EEB461 – Perspectives in Ecology and Evolutionary Biology of Fungi

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Meetings: Tues, Thur 11:10 am – 12:25 pm; Dabney 488

Office hours (Matheny): by appointment.
Office hours (Harrower): by appointment.

Blackboard site: https://blackboard.utk.edu/

There is no textbook associated with the course. Readings will be posted as PDFs on Blackboard.

Scope
This course will introduce students to ecology and evolutionary biology of fungi, revealed mostly through use of molecular techniques. Many fungi, and the ecological roles they serve, are often obscure due to their ephemeral nature, difficulty of detection, and convergent gross morphological similarities. Despite these limitations, advances in molecular biology have uncovered an unanticipated depth of diversity in fungi and permitted scientists to address research questions not possible until only recently. This seminar will provide an overview of the revolution in fungal evolution and ecology by examining the primary literature, most of it published recently with an occasional mixture of classic papers that have withstood the test of time.

Course learning objectives
(1) Be able to read and interpret scientific texts, figures, and tables.
(2) Learn the five 'big ideas' in biology and how to identify them in the scientific literature.
(3) Identify biological scenarios that incorporate the 'big ideas' in biology.
(4) Be able to discuss the depth of fungal taxonomic diversity.
(5) Explain how ecology and evolution shapes fungal genetic diversity.
(6) Be able to discuss functional diversity of fungi in ecological contexts.
(7) Improve your writing.

Format, Expectations, and Grading
The course is organized around three major themes of biodiversity: taxonomic, genetic, and functional diversity. Several years ago the National Science Foundation announced a campaign to fund proposals that intersect these three topics and to spur research that integrates these disparate disciplines. The course will begin with several background lectures providing an introduction and background to fungal biology, fungal ecology, and methods of evolutionary analysis. When necessary, background material may also be presented before discussion of assigned readings. In total, approximately thirty papers from the primary literature will be assigned for reading and student-led discussions. This sounds like a lot (it is!), but because of

the amount of reading, writing, and discussion required, there will be only two take-home exams. As a conciliatory note, most paired readings include a main research paper preceded by a short commentary paper or paired with a short *Science* or *Nature* paper.

A short quiz will be presented at the beginning of each class to which a reading has been assigned. This will ensure that students come to class having read and understood the material. Quiz questions may also serve as points of discussion.

Students will submit one research paper that summarizes and synthesizes each major theme of the course (taxonomic, genetic, and functional diversity). Details about paper guidelines and expectations will be forthcoming.

Grades are based on quizzes, the research paper, and the two take-home exams. Up to five points will be assigned for each quiz. Roughly, a total of 25 quizzes will be given. The two lowest scores will be discarded. Thus, up to 115 quiz points are possible. The research paper will be worth 100 points. The two take-home exams, based on materials presented in lecture and topics presented in the papers, will constitute 75 points each. These will be primarily a mixture of short answer and essay questions. Thus, 365 total points are possible.

Field trip(s)

If the weather is conducive, field trips will be planned to introduce students to fungi in the field. Excursions will likely be a half-day affair during the morning on non-home football weekends. Possible dates include **Sep 10**, **Oct 1, Oct 8, Oct 22, and/or Oct 29**.

Five 'big ideas' in biology – the FBIs

You will be expected to routinely apply the five 'big ideas' or FBIs in biology to various biological scenarios introduced in the course. In addition, if given a biological scenario, you should be able to recognize and explain any of the big ideas.

(1) ***Evolution***: Populations of organisms and their cellular components have changed over time through both selective and non-selective evolutionary processes.
(2) ***Structure and Function***: All living systems (organisms, ecosystems, etc.) are made of structural components whose arrangement determines the function of the systems.
(3) ***Information Flow and Storage***: Information (DNA, for example) and signals are used and exchanged within and among organisms to direct their functioning.
(4) ***Transformation of Energy and Matter***: All living things acquire, use, and release matter and energy for cellular / organismal functioning.
(5) ***Systems***: Living systems are interconnected, and they interact and influence each other on multiple levels.

Disability Statement

The Office of Disability Services (ODS) is committed to providing equal opportunities for students with disabilities at the University of Tennessee. Appropriate accommodations will be made to enable persons with disabilities to satisfy the General Education requirements. EEB409 is a WC or writing-intensive course. Students with documented disabilities should contact the Office of Disability Services for assistance with appropriate accommodations at (865) 974-6087 or *ods@tennessee.edu*.

Class Schedule EEB461 Fall 2016 (tentative and subject to change)

No.	Date	Topic
01	Th Aug 18	Course organization Lecture 1: Introduction to fungal biology
02	Tu Aug 23	Lecture 2: Ecological roles of fungi / Molecular techniques and characters used in fungal molecular ecology
03	Th Aug 25	Lecture 3: Phylogeny reconstruction and tree thinking
04	Tu Aug 30	**Section I: Taxonomic diversity of fungi** - Fungal diversity – an overview - How many fungal species are known?
05	Th Sep 1	**No class**
06	Tu Sep 6	Global diversity and distribution of macrofungi
07	Th Sep 8	How to know unknown fungi: the role of a herbarium
08	Tu Sep 13	- Fungal ecology catches fire (commentary) - Species abundance distributions and richness estimations in fungal metagenomics – lessons learned from community ecology
09	Th Sep 15	- Scaling up: examining the macroecology of ectomycorrhizal fungi (commentary) - Global diversity and geography of soil fungi
10	Tu Sep 20	Global diversity and distribution of arbuscular mycorrhizal fungi
11	Th Sep 22	Evolutionary criteria outperform operational approaches in producing ecologically relevant fungal species
12	Tu Sep 27	**Section II: Genetic diversity of fungi** Species and speciation in fungi
13	Th Sep 29	- Eukaryotic microbes, species recognition and the geographic limits of species: examples from the Kingdom fungi - The fungus *Armillaria bulbosa* is among the largest and oldest living organisms
14	Tu Oct 4	The ectomycorrhizal fungus *Amanita phalloides* was introduced and is expanding its range on the west coast of North America **Hand out mid-term take-home exam**
	Th Oct 6	**Fall Break – no class**
15	Tu Oct 11	Frequent circumarctic and rare transequatorial dispersals in the lichenised agaric genus *Lichenomphalia*
16	Th Oct 13	Phylogeographic analyses of a boreal-temperate ectomycorrhizal basidiomycete, *Amanita muscaria*, suggest forest refugia in Alaska during the last glacial maximum **Take-home mid-term exam due**
17	Tu Oct 18	The genetic diversity of arbuscular mycorrhizal fungi in natural ecosystems – a key to understanding the ecology and functioning of the mycorrhizal symbiosis
18	Th Oct 20	Evolutionary ecology of pungency in wild chilies
19	Tu Oct 25	Bread, beer and wine: *Saccharomyces cerevisiae* diversity reflects human history
20	Th Oct 27	**Section III: Functional diversity of fungi** Mycorrhizal fungi: their habitats and nutritional strategies
21	Tu Nov 1	Mycorrhizal vs saprotrophic status of fungi: the isotopic evidence
22	Th Nov 3	Decomposers in disguise: mycorrhizal fungi as regulators of soil C dynamics in ecosystems under global change
23	Tu Nov 8	Friend or foe? Evolutionary history of glycoside hydrolase family 32 genes encoding for sucrolytic activity in fungi and its implications for plant-fungal

		symbioses
24	Th Nov 10	The irreversible loss of a decomposition pathway and the single origin of an ectomycorrhizal symbiosis **Research paper (first draft) due**
25	Tu Nov 15	Ectomycorrhizal fungi – potential organic matter decomposers, yet not saprotrophs
26	Th Nov 17	The Paleozoic origin of enzymatic lignin decomposition reconstructed from 31 fungal genomes
27	Tu Nov 22	Mycorrhizas and nutrient cycling in ecosystems – a journey towards relevance?
	Th Nov 24	**Thanksgiving 24-25 Nov – no class**
28	Tu Nov 29	Mushrooms and society - A fungal perspective on conservation biology - California porcini: three new taxa, observations on their harvest, and the tragedy of no commons **Hand out take-home exam**
29	Th Dec 1	**Research paper (final draft) due**
	Mon Dec 5	**Take home exam due at 10:15 am**

Grading scale EEB461, fall semester 2016

Percentage of total points (600)	Letter grade	Scale
94-100	A	4.0
91-93	A-	3.7
88-90	B+	3.3
84-87	B	3.0
81-83	B-	2.7
78-80	C+	2.3
74-77	C	2.0
71-73	C-	1.7
68-70	D+	1.3
64-67	D	1.0
61-63	D-	0.7
<61	F	0.0