

Program Description The Fungal Kingdom Fall, 2006

The Fungal Kingdom was a junior/senior-level program that focused on the biology and ecology of lichens and fungi. We covered the material through lectures, discussions, group activities, study questions and other written work, labs, and extensive field trips. Students finished the quarter with proficiency in and/or knowledge of:

- Mushroom taxonomy and identification;
- Lichen taxonomy and identification;
- Ecology and biology of fungi;
- Ecology and biology of lichens;
- Microscope skills, including slide preparation and oil immersion;
- Technical writing skills;
- Library research skills;
- Presentation skills— oral and written communication;
- Critical thinking as demonstrated through writing projects and discussions.

In addition to two extended field trips—the OR coast and Mt. Adams—we took several one-day field trips and students collected specimens on their own. Students also worked with a wide variety of keys to accurately identify mushrooms and lichens. They were required to keep an up-to-date field notebook and prepare a collection of twenty mushroom specimens and twenty lichens. Each specimen was accompanied by a detailed description, drawings which of the overall shape and stature, as well as close up drawings of key identifying features. Students did extensive microscopic work with the fungi, measuring spores and observing other microscopic features necessary for positive identifications. Students also attempted to isolate pure cultures of fungi and/or alga, either from lichens or from fruiting bodies and submit a collection of the pure collections thus obtained.

Students completed weekly study questions, which were discussed in small groups. Each student was required to locate two peer-reviewed research papers on the ecology of fungi and lichens published within the last 10 years and wrote a one-page summary of each paper and gave a short presentation to the class. Student progress was assessed through weekly take-home quizzes, questions and conversations with individual students, paper summaries and presentations, review of collections, and a comprehensive final exam that included identification of mushrooms and lichens.

Topics covered in lectures included: Introduction to fungi and fungal diversity, Introduction to lichens, Fungal structure, Fungal growth, differentiation, and development, Isolation of fungal cultures, Mycorrhizal symbiosis, Lichen symbionts, Lichen morphology & reproduction, Fungal nutrition, Fungal reproduction and spores, Lichen nutrition, Nitrogen metabolism in lichens, Ecology of mycorrhizal fungi, Lichens and air pollution, Cultivation of fungi, Fungi as plant pathogens, and Fungal phylogenetics.

Texts

- Lichen Biology* by Thomas H. Nash III Cambridge University Press ISBN: 0521459745
Fungal Biology-4th ed by J.W. Deacon. Blackwell Publishers; 4th edition. ISBN: 1405130660
Macrolichens of the Pacific Northwest by Bruce McCune and Linda Geiser
How to Identify Mushrooms to Genus III: Microscopic Features by David Largent
Mushrooms Demystified by David Arora
Lichens of North America by Brodo, Sharnoff, & Sharnoff (optional)
Matchmaker, a mushroom identification CD.

Additional Readings

- Bridge, Paul. 2002. The history and application of molecular mycology. *Mycologist* 16(3): 90-99.
- Cairney, John W.G. and Andrew A. Meharg. 2002. Interactions between ectomycorrhizal fungi and soil saprotrophs: implications for decomposition of organic matter in soils and degradation of organic pollutants in the rhizosphere. *Can J of Bot* 80: 803-809.
- Dahlman, Mattias, Eric Danell, and Joseph W. Spatafora. 2000. Molecular systematics of *Craterellus*: cladistic analysis of nuclear LSU rDNA sequence data. *Mycological Research* 104(4): 388-394.
- Down, Graeme. 2002. Fungal family trees: finding relationships from molecular data. *Mycologist* 16(2): 51-58.
- Finlay, Roger D. 2004. Mycorrhizal fungi and their multifunctional roles. *Mycologist*, 18(2): 91-96.
- Finlay, Roger D. 2005. Mycorrhizal symbiosis: myths, misconceptions, new perspectives and further research priorities. *Mycologist*, 19(3): 90-95.
- Grube, Martin and Katarina Winka. 2002. Progress in understanding the evolution and classification of lichenized ascomycetes. *Mycologist* 16(2): 67-76.
- Hansen, E.M. and Ellen Michaels Goheen. 2000. *Phellinus* weirii and other native root pathogens as determinants of forest structure and process in western North America. *Annual Reviews of Phytopath* 38: 515-539.
- Hansen, Everett M. and Jeffrey K. Stone. 2005. Impacts of plant pathogenic fungi on plant communities. Pp 461-474 in Dighton, John, James F. White, and Peter Oudemans, ed. *The fungal community: its organization and role in the ecosystem*, 3rd ed. CRC Taylor & Francis, Boca Raton, Florida.
- Helgason, Thorunn and Alastair Fitter. 2005. The ecology and evolution of the arbuscular mycorrhizal fungi. *Mycologist*, 19(3): 96-101.
- Leake, J.R., D.P. Donnelly, and L. Boddy. 2002. Interactions between ecto-mycorrhizal and saprotrophic fungi. Pp 345-372 in van der Heijden, M.G.A. and I. Sanders, ed. *Mycorrhizal Ecology. Ecological Studies Vol. 157*. Springer-Verlag, Berlin. A handout with final versions of the figures will be provided in class.

- Leake, Jonathan R. 2005. Plants parasitic on fungi: unearthing the fungi in myco-heterotrophs and debunking the 'saprophytic' plant myth. *Mycologist* 19(3): 113-122.
- Lindahl, B.O., A.F.S. Taylor, and Roger D. Finlay. 2002. Defining nutritional constraints on carbon cycling in boreal forests – towards a less 'phytcentric' perspective. *Plant and Soil* 242: 123–135.
- Moncalvo, Jean-Marc, and 13 others. 2002. One hundred and seventeen clades of euagarics. *Molecular Phylogenetics and Evolution* 23: 357-400.
- Money, Nicholas P. 2004. The fungal dining habit: a biomechanical perspective. *Mycologist*, 18(2) May. p. 71-76.
- Mycological Research News. *Mycological Research* 104(4): 385-387.
- Nout, M.J.R. and J.L. Kiers. 2005. Tempe fermentation, innovation and functionality: update into the third millenium. *J of App Microbiol* 98, 789–805
- Nout, M.J.R. and K.E.Aidoo. 2002. Asian Fungal Fermented Food from *The Mycota X: Industrial Applications*. D.Osiewacz (Ed.) © Springer-Verlag Berlin Heidelberg
- Petersen, Ronald H. and Karen W. Hughes. 1999. Species and speciation in mushrooms. *BioScience* 49(6): 440-452.
- Pilz, David, Randy Molina, and Jim Mayo. 2006. Effects of Thinning Young Forests on Chanterelle Mushroom Production. *J. Forestry*, January/February. p. 9-14.
- Rayner, A.D.M. . 1998 Fountains of the forest – the interconnectedness between trees and fungi. *Mycol. Res.* 102 (12): 1441–1449
- Read, D.J. and J. Perez-Moreno. 2003. Mycorrhizas and nutrient cycling in ecosystems -- a journey towards relevance? *New Phytologist* 157: 475-492.
- Read, David. 1997. Mycorrhizal fungi: the ties that bind. *Nature* 388: 517-518.
- Redhead, Scott A. 2000. Bully for Coprinus: a story of manure, minutiae, and molecules. *McIlvainea* 14(2): 5-14.
- Robinson, David and Alastair Fitter. 1999. The magnitude and control of carbon transfer between plants linked by a common mycorrhizal network. *J of Experimental Botany* 50(330): 9-13.
- Seymour, Fabian A., Peter D. Crittenden and Paul S. Dyer. 2005. Sex in the extremes: lichen-forming fungi. *Mycologist*, Volume 19, Part 2. p. 51-58.
- Simard, Suzanne W. and Daniel M. Durall. 2004. Mycorrhizal networks: a review of their extent, function, and importance. *Can J of Bot* 82: 1140-1165
- Taylor, Andy F.S. and Ian Alexander. 2005. The ectomycorrhizal symbiosis: life in the real world. *Mycologist*, 19(3): 102-112.
- Wiebe, Marilyn G. 2004. Quorn™ Myco-protein – Overview of a successful fungal product. *Mycologist*, 18 1) February. p. 17-20.