

Cambridge University Press

978-0-521-70073-3 - Introduction to Bryophytes

Edited by Alain Vanderpoorten and Bernard Goffinet

Frontmatter

[More information](#)

INTRODUCTION TO BRYOPHYTES

Bryophytes mark a pivotal step in land plant evolution, and their significance in the regulation of ecosystems and the conservation of biodiversity is becoming increasingly acknowledged. This introductory textbook assumes no prior knowledge of bryophyte biology, making it ideal for advanced undergraduate and graduate students, as well as for amateur botanists. The authors expertly summarize the diversity of bryophytes and outline recent advances in our understanding of their evolutionary history, their ecological roles and preferences, their distribution patterns and conservation needs. The text is highly illustrated throughout, with boxed summaries of topics of current relevance in bryophyte biology, and a glossary of technical terms.

ALAIN VANDERPOORTEN is a Research Associate of the Belgian Funds for Scientific Research at the University of Liège, Belgium, where he teaches molecular systematics, biogeography and landscape ecology. His research presently focuses on the evolution of endemism.

BERNARD GOFFINET is an Associate Professor in Ecology and Evolutionary Biology at the University of Connecticut. His current research spans chloroplast genome evolution in liverworts, the phylogenetic history of mosses and the systematics of lichen-forming fungi. He teaches bryophyte and lichen biology and green plant evolution.

Cambridge University Press
978-0-521-70073-3 - Introduction to Bryophytes
Edited by Alain Vanderpoorten and Bernard Goffinet
Frontmatter
[More information](#)

INTRODUCTION TO
BRYOPHYTES

Edited by

ALAIN VANDERPOORTEN
University of Liège, Belgium

and

BERNARD GOFFINET
University of Connecticut, USA



Cambridge University Press
978-0-521-70073-3 - Introduction to Bryophytes
Edited by Alain Vanderpoorten and Bernard Goffinet
Frontmatter
[More information](#)

CAMBRIDGE UNIVERSITY PRESS
Cambridge, New York, Melbourne, Madrid, Cape Town, Singapore, São Paulo, Delhi
Cambridge University Press
The Edinburgh Building, Cambridge CB2 8RU, UK
Published in the United States of America by Cambridge University Press, New York

www.cambridge.org
Information on this title: www.cambridge.org/9780521877121

© A. Vanderpoorten and B. Goffinet 2009

This publication is in copyright. Subject to statutory exception
and to the provisions of relevant collective licensing agreements,
no reproduction of any part may take place without
the written permission of Cambridge University Press.

First published 2009

Printed in the United Kingdom at the University Press, Cambridge

A catalogue record for this publication is available from the British Library

Library of Congress Cataloging-in-Publication Data

Introduction to bryophytes / edited by Alain Vanderpoorten and Bernard Goffinet.
p. cm.

Includes bibliographical references and index.

ISBN 978-0-521-87712-1 (hardback) – ISBN 978-0-521-70073-3 (pbk.) 1. Bryophytes.
I. Vanderpoorten, Alain. II. Goffinet, Bernard. III. Title.

QK533.I57 2009
588–dc22

2008054301

ISBN 978-0-521-87712-1 hardback
ISBN 978-0-521-70073-3 paperback

Cambridge University Press has no responsibility for the persistence or
accuracy of URLs for external or third-party internet websites referred to
in this publication, and does not guarantee that any content on such
websites is, or will remain, accurate or appropriate.

Contents

<i>Preface</i>	<i>page vii</i>
1 Evolutionary significance of bryophytes	1
1.1 What do we call a bryophyte?	2
1.2 Bryophytes are embryophytes	8
1.3 Bryophytes and land plant evolution	9
1.4 Bryophytes and the conquest of land	15
2 Ecological significance of bryophytes	26
2.1 Water and biogeochemical cycles	26
2.2 Vegetation succession and soil formation	34
2.3 Bryophytes as food and as shelter	40
3 Liverworts	43
3.1 Structure and development	43
3.2 Classification and macroevolution	62
3.3 Biogeography and ecology	65
4 Mosses	70
4.1 Structure and development	70
4.2 Classification and macroevolution	101
4.3 Biogeography and ecology	104
5 Hornworts	106
5.1 Structure and development	106
5.2 Classification and macroevolution	120
5.3 Biogeography and ecology	121

vi	<i>Contents</i>	
6	Biogeography	124
6.1	Bryophyte diversity and distribution patterns	127
6.2	Origin and evolution of bryophyte distribution patterns	130
6.3	Evolutionary significance of bryophyte distribution patterns	141
7	Ecology	153
7.1	Global ecology	153
7.2	Landscape ecology	156
7.3	Population ecology	162
8	Physiological ecology	185
8.1	Water relations	185
8.2	Light	195
8.3	Mineral nutrition	202
8.4	Temperature	206
9	Bryophytes in a changing world	214
9.1	Impact of pollution on bryophytes	214
9.2	Application to bioindication	224
9.3	Adaptation to a changing environment	229
10	Conservation biology	232
10.1	Levels of threats and the need for conservation	233
10.2	Why are bryophytes threatened?	237
10.3	Conservation strategies	244
10.4	Restoration ecology	248
	<i>Glossary</i>	256
	<i>References</i>	267
	<i>Index</i>	294
	<i>Colour plates to be found between pages 152 and 153.</i>	

Cambridge University Press

978-0-521-70073-3 - Introduction to Bryophytes

Edited by Alain Vanderpoorten and Bernard Goffinet

Frontmatter

[More information](#)

Preface

The concept for a book providing an introduction to the biology of bryophytes emanates from our passion for these land plants and the lack of recent manuals offering general insights into their fascinating diversity and evolutionary history. Throughout its history, bryological research has contributed significantly to the field of plant sciences, starting with the discovery of sex chromosomes in plants and culminating most recently with the assembly of the *Physcomitrella* genome, fundamental for the study of the evolution of genes and their function during the diversification of land plants. Bryophytes are, in fact, pivotal in land plant evolution, and the recent advances in molecular phylogenetics and genomics have allowed for a clearer picture of land colonization and subsequent evolution to emerge. Ecologically, the significance of bryophytes for the regulation of global biogeochemical cycles, especially carbon, has long been acknowledged and has gained much attention in the present context of global changes. Finally, there has been an increasing concern for the conservation biology of cryptogams, and bryophytes in particular.

The aim of the present book is to offer a stepping-stone to anyone interested in discovering the fundamentals of the biology of bryophytes, making the bridge with more comprehensive treatises such as Goffinet and Shaw's *Bryophyte Biology* (2009) and Glime's *Bryophyte Ecology* (2007a). In *Introduction to Bryophytes*, we make an attempt at summarizing and explaining the recent advances made across the various aspects of bryophyte biology at a level that would be palatable to beginners. The focus of the book is thus to open the door to the curious mind and to inspire students, from late undergraduates to post-doctoral researchers, to engage in bryological research.

The book follows what we consider to be an intuitively natural flow. We focus first on the origin of bryophytes in the context of land plant evolution and on the significance of bryophytes in today's world. The morphological

Cambridge University Press

978-0-521-70073-3 - Introduction to Bryophytes

Edited by Alain Vanderpoorten and Bernard Goffinet

Frontmatter

[More information](#)

viii

Preface

diversity of bryophytes are outlined and their associations with fungi and cyanobacteria are summarized, before their ecophysiological features are reviewed. We describe the parameters that shape bryophyte communities and the global distribution of the species that compose them. Finally, we examine the threats facing bryophytes and review approaches designed to conserve them. Some aspects of bryophyte biology merited closer attention and are addressed in box essays. All technical terms are defined in a glossary. Spectacular illustrations of many of the terms used in the present volume can also be found in Malcolm and Malcolm (2006).

Writing this textbook has been a definite challenge and we could not have completed it without Robynn Shannon's diligent editorial comments on substance and form. Her repeated calls for clarification and simplification, along with her improvements of the style, have been essential. We also deeply acknowledge the help of the many colleagues who reviewed different chapters of the book, including Peter Alpert (Physiological ecology), Jeff Bates (Physiological ecology and Bryophytes in a changing world), Richard Beckett (Physiological ecology), Jeff Duckett (Evolutionary significance), Rob Gradstein (Liverworts), Mark Hill (Ecology), Jon Shaw (Biogeography), Line Rochefort (Conservation biology), Hakan Rydin (Ecology), Juan Carlos Villarreal (Hornworts) and Harald Zechmeister (Bryophytes in a changing world). We extend our thanks to Virge Kask for her original drawings and Delphine Aigoïn, Neil Bell, Paul Davison, Virginie Hutsemékers, Patrick Degroot, Claude Dopagne, Jan-Peter Frahm, Harald Kürschner, Juul Limpens, Barbara Murray, the Peatland Ecology Research Group, Christine Rieser, Gordon Rothero, Ricardo Rozzi, Martin Simard, Juan Carlos Villarreal and Norman Wickett for sharing some of their photographs and/or providing material for our illustrations.

Our research has been possible over the years with financial support from the Belgian and American National Science Foundations, the Fonds Léopold III, the Belgian Academy of Sciences, the Walloon Ministry of the Environment and the National Geographic Society, for which we are grateful. Finally, we also take this opportunity to thank our families, colleagues and friends who have encouraged, motivated and inspired our research from the beginning of our careers, namely André Sotiaux, Jacques Lambinon, Jonathan Shaw, Dale Vitt and the late Lewis Anderson.