Feb)
Final lab exam	25% (Tue. 4 April)
Final lecture exam	30% (TBA)

“...valuable insights for understanding the origin and biodiversity of groups such as flowering plants could be gained from a solid understanding of homosporous lineages.”

- C. Haufler, 2002

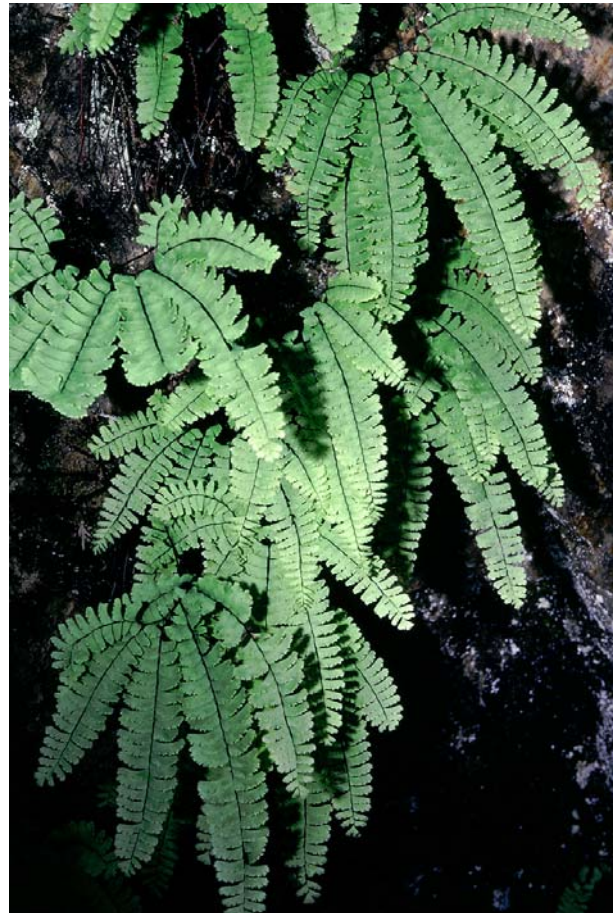
**TEXTBOOK:** None, you will be provided with a reference list of major literature, most of which will be on Reserve at Woodward Library. In addition, you will be given references to the journal literature during lectures.

**BIOL 322 Lab Manual:** available during 1<sup>st</sup> week of class.

\*Wilson, E.O. 1989. The coming pluralization of biology and the stewardship of systematics. *BioScience* 39: 242-245.



*Sphaeropteris medullaris* – New Zealand



*Adiantum aleuticum* – British Columbia

Photos: Michael W. Hawkes

## **LECTURE SCHEDULE 2006**

**Note: Sequence of lectures subject to change**

### **JANUARY**

- Th 5** • Course scope & organization. Introduction to ferns & lycophytes and their place in the Green Plant Tree-of-Life
- Salient features of vascular plant anatomy with emphasis on ferns & lycophytes
- T 10** • Introduction to reproductive biology of ferns & lycophytes
- They came from the sea: origin of land plants from green algae, including comments on life history evolution
- Th 12** • Types of fossils & how they form
- The primary terrestrial radiation: Early Silo-Devonian land plants
  - Phylum Lycopodiophyta (Part 1: Homosporous groups). Extant members of this ancient land plant lineage
- T 17 Labs 1 & 2**
- Th 19** • Lycopodiophyta (Part 2: Heterosporous, ligulate groups)
- The Monilophytes, an enlarged 'ferns', Phylum Polypodiophyta: Overview
  - Ancient & enigmatic fern lineages Part 1: the Horsetails (Class Equisetopsida)
  - **SLIDE SHOW #1:** Introduction to extant lycophytes and ferns from an ecological perspective
- T 24 Labs 3 & 4**
- Th 26** • Ancient & enigmatic fern lineages Part 2: Whisk ferns (Psilotales), ophioglossoid ferns (Ophioglossales), & marattioid ferns (Marattiales)
- Leptosporangiate ferns: Filicales overview, including Osmundaceae
- T 31** • Carboniferous Park: Extinct arborescent lycophytes and horsetails
- Lab 5** (approx. 1.5 hrs)

### **FEBRUARY**

- Th 2** • **SLIDE SHOW #2:** Ferns & lycophytes in the wild: New Zealand, Australia, Hawai'i, Ecuador & British Columbia
- T 7 Labs 6, 7**
- Th 9** • **LECTURE MID-TERM EXAM (50 min)**

### **MID-TERM BREAK 14-17 FEBRUARY**

#### **T 21 LAB MID-TERM EXAM**

- Th 23** • Fern & lycophyte breeding systems: Introduction, terminology, cytogenetics, isozyme electrophoresis
- T 28 Labs 8 & 9**

### **MARCH**

- Th 2** • Fern & lycophyte breeding systems: (cont.)

Polyploidy & gene silencing; Hybridization, polyploidy & reticulate evolution

**T 7 Labs 10 & 11**

- Th 9** • Water ferns Part 1  
• Water ferns Part 2

**T 14 Lab 12**

**Th 16 • Special Topics on:** 'Organism – environment integration at a morphological, anatomical, ultrastructural, physiological, & biochemical level.'

- Photosynthesis in deep shade
- CAM photosynthesis in ferns & lycophytes

**T 21 Labs 13 & 14**

**Th 23 • Special topics (continued):**

- Arid land ferns & lycophytes: 'glass-phase' & the resurrection plant
- Ant-fern interactions (myrmecophytic ferns)

**T 28 Lab 15**

**Th 30** • Guest lecture: Dr. Hardeep Rai - Phylogeny & systematics overview

## APRIL

**T 4 LAB EXAM**

**Th 6** • Final exam review; teaching evaluations

**FINAL LECTURE EXAM** (to be scheduled by the Registrar's Office)



*Lycopodiella cernua* – Hawai'i



*Isoetes howellii* – British Columbia

Photos: Michael W. Hawkes

## **LAB SCHEDULE – 2006**

### **JANUARY**

- Th 5** Lecture  
**T 10** **No lab (extra lecture time)**  
**Th 12** Lecture  
**T 17** **Lab 1:** Paleobotany I. The Primary Terrestrial Radiation: Early Silo-Devonian Land Plants (extinct fossil taxa)  
**Lab 2:** Extant Lycopodiophyta, Part 1: Homosporous lycopods  
**Th 19** Lecture  
**T 24** **Lab 3:** Extant Lycopodiophyta, Part 2: Heterosporous, ligulate lycopods  
**Lab 4:** Ancient ferns from the abyss of deep time, Part 1: the horsetails (Polypodiophyta, Equisetopsida)  
**Th 26** Lecture  
**T 31** Lecture and  
**Lab 5:** Paleobotany II: Carboniferous Park. Extinct arborescent lycophytes & horsetails

### **FEBRUARY**

- Th 2** Lecture  
**T 7** **Lab 6:** Ancient ferns from the abyss of deep time, Part 2: Whisk ferns (Psilotales) & Ophioglossoid ferns (Ophioglossales)  
**Lab 7:** Ancient ferns from the abyss of deep time, Part 3: Marattioid ferns (Marattiales)  
**Th 9** **LECTURE MID-TERM EXAM (50 minutes)**

### **MID-TERM BREAK 14-17 FEBRUARY – NO LABS**

- T 21** **LAB MID-TERM EXAM**  
**Th 23** Lecture  
**T 28** **Lab 8:** Ancient leptosporangiate ferns — osmundaceous ferns (Osmundaceae) & filmy ferns (Hymenophyllaceae)  
**Lab 9:** Gleichenioid ferns (Gleicheniaceae & Matoniaceae)

### **MARCH**

- Th 2** Lecture  
**T 7** **Lab 10:** Schizaeoid ferns (Schizaeaceae)  
**Lab 11:** Tree ferns (Cyatheaceae & Dicksoniaceae)  
**Th 9** Lecture  
**T 14** **Lab 12:** Water ferns (Marsileaceae & Salviniaceae)  
**Th 16** Lecture  
**T 21** **Lab 13:** Polypod ferns, Part 1: (Dennstaedtiaceae & Pteridaceae)  
**Lab 14:** Polypod ferns, Part 2: (Dryopteridaceae & Davalliaceae)  
**Th 23** Lecture  
**T 28** **Lab 15:** Polypod ferns, Part 3: (Aspleniaceae, Blechnaceae & Polypodiaceae)  
**Th 30** Lecture

### **APRIL**

- T 4** **FINAL LAB EXAM**  
**T 6** Final exam review; teaching evaluations