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978-0-521-51349-4 - Ecosystem Ecology: A New Synthesis

Edited by David G. Raffaelli and Christopher L. J. Frid

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Ecosystem Ecology

A New Synthesis

What can ecological science contribute to the sustainable management and conservation of the natural systems that underpin human well-being?

Bridging the natural, physical and social sciences, this book shows how ecosystem ecology can inform the ecosystem services approach to environmental management. The authors recognise that ecosystems are rich in linkages of varying strength between biophysical and social elements that generate powerful intrinsic dynamics. Unlike traditional reductionist approaches, the holistic perspective adopted here is able to explain the increasing range of scientific studies that have highlighted unexpected consequences of human activity, such as the lack of recovery of cod populations on the Grand Banks despite nearly two decades of fishery closures, or the degradation of Australia's fertile land through salt intrusion.

Written primarily for researchers and graduate students in ecology and environmental management, it provides an accessible discussion of some of the most important aspects of ecosystem ecology and the potential relationships between them.

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CAMBRIDGE UNIVERSITY PRESS

Cambridge, New York, Melbourne, Madrid, Cape Town, Singapore,
São Paulo, Delhi, Dubai, Tokyo

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/9780521513494

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First published 2010

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 Cataloguing in Publication data

Ecosystem ecology : a new synthesis / [edited by] David G. Raffaelli, Christopher L. J. Frid.

p. cm. - (Ecological reviews)

ISBN 978-0-521-51349-4 (hardback)

1. Biotic communities--Research. 2. Human ecology--Research. 3. Ecosystem
management--Research. I. Raffaelli, D. G. (Dave G.) II. Frid, Chris. III. Title. IV. Series.
QH541.2.E256 2010

577--dc22

ISBN 978-0-521-51349-4 Hardback

ISBN 978-0-521-73503-2 Paperback

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Preface

What can ecological science contribute to the sustainable management and conservation of the natural systems that underpin human well-being? This is a question that is taxing many professional ecologists, learned societies and science funders. The question has been driven by both the increased awareness of the present ecological crisis and the publication of several documents influential at the highest political level, such as the Intergovernmental Panel on Climate Change (IPCC) reports, the Stern Review, GEO4 and, most relevant to the present volume, the Millennium Ecosystem Assessment. The impetus and stimulation for this volume came in part from workshops hosted by UK Pop Net and the British Ecological Society (BES) in 2003 and 2007, respectively, which aimed to seek an answer to the question: how can mainstream ecology, and by definition the ecologists within learned societies like the BES, contribute to national and international initiatives aimed at implementing a holistic ecosystem approach for environmental management? That workshop revealed a huge potential within the community but also frustrations about, and ignorance of, the different perspectives on ecosystem ecology held by the different sectors within mainstream ecology: reductionist versus holistic approaches, inter-disciplinary versus mono-disciplinary approaches, those which recognise humans as part of versus apart from the ecosystem.

Ecosystem Ecology implies both a different perspective and a different approach to the science. The more holistic view tends to regard the ecosystem as rich in ecological linkages, some of which may be strong but many of which will be individually weak. However, the number of linkages provides a system with a powerful intrinsic dynamic. It therefore follows that a reductionist approach to the study of the system may readily identify any strong links but may fail to correctly understand the system's topology and dynamics. Legislative and environmental management frameworks have in recent years placed greater emphasis on a holistic, ecosystem approach. In part this might be a response to political power passing to the 1960's 'silent spring' generation but it might also be due to the increasing range of scientific studies that have highlighted unexpected, based on reductionist views, consequences of human activities.

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Examples include the lack of recovery of cod populations on the Grand Banks after nearly two decades of fishery closures, the massive underestimation of the importance of mature forests to carbon sequestration and the impacts of an alien (non-native) species of small jellyfish on the ecology of the Black Sea.

This volume is not an attempt to provide an overarching theory or framework that will bring these different approaches under a single banner. Rather it aims to make accessible, for those willing to make the journey, approaches which might otherwise seem too demanding or even not worthwhile to tackle at first sight. Many of the aspects of ecosystem ecology that are explored in this book have been around and actively pursued for some time, but often without explicit acknowledgement of the potential connections, relationships and synergies between them.

In Chapter 1, we briefly review some of these different approaches and attempt to place their origins in an historical context in order to account for their often divergent trajectories and isolation of the different research schools, and we illustrate the potential linkages and analogies between them to encourage better integration of those ideas. Chapter 2 examines theoretical approaches at the population, assemblage and ecosystem scales and the connections and links between them. This raises the question as to whether increasing computer power and hence the ability to run more complex models has now moved to the point where our focus should return to the collection and analysis of empirical data on the systems of interest. The linking of the physical world, as constrained by the Laws of Thermodynamics, with the response of the biological part of the ecosystem forms the central theme of Chapter 3. These linkages illustrate the dynamic nature of ecosystems and the need to study them from this perspective if we are to develop the understanding necessary to then develop environmental management schemes.

As environmental management has moved up the political agenda, science has been asked to provide measures of the health of the environment. Chapter 4 examines the concept of ecosystem health and the approaches available to assess it. With politicians trying to balance the need to deliver all 'three pillars' of sustainability (ecological, social and economic), so ecosystem health assessments often feature measures of the human aspects of the ecosystem. Chapter 5 examines how interdisciplinary studies of the ecosystem are developing and the barriers that are being encountered as social scientists, economists and ecologists attempt to bring their expertise to bear simultaneously on problems of sustainable ecosystem management.

In Chapter 6 we further explore the science that links ecosystem processes with human activities, the ecosystem services approach. Once again this highlights the benefits of holistic ecology and the need for interdisciplinary working. In Chapter 7 we draw together many of the themes developed in earlier

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chapters and consider explicitly how ecosystem ecology is relevant to those who make and implement environmental, in its broadest sense, policy.

Finally, we wish to thank the team of authors for agreeing to be part of this project, for contributing their expertise and for their patience and forbearance as we have struggled to pull the whole together. In the best traditions of ecosystem science we hope that the whole is more than the sum of the parts!