



# Protected Areas

Are They Safeguarding Biodiversity?

Edited by Lucas N. Joppa, Jonathan E. M. Baillie and John G. Robinson

WILEY Blackwell

**ZSL**  
LIVING CONSERVATION



## **Protected Areas**

## Conservation Science and Practice Series

Published in association with the Zoological Society of London

Wiley-Blackwell and the Zoological Society of London are proud to present our *Conservation Science and Practice* series. Each book in the series reviews a key issue in conservation today from a multi-disciplinary viewpoint.

Each book proposal will be assessed by independent academic referees, as well as our Series Editorial Panel. Members of the Panel include:

Richard Cowling, *Nelson Mandela Metropolitan University, Port Elizabeth, South Africa*

John Gittleman, *Institute of Ecology, University of Georgia, USA*

Andrew Knight, *University of Stellenbosch, South Africa*

Nigel Leader-Williams, *University of Cambridge, UK*

Georgina Mace, *University College London, UK*

Daniel Pauly, *University of British Columbia, Canada*

Stuart Pimm, *Duke University, USA*

Hugh Possingham, *University of Queensland, Australia*

Peter Raven, *Missouri Botanical Gardens, USA*

Helen Regan, *University of California, Riverside, USA*

Alex Rogers, *University of Oxford, UK*

Michael Samways, *University of Stellenbosch, South Africa*

Nigel Stork, *Griffith University, Australia*

## Previously published

### **Elephants and Savanna Woodland Ecosystems:**

#### **A Study from Chobe National Park, Botswana**

Edited by Christina Skarpe, Johan T. du Toit and Stein R. Moe

ISBN: 978-0-470-67176-4 Hardcover; May 2014

### **Biodiversity Monitoring and Conservation:**

#### **Bridging the Gap between Global Commitment and Local Action**

Edited by Ben Collen, Nathalie Pettorelli, Jonathan E.M. Baillie and Sarah M. Durant

ISBN: 978-1-4443-3291-9 Hardcover;

ISBN: 978-1-4443-3292-6 Paperback; April 2013

### **Biodiversity Conservation and Poverty Alleviation:**

#### **Exploring the Evidence for a Link**

Edited by Dilys Roe, Joanna Elliott, Chris Sandbrook and Matt Walpole

ISBN: 978-0-470-67478-9 Paperback;

ISBN: 978-0-470-67479-6 Hardcover; December 2012

### **Applied Population and Community Ecology:**

#### **The Case of Feral Pigs in Australia**

Edited by Jim Hone

ISBN: 978-0-470-65864-2 Hardcover; July 2012

### **Tropical Forest Conservation and Industry**

#### **Partnership: An Experience from the Congo Basin**

Edited by Connie J. Clark and John R. Poulsen

ISBN: 978-0-4706-7373-7 Hardcover; March 2012

### **Reintroduction Biology: Integrating Science and Management**

Edited by John G. Ewen, Doug. P. Armstrong,

Kevin A. Parker and Philip J. Seddon

ISBN: 978-1-4051-8674-2 Paperback;

ISBN: 978-1-4443-6156-8 Hardcover; January 2012

### **Trade-offs in Conservation: Deciding What to Save**

Edited by Nigel Leader-Williams, William M. Adams and Robert J. Smith

ISBN: 978-1-4051-9383-2 Paperback;

ISBN: 978-1-4051-9384-9 Hardcover; September 2010

### **Urban Biodiversity and Design**

Edited by Norbert Müller, Peter Werner and

John G. Kelcey

ISBN: 978-1-4443-3267-4 Paperback;

ISBN: 978-1-4443-3266-7 Hardcover; April 2010

### **Wild Rangelands: Conserving Wildlife While Maintaining Livestock in Semi-Arid Ecosystems**

Edited by Johan T. du Toit, Richard Kock and James C. Deutsch

Edited by Glyn Davies and David Brown

ISBN: 978-1-4051-6779-6 Paperback; December 2007

### **Reintroduction of Top-Order Predators**

Edited by Matt W. Hayward and Michael J. Somers

ISBN: 978-1-4051-7680-4 Paperback; ISBN:

978-1-4051-9273-6 Hardcover; April 2009

### **Recreational Hunting, Conservation and Rural Livelihoods: Science and Practice**

Edited by Barney Dickson, Jonathan Hutton and Bill Adams

ISBN: 978-1-4051-6785-7 Paperback;

ISBN: 978-1-4051-9142-5 Hardcover; March 2009

### **Participatory Research in Conservation and Rural Livelihoods: Doing Science Together**

Edited by Louise Fortmann

ISBN: 978-1-4051-7679-8 Paperback; October 2008

### **Bushmeat and Livelihoods: Wildlife Management and Poverty Reduction**

Edited by Glyn Davies and David Brown

ISBN: 978-1-4051-6779-6 Paperback; December 2007

### **Managing and Designing Landscapes for Conservation: Moving from Perspectives to Principles**

Edited by David Lindenmayer and Richard Hobbs

ISBN: 978-1-4051-5914-2 Paperback; December 2007



# **Protected Areas: Are They Safeguarding Biodiversity?**

*Edited by*

**Lucas N. Joppa, Jonathan E. M. Baillie and John G. Robinson**

**WILEY** Blackwell

This edition first published 2016 © 2016 by John Wiley & Sons, Ltd.

*Registered Office*

John Wiley & Sons, Ltd, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK

*Editorial Offices*

9600 Garsington Road, Oxford, OX4 2DQ, UK

The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK

111 River Street, Hoboken, NJ 07030-5774, USA

For details of our global editorial offices, for customer services and for information about how to apply for permission to reuse the copyright material in this book please see our website at [www.wiley.com/wiley-blackwell](http://www.wiley.com/wiley-blackwell).

The right of the author to be identified as the author of this work has been asserted in accordance with the UK Copyright, Designs and Patents Act 1988.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, except as permitted by the UK Copyright, Designs and Patents Act 1988, without the prior permission of the publisher.

Designations used by companies to distinguish their products are often claimed as trademarks. All brand names and product names used in this book are trade names, service marks, trademarks or registered trademarks of their respective owners. The publisher is not associated with any product or vendor mentioned in this book.

Limit of Liability/Disclaimer of Warranty: While the publisher and author(s) have used their best efforts in preparing this book, they make no representations or warranties with respect to the accuracy or completeness of the contents of this book and specifically disclaim any implied warranties of merchantability or fitness for a particular purpose. It is sold on the understanding that the publisher is not engaged in rendering professional services and neither the publisher nor the author shall be liable for damages arising herefrom. If professional advice or other expert assistance is required, the services of a competent professional should be sought.

*Library of Congress Cataloging-in-Publication Data*

Names: Joppa, Lucas, editor. | Baillie, Jonathan, editor. | Robinson, John G., editor.

Title: Protected areas : are they safeguarding biodiversity? / edited by Lucas Joppa, Jonathan Baillie, and John Robinson.

Description: Chichester, West Sussex : John Wiley & Sons, Inc., 2016. | Includes bibliographical references and index.

Identifiers: LCCN 2015036766 | ISBN 9781118338162 (cloth) | ISBN 9781118338155 (pbk.)

Subjects: LCSH: Protected areas. | Natural resources conservation areas. | Biodiversity conservation. | Wildlife conservation.

Classification: LCC S944.5.P78 P754 2016 | DDC 333.72--dc23 LC record available at <http://lcn.loc.gov/2015036766>

A catalogue record for this book is available from the British Library.

Wiley also publishes its books in a variety of electronic formats. Some content that appears in print may not be available in electronic books.

Cover image: Getty/Kandfoto

Set in 10/12pt Minion by SPi Global, Pondicherry, India



# Contents

Contributors	ix
Introduction: Do Protected Areas Safeguard Biodiversity? <i>J. E. M. Baillie, L. Joppa and J. G. Robinson</i>	1
<b>Part I The Global Protected Area Portfolio</b>	<b>11</b>
1. Government Commitments for Protected Areas: Status of Implementation and Sources of Leverage to Enhance Ambition <i>L. Krueger</i>	13
2. Protected Area Diversity and Potential for Improvement <i>N. Dudley and S. Stolton</i>	34
3. Sound Investments: Protected Areas as Natural Solutions to Climate Change and Biodiversity Conservation <i>K. MacKinnon</i>	49
4. Optimal Protection of the World's Threatened Birds, Mammals, and Amphibians <i>J. E. M. Watson, D. B. Segan and R. A. Fuller</i>	66
5. Maintaining a Global Data Set on Protected Areas <i>A. Milam, S. Kenney, D. Juffe-Bignoli, B. Bertzky, C. Corrigan, B. MacSharry, N. D. Burgess and N. Kingston</i>	81
<b>Part II The Fate of Species in Protected Areas</b>	<b>103</b>
6. Species Population Trends in Protected Areas <i>B. Collen, L. McRae, E. Nicholson, I. D. Craigie, E. J. Milner-Gulland, J. Loh and S. Whitmee</i>	105
7. Effectiveness of Protected Areas in Conserving Large Carnivores in Europe <i>L. Santini, L. Boitani, L. Maiorano and C. Rondinini</i>	122
8. Towards Understanding Drivers of Wildlife Population Trends in Terrestrial Protected Areas <i>M. Barnes, I. D. Craigie and M. Hockings</i>	134

<b>Part III</b>	<b>Managing Protected Areas at System Scales</b>	<b>151</b>
9.	Toward Assessing the Vulnerability of US National Parks to Land Use and Climate Change <i>A. Hansen, C. Davis, J. Haas and N. Piekielek</i>	153
10.	Integrating Community-Managed Areas into Protected Area Systems: The Promise of Synergies and the Reality of Trade-Offs <i>M. Rao, H. Nagendra, G. Shahabuddin and L. R. Carrasco</i>	169
11.	The Importance of Asia's Protected Areas for Safeguarding Commercially High Value Species <i>J. Walston, E. J. Stokes and S. Hedges</i>	190
<b>Part IV</b>	<b>Monitoring Protected Areas at System Scales</b>	<b>209</b>
12.	Monitoring Protected Area Coverage and Impact on Key Biodiversity Areas, Important Bird Areas and Alliance for Zero Extinction Sites <i>S. H. M. Butchart, T. M. Brooks, J. P. W. Scharlemann and M. A. K. Mwangi</i>	211
13.	Camera Traps for Conservation: Monitoring Protected Area Investments <i>T. G. O'Brien</i>	228
14.	Monitoring Protected Areas from Space <i>N. Pettorelli, M. Wegmann, L. Gurney and G. Dubois</i>	242
	Index	260

# Contributors

- J. E. M. Baillie** Zoological Society of London, London, UK
- M. Barnes** Centre of Excellence for Environmental Decisions, The University of Queensland, St. Lucia, Queensland, Australia  
School of Geography Planning and Environmental Management, The University of Queensland, St. Lucia, Queensland, Australia
- B. Bertzky** United Nations Environment Programme World Conservation Monitoring Centre, Cambridge, UK  
Institute for Environment and Sustainability (IES), European Commission, Joint Research Centre (JRC), Ispra, Italy
- L. Boitani** Department of Biology and Biotechnologies, Università di Roma, Rome, Italy
- T. M. Brooks** NatureServe, Arlington, VA, USA; IUCN, Gland, Switzerland
- N. D. Burgess** United Nations Environment Programme World Conservation Monitoring Centre, Cambridge, UK  
Center for Macroecology, Evolution, and Climate, Natural History Museum of Denmark, University of Copenhagen, Copenhagen, Denmark
- S. H. M. Butchart** BirdLife International, Cambridge, UK
- L. R. Carrasco** Department of Biological Sciences, National University of Singapore, Singapore
- B. Collen** Centre for Biodiversity & Environment Research, University College London, London, UK
- C. Corrigan** United Nations Environment Programme World Conservation Monitoring Centre, Cambridge, UK
- I. D. Craigie** ARC Centre of Excellence for Coral Reef Studies, James Cook University, Townsville, Queensland, Australia
- C. Davis** College of Forestry and Conservation, University of Montana, Missoula, MT, USA
- G. Dubois** European Commission – Joint Research Centre, Brussels, Belgium
- N. Dudley** Equilibrium Research, Bristol, UK
- R. A. Fuller** School of Biological Sciences, University of Queensland, St. Lucia, Queensland, Australia
- L. Gurney** European Commission – Joint Research Centre, Brussels, Belgium
- J. Haas** USDA Forest Service, Rocky Mountain Research Station, Fort Collins, CO, USA
- A. Hansen** Ecology Department, Montana State University, Bozeman, MT, USA
- S. Hedges** Wildlife Conservation Society, Bronx, NY, USA
- M. Hockings** School of Geography Planning and Environmental Management, The University of Queensland, St. Lucia, Queensland, Australia

- L. Joppa** Microsoft Research, Cambridge, UK
- D. Juffe-Bignoli** United Nations Environment Programme World Conservation Monitoring Centre, Cambridge, UK
- S. Kenney** United Nations Environment Programme World Conservation Monitoring Centre, Cambridge, UK
- N. Kingston** United Nations Environment Programme World Conservation Monitoring Centre, Cambridge, UK
- L. Krueger** The Nature Conservancy, Arlington, VA, USA
- J. Loh** WWF International, Gland, Switzerland  
School of Anthropology and Conservation, University of Kent, Canterbury, UK
- K. MacKinnon** IUCN World Commission on Protected Areas (WCPA) Cambridge, UK
- B. MacSharry** United Nations Environment Programme World Conservation Monitoring Centre, Cambridge, UK
- L. Maiorano** Department of Biology and Biotechnologies, Università di Roma, Rome, Italy
- L. McRae** Institute of Zoology, Zoological Society of London, London, UK
- A. Milam** United Nations Environment Programme World Conservation Monitoring Centre, Cambridge, UK  
EcoLogic, LLC, Birmingham, AL, USA
- E. J. Milner-Gulland** Department of Life Sciences, Imperial College London, Berkshire, UK  
Department of Zoology, Oxford University, Oxford, UK
- M. A. K. Mwangi** BirdLife International, Cambridge, UK
- H. Nagendra** School of Development, Azim Premji University, Bangalore, India
- E. Nicholson** School of Botany, University of Melbourne, Melbourne, Victoria, Australia  
Deakin University, Geelong, Australia. School of Life and Environmental Sciences, Centre for Integrative Ecology (Burwood Campus), Australia
- T. G. O'Brien** Wildlife Conservation Society, Bronx, NY, USA  
Mpala Research Centre, Nanyuki, Kenya
- N. Pettorelli** Institute of Zoology, Zoological Society of London, London, UK
- N. Piekielek** University Libraries, 208L Paterno Library, The Pennsylvania State University, University Park, PA, United States
- M. Rao** Wildlife Conservation Society, Bronx, NY, USA
- J. G. Robinson** Wildlife Conservation Society, Bronx, NY, USA
- C. Rondinini** Department of Biology and Biotechnologies, Università di Roma, Rome, Italy
- L. Santini** Department of Biology and Biotechnologies, Università di Roma, Rome, Italy
- J. P. W. Scharlemann** United Nations Environment Programme World Conservation Monitoring Centre, Cambridge, UK  
School of Life Sciences, University of Sussex, Brighton, UK

**D. B. Segan** Wildlife Conservation Society, Bronx, NY, USA

**G. Shahabuddin** Centre for Ecology, Development and Research, Uttarakhand, India

**E. J. Stokes** Wildlife Conservation Society, Bronx, NY, USA

**S. Stolton** Equilibrium Research, Bristol, UK

**J. Walston** Wildlife Conservation Society, Bronx, NY, USA

**J. E. M. Watson** Wildlife Conservation Society, Bronx, NY, USA

School of Biological Sciences, University of Queensland, St. Lucia, Queensland, Australia

School of Geography, Planning and Environmental Management, University of Queensland, St. Lucia, Queensland, Australia

**M. Wegmann** Remote Sensing and Biodiversity Research, University of Würzburg, Würzburg, Germany

German Aerospace Centre, Cologne, Germany

**S. Whitmee** Centre for Biodiversity & Environment Research, University College London, London, UK

Institute of Zoology, Zoological Society of London, London, UK

International Union for Conservation of Nature, Cambridge, UK



# Introduction: Do Protected Areas Safeguard Biodiversity?

*J. E. M. Baillie<sup>1</sup>, L. Joppa<sup>2</sup> and J. G. Robinson<sup>3</sup>*

<sup>1</sup>Zoological Society of London, London, UK

<sup>2</sup>Microsoft Research, Redmond, WA, USA

<sup>3</sup>Wildlife Conservation Society, Bronx, NY, USA

In 1959, the UN Economic and Social Council called for a list of the world's national parks and equivalent reserves to recognise their economic, social and scientific importance and for their role in environmental well-being. The protected area network at the time covered roughly 2,000,000 km<sup>2</sup> and is now rapidly approaching 20,000,000 km<sup>2</sup> (WDPA, 2014). This tenfold increase in protected area coverage over 50 years has been one of the greatest successes in conservation. But protected areas are not an end in themselves, and to a large extent, biodiversity loss has continued unabated. Populations of many species have continued to decline, some species have gone extinct, and the integrity of ecosystems has increasingly been threatened. The world population has more than doubled, as has the human consumption of water, food and energy. Ever-increasing land conversion, carbon emissions, spread of invasive alien species, nitrogen pollution and over-exploitation have driven biodiversity loss. Ecosystems such as forests, coral reefs, mangroves and seagrass beds are on the decline (Butchart et al., 2010; Emmott, 2013), taking with them the species they contain (WWF, 2012). And these trends are not changing; the United Nations projected there will be 9.6 billion people on the planet by 2050 (United Nations, 2013) and the consumption of food, water and energy will more than double, resulting in the conversion of many of the last remaining wild spaces. As human population increases and land is converted or degraded, protected areas will therefore play an increasingly important role in conserving biodiversity. The imperatives of providing resources to meet the needs of an expanding human population while protecting other life forms will surely collide, and there will be growing pressures to develop or exploit