Environmental Biology

Environmental Biology offers a fresh, problem-solving treatment of the topic for students requiring a biology background before further study in environmental science, sustainable development or environmental engineering.

The text begins with an environmental theme that carries throughout, using three major case studies with a regional focus. Key foundational knowledge in biology is introduced and developed as the text progresses, with students encouraged to integrate their accumulating learning to reach solutions. A comprehensive coverage of scientific method, including field experimentation and field techniques, is an important part of the approach. While emphasising the environmental theme, the book introduces all facets of the discipline of biology, including cell biology, evolution, ecology, conservation and restoration.

With over 500 line drawings, diagrams and photos throughout, including full-colour sections, each chapter includes:

- chapter summaries
- comprehension questions
- activities that reinforce learning and encourage scientific analysis
- topics for debate with other students
- lists of further reading.

An online Instructors' Resource offers multiple-choice questions, 'Test your knowledge' solutions, video footage, a full repository of text-based and supplementary photos, and a vast list of relevant journal articles.

Mike Calver is Associate Professor in the School of Biological Sciences and Biotechnology at Murdoch University.

Alan Lymbery is Associate Professor of Parasitology in the School of Veterinary and Biomedical Sciences at Murdoch University.

Jen McComb is Emeritus Professor in the School of Biological Sciences and Biotechnology at Murdoch University.

Mike Bamford is Consulting Ecologist at Bamford Consulting.

Environmental Biology

Edited by
Mike Calver
Alan Lymbery
Jen McComb
Mike Bamford

Illustrated by Belinda Cale and Mike Bamford

CAMBRIDGE
UNIVERSITY PRESS

CAMBRIDGE UNIVERSITY PRESS
Cambridge, New York, Melbourne, Madrid, Cape Town, Singapore, São Paulo, Delhi

Cambridge University Press
477 Williamstown Road, Port Melbourne, VIC 3207, Australia

www.cambridge.edu.au
Information on this title: www.cambridge.org/9780521679824

First published 2009

Designed by Pier Vido
Typeset by Aptara Corp
Printed in China by Printplus

National Library of Australia Cataloguing in Publication data

Calver, Michael
Environmental Biology / Michael Calver … [et al.]
9780521679824 (pbk.)
Includes index.
Biology
Environment
Ecology
570
978-0-521-67982-4 paperback

Contents

Contributors

Mike Bamford is Consulting Ecologist at Bamford Consulting

Mike Calver is Associate Professor in the School of Biological Sciences and Biotechnology at Murdoch University

Alan Lymbery is Associate Professor of Parasitology in the School of Veterinary and Biomedical Sciences at Murdoch University

Jen McComb is Emeritus Professor in the School of Biological Sciences and Biotechnology at Murdoch University

David Ayre is Professor in the School of Biological Sciences at the University of Wollongong.

Barbara Bowen is Lecturer in the School of Biological Sciences and Biotechnology at Murdoch University.

Stuart Bradley is Professor and Dean of the Faculty of Sustainability, Environmental and Life Sciences at Murdoch University.

Treena Burgess is Postdoctoral Fellow in the School of Biological Sciences and Biotechnology at Murdoch University.

Jane Chambers is Senior Lecturer in the School of Environmental Science at Murdoch University.

Mathew Crowther is Lecturer in the School of Biological Sciences at the University of Sydney.

Jenny Davis is Professor in the School of Biological Sciences at Monash University

Bernie Dell is Professor in the School of Biological Sciences and Biotechnology at Murdoch University.

Chris Dickman is Professor in the School of Biological Sciences at the University of Sydney.

Mark Garkaklis is Adjunct Lecturer in the School of Biological Sciences and Biotechnology at Murdoch University.

Howard Gill is Senior Lecturer in the School of Biological Sciences and Biotechnology at Murdoch University.

Richard Hobbs is Professor in the School of Plant Biology at the University of Western Australia

Stephen Hopper is Director, Royal Botanic Gardens Kew, United Kingdom

Pierre Horwitz is Associate Professor in the School of Natural Sciences at Edith Cowan University

Carolyn Jones is Senior Lecturer in the School of Biological Sciences and Biotechnology at Murdoch University.

Annette Koenders is Senior Lecturer in the School of Natural Sciences at Edith Cowan University.

Philip Ladd is Senior Lecturer in the School of Environmental Science at Murdoch University.

Dan Lunney is Principal Research Scientist in the Department of Environment and Climate Change New South Wales

Arthur McComb is Emeritus Professor in the School of Environmental Science at Murdoch University.

Graham O'Hara is Associate Professor in the School of Biological Sciences and Biotechnology at Murdoch University.

Eric Paling is Associate Professor in the School of Environmental Science at Murdoch University.

Harry Recher is Emeritus Professor in the School of Natural Sciences at Edith Cowan University.

Luke Twomey is Principal Scientist of the Swan River Trust, Western Australia

Mike van Keulen is Senior Lecturer in the School of Biological Sciences and Biotechnology at Murdoch University.

Grant Wardell-Johnson is Associate Professor in the School of Environmental Biology at Curtin University of Technology.

Preface

There are many excellent introductory biology textbooks available, so why write another? The answer lies partly in the rapid expansion of modern biology and partly in the needs and aspirations of modern students.

The second half of the 20th century and the early 21st century have seen such major developments as the unravelling of the structure of DNA, the complete cataloguing of the genome of humans and other species, and the first successful cloning. These developments are reflected in university biology curricula, which offer new units and courses in subjects such as molecular genetics and biotechnology and a much greater prominence for molecular biology in introductory textbooks. Simultaneously, other biologists have noted with concern the impacts of climate change, increasing human populations and changing technologies on natural environments and other species. They note that the rate of extinction in species at present is well above the background extinction rate shown in the fossil record, suggesting that the world is in a period of human-caused mass extinction that is reducing our biological heritage. These realisations are reflected in the curricula too, with new courses and units in conservation biology and restoration biology, as well as chapters on conservation in introductory textbooks.

Students majoring in biology at university need a thorough grounding in all these new areas as well as the more traditional aspects of the discipline. They are well served by existing textbooks, but many non-majors lack the space in their crowded timetables to cover all the topics in such detail. Instead, they need to emphasise the biology of direct relevance to their major field of study. Unfortunately, for many students it may not be clear how basic biology is relevant to their varying majors. This has long been recognised in biomedical education, where biology textbooks for physicians, dentists and other health professionals take an explicit human emphasis in their examples. Similarly, we believe that there is a need for a text with an environmental emphasis for those students needing a semester of biology as background for their specialist studies in environmental science, conservation biology, sustainable development, environmental engineering and related fields.

Environmental Biology is our attempt to meet that need. It begins with an account of the human species and our impact on the environment, before developing the biological knowledge and skills necessary to solve environmental problems through a consideration of scientific method (including the major unifying theories of evolution and the cell), biodiversity and the interactions of organisms with each other and with the physical environment. The final chapters integrate this background material in the applied disciplines of conservation biology and environmental restoration. The specialist chapter authors are all experienced researchers and accomplished teachers, and they illustrate their points with theoretical and practical environmental examples. We hope that this approach will enable students with interests in environmental science or sustainable development to see immediately the relevance of biology to their major discipline and integrate biological knowledge and skills into solving pressing environmental problems.

Acknowledgements

A project such as this is possible only because of the generosity, assistance and hard work of many people. We are grateful to the chapter authors who have endured our questioning and nagging and accepted with good grace the editorial adjustments necessary to ensure a uniform style across all chapters. Many also kindly provided excellent photographs to illustrate their chapters.

Individual copyright holders are acknowledged in the text for permission to include figures, tables and quotes, but we would particularly like to thank Rodney Armistead, Richard Calver, Jane Chambers, Jenny Davis, Bernie Dell, Bill Dunstan, Hugh Finn, Ray Froend, Alex George, Richard Hobbs, John Huisman, N. Insalud, Manfred Jusaitis, Philip Ladd, Dan Lunney, Jenny Lawrence, David Macey, Neville Marchant, John Martin, Brett Mawbey, Ron Mawbey, Martina Müller, Jim Negus, Eric Paling, H. Patterson, John Plaza, Michael Shane, Laurie Twigg, Grant Wardell-Johnston, Maria Waters and Robert Whyte for generously providing photographs from their own collections. Jiri and Marie Lochman quickly and efficiently met our urgent requests for photographs to cover gaps in our requirements. Belinda Cale drew most of the original illustrations and adaptations, impressing everyone with her knack for turning rough conceptions into polished images.

We wore out many people at Cambridge University Press with the demands and mistakes that only novice editors can make. Thuong Du, Zoe Hamilton, Jill Henry, Karen Hildebrandt, Jodie Howell, Debbie Lee and Joy Window all gave valued advice and encouragement. Finally, we thank our families, friends and colleagues for their boundless patience during the book's long gestation.

Every effort has been made to trace and acknowledge copyright. The publishers apologise for any accidental infringement and welcome information that would rectify any error or omission in subsequent editions.