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Norwich, VT. 05055
November 17, 1992

Mr. Brian Lamb
C. Spren
400 North Capitol St. NW.
Washington, DC. 20001

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Dear Mr. Lamb:

I have for sometime admired your Booknotes interviews and catch them as often as possible. Because your biographical approach seems to bring out the character of the author as well as information on the subject of his book, the interviews are both entertaining and informative and can appeal to a wide variety of interests. Therefore it seems to me that a book review by you will attract readers and disseminate information about public concerns better than some other types of program.

Such a concern is the problem of disappearing species and the protection of biodiversity. If you had not already reviewed the book, published in October, by Edward O. Wilson, The Diversity of Life (as you may well have done, since it was prominently reviewed on the front page of the NYT Book Review and I have no way of checking on your programs) I think it would be a rewarding book and author to take on and would be good publicity for a problem still not as widely discussed as it might be.

I enclose the NYTBR article and also a relevant section from a special issue on biodiversity with an interview with Wilson in

Defenders ^{containing also} ~~and~~ other relevant articles.

I suppose you actually broadcast ~~those~~ interviews in which the authors respond comfortably and well - or maybe they all do under your inviting and undemanding questions. Presumably they are all so full of their own work that they are bound to be informative unless they are really tongue-tied.

Sincerely yours,

[REDACTED]

October 4, 1992 \$1.00
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NYTBR

In the Footsteps of The Dodo

THE DIVERSITY OF LIFE

By Edward O. Wilson.

Illustrated. 424 pp. Cambridge, Mass.:

The Belknap Press/

Harvard University Press. \$29.95.

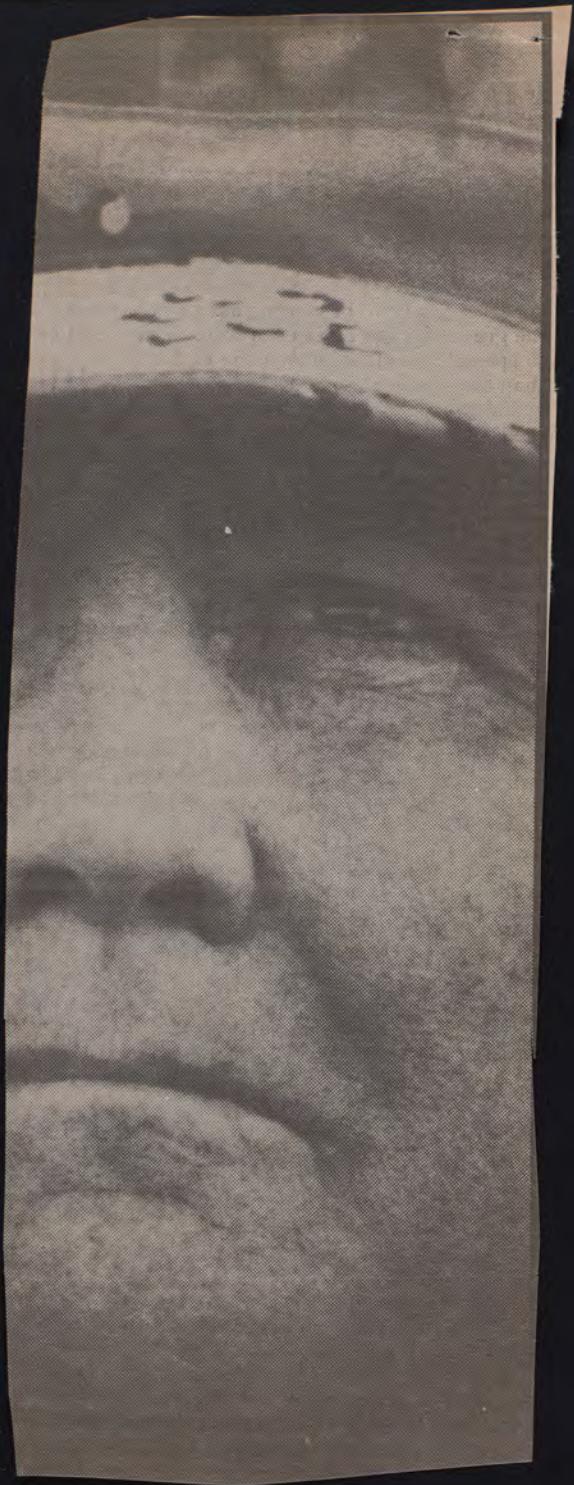
By David Papineau

IN the Beatles cartoon "Yellow Submarine," there is a creature called the Vacuum Cleaner Monster, which sucks up everything in sight until it is the only thing left, and then it sucks itself up too. In the biological realm, this is a difficult trick to pull off. Most species that start destroying their own habitat simply manage to reduce their food supply, and so shrink in number before they can do further damage. The only species with real destructive powers are those whose adaptability and varied appetites allow them to switch to new food sources when they have exhausted old ones. Our planet does, however, house one species that takes adaptability and varied appetites to perilous extremes.

The central message of Edward O. Wilson's stirring new book, "The Diversity of Life," is that Homo sapiens is in imminent danger of precipitating a biological disaster to rival anything in evolutionary history. Mr. Wilson, the Frank B. Baird Jr. Professor of Science and the curator of entomology at the Museum of Comparative Zoology at Harvard University, is the doyen of American biology. Two decades

Continued on page 24

David Papineau is a professor of the philosophy of science at King's College, London, and the author of "Reality and Representation."



'RE FROM
KLYN,
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"Brooklyn is unique—
a state of mind, a state
of heart, all captured in
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—Frank Sinatra

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have to grow up in
Brooklyn to know
it!"—Carol Burnett

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TITLE, BROWN and COMPANY



Crime

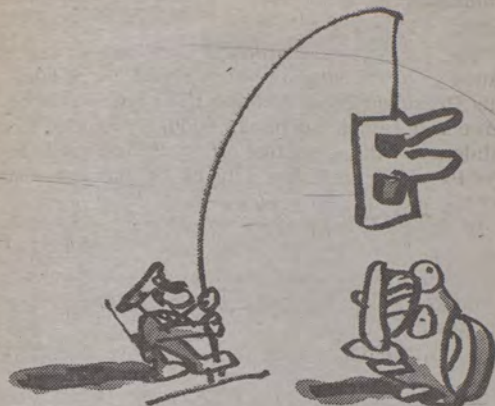
By Marilyn Stasio

Would a joke about Northrop Frye make you (a) laugh or (b) cringe? Do you agree with the following statement: "Nowhere was a place more cold-blooded than a graduate English department"? Have you ever wanted to strangle your (a) faculty adviser, (b) graduate assistant or (c) college-age child? If you liked this little quiz, then have I got a book for you.

LOVE COOLS (Putnam, \$19.95), W. Edward Blain's second campus mystery, after "Passion Play," delivers a devious murder plot that catches the conscience, or lack of it, of the summer faculty at the Stone Mountain Theater in Virginia's Shenandoah Valley. Fierce professional rivalries break out among this cutthroat gang of teachers after an esteemed Shakespearean scholar dies in a fire. Although her last manuscript was presumably destroyed, two thematically different versions surface, giving rise to grave charges of fraud.

Mr. Blain, who is chairman of the English department at Woodberry Forest School in Virginia, creates a wonderfully poisonous atmosphere in which his articulate characters wage their vendettas, along plot lines that cunningly parallel those of the two shows in rehearsal. Leaving the unethical grown-ups to play at the dirty tricks of "A Midsummer Night's Dream," the director's sensitive adolescent son wraps himself in young Hamlet's black mantle of revenge to get back at a sadistic teacher. For all the palpable hits he scores with his satirical thrusts at academe, Mr. Blain takes Hamlet's theme—the alienation and betrayal of children by their parents—very much to heart.

The three friends named Phoebe, Anne and Diana who give themselves such enigmatic airs in Minette Walters's intriguing first mystery, **THE ICE HOUSE** (St. Martin's, \$18.95), have lived in the



BILL CHARNATZ

tive to the psyches of his characters, he examines both victims and victimizers for the generational patterns of abuse that can produce a monster like Bobby. "Everyone was raised wrong," a more subtle villain notes. "That's one of the nice things about growing up. You finally realize it." And if you don't, you make movies.

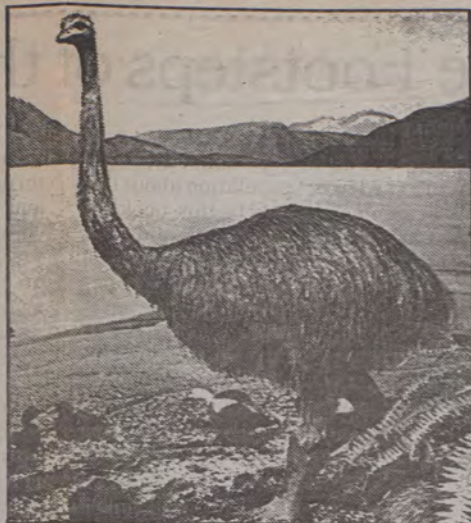
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Susan Kelly's solidly researched plots give her Liz Connors mysteries backbone and guarantee that her heroine, a crime reporter from Cambridge, Mass., is not your ordinary 5-foot-10-inch redheaded amateur sleuth. Once again, the plot's the thing in **OUT OF THE DARKNESS** (Villard, \$18), which finds Liz doing the legwork for a best-selling author of true-crime books who has blown in from the Coast to write up a local serial killer case. Griffin Marcus is sure he knows who has been strangling women and dumping their bodies along the Merrimack River; but when Liz starts investi-

smoke that blocked the sunlight. It took 20 million years — more than 2,000 times the span of recorded human history — for species levels to recover.

The imminent collapse, caused by overpopulation, overgrazing and deforestation, won't be quite as sudden, but its effects will last just as long. What is to be done, then? How can we stop the destruction that is already under way? Mr. Wilson suggests that we make a complete survey of the world's fauna and flora in order to identify the "hot spots" for conservation. He also hopes to persuade deforesters that they are acting against their own economic interests and that there are alternatives. For instance, he suggests that "extraction farming" — harvesting the natural products of the forest without harming it — is feasible in many tropical areas. He cites as a model the half-million traditional rubber tappers of Brazil, who make their living from forest latex and other wild products. Mr. Wilson suggests that this kind of farming will spread as the world develops a taste for tropical fruit, and perhaps even for river turtle and iguana.

ECONOMIC arguments, however, only stretch so far. Some tropical regions may well be economically suited to extraction farming, and in those cases the opportunity should be taken. But other regions can increase their profits only by cutting down trees and creating pasture instead. While it is true that short-term profits may incur long-term costs (Mr. Wilson mentions that important pharmaceuticals may be lost when certain species disappear) and that climatic side effects will probably follow large-scale deforestation, these prospects have little economic force. Precisely because the effects of deforestation are long-



AMERICAN MUSEUM OF NATURAL HISTORY

Reconstruction of the moa, an extinct flightless bird of New Zealand.

term and, for the time being, intangible, they are outweighed in economic calculations by the short-term certainties of profit.

At the end of his book, Mr. Wilson takes off his gloves. Killing species is not just economically unwise, he says, it is wrong. The diversity of nature is as much part of our heritage as paintings and buildings. It may not be our own creation, but it is an essential part of the world that nurtures us and makes us human. We quite rightly go to great lengths to preserve the Parthenon and the Mona Lisa. But our descendants will not thank us if at the same time we allow the elephant, the chimpanzee and hundreds of thousands of other species to perish.

This is not to say that every species must

survive. After all, occasional extinctions are normal, and it makes little biological sense to fight for every last one, however feeble and uninteresting, no matter what the human cost. What we're facing in the next few years, though, is not the natural turnover of evolution, but massive and irreversible annihilation. Once we fully appreciate this threat, the economic arguments seem to fade into insignificance.

The real question, though Mr. Wilson does not emphasize it, is not whether biodiversity is worth saving, but who is going to pay for it. For better or worse, most of the threatened species are in countries with few economic resources, countries where the concern for diversity is likely to be viewed as a luxury for the rich. These countries are understandably unreceptive to moral lectures from the nations that cut down their own primeval forests long ago, that now dispense huge subsidies to keep those areas as farmland and that maintain strict immigration controls to keep aliens out.

It is difficult not to sympathize. The collapse of biodiversity will be the whole world's loss, and those who live in relative ease cannot expect the most hard-pressed nations to bear the brunt of stemming it. This year's Earth Summit in Rio de Janeiro, in which the nations of the world tried to outline a coherent environmental policy, did, despite the squabbling, put the issue of biodiversity on the international agenda. But real progress will occur only when a general political will develops in the northern nations. As long as politicians are still able to win votes by putting industrial jobs ahead of conservation, it will be clear that the message has not hit home. "The Diversity of Life" should play an important part in getting it across. □

Raising the Roof

HOMES IN THE HEARTLAND

Balloon Frame Farmhouses of the Upper Midwest, 1850-1920.

By Fred W. Peterson.

Illustrated. 296 pp. Lawrence: University Press of Kansas. \$35.

By Philip M. Isaacson

EASTERNERS have been a house-proud people since the time of the first settlements. The early generations, who were mainly English, or of English descent, put up provincial replicas in America of popular English styles in regular succession. A walk through an old New England town is a journey through architectural history.

In "Homes in the Heartland," Fred W. Peterson, a professor of art history at the University of Minnesota, takes another kind of journey. He travels through the rural parts of the Upper Midwest — Wisconsin, Minnesota, North Dakota, South Dakota and Iowa — observing the forms created by a less house-proud people, the first generations of Midwestern farmers. Mr. Peterson's journey, which begins with farmhouses built about 1850, does not reveal a replication of Eastern American or European tastes; rather, it discloses and analyzes a style that was primarily local, stark, forthright, practical and expressive of the way its structures were put together.

That way is at the core of Mr. Peterson's analysis. A simple modular structural system called a balloon frame (invented in Chicago in the 1830's) dictated the proportions and contributed to the appearance of the buildings. Before 1850, wooden houses in this country relied on box frames. The frames were heavy and expensive, created from posts and beams that required years to season and the services of a skilled housewright to join to one another.

The balloon frame, on the other hand, was constructed of readily available light lumber milled to standard dimensions. Cut and nailed to become slim studs, joists and rafters, the lumber was the chief component in an integrated structural system, a lightweight network in which each part was regular, proportional to every other part and contributed to the strength of the whole. While the term "balloon

Philip M. Isaacson's most recent books are "Round Buildings, Square Buildings and Buildings That Wiggle Like a Fish" and, forthcoming, "A Short Walk Around the Pyramids and Through the World of Art."

frame" was originally derogatory, meant to suggest that such a house "would blow or float away because it appears so lightweight," Mr. Peterson notes that the structures easily passed the tests of "standing against the strong winds of the prairie and bearing up beneath the heavy snows of the region." Indeed, since the last quarter of the 19th century virtually all wooden buildings in America have employed balloon frames.

Balloon frames quickly grew to become the accepted structural system in the region. They were low cost, strong, amenable to modification, within the skills of local carpenters and perhaps the farmers themselves. To a people still engaged in transforming the wilderness, a process in which the adage "A house doesn't pay for the barn" was apt, the balloon frame eased the graduation from elemental shelter — from log cabins, sod houses and shanties — to permanent homes.

MR. PETERSON classifies the physical results of that evolution into 10 types, starting with the one-story gabled rectangle farmhouse and the two-story foursquare farmhouse. The general reader will be less interested in these distinctions than in the qualities common to all of them, the economic circumstances that made the structures possible, the ways in which they were used, the parallels between the acceptance of the balloon frame and technological innovations in farming, the social and esthetic factors that influenced the appearance of the buildings and a general consideration of the settlement of the rural Upper Midwest. Mr. Peterson treats each of these with a sympathy so becoming that it illuminates the lives of the builder-farmers.

As objects in a flat landscape, the farmhouses of the Upper Midwest are compact, clear, proportional in accord with a practical scheme of building, and in geometric fellowship with the furrows, lanes and roads around them. Sometimes picturesque, less often monumental, they are a vernacular expression compounded of a variety of ethnic factors, the influence of the urban centers, the internal logic of their frames, the requirements of hard use and the limitations of a not-yet-established rural economy.

Mr. Peterson presents the scholarly reader with a well-defended sorting out of architectural types from what otherwise would be a bewildering mass. For the rest of us he has provided an engrossing account of a fundamental episode in American history, the early settlement of the prairie. In many ways the balloon frame stands as a metaphor for that episode. □

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THE NEW YORK TIMES BOOK REVIEW

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In the Footsteps of the Dodo

Continued from page 1

ago he popularized the term "sociobiology," and generated a small industry of speculation about the biological basis of human nature. In this book he stops asking what biology does to humans, and asks instead what we humans are doing to biology.

The focus of his book is the extinction of species. As Mr. Wilson observes, other kinds of environmental damage can in principle be repaired, but a defunct species is gone forever. Not that the destruction of animal species by humans is a new phenomenon. For those who still believe there was a golden age of ecological harmony before our technological fall, Mr. Wilson produces strong evidence that prehistoric tribes killed off the mammoths, the moas and many other large animals.

STILL, the human population explosion of the late 20th century has lifted our destructiveness to altogether new levels. Our hunger for agricultural land and grazing pastures means that we are now wiping out not just individual animals, but whole ecosystems. As we chop down and burn primeval forests, we also suck species into oblivion — now at the staggering rate, Mr. Wilson estimates, of 27,000 species per year, 74 a day, 3 every hour.

Even at this swift rate, though, it will take hundreds of years to exhaust the stock of species, so diverse are the creations of nature. No one knows exactly how many species currently exist. About 1.4 million are catalogued, of which insects constitute more than half, higher plants 250,000, birds 9,000 and mammals 4,000. But it is anybody's guess how many more species are still lurking in forest canopies and at the bottom of the oceans. Few biologists would put the figure at under 10 million, and some think it may be 10 times that.

"The Diversity of Life" is as much a celebration of this profusion as a warning of its imminent demise. Mr. Wilson, who is also the author of "On Human Nature" and "Sociobiology," writes urgently, as if to capture the kaleidoscope of nature before it breaks up into long-lost fragments. In the Amazon basin, he lists the lives hiding among the fallen trees and rotting branches: "basidiomycete fungi, slime molds, ponerine ants, scolytid beetles, bark lice, earwigs, embiopteran web spinners, zorapterans, entomobryomorph springtails, japygid diplurans, schizomid arachnids, pseudoscorpions, real scorpions." The green conure parrot of Mexico, he tells us, provides a habitat for 30 species of feather mites, each of which lives on different parts of different feathers. In the forests of Costa Rica, he watches insects that eat the lichen that grows on the small trees that grow on the beds of orchids that grow on the big trees. Mr. Wilson even seems to delight in the cigar-shaped, half-meter-long cookie-

cutter shark, whose habits were exposed in 1971: "It thrusts its maw into the bodies" of living porpoises and whales, he writes, and "twists to slice out five-centimeter-wide conical plugs of skin and flesh."

Interleaved with this catalogue of marvels is an introduction to macroevolutionary theory. In sharp contrast to the pleasingly simple laws that dictate developments within existing species, the forces that govern the proliferation of new species are complex and ill understood. Mr. Wilson is an excellent guide to the broad movements of evolution. He explains how each geographical setting has room for only a limited number of species, and how accidents of migration often determine which new species will take root. A species that arrives at an empty place, like the first finches on the Galápagos Islands, radiates into different niches and eventually divides into different species. This process, Mr. Wilson explains, has yielded a steady increase in the diversity of species since evolution began, an increase that has accelerated over the last 100 million years.

Some of this acceleration is the result of the continents having split into separate landmasses;

What we're facing in the next few years is not the natural turnover of evolution, but massive and irreversible annihilation.

with the formation of new, smaller continents, the number of sites where species could form multiplied. Equally important has been the proliferation of tropical forests, places that contain many isolated habitats whose boundaries are created by differences in climate and altitude. This womb of biodiversity at present houses about half the species on earth.

But now the trend has reversed; the number of species is decreasing. Mr. Wilson suggests that at the current rates, 20 percent of existing species will become extinct in the next 30 years. The last comparable evolutionary disaster was the disappearance of the dinosaurs 65 million years ago. Many paleontologists now think this was caused by a meteorite six miles in diameter colliding with the earth and sending up a huge cloud of dust and

Along Came a Spider

Krakatau, earlier misnamed Krakatoa, an island the size of Manhattan located midway in the Sunda Strait between Sumatra and Java, came to an end on Monday morning, Aug. 27, 1883. It was dismembered by a series of powerful volcanic eruptions. . . .

Rakata, the ash-covered mountain of old Krakatau, survived as a sterile island. But life quickly enveloped it again. In a sense, the spinning reel of biological history halted, then reversed, like a motion picture run backward, as living organisms began to return to Rakata. . . .

The first search for life on Rakata was conducted by a French expedition in May 1884, nine months after the explosions. . . . The ship's naturalist wrote that "notwithstanding all my researches, I was not able to observe any symptom of animal life. I only discovered one microscopic spider — only one; this strange pioneer of the renovation was busy

spinning its web."

A baby spider? How could a tiny wingless creature reach the empty island so quickly? Arachnologists know that a majority of species "balloon" at some point in their life cycle. The spider stands on the edge of a leaf or some other exposed spot and lets out a thread of silk from the spinnerets at the posterior tip of its abdomen. As the strand grows it catches an air current and stretches downwind, like the string of a kite. The spider spins more and more of the silk until the thread exerts a strong pull on its body. Then it releases its grip on the surface and soars upward. Not just pinhead-sized babies but large spiders can occasionally reach thousands of meters of altitude and travel hundreds of kilometers before settling to the ground to start a new life. Either that or land on the water and die. The voyagers have no control over their own descent.

From "The Diversity of Life."

DEFENDERS VIEW

HEEDING THE WARNING

SIX MONTHS AGO, biodiversity—a contraction of “biological diversity”—was an obscure scientific term heard more often in the ivory towers of academia than on Main Street, U.S.A. Today, however, in the wake of the Rio Earth Summit, concerned politicians and policy makers are proposing that the preservation of biodiversity (the variety of life on Earth) be made a full-fledged plank of U.S. foreign policy, alongside trade and defense.

Such a move is overdue. Two years ago the Environmental Protection Agency's science advisory board, a blue-ribbon panel of 33 scientists, identified the four greatest risks to the environment and human welfare as ozone depletion, global warming, loss of species and loss of natural habitat. Scientists and leaders of other countries share the board's concerns. In the last three years we've seen international treaties signed on ozone depletion, global warming and biodiversity, the last covering species and habitat loss. The U.S. signed the first two, although it insisted on omitting from the global-warming treaty any target dates for reducing carbon dioxide emissions. But sadly, it spurned the biodiversity treaty—signed in Rio by leaders of 165 other countries, including every other industrialized nation.

The attention now being given by world leaders to species conservation, the topic of this special issue of DEFENDERS, makes perfect sense. Humanity literally is sustained by the rich living resources of the planet. Without native plant varieties, insect pollinators, beneficial soil bacteria and fungi digesters, the Earth would rapidly become barren. More than 40 percent of all prescriptions sold by pharmacies are derived from plants and other organisms, including aspirin, developed from the meadowsweet, and two alkaloids found in the rosy periwinkle that cure most victims of Hodgkin's disease and acute lymphocytic leukemia. Yet fewer than three percent of the world's known 220,000 species of flowering plants have been examined for medicinal use.

These are just two examples of the “unmined riches” that Pulitzer prizewinning Harvard professor Edward O. Wilson notes in his latest book, *The Diversity of Life*—being published in October. Wilson has predicted that if current extinction rates continue, the earth will lose 20 percent of all its living species by the year 2020! In the interview leading off this issue of DEFENDERS, Wilson talks with associate editor Joel Bourne about this threat and ways to turn it around.

One of those ways is vigorous U.S. leadership in biodiversity conservation. In a second feature, experts of the World Resources Institute, an environmental think tank

in Washington, D.C., outline a plan to protect global biodiversity in the aftermath of the Rio summit. Defenders is one of 46 partner organizations that contributed to the ambitious *Global Biodiversity Strategy* developed by W.R.I., the World Conservation Union and the United Nations Environment Programme that formed the basis of many of the provisions agreed to in Rio. Defenders joins in calling for an aggressive, all-fronts action plan to protect biodiversity in the coming decade.

The U.S. needs to sign the biodiversity treaty and become its champion. But this country

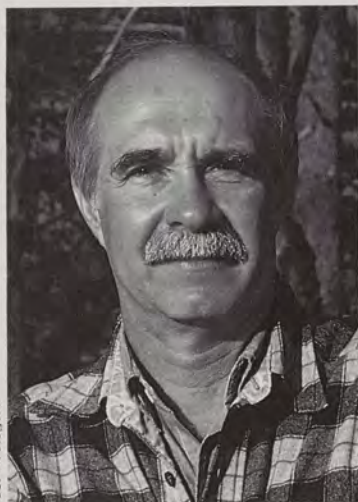
cannot lead the world in species and habitat conservation until we take care of the problems in our own back yard. DEFENDERS field correspondent Douglas Chadwick reports on the progress of the federal gap analysis program—an effective method of taking inventory of each state's species-rich habitats that has been woefully underfunded by our government even though it costs a mere penny per acre. If the U.S. is to recapture the mantle of world leadership, along with protecting the priceless biological heritage on which our own economy and quality of life depend, Congress and the administration must fully fund gap analysis, reauthorize a strong Endangered Species Act and push for new legislation to safe-

guard not only imperiled species but also the biotic communities of which they are part.

All of these actions are vital. The Endangered Species Act was meant to be a safety net to catch species falling through the cracks of battered ecosystems. It was never meant to carry nearly all of the nongame conservation load. We desperately need a law to protect priority habitat areas before their inhabitants become endangered. This legislation, which we could call the National Wildlife Stewardship Act, should provide for state and regional partnerships to draft conservation plans and preserve priority areas. These plans could be funded by federal, state, local and private contributions.

In a speech at the Rio conference, Senator Albert Gore (D-Tennessee) said, “The central organizing principle in the post-Cold War world must become the task of saving the Earth's environment.” Thinking back to the scientific advisory board's warning, we all have much work ahead of us. Perhaps the greatest challenge lies in halting the loss of species and their natural habitat. We've been warned by scientists. Now it is time to act.

Rodger Schlachten



Joel W. Rogers

ALL CREATURES, GREAT AND SMALL

Saving the Earth's rich panoply of life is urgent
for the human future, warns biologist E. O. Wilson

DEFENDERS Interview by Joel Bourne

*Go to the ant . . . , consider her ways,
and be wise. —Proverbs 6:6*

GREAT IDEAS have often come from the study of little things, and the works of Edward O. Wilson are no exception. Through his studies of ants and other invertebrates, the famed Harvard entomologist and evolutionary biologist has not only expanded our knowledge of the behavior and biology of social insects, but has also revealed the vital dependence of humanity on the smaller forms of life. Of his numerous books, two have been awarded the Pulitzer Prize for nonfiction: *On Human Nature* in 1979 and *The Ants*, which he wrote with Bert Holldobler, in 1991. *Biophilia*, his collection of essays published in 1984, is an eloquent description of the conservation ethic. Now in his latest book, *The Diversity of Life*, Wilson sends out a clarion call — pre-

The sixth is now under way, according to Wilson, caused entirely by the destruction of natural ecosystems by humanity. In less than a century, *Homo sapiens* will have destroyed what evolution took millions of years to create, possibly jeopardizing its own existence in the process.

Despite these gloomy predictions, Wilson is confident that it is not too late to turn things around. He offers a five-part plan designed not only to save the world's biodiversity but to enhance it and the quality of life on Earth. It includes surveying the world's flora and fauna; creating biological wealth; promoting sustainable development; saving remaining ecosystems; and restoring native wildlands. It is a plan, he admits, that must have the international cooperation of governments to succeed.

In *The Diversity of Life*, Wilson tells his readers: "I feel no hesitation in urging the strong hand of protective law and international protocols in the preservation of biological wealth. . . . In democratic societies people may think that their government is bound by an ecological version of the Hippocratic oath, to take no action that knowingly endangers biodiversity. But that is not enough. The commitment must be much deeper—to let no species knowingly die, to take all reasonable action to protect every species and race in perpetuity."

Known as the "dean of biodiversity studies," Edward O. Wilson was born in Birmingham, Alabama, in 1929 and received his undergraduate and master's degrees in biology from the University of Alabama. He received his doctorate from Harvard University in 1955 and has been on the Harvard

faculty ever since. He is currently the Mellon Professor of the Sciences, the Frank B. Baird, Jr., Professor of Science and curator in entomology at the Harvard Museum of Comparative Zoology.

How long was this book in the making?

In one sense it was 50 years in the making. My whole life has been moving toward a rendezvous with the problems of biodiversity. I was born a naturalist, grew up a naturalist in the South and have always been deeply interested in biological diversity. I like to say about my life that I was one of the naturalists who had the unique experience of seeing our view of the natural world change, particularly in the tropics, from one of an unlimited frontier of jungles and other marvelous places to a series of threatened nature reserves.

I was raised on William Beebe, Frank Buck, Ivan Sanderson and other adventurers who went to the tropics in the same manner as pioneers entering a largely unknown wilderness. And it never occurred to me or other young biologists in the 40s and 50s that any of that would come to an end. Of course we've had the experience in the 60s, 70s and 80s of awakening to how limited the world really is and how rapidly those natural environments and the biological diversity were disappearing. So that was a unique transition.

It will never happen again. From now on biologists and dedicated naturalists will regard the world as very finite and the natural habitats as threatened reserves under their stewardship. That's a big change in attitude. So in one sense my coming to this book was 50 years. In the narrower sense it took about two years.

What was your purpose in writing

BIODIVERSITY AFTER RIO



serve endangered ecosystems or risk losing a fifth of all life forms on Earth over the next three decades.

Wilson claims that this is not an "alarmist" book, and he presents his evidence in thoughtful, almost lyrical prose, taking the reader from the great theaters of evolution to the wonders of diversity with the enthusiasm of a guide in the rainforest. Yet the information is alarming. Throughout its history the Earth has experienced five great episodes of extinction because of climate change from glaciation, volcanic activity and meteorite strikes.



this book? Is it your grand opus? Is it a call to arms?

Yes. It was written because the subject is a passion of mine and I wanted to write a book about it for a long time. But I moved quickly now because we've become aware in the last few years how serious the crisis in biodiversity is, and I became increasingly concerned about how poorly it was understood. Most of the speeches and op-ed pieces on the environment during the past ten years have bypassed biodiversity entirely. Very few political speeches up to this time have even mentioned it in passing, and then usually indirectly through references to habitat destruction and loss of the tropical forests. As I began talking to groups in lectures and seminars and to journalists about the subject, it became apparent that not very much is known about it in the larger public domain. Furthermore, it's a difficult subject to understand.

If you think about what are considered to be the other critical environmental issues that concern the public and the policy makers, they can be entirely grouped in one category, the

deterioration of the physical environment. Usually that is of such a nature that it is easily grasped, such as increasing toxic pollution. Everyone can also understand what it means when the ozone layer thins out and we start seeing more cases of melanoma. People can also appreciate warnings about the greenhouse effect and climatic warming. But they have much greater difficulty seeing the relationship between habitat destruction and species extinction. And even more importantly what species extinction means to their lives.

So the main role of this book is twofold. It is first of all to define the loss of biological diversity as the other major category of environmental change, in addition to deterioration of the physical environment. To define through the best scientific evidence that I could put together what it is, its magnitude, just exactly what is happening against the backdrop of what has transpired over the past 500 million years, before humans came along, so we could have a basis for comparison. Then to define what it means to humanity and what we can

Edward O. Wilson in his lab at the Museum of Comparative Zoology at Harvard. At left is a colony of leaf-cutter ants, his signature species.

do about it and what we should do about it. In other words, this book is intended to be something of a wake-up call. Not just another alarmist book, but one that describes what the situation is as precisely as possible and assembles the best ideas available about the solution to the problem.

You mention in the book a paradox—more species are now living than have ever lived in the past. Yet you also say we are in the midst of the sixth great spasm of extinction. As you describe in detail, life has always bounced back with an incredible amount of diversity, but it has always taken eons.

That's the point. You've just articulated one of the main reasons I wrote the book. To address the crucial issues of how fast biodiversity is created and how fast it is being eliminated. One of the commonest questions I get, or shall I say counter-propositions, is of that nature. Why should

we worry, because evolution always brings biodiversity up to the mark? But when you look at the curve that paleontologists have compiled so meticulously, you find that after the previous five big downturns, full recovery required between 10 million and 100 million years. The answer to this query of why should we worry, because evolution will bring it all back, is of course it will, but our descendants will be mightily peeved to learn that they're going to have to wait 10 million years or five times the full length of the entire history of the human species since its evolutionary origin to see it recover from what we're doing in less than 100 years.

And it won't even happen nearly so fast, because we've preempted so much of the world. You have to have natural environments for most evolution to occur, and not only are we eliminating what was created over the past few hundred million years but we are eliminating the theaters of evolution—the natural environments in which evolution can proceed if we now allow biodiversity to start coming back.

You have predicted that if the current extinction rate continues, we could lose up to one quarter of the species on Earth within the next 50 years.

This is the other issue of concern that has been raised by large groups of people: how sure are we that a large amount of extinction is occurring? The answer to that is the area/

species relation, one of the strongest rules in ecology and in fact biology itself. There is a quite regular relation between the area of a natural environment, such as an island in the sea or a patch of rainforest, and the number of species that can persist there

indefinitely. If you increase the area ten times, you double the number of species, very roughly. The exact amount varies, whether it doubles or is 65 percent or 45 percent, according to the group and circumstance, but it is in that range.

Inevitably we have doomed a large number of species that are still with us only as the living dead. A lot of habitats have been reduced by 90 percent or more. They still have fairly rich faunas, but those faunas are destined to decline quite rapidly now. Because the areas that are left to them, such as the forests of Madagascar or those of the Brazilian Atlantic, are not large enough to maintain the faunas that were there just 50 or 100 years ago.

The other line of evidence, of course, is the direct observation of mass extinction. It's a rule that whenever biologists have studied a natural environment carefully before and after major disturbances, they see mass extinction because of the change in the environment. If we would collect on the western slopes of the northern Andes or some South Pacific islands that have been more recently deforested, we might see a fairly substantial fauna still in existence. But if we also had a record of what was discovered there 100 years ago, before the disturbance began, the rule is, around the world, that we would find that there had been substantial extinction. Some of these hecatombs are quite appalling and some quite recent. Fifty percent of the freshwater fishes of peninsular Malaysia, for example. All of the native tree snails of the island of Moorea. That will also soon be true of Tahiti and is on the verge of becoming true in Hawaii.

Has anyone challenged your prediction of species loss?

There have been a couple of biologists who expressed skepticism on the high estimates that a number of us have suggested of extinction rates worldwide. They don't have any quantitative counter-evidence, but they have nevertheless doubted whether the numbers were so high. But even when they were expressing doubts, they agreed that extinction is a serious problem. I sent the three biologists I knew to be dubious my chapter on extinction. I also sent it to Daniel Simberloff, a former student of mine well-known as an outstanding mathematical ecologist who is very rigorous and conservative in the way he makes and accepts estimates of this kind from data in the field. None has, for the time being, questioned my esti-

mates. The exercise was done in a very collegial manner. There is not yet a serious division among ecologists on the matter. All with whom I am familiar agree that humanity has a very serious problem.

Defenders and other organizations have concentrated on large predators and other megafauna, yet you write, "The humble and the ignored are often the star species." Should we now focus on saving ants, bacteria, "the humble and ignored"?

I think what we should do is not lose any of our intensity or concern about megafauna, especially since megafauna species tend to be umbrella species. If you can save enough of the environment to keep the Philippine eagle going or the panda, then you're automatically saving a large number of other plant and animal species because the megafauna require so much land and so complex an environment.

What we should do, however, is broaden our goals and shift the focus somewhat to ecosystems, including large studies on small organisms, because they probably are in many cases critical to the survival of many ecosystems, including those in which the megafaunas exist. I wouldn't for a minute devalue eagles and pandas and so on. They are extremely valuable species for many reasons. But we do have to move now to include entire ecosystems. There are certain ecosystems, purely from the point of view of biological diversity, that are extremely rich and valuable in their own right even if they do not have charismatic big species in them. There are many such ecosystems in the tropics that are also quite limited. They may have no large vertebrates but otherwise have so great a richness and distinctiveness that they need to be protected in their own right.

You have also said that if insects were to disappear, humans would go extinct very shortly thereafter because of the ecosystem services these species provide.

That's correct. If you deleted some

Leaf-cutter ants carry leaf segments down a tree in Panama to cultivate a fungus garden that sustains the ants.

We should broaden our goals and shift the focus to ecosystems, including large studies on small organisms.



group of major small organisms such as bacteria or fungi or insects, it would be catastrophic. But if you took out, sorry to say, the birds or the mammals, there would be big changes, but they would not be catastrophic, in the sense that most of life would continue to exist. There would be a very substantial reorganization of the ecosystem, but it would not be the end of a large part of the rest of life that would be the case if fungi or bacteria or insects or possibly other small organisms were removed. It's one more reason for holding onto the small organisms. And there is so much to be learned about these creatures. I'm in the process of doing a full study of the largest genus of ants in the world, which has at least 600 species in the western hemisphere. I'm in the process of describing 350 species new to science. The amount of novelty is amazing. Any one of the millions of new species of animals and plants awaiting discovery could offer scientific information, new products, new pharmaceuticals of great value.

You discuss many of the benefits derived from biodiversity in your book, but you also point out a deeper value of diversity.

We may be psychologically closer to the rest of life than we had realized, in the sense of needing its existence for our own full psychological development. My book *Biophilia* was a full exposition of this idea of what

the rest of life means to us, and it's a theme I carry further in *The Diversity of Life*.

There is physical dependency on the rest of life but also still unmeasured psychological dependency. A great many people in the field of conservation science sense that we've

got to do better than just saying the products of these species will benefit humanity. If we didn't intuitively sense that there is something more, then very few people would care. The fact is that people do care. The more they know, the more they care.

If a group of major small organisms were deleted — such as bacteria, fungi or insects — it would be catastrophic.



Top, two male hercules beetles, up to six inches long, fight over access to females nearby in a Costa Rican rainforest. Possessing one of the deadliest toxins in nature, the poison-arrow frog warns predators with its bright hues.



Michael Fogden/DRK Photo



Michael Fogden/DRK Photo

A spiny long-horned grasshopper in Ecuador, top, assumes a threat posture. Also providing protection are camouflage and prickly armor. Termites emerge from a nest in the Amazon basin of Peru. They are the main turners of tropical soils.

You talk about a new environmentalism. Does this entail caring about and preserving every species?

Yes. We can see a major shift in thinking that began in conservation circles about ten years ago. It went from viewing the preservation of the environment as an alternative to economic development, justifiable largely on esthetic or other largely psychological grounds, to the important new view that economic development *depends* upon conservation and that the two should be advanced together.

How did you view the Rio conference? Did we make progress?

I think humanity made significant progress largely because of the symbolic importance created by the assembling of more heads of state than had ever come together in the history of the world for a common goal. That event alone gave new urgency and cachet to the global environmental movement.

In addition, in the domain that I am personally most interested in and consider the most important of all the environmental issues, the Rio conference moved biodiversity to center stage for the first time. That was a very strong plus. Even though the biodiversity convention adopted was relatively weak, it represents an important beginning.

Since they contain more than half of our species, you are suggesting that the world's focus should be—

Disproportionately on the tropical forests and the tropical coral reefs and a few other species-rich environments which are by and large concentrated in the tropical zones. The old-growth temperate forests in the United States are very important reservoirs of biological diversity far beyond the few star species like the spotted owl. To remove a big chunk from the forest in the Pacific Northwest would extinguish some species limited to that piece of land. But a similar piece taken out of Ecuador would erase the last remnants of a far larger number of species. I cite this not to devalue our forests. We need to save every scrap that we can of old-growth Pacific Northwest forests and other American habitats. I say it only to show how important those tropical

forests are. And how we have to be so careful with them.

What can U.S. conservation groups and their members do to save rainforests in the tropics?

I think it would go something like this. We must agree that if we can't preserve our own natural environment and species, we are in poor condition to advise the rest of the world. We have already developed a very substantial foreign defense policy, an increasingly sophisticated trade and economic policy, and we should similarly work toward developing a global environmental policy, whose prototype is to be seen in the Rio conference treaties. What the average wildlife enthusiast or naturalist should do, in addition to being a local conservationist, is to extend political concern to the development of a wise global environmental policy. To do so can be justified even in narrow terms of national self-interest.

You have said that the world's species are part of the global commons. Is nationalism an obstacle to preserving biodiversity?

I see narrow nationalism as a major obstacle—a reaction to global environmentalism by assertion of the right to destroy a country's own natural resources and biodiversity. That attitude unfortunately was expressed, for example, by the Malaysian representative in Rio.

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If we can't preserve our own natural environment and species, we are in poor condition to advise the rest of the world.

In effect he said that Malaysians will not let the developed countries deny them the right to clear their own forests for short-term economic gain. In a legal sense that right exists. But to follow through would be a tragic act of self-destruction.

What are the other major obstacles to preserving biodiversity?

The greatest obstacle is rapid population growth in the near vicinity of many of the biologically rich areas. The second greatest obstacle is the



Chris Newbert/Bruce Coleman, Inc.

primitive agricultural methods and very limited markets of most of the people living on the land near biologically diverse areas. The third greatest obstacle is the unrestrained international markets which are contributing to clearcutting. None of these difficulties are insoluble. The living standards and economic prospects of rural populations can be substantially improved at low cost often with relatively low technology and by imaginative market development. It costs very little per capita to introduce improved agricultural methods and crops into some of the most impoverished areas, including those next to the remaining forests and other natural preserves. By creating new markets for agricultural and timber products in those areas, it should be possible to make far better use of the land already under cultivation and take pressures off the wildland.

The problem has been worsened because countries like Brazil and Indonesia have mindlessly poured people into areas like the western Amazon and Sumatra and bade them cut the forests down to make new farms. These people then occupy areas that can yield crops for only several years, and they also often grow the wrong crops because they don't know anything else and because they must address the only local markets to which they have access. With a little bit of planning in zoning and market development, it is possible to accom-

The marine equivalent of a tropical forest and equally endangered, a Red Sea coral reef shelters thousands of species. Opposite, Amazon rainforest burns in the Jari plantation, a tree farm the size of Connecticut widely criticized by environmentalists. One owner was an American, Daniel Ludwig.

modate a large part of these growing populations without destroying the best parts of the biosphere reserves.

You say that we are now entering the age of ecosystem restoration. What are the first steps?

The movement has already begun locally, driven by inspiration and imagination, and it has the potential to spawn major new technologies. I can't think of anything more interesting and inspiring than environmental restoration. It has a lot of scientific and technical challenges, which if met will improve the quality of life in many ways. Not least, it will allow people everywhere to see the original grasslands and forests and lake ecosystems come back to life in their own neighborhood. The more that people learn about natural history and what can be called the deep history of their country and local environs—the history of life in large and small areas that existed before humanity came along and started removing most of the species—I think the more motivated they will be to see that restoration proceed and the



more it will infiltrate local culture and tradition and enhance civic pride.

One difference between the biodiversity issue and other categories of environment change to me is that biodiversity is interesting. The others are really very boring. Everybody wants to see the ozone hole closed and everybody wants to see toxic pollution abated and stopped, but those are basically dull subjects. In such cases, environmental actions are just ameliorative measures to halt something unpleasant and dysfunc-

tional that is going on, like taking antibiotics or having an ingrown toenail removed. In great contrast is biodiversity, whose protection can not only turn the world around but also yield a considerable new economic and social advance based on scientific information. And a new realization of beauty and strength in humanity.

At the risk of trivializing the issue, imagine the difference between taking a class on a field trip to see a new sewage-treatment plant versus taking a class on a field trip to see a restored

natural forest with birds, butterflies and plants coming back and explaining to the kids what is happening. Humanity has an affinity for this kind of enterprise. It stirs the embers of our most ancient traditions and offers deep pleasures for which we are genetically prepared. □

Joel Bourne is associate editor of this magazine. Edward O. Wilson's The Diversity of Life will be published in October by Harvard University Press.

THE NEW CONSERVATION CHALLENGE

To halt species extinctions, the world must adopt fresh strategies reaching even to the local community

by Charles V. Barber, Kenton R. Miller and Walter V. Reid

THE DIPLOMATIC and media furor that erupted from United States refusal last June to join most of the world's other nations in signing the new convention on biological diversity resulted, ironically, in putting biodiversity firmly on the international political agenda, as well as making a large cadre of journalists familiar with the issue. But it remains to be seen whether the momentum generated in Rio de Janeiro can be channeled into on-the-ground action to save, study and sustainably use biodiversity in the coming decade and beyond.

At the United Nations Conference on Environment and Development in Rio, the 12-nation European Community and 153 other countries signed the biodiversity convention. In addition, all governments present assented to the text of Agenda 21, an ambitious—although nonbinding—blueprint for realizing sustainable

development. Chapter 15 of Agenda 21 addresses biodiversity, giving additional support for implementation of the convention. However, the prospect that a convention on forests might also be adopted at UNCED was derailed months before the conference began. In fact, it was only after much acrimonious negotiation that a set of nonbinding forest principles was finally adopted in Rio. Weak as they are, these principles at least acknowledge that forests are in trouble everywhere—not just in the tropics—and that forestry plans should take account of the needs and wishes of forest-dwelling peoples. As a means of ensuring the survival of forests and their denizens, though, the principles fall far short: nowhere do they even recognize the need to preserve key rainforest areas identified as biodiversity “hot spots.” Debate in coming months is likely to center on “next steps” toward international agreements on forests, with some industrial countries pushing for a legally binding forest convention and many developing countries dead-set against it.

In the meantime, there is much that nations, communities and activists should be doing to build on both the biodiversity convention and Agenda 21, which represent only the first steps in an international effort to conserve biodiversity. What's needed is an all-fronts action plan like the one articulated in the *Global Biodiversity Strategy* released last

February by the World Resources Institute (WRI), the World Conservation Union (IUCN) and the United Nations Environment Programme (UNEP) after three years of intensive, broad-based consultation and research. UNCED's actions on biodiversity provide important tools for implementing the strategy, but UNCED did not take up many of the most crucial actions spelled out in the strategy. These will need to be pursued independently and aggressively during the coming decade.

It is crucial that the focus of action shift from the international to the national and local levels. Some biodiversity issues must be dealt with internationally, but most of the problem lies in our own respective backyards. In the United States, we need

to reexamine our policies for conservation and exploitation of living resources and to set in motion a process to develop a durable, equitable and effective national biodiversity policy.

Although studded with “as far as possible and appropriate” and other such qualifying phrases, the biodiversity convention commits parties to take substantive action in many key areas, including:

- Development of national plans, strategies or programs for the conservation and sustainable use of biodiversity.

- Inventory and monitoring of components of biodiversity and of processes adversely impacting it.

- Development and strengthening of *in situ* (on-site) mechanisms for biodiversity conservation both within and outside of protected areas.

- Development of *ex situ* (off-site) mechanisms for biodiversity conservation, as a complement to *in situ* approaches.

- Restoration of degraded ecosystems and recovery of endangered species.

- Regulation of the release of genetically modified organisms.

- Preservation and maintenance of indigenous and local systems of biological resource management, and equitable sharing of benefits with local communities.

- Integration of biodiversity concerns into national decision-making.

- Promotion of research, training and public awareness.

- Assessment of impacts on biodiversity of proposed projects, programs and policies.

- The extent to which these commitments will lead to concrete action

Children visit the “Tree of Life” at the Earth Summit in Rio. A symbol of the global environment, the tree was hung with notes from around the world.

BIODIVERSITY AFTER RIO





is unclear. As UNCED Chairman Maurice Strong noted at a press conference on June 14, it is up to all of us to hold our respective governments' feet to the fire on the commitments made at Rio. And it's particularly up to us Americans, whose odd-man-out government refused to make any commitments, to educate our leaders and fellow citizens on how crucial it is that our country put its enormous heft behind efforts to conserve biodiversity here and abroad.

Several weak or controversial points in the convention need immediate attention. The provisions on intellectual property rights and technology transfer are exceptionally confusing. Several industrial countries have expressed their discomfort with these sections, while one—the United States—refused to sign on grounds that the property rights of biotechnology companies would be compromised, stunting the growth of that industry. Sorting out this complex and contentious issue may well require a separately negotiated protocol, a possibility provided for in the convention.

The Global Environmental Facility (GEF) has been designated as the interim funding mechanism for the convention until such time as the Conference of the Parties establishes a permanent mechanism. Concern is high about the governance of GEF (which is managed by the World Bank, the United Nations Development Program and UNEP), the extent and

power of public participation, and the competence of the GEF mechanism to move large amounts of funding into useful activities. Thus, the GEF is likely to be central to debates on the financing of the convention's activities for some time to come.

Actions that the *Global Biodiversity Strategy* identifies as key for conserving biodiversity—such as land reform, ensuring indigenous land rights, empowering local communities and making a real effort to reduce Third World debt—were treated weakly or ignored in the convention.

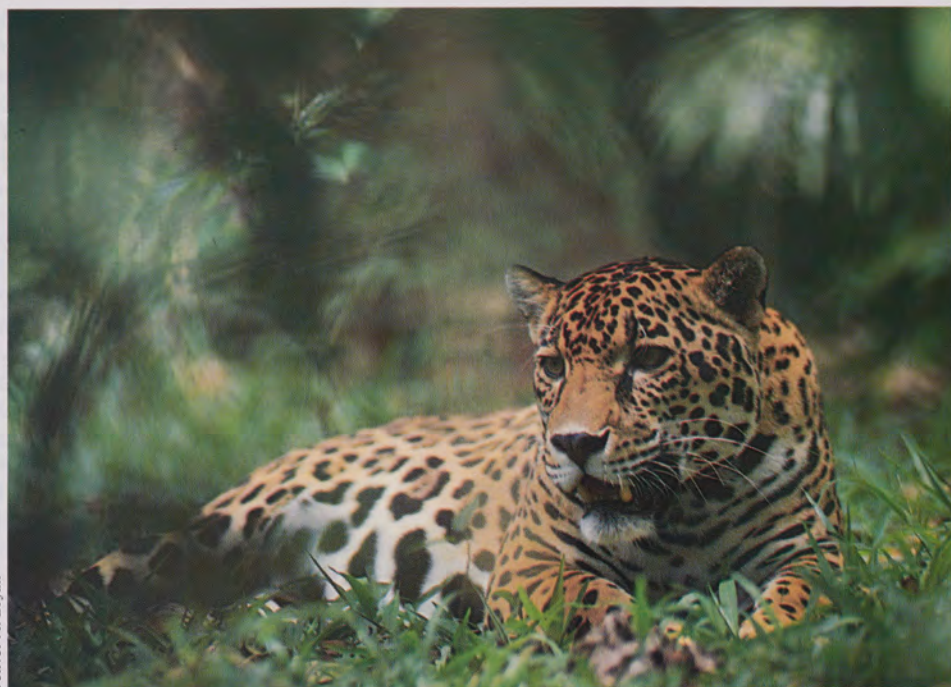
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**It is up to all of us
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tive governments'
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Michael Fogden/DRK Photo



Denver A. Bryan



Brian Parker/Tom Stuck and Associates



Bamboo and tree ferns thrive in Costa Rica's Monteverde Cloud Forest Reserve. A resting jaguar in the jungle of Belize and a male Sumatran orangutan are examples of "umbrella" species which when protected can save habitat for much other wildlife.

In the final analysis, the convention on biological diversity is an agreement between national governments that largely excludes nongovernmental organizations, the private sector, local communities and the rest of the wide range of actors who must be involved in conserving biodiversity in the 1990s and beyond. It is an important piece of an overall strategy, but it is only one piece. It is one kind of instrument (international law), involving only one type of actor (national governments). The need remains for the *Global Biodiversity Strategy's* overall, comprehensive framework, within which the convention is a necessary, but not sufficient, component.

At its May meeting in Nairobi, the Intergovernmental Negotiating Committee (INC) for the biodiversity convention adopted several resolutions on "interim arrangements"—steps to be taken in the years before the convention enters into force. It's clear that governments already recognize that action to conserve biodiversity cannot wait for what may be a lengthy process of ratification by the 30 countries necessary to bring the convention into force. Now they must be brought to a further recognition—that governments alone cannot conserve biodiversity, that a wider range of actors must be mobilized to shore up the framework provided by the convention and fill in the missing pieces.

Forty-six scientific, conservation, community and governmental organizations, including Defenders of Wildlife, and more than 500 individuals all over the world were consulted in the development of the *Global Biodiversity Strategy*. This wide-ranging dialogue among many constituencies from many cultures managed to come to terms on a three-part paradigm for needed actions. The first is to save biodiversity through networks of protected areas (national parks and forest and wildlife reserves), off-site support facilities (seed banks, botanic gardens, zoos, tissue cultures, aquaria), and provision of buffer

zones, corridors and other landscape-scale mechanisms to weave protection into the fabric of regional economic development. The second action is to study biodiversity through inventorying its components, creating data bases relevant to science, industry, education and land-use planning; mounting awareness campaigns; and expanding research and monitoring efforts. The third needed action is to use biodiversity in ways that are sustainable (forestry, fisheries, wildlife, agriculture) and equitable (fair share of benefits to local people, indigenous peoples' rights, farmers' rights regarding their contribution to genetic resource identification and selection, and global sharing of costs).

The strategy elaborated on the objectives implicit in this save-study-use approach by proposing 85 actions, five of which are particularly catalytic:

Achieve and implement a convention on biological diversity. The con-

vention was signed at UNCED, but implementing it will be the work of years.

Call on the United Nations to establish an International Biodiversity Decade to provide a framework for concerted international action. Obviously, biodiversity will *not* be conserved by the convention alone nor by current levels of investment.

Establish a widely representative international panel on biodiversity conservation to ensure continuing dialogue and to craft policy options that address the social, economic and institutional issues affecting biodiversity. The advisory mechanisms provided for in the convention and Agenda 21 are potentially valuable, but they will be limited to government-appointed scientists and an agenda set by signatories (and later, parties) to the convention.

Establish an early warning system, a global network linking universities,

The convention on biological diversity is an important piece of an overall strategy, but it is only one piece.

paradigm for needed actions. The first is to save biodiversity through networks of protected areas (national parks and forest and wildlife reserves), off-site support facilities (seed banks, botanic gardens, zoos, tissue cultures, aquaria), and provision of buffer



Photographs by Carlos Humberto TDC/Contact Press Images

NGOs and communities to provide "alerts" on the status of species, genetic resources and ecosystems, and on immediate threats to them.

Prepare national policies, plans and strategies to define national and local assets, options for conservation and use and priorities for action and investment. This provision, which has been included in the convention and Agenda 21, is key to progress, since it will foster dialogue, integration of efforts and agreement on needs.

The strategy was developed by a team from leading institutions around the world. Since many of the same people were involved in drafting the biodiversity components of Agenda 21 and in negotiating or advising on the convention, it is not surprising that many of the strategy's concepts appear in these documents. That said, however, the strategy goes well beyond these documents in calling for action by a whole range of institutions, spe-

cifically including NGOs, communities, science, and business and industry. Moreover, the strategy forthrightly raises a number of sensitive and hard questions that were more or less swept under the rug or bargained down to a vague "lowest common denominator" in the UNCED process. Some of these questions are as follows:

Who owns biodiversity—and by what right? The convention and Agenda 21 declare that nations are sovereign over their natural resources, including biodiversity—which spells the end of the free-for-all grab of genetic resources from the rainforests and other rich environments. But when most of Earth's species have not even been named, much less studied, how can countries exercise sovereignty over them? These two documents encourage countries to establish procedures that facilitate the systematic exploration of their biotic wealth and its use.

The exercise of sovereignty assumes

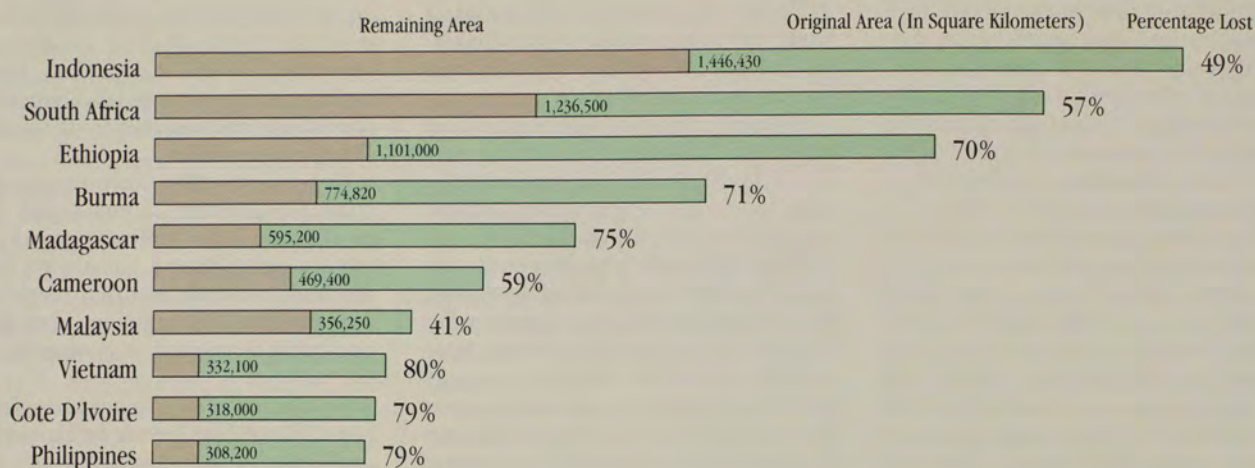
that each country should establish programs to inventory biotic wealth and to foster research that will provide information by which to make rational decisions for conservation and use of biological resources. With monetary and technological wealth concentrated in the North and biotic wealth in the South, this situation seems ripe for new kinds of international cooperation.

But is it really the country that owns biodiversity? Some argue that biodiversity is a "cultural resource," meaning that nature has always been the human abode and that particular cultures have over millennia bred plant and animal species and shaped the

Being unfurled on Copacabana Beach is an "Earth Flag" made by Canadians and signed by thousands. Opposite, U.S. Senator Albert Gore (D-Tennessee) joins native leaders in backing the biodiversity agreement at the summit.



Loss of Habitat in Selected Countries



Source: IUCN/ UNEP 1986

As the world's only remaining "super-power," the United States has a major role to play in global efforts to conserve biodiversity.

landscape. In most parts of the world, ancient traditions dictated how to manage nature until displaced by more recent ownership patterns, which often exclude traditional inhabitants, alienating peoples from their lands and devaluing their stewardship roles. Parks and reserves have often fallen into this trap, especially in developing countries where whole settlements have been moved to create parks and wildlife reserves, leaving the sites without adequate protection by public authorities

and a disenfranchised community without alternative livelihoods.

The question of rights is further complicated by the issue of intellectual property rights. For example, native communities have invested thousands of years in selecting plants and animals for foods and medicines. Modern

technologists take these selected genetic materials and add intensive technological know-how to produce more disease-resistant strains of plants or animals or new medicines—and

then sell them on the world market for considerable profit, without sharing it with the people who contributed so importantly to the enterprise.

How can the returns from intellectual property be shared equitably? The Food and Agriculture Organization argues in favor of "farmers' rights" whereby rural communities that identified and selected genetic materials should share in the profits made from subsequent applications of biotechnologies. Others argue that patents protect profits as a type of reward system to foster creativity and entrepreneurship on the part of scientists, engineers and related industry.

Is lack of funding really the main problem? Much of the biodiversity debate at UNCED revolved around money: How much would the North pay the South, and on what terms, in exchange for conservation measures and continued access to the full complement of tropical genetic resources? While new funding for biodiversity conservation is definitely necessary, its effectiveness is fully contingent on a range of policy reforms that countries must undertake themselves at the national and local levels, and in concert with other countries at the international level.

Inequitable land tenure arrangements, overcentralization of power in

policy-making and implementation, subsidies to special interests and other economic distortions, and abuses of human rights and legal process all need to be addressed within countries if additional funding is not to be wasted. Internationally, the effects of current trade patterns and practices, and the crushing burden of Third World debt, must be addressed if the benefits of increased international funding are to be realized.

How can costs and benefits be shared? Under the provisions of the convention, countries are encouraged to establish ways to share in both the costs and benefits of conserving and using biodiversity and biological resources. Thus, countries of origin of genetic materials should receive a fair share in the revenues derived from the subsequent use of those resources. But what is a fair share? How can these benefits reach the people living in rural areas who have often carried the opportunity cost of not harvesting resources in order to protect nature?

Further, countries in the South may require financial and technological support in setting up protected areas, in developing inventories and germplasm banks, and in achieving sustainable forestry. What type of cost sharing is reasonable? Under the terms

of the convention, industrialized countries would contribute new and additional funds, over and above current levels of development assistance, that would be used to invest in developing-country activities in conservation and sustainable use. Thus, developing countries could use traditional assistance for helping to eradicate poverty and for other purposes, and in addition invest in biodiversity.

On the international stage, the United States should retake the leadership position it held at the first UN summit on the environment held in Stockholm in 1972. Rather than cowering at perceived threats to its economic interests, the United States should sign the biodiversity convention, take the lead in negotiating processes to clarify vague language that troubles its biotechnology industry, and use its diplomatic clout to push for early ratification and entry into force.

Equally important, the United States must lead by attending to the rapid erosion of biodiversity occurring within our own borders. This can best be accomplished through a process of research and dialogue leading to establishment of a national biodiversity policy. The well-publicized conflicts between endangered species and economic well-being symbolize a conflict between outdated resource-management policies—designed more than a century ago to open the potential of the nation's resources through subsidized land, water, timber and grazing—and today's vastly changed social and environmental needs.

The overexploitation of natural resources may once have been justified as a means to jump-start regional economic development, but now the need is for sustainable resource use. Commodity production was once the only demand on many natural ecosystems, but it must now be balanced with demands for recreation, wilderness, watershed protection and research. And though the ecological costs of resource degradation were once unknown or ignored, they are now all too clear and present.

Federal and state policies have not kept pace with these changing realities. Unable to reform outdated policies in the face of opposition from entrenched special interests, the legis-

lative and regulatory response has been piecemeal—meeting urgent needs but rarely addressing underlying problems. The operation of the Endangered Species Act exemplifies the problem. Little is done to address the degradation of habitats and ecosystems until a species is threatened with extinction from the planet. At this point, though, options are few and conflicts likely.

An effective approach to conserving biodiversity in the United States will require basic changes in how planners approach biological resource management and conservation. Over the last decade, the emphasis in pollution control has shifted from end-



Carlos Humberto TDC

Contact Press Images

Americans take part in a march of some 6,000 people protesting the refusal of President Bush to sign the biodiversity convention in Rio.

of-the-pipe regulation to "pollution prevention"—minimizing the generation of pollutants rather than cleaning up once they are produced. It is long past time for a similar shift to take place in biological resource management. Relying on the spotted owls of the world to force changes in policies that need reform in any event is inefficient and bound to generate conflict. What is needed is a national biodiversity policy, accompanied by federal legislation that gives agencies the authority to anticipate and prevent biodiversity loss. The Endangered Species Act must be a strong, continuing part of that framework, but it should be the last line of defense against extinction, not the first.

Relating biodiversity to sustainable development gives rise to the proverbial chicken-or-egg dilemma: must a country achieve a certain level of development before it can afford to conserve its biodiversity, or is con-

serving biodiversity necessary to make development possible? Environmentalists, most governments of the North and ecological economists will argue the latter—that there is little chance of achieving a sustainable society without retaining nature's variety and keeping all natural systems in good running order. But the South questions whether public funds should be diverted from poverty eradication efforts and from health and education to save species and genetic materials that are unlikely to confer any great benefits on its citizenry.

The answer, of course, is both to save diversity *and* to distribute its benefits more fairly. The example of Costa Rica was ever-present in Rio and during the negotiations for the convention. There, investments in biodiversity have already created jobs, contributed to the intellectual and cultural development of the country, and set the stage for new economies in the longer term.

In short, many of the obstacles to conserving biodiversity do not lie in the scientific realm or in the traditional ambit of "nature conservation." Rather, they implicate basic aspects of how we manage our economies and societies, and who benefits and who loses from current arrangements. Changes of this magnitude require more than an international convention or summit meeting. They can only come about through a sustained and broad-based process of dialogue, negotiation and action within each nation.

As the world's only remaining "superpower," the United States has a major role to play in global efforts to conserve biodiversity. The United States myopically refused to take up that role at Rio, but it is likely that more forward-thinking policy-makers will prevail in the coming months and years. They will have a full agenda, both at home and abroad. □

Charles V. Barber is an associate of the biological resources and institutions program of the World Resources Institute (WRI), a center for policy research on global environmental issues, located in Washington, D.C. Kenton R. Miller is director of the program, and Walter V. Reid is a WRI vice president.

U.S. ROLE IN RIO: TOO LITTLE, TOO LATE

Despite last-minute efforts, Reilly failed to win Bush's blessing even for a weaker pact

FEW AGREEMENTS have ignited such a political firestorm or have shown such global promise. The decisions made at Yalta by Roosevelt, Churchill and Stalin come to mind in terms of the sheer geographical area affected. The Magna Carta, which became the basis for Britain's parliamentary democracy, is comparable in the breadth of its ideas. Yet the convention on biological diversity adopted at the Earth Summit in Rio attempted no less than the preservation of all life forms on earth. It was signed by leaders of 165 nations, including all the industrialized countries. The President of the United States was not among them.

The Bush administration, hostile to the idea of the Earth Summit from the start, came to oppose the biodiversity convention in particular. In mid-April, the White House Council on Competitiveness, chaired by Vice President Dan Quayle, circu-

lated a memo harshly criticizing the convention as a possible threat to the U.S. economy and to biotechnology industries. Later, just days before the last round of pre-conference negotiations in Nairobi, Kenya, the administration replaced the leading U.S. negotiator, who had been in favor of the treaty.

Defenders, a strong proponent of the biodiversity convention, was one of a handful of environmental groups that took part in the preparatory meetings, pushing for strong conservation requirements. John Fitzgerald, Defenders counsel for wildlife policy,

worked with representatives in Nairobi and in Rio on the draft convention, while at home the organization urged key members of Congress to try to get a supporting resolution passed.

But opposition from the administration set the stage for an all-out assault on the draft treaty at the Nairobi meetings. Despite an earlier agreement to discuss only sections marked as controversial, the U.S. team proposed rewriting major parts of the draft and even dropping key sections outlining conservation duties. This included changes in numerous paragraphs that U.S. negotiators previously had approved.

For the next two weeks, in an effort to achieve consensus, representatives of more than 100 countries tried to accommodate U.S. demands and those of its two unlikely allies, India and Malaysia, which have strong pro-development agendas. The U.S. successfully opposed developing global lists of threatened species and habitat, and it weakened the duty

of signatory nations to conserve biological resources and regulate activities that harm them.

Several countries were surprised and frustrated at the U.S. role of spoiler, according to Fitzgerald. "Some of the representatives said privately that they and others feared the U.S. would cut aid to them if they opposed U.S. demands," he said. "Many countries were willing to sign a much tougher treaty." After winning numerous concessions, U.S. negotiators initialed the weakened draft, and it was considered ready for signing at the summit.

At the Rio conference, however, the Bush administration backed away from even a weakened convention, objecting to the funding mechanism and the convention's presumed effect



President Fernando Collor de Mello of Brazil speaks at the opening of the Global Forum, a meeting of some 20,000 nongovernmental activists from 171 nations held during the summit.

on the ability of U.S. biotechnology firms to protect their patents. William K. Reilly, administrator of the Environmental Protection Agency and the chief U.S. negotiator in Rio, tried to persuade President Bush to accept the convention if further concessions could be won. But during the critical negotiations, a Reilly memorandum to the President outlining his plan was leaked to the press by a White House source, along with a firm rejection by high administration officials. The publicity embarrassed Reilly and seriously undermined U.S. credibility at the summit.

Public pressure on the President mounted as well. Defenders and 13 other national environmental groups wrote a joint letter to President Bush urging him to sign the treaty, even if

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Carlos Humberto TDC/Contact Press Images

he noted specific problems that could be worked out at a later date. Other countries that had reservations about the treaty, including Britain, Japan and Germany, found ways to sign.

After returning from Rio, Reilly was critical of the administration's handling of the conference. In an internal EPA memo made public by the Associated Press, Reilly tried to explain why the U.S. received the lion's share of bad publicity at the summit, asserting: "We assigned a low priority to the negotiation of the biodiversity treaty, were slow to engage the climate issue [and] were last to commit our President to attend Rio. We put our delegation together late, and we committed few resources. No doubt, this contributed to negative feelings toward the United States."

The biodiversity convention will become international law once 30 nations ratify it. The U.S. can still participate as an observer in forthcoming meetings on the treaty or can sign at a later date. —Joel Bourne

Congress Marks Time on Biodiversity Bills

ALTHOUGH President Bush pledged in his speech at the Rio summit that the U.S. will exceed the requirements of the biodiversity treaty, the administration has yet to make any progress toward honoring that pledge and has opposed biodiversity legislation being considered in Congress. Defenders is supporting biodiversity bills sponsored by Representatives James Scheuer (D-New York) and Gerry Studds (D-Massachusetts) and Senator Daniel Patrick Moynihan (D-New York). Congressman Scheuer's initial proposal in 1988 would have required federal agencies to adopt strategies to preserve biodiversity. Because this encountered strong opposition, his current bill would only establish a center for bio-

diversity research at the Smithsonian Institution, a proposal even President Bush endorsed shortly before going to Rio.

The latest Scheuer bill has been approved by the House Committee on Science, Space and Technology and is awaiting action by the House Committee on Merchant Marine and Fisheries. Congressman Studds' bill, which is based on the broader Scheuer bill, was approved last year by the House Subcommittee on Fisheries and Wildlife Conservation and the Environment, which he chairs. It is still awaiting action by the full Committee on Merchant Marine and Fisheries. No action has yet been taken on the Moynihan bill. Time is running out for action by the present Congress. □

U.S. IMPERATIVE: NETWORKING HABITATS

Conservation biologists are working toward protection of entire ecosystems rather than just single species

by Douglas H. Chadwick

BART BUTTERFIELD, a researcher at the University of Idaho, was sitting in front of a computer screen that glittered with more colors than a rainbow trout, all packed neatly within the ham-hock shape of Idaho. The image looked like a video game, yet it represented the latest stage of a program that could dramatically change the focus of wildlife conservation from single species to whole ecosystems. The first step toward protecting America's biological diversity, it is known as gap analysis.

This I had to see in action. "What can your program tell me about, say, . . . the veery?" I asked Butterfield, attempting to stump him. He typed in the commands, and fine colored lines began to spread downward from the top of the screen while the background filled in with gray polygons of different crosshatched patterns. Within seconds I was looking at a finished picture of the whereabouts

birds might be found in a place they hadn't bothered to check. Sure enough, when they looked there, they came up with sharp-tails."

When I last reported on gap analysis for DEFENDERS in 1990, the program was in its infancy. Michael Scott, a U.S. Fish and Wildlife Service (FWS) biologist stationed at the University of Idaho Cooperative Wildlife Research Unit, colleague Blair Csuti and several other specialists in biodiversity conservation devised the technique using information from state and federal agencies, university researchers and the natural heritage data base compiled for each state by The Nature Conservancy. Scott began a pilot project for Idaho, intending to produce a map that would show all major vegetation types in the state together with the distribution of as many animals as was practical. With the help of a potent computer program known as Geographic Information System (GIS), the map would

yield a portrait of the biodiversity or species richness of any area in Idaho.

"We finally put the whole thing together just last month," Butterfield said. "We don't have nearly the money or manpower to inventory every member of every wildlife community, but we've learned that plants are a pretty good stand-in. They don't move around or hide in the brush. You can go out and sample them in detail, adding to existing data from aerial photos and satellite imagery, and you know that certain animals are almost always going to be associated with each kind of habitat. So our base layer is a map representing all the different known vegetation types in the state. It gives us our first overall picture of the ecosystems we're dealing with. We

consider it a kind of coarse filter. On top of the base layer, we now have maps for each breeding terrestrial vertebrate in the state—357 native species."

"Okay, how about a map for the boreal red-backed vole?" I said, picking another fairly obscure species. Butterfield looked over his checklist. "*Clethrionomys gapperi* coming up," he replied. And it did, with the same scope and detail as before. The best I could have hoped for until recently was a hand-drawn outline against a meaningless background. If I were a researcher looking into a possible relationship between veeries and red-backed voles, the GIS program could prove or disprove my guesses almost in a flash, for it can overlay both maps on the same background. GIS can overlay hundreds of such maps. This is how it generates portraits of species richness.

"We had hoped to include some easily identified invertebrates, like butterflies, to round out our measures of species richness," Butterfield added. "Other states with more butterfly collectors and fewer big tracts of wilderness could do that, but we realized Idaho just doesn't have enough complete sampling yet. The beauty of GAP, though, is that you can keep adding to it as new information comes in. It is an ongoing, evolving system." Rather like nature itself, I thought. Researchers hope to build map layers for aquatic organisms, soil types and other dimensions of ecosystems in the near future.

Butterfield went on to punch up the data base for trumpeter swans, showing them tightly clustered around lakes, ponds and rivers in a limited region. "We have very precise, accu-

A veery, one of numerous migratory songbirds declining because of loss of habitat, broods eggs in its nest.

BIODIVERSITY AFTER RIO



of the secretive thrush with the flute-like song.

"The old maps just showed whether veeries were present or absent in a county," Butterfield said. "Our data indicated that they use mainly riparian areas. So a detailed map of those vegetation types, combined with available sighting records, is going to give you a much clearer idea of where veeries actually are in the state. You see, gap analysis predicts as well as documents. We told some Fish and Game researchers working on sharp-tailed grouse that our map said the



rate information for all sensitive, threatened, or endangered species," he said. "And we can overlay that on maps showing land ownership and management, just as we do with overall species richness to pinpoint areas with adequate safeguards and areas at risk."

When species maps are overlaid on

number of possibilities once the data sets are in the computer," Csuti says, "and test how each protection strategy will do without having to go out and learn by trial and error in the field."

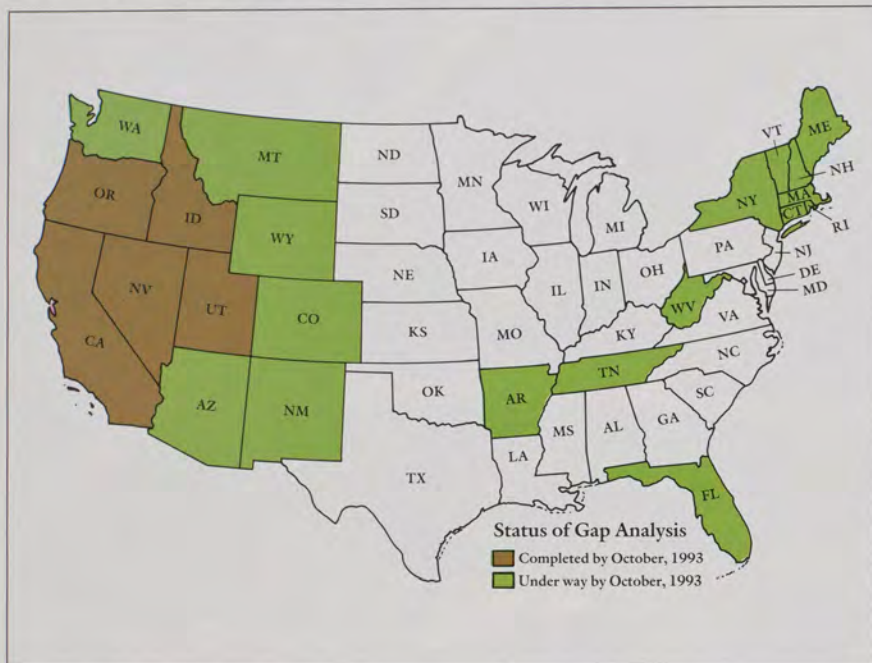
The elements are at last in place to begin fashioning a national network of conservation areas that represent every type of native habitat, are lo-

amusement parks. Ideally, it would be more like a parallel realm of wildness and majesty thriving next to lands dominated by humans, with integrated boundaries between the two. It need not be huge, merely sufficiently large and connected to be self-sustaining. Biodiversity planning through gap analysis is currently our best means for outlining what such a realm might look like.

From the GAP lab, I wandered into Mike Scott's office, a busy warren cluttered with publications, dozens of them by him. "We found that of 65 native vegetation types in the state, 27 have less than ten percent of their total area within lands managed to ensure their future over the long term," he began. "Six vegetation types have virtually no acreage within reserves. Let's take the example of two communities dominated by western juniper. They're not very highly regarded; range managers traditionally think of juniper as something to eradicate to improve grazing. But look at how often we've turned around to find that once-common species suddenly have become scarce."

"What GAP is telling us," Scott continued, "is that we would be wise to get some juniper communities under protection now, while we still have plenty to choose from. Especially since GAP also revealed a strong link between them and neotropical migratory birds." These are the species that fly between North American breeding grounds and distant wintering sites at warmer latitudes, mainly in Central and South America. They include many of our most familiar and cherished songbirds. The declines of some species in recent years are causing growing concern.

Oregon is close to completing gap analysis, and Utah is less than a year away, Scott said. Washington, Nevada, Arizona and California should wrap up their portion not long afterward. More encouraging yet, Scott and his colleagues have been able to win support from the Fish and Wildlife Service, the National Fish and Wildlife Foundation and Congress for the first stage of extending GAP across the country to fashion a comprehensive inventory of biological resources. Overseen by the FWS cooperative research center, this long-overdue ef-



U.S. Fish and Wildlife Service

a map of Idaho's reserves, the combination reveals gaps in the existing network of protection—hence the name—and provides a framework for efforts to fill them in. Another overlay showing proposed developments, sources of contamination and so forth would help identify potential conflicts and suggest designs that could keep them to a minimum. Here lies the enormous practical value of GAP. It all but leads managers by the hand toward solutions.

Blair Csuti told me that if you divide Idaho into 407 computer grid areas of equal size, you find that just seven of them will together contain 96 percent of all the terrestrial vertebrates. "You can play with any

cated in the right places, and are buffered from neighboring development activities. The network would include linkages between areas to prevent inbreeding and make populations less vulnerable to disease epidemics, climate change and periodic natural catastrophes such as flood, fire, hurricanes and drought.

In some situations, new refuges—or redesigns of old ones—may be called for. Elsewhere, land swaps, alliances with private or corporate landowners, or other innovations might work better. Most of the biodiversity in this country exists on lands outside officially protected areas and unlikely to be made into reserves. A prime function of GAP, therefore, is to suggest where to emphasize and improve wildlife protection on lands used for other purposes as well.

The end result would not resemble the antiquated model we have followed for so long, with little, isolated nature reserves scattered across the country as if they were museums or

The result would be a realm of wildness thriving next to lands dominated by humans, with integrated boundaries between the two.

fort will be spearheaded by the cooperative research unit in each state. Defenders of Wildlife has played a key role in seeking to make GAP a national program and in shaking loose federal funding for it.

Unfortunately, FWS has not yet made a firm commitment to use the information for developing large-scale conservation strategies. Another discouraging note is that there is not enough money to go around. In many states, GAP hasn't started yet. Given the level at which the federal government so far has funded the national gap analysis project, in some states it won't be finished before the year 2006. Needless further losses of species and erosion of landscape linkages between reserves will have taken place before then. By the time the last states are wrapping things up, a lot of information from the first states will be out of date and in need of revision. That will make regionwide planning more difficult to coordinate instead of making it easier, which GAP was expressly designed to do.

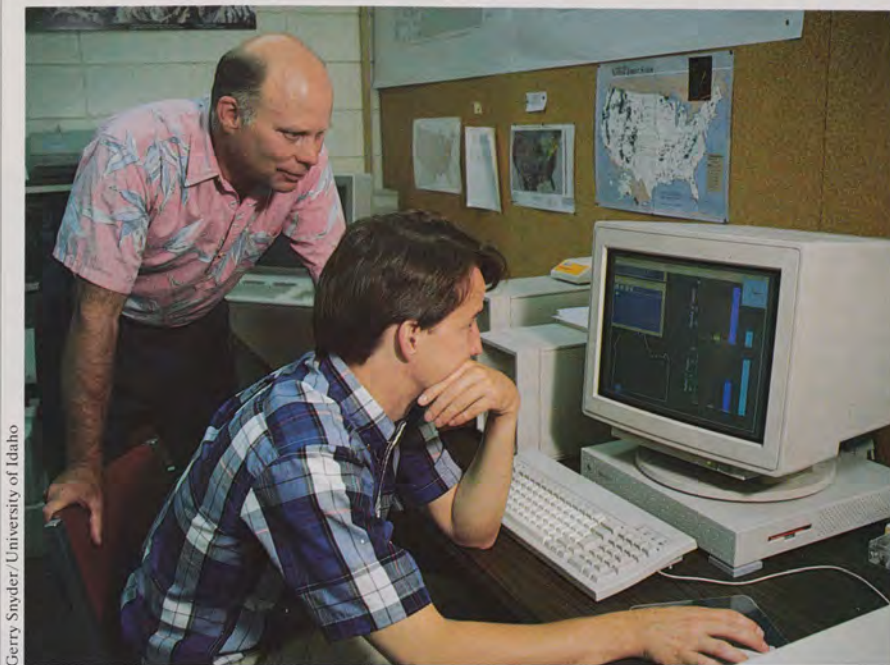
I could tell from listening to the succession of phone calls in Scott's office that part of the delay has to do with plain old government inertia, along with predictable birthing pains. But there is outright resistance as well. Oil and gas lobbyists, miners, grazers and timber representatives are apprehensive, though some have expressed support for GAP as a means of finding common ground in longstanding disputes. Anti-environmentalists have jeered any mention of biodiversity from the start. They say they stand for multiple use of wildlands. But true multiple use—by multiple species—is not what they have in mind.

Scott said, "I tell people, 'Look, I'm offering you a data set you can use to make judgments on vital issues. Granted, some of it could be good news for you, or it could be bad news. But it's *real* news. It's knowledge—of the kind everyone ought to have available.' A number of resource managers say they have no problem with gap analysis in principle but find its scale too broad for their needs. Scott readily admits that the complaint is justified, but only to a degree.

"We map at a resolution of one to 100,000," he said, "which means that our smallest units of vegetation cover

at least a couple of hundred acres. What the Forest Service district ranger wants is something that will help deal with the 40-acre timber-cutting units everyone's arguing over in the backyard. The local BLM (federal Bureau of Land Management) range specialist is worrying about a particular grazing allotment. We could handle it; with

nology are largely what made gap analysis possible. Further breakthroughs are bound to make it still faster and cheaper and at the same time infinitely more detailed and practical. The capabilities of computers and remote-sensing devices—satellites whose incredible powers of resolution are now available only to the



Gerry Snyder/University of Idaho

extensive groundwork, we could go into incredible detail. And we will before long. But it's going to up the cost considerably. Right now, we're suggesting that managers put the coarse filter to work in their decisions. We're encouraging them to get beyond the old piecemeal approach—to look past the one timber sale or pasture and over the next hill—and start thinking about how what they're doing relates to the rest of the ecosystem."

Butterfield observed, "When I talk about GAP to the public, to resource agencies, whoever, almost everyone agrees with me that it's a good thing." He paused a moment and continued: "Then they go back to their job." Business as usual. "Still," he added, "we have a pile of requests for our data base coming in from various government and conservation groups. Once we release our digital information, people are going to find more uses for it than anyone imagined."

Here is an invention that ought to sell itself. Quantum advances in tech-

Gap analysis program director Mike Scott, left, and Bart Butterfield examine a GAP habitat map of Idaho.

military—should soon be such that we will have little excuse left for being without a thorough picture of America's living heritage.

Sara Vickerman, Defenders' regional program director stationed in Portland, Oregon, has been a leading proponent of GAP among state and federal managers and is fighting for financial support to carry it off. "The 1992 federal appropriation for gap analysis is around \$2 million," she told me. "By increasing that to \$4 million annually, we could be done by 1998 instead of dragging things out until 2006." Hoping to deflect some of the scorn heaped upon it in Rio, the Bush administration proposed to increase its aid to foreign forestry programs next year to \$270 million. This was proffered as proof of U.S. concern about protecting biodiversity. In view of the ragged state of our own

forests—not to mention our wetlands and native prairies—\$4 million for biodiversity here at home would hardly be overdoing things, I thought. Nationwide it adds up to less than 50 cents per square mile. The Office of Management and Budget recommended that the Department of the Interior ask for full funding of \$4 million for GAP in 1993. But Secretary of the Interior Manuel Lujan, Jr., requested only \$1.3 million.

Vickerman invited me to a meeting she had put together in Portland where representatives of FWS, state fish and wildlife departments, cooperative wildlife research units in several Western states and California's new Executive Council on Biodiversity were to discuss GAP and ways to speed its progress. At the meeting it quickly became apparent that uniform procedures are not being used in all the states already committed to gap analysis. Even the scales differ. That's not so bad up to a point, but if we are ever to get on with landscape-scale planning, maps for adjoining states are going to have to match up. Such problems underscore the need for managers to get a lot better at reaching across arbitrary boundaries the way ecosystems do.

The longer I listened to administrators politely haggle over turf, over who should take the lead in standardizing regional data and over how to pay the bills, the more I realized what a wide-eyed idealist I had been. Like

it or not, this is where gap analysis, with all its promise, is chugging along at the moment. The jockeying, the tentative agreements, the dissection of GAP's strengths and shortcomings are part of building the necessary bridge between a potent theory and its everyday application.

Charles Ault of the FWS Southwest regional office in Albuquerque has already crossed that bridge in his mind. "For the first time, you could say, okay, I'm going to lay out a

Douglas fir timber sale," he hypothesized. "With gap analysis, suddenly I can see that this represents X percent of the Doug fir in my district, Y percent of Doug fir in the ecoregion and Z percent of Doug fir everywhere. Then I can begin visualizing how that relates to the spotted owl or marten or some other species of concern."

"We're petitioned every month to list species," lamented another FWS representative. "Our people are completely tied up doing new inventories and studies and writing controversial decisions. It's a shame we have to respond like this. We ought to have a data base to go to right away for answers. The way things are now, you could give me a billion dollars and a hundred new staff and I still couldn't keep up. If we don't get organized pretty soon, we're going to go under. We might as well all go home. We've got to have this national data base. Let's get on with it."

Some tests of GAP's utility have already been made. In a minor but telling case, the military shifted the locale of a proposed bombing site on BLM rangeland in Idaho after Mike Scott

sent them a species-richness map of the affected area. "No big expense. No big deal," Scott shrugged. "It was cheap, easy and agreeable. We should have this kind of data available for any party to use so they don't have to go ferreting it out themselves from a host of different agencies."

Early on, the California GAP inventory homed in on a community of plants and animals in the southern part of the state known as coastal sage scrub, a species-rich area under very intense pressure. Once widespread and viewed as undesirable,



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Photographs by B. "Moose" Peterson, WRP

much like juniper in Idaho today, coastal sage scrub was quickly reduced to less than 15 percent of its former extent. Now both its future and the future of hundreds of millions of dollars' worth of development are up in the air. The community harbors 58 species or subspecies of plants and animals that are either on the threatened and endangered list or are candidates for it. These include the coastal cactus wren, California coastal gnatcatcher (known among local developers as the southern spotted owl), orange-throated whiptail liz-

ard, San Diego thornmint and several types of a succulent plant known as *Dudleya*.

Clearly, the time for proper biodiversity planning here has already passed by. Even so, by conducting gap analysis on a much finer scale than usual, researchers have been able to map out what is left of coastal sage scrub with great precision. They have found the community more highly fragmented than anyone realized. The challenge was determining how closely tied the affected species are to remaining habitat islands of coastal

sage scrub, as opposed to intervening vegetation types. Computer modelers are also looking for places where restoration specialists can plant coastal sage to bridge critical gaps. In the end, planners should have enough information to determine the best design for protected zones and linkages between them—and for the location of future building sites.

In some places California already has proved capable of transcending the old ecology-versus-economy feud to find solutions to extremely complicated resource issues. On the Carrizo Plain west of Bakersfield, for example, development was at odds with a biologically rich community that had come to include all kinds of imperiled life forms. Among residents

The blunt-nosed leopard lizard and San Joaquin kit foxes are among the endangered residents of California's Carrizo Plain, below. A gap analysis program helped create an 80,000-acre reserve there. The California coastal gnatcatcher, opposite, is one of 58 imperiled species in the dwindling California scrub, bottom. Less than 15 percent of scrub habitat remains.



Photographs by Tupper Ansel Blake

in critical condition were the San Joaquin kit fox, San Joaquin antelope squirrel, giant kangaroo rat—another species considered common not long ago—and blunt-nosed leopard lizard. The Nature Conservancy pulled in Chevron and other oil producers, private landowners, BLM, the California Department of Fish and Game and other interests to confront the situation together. The upshot is an 80,000-acre natural area, with multiple ownership.

"In a way, it's amazing," remarked Frank Davis, a specialist in computer analysis of ecosystems who is in the geography department of the University of California at Santa Barbara. "Through these kinds of joint ventures, you can still in this day and age establish a major reserve. This one was right in an area heavily used by agriculture and oil interests."

One of the encouraging facts about California's GAP effort is that half of the initial funds supporting it were donated by Kenneth H. Hofmann, chairman of the board of the Hofmann Company, a homebuilding and development firm. "Initially it may seem strange that a developer would support gap analysis," he wrote a member of Congress last March. "However, homebuilders need to know where to build with the least environmental damage. And conservationists need to know where and how our money can best be spent. It is a matter of good planning. We can no longer afford

to have protection on a species-by-species basis. Both people and wildlife need more certainty, with less wasted time and less wasted money. I believe that 'gap analysis' and 'biodiversity' will be to the 1990s what 'endangered species' has been to the 1970s and 1980s."

"If we can just get everyone sitting around the same table talking, we can get rid of the 90 percent of the problems that are a matter of perceptions and prejudice and focus on the



Landsat imagery by NASA/GSFC

ten percent that are real," said Kent Smith, a Californian who chairs the National GAP Working Group. "This is what California's Coordinated Resource Management Planning process does, and it is proving one of the most effective tools we have for biodiversity conservation."

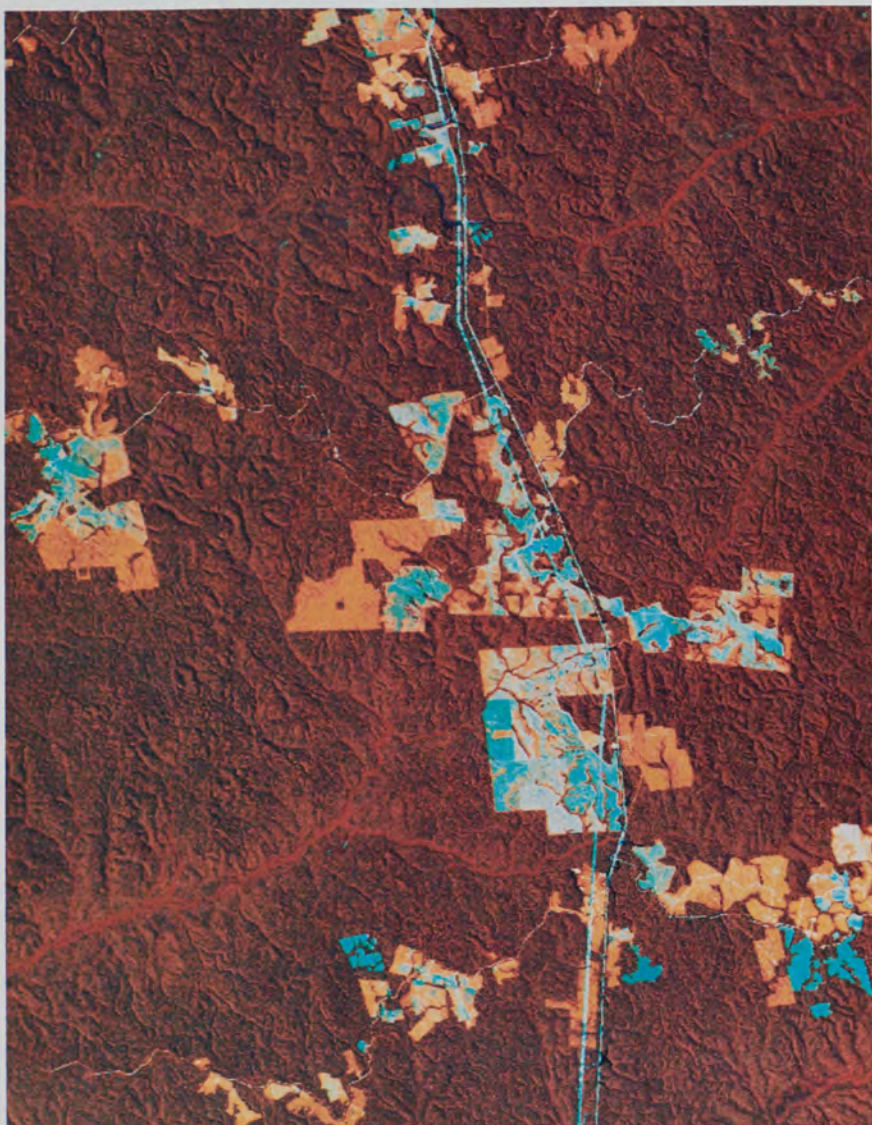
Along the East Branch of the North Fork of California's Feather River, a unique consortium of public and private interests, including developers, began in 1985 to make inventories of beleaguered wetlands and surrounding areas. As they gained information, they attracted more money from individuals and corporations, and the effort has resulted in creation of a 763,000-acre coordinated resource management area. Streams are being

restored, the fish populations have doubled, waterfowl have increased sevenfold, and the area's economy is showing new life as well.

Once you have the data spread out before everybody in true democratic fashion, claims as to who's right and who's wrong become more a matter of analysis than of rhetoric. The computer is a neutral party. A state-of-the-art graphic display not only lets our visually oriented species grasp complex problems, it can draw forth megabytes of the spirit of cooperation.

Although the Portland meeting was a real nuts-and-bolts affair, I couldn't escape the sense of something much larger hovering near. The growing effort to conserve biodiversity may be technically driven in one respect, but

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When the data are presented in true democratic fashion, claims as to who's right or wrong are more a matter of analysis than of rhetoric.



Infrared photos taken from a NASA satellite show worse deforestation in Mt. Hood National Forest, Oregon, opposite, than in Brazil's Amazon rainforest. Logged areas appear blue, regrowth areas appear light red, and living Oregon old growth and Amazon rainforest are shown in darker red.

in another respect it is driven by a fundamental shift in philosophy and resource ethics. Where earlier resource management was individualistic and divisive, biodiversity is unifying—holistic. Where the perspective used to revolve around human needs, biodiversity recognizes that the needs of humanity and nature are inextricably tied together. Where the old outlook was regulatory, static and defensive, biodiversity is cooperative and open-ended—evolutionary. It is in tune with the nature of the living world.

At last June's Earth Summit in Rio, Bush administration delegates insisted that the U.S. system of parks and preserves, coupled with the Endangered Species Act and other environmental

legislation, is perfectly adequate when it comes to protecting this nation's biological resources; our solution could serve as a model for other countries, they said. Many Americans assume more or less the same thing, which is one reason resource managers, biologists and conservation professionals in the U.S. did not begin to embrace biodiversity until some time after many other members of the international community. But the plain fact is that the U.S. threatened and endangered list has lengthened from 109 species in 1973 to almost 620 today. Some 4,000 species are considered candidates, a backlog of 50 years at the rate the government is currently considering their cases. Thousands more species ought to be

considered candidates but have not yet been granted any official attention whatsoever. Meanwhile, the number of species slipping from reasonable health toward rare or threatened status continues to grow.

A California biodiversity study using native fish as an indicator found two thirds of the state's species on the decline, a comparatively worse rate than in the Amazon. And satellite images recently released by the Goddard Space Flight Center dramatically portray a degree of fragmentation and loss in the evergreen forests of America's Pacific Northwest—our temperate rainforests, generally recognized as the biggest and richest in the country—that is far beyond anything in Amazonia's tropical forests.

Inventories of our parks and preserves show that many hold habitats that the animals they are supposed to protect use only part of the year or only during a limited part of their life cycles. Quite a few sanctuaries set aside in areas of scenic beauty turn out to be fairly poor in species to begin with; a stream meandering through somebody's abandoned woodlot may support a greater variety of lives than a breathtaking high mountain park. Moreover, most existing reserves are too small and too far apart to maintain the sort of gene flow that prevents inbreeding. Without connections to other wildlands, the communities within them can only become less robust over time, less able to cope with changes in the environment—and ultimately less diverse, less full of life.

Biodiversity is something that we are part of and that is part of every human being. It helped make us what we are, and it underpins the vitality of our future. The means to conserve it are at hand. Now is the time to begin using them in earnest. □

Douglas H. Chadwick, a DEFENDERS field correspondent, wrote "The Biodiversity Challenge," May/June 90.

