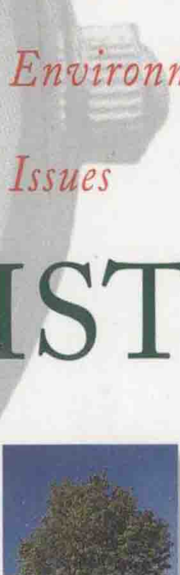
10 MINUTE ECOLOGIST

20 Answered Questions for Busy People Facing Environmental Issues



JOHN JANOVY, JR.

FROM THE AUTHOR OF *KEITH COUNTY JOURNAL*

10 minute ecologist

20 ANSWERED QUESTIONS FOR BUSY PEOPLE FACING ENVIRONMENTAL ISSUES

John Janovy, Jr.

A Thomas Dunne Book
St. Martin's Press
New York

A THOMAS DUNNE BOOK.
An imprint of St. Martin's Press.

DESIGN BY SONGHEE KIM

Library of Congress Cataloging-in-Publication Data
Janovy, John, Jr.
10 minute ecologist : 20 answered questions for busy people facing environmental issues / John Janovy, Jr.—1st ed.
p. cm.
ISBN 0-312-17043-2
1. Ecology—Popular works. I. Title.
QH541.13.J35 1997 97-13785
577—dc21 CIP

First Edition: October 1997

10 9 8 7 6 5 4 3 2 1

ACKNOWLEDGMENTS

I WOULD LIKE TO THANK THE VARIOUS PEOPLE WHO helped with this book project. Scott and Elizabeth Snyder both read parts of the early manuscript and gave their comments and encouragement. Scott was a doctoral student in my lab at the time, and Liz was a middle-school science teacher in a rural Nebraska community. Some members of the Nebraska Nature Conservancy board of trustees also read the manuscript and provided comments. I greatly appreciate the education I received as a result of my service on that board of trustees, an education provided by the Nebraska Nature Conservancy staff, members of the board, and various individuals associated with the national organization of the Nature Conservancy. Cara Stanko and Kayleen Karnopp, students who worked in my office, helped with library research. Particular thanks are due Scott Slovic, director of the Center for Environmental Arts and Humanities—a remarkable program designed to help us articulate our relationships with the planet—at the University of Nevada/Reno, for supplying suggestions about additional readings.

PREFACE

I WAS SITTING IN A MEETING ONE DAY LISTENING TO ONE of the world's most distinguished scientists talk about biodiversity. His audience was made up mainly of business executives and attorneys who, because of various factors such as government regulation or marketplace events, suddenly found themselves dealing with environmental issues. As I looked around the room, I could see the audience paying close attention to the speaker. But afterward someone said to me: "I loved that speech but I still don't know what biodiversity really means or why it's so important." At that point I decided all these businessmen needed help. But they didn't have the time to go back to college and major in biology. That's when I decided to write this book.

10 Minute Ecologist was originally intended for business executives suddenly in need of education on environmental matters, whether because of government regulations, public protests, or even a feeling that maybe they should be doing "something for the environment." But it's also an excellent book for anyone newly involved in ecological issues, regardless of the nature of that involvement. My goal is to avoid polemics and provide plain, easily understood, nonthreatening information. I'm not taking a side in any debate. Nor do I believe this book is all a person needs in order to interpret the positions in a controversy. It will do wonders, however, for anyone who is now a CEO on his way to a public hearing on an environmental-impact statement but can't remember anything from tenth-grade biology. It will also do wonders for anyone who does not consider himself or herself a trained ecologist but who reads about environmental issues in the daily newspapers and asks, "Should I be worried about this?" My early manuscript readers were public school teachers; their favorable response to the "work in progress" suggests that *10 Minute Ecologist* may also find a useful place on teachers' bookshelves. Regardless of who ends up reading it, I hope this book actually serves as an introduction to the Suggested Readings on page 123.

I wrote this book as a series of relatively short answers to twenty questions. Each answer should take about ten minutes to read, thus the title. Nobody's going to become an ecologist in ten minutes a day, of course, but if we don't all make an effort to become more scientifically literate, then environmental issues will continue to be resolved in an atmosphere of public ignorance. There are not many secrets or big discoveries revealed in the following pages. Virtually all the information in this book is fairly common knowledge to professional ecologists. Many of the examples I've used have been written about time after time and cited in all the leading texts. But these questions are ones I've heard asked time and time again by responsible, concerned, well-educated, and successful people.

I've often felt that if paperback fiction, movies, and television all dealt with substantive ecological issues at the same level they deal with issues of politics, law, race, and economics, then maybe as a nation we'd be better educated on the way natural systems operate. As a result of this feeling, I've tried very hard to make reasonably complex ideas accessible to the same audience that reads paperbacks and watches television.

John Janovy, Jr.

CONTENTS

1
how do we humans view the world?

HUMANS ARE LARGE, SHORTSIGHTED, VERY INTELLIGENT animals. This set of traits dictates how we view the world. Our world-view, in turn, often directs our actions. Actions, whether by humans or insects, always have an effect on an organism's immediate environment. At the very least, we all consume food and produce wastes, and many species, including our own, use natural materials to build "houses." We reproduce and increase in numbers, and we alter our environments in order to accomplish this reproduction. Other species influence our actions (disease-causing organisms, food- and fiber-producing organisms). The nonliving elements of our environment—for example, air temperature, water, minerals—also influence our actions. Organisms and their products are called biotic factors of the environment; nonliving elements are the abiotic factors. Ecology is the study of the interactions between organisms—for example, humans—and both the abiotic and biotic factors that influence their lives. But ecological interactions are dictated to a great extent by a species' genetic traits, and for humans, "genetic traits" means large size, shortsightedness, and intelligence.

Our large size is one of the most important of our traits, important in the sense that it strongly influences our interactions with other species. We see other large animals, and large plants, before we notice smaller ones, and typically we need to learn how to look for small organisms before we notice them at all. The smaller the plants and animals, the worse this problem of nonrecognition. But the vast majority of living things are tiny. The average size of animals is about half an inch long. Thus we are predisposed, by virtue of having been born human, to ignore most of the living creatures whose lives also depend on the only planet in the universe known to support life. This is the major problem most people must solve when trying to understand the natural world. Not only a ten-minute ecologist, but a ten-year ecologist, as well, must accept the fact that our view is distorted by our size, then learn to "see" the unseeable. Tiny worms occur by the millions in most lakes and many streams; bacteria cover the surface of every grain of sand; microscopic plants fill the oceans; fungi "eat" the beautiful fall leaves that finally end up on the forest floor.

Is all this little life important? Yes, it is very important. The richness of the soil, the ability of plants to trap nitrogen and make protein, and a host of other fundamental life processes depend on microscopic organisms. Most important of these processes is the movement of nitrogen through the environment. Without microscopic organisms, especially bacteria associated with plant roots, we would not be able to utilize the nitrogen in the air. Without nitrogen, we would not be able to build the proteins that are an essential part of our bodies. Without nitrogen, we would not be able to build the genetic information we pass on to our offspring. These statements are true for snakes and fish as well as for humans. In later chapters, the details of nutrient cycles and energy flow are discussed. But for now, we need only to remember that the flow of nutrients into our food, thence into our bodies, is ultimately dependent on microscopic life in the soil, water, and air.

Our shortsightedness is sometimes considered a trait that we inherited from our nonhuman ancestors. Indeed, shortsightedness is far and away the most common shared trait among animals. That is, virtually all species respond to immediate environmental changes (shifting light patterns, noises, passing members of the opposite sex, and so on) and tend to ignore the more "distant" factors, such as next year's price of corn and predicted oil shortages. We're not much different from the grasshoppers in this regard. Although certain individuals, and the insurance industry, try to plan far ahead, most of us spend most of our time worrying about, being happy about, and reacting to events that occur over a day or week.

Language and culture have given humans the power to act over great distances and relatively long periods of time, however. Furthermore, culture provides us with the power to act in large groups—for instance, nations and industries—to accomplish large tasks we could not do either as individuals or as families. Language and culture are as much a part of our basic biology as our shortsightedness. Thus we've inherited two opposing traits, one from our nonhuman ancestors (shortsightedness) and the other from our human ancestors (language and culture). One of these traits gives us the power to act over long distances and times; the other trait blinds us to the results of such acts.

"Environmental problems" are primarily human problems produced by the interaction between these two opposing traits. For example, because of our shortsightedness, we consume resources without worrying much about the long-term supply of them (water, fossil fuel). But because of our language and culture, we are disturbed by the thought of destroying the natural world, which many of us view as God's creation. Plants and animals, including entire species that may be displaced by our actions, don't worry about anything; they just live or die. Aside from possibly the apes, no other species has language and culture in anything approaching the human sense. So "environmental problems" have a very real philosophical component—namely, the question of how humans should interact with their environments, with the other species that occupy Earth, and with one another as individuals. But "environmental problems" also have a practical component, because Earth's ability to support human life depends to a certain extent on the planet's supply of nonhuman organisms, and on Earth's ability to sustain that supply.

Language and culture are products of our intelligence, and actions made possible by our intelligence are modified, in turn, by language and culture. Thus we also have a positive feedback system. Computers are a superb example of this feedback system at work. Mainly during the twentieth century, and primarily during the last half of that century, our intelligence gave us the power and inclination to think about ways to carry out certain calculations, and other mathematical procedures, faster and more accurately than could be done by people with pencils. The result of these language and culture activities (thinking and building) was the computer. The computer has, in turn, significantly modified our language and culture, providing new metaphors, new kinds of interactions between individuals and nations, new ways of waging war, and new sources of information.

The computer is only one of a great many human products that alter our vision and which are then themselves altered by that vision. Indeed, many, and possibly most, humans tend to view the world in terms of human products and through the vision-altering effects of these products. Human history is short, in the natural sense; a few thousand years is not a very long time. But during that few thousand years, we've been building things, modifying our language and culture, and consequently changing our view of the world because of what we've built. Some people claim that because of these feedback cycles, humans have lost touch with the planet that supports them. Other people claim that human activities are perfectly natural because we are, after all, a species of living organism that evolved on Earth. When these two groups of people get together, the result is often an environmental issue.

In the not-too-distant past, human products were primarily art, music, literature, machines, and buildings—relatively long-lived, tangible items. Recently, however, human products have come to include electronic images and sounds, which bear only a superficial resemblance to anything alive. These images and sounds can be manipulated in uncountable ways, and the results are often quite seductive for humans, who are, by definition, very intelligent animals who use their imaginations and often seek mental stimulation. We have thus generated a philosophical problem: whether our electronic images are "real." The answer is relatively simple: yes. Images are real. But (and this is a fairly large "but") these very real images, real in the philosophical sense, may have absolutely no connection with any of the natural processes that support life on Earth, and indeed may convince us that we've successfully separated ourselves from these processes.

Thus we've arrived at perhaps the most central issue of humanity's modern worldview, the question of whether our perceptions, upon which we so often act, match the reality of having been born large, shortsighted, intelligent, and ultimately dependent on processes carried out by bacteria. The answer to this question varies according to individuals, societies, and periods of history. The deeply religious among us may claim that the answer does not matter, for our lives are governed by forces over which we have no control, committed to ends we cannot fathom. The more cynical among us may claim that in an electronic age, we lack the capacity for joining our perception with the more earthly kinds of reality. Between these two extremes lies a vast territory of human thought, action, and rationale. Somewhere in that territory stands the ecologist, who believes that humans must act wisely in their relationships with Earth. And the more tightly human perception is governed by knowledge of the planet, claims the ecologist, the better the future looks for all of us.

2

what is a species?

A SPECIES IS A KIND OF PLANT, ANIMAL, FUNGUS, OR microbe. The word "species" is both singular and plural (a species, many species). Most people can distinguish a few common species—dog, cat, rose. Some people, particularly hunters and fishermen, can distinguish a few more species—quail, pheasant, mallard, pintail, walleye, bluegill, channel catfish. People who work in greenhouses and nurseries usually learn to distinguish several dozen species. People who frequent zoos learn some exotic ones—gorilla, hyena, zebra, crowned crane. In the overwhelming majority of cases, the species recognized by an average citizen are, like the citizen, large ones. Most people are quite surprised to learn that what they think of as one species may actually be several.

"What is a species?" is one of the most persistent questions in biology. People have been asking it for a very long time, and arguing about their answers for an equally long time. The question is persistent, and the answers open to discussion, because the criteria for distinguishing kinds are not always obvious. It's not too difficult to tell a zebra from a quail. But it's a little more of a challenge to learn to distinguish the three different species of zebras from one another, or the six or seven species of quail that live in the United States. In addition, remember, the vast majority of species are small, and belong to groups of plants and animals that we think of as exotic.

Small size and lack of information also contribute to our uncertainty about what constitutes a species among these relatively unknown organisms.

Most biologists use structural characteristics to distinguish species of organisms we call plants, animals, and fungi. Microbiologists may use some functional characteristics to distinguish between bacteria—for instance, the ability to grow in a certain kind of broth. Modern science has produced chemical methods for distinguishing between kinds—most notably the use of DNA (raw genetic information)—but it's still not clear how best to use such methods. In current discussions of ecology, especially if politics is involved, one often hears about "known species," "unknown species," and "endangered species." I'll deal with these subjects in a moment, but before I do, there are two additional things one needs to know about species. First, they are generally considered to be reproductively isolated from one another. That is, in the vast majority of cases, two different species either cannot or do not interbreed and produce fertile offspring. Second, the species is considered to be an evolving unit. In other words, species (reproductively isolated kinds) evolve from other species and eventually evolve into still other species. Species disappear from the face of the Earth, a process known as extinction. A species that dies out, down to the very last individual, has become extinct. So has a species that's evolved into another one.

"Known" species are better called "described" species. By "described," we mean that someone has taken the trouble to study the organism very carefully, decided which structures are best used to distinguish it from others, written a paper containing the results of such study, and published this paper in a scholarly publication so that other scientists have access to the information. In many instances, and ideally, specimens of the new species have been deposited in a museum. Thus if a scientist collects some organisms—say, ants—and wants to know what kind they are, then he or she consults the published scholarly works on ants, in order to learn how to identify the specimens, and may actually borrow museum specimens to use in accomplishing the task. For this reason, museum research collections are exceedingly valuable, and the expertise needed to maintain such collections helps dispel our ignorance about the natural world.

Attempts to identify specimens sometimes end in failure. You simply cannot always determine, from the scientific literature, what kind of organism you have in hand. At this point, you begin to suspect that you're looking at a new species that must be "described" as above. Then you do hundreds of measurements, make dozens of drawings, compare structures with those of known species, write the paper summarizing the results of all this work, and then submit the paper to a learned journal. Experts review the research, and if they find it acceptable, the paper gets published. You are then known in the discipline as the describer of a new species.

Described species must have scientific names assigned to them. Scientific names are much more than arcane professorly jargon; they are guides to the literature. Through use of a scientific name, a scientist can discover a massive amount of information about a species, because all of the scientific literature about that species also uses the same name. Sometimes scientific names are changed, because people do additional research and discover that the names need to be changed for a variety of reasons too involved to be included in this book. But someone skilled in the use of scientific names can trace these kinds of decisions backward in history to the original published description.

Scientific names of the hundreds of thousands of known plants, animals, fungi, and bacteria consist of two words: a genus name and a specific name. For example, the familiar pet dog is *Canis familiaris. Canis* is the generic name; *familiaris* is the specific name. This is the name given to the dog by Carl von Linné (Linnaeus), the man who invented this system of nomenclature in the 1700s. In print, scientific names are italicized. Sometimes species are named in honor of people—for example, *Salsuginus thalkeni,* a worm named after a landowner (Mr. Thalken) who gave scientists permission to use his property, or *Actinocephalus carrilynnae,* a species named after the describer's sister Carri Lynn. Species may also be named from some notable character they have, the place they were found, or other reasons. Usually the newly discovered species belongs to a known genus, and this fact dictates the generic name. If the species does not belong to a known genus, the scientist must describe a new genus, too, to go along with the new species, and make the case convincingly to the anonymous editorial reviewers.

Unknown species are those living in nature, unstudied, in many cases undiscovered, and certainly undescribed by scientists. Most people are very surprised to learn how common unknown species are. They are everywhere. We have a long way to go before we discover all the species that occupy this planet. The fact that most organisms are small means that a great many evade discovery. The fact that most organisms live in the tropics, where fieldwork is expensive and difficult, further contributes to their obscurity. In addition, human scientists are large animals that generally prefer to study large organisms, so tend to ignore the small ones. Unknown species are so common that almost any serious undergraduate biology student can discover and describe one, even in the United States and Europe, sometimes in a local meadow, especially if that student is willing to learn how to use a microscope well.

One of the central issues in the current environmental debate concerns biodiversity, a term that refers to numbers of species. The main reason biodiversity is an issue is this ease of finding unknown, by which I mean new, in the scientific sense, species. Thus scientists are able, by virtue of their knowledge about the number of unknown species they discover, to predict how many are yet to be discovered. From this kind of scientific activity, we know that our current inventory of known species, even though it numbers well over a million, is far from complete, and in fact may be but a small fraction of the kinds of organisms that actually occupy Earth with us. Scientists get uncomfortable in the presence of ignorance, especially when they can see decisions being made without sufficient knowledge to understand the consequences. This is the reason biodiversity is an environmental hot button.

"Endangered species" are those whose populations are low. Every species needs to be present on Earth in certain numbers to ensure survival. That is, the individuals must be able to find mates and produce