

# The Fungal Community Its Organization and Role in the Ecosystem

Fourth Edition

edited by

John Dighton

James F. White



**CRC Press**

Taylor & Francis Group

Boca Raton London New York

---

CRC Press is an imprint of the  
Taylor & Francis Group, an Informa business

# Contents

|                    |      |
|--------------------|------|
| Introduction.....  | xiii |
| Editors.....       | xv   |
| Contributors ..... | xvii |

## **Part I** **Integrating Genomics and Metagenomics into Community Analysis**

|   |   |
|---|---|
| Chapter 1<br>Molecular Community Ecology of Arbuscular Mycorrhizal Fungi..... | 3 |
| <b>Joe D. Taylor, Thorunn Helgason, and Maarja Öpik</b>                       |   |

|   |    |
|---|----|
| Chapter 2<br>Comparative and Functional Genomics of Ectomycorrhizal Symbiosis ..... | 27 |
| <b>Joske Ruytinx and Francis Martin</b>   |    |

|  |    |
|--|----|
| Chapter 3<br>Early Fungi: Evidence from the Fossil Record..... | 37 |
| <b>Michael Krings, Thomas N. Taylor, and Carla J. Harper</b>   |    |

|   |    |
|---|----|
| Chapter 4<br>Evolution of Lichens .....       | 53 |
| <b>H. Thorsten Lumbsch and Jouko Rikkinen</b> |    |

## **Part II** **Recent Advances in Fungal Endophyte Research**

|  |    |
|--|----|
| Chapter 5<br>A Novel Framework for Decoding Fungal Endophyte Diversity ..... | 65 |
| <b>Natalie Christian, Briana K. Whitaker, and Keith Clay</b>                 |    |

|  |    |
|--|----|
| Chapter 6<br>Foliar Endophyte Communities and Leaf Traits in Tropical Trees..... | 79 |
| <b>Sunshine Van Bael, Catalina Estrada, and A. Elizabeth Arnold</b>              |    |

|  |    |
|--|----|
| Chapter 7<br>Community Assembly of Phyllosphere Endophytes: A Closer Look at Fungal Life Cycle Dynamics, Competition,<br>and Phytochemistry in the Shaping of the Fungal Community ..... | 95 |
| <b>Christopher B. Zambell and James F. White</b>   |    |

|   |     |
|---|-----|
| Chapter 8<br>Interactions between Fungal Endophytes and Bacterial Colonizers of Fescue Grass..... | 109 |
| <b>Elizabeth Lewis Roberts and Christopher Mark Adamchek</b>                                      |     |

**Part III****Fungal Communities in Terrestrial Ecosystems**

## Chapter 9

Geomycology: Geoactive Fungal Roles in the Biosphere.....121

**Geoffrey Michael Gadd**

## Chapter 10

Lichens and Microfungi in Biological Soil Crusts: Structure and Function Now and in the Future .....137

**Jayne Belnap and Otto L. Lange**

## Chapter 11

Ecology of Fungal Phylloplane Epiphytes.....159

**Katalin Malcolm and John Dighton**

## Chapter 12

Wood Decay Communities in Angiosperm Wood .....169

**Lynne Boddy, Jennifer Hiscox, Emma C. Gilmartin, Sarah R. Johnston, and Jacob Heilmann-Clausen**

## Chapter 13

Lichens in Natural Ecosystems.....191

**Darwyn Coxson and Natalie Howe**

**Part IV****Fungal Communities in Marine and Aquatic Ecosystems**

## Chapter 14

Diversity and Role of Fungi in the Marine Ecosystem.....207

**Chandalata Raghukumar**

## Chapter 15

Aquatic Hyphomycete Communities in Freshwater .....225

**Kandikere R. Sridhar**

## Chapter 16

The Ecology of Chytrid and Aphelid Parasites of Phytoplankton.....239

**Thomas G. Jephcott, Floris F. van Ogtrop, Frank H. Gleason, Deborah J. Macarthur, and Bettina Scholz**

## Chapter 17

Crown Oomycetes Have Evolved as Effective Plant and Animal Parasites .....257

**Agostina V. Marano, Frank H. Gleason, Sarah C. O. Rocha, Carmen L. A. Pires-Zottarelli, and José I. de Souza**

**Part V****Fungal Adaptations to Stress and Conservation**

## Chapter 18

Adaptations of Fungi and Fungal-Like Organisms for Growth under Reduced Dissolved Oxygen Concentrations.....275

**Sandra Kittelmann, Cathrine S. Manohar, Ray Kearney, Donald O. Natvig, and Frank H. Gleason**

## Chapter 19

Fungi in Extreme and Stressful Environments..... 293

**Sharon A. Cantrell**

## Chapter 20

Reaching the Wind: Boundary Layer Escape as a Constraint on Ascomycete Spore Dispersal..... 309

**Anne Pringle, Michael Brenner, Joerg Fritz, Marcus Roper, and Agnese Seminara**

## Chapter 21

Who Cares? The Human Perspective on Fungal Conservation.....321

**Elizabeth S. Barron****Part VI****Fungal–Faunal Interactions**

## Chapter 22

Belowground Trophic Interactions.....333

**Amy Treonis**

## Chapter 23

Mycophagy and Spore Dispersal by Vertebrates..... 347

**Alessandra Zambonelli, Francesca Ori, and Ian Hall**

## Chapter 24

The Fungal Spore: Myrmecophilous Ophiocordyceps as a Case Study.....359

**João P. M. Araújo and David P. Hughes**

## Chapter 25

Coevolution of Fungi and Invertebrates..... 369

**Xingzhong Liu, Lin Wang, and Meichun Xiang**

## Chapter 26

Fungal Diversity of Macrotermes–Termitomyces Nests in Tsavo, Kenya..... 377

**Jouko Rikkinen and Risto Vesala**

|  |     |
|--|-----|
| Chapter 27<br>Emerging Mycoses and Fungus-Like Diseases of Vertebrate Wildlife.....  | 385 |
| <b>Hannah T. Reynolds, Daniel Raudabaugh, Osu Lilje, Matthew Allender, Andrew N. Miller,<br/>and Frank H. Gleason</b>                                |     |
| Chapter 28<br><i>Geomyces</i> and <i>Pseudogymnoascus</i> : Emergence of a Primary Pathogen, the Causative Agent of Bat White-Nose<br>Syndrome ..... | 405 |
| <b>Michelle L. Verant, Andrew M. Minnis, Daniel L. Lindner, and David S. Blehert</b>   |     |
| <b>Part VII</b><br><b>Fungal Communities, Climate Change, and Pollution</b>  |     |
| Chapter 29<br>Mycorrhizal Fungi and Accompanying Microorganisms in Improving Phytoremediation Techniques.....  | 419 |
| <b>Piotr Rozpądek, Agnieszka Domka, and Katarzyna Turnau</b>   |     |
| Chapter 30<br>Effects of Toxic Metals on Chytrids, Fungal-Like Organisms, and Higher Fungi .....   | 433 |
| <b>Linda Henderson, Erna Lilje, Katie Robinson, Frank H. Gleason, and Osu Lilje</b>  |     |
| Chapter 31<br>The Fungal Community in Organically Polluted Systems .....   | 459 |
| <b>Hauke Harms, Lukas Y. Wick, and Dietmar Schlosser</b>   |     |
| Chapter 32<br>Fungal Communities and Climate Change.....   | 471 |
| <b>Jennifer M. Talbot</b>  |     |
| <b>Part VIII</b><br><b>Fungi in the Built Environment</b>  |     |
| Chapter 33<br>Decomposition of Wooden Structures by Fungi.....   | 491 |
| <b>Benjamin W. Held</b>  |     |
| Chapter 34<br>Fungal Degradation of Our Cultural Heritage.....   | 501 |
| <b>John Dighton</b>  |     |
| Chapter 35<br>Microorganisms for Safeguarding Cultural Heritage.....   | 509 |
| <b>Edith Joseph, Saskia Bindschedler, Monica Albini, Lucrezia Comensoli, Wafa Kooli, and Lidia Mathys</b>  |     |

**Part IX****Fungal Signaling and Communication**

## Chapter 36

Airborne Signals: Volatile-Mediated Communication between Plants, Fungi, and Microorganisms .....521

**Samantha Lee, Guohua Yin, and Joan W. Bennett**

## Chapter 37

Mycorrhizal Fungal Networks as Plant Communication Systems .....539

**David Johnson and Lucy Gilbert**

## Chapter 38

Fungal–Fungal Interactions: From Natural Ecosystems to Managed Plant Production, with Emphasis on Biological Control of Plant Diseases..... 549

**Dan Funck Jensen, Magnus Karlsson, and Björn D. Lindahl**

## Chapter 39

Ecology and Evolution of Fungal-Bacterial Interactions..... 563

**Stefan Olsson, Paola Bonfante, and Teresa E. Pawlowska**

Index ..... 585