

# BIOSPHERE 2000

PROTECTING OUR GLOBAL ENVIRONMENT

SECOND EDITION



Donald G. Kaufman  
Cecilia M. Franz

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**PROTECTING OUR GLOBAL  
ENVIRONMENT**

**Donald G. Kautman**

MIAMI UNIVERSITY

**Cecilia M. Franz**

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**KENDALL/HUNT PUBLISHING COMPANY**  
4050 Westmark Drive Dubuque, Iowa 52002

**Biosphere 2000**  
**Protecting Our Global Environment**  
**2nd edition**

**Donald G. Kaufman**  
**Miami University**

**Cecilia M. Franz**  
**Miami University**

**Kendall/Hunt Publishing Company**

**Design, Layout, and Production:** The Oxford Associates, Oxford, Ohio

**Art Direction:** Carole Katz, The Oxford Associates

**Cover Photo:** Thomas Collins, The Oxford Associates

**Printer and Binder:** The C.J. Krehbiel Company

Cover photo: An early autumn morning in Magee Marsh, a wetland on the Ohio shore of Lake Erie, finds a lone egret in the shallows.



Printed with non-toxic soy-based inks on Simpson Satin-Kote Recycled paper, containing 50% recycled fiber including 10% post-consumer waste.

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Biosphere 2000: Protecting Our Global Environment, second edition

Copyright © 1996 by Donald G. Kaufman and Cecilia M. Franz  
ISBN 0-7872-0460-9

Library of Congress Catalog Card Number: 95-77236

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10 9 8 7 6 5 4 3 2

# Living on Round River

“One of the marvels of early Wisconsin,” wrote the ecologist Aldo Leopold, “was the Round River, a river that flowed into itself, and thus sped around and around in a never-ending circuit. Paul Bunyan discovered it, and the Bunyan saga tells how he floated many a log down its restless waters.

“No one has suspected Paul of speaking in parables, yet in this instance he did. Wisconsin not only had a round river, Wisconsin is one. The current is the stream of energy which flows out of the soil into plants, thence into animals, thence back into the soil in a never-ending circuit of life.”

Implicit in Leopold’s writing is the idea that the entire earth is also a round river. And we — the humans who live on the river — are bound up with it, part and parcel of the environment that we affect and are affected by.

## Themes

This book is an environmental primer, a foray into the workings and the wonder of the earth and the problems that beset it. It is written for use in introductory environmental science college courses or in general ecology courses with an environmental emphasis, but it contains a message and information for all individuals and communities. Throughout the text, we emphasize three themes.

First, despite the scope and gravity of environmental problems, we find reason to hope. This book is not a death knell for a doomed planet, nor is it an apologia for past failures. Inarguably, humanity faces many complex environmental problems, but focusing on the difficulty of resolving problems can only paralyze us. We have attempted to examine the many environmental problems that beset us, the dimensions of those problems, and their varied and interrelated causes. While we acknowledge the difficulty of the present situation, we take a positive approach. For example, we consider the opportunity solid wastes present as well as the problem; we look at solid wastes as “unrealized resources” that society can and should begin to use more fully. Moreover, our text contains no unit or section on pollution per se. Rather, Chapter 6, Ecosystem Degradation, presents a general discus-

sion of the topic, including the types and sources of pollution and their effects and associated problems. Specific information on pollution is then integrated into appropriate chapters, especially those on air, water, and soil. Finally, throughout the text we offer lists of practical things — called *What You Can Do* — that individuals can do to help protect and preserve resources and natural systems. These suggestions enable students, teachers, classes, and communities to become active participants in the greatest challenge humans have ever faced: the struggle to preserve our global environment.

A second major theme of the book is that environmental problems, although complex, can be solved through the use of an interdisciplinary problem-solving model. This flexible and effective model, introduced in Chapter 2, is based on similar models developed for use in the social sciences, and it has been applied successfully to many environmental problems. Its five steps are 1) identify the problem; 2) set goals and objectives; 3) design and conduct a study; 4) propose alternative solutions; and 5) implement, monitor, and reevaluate the chosen solution.

A third important theme of the text is that many problems can be avoided altogether through environmentally sound resource management. Such management is proactive and cost-effective: by preventing environmental problems, we avoid the necessity of costly remedies. Of course, “management” is a tricky idea; experience has shown that we can’t manage natural systems in the sense that we can do whatever we like. Further, many environmentalists argue that effective management is impossible until we first learn to manage our own species, primarily by controlling population growth and reducing resource consumption by wealthy societies. We (and many others) believe that environmentally sound management should be based on a stewardship or land ethic of resource use. The land ethic was initially proposed by Aldo Leopold, who was among the first to merge the scientific lessons of ecology with the philosophical awareness of ethics. He explained his land ethic in his influential writings, particularly *A Sand County Almanac and Sketches Here and There*. Leopold encouraged us to view “the land” as a community of organisms inti-



mately bound up with its physical environment and sparked by a current of energy flowing through its living parts. His works sparked the imagination of generations of scientists and nonscientists alike, who came to realize that treating nature as if it were disposable property would eventually lead to the demise of this community and hence to the collapse of modern civilization. Leopold maintained that each human is "but a plain member and citizen of the land-community," entitled to a share of resources but charged with the responsibility to act as a steward, or caretaker, of the land-community.

## How This Book Began

During the fall semester in 1983 one of us (Donald Kaufman) taught an environmental science class for honors students at Miami University, Oxford, Ohio. At the end of the semester the students agreed to do additional research on specific natural systems or resources with the long-term goal of incorporating their research into a textbook for first- and second-year college students taking their first, and possibly only, environmental science course. While there are many books targeted for these students, none had been developed with the assistance of undergraduate nonmajors. The students believed that a book developed by students would be helpful to their peers. This was the origin of the book development team. One of the first things we did was to send a questionnaire to university professors nationwide who teach environmental science or resource management courses. We asked them to suggest resources or natural systems that best illustrate environmental principles. Each student selected a topic from these suggestions, developed a comprehensive research plan, and, for the next three years, pursued that plan in extensive library and field investigations. For example, one student traveled to Boston to meet with a leading authority on whales, while another ventured to the Everglades of Florida.

These students, and others who later joined the project, focused on the environmental problems associated with each resource and how it had been managed in the past. They summarized and evaluated various management strategies and made suggestions for future management. After years of effort, they completed extensive reports, which form the basis for the *Environmental Science in Action* sections that supplement many of the chapters. These essays give concreteness to the environmental principles discussed.

It's impressive enough to realize that these students — 18 and 19 years old when the project began — took on this work simply because they thought it important and worthwhile. What's even more impres-

sive is that they took the initiative to seek and secure the financial support needed to fund their research. A grant from the George Gund Foundation of Cleveland, Ohio, supported student researchers during the summer months. Additional grants from Miami University's Fund for Excellence financed student travel and provided students with support as they worked to refine their preliminary reports.

Our project had its detractors. A fellow professor maintained that undergraduates were not capable of either the intense research or the long-term commitment necessary to accomplish such an ambitious goal. Clearly, the students proved him wrong; more importantly, they proved to themselves that individuals working toward a common goal can achieve it, despite the difficulty. And so, in honor of the students whose work and enthusiasm gave birth to this text, we established the Global Heritage Endowment (GHE) to enable undergraduate students to undertake environmental projects or research. We donated all of our royalties from the first edition to the GHE, which is managed by the Miami University Foundation; 25 percent of our royalties from this second edition, and any future editions, are also earmarked for the endowment. The GHE awards grants annually, on a competitive basis, and it is open to students throughout North America. Grants have thus far been given to students at Marysville College, Tennessee (1994), Miami University, Ohio (1995), and the University of Nevada at Las Vegas (1995). We invite students or their teachers to write to us for details.

## Organization

The Prologue invites readers to examine their worldview in order to understand the values, beliefs, and attitudes that shape our actions toward the environment, how we use resources, and how we respond to environmental problems.

The body of the text is divided into seven major units. Unit I, The Biosphere and Environmental Science, consists of two chapters; Chapter 1 looks at the development of the biosphere and presents an overview of environmental problems; Chapter 2 shows how science, environmental science, and environmental studies can help us to better understand how nature works and how to alleviate environmental problems.

Unit II examines how the biosphere works. Chapters 3 to 5 present principles of ecosystem structure, function, development, and equilibrium. Chapter 6 looks at the degradation of ecosystems, focusing on degradation caused by human activities. Chapter 7 discusses the application of ecological principles to restoring and preserving ecosystems.

Units III through VI are devoted to a study of resources that have common qualities or that are linked

in a significant way. Unit III considers the environmental imperative to balance the human population, food, and energy resources. The three chapters on energy explore the environmental issues related to energy consumption, society's use of fossil fuels, and alternative sources of energy.

Protecting major biospheric components — air, water, soil, and biological resources — is examined in Unit IV.

Resources critical to industrial societies — minerals, nuclear resources, toxic and hazardous substances, and “unrealized resources”— are discussed in Unit V.

Unit VI is concerned with “heritage” resources: public lands, wilderness, and cultural resources. Clean air, clean water, and fertile soil can help to feed our bodies, but wild lands and the cultural artifacts to which they give rise nourish our spirits.

Finally, Unit VII, *An Environmental Legacy: Shaping Human Impacts on the Biosphere*, looks at the cultural systems that shape human attitudes and behavior toward the natural world. We review the historical impact of religion, ethics, economics and politics, but we focus on the present and future. Our goal is to show how these powerful factors can and are being used to modify and enhance human interactions with the biosphere.

## Special Features

*Biosphere 2000* has many special features. The text asks readers to examine their worldview *before* they begin to study ecological principles and environmental issues. It includes four chapters that are unique to environmental science texts: applied ecology (Chapter 7), unrealized resources (Chapter 21), cultural resources (Chapter 24), and environmental education (Chapter 28). Just as an understanding of ecological concepts is crucial to environmental awareness, a knowledge of the diverse social forces that affect environmental decisions is also vital. Chapters on religion and ethics (Chapter 25), politics and economics (Chapter 26), and law and dispute resolution (Chapter 27) illustrate how attitudes and behaviors are shaped by these important disciplines and how these disciplines can be used to help or hinder environmentally sound management.

*Environmental Science in Action* sections supplement many of the text's chapters; each presents a comprehensive study of a particular ecosystem or resource in order to illustrate concepts or principles discussed in the accompanying chapter. Similarly, selected essays, entitled *Focus On*, give readers a closer look at a specific resource, illustrate an ecological principle, or delve more deeply into a particular environmental issue. Many are written by guest essayists and thus offer a variety of points of views.

Other features of the text include:

- Chapter objectives
- Key terms
- Discussion questions
- Bibliography for further reading and research
- Glossary
- Use of many real-life, current examples to illustrate principles throughout the text. Our goal in selecting examples is to give readers a global perspective on environmental issues. In addition, we have included numerous examples and statistics from Canada and Mexico in order to help U.S. students better understand their continental neighbors.
- *What You Can Do* sections contain specific suggestions on ways individuals can become involved in environmental issues, help to preserve natural systems, and protect resources. We invite students and teachers to write to us with additional suggestions for future editions of *Biosphere 2000*.

## Supplementary Materials

The supplementary materials accompanying *Biosphere 2000* are:

- *Teacher's Resource Guide and Test Bank* by Donald Kaufman, Lisa Breidenstein, and Bobbie Oh. For each chapter, the manual presents an overview, lecture outline, student objectives, teaching tips, and a list of resources for further study. The test bank features multiple-choice, true/false, sentence-completion, and critical-thinking questions.
- *Student's Resource Guide* (ISBN 0-7872-0461-7), authored by Donald Kaufman, Cheryl Puterbaugh, Laura Heyduk, and a group of current undergraduates at Miami University. The guide contains, for each chapter, a chapter overview and outline, learning objectives, key terms, suggested activities, and approximately 20 review questions.
- Transparency Acetates: A complete package of full-color acetates are available to adopters.

## Acknowledgments

The second edition of *Biosphere 2000* has benefited from the help and participation of students, educators, and environmental professionals. Any errors that may remain are, of course, our responsibility.

We wish first of all to thank everyone at Kendall/Hunt who helped to guide the revision of *Biosphere 2000*. It is such a pleasure to work with a company that is committed to producing a first-rate text in an environmentally sound manner.

We are most grateful to The Oxford Associates (TOA), the company responsible for the design and production of *Biosphere 2000*, especially Thomas Collins and Carole Katz. Tom is the founder and president of TOA. When we approached him in the fall of 1994 with the idea of producing a second edition of *Biosphere 2000*, Tom listened carefully and offered us sage advice. His belief in the text and in the merit of our student-inspired project was very important to us. Tom's organizational and management skills helped to launch the second edition, and over the next nine months, he kept a watchful eye on its progress. The revision was made much easier because we had the good fortune to work with Carole Katz, whose intelligence, insight, and creativity combined to produce an elegant and effective design and layout. Before the revision process began, we had a rather vague notion of what we wanted the second edition to look like. Carole interpreted our thoughts and wishes and gave shape and form to our vision, and for that we owe her a debt of gratitude. Others at TOA whom we wish to thank include Tony Marsico and Kim Mackey and, for quickly and efficiently compiling the index, Bernadette Adams, Amy Oldham, and Meg White.

In order to do a good job of revising, updating, and producing the second edition in nine months, we turned to family and friends for assistance with selected chapters: Chris Brueske, CH2M HILL (Chapters 14 through 16); Cynthia Durgan, a Master's candidate in Miami University's Department of Botany (Chapters 3 through 7 and selected sections throughout the text); Greg McNelly, Clean Sites, Inc. (Chapter 20); John Perrine, Defenders of Wildlife (Chapter 17); Walter Quaider, U.S. Department of Energy (Chapter 19); Susan Smiley, U.S. Department of Energy (Chapter 19); Clark Sorensen, Information Systems and Services, Indiana University (Chapter 13); and Lisa Taylor, Center for Chemical Education, Miami University (Chapters 17, 18, and 21). Last but not least, Patricia Kaufman, Department of History and Social Studies, Talawanda High School, updated Chapters 25 through 28. She also focused her considerable energy on improving the glossary, and we are grateful to her for her thoughtful, careful, and thorough work. Thanks, too, to Dave Berg for his contribution to Chapter 2 and for his help with miscellaneous tasks and errands.

As with the first edition of *Biosphere 2000*, we tapped the special talents of certain friends and associates to produce this textbook. Susan Friedmann, a freelance artist living and working in Cincinnati, Ohio, created several new illustrations to add to those which

she created years ago. Mary Sohngen, former Professor of English, Miami University, carefully and quickly edited the page proofs. A number of people in the Miami and Oxford communities generously allowed us the use of their photographs; their contribution has made this a better and more interesting text. We wish to thank in particular Scott Bagley, Hardy Eshbaugh, David Gorchoy, Andy Jones, Carole Katz and Jonathan Levy, Patricia Kaufman, Orie Loucks, Ruth McCleod, Alan Straus, and Mike Vanni. A special thanks to Dolph Greenberg, who provided several dozen slides for the text. His talent as a photographer is exceeded only by his dedication to his students and to the native American tribes with whom he works.

We are also grateful to the following individuals and organizations who provided needed information, usually on short notice, or who generously allowed us the use of their slides at no cost or for a reduced fee: Anne Marie Amantia, Population Action International; Scott Anger, a freelance photographer; George Coakley, U.S. Bureau of Mines; Inez Connor, U.S. Fish and Wildlife Service; John Cook, Tufts University School of Nutrition; Helen Fischer, U.S. Environmental Protection Agency; Tevia Hollenkamp, U.S. Forest Service; Douglas MacCleery, U.S. Forest Service; Christopher Millette, a photographer with *The Charleston Gazette*; Hugh Minor and Jaya Sarkar, Childreach, the U.S. member of PLAN International; B.L. Turner, University of Texas at Austin; Joel Tuhy, The Nature Conservancy; and LaVonda Walton, U.S. Fish and Wildlife Service.

Revising and producing a textbook entails tasks too numerous to mention. For cheerfully taking on those tasks, and for putting in extra hours in the evenings and on weekends in order to help us meet our deadlines, we are indebted to our associate, Bobbie Oh, and student workers Scott Bagley, Laura Heyduk, Chris Carter, Emily Mager, and Stacy Yee. All performed myriad needed tasks; Stacy and Laura also handled word-processing, while Chris developed a database for the text and Emily compiled the bibliography. A special thanks to Scott, who spent countless hours in the library (and usually managed to find whatever we needed in less than 24 hours!), and Bobbie, who kept the rest of our projects going while we devoted ourselves to the textbook. Thanks to these six people, we managed to keep our heads above water — most of the time. On those occasions when the list of tasks became too long, and the time to complete them too short, two long-time associates came to our aid: Lisa Taylor and Karla Armbruster. Our deepest thanks to them both.

Donald G. Kaufman  
Cecilia M. Franz

# Reviewers

We would like to thank the following academic and technical reviewers:

**Clark E. Adams**, Texas A&M University

**David Adams**, North Carolina State University

**Will Ambrose**, Bates College, Maine

**Doug Ammon**, Clean Sites, Inc., Alexandria, Virginia

**Valerie A. Anderson**, California State University, Sacramento

**Susan Arentsen**, U.S. Environmental Protection Agency, Cincinnati, Ohio

**Lisa Bardwell**, University of Michigan, Ann Arbor

**Jeff Binkley**, Roy F. Weston, Inc. (hazardous waste remediation), Okemos, Michigan

**Neil Blackstone**, Northern Illinois University

**Dale J. Blahna**, Northeastern Illinois University

**Gary Blevins**, Spokane Falls Community College, Washington

**Anne Brataas**, Pioneer Press, St. Paul, Minnesota

**W.M. Brock**, Great Basin National Park, Baker, Nevada

**Moonyean Brower**, Armstrong State College, Georgia

**Warren Buss**, University of Northern Colorado

**William Calder**, University of Arizona

**Edwin Toby Clark**, Clean Sites, Inc., Alexandria, Virginia

**LuAnne Clark**, Lansing Community College, Michigan

**Paul Doscher**, Society for the Protection of New Hampshire Trees, Concord, New Hampshire

**Robert Dulli**, National Geographic Society, Washington, D.C.

**Steve Edwards**, Miami Oxford Recycling Enterprise, Oxford, Ohio

**Hardy Eshbaugh**, Miami University, Oxford, Ohio

**Eric Fitch**, Director, Coastal Zone and Natural Resource Studies, University of West Florida

**Lloyd Fitzpatrick**, University of North Texas

**Herman S. Forest**, State University of New York, Geneseo

**Judith Franklin**, Oakland Community College, Michigan

**Dwain Freels**, Director, Future Farmers of America, Oxford, Ohio

**Gerald Gaffney**, Southern Illinois University

**Greg Githens**, O.H. Materials Company (hazardous and toxic waste management), Findlay, Ohio

**Wright Gwyn**, Director of the Environmental Awareness and Recycling Program, Forest Park and Green Hills, Ohio

**Elmer B. Hadley**, University of Illinois, Chicago

**John Harley**, Eastern Kentucky University

**Anne Heise**, Washtenaw Community College, Michigan

**Clyde Hibbs**, Professor Emeritus, Ball State University, Indiana

**William Hinger**, Environmental Specialist, Huntington Mortgage Company, Columbus, Ohio

**Harry L. Holloway, Jr.**, University of North Dakota

**Verne B. Howe**, Southern Vermont College

**Mario Huerta**, Environmental Education Specialist, Foundation Mexicana para la Educacion Ambiental, Tepotzotlan, Mexico

**Hugo H. John**, University of Connecticut, Storrs

**Mary Mederios Kent**, Population Reference Bureau, Inc., Washington, D.C.

**Robert Kleinhenz**, Ross Incineration Services, Inc., Grafton, Ohio

**David Knowles**, East Carolina University

**Barbara Knuth**, Cornell University, Ithaca, New York

**Kirk E. La Gory**, Argonne National Laboratory, Argonne, Illinois

**Terry A. Larson**, College of Lake County, Illinois

**Rebecca Lorato**, Lansing Community College, Michigan

**Anne Lynn**, U.S. Department of Agriculture Soil Conservation Service, College Park, Maryland

**Margaret Lynn**, Ohio Department of Health, Columbus, Ohio



**Timothy Lyon**, Ball State University, Indiana  
**John Lytle**, Director of Air Pollution Services, Burgess & Niple, Ltd., Columbus, Ohio  
**Margaret Martin**, Planergy, Inc., Houston, Texas  
**Lisa McDaniel**, Environ-Protection Systems, Chantilly, Virginia  
**Greg McNelly**, Clean Sites, Inc., Alexandria, Virginia  
**Rick Melberth**, State University of New York-Plattsburgh  
**Mary Beth Metzler**, Technical Communications, Rensselaer Polytechnic Institute  
**Dennis Miller**, Oak Ridge National Laboratory, Oak Ridge, Tennessee  
**James Millette**, McCrone Environmental Services, Inc., Norcross, Georgia  
**Graham Mitchell**, Ohio Environmental Protection Agency, Dayton, Ohio  
**Nancy Moeckel**, Natural Resources Specialist, Brill Science Library, Miami University  
**Earnie Montgomery**, Tulsa Junior College, Oklahoma  
**Joseph Moore**, California State University, Northridge  
**Mary Ann Moore**, Wellesley College, Massachusetts  
**Steven Oberjohn**, Westinghouse Environmental Management Company, Cincinnati, Ohio  
**Dan Philips**, Pensacola Junior College, Florida  
**Kay Phillips**, Miami University, Oxford, Ohio  
**Anantha Prasad**, University of Illinois, Urbana  
**Joseph Priest**, Miami University, Oxford, Ohio  
**Ernest Puber**, Northeastern University, Boston, Massachusetts  
**Claire Puchy**, Oregon Department of Fish and Wildlife, Portland, Oregon  
**Dan Quisenberry**, Mercer University, Georgia

**Carl H. Reidel**, University of Vermont  
**Joe Rogers**, Environmental Control Technology Corporation, Ann Arbor, Michigan  
**William Rogers**, Winthrop College, South Carolina  
**Michael Rourke**, Bakersfield College, California  
**Judith Salisbury**, New Alchemy Institute, East Falmouth, Massachusetts  
**F.A. Schoolmaster**, North Texas State University  
**Philbin Scott**, McDonnell Douglas, Mesa, Arizona  
**Carol Skinner**, Edinboro State University, Pennsylvania  
**Clark Sorensen**, Manager of Information Systems and Services, Indiana University, Bloomington, Indiana  
**Melinda Thiessen**, Science Communications and Community Relations Consultant, Seattle, Washington  
**Jim Thomas**, Hanford Education Action League (HEAL), Spokane, Washington  
**John Thompson**, Central States Education Center, Urbana, Illinois  
**David Todt**, Shawnee State University, Portsmouth, Ohio  
**Catherine Tompson**, Baltimore Zoo, Baltimore, Maryland  
**Don Van Meter**, Ball State University, Indiana  
**Barbara Venneman-Fedders**, New River Gorge National River, Beckley, West Virginia  
**John D. Vitek**, Oklahoma State University  
**Mary C. Wade**, College of Lake County, Illinois  
**Robert Whyte**, Lake County Health Department, Waukegan, Illinois  
**John Wilson**, Aullwood Audubon Center and Farm, Dayton, Ohio  
**Arthur L. Youngman**, Wichita State University, Kansas

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