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Forest Ecosystems

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THE JOHNS HOPKINS UNIVERSITY PRESS
BALTIMORE AND LONDON

649. p.

To Carol, Kyna, Dave, and Maia

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Printed in the United States of America on acid-free paper

The Johns Hopkins University Press
2715 North Charles Street
Baltimore, Maryland 21218-4319
The Johns Hopkins Press Ltd., London

Library of Congress Cataloging-in-Publication Data

Perry, David A.

Forest ecosystems / David A. Perry.

p. cm.

Includes bibliographical references (p.) and index.

ISBN 0-8018-4760-5 (hc : alk. paper). — ISBN 0-8018-4987-X (pbk.
paper) 1. Forest ecology. I. Tide.

QK938.F6P46 1994

581.5'2642—dc20

94-10796

CIP

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



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Preface

For many years, the only ecology textbook that was aimed specifically at forestry students was the classic by Steven Spurr and Burton Barnes, which still sits on my shelf and does not collect dust. I first encountered this book shortly after beginning work as a researcher for the U.S. Forest Service in Montana. Although fresh out of a Ph.D. program in ecology, I found this "undergraduate" text packed with new information that kept my attention from cover to cover.

What Spurr and Barnes accomplished became a model for me of what a forest ecology text must do. It must communicate to students who may only have one ecology course, but in a way that does not gloss over the complexity of natural systems. It must also serve as a reservoir of state-of-the-art knowledge, not only for students but for practicing land managers, scientists, and increasingly, policy makers and private citizens who have a very real stake in the way that resources are managed and protected. In other words, a good ecology text must find a balance between complexity and simplicity that allows communication to a wide audience. That is what I have attempted to do in this book.

The academic target is advanced undergraduate to graduate students who may or may not have had a previous ecology course. The level of detail varies from fairly simple expositions of things such as the world's forest types and the subdisciplines of ecology to detailed discussions of processes such as productivity, succession, nutrient cycling, and stability. Basic ecologic concepts are introduced and discussed, but in ecology, *basic* seldom translates to *simple*.

In the 20 years since I first picked up Spurr and Barnes, both the science of ecology and the science and art of land management have undergone revolutionary changes that continue to build momentum. Once fragmented into various subdisciplines whose members rarely communicated among themselves except to argue, ecologists are now grappling with fitting these diverse pieces into a coherent whole—the "search for pattern" as Robert May describes it. At one time distressingly aloof from the environmental problems that plague us, the Ecological Society of America has recently begun urging its members to become actively involved in addressing the world's problems and helping human societies steer a course that both restores and sustains the health of the biosphere.

Until recently, the predominant management paradigm of modern forestry (like that of its model, modern agriculture) has been to deal with the bewildering complexity of nature by eliminating it, by homogenizing forests to focus on a single crop. This approach, however, entails costs that are increasingly unacceptable to many people. I have traveled on five continents in the past few years, and everywhere, I have found the same concerns about the loss of biologic diversity and the long-term stability of landscapes that are dominated by tree farms. In Germany, the United States, Canada, Chile, New Zealand, Australia, and elsewhere, public concerns have forced a reevaluation of forest management practices. This remarkable phenomenon increasingly springs from the grass roots, from the people who live and work both in and around forests. Indigenous people in Canada barricade logging roads. Peasants in India hug trees to keep them from being cut. I recently spoke with representatives from a group of small farmers (*campesinos*) in Nicaragua who had been sent by their people to the United States to seek help in learning how to balance their economic needs with restoring and maintaining their forests, soils, and waters. Grass-roots groups of

environmentalists and loggers are forming in my own area, the Pacific Northwest, to address these same issues. They are the clientele that many ecologists and resource managers will serve in the future.

If society is to find the proper balance between producing marketable goods and preserving the health and diversity of ecosystems, those who are stewards of the land—both professionals and private citizens—must begin by understanding how natural systems are built and work. This defines the ecologic possibilities and constraints that must inform any sensible economic program. As Levins and Lewontin (1985) and Lubchenco et al. (1991) point out, understanding complexity is the central problem, and communicating the complexity of nature has been my primary goal in this book. Sending a manager or a citizen-activist into the world with an oversimplified view of what that world is actually like is a disservice both to the individual and to society. Of course, one can quickly present more “facts” than any student can soak up and retain; I want students to come away from this book with a feeling for the rhythms of nature: dynamic patterns in space and time, interrelationships, links between the way systems are built and how they work. The details are always there on the shelf when needed, and our understanding of these details constantly grows and changes anyway. But complexity is . . . well, *complex*, and the workings of nature are poorly understood. I have taken some pains to discuss what is not, as well as what is known, because understanding the level of ignorance underpinning our land-management decisions is in itself an important kind of knowledge that defines the bounds of prudent action.

No single text can do justice to all of modern ecology, at least not one small enough for one person to lift (much less *afford*). Every author brings a set of both conscious and unconscious screens to the overwhelming mass of information that is available, and it is only fair that a prospective reader be given some idea of where an author is coming from. I was imprinted at an early age by a worldview with two basic elements: *wholeness*, and *utilitarianism*. Nature is a complex and mysterious affair, to be treated with *respect* and *humility*, but it is also where people make their living. Consequently, my focus as a scientist has been on how diverse parts interact to form systems and how humans can *merge with the natural flow* and extract values in a way that sustains the health and diversity of nature. I have little patience with the old debate about “holism versus reductionism.” As most ecologists now realize, nature is too complex to yield to such simple dichotomies. I agree completely with the emerging view of nature as pluralistic (or dialectic, in the terminology of Levins and Lewontin): the parts and the whole interact to sustain one another, and one cannot be understood without the other. It follows that the critical focus cannot be on “parts” or “wholes”; rather, it must be on what makes a collection of objects into a *coherent whole*—that is, it must be on *interactions*. Once an individual chooses to focus on interactions, it quickly becomes apparent that the boundaries we use to distinguish “part” from “whole” become blurred and even meaningless. What is a part of one thing is a whole for another set of things. No single forest is isolated from landscapes, regions, or the globe, and global processes are mediated by the smallest organisms on Earth. Ultimately, we are all participants in nature’s grand dance. For me, that is what must be learned if we are to survive as a species.