The Balance of Nature and Human Impact

It is clear that nature is undergoing rapid changes as a result of human activities such as industry, agriculture, travel, fisheries and urbanization. What effects do these activities have? Are they disturbing equilibria in ecological populations and communities, thus upsetting the balance of nature, or are they enhancing naturally occurring disequilibria, perhaps with even worse consequences?

It is often argued that large-scale fluctuations in climate and sea levels have occurred over and over again in the geological past, long before human activities could possibly have had any impact, and that human effects are very small compared to those that occur naturally. Should we conclude that human activity cannot significantly affect the environment, or are these naturally occurring fluctuations actually being dangerously enhanced by humans?

This book examines these questions, first by providing evidence for equilibrium and nonequilibrium conditions in relatively undisturbed ecosystems, and second by examining human-induced effects.

Klaus Rohde is Professor Emeritus at the University of New England, Armidale, Australia. He is well known for his work on the ecology, biogeography and ultrastructure of parasites, particularly marine parasites, and on latitudinal gradients in biodiversity. He has published extensively on parasite ecology, non-equilibrium ecology and marine parasitology.

The Balance of Nature and Human Impact

Edited by

KLAUS ROHDE

University of New England
Armidale, Australia

CAMBRIDGE
UNIVERSITY PRESS

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

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/9781107019614

First published 2013

Printed and bound in the United Kingdom by the MPG Books Group

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

Library of Congress Cataloging-in-Publication Data
The balance of nature and human impact / edited by Klaus Rohde,
University of New England, Armidale, Australia.
pages cm
Includes index.
ISBN 978-1-107-01961-4
1. Population biology. 2. Biotic communities. 3. Nature – Effect of human beings on.
I. Rohde, Klaus, 1932–
QH352.B34 2013
576.8–dc23

2012028838

ISBN 978-1-107-01961-4 Hardback

Contents

Color plates are to be found between pp. 48 and 49.

Foreword

As a somewhat obsessive, but far from expert, sea kayaker, I attend to issues of stability a good deal. Kayakers distinguish two kinds. Primary or initial stability is a measure of how much a kayak rocks in the water when it is displaced from the level. Secondary or final stability is a measure of how readily a kayak capsizes. Beginners instinctively confuse the two. They are concerned that the rocking associated with the primary stability characteristics of a boat reflects its secondary stability, and in overreacting to the former they can overwhelm the latter, and get very wet as a consequence. With practice, one learns to improve the primary stability that is experienced under an increasingly wide variety of conditions of wind and wave, to reduce the likelihood of unintentionally exceeding a kayak's secondary stability, and then to be able to use boats with inherently lower stability of both kinds. In a world in which the abundances and distributions of the majority of organisms are heavily influenced, and often continually buffeted, directly or indirectly by anthropogenic activities, we need to become the population management equivalent of more expert kayakers. This book provides one further step along that course.

Historically, ecologists have spent a lot of time debating whether populations have the equivalent of primary stability (i.e. whether they have their dynamics in some way bounded), how it varies intraspecifically and interspecifically, and what that might mean in turn for the structure and composition of assemblages and communities. Indeed, a plethora of measures have been developed to assess that stability, far in advance of what any typical group of kayakers might think of, but perhaps not dissimilar to the technicalities of boat and ship design. This book reveals that the debate is not over. However, in broad strokes, it is clear that (i) there is an enormous range of population behavior, and it is difficult to categorize in simple terms; (ii) that behavior can be very context specific, with regard to species, space, and time; and (iii) in consequence it can be difficult a priori to predict for any given case without knowing a good deal about those specifics. What is then key to understand is how natural population behavior is reshaped by anthropogenic pressures, just as the wake of a passing vessel can dominate the primary stability experienced by a kayaker, by setting up movements that are commonly at odds with those that were otherwise being felt. Put crudely, do those pressures act in a similar way to those more naturally experienced by a population or are they substantially different in character? This book offers some answers to that question.

More and more, however, the concerns of ecologists are becoming focused on issues of secondary stability. Are there "tipping" points that rapidly throw populations and communities from one state to another (the equivalent of the kayak being the correct or the wrong way up), how can those points be recognized, and under what circumstances do they occur? The challenge here is that the answers may well once again be very context specific, begging the question of whether there are practically (as opposed perhaps to theoretically) useful generalizations, or whether every case has to be considered in its own terms. Again, the chapters of this book have something to say on the issue. For the kayaker, a shift in balance, a paddle stroke and a brace, each exacted at the right time, can prevent the loss of secondary stability or indeed bring that loss about. For the population manager, much the same is likely commonly true for the tools they have at their disposal to influence movements, births, and deaths. For both kayaker and population manager, what is needed is sufficient experience to gauge what actions are most appropriate and when. It has been argued that it takes a skillful kayaker to complete an Eskimo roll when they have lost secondary stability, but far more skill not to lose that stability in the first place.

Of course, for the population manager, as for the kayaker, ultimately what is required is a synthetic understanding of both primary and secondary stability, and how they interact. Only then will it be possible to ensure some degree of understanding or control over the futures of species, assemblages, and communities. This book helps in bringing both sets of issues within the same covers.

Kevin J. Gaston
Environment & Sustainability Institute
University of Exeter

List of contributors

Professor Inger G. Alsos
Tromsø University Museum, University of Tromsø, NO-9037, Tromsø, Norway
inger.g.alsos@uit.no

Associate Professor Nigel R. Andrew
Zoology, University of New England, Armidale 2351, Australia nigel.andrew@une.edu.au

Associate Professor Michael Box
School of Physics, University of New South Wales, Sydney NSW 2052, Australia
M.Box@unsw.edu.au

Professor Christian Brochmann
National Centre for Biosystematics, Natural History Museum, University of Oslo,
P.O. Box 1172 Blindern NO-0318 Oslo, Norway christian.brochmann@nhm.uio.no

Professor Daniel Brooks
Department of Ecology & Evolutionary Biology, University of Toronto, 25 Harbord St.
Toronto, ON Canada, M5S 3G5. Postal address: 1821 Greenbriar Lane, Lincoln, NE
68506, USA dan.brooks@utoronto.ca

Associate Professor Peter J. Clarke
Botany, University of New England, Armidale NSW 2351, Australia
pclarke1@une.edu.au

Professor Yihong Du
Mathematics, School of Science and Technology, University of New England, Armidale
NSW 2351, Australia ydu@turing.une.edu.au

Professor Mary E. Edwards
Geography and Environment, University of Southampton, Highfield, Southampton,
SO17 1BJ, United Kingdom M.E.Edwards@soton.ac.uk

Professor Hugh A. Ford
Zoology, University of New England, Armidale 2351, Australia hford@une.edu.au

Dr. Graham Forrester
Dept. of Natural Resources Science, University of Rhode Island, Kingston, RI 02881, USA forrester.graham@gmail.com

Associate Professor Len Gillman
School of Applied Science, Auckland University of Technology, Auckland, Private Bag 92006, New Zealand len.gillman@aut.ac.nz

Professor Harold Heatwole
Zoology, University of North Carolina, NC, Raleigh, NC 27695–7617, USA (postal address), and Zoology, University of New England, Armidale, Australia halfh@ncsu.edu

Dr. Eric Hoberg
Chief Curator, US National Parasite Collection, ARS, USDA Animal Parasitic Diseases Laboratory BARC East 1180, 10300 Baltimore Avenue, Beltsville, MD 20705 Eric.Hoberg@ARS.USDA.GOV

Dr. Aneta Kostadinova
Institute of Parasitology, Biology Centre of the Academy of Sciences of the Czech Republic, Branišovská 31, 370 05 České Budějovice, Czech Republic aneta.kostadinova@uv.es

Professor Boris R. Krasnov
Mitrani Department of Desert Ecology, Jacob Blaustein Institutes for Desert Research, Ben-Gurion University of the Negev, Sede Boqer Campus, 84990 Midreshet Ben-Gurion, Israel krasnov@bgu.ac.il

Professor Michael J. Lawes
Research Institute for the Environment and Livelihoods, Charles Darwin University, Darwin, NT 0909, Australia michael.lawes@cdu.edu.au

Professor Harvey B. Lillywhite
Department of Biology and Director, Seahorse Key Marine Laboratory, University of Florida, Gainesville, Florida 32611–8525, USA hblill@ufl.edu

Associate Professor Brian McGill
School Biology and Ecology & Sustainable Solutions Initiative, University of Maine, Deering Hall 303 Orono, ME 04469, USA mail@brianmcgill.org

Professor Camilo Mora
Department of Geography, University of Hawaii Manoa, USA cmora@hawaii.edu

Professor Serge Morand
Institut des Sciences de l'Evolution – CNRS, CC065, Université Montpellier 2, Montpellier Cedex, France serge.morand@univ-montp2.fr

Dr. Lloyd W. Morrison
Department of Biology, Missouri State University, 901 S. National Ave., Springfield MO 65897, USA LloydMorrison@MissouriState.edu

Dr. Ana Pérez-del-Olmo
Departament de Biologia Animal, de Biologia Vegetal i d'Ecologia, Universitat Autònoma de Barcelona, 08193 Cerdanyola del Vallès, Barcelona, Spain ana.perez@uab.es

Dr. Annapaola Rizzoli
Centro Ricerca ed Innovazione, Dipartimento di Biodiversita ed Ecologia Molecolare, Fondazione Edmund Mach, 38010 San Michele all'Adige (TN), Italy annapaola.rizzoli@mach.it

Professor Klaus Rohde
Zoology, University of New England, Armidale NSW 2351, Australia krohde@une.edu.au

Professor Peter F. Sale
Assistant Director, United Nations University, Institute for Water, Environment and Health, Hamilton ON, and Professor Emeritus, University of Windsor, Canada sale@uwindsor.ca

Dr. Andrea Šimková
Department of Botany and Zoology, Faculty of Science, Masaryk University, Kotlářská 2, 61137 Brno, Czech Republic simkova@sci.muni.cz

Dr. Mark Steele
Department of Biology, California State University, Northridge, CA 91330–8303 mark.steele@csun.edu

Associate Professor G. H. Walter
School of Biological Sciences, The University of Queensland, Brisbane Qld 4072 Australia g.walter@uq.edu.au

Dr. Shane Wright
School of Biological Sciences, University of Auckland, Auckland, Private Bag 92019, New Zealand sd.wright@auckland.ac.nz

Professor Fernando A. Zapata
Department of Biology, Universidad del Valle, Apartado Aéreo 25360, Cali, Colombia fernando.zapata@correounivalle.edu.co

Acknowledgments

The authors and editor wish to thank the following for reviewing chapters in this book.

Associate Professor Nigel Andrew, Zoology, University of New England, Armidale, Australia

Professor Stuart Barker, Animal Science, University of New England, Armidale, Australia

Professor William Bond, Department of Botany, University of Cape Town, Rondebosch, South Africa

Associate Professor Michael Box, Physics, University of New South Wales, Sydney, Australia

Associate Professor Peter Clarke, Botany, University of New England, Armidale, Australia

Associate Professor Indraneil Das, Institute of Biodiversity and Environmental Conservation, Universiti Malaysia Sarawak, Kota Samarahan, Sarawak

Professor Fordyce Davidson, Mathematics, University of Dundee, Dundee, UK

Professor Christopher Dickman, Biological Sciences, University of Sydney, Australia

Dr. Andrew Glikson, Earth and Marine Science, Australian National University, Canberra, Australia

Professor Harold Heatwole, Zoology, University of North Carolina, Raleigh NC, USA, and University of New England, Armidale, Australia

Professor Ingibjörg Svala Jónsdóttir, University of Iceland, Reykjavik, Iceland

Professor David Karoly, Earth Sciences, University of Melbourne, Australia

Professor Boris Krasnov, Desert Research, Ben Gurion University, Mizpe-Ramon, Israel

Dr. Lesley T. Lancaster, National Center for Ecological Analysis and Synthesis, University of California, Santa Barbara, CA, USA

Dr. Tommy Leung, Zoology, University of New England, Armidale, Australia

Professor Serge Morand, Institut des sciences de l'évolution, Université Montpellier 2, France

Dr. Chris Pavey, CSIRO Ecosystem Sciences, Business & Innovation Centre, Desert Knowledge Precinct, Alice Springs, Australia

Professor Robert Poulin, Zoology, University of Otago, Dunedin, New Zealand

Professor Harry F. Recher, AM, FRZS, POB 154, Brooklyn, NSW, Australia

Professor Thomas W. Schoener, Evolution and Ecology, University of California at Davis, CA, USA

Dr. John Terblanche, Conservation Ecology and Entomology, Stellenbosch University, Matieland, South Africa

Dr. John Veron, Australian Institute of Marine Science, Townsville, Australia

Ass. Professor J. Wilson White, Biology and Marine Biology, University of North Carolina, Wilmington, NC, USA

Associate Professor Ian Whittington, Earth and Environmental Science, University of Adelaide, Australia

Dr. John W. Wilkinson, Amphibian & Reptile Conservation, Boscombe, Bournemouth, Dorset, UK

Professor Yihong Du, Mathematics, University of New England, Armidale, Australia

We thank **Cesar Luis Barrio-Amorós**, Instituto de Biodivesidad Tropical, San José, Pérez Zeledón, San Isidro, Costa Rica for the cover photo.

Professor David Jablonski, Geophysical Sciences, University of Chicago, kindly provided advice and references for Chapter 11.

E.P. Hoberg and D.R. Brooks are grateful to **Alycia Stigall** at the OHIO Center for Ecology and Evolutionary Studies, Ohio University, for sharing preprints of several papers and for discussions about invasion and faunal structure.