

Fungi in the Environment

Fungi in the Environment. British Mycological Society Symposium No. 25. 2007. G.M. Gadd, S.C. Watkinson, P.S. Dyer (Eds). Cambridge University Press. www.cambridge.org/9780521850292. ISBN-13 978-0-521-85029-2 hardback. 406 pp. Price: \$160.00.

I volunteered to review this book with a preconceived notion of the term "environment" as forests, streams, oceans, glaciers, deserts, houses, etc. The first four chapters thus took me somewhat aback: "Imaging complex nutrient dynamics in mycelial networks," "Natural history of the fungal hypha: how Woronin bodies support a multicellular lifestyle," "Environmental sensing and the filamentous fungal lifestyle," and "Mathematical modelling of the form and function of fungal mycelia." Adjusting my vision to the reality that fungi are *always* in an environment, and environments may range from the atomic to beyond the planet, I plunged ahead. Well, "struggled" is perhaps the better word. As is true of most multi-authored-books, the different chapters range from very accessible to hyper-sophisticated. This is not a complaint, rather a recognition that not every chapter will be rewarding to every reader. I suspect, indeed, that the authors of some chapters will not be able to follow certain other chapters without considerable preparation and effort.

That said, let's see how the editors describe their intent about this 2004 symposium and this resulting book. "The prime objective was to produce a volume that would highlight the roles and importance of fungi in the environment together with the modern approaches and tools that are now revealing the importance of fungi in a wider biological context." This sweeping goal would fill libraries if taken literally, were it not for the term "highlight," which reduces it to a realm of possibility. And that limited realm is mostly realized well for the included chapters. The book is divided into six topic areas: 1) Imaging and modelling of fungi in the environment, 2) Functional ecology of saprotrophic fungi, 3) Mutualistic interactions in the environment, 4) Pathogenic interactions in the environment, 5) Environmental population genetics of fungi, and 6) Molecular ecology of fungi in the environment. Adding "environment" to most of the topic titles was evidently felt necessary to remind readers that the environment can be at the molecular level. All 18 chapters embodied in these topical sections are competently written, but they range from extremely complex and specialized to highly informative for students and generalists.

Topic 1 on imaging and modeling includes chapters on imaging complex nutrient dynamics in mycelial networks, the role of Woronin bodies in the Ascomycota, environmental sensing by filamentous fungi, and mathematical modelling of mycelial form and function. I have little depth of background in these areas, and to understand all that the chapters contain would take me weeks of intensive study. Nonethe-



less, with reasonable diligence I could skim off the major points, but please don't ask me to present a lecture on them. Study of these chapters reinforced and expanded my appreciation for the elegance and complexity of what happens at the cellular and molecular levels of hyphae as they interact with their immediate micro-environments as well as for the inventiveness and skills of the scientists who study them.

Topic 2 on functional ecology of saprotrophs contains chapters on mineral transformations and biogeochemical cycles, mycelial responses in heterogeneous environments, and the meaning of natural abundances of ^{15}N and ^{14}C in saprotrophs. Here we encounter differences in form and function between rock- and stone-dwelling fungi such as those that live on the surface of rock and building stone, on pebbles, within the rock subsurface in pre-existing cracks and fissures, inside cavities and among crystal grains, or that actively penetrate submerged rock. Their functions are legion, and their importance to life on earth make fascinating reading. We learn how mycelia respond to heterogeneous environments in contrast to what we see on a homogeneous Petri plate, how mycelial foraging patterns have much in common with those not only of plants but also of ants, how mycelia respond to the discovery of new resources, and much more. Then, the meaning of C and N isotope values of fungi is explained with special reference to interpreting their interactions with substrates.

The roles of mycorrhizae in global carbon sequestration are explored in Topic 3 on mutualistic interactions. Particular emphasis is devoted to the significant direct and indirect contribution of mycorrhizae to soil C pools and fluxes and how these relate to plant community composition. Mycorrhizal sequestration of C is particularly pronounced in boreal and heathland biomes. The chapter on water relations in lichens is lucidly written and explains the mechanisms by which lichens can withstand extended exposure to extremes of solar radiation, drought and temperatures. A rather complex presentation on the genomics of the arbuscular mycorrhizal symbiosis requires a solid background in the topic to be appreciated. Research in this area has focused on rice, but work is progressing on a few other mycorrhizal plants. The implications for improving food production by genetic modification of the fungal-host symbiotic interaction are considerable.

In Topic 4, pathogenic interactions, the functional genomics of the rice blast fungus are described along lines similar to the preceding chapter on arbuscular mycorrhizal fungi. The implications to ultimate disease control are substantial. After reading these two genomic papers, the preceding one on mutualists and this one on pathogens, I was left with curiosity on how the two types of fungi are similar and how they differ genetically in their interactions with their host. I could not really pull it out of the two papers myself, so I hope genomics researchers will do so before long. That could tell us much about why some fungi increase plant health and others subvert it. The chapter on use of DNA microarrays to

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study interactions between nematode-trapping fungi and nematodes details the morphologic and DNA activities of the fascinating trapping phenomenon; these studies are just beginning but show considerable promise. The role of glucans is illuminated in the life of human fungal pathogens, but much remains to be learned about how fungal glucans affect the biochemistry of the pathogenesis and the host immune defenses. The final chapter in topic 4, "Plagues upon houses and cars: the unnatural history of *Meruliporia incrassata*, *Serpula lacrymans* and *Sphaerobolus stellatus*," wins the prize as the most readable and entertaining yet immensely informative contribution to the symposium. Whether you live in a house, a yurt, or out of an automobile, you will enjoy learning about its potential plagues through author Nicholas Money's superb pedagogic craftsmanship.

Topic 5 on environmental population genetics deals with recognition, maintenance and selection of species, matters of special interest about fungal phylogenetics in respect to speciation, adaptation, geography and taxonomy. The companion chapter on application of multilocus sequence typing and multilocus microsatellite typing in fungal population genetics and epidemiology updates these specialized techniques, at

least for the specialist. And finally, topic 6 on molecular ecology of fungi in the environment includes an exposé of the astonishing diversity of fungi in the guts of beetles and a summary of the importance of ascomycete laccase genes for decomposition of salt marsh plants.

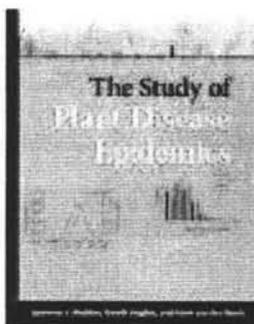
The symposium that engendered this book was held in 2004, thus it is fair to ask how up-to-date these review chapters are, especially because many of the topics are rapidly advancing. The cited literature shows a scattering of 2005 papers, so authors were given some opportunity for updating. Still, most references are dated 2003 and before. Readers interested in the topics presented will nonetheless find lots of meaty food for thought. Perhaps a third of the chapters require an advanced knowledge of the subject matter to find them meaningful. Look at the book in a library to see if it meets your needs before committing the rather spendy purchase price. The cover, binding and paper are all of the high quality typical of Cambridge University books.

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The Study of Plant Disease Epidemics

The Study of Plant Disease Epidemics. 2007. Laurence V. Madden, Gareth Hughes, Frank van den Bosch. APS Press, 3340 Pilot Knob Road, St. Paul, MN 55121, <http://www.shopapspress.org>. ISBN: 978-0-89054-354-2. 432 pp. Price: \$89.00.



This book fills a need for a comprehensive plant epidemiology textbook. Apparently built upon the previous work of Campbell and Madden in the 1990 "Introduction to Plant Disease Epidemiology," this book provides the theoretical background and skill development to complement an advanced undergraduate course or a graduate course in plant disease epidemiology. It would be extremely useful for a student beginning to develop an epidemiology project, and with its clear sections and handy index it can also serve as a practical epidemiological statistics reference for any plant pathologist.

The text is organized into 12 sections, most of which are heavily analytical. The first section provides a brief introduction to some concepts and some history. The next two sections describe the basics of measuring plant disease and model construction and interpretation and, in the remainder of the book, the authors draw upon these concepts to build a very practical approach to understanding plant disease epidemiology. The sections are packed with model development and cover a dizzying array of approaches and specific problems. The sheer depth of the analytical topics covered pre-

cludes much exploration of the underlying questions. Organisms are left behind but so too is any indication of what the major problems of plant disease epidemiology might be, and there is little in the way of development of new questions here. However, at the end of each section, there is some useful discussion and guidance about interpretation and model design. Each section is referenced and also includes suggestions for further reading, which presumably provide more discussion and/or connection to real world examples. Certainly not all of the text is likely to be relevant to any particular study, but the completeness of the work means that virtually every epidemiological study will draw heavily on the concepts and analyses outlined here. It includes a good number of practical examples worked in SAS, but not R, the now standard open source software for statistical analysis.

Although the book is clearly aimed at a mathematically literate audience, it has enough introductory information and simple examples to remain accessible to those who are interested and focused but not expert epidemiologists. It is not an interesting or easy read, but its completeness and accessibility make it very well suited as a reference book. It is a great companion to understanding the dense and abundant epidemiology literature. Probably every plant pathologist should have this text, and any mycologist who wants to keep a foot in the world of plant epidemiology would find this book quite useful.

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