WildEARTH

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The First Thousand Days of the Next Thousand Years

The Wildlands Project at Three

WILDLANDS

THE WILDLANDS PROJECT

OUR MISSION

The mission of The Wildlands Project is to help protect and restore the ecological richness and native biodiversity of North America through the establishment of a connected system of reserves.

As a new millennium begins, society approaches a watershed for wildlife and wilderness. The environment of North America is at risk and an audacious plan is needed for its survival and recovery. Healing the land means reconnecting its parts so that vital flows can be renewed. The land has given much to us; now it is time to give something back—to begin to allow nature to come out of hiding and to restore the links that will sustain both wilderness and the spirit of future human generations.

The idea is simple. To stem the disappearance of wildlife and wilderness we must allow the recovery of whole ecosystems and landscapes in every region of North America. Allowing these systems to recover requires a long-term master plan.

A feature of this design is that it rests on the spirit of social responsibility that has built so many great institutions in the past. Jobs will be created, not lost; land will be given freely, not taken.

OUR VISION

Our vision is simple: we live for the day when Grizzlies in Chihuahua have an unbroken connection to Grizzlies in Alaska; when Gray Wolf populations are continuous from Durango to Labrador; when vast unbroken forests and flowing plains again thrive and support pre-Columbian populations of plants and animals; when humans dwell with respect, harmony, and affection for the land; when we come to live no longer as strangers and aliens on this continent.

Our vision is continental: from Panama and the Caribbean to Alaska and Greenland, from the high peaks to the continental shelves, we seek to bring together conservationists, ecologists, indigenous peoples, and others to protect and restore evolutionary processes and biodiversity. We seek to assist other conservation organizations, and to develop cooperative relationships with activists and grassroots groups everywhere who are committed to these goals.

THE PROBLEM: Biological Impoverishment

We are called to our task because existing parks and wildlife refuges have not adequately protected life in North America. While these areas preserve landscapes of spectacular scenery and areas ideally suited to non-mechanized forms of recreation, they are too small, too isolated, and represent too few types of ecosystems to perpetuate the biodiversity of the continent. Despite the establishment of Parks and other reserves from Canada to Central America, true wilderness and wilderness-dependent species are in precipitous decline:

√ Large predators like the Grizzly Bear, Gray Wolf, Wolverine, Puma, Jaguar, Green Sea Turtle, and American Crocodile have been exterminated from most of their pre-Columbian range and are imperiled in much of their remaining habitat. Populations of many songbirds are crashing and waterfowl and shorebird populations are reaching new lows.

√ Native forests have been extensively cleared, leaving only scattered remnants of most forest types. Even extensive forest types, such as boreal, face imminent destruction in many areas.

√ Tallgrass and shortgrass prairies, once the habitat of the most spectacular large mammal concentrations on the continent, have been almost entirely destroyed or domesticated.

THE SOLUTION: Big Wilderness

The failure of reserves to prevent the losses just mentioned rests in large part with their historic purpose and design: to protect scenery and recreation or to create outdoor zoos. The Wildlands Project, in contrast, calls for reserves established to protect wild habitat, biodiversity, ecological integrity, ecological services, and evolutionary processes—that is, vast interconnected areas of true wilderness. We reject the notion that wilderness is merely remote, scenic terrain suitable for backpacking. Rather, we see wilderness as the home for unfettered life, free from industrial human intervention.

Mission Statement

Wilderness means:

- Extensive areas of native vegetation in various successional stages off-limits to human exploitation. We recognize that most of Earth has been colonized by humans only in the last several thousand years.
- Viable, self-reproducing, genetically diverse populations of all native plant and animal species, including large predators. Diversity at the genetic, species, ecosystem, and landscape levels is fundamental to the integrity of nature.
- Vast landscapes without roads, dams, motorized vehicles, powerlines, overflights, or other artifacts of civilization, where evolutionary and ecological processes that represent four billion years of Earth wisdom can continue. Such wilderness is absolutely essential to the comprehensive maintenance of biodiversity. It is not a solution to every ecological problem, but without it the planet will sink further into biological poverty.

THE MEANS: Core Reserves, Corridors, Buffers, and Restoration

We are committed to a proposal based on the requirements of all native species to flourish within the ebb and flow of ecological processes, rather than within the constraints of what industrial civilization is content to leave alone. Present reserves—parks, wilderness areas, refuges—exist as discrete islands of nature in a sea of human modified landscapes. Building upon those natural areas, we seek to develop a system of large, wild core reserves where biodiversity and ecological processes dominate.

Core reserves would be linked by biological corridors to allow for the natural dispersal of wide-ranging species, for genetic exchange between populations, and for migration of organisms in response to climate change.

Buffers would be established around core reserves and corridors to protect their integrity from disruptive human activities. Only human activity compatible with protection of the core reserves and corridors would be allowed. Buffers would also be managed to restore ecological health, extirpated species, and natural disturbance regimes. Intensive human activity associated with civilization—agriculture, industrial production, urban centers—could continue outside the buffers.

Implementation of such a system would take place over many decades. Existing natural areas should be protected immediately. Other areas, already degraded, will be identified and restoration undertaken.

The Wildlands Project sets a new agenda for the conservation movement. For the first time a proposal based on the needs of all life, rather than just human life, will be clearly enunciated. Both conservationists and those who would reduce nature to resources will have to confront the reality of what is required for a healthy, viable, and diverse North America. Citizens, activists, and policy makers will be able to confront the real choices because the choices will be on the agenda. It will no longer be possible to operate in a business-as-usual manner and ignore what is at stake.

The Wildlands Project will also inspire the development of indigenous proposals for other continents.

THE PROJECT

The Wildlands Project is a non-profit publicly supported organization based in Tucson, Arizona. We are a group of conservation biologists and citizen conservationists from across the continent devoted to forming a North American Wilderness Recovery Strategy.

We work in cooperation with independent grassroots organizations throughout the continent to develop proposals for each bioregion. These organizations include Alliance for the Wild Rockies, Northwest Ecosystem Alliance, Sky Island Alliance, Siskiyou Regional Education Project, Coast Range Association (Oregon), Northern Appalachian Restoration Project, RESTORE: The North Woods, Canadian Parks and Wilderness Society, Southern Appalachian Biodiversity Project, and many others. Development of regional wilderness proposals is based upon principles of conservation biology. Draft proposals are developed through discussions and conferences that bring together regional activists, conservation biologists and other scientists, and conservation groups across the spectrum of the movement. The Wildlands Project supports this process through funding, networking, and offering technical expertise.

We undertake and encourage research on appropriate human activities in buffers, reintroduction of extirpated species, design of connecting corridors (especially through areas with significant human obstacles), overcoming fragmentation and achieving habitat connectivity, population viability, and control of exotic species.

As proposals are drafted we publish the results in pamphlet form, in *Wild Earth*, and in other conservation publications to reach a wide audience. Videos, slide shows, and academic articles will be produced and traveling exhibits will be organized to educate the public about the proposals. When proposals for all bioregions of the continent have been completed, a book and compendium of maps will be produced, as well as updated videos and related materials.

In short, our job is to educate the public, the environmental movement, government agencies, the academic community, and others about the importance of biodiversity and what is necessary to protect it. ∎

The Wildlands Project welcomes the participation and support of all persons and organizations interested in these issues.

WILD EARTH

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Whimbrel (*Numenius phaeopus*) *illustration by D.D. Tyler*

Cover art: *Timber Wolf*, linoleum block print by Colorado artist Amy Grogan

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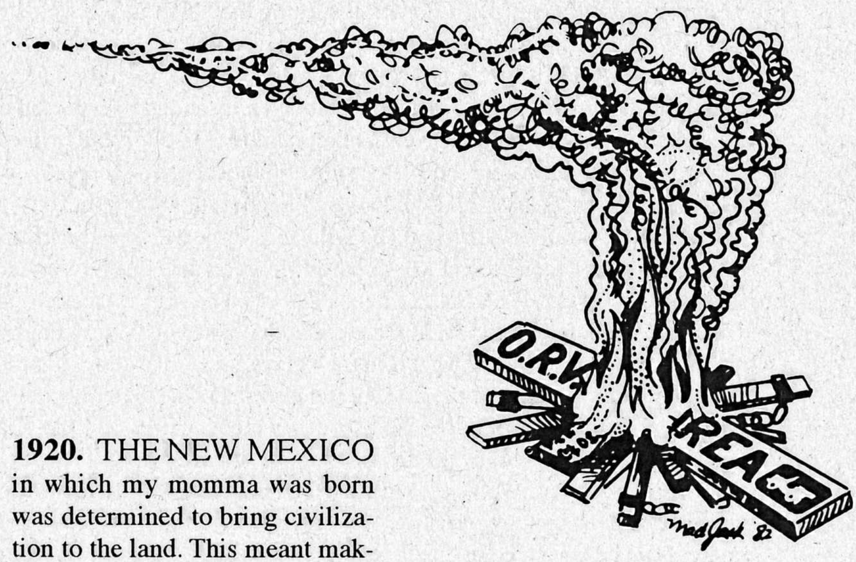
Around the Campfire



1920. THE NEW MEXICO in which my momma was born was determined to bring civilization to the land. This meant making the range safe for the white-faced cow and the sportsman's buck. The last packs of Lobos were hunted down on the high plains; then came the more difficult task of tracking down the scattered packs and loners in the western mountains and southern deserts.

1946. The New Mexico in which I was born was wolfless. Federal dollars, Newhouse traps, strychnine, and repeating rifles had done the job. But one of the ringleaders in the campaign to exterminate the wolf was having a change of heart. This man—Aldo Leopold—was polishing a wolf elegy for his book, *A Sand County Almanac*. Did we know what we had done when we killed the last of the Lobos, he wondered. Could we even imagine what we had lost when we extinguished the green fire that shone in the eyes of wild wolves?

1995. New Mexicans both newly arrived and those claiming generations of inhabitancy decide that a New Mexico without Lobos is not really New Mexico, that humans without wolves have lost something priceless, something we need to be really human. Like Aldo Leopold, they have come to understand what the howl of the wolf means, that a land emptied of it is an empty land, that a people who fear sharing the land with wolves are a pitiful people, a people afraid of wild things and sunsets.

Two months ago I sat in an auditorium in Socorro, New Mexico, for the US Fish & Wildlife Service's public hearing on reintroduction of the Mexican Wolf. When Jim Winder, a public lands rancher with roots stretching back into the last century, got up to testify that he could live with wolves, I realized that The Wildlands Project wasn't so improbable after all.

We of The Wildlands Project (TWP) hold as our mission the protection and restoration of the ecological richness and native biodiversity of North America. We propose to accomplish this by applying the science of conservation biology to design and establish a connected system of reserves throughout the continent. In this second special issue of *Wild Earth* about The Wildlands Project, we catalogue the progress made both in theory and practice toward that lofty goal.

continued...

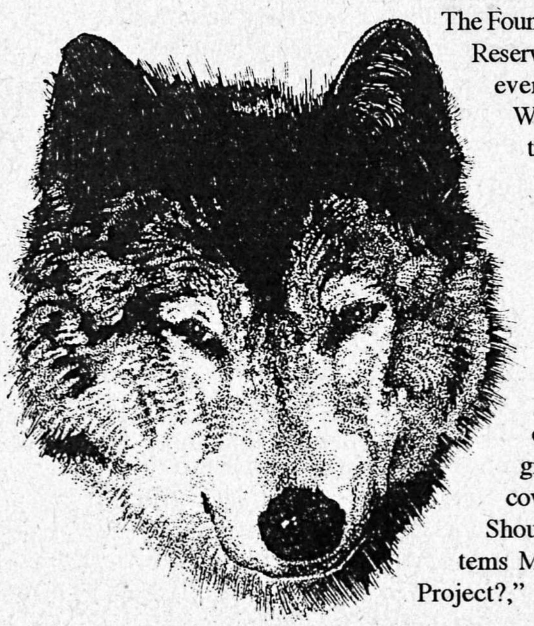
To better spread the word, we're sending this issue to Sierra Club and other conservation leaders and to members of the Society for Conservation Biology, in addition to regular subscribers of *Wild Earth*. It's fitting that this second Wildlands Project special issue marks the completion of *Wild Earth*'s fifth volume—our first half decade of publishing the most visionary writing on biodiversity and wilderness issues, of promoting New Conservation Movement groups and campaigns, and of serving as publishing wing of sister organization The Wildlands Project. (If this is your first view of *Wild Earth* and The Wildlands Project, reading The Wildlands Project Mission Statement on the inside front cover and *WE*'s Statement of Purpose on page 96 will help you understand what these collaborating entities aim to accomplish and what role each plays.)

In the three years since the first special issue of *Wild Earth*, The Wildlands Project has held dozens of meetings around North America to begin the mapping of science-based reserve designs. We've spread the word about marrying conservation biology and conservation advocacy. Our progress can be measured in three areas.

First, we have influenced a variety of conservation groups to use science-based arguments to defend Nature and to apply The Wildlands Project model to reserve design and land management. Second, with our key cooperating groups, we have begun the real work of designing reserve networks in various regions of North America. Third, both the science and the politics of The Wildlands Project have become more detailed and sophisticated.

This issue presents our progress in theory, advocacy, and reserve design.

In "Wilderness: From Scenery to Nature," I set out the evolution of nature reserve design and advocacy from scenic National Parks to the protection of all Nature. In "Wilderness Areas and National Parks: The Foundation for an Ecological Reserve Network," I argue that even with changing goals, Wilderness Areas and National Parks remain the basic building blocks for protecting Nature.



In "Science Grounding Strategy: Conservation Biology in Wildlands Work," Reed Noss invites scientists to employ their expertise in helping ground a wilderness recovery strategy. In "What Should Endangered Ecosystems Mean to The Wildlands Project?," Reed urges the nature preservation movement to turn its attention to protecting and restoring samples of all native ecosystems.

In "Getting from Here to There: An Outline of The Wildlands Reserve Design Process," David Johns and Michael Soulé show us how to translate vision into reality. Of course, without actual proposals for actual landscapes, all of the above is theory, hot air. But hot air can lead to lines on maps. Lines on maps can lead to public support which can lead to nature reserves which can lead to healthy populations of wolves and Caribou or Jaguars and tapirs. The center of the magazine updates you on reserve design progress in six key regions of North America: the Southern Rockies (by Roz McClellan), New England's Northern Forest (Jamie Sayen), northern Minnesota (Mike Biltonen), the North Cascades (Peter Morrison et al.), Costa Rica (George Powell et al.), and the Klamath-Siskiyou mountains of Oregon and California (Ken Vance-Borland et al.). Then Rod Mondt, field director of TWP, wraps it up with "Real Work and Wild Vision."

All is not sweetness and light, of course. (Newt Gingrich hasn't called to invite me to a power lunch with the GOP satraps to figure out how to implement The Wildlands Project. Hell, Bill Clinton hasn't even called.) There *are* real problems with designing nature reserves; there are even bigger problems trying to establish them. Steve Trombulak, Reed Noss, and Jim Strittholt hang these problems up to dry for all of us to see in "Obstacles to Implementing The Wildlands Project Vision." Among the problems we face are the dumped-spaghetti-plate of roads fragmenting wildlands. Kraig Klungness and Katie Alvord Scarborough look at that mess in "ROAD-RIP and The Wildlands Project." Law professor Eric Freyfogle takes a look at another big problem—how to protect biodiversity and wilderness on private land—in "Land Ownership, Private and Wild." In "Endangered Interrelationships..." biologist Don Windsor reminds us that biodiversity means much more than just big animals; equally important are the many parasites that inhabit all animals' bodies and the networks of relationships all these organisms form.

Perhaps the greatest obstacle to implementation of The Wildlands Project's vision is in the hearts of men and women. Back to 1920. Lots of folks still live there. Terry Tempest Williams takes on that monumental problem, and sets the tone for this whole issue, in her opening "Testimony."

To find out how you can help realize our dream of a wild North America, contact The Wildlands Project (POB 5365 Tucson, AZ 85703; 520-884-0875; FAX 520-884-0962). Stay in touch by subscribing to *Wild Earth*. If you want additional copies of this issue, contact Tucson. Happy Trails.

—Dave Foreman

illustration by Sarah Lauterbach

Testimony

by Terry Tempest Williams

To bear testimony is to bear witness, to speak from the truth of our lives.
Barry Lopez reminds us, "the correspondence between the interior and exterior landscape is story."
The act of bearing testimony is the act of storytelling, a gesture on behalf of community.
Our wildlands are under siege; even the idea of wildness is being compromised in the name of intellectual abstractions.
We must continue to speak out of the humility of our bodies and the bedrock knowledge we hold in our bones.
Wild hearts. Open minds. Alert eyes. Our testimonies allow us to put our love into action.

The following is the testimony I presented before the Senate Subcommittee on Forest & Public Lands Management regarding the Utah Public Lands Management Act of 1995, in Washington, DC, 13 July 1995.

Mr. Chairman, members of this subcommittee, my name is Terry Tempest Williams. I am a native of Utah. My family roots run deep holding me in place—five, six generations of Mormon stock run through my veins. Our family has made its living on the land for the last six decades laying pipe in the Utah substrate. We are a family of pipeline contractors and although I have never dug the ditches, I love and care for the men who do: my brothers, cousins, uncle, father, John Henry Tempest, my grandfather, John Henry Tempest Jr., who is in his ninetieth year, even my great grandfather, John Henry Tempest Sr. We understand the power of continuity and our debt to these lands that have given us livelihood. As a Utah family, we would like to enter into the Congressional Record personal letters, four generations worth, of why we care about wilderness, why we do not favor Senate Bill 884, and why we want more wilderness designation in Utah, not less. Some of the letters are forthcoming, some I have brought with me. With a large, extended family I trust you can appreciate the organizational logistics. These letters represent men and women, Republicans and Democrats alike, registered voters and voices too young to vote but not too young to register their opinions. They are individual and original, some sealed, some open. It is a gesture of sincere concern for what we hold dear.

I appreciate this time to be able to share with you some of my own thoughts about the Utah Public Lands Management Act of 1995.

- It is not a wilderness bill that the majority of Utahns recognize, want or desire.
- It is not a wilderness bill that honors or respects our history as a people.
- It is not a wilderness bill that honors or respects the natural laws required for a healthy environment.
- And it is not a wilderness bill that takes an empathetic stance toward our future.
- It is a wilderness bill that lacks vision and undermines the bipartisan principles inherent in the Wilderness Act of 1964.

Dead Junipers, *woodcut by Patrick Dengate*

Quite simply, in the name of political expediency and with eyes capable of seeing only through the lens of economics, our public lands in Utah are being sacrificed. Our Congressional delegation has told you that this issue must be resolved, now, that this debate over the wildlands in Utah has torn our state in half. But I prefer to take the artist Frederick Sommer's approach when he says, "Quarreling is the cork of a good wish."

What is it we wish for?

In Utah, there was a man with a vision. He dreamed of a civilization bright with lights and strong of belief. He knew the industrious nature of work and picked the beehive as his symbol. He loved the land he saw before him, a landscape so vast, pristine, and virginal, that he recognized it as the kingdom of God, a place for Saints with a desire for home. The desert country of the Great Basin and Colorado Plateau was an answer to prayers of spiritual sovereignty.

He sent families north into the mountains and south into the valleys where red rock walls rose upward like praying hands. He said, "We will create Zion among the wilderness." And with great stamina and imagination akin only to communities committed to faith, the building of culture among the pioneers began. Humble ranches, small businesses, and cottage industries of silk and wool sprung up and a United Order was dreamed.

Brigham Young, the colonizing prophet of the Mormons, brought with him not only a religion and a life but a land ethic.

"Here are the stupendous works of the God of Nature, though all do not appreciate His wisdom as manifested in his works...I could sit here for a month and reflect on the mercies of God."

Time. Reflection. Mercy. I do not find in the Utah Public Lands Act of 1995 these qualities revered by our forefathers. There is little gratitude extended on behalf of these sacred lands.

Only a few generations ago, Utah was settled on spiritual grounds. It is ironic that now Utah must be protected on spiritual grounds for the generations to come.

What do we wish for?

To be whole. To be complete. Wildness reminds us what it means to be human, what we are connected to rather than what we are separate from. "Our troubles," Pulitzer-prize winning scientist Edward O. Wilson writes, "arise from the fact that we do not know what we are and cannot agree on what we want to be...Humanity is part of nature, a species that evolved among other species. The more closely we identify ourselves with the rest of life, the more quickly we will be able to discover the sources of human sensibility and acquire knowledge on which an enduring ethic, a sense of preferred direction, can be built."

Wilderness is both the bedrock of lands of southern Utah and a metaphor of "unlimited possibility." The question must be asked, "How can we cut ourselves off from the very source of our creation?"

This is not about economics. This is not about the preservation of ranching culture in America. And it is especially not about settling a political feud once and for all. This is about putting ourselves in accordance with nature, of consecrating these lands by remembering our relationships to them. A strong wilderness bill as recommended by Congressman Maurice Hinchey, HR 1500, is an act of such consecration. At a recent family gathering, my uncle Richard Tempest, a former Republican state senator, said simply, "Wilderness is a feeling."

Mr. Chairman, if you knew wilderness in the way that you know love, you would be unwilling to let it go. We are talking about the body of the beloved, not real estate. We must ask ourselves as Americans, "Can we really survive the worship of our own destructiveness?" We do

Prickly Pear, *woodcut by Patrick Dengate* not exist in isolation. Our sense of community and compassionate intelligence must be extended to all life forms, plants, animals, rocks, rivers, and human beings. This is the story of our past and it will be the story of our future.

Senate Bill 884 falls desperately short of these ideals.

Who can say how much of nature can be destroyed without consequence? Who can say how much land can be used for extractive purposes until it is rendered barren forever? And who can say what the human spirit will be crying out for one hundred years from now? Two hundred years from now? A few weeks ago, Yosemite National Park had to close their gates and not allow any more visitors entry. The park was overcrowded. Last week, Yellowstone reported traffic gridlocks in the Lamar Valley, carloads of families with the wish of seeing a wolf. Did our country's lawmakers who held the vision of national parks in the nineteenth century dream of this kind of hunger? In the same vein, can you as our lawmakers today toward the end of the twentieth century imagine what the sanctity of wilderness in Utah might hold for us as a people at the turn of the twenty-first century?

We must act with this kind of vision and concern not just for ourselves, but for our children and our children's children. This is our natural heritage. And we are desperate for visionary leadership.

It's strange how deserts turn us into believers. I believe in walking in a landscape of mirages, because you learn humility. I believe in living in a land of little water, because life is drawn together. And I believe in the gathering of bones as a testament to spirits that have moved on.

If the desert is holy, it is because it is a forgotten place that allows us to remember the sacred. Perhaps that is why every pilgrimage to the desert is a pilgrimage to the self. There is no place to hide and so we are found.

Wilderness courts our souls. When I sat in church throughout my growing years, I listened to teachings about Christ walking in the wilderness for forty days and forty nights, reclaiming his strength, where he was able to say to Satan, "Get thee hence." And when I imagined Joseph Smith kneeling in a grove of trees as he received his vision to create a new religion, I believed their sojourns into nature were sacred. Are ours any less?

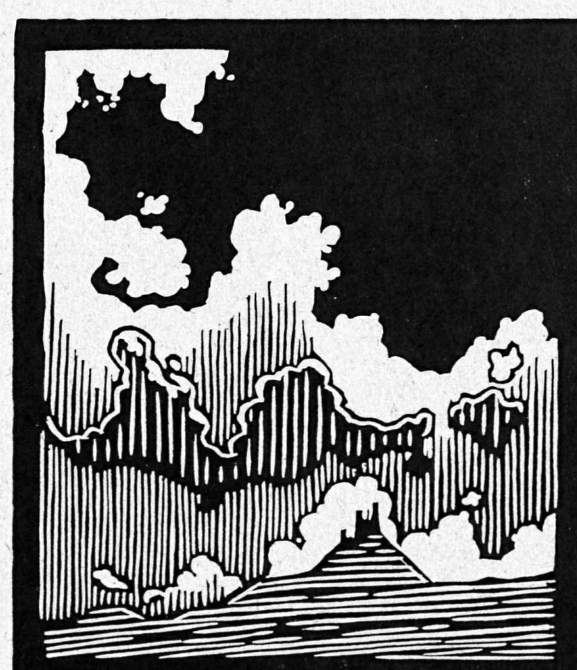
There is a Mormon scripture, from the Doctrine and Covenants section 88:44-47, that I carry with me:

The earth rolls upon her wings, and the sun giveth his light by day, and the moon giveth her light by night, and the stars also give their light, as they roll upon their wings in their glory, in the midst and power of God.
Unto what shall I liken these kingdoms that ye may understand?
Behold all these are kingdoms and any man who hath seen any or the least of these hath seen God moving in his majesty and power.

Without a philosophy of wildness and the recognition of its inherent spiritual value, we will as E.O. Wilson reminds us, "descend farther from heaven's air if we forget how much the natural world means to us."

For those of us who so love these lands in Utah, who recognize America's Redrock Wilderness as a sanctuary for the preservation of our souls, Senate Bill 884, the Utah Public Lands Management Act of 1995, is the beginning of this forgetting, a forgetting we may never reclaim. ∎

Terry Tempest Williams is Naturalist-in-Residence at the Utah Museum of Natural History in Salt Lake City, and the author of Pieces of White Shell, Refuge, An Unspoken Hunger *and other works of natural history. Her latest book is* Desert Quartet. *She serves on the boards of The Wildlands Project and Southern Utah Wilderness Alliance (141 South 1100 East, Salt Lake City, UT 84105).*



Butte, *woodcut by Patrick Dengate*

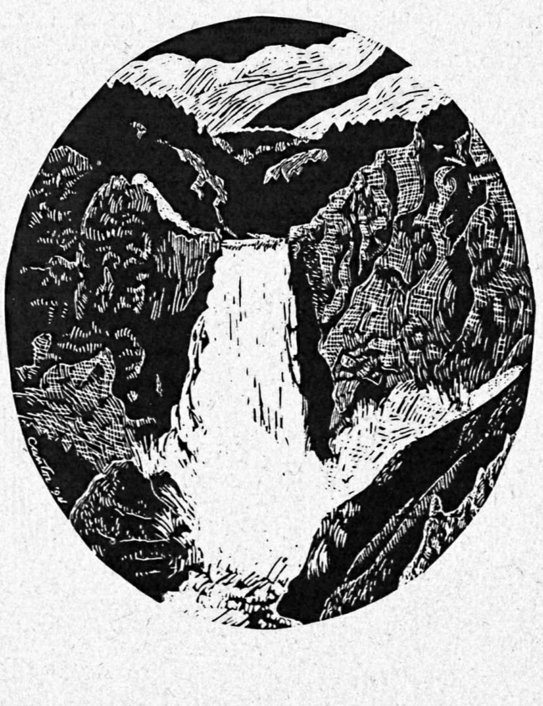
Wilder

From Scenery

TWO SCENES, ONLY MONTHS APART:

October 31, 1994. President Bill Clinton lifts his pen from the California Desert Protection Act and the acreage of the National Wilderness Preservation System soars to over 100 million acres, nearly half of which is outside Alaska, and the acreage of the National Park System jumps to almost 90 million acres, over one-third outside Alaska. American Wilderness Areas and National Parks—the world's finest nature reserve system—are a legacy of citizen conservationists from Barrow to Key West, of courageous federal agency employees, and of farsighted elected officials. One hundred million acres is more than I thought we would ever protect when I enlisted in the wilderness wars (and I'm far from a hoary old war-horse like Dave Brower or Ed Wayburn—I've only been fighting for a quarter of a century).

February 14, 1995. *The New York Times* reports on a National Biological Service study done by three distinguished biologists. Reed Noss, editor of the widely-cited scientific journal *Conservation Biology* and one the report's authors, says, "We're not just losing single species here and there, we're losing entire assemblages of species and their habitats."The comprehensive review shows that ecosystems covering half the area of the 48 states are endangered or threatened. The Longleaf Pine Ecosystem, for example, once the dominant vegetation of the coastal plain from Virginia to Texas and covering more than 60 million acres, remains only in dabs and scraps covering less than 2 percent of its original sprawl. Ninety-nine percent of the native grassland of California has been lost. There has been a 90 percent loss of riparian ecosystems in Arizona and New Mexico. Of the various natural ecosystem types in the United States, 58 have declined by 85 percent or more and 38 by 70 to 84 percent. [See Reed's article "What Do Endangered Ecosystems Mean to The Wildlands Project?" in this issue.]



The dissonance between these two events is as jarring as chain saws in the forest, dirt bikes in the desert, the exploding of harpoons in the polar sea.

How have we lost so much while we have protected so much?

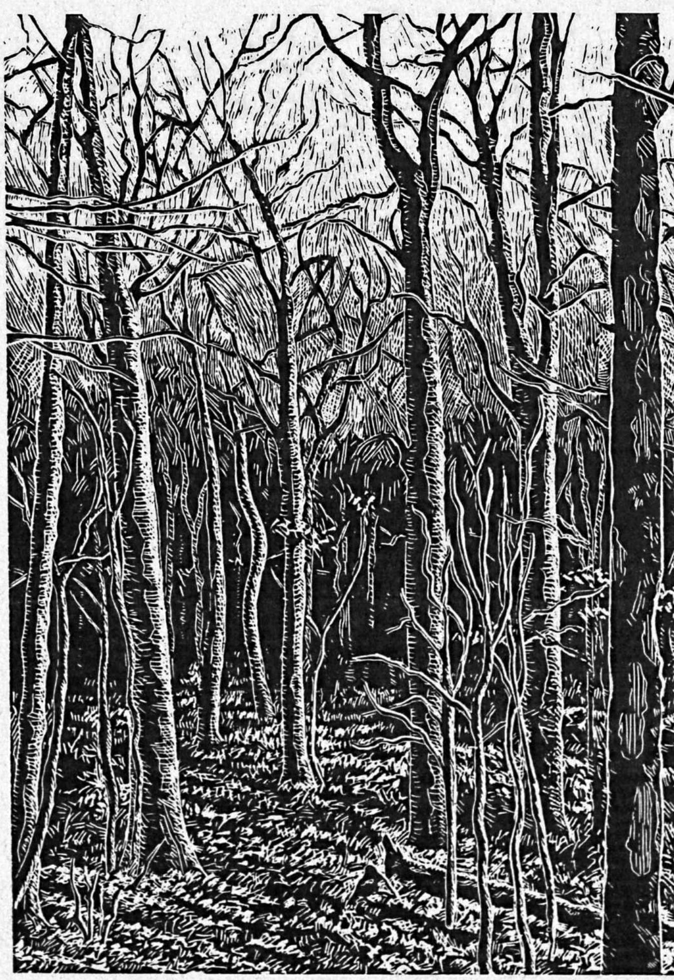
The answer lies in the goals, arguments, and process used to establish Wilderness Areas and National Parks over the last century.

A shorter version of this article originally appeared in *Sierra*.

ness
to Nature

by Dave Foreman

In his epochal study, *National Parks: The American Experience* (University of Nebraska Press, 1979), Alfred Runte discusses the arguments crafted to support establishment of the early National Parks. Foremost was what Runte terms *monumentalism*—the preservation of inspirational scenic grandeur like the Grand Canyon or Yosemite Valley and the protection of the curiosities of nature like Yellowstone's hot pots and geysers. Later proposals for National Parks had to measure up to the scenic quality of Mt. Rainier or Crater Lake. Even the heavily glaciated Olympic Mountains were denied National Park designation for many years because they weren't deemed up to snuff. Then, after the icy mountains were grudgingly accepted as National Park material, the National Park Service and even some conservation groups bristled over including the lush temperate rainforests of the Hoh and Quinalt valleys in the new Park, seeing them as mere trees unworthy of National Park designation. National Park status was only for the "crown jewels" of American nature, an award akin to the Congressional Medal of Honor. If a substandard area became a National Park, it would tarnish the *idea* of National Parks as well as diminish all other National Parks. (In our slightly more enlightened age, the stupendous conifers are the most celebrated feature of Olympic National Park.)



A second argument for new National Parks, Runte explains, was based on *"worthless lands."* Areas proposed for protection, conservationists argued, were unsuitable for agriculture, mining, grazing, logging, and other make-a-buck uses. Yellowstone could be set aside because no one in his right mind would try to grow corn there; no one wanted to mine the glaciers of Mt. Rainier or log the sheer cliffs of the Grand Canyon. The worthless-lands argument often led Park advocates to agree to boundaries gerrymandered around economically valuable forests eyed by timber interests, or simply to avoid proposing timbered lands altogether. Where Parks were designated over industry objections (such as Kings Canyon National Park which was coveted as a reservoir site by Central Valley irrigators), protection prevailed only because of the dogged efforts of the Sierra Club and allied groups. Such campaigns took decades.

illustrations by Evan Cantor

RIGHT NOW, TODAY, LIFE FACES THE SIXTH GREAT EXTINCTION EVENT IN EARTH HISTORY.

When the great conservationist Aldo Leopold and fellow rangers called for protecting Wilderness Areas on the National Forests in the 1920s and '30s, they adapted the monumentalism and worthless-lands arguments with success. The Forest Service's enthusiasm for Leopold's wilderness idea was, in fact, partly an attempt to head off the Park Service's raid on the more scenic chunks of the National Forests. "Why transfer this land to the Park Service?" the Forest Service asked. "We have our own system to recognize and protect the crown jewels of American scenery!" Wilderness advocates also reiterated the *utilitarian* arguments used decades earlier for land protection. The Adirondack Preserve in New York, for example, had been set aside to protect the watershed for booming New York City. The first Forest Reserves in the West had been established to protect watersheds above towns and agricultural regions. Such utilitarian arguments became standard for Wilderness Area advocacy in the twentieth century.

The most common argument for designating Wilderness Areas, though, touted their *recreational* values. Leopold, who railed against "Ford dust" in the backcountry, feared that growing automobile access to the National Forests would supplant the pioneer skills of early foresters. "Wilderness areas are first of all a series of sanctuaries for the primitive arts of wilderness travel, especially canoeing and packing," said Leopold. He defined Wilderness Areas as scenic roadless areas suitable for pack trips of two weeks' duration without crossing a road. Bob Marshall in the 1930s elaborated on the recreation arguments. Wilderness Areas were reservoirs of freedom and inspiration for those willing to hike the trails and climb the peaks. John Muir, of course, had used similar recreation arguments for the first National Parks.

In the final analysis, most areas in the National Wilderness Preservation System and the National Park System were (and are) decreed because they had friends. Conservationists know that the way to protect an area is to develop a constituency for it. We create those advocates by getting them into the area. Members of a Sierra Club group or individual hikers discover a wild place on public land. They hike the trails, run the rivers, climb the peaks, camp near its lakes. They photograph the area and show slides to others to persuade them to write letters in its support. We backcountry recreationists fall in love with wild places that appeal to our sense of natural beauty. Conservationists also know the many political compromises made in establishing boundaries by chopping off areas coveted by industry for lumber, forage, minerals, oil & gas, irrigation water, and other natural resources—"worthless" lands coming back to haunt us.

The character of the National Wilderness Preservation and National Park Systems is formed by these monumental, worthless, utilitarian, and recreational arguments. Wilderness Areas and National Parks are generally scenic, have rough terrain that prevented easy resource exploitation or lack valuable natural resources (timber and minerals especially), and are popular for non-motorized recreation.

So, in 1995, despite the protection of nearly 50 million acres of Wilderness Areas and about 30 million acres of National Parks in the United States outside of Alaska, we see true wilderness—biological diversity with integrity—in precipitous decline. In 1992, The Wildlands Project cited some of these losses in its mission statement:

- Wide-ranging, large carnivores like Grizzly Bear, Gray Wolf, Mountain Lion, Lynx, Wolverine, and Jaguar have been exterminated from many parts of their pre-European settlement ranges and are in decline elsewhere.
- Populations of many songbirds are crashing.
- Waterfowl and shorebird populations are approaching record lows.
- Native forests have been extensively cleared and degraded, leaving only remnants of most forest types—such as the grand California redwoods and the low-elevation coniferous forests of the Pacific Northwest. Forest types with significant natural acreages, such as those of the Northern Rockies, face imminent destruction.
- Tallgrass and Shortgrass Prairies, once the habitat of the most spectacular large mammal concentrations on the continent, have been almost entirely converted to agriculture or other human uses.

It is important to note, however, that *ecological integrity* has always been at least a minor goal and secondary justification in Wilderness Area and National Park advocacy. At the Sierra Club Biennial Wilderness Conferences from 1949 to 1973, scientists and others presented ecological arguments for wilderness preservation and discussed the scientific values of Wilderness Areas and National Parks. In the 1920s and 30s, the Ecological Society of America and the American Society of Mammalogists developed proposals for ecological reserves on the public lands. The eminent ecologist Victor Shelford was an early proponent of protected wildlands big enough to sustain populations of large carnivores.

Some of this country's greatest conservationists have been scientists, too. One of the many hats John Muir wore was that of a scientist. Aldo Leopold was a pioneer in the sciences of wildlife management and ecology, and argued for Wilderness Areas as ecological baselines. Bob Marshall had a Ph.D. in plant physiology. Olaus Murie, long-time president of The Wilderness Society, was an early wildlife ecologist and one of the first to defend the wolf.

Moreover, not all National Parks were protected primarily for their scenery. Mt. McKinley National Park was set aside in 1917 not for its stunning mountain but as a wildlife reserve. Everglades National Park, finally established in 1947, was specifically protected as a wilderness ecosystem. Even the Forest Service used ecosystem representation to recommend areas for Wilderness in the Second Roadless Area Review and Evaluation (RARE II) in 1977-79.

Somehow, though, professional biologists and advocates for wilderness preservation drifted apart—never far apart, but far enough so that the United States Forest Service lumped its wilderness program under the division of recreation.

That drifting apart was brought to an abrupt halt when the most important—and most depressing—scientific discovery of the twentieth century was revealed some fifteen years ago. During the 1970s, field biologists had grown increasingly alarmed at population losses in a myriad of species and by the loss of ecosystems of all kinds around the world. Tropical rainforests were falling to saw and torch. Coral reefs were dying from god knows what. Ocean fish stocks were crashing. Elephants, rhinos, Gorillas, Tigers, and other charismatic megafauna were being slaughtered. Frogs everywhere were vanishing. These staggering losses were in oceans and on the highest peaks; they were in deserts and in rivers, in tropical rainforests and Arctic tundra alike.

A few scientists—like Michael Soulé, later founder of the Society for Conservation Biology, and Harvard's famed entomologist E.O. Wilson—put these disturbing anecdotes and bits of data together. They knew, through studies of the fossil record, that in the 500 million years or so of terrestrial evolution there had been five great extinction events—the hard punctuations in the equilibrium. The last occurred 65 million years ago at the end of the Cretaceous when dinosaurs became extinct. Wilson and company calculated that the current rate of extinction was one thousand to ten thousand times the background rate of extinction in the fossil record. That discovery hit with all the subtlety of an asteroid striking Earth:

RIGHT NOW, TODAY, LIFE FACES THE SIXTH GREAT EXTINCTION EVENT IN EARTH HISTORY.

The cause is just as disturbing: eating, manufacturing, traveling, warring, and breeding by five and a half billion human beings.

The crisis we face is biological meltdown.

Wilson warns that one-third of all species on Earth could become extinct in 40 years. Soulé says that the only large mammals that will be left after the turn of the century will be those we consciously choose to protect; that for all practical purposes "the evolution of new species of large vertebrates has come to a screeching halt."

That 1980 realization shook the daylights out of biology and conservation. Biology could no longer be removed from activism, if scientists wished their research subjects to survive. Conservation could no longer be about protecting outdoor museums and art galleries, and setting aside backpacking parks and open-air zoos. Biologists and conservationists began to understand that species can't be brought back from the brink of extinction one by one. Nature reserves had to protect entire ecosystems, guarding the flow and dance of evolution.

A new branch of applied biology was launched. Conservation biology, Michael Soulé declared, is a *crisis* discipline.

Conservation biologists immediately turned their attention to nature reserves. Why hadn't National Parks, Wilderness Areas, and other reserves prevented the extinction crisis? How could reserves be better designed and managed in the future to protect biological diversity? Looking back, we see that four lines of scientific inquiry led to the sort of reserve design now proposed by The Wildlands Project and our allies.

Conservation biologists first drew on an obscure corner of population biology called *island biogeography* for insights. In the 1960s, E.O. Wilson and Robert MacArthur studied colonization and extinction rates in oceanic islands like the Hawaiian chain. They hoped to devise a mathematical formula for the number of species an island can hold, based on factors such as the island's size and its distance from mainland.

They also looked at continental islands. Oceanic islands have never been connected to the continents. Hawaii, for example, is a group of volcanic peaks rising from the sea floor. Any plants or animals had to get there from somewhere else. But continental islands, like Borneo or Vancouver or Ireland, were once part of nearby continents. When the glaciers melted 10,000 years ago and the sea level rose, these high spots were cut off from the rest of the continents and became islands. Over the years, continental islands invariably lose species of plants and animals that remain on their parent continents, a process called *relaxation*. On continental islands, island biogeographers tried to develop formulas for the rate of species loss and for future colonization, and to determine whether equilibrium would someday be reached.

Certain generalities jumped out at the researchers. The first species to vanish from continental islands are the big guys. Tigers. Elephants. Bears. The larger the island, the slower the rate at which species disappear. The farther an island is from the mainland, the more species it loses; the closer, the fewer. An isolated island loses more species than one in an archipelago.

In 1985, as Soulé, David Ehrenfeld, Jared Diamond, William Conway, Peter Brussard, and other top biologists were forming the Society for Conservation Biology, ecologist William Newmark looked at a map of the western United States and realized that its National Parks were also islands. As the sea of development had swept over North America, National Parks had become islands of natural habitat. Did island biogeography apply?

Newmark found that the smaller the National Park and the more isolated it was from other wildlands, the more species it had lost. The first species to go had been the large, wide-ranging critters—Gray Wolf, Grizzly Bear, Wolverine. Faunal relaxation had occurred, *and was still occurring.* Newmark predicted that all National Parks would continue to lose species. Even Yellowstone National Park isn't big enough to maintain viable populations of all the large wide-ranging mammals. Only the complex of National Parks in the Canadian Rockies is substantial enough to ensure their survival.

While Newmark was applying island biogeography to National Parks, Reed Noss and Larry Harris at the University of Florida were using the *metapopulation* concept to design reserves for the Florida Panther, an Endangered subspecies, and the Florida Black Bear, a Threatened subspecies. Metapopulations are populations of subpopulations. A small isolated population of bears or Panthers faces genetic and stochastic threats. With few members of the population, inbreeding is likely, and this can lead to all kinds of genetic weirdness. Also a small population is more vulnerable than a large one to local extinction (*winking out* in ecological jargon). If the animals are isolated, their habitat can't be recolonized by members of the species from another population. But if habitats are connected so that animals can move between them—even as little as one horny adolescent every ten years—then inbreeding is usually avoided, and a habitat whose population winks out can be recolonized by dispersers from a nearby population.

Noss and Harris designed a nature reserve system for Florida consisting of core reserves surrounded by buffer zones and linked by habitat corridors. Florida is the fastest growing state in the nation. When the Noss proposal, calling for 60 percent of Florida to be protected in such a nature reserve network, was published in 1985, it was considered...well, impractical. But over the last decade this visionary application of conservation biology has been refined by the State of Florida, and now state agencies and The Nature Conservancy are using the refinement to set priorities for land acquisition and protection of key areas.

In 1994 the Florida Game and Fresh Water Fish Commission published a 239 page document, *Closing the Gaps In Florida's Wildlife Habitat Conservation System.* Using GIS computer mapping technology, *Closing the Gaps* identified Biodiversity Hot Spots for Florida. The study looked in detail at range occurrences and habitat needs for 33 sensitive species ranging from the Florida Panther to the Pine Barrens Treefrog, and at 25,000 known locations of rare plants, animals, and natural communities. Existing conservation lands in Florida cover 6.95 million acres. The hot spots—called Strategic Habitat Conservation Areas—encompass another 4.82 million acres. Florida is working with private landowners to protect identified areas and has appropriated $3.2 billion to purchase Strategic Habitat Conservation Areas by the year 2000. Once a new Ph.D.'s pie-in-the-sky, a conservation biology-based reserve system is now the master plan for land protection in Florida.

While metapopulation dynamics and island biogeography theory were being applied to nature reserve design, biologists were beginning to recognize the value of large carnivores to their ecosystems. Previously, scientists had tended to see wolves and Wolverines and Jaguars as relatively unimportant species perched on top of the food chain. They really didn't have that much influence on the overall functioning of the natural system, biologists thought. Until the 1930s, in fact, the National Park Service used guns, traps, and poison to exterminate Gray Wolves and Mountain Lions from Yellowstone and other Parks (they succeeded with the wolf). Early in his career, even Aldo Leopold beat the drum for killing predators.

Today, biologists know that lions and bears and wolves are ecologically essential, in addition to being important for a sense of wildness in the landscape. For example, the eastern United States is overrun with White-tailed Deer. Their predation on trees is preventing forest regeneration and altering species composition, according to University of Wisconsin botanists Don Waller, Steve Solheim, and William Alverson. If allowed to return, wolves and Mountain Lions would scatter deer from their concentrated wintering yards and reduce their numbers, thereby allowing the forest to return to more natural patterns of succession and species composition.

Large herds of Elk are overgrazing Yellowstone National Park. Conservation biologists hope that the recent reintroduction of the Gray Wolf will control Elk numbers and keep large herds from loafing in open grasslands.

Michael Soulé has shown that native songbirds survive in suburban San Diego canyons where Coyotes remain; they disappear when Coyotes disappear. Coyotes eat foxes and prowling house cats. Foxes and cats eat quail, cactus wrens, gnatcatchers, and their nestlings. Michael Soulé calls this phenomenon of increasing mid-sized carnivores because of decreasing large carnivores *mesopredator release.*

In the East, David Wilcove, staff ecologist for the Environmental Defense Fund, has found that songbirds are victims of the extirpation of wolves and Cougars. Neotropical migrant songbirds such as warblers, thrushes, and flycatchers winter in Central America and breed in the United States and Canada. The adverse effects of forest fragmentation on songbird populations are well documented; but Wilcove has shown that songbird declines are partly due to the absence of large carnivores in the East. Cougars and Gray Wolves don't eat warblers or their eggs, but raccoons, foxes, and possums do, and the Cougars and wolves eat these midsize predators. When the big guys were hunted out, the populations of the middling guys exploded—with dire results for the birds. Soulé's mesopredator release rears its ugly head again.

On the Great Plains, the tiny Swift Fox is Endangered. Why? Because the wolf is gone. Swift Foxes scavenged on wolf kills but wolves didn't bother their little cousins. Coyotes, however, eat Swift Foxes. Wolves eat Coyotes. Get rid of the wolf and Swift Foxes don't have wolf kills to clean up, and abundant Coyotes eat up the foxes.

John Terborgh of Duke University (in my mind the dean of tropical ecology) is currently studying the ecological effects of eliminating large carnivores from tropical forests. He tells us that large carnivores are major regulators of prey species numbers—the opposite of once-upon-a-time ecological orthodoxy. He has also found that the removal or population decline of large carnivores can alter plant species composition, particularly the balance between large- and small-seeded plants, due to increased plant predation by animals normally preyed upon by large carnivores.

In addition to being critical players in various eat-or-be-eaten schemes, large carnivores are valuable as *umbrella species*. Simply put, if enough habitat is protected to maintain viable populations of top predators like Wolverines or Harpy Eagles, then most of the other species in the region will also be protected. Those that aren't, such as rare plants with very restricted habitats, can usually be protected with vest-pocket preserves of the old Nature Conservancy variety.

A final piece in conservation biology's big-picture puzzle is the importance of natural disturbances. Caribbean forests are adapted to periodic hurricanes. Many plant communities in North America evolved with wildfire. Floods are crucial to new trees sprouting in riparian forests. To be viable, habitats must be large enough to absorb major natural disturbances (types of *stochastic events* in ecologist lingo). When Yellowstone burned in 1988, there was a great hue and cry over the imagined destruction; but ecologists tell us that the fire was natural and beneficial. Because Yellowstone National Park covers two million acres and is surrounded by several million acres more of National Forest Wilderness Areas and roadless areas, the extensive fires affected only a portion of the total reserve area.

In addition to being critical players in various eat-or-be-eaten schemes, large carnivores are valuable as umbrella species.

Harpy Eagle *by Darren Burkey*

Things didn't turn out so well when The Nature Conservancy's Cathedral Pines Preserve in Connecticut was hammered by tornadoes in 1989. In this tiny patch of remnant old-growth White Pine forest (with some trees 150 feet tall), 70 percent of the trees were knocked flat, devastating the entire forest patch. Had the tornadoes ripped through an old-growth forest of hundreds of thousands of acres, they instead would have played a positive role by opening up small sections to new forest growth.

These four areas of recent ecological research—island biogeography, metapopulation theory, large carnivore ecology, and natural disturbance dynamics—are the foundation for The Wildlands Project. We used insights from these four fields to set our goals for protecting Nature in a reserve network. For a conservation strategy to succeed, it must have clearly defined goals. These goals should be scientifically justifiable and they should be visionary and idealistic. Reed Noss, science director for the Project, set out the four fundamental goals of The Wildlands Project in 1992:

deep forests, rolling grasslands, and fertile river valleys on which a disproportionate number of rare and Endangered species depend have passed into private ownership or, if public, have been "released" for development and resource exploitation. To make matters worse, the elimination of large carnivores, suppression of natural fire, and livestock grazing have degraded even the largest and most remote Wilderness Areas and National Parks in the lower 48 states.

To achieve TWP's four reserve design goals, we must go beyond current National Park, Wildlife Refuge, and Wilderness Area systems. Our ecological model for nature reserves consists of large Wilderness cores, buffer zones, and biological corridors. The core Wilderness Areas would be strictly managed to protect and, where necessary, to restore native biological diversity and natural processes. Traditional wilderness recreation is entirely compatible, so long as ecological considerations come first. Biological corridors would provide secure routes between core reserves for the dispersal of wide-ranging species, for genetic exchange between populations, and for mi-

1) Represent, in a system of protected areas, all native ecosystem types and seral stages across their natural range of variation.

2) Maintain viable populations of all native species in natural patterns of abundance and distribution.

3) Maintain ecological and evolutionary processes, such as disturbance regimes, hydrological processes, nutrient cycles, and biotic interactions, including predation.

4) Design and manage the system to be responsive to short-term and long-term environmental change and to maintain the evolutionary potential of lineages.

With the criteria embodied in these goals, we can look closely at existing Wilderness Areas and National Parks and answer our original question—why has the world's greatest nature reserve system failed to prevent biological meltdown in the United States?

As we have seen, Wilderness Areas and National Parks are generally islands of wild habitat in a matrix of human-altered landscapes. By fragmenting wildlife habitat, we imperil species from Grizzlies to warblers who need large, intact ecosystems. Because they have been chosen largely for their scenic and recreational values, and to minimize resource conflicts with extractive industries, Wilderness Areas and National Parks are often "rock and ice"—high elevation, arid, or rough areas which are beautiful and are popular for backpacking, but which also are *relatively* unproductive habitats. For the most part, the richer

gration of plants and animals in response to climate change. Surrounding the core reserves, buffer zones would allow increasing levels of compatible human activity away from the cores. Active intervention or protective management, depending on the area, would aid in the restoration of extirpated species and natural conditions.

Admittedly, there has been some debate among scientists about reserve design. Some aspects of corridors have been criticized. Several "scientists" representing the anti-conservation wise use/militia movement have misstated these controversies, ignoring the general consensus that has emerged among reputable scientists on all sides of these discussions.

This emerging consensus has been summarized in several forms during the last five years. In 1990 with the Conservation Strategy for the Northern Spotted Owl, Jack Ward Thomas, now

Chief of the Forest Service, set forth five reserve design principles "widely accepted among specialists in the fields of ecology and conservation biology." In 1992, Reed Noss updated those five and added an important sixth principle:

1. Species well distributed across their native range are less susceptible to extinction than species confined to small portions of their range.

2. Large blocks of habitat containing large populations of a target species are superior to small blocks of habitat containing small populations.

3. Blocks of habitat close together are better than blocks far apart.

4. Habitat in contiguous blocks is better than fragmented habitat.

5. Interconnected blocks of habitat are better than isolated blocks; corridors or linkages function better when habitat within them resembles that preferred by target species.

6. Blocks of habitat that are roadless or otherwise inaccessible to humans are better than roaded and accessible habitat blocks.

Based on his studies of faunal extinctions in fragmented chaparral habitats in San Diego County, Michael Soulé summarized some reserve design principles in a very understandable way for us layfolk:

A. Bigger is better.
B. Single large is usually better than several small.
C. Large native carnivores are better than none.
D. Intact habitat is better than artificially disturbed.
E. Connected habitat is usually better than fragmented.

In a 1995 report for the World Wildlife Fund, *Maintaining Ecological Integrity in Representative Reserve Networks*, Noss added several more fundamental principles:

- Ecosystems are not only more complex than we think, but more complex than we *can* think (Egler 1977).
- The less data or more uncertainty involved, the more conservative a conservation plan must be (i.e., the more protection it must offer).
- Natural is not an absolute, but a relative concept.
- In order to be comprehensive, biodiversity conservation must be concerned with multiple levels of biological organization and with many different spatial and temporal scales.
- Conservation biology is interdisciplinary, but biology must determine the bottom line (for instance, where conflicts with socio-economic objectives occur).
- Conservation strategy must not treat all species as equal but must focus on species and habitats threatened by human activities (Diamond 1976).
- Ecosystem boundaries should be determined by reference to ecology, not politics.
- Because conservation value varies across a regional landscape, zoning is a useful approach to land-use planning and reserve network design.
- Ecosystem health and integrity depend on the maintenance of ecological processes.
- Human disturbances that mimic or simulate natural disturbances are less likely to threaten ecological integrity than are disturbances radically different from the natural regime.
- Ecosystem management requires cooperation among agencies and landowners and coordination of inventory, research, monitoring, and management activities.
- Management must be adaptive.
- Natural areas have a critical role to play as benchmarks or control areas for management experiments, and as refugia from which areas being restored can be recolonized by native species.

illustration by Kurt Seaberg

Now what? Where do we go with all this?

Conservation biology has shown us the crisis we face (and it *is* a crisis despite the sugary "What, me worry?" attitude of Eco-Pollyannas like Gregg Easterbrook); conservation biology has developed the theory supporting the protection of biological diversity; and conservation biology has set out a new model of how nature reserves should be designed. It is up to citizen conservationists to apply conservation biology to specific land use decisions and Wilderness Area proposals. We have the political expertise, the love for the land, and the ability to mobilize support that an ambitious Nature protection campaign demands.

There is wide agreement among conservation biologists that existing Wilderness Areas, National Parks, and other federal and state reserves are the building blocks for an ecological reserve network (see my companion article in this issue). Inspired by Noss's and Soulé's work, conservationists in the Northern Rockies, led by the Alliance for the Wild Rockies, applied conservation biology principles there as early as 1990. Biologists like pioneer Grizzly Bear researcher John Craighead and conservationists like former Wilderness Society head Stewart Brandborg reckoned that if Yellowstone is not large enough to maintain viable populations of Grizzlies and Wolverines, then we need to link Yellowstone with the big Wilderness Areas of central Idaho, the Glacier National Park/Bob Marshall Wilderness complex in northern Montana, and on into Canada's Banff/Jasper National Park complex. Maintaining metapopulations of wide-ranging species means landscape connectivity must be protected throughout the entire Northern Rockies. The Northern Rockies Ecosystem Protection Act (NREPA), which would designate 20 million acres of new Wilderness Areas in the United States and protect corridors between areas, has been introduced into Congress and drew over 60 cosponsors in 1994. The proposal is now being refined by scientists and conservationists in Canada and the United States for a Yellowstone to Yukon reserve system. Scores of grassroots wilderness groups have helped advance the legislation. The Sierra Club was the first major national conservation organization to endorse NREPA.

Other conservation groups are using conservation biology to develop alternative proposals for the next generation of National Forest Management Plans. They are seeking to identify biological hot spots including habitat for sensitive species, remaining natural forest, and travel corridors for wide-ranging species. With such maps they will argue for expanding existing Wilderness Areas into ecologically rich habitats and for protecting wildlife linkages. In many areas roads need to be closed in sensitive ecosystems, once-present species like wolves and Mountain Lions reintroduced, and damaged watersheds restored. The Southern Rockies Ecosystem Project is coordinating several groups in a comprehensive conservation biology approach to new National Forest Plans in Colorado. The Southern Appalachian Forest Coalition is developing a conservation biology management strategy for all National Forests in its region. SREP and SAFC are the best examples of regional coalitions working from conservation biology principles.

One of the central messages of conservation biology is that ecosystems and wildlife ranges do not follow political boundaries. Many nature reserves will need to cross international borders. The best application of this so far is in Central America where a consortium of government agencies, scientists, and private groups are working with Wildlife Conservation International to link existing National Parks and other reserves from Panama to Mexico's Yucatan. This proposed nature reserve network, called *Paseo Pantera* (Path of the Panther), would allow Jaguars and Mountain Lions to move between core reserves throughout Central America. [See *Wild Earth*'s first special issue on TWP.]

To the north, the Canadian Parks and Wilderness Society and World Wildlife Fund Canada are incorporating conservation biology in their Endangered Spaces campaign throughout Canada. In every province and territory, scientists and activists are working to identify core reserves and connecting corridors based on the needs of large carnivores, biological hot spots, and "enduring features" on the landscape. The Canadians are working with conservationists in Alaska and the northern part of the lower 48 states on cross-border reserves and linkages.

National conservation groups in the United States like the Sierra Club, Wilderness Society, Defenders of Wildlife, World Wildlife Fund, and American Wildlands have been influenced by The Wildlands Project and are seeking to incorporate conservation biology into their work. The Sierra Club's Ecoregions Campaign could become a promising initiative for bringing conservation biology to conservation policy. Early this year the Sierra Club brought together Noss and Soulé with Club activists and public opinion, political, and marketing experts to explore how to "sell" biodiversity to politicians and the public.

In fifteen years, conservation biology has wrought a revolution. The goal for nature reserves has moved beyond protecting scenery to protecting all Nature—the diversity of genes, species, ecosystems, and natural processes. No longer are conservationists content with protecting remnant and isolated roadless areas; more and more biologists have come to agree with Reed Noss, who says, "Wilderness recovery, I firmly believe, is the most important task of our generation." Recycling, living more simply, and protecting human health through pollution control are all important. But it is only by encouraging wilderness recovery that we can learn humility and respect; that we can come home, at last. And that the grand dance of life will continue in all its beauty, integrity, and evolutionary potential. ▮

Dave Foreman is the chairman of The Wildlands Project, publisher of Wild Earth, *and a member of the Sierra Club board of directors.*

Science Grounding Strategy

Conservation Biology in Wildlands Work

by Reed F. Noss

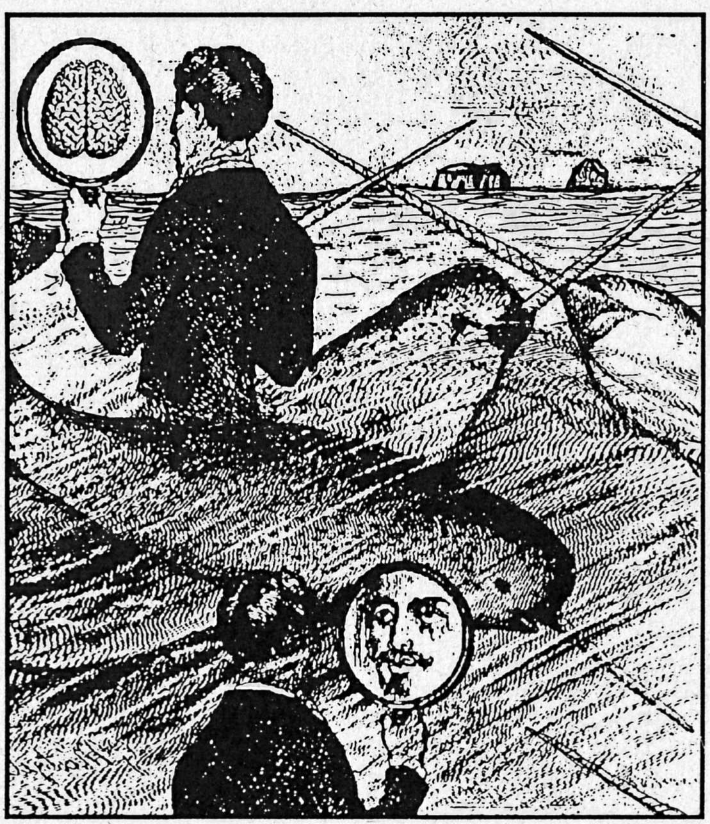
Conservation biology—which can be defined as science in the service of conservation—is fundamental to The Wildlands Project. It provides the theories, concepts, methods, and data for putting together proposals for wildlands recovery that, if implemented, have reasonable chances of success. Reserve network proposals that are thoroughly grounded in conservation biology and have received the benefit of peer review will be more defensible in the arenas of science and public policy. Several professional conservation biologists—Michael Soulé, Steve Trombulak, and myself—have been closely involved with the project, and dozens more have offered their services on specific proposals over the last few years. But many other conservation biologists have been leery of The Wildlands Project. Their hesitancy to get actively involved is not surprising. Scientists have been trained to separate fact and value (which, ultimately, is impossible) and to be totally objective (also impossible, but worth trying if you want to practice science). Bold advocacy scares scientists, who are by nature conservative. On the other hand, scientists are at their best as skeptics and critics. The Wildlands Project can benefit from their questioning, probing, and critical review. Because there is abundant misunderstanding about The Wildlands Project, in large part perpetrated by the press, we have strived to explain ourselves to the scientific community and to solicit its input on our strategy and proposals. We need scientists and (we believe) they need us.

We have made a special effort to communicate with the Society for Conservation Biology (SCB), the major professional society of scientists interested in conservation problems. In 1993, at the annual meeting of SCB at Arizona State University in Tempe, we presented a symposium on The Wildlands Project. We invited scientists formally involved with the project, as well as others doing research in similar areas of conservation biology, to provide a scientific background on the principles underlying the project. Dave Foreman, Michael Soulé, and I—all of us among the founders of the project—presented our views on why the project was founded, why we think it is needed (in other words, why it doesn't simply duplicate existing efforts), and what it's trying to do. Briefly, we told the conservation biologists in 1993 that The Wildlands Project represents a loose coalition of regionally-based groups across North America, each of which is com-

The Wildlands Project is trying to put a little flesh on the often vague mission of protecting and restoring biodiversity that most conservation biologists, publicly or privately, believe in.

illustration by Mary Elder Jacobsen

posed of conservation scientists and activists, and each interested in developing long-term strategies to restore native biological diversity, ecological integrity, and wildness to their region. On a broader scale, project directors and staff develop and demonstrate reserve design models that can be adapted and applied to various regions; and we try to articulate a vision of what the continent of North America might look like in 100 or 200 years if we can reduce the scale of human activities and give wild nature a chance to recover. Thus, we give conservation biologists something hopeful to work for. Our technical approach is the familiar map-based conservation planning, which involves an iterative process of reserve selection, reserve network design, and development of management and restoration plans.



Following the main presentations at the meeting in Tempe, we asked a panel of scientists from academia, government, and the private conservation community to critique The Wildlands Project. Anything this big and ambitious has to have its weak points, and sure enough, our panel located them for us. They told us (expectedly) that we were making wildly utopian assumptions about the future, especially given the facts of human population growth and resource consumption. They told us that our values (principally wildness and biodiversity) were not necessarily shared by other citizens, at least not to this degree. They warned us of potential backlash against our ambitious proposals and felt that our goals were politically unrealistic. There was little criticism of the scientific underpinning of our proposals, although some pointed out that the benefits of corridors and roadless areas, in particular, were insufficiently validated to form the basis of our approach. This review was generally friendly and helped us refine our arguments and models. It did not persuade us to change our basic goals or conceptual models. The SCB symposium and The Wildlands Project in general was covered as a major news story in *Science* magazine and, subsequently, in many newspapers and magazines around the continent. As usual, the reporters did not get all their facts straight and exaggerated some aspects of the project. "Human exclusion zones" (a term we never used) became a topic of much discussion and inspired a few nasty editorials. Hence The Wildlands Project became controversial and remains so. This is as expected and as hoped. If it were not controversial, we wouldn't be doing our job.

At the 1995 annual meeting of SCB at Colorado State University in Fort Collins, The Wildlands Project presented a second symposium. As in the first symposium, the lecture hall was filled beyond capacity. This time we provided an update on the project and described several research efforts in progress. In my introduction I explained that The Wildlands Project has a unique role in the sociology of science. Much of what we are trying to do is shake people—especially environmentalists and conservation biologists—out of their self-fulfilling resignation that the world is falling apart and there's nothing we can do about it. We are putting forth a positive vision of the future from the perspective of all life, not just humans. While recognizing that further ecological damage is bound to occur, we are trying to identify the hot spots and vital points of the natural landscape using established and innovative methods of conservation biology. We are joining with activists and working like hell to protect those critical areas now, before it's too late; but meanwhile, we are also seeking to establish long-term restoration strategies and harmonious human-nature relationships for the rest of the landscape. We believe a positive vision of the future is a better motivator for getting things accomplished than a vision of despair. Steve Trombulak, in the closing lecture of the symposium, addressed some of the challenges—technical, scientific, and sociopolitical—that make it difficult to implement our vision. The difficulties are formidable and our adversaries (such as the indefatigable Dr. Mike Coffman of Environmental Perspectives, Inc.) have been busy publishing lies and distortions about us. But the audience of SCB scientists found Steve's call for conservation biologists to join activists in the good fight inspiring. We won some converts. Before we move into the lengthier discussions in this second issue of *Wild Earth* devoted to The Wildlands Project, I will identify some of the major areas of misunderstanding about TWP that I pointed out to conservation biologists in Fort Collins.

illustration by Jim Nollman

First, the press has gone out of its way to make the project appear more radical than it really is. Beginning with the 1993 article in *Science*, the press has given the impression that the reserve networks we're planning are proposed to be established right away. In fact, in most cases we are talking about phasing in conservation over a period of several decades, with full recovery often requiring a century or more. We assume (optimistically, of course) that during this time, socioeconomic and cultural transitions will occur in many regions, moving them from a strict dependence on commodity production as a means of employment to more diversified economies. Such transitions are already well underway in regions such as the Pacific Northwest and Rocky Mountains. I refer readers, for example, to the work of economist Tom Power at the University of Montana, which shows that the healthiest economies in Montana are now in counties with the most wilderness and the least resource extraction.

Second, the press has suggested—often very explicitly—that we are trying to kick people off the land and even out of their homes in order to establish our reserve networks. In other words, our reserves are to be closed to all human uses. This charge is absolutely false. We envision a variety of benign human uses even within our proposed core areas—except in the most sensitive local sites, such as around bear dens, bird rookeries, endangered plant populations, and so on—the places that existing conservation policies in most regions already strive to protect (in principle if not in fact). Compatible uses of core areas in our wildlands proposals might include non-motorized recreation, non-intrusive ecological research, and environmental education. Furthermore, many of these core areas will require active restoration and management, employing many workers for a long time to come. For our buffer zones and other transitional areas, we foresee experiments in "sustainable forestry" and other "ecosystem management," if applied sensitively, to be compatible with our conservation goals. It is true that we are emphasizing road removal and restricted access in all zones. In most cases, you can't maintain the more sensitive fauna—large carnivores, for example—with high road densities.

Third, some misunderstanding remains about where and how science enters the wilderness recovery process we're advocating. How can conservation biologists be involved in something like this without sacrificing their standing as impartial, neutral observers? Scientists in SCB and elsewhere have long debated the issue of advocacy; this is not the place to get into it in detail. We must remember that conservation biology has almost always been defined as a mission-oriented discipline. But what does it mean to be oriented toward a mission, and what is the mission? The Wildlands Project is trying to put a little flesh on the often vague mission of protecting and restoring biodiversity that most conservation biologists, publicly or privately, believe in. That means setting explicit goals and objectives. If a scientist agrees with our general goals—full representation of ecosystem types in protected areas, maintaining viable populations of all native species, sustaining natural ecological and evolutionary processes, and so on—then he or she is free to test the hypotheses and obtain the information necessary to fulfill these goals using methods just as objective and rigorous as in any other kind of science.

One of the guiding presuppositions of The Wildlands Project is that maintaining biodiversity (or, more broadly, ecological integrity) is good. Biologists are comfortable with this idea; it legitimates their profession. Indicators of biodiversity—at several levels of biological organization—can be developed, measured, mapped, and analyzed in reasonably unbiased ways. Conservation biologists spend entire careers doing these things, and whole technologies (GIS, remote sensing, etc.) have been adapted to serve their purposes. The concept of wildness—which also guides The Wildlands Project—is not as familiar to most conservation biologists. It makes them feel uncomfortable, in their rational minds, because it lies largely outside the domain of science. Yet wildness is surely complementary to biodiversity. This is what I ask scientists who say that concepts such as wildness have no place in conservation biology: Would you be satisfied if most species on Earth were maintained in minimally viable populations, but were all securely confined to zoos, aquaria, botanical gardens, and the like? I have not found any conservation biologists who are comfortable with this level of domestication. Most conservation biologists, implicitly or explicitly, are talking about maintaining wild populations in wild environments. Truly wild. A landscape where every acre is intensively managed (increasingly the case in our National Forests, for example) is not much different from a zoo. I do not believe that containment of biodiversity in zoos—indoor or outdoor—provides a satisfying vision or a suitable mission for conservation biology. That's why, in The Wildlands Project, we use that quaint, antiquated, politically incorrect term "wilderness."

As you will see from the papers herein, one thing The Wildlands Project hopes to do for conservation biology is provide a framework for synthesis—something the discipline desperately needs. Most scientists spend much time on analysis (a largely left-brain activity) and little on synthesis (a right-brain activity). Similarly, most conservation biologists are specialists, off doing their own thing with their favorite organisms and not talking much with each other. We still need those detailed, specialized, analytic studies. Here though, with The Wildlands Project, is a framework within which population genetics, metapopulation modeling, reserve selection algorithms, reserve design, wildlife biology, forestry, botany, and all the other specialties that define conservation biology can be brought together for a common purpose. And the purpose is noble and good. ▮

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What Should Endangered Ecosystems Mean to The Wildlands Project?

[The goal of the Act is] to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved.
US Endangered Species Act of 1973 (P.L. 94-325)

by Reed F. Noss

CONSERVING HEALTHY ECOSYSTEMS is recognized as the best way to protect biodiversity and prevent species from declining to the point where they require individual attention. If a species has already declined to imperiled status, then protecting or restoring its habitat—the ecosystem upon which it depends—is the only way to bring about its recovery in the wild. One of the major objectives of The Wildlands Project is to design reserve networks that encompass all kinds of native ecosystems (habitats, communities, landscapes, etc.). This objective is by no means unique to the Project; indeed, representation of all ecosystems in protected areas is probably the best accepted conservation goal worldwide. The strategy of protecting examples of ecosystems has been called a "coarse filter." That is, by protecting assemblages of species in their natural habitats, we don't have to worry about each species individually. If the habitats remain healthy, so presumably will populations of species that depend on those habitats. In practice, the coarse filter usually needs to be complemented by a fine filter that focuses on those species with very demanding requirements—for example, large carnivores that range over huge areas and use many kinds of habitats, species with very localized distributions, and any other species extremely sensitive to human activities. Nevertheless, most biologists agree that the coarse filter is likely to capture the vast majority of species and is especially useful for organisms that are difficult to inventory and about which little is known, such as soil invertebrates, fungi, and bacteria. The coarse filter is also generally more efficient and cost-effective than a species-by-species approach, and may have a greater chance of ultimate success.

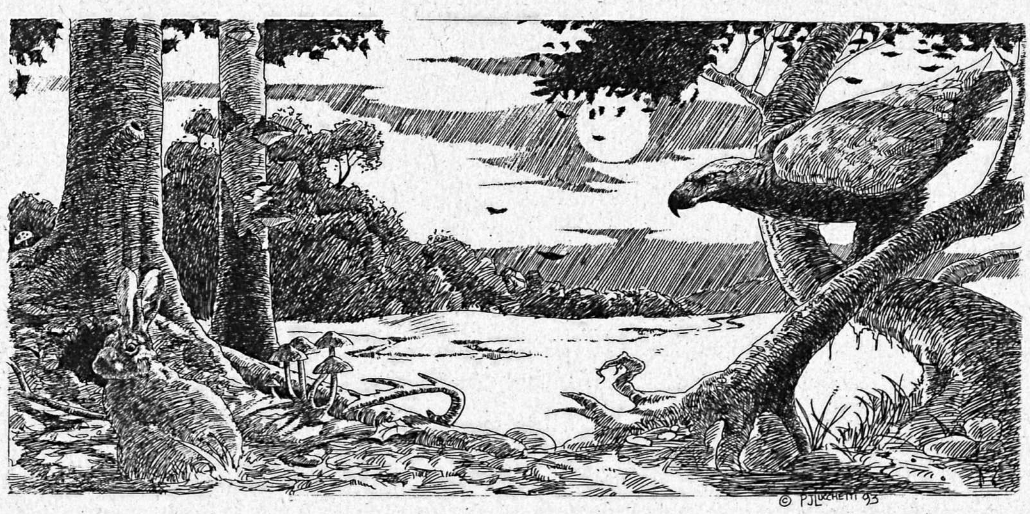


illustration by Peter Lucchetti

Like any strategy, however; the coarse filter has its limitations. One major problem is classification; ecologists can argue for years about the best way of classifying all the habitats or communities in a region and about which level of splitting or lumping is optimal for conservation purposes. In this article I will address another problem: For many kinds of habitats and communities around the world, opportunities for adequate representation have been precluded by human activities. How can the coarse filter deal with ecosystems that have already been eliminated or drastically reduced? How can we conserve endangered ecosystems?

Most common conservation evaluation techniques do not address well the problem of endangered ecosystems. Many representation analyses, such as the Gap Analysis project of the National Biological Service, use vegetation types as surrogates for biodiversity. Maps of actual or existing vegetation are produced, overlaid by maps showing boundaries of existing reserves, and vegetation types that are unrepresented or under-represented in existing reserves are shown as gaps in the reserve network. Those types then become priorities for protection. A problem with this kind of analysis, especially in regions where the natural vegetation has been mostly replaced by human land uses, is that all vegetation types are treated as equal. The goal is to represent some arbitrary proportion of each type in reserves. Never mind that some kinds of vegetation may have once dominated the region and are now reduced to a few scattered scraps, or that other kinds have increased greatly due to human activity, such as agriculture, grazing, logging, or fire suppression. An historical perspective is lacking in any approach based solely on existing land cover. One way around this problem is to map physical habitats instead of vegetation, and strive to represent all physical types in reserves. This approach is being used in the Canadian gap analysis spearheaded by World Wildlife Fund Canada, and it makes sense ecologically. However, important biotic communities formed through quirks of biogeographic history and maintained by processes such as fire or hydrological regimes would not be protected by focusing on physical habitats alone. A given physical habitat can support many different kinds of biotic communities, some of which are much more natural or biologically rich than others. Thus, conservationists need some way of identifying kinds of ecosystems—ideally, defined by both biotic and abiotic qualities—that have suffered disproportionate losses since European settlement. Those ecosystems would be logical priorities for protection and restoration. The chances are high that many species associated with reduced ecosystems are now threatened and would be better served by focusing on their collective habitat requirements than by preparing a series of individual recovery plans.

ENDANGERED ECOSYSTEMS IN THE UNITED STATES

With these thoughts in mind I set out a few years ago to collect all the information I could find, from published and unpublished sources, on losses and degradation of natural ecosystems in the United States. I focused on the United States because I was working on a US government-funded project at the time. I invited Mike Scott and Ted LaRoe (now deceased) of the US Fish and Wildlife Service (now National Biological Service) to help as coauthors. We defined an ecosystem as any assemblage of species and/or habitat features that can be classified at some hierarchical level and delineated on a map. Mappable ecosystems include physical habitats, vegetation types, plant associations, and natural communities defined by floristics, structure, age, geography, condition, or other ecologically relevant factors. Thus, old-growth eastern deciduous forests, South Florida pine rocklands, inland Atlantic White-cedar swamp, maritime sage scrub, vernal pools, submersed aquatic vegetation, and free-flowing rivers are all mappable ecosystems. We amassed reams of information on the status of various ecosystems and their losses since Europeans arrived on the continent. Much of the information represented best estimates by experts, such as ecologists with state natural heritage programs, and had never before been published. Our extensive review was finally published, after many months of delay explainable only by politics, by the National Biological Service (NBS) last spring (Noss, R.F., E.T. LaRoe III, and J.M. Scott. 1995. Endangered Ecosystems of the United States: A Preliminary Assessment of Loss and Degradation. Biological Report 28. US Dept. of Interior, National Biological Service, Washington, DC). Its publication sparked a front-page story in the *New York Times* and apparently made some bureaucrats and politicians very nervous. Since publication of the NBS report, Rob Peters (senior ecologist with Defenders of Wildlife) and I have completed further analyses of endangered ecosystems; as of this writing, our report is in press.*

Our NBS review of information on endangered ecosystems revealed staggering losses over the last 200 years. We categorized ecosystem types for which estimates of decline were available into three major groups: critically endangered (showing declines of over 98% since settlement), endangered (85-98% decline), and threatened (70-84% decline). We defined "decline" to include outright losses, such as conversion of a prairie to a corn field or shopping mall, as well as significant degradation of ecological structure, function, or composition. Degradation is qualitative and requires judgment calls, but it can be just as devastating ecologically as outright conversion. For example, an

*For a copy contact Defenders of Wildlife at 1101 14th Street NW, Suite 1400, Washington, DC 20005.

overgrazed sagebrush steppe may still be mapped as sagebrush, but its herbaceous layer is now dominated by exotic annual grasses instead of native perennial grasses, its fire regime is entirely different from the regime prior to grazing, and its species richness or evenness is lower. It is a new community ecologically and one that is of much reduced value in terms of biodiversity.

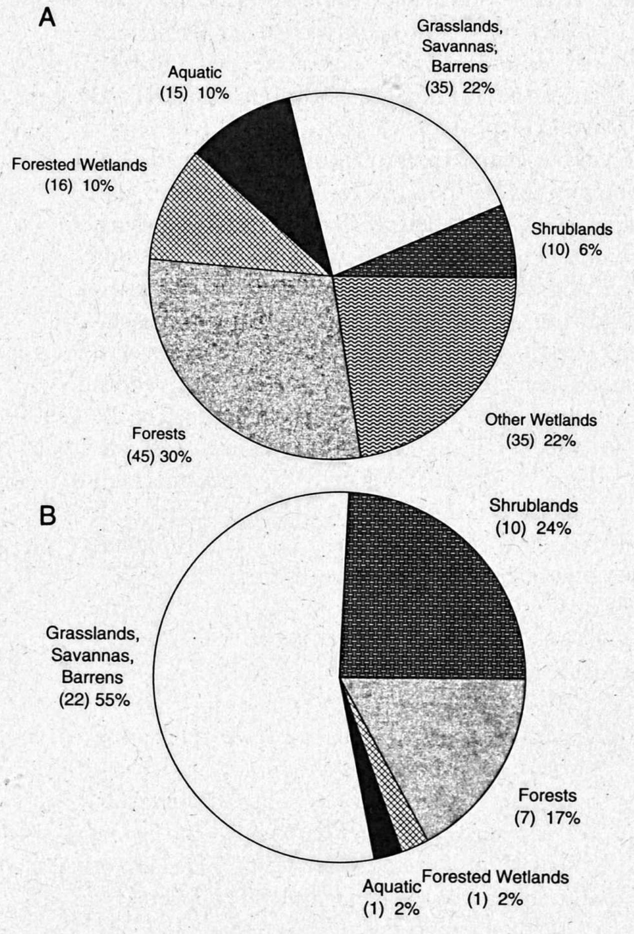


Figure 1. (A) Distribution of ecosystem types that have declined by 70% or more since European settlement, within six general habitat categories. In order to include general wetland loss statistics, which are usually organized by state, a number was added in the wetland category for each state with declines exceeding 70%. The figure shows that the greatest number of reported declines are among forest and wetland habitats and communities. (B) Distribution of ecosystem types that have declined by 98% or more, within the same habitat categories. In most regions the most severe losses are of grasslands and savannas or barrens. However, declines in aquatic ecosystems, though represented by relatively few "types," are widespread and critical. From Noss, LaRoe, and Scott (1995)

Estimates of ecosystem declines can be further grouped into several major habitat categories to give a general picture of the kinds of habitats that have suffered greatest losses (Fig. 1). Considering all ecosystems showing declines of 70% or more (the threatened, endangered, and critically endangered categories combined), most of the losses are among forests and wetlands, followed by grasslands, savannas, and barrens (Fig. 1A). However, considering only the critically endangered ecosystems, which have declined by over 98%, savannas, grasslands, and barrens dominate the list (Fig. 1B). Some kinds of ecosystems fit into more than one habitat category. For example, Longleaf Pine-Wiregrass communities, because they include a range of tree densities, are included in both the forest and savanna categories. One glaring bias in the data shown in Fig. 1 is the small percentage of ecosystems in the aquatic habitat category. This reflects the very poor reporting of losses of aquatic biodiversity at the ecosystem level; that is, very few examples of specific types of aquatic habitats showing declines are in the literature. Yet, available data suggest that these communities have been severely degraded virtually everywhere. For example, 98% of streams nationwide do not meet even the minimal criteria for consideration as federal Wild or Scenic Rivers. Extinction rates of aquatic organisms in North America, including freshwater fish and mollusks, are higher than for terrestrial organisms.

As part of the report Rob Peters and I wrote for Defenders of Wildlife, we analyzed the NBS data by grouping communities and habitats into major ecosystem types (though not as broad as the habitat categories in Fig. 1) and scoring them in terms of four criteria: extent of decline, present area (rarity), imminence of threat, and number of threatened and endangered species associated with them. I do not have the space here to describe the ranking methodology or justification (refer to the Defenders report), but I will list below in approximate priority order (there were several ties) the 21 major ecosystem types that stood out as most endangered in the United States by the four criteria. Most of the 21 ecosystems are broad vegetation or landscape types that comprise many different plant communities. For example, the South Florida landscape is a mosaic of upland and wetland ecosystems. The eastern grasslands, savannas, and barrens comprise dozens of plant communities east of the Great Plains. We grouped these many communities because they are ecologically similar and face similar threats. Again, the list below, adapted from the Defenders report, was developed from the NBS data and therefore applies only to the United States. I have tried to expand this research to all of North America, but have not been able to obtain the necessary funding.

South Florida Landscape

The best known ecosystem of South Florida is the Everglades, whose hydrological regime stretches from the chain of lakes below Orlando, some 200 miles north of Everglades National Park, south to Florida Bay. Mismanagement of water, including withdrawals for agriculture and urban areas, has resulted in near ecological collapse of this ecosystem and declines in wading bird populations by some 90% over the last few decades. But even more endangered are certain upland habitats in South Florida, most notably the pine rocklands, rare subtropical communities that occur on outcroppings of Miami Rock Ridge limestones. Development in the vicinity of Miami and in the Keys has eliminated over 98% of the pine rocklands. Current threats include fire suppression, urban development, fragmentation by roads, and invasion by exotic species. Other imperiled communities in the South Florida landscape include Slash Pine forests of southwest Florida, tropical hardwood hammocks, the estuarine and marine ecosystems of Florida Bay, and coral reefs.

Southern Appalachian Spruce-Fir Forest

The boreal spruce-fir forests of the Southern Appalachians, dominated by Fraser Fir and Red Spruce, are in severe decline. Well-developed, mature stands of Fraser Fir, which occur only above 6000 feet, are virtually non-existent today. All that remains is a "ghost forest" standing above tiny firs. The culprit is an exotic insect, the Balsam Wooly Adelgid. The spruce are also declining, probably as a consequence of heavy air pollution ("acid fog") drifting in from the adjacent Tennessee Valley.

Longleaf Pine Forests and Savannas

Longleaf Pine communities, usually including Wiregrass as the dominant ground layer, once covered over 60% of the uplands of the Southeastern Coastal Plain. Most of the biodiversity of this ecosystem is herbaceous; a single stand might contain 200 herb species, one of the highest diversities of herbaceous plants on Earth. This diversity was promoted by frequent lightning fires. Longleaf Pine communities have declined by over 98% in the Southeastern Coastal Plain and by over 85% in the West Gulf Coastal Plain since European settlement, having been replaced by tree farms and agriculture, and by hardwood forests that invaded after the grass matrix was destroyed by agriculture or fires were suppressed actively or passively by roads and other firebreaks. Remaining sites are mostly fragmented and degraded; they lack many of the species characteristic of this ecosystem, such as the endangered Red-cockaded Woodpecker. Some 27 federally listed species and 99 federal candidates are associated with Longleaf Pine and Wiregrass in the Southeast.

Eastern Grasslands, Savannas, and Barrens

In the eastern, southern, and midwestern states, the forest that dominated the landscape was spotted with communities that are naturally treeless or in which trees occur as widely spaced individuals or open groves. These communities occurred commonly in the broad ecotone between the tallgrass prairie and eastern deciduous forest. Some of the rarest natural communities in the country are in this category: the Hempstead Plains grasslands of Long Island; the alvar grasslands and calcareous pavement barrens of New York; the serpentine barrens and Pocono till barrens of Maryland, Pennsylvania, and other eastern states; the calcareous glades and cedar barrens of Tennessee, Louisiana, and adjacent states; the bluegrass savanna-woodlands of Kentucky; the oak openings of the Great Lakes region; and the many types of oak savanna across the Midwest. Virtually all of the great canebrakes of the Southeast have been lost. Burning by Native Americans may have been more important than lightning ignitions in maintaining many of these communities. The more fertile grasslands and savannas were destroyed by agriculture after European settlement, but fire suppression and, in some areas, suburban development, have been the greatest threats recently.

Northwestern Grasslands and Savannas

The grasslands and savannas of the Pacific Northwest have fared no better than their counterparts in other regions. Virtually gone is the great Palouse prairie of eastern Washington, northwestern Oregon, and northwestern Idaho—only 0.1% remains, with most of the rest plowed and converted to wheat fields. The shrub steppe (High Desert) of eastern Oregon and adjacent Idaho, which extends southward into the Great Basin, was once a shifting mosaic of sagebrush, other shrubs, and grasslands. These grasslands have declined by over 90%, a consequence of livestock grazing and subsequent alteration of natural fire regimes and invasion by Cheatgrass and other alien plants. In the Willamette Valley of western Oregon, some 99.9% of the native grasslands and oak savannas have been destroyed, chiefly by agriculture.

California Native Grasslands

By one estimate the 22 million acres of native grassland in California existing prior to European settlement have been reduced to 220,000 acres, a 99% loss. Some grassland types, such as needlegrass steppe, have declined by over 99%. Agriculture, urban development, livestock grazing, fire suppression, and exotic invasions all share responsibility for the loss of these grasslands. The remnants often can be found on serpentine substrates, where the native plants have a slight competitive edge over the aliens. Many hundreds of thousands of acres of non-native grasslands now blanket California.

Southwestern Riparian Forests

The riparian forests of the Southwest are the most structurally diverse and species-rich communities in the region. An estimated 80% of all vertebrate species in Arizona and New Mexico depend on riparian areas for at least part of their life cycles, and most cannot survive without access to riparian zones. More than 100 state and federally listed species in Arizona and New Mexico are associated with riparian cottonwood/willow forests. These communities have declined by over 90% since European settlement, the major cause being livestock grazing. Other threats include dams, water withdrawals for irrigation, conversion to agriculture or urban habitats, and invasion of alien species.

Coastal Communities

Wild ocean shorelines outside of Alaska are now limited to a small part of Maine, the "Big Bend" coast of Florida (along the Gulf of Mexico where the peninsula meets the panhandle), a section of the Olympic Peninsula of Washington that is a National Park, and smaller stretches in other states. Similarly, the Great Lakes and other lakes have been heavily developed. Beach and coastal strand communities (occurring on dunes) are most heavily affected; in many coastal states, these are considered among the rarest and most vulnerable habitats. Estuarine and near-shore marine communities, including seagrass beds, are also heavily modified in most coastal regions.

Southern California Coastal Sage Scrub

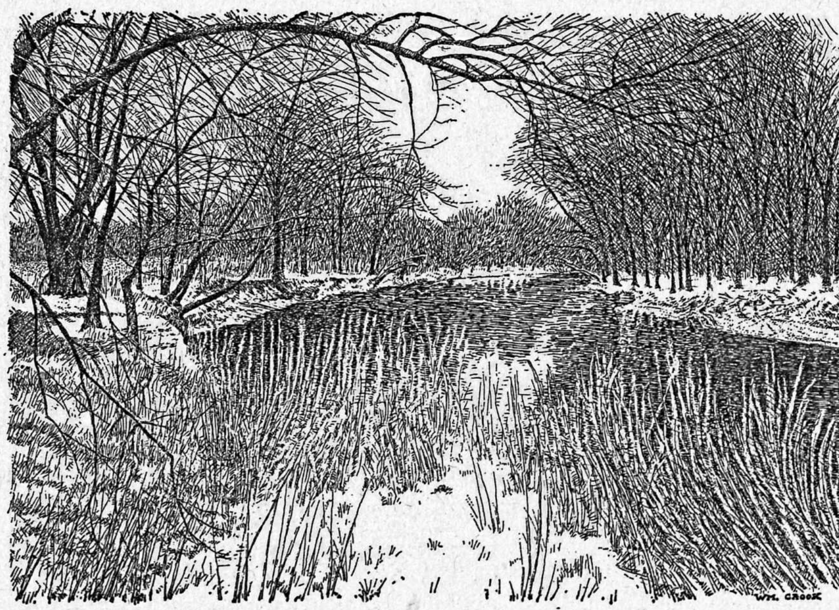
The coastal sage scrub of southern California, dominated by California Sagebrush, buckwheat, and several herbaceous sage (*Salvia*) species, is situated on real estate worth billions of dollars. It is also a hotbed of rare species. Two federally listed species and 53 candidate species are associated with this community. The most notorious of these species is the California Gnatcatcher, listed as Threatened, which has interfered with the plans of developers. The gnatcatcher and other species have become imperiled as the coastal sage scrub has declined by as much as 90% since European settlement. The state's Natural Community Conservation Planning process, although promising a scientific approach to ecosystem-level conservation, has so far not succeeded in granting secure protection to this community.

Hawaiian Dry Forests

Hawaiian dry forests, found mostly on leeward slopes with less than 50 inches of rainfall annually, contain a high diversity of trees in open-statured stands. The lowland dry forests, where annual rainfall may be as little as 10 inches, are savanna-like and grade into shrubland and grassland. Many of the trees in these lowland forests are deciduous. On the main islands of Hawaii, an estimated 90% of the dry forests and associated shrublands and grasslands have been destroyed. Some of the rarest trees in Hawaii are found in these forests, including endemic genera that are virtually extinct in the wild. The many listed and candidate species include vines, shrubs, trees, herbs, and birds. Destruction of dry forests in Hawaii began with the Polynesians prior to European contact, but has escalated recently. Alien trees and grasses and feral animals are among the greatest threats.

Large Streams and Rivers

Dam and levee construction, channelization, water diversion for agriculture, sewage and chemical pollutants, and silt from farmlands, clearcuts, and construction sites are among the many insults to freshwater ecosystems. Although lakes and small streams are also affected by these and other activities, large streams and rivers appear to be the most highly endangered aquatic ecosystems. As mentioned above, 98% of streams nationwide are degraded enough to be unworthy of federal designation as Wild or Scenic Rivers. Only 42 high-quality, free-flowing (no major dams) rivers longer than 124 miles remain in the 48 conterminous states. Only six rivers this long flow unimpounded to the sea. In the Mississippi Alluvial Plain, virtually every stream has been channelized, leveed, or otherwise altered.



Caves and Karst Systems

Little information exists on the status of caves and karst landscapes around the country, but reports suggest that very few caves are pristine. The faunas of caves include both terrestrial and aquatic forms. Some—like endemic blind crayfish, fish, salamanders, and insects—are restricted to cave environments for their entire life cycles. Others, such as bats, hibernate or bear young in caves but forage elsewhere. The aquatic communities of caves in most regions have been severely altered by groundwater pollution. Above-ground development has sealed cave entrances or altered air flow in many caves, changing the microclimate and preventing bats from entering or exiting. Bats are easily disturbed in caves; arousal during hibernation can be lethal and mothers in maternity colonies often drop their young when disturbed. I estimate that probably less than 10% of cave biotas nationwide are intact.

illustration by William Crook Jr. from his Sangamon River Series

Tallgrass Prairie

The tallgrass prairie of the Midwest and Great Plains was a biome unique to North America and one of the greatest natural spectacles on Earth. An estimated 99% of the tallgrass prairie east of the Missouri River and 85% west of the Missouri River has been destroyed, mostly by agriculture but some by fire suppression. The remaining pieces of prairie are mostly tiny sites that were too rocky, sandy, wet, dry, or inaccessible to plow. None of them can support the entire prairie ecosystem, which would include thousands of free-roaming American Bison.

California Riparian Forests and Wetlands

The losses of riparian forests in California rival those of the desert Southwest described earlier (and, of course, California includes some of the desert Southwest). Many riparian areas also qualify as wetlands. Estimated losses of riparian forest throughout California are about 90%. Losses in the Central Valley may be as high as 98%, or even 99.9% for riparian oak forests. Similarly, estimates of wetland losses in California range from 91% statewide to 94-96% in the Central Valley. Vernal pools, unique wetlands that form briefly with winter rains and are home to many rare and endemic plants, have declined by as much as 88% in the Central Valley and 97% in southern California. The loss of coastal wetlands is estimated at 80-90%. Again, agriculture has been the primary culprit, but urban development is rapidly becoming a leading threat.

Florida Scrub

The Florida scrub is a showcase of evolution. Occupying coastal dunes and ridges that define ancient shorelines, scrub vegetation includes sparse patches of Florida Rosemary and lichens, thickets of stunted oaks, and dense stands of Sand Pine. These communities form a successional sequence, set back every 10 to 50 years by intense, stand-replacing fires. The ancient scrubs of the Lake Wales Ridge of south-central Florida are especially valuable, with some of the greatest densities of endemic species and subspecies of any continental habitat in the world. These taxa apparently evolved during interglacial periods when sea levels were much higher than today, and present scrub sites were an archipelago of islands. Citrus farming and housing development are the greatest threats to the Florida scrub and some 65-75% has already been eliminated.

Old-growth Eastern Deciduous Forest

The broad category of eastern deciduous forest includes hundreds of plant communities, some more endangered than others. Across these communities, however, old-growth and primary (virgin) stands have been virtually eliminated, with losses estimated at over 99%. The biological consequences of this loss are hard to decipher. In regions such as the Southern Appalachians, most of the terrestrial species listed as threatened or endangered are associated with deciduous forests, especially older stands. Remnant old-growth stands are still being discovered in the East, and may be more abundant than previously suspected, but most are tiny. Some second-growth forests are regaining old-growth characteristics, but research suggests that decades or even centuries may be required for the herbaceous species composition of these forests to recover fully.

Old-growth Forests of the Pacific Northwest

This category comprises the "westside" forests that occur from northwestern California through western Washington, west of the crest of the Cascade Mountains. Included is the Klamath-Siskiyou province of northwestern California and southwestern Oregon, one of the centers of temperate biodiversity worldwide, and the coastal Redwoods, the largest living things in the world. Douglas-fir, the dominant tree during the first several hundred years of succession in most westside forests, rivals coastal Redwood in height and biomass. Collectively, these forests are home to thousands of species. Four federally listed species and 22 candidates are associated with old-growth Douglas-fir forests. Loggers have destroyed some 90% of the westside old growth. Plans to protect the Northern Spotted Owl, Marbled Murrelet, salmon stocks, and the biggest trees will protect some of the remaining old growth; but about 30% will be logged under President Clinton's forest plan, and much of the rest is now open to "salvage" cutting due to recent passage of the infamous recisions rider.

Old-growth Red and White Pine Forests

The forests of the Great Lakes states, especially northern Michigan and much of northern Wisconsin and Minnesota, once were distinguished by their old-growth Red and White Pines. White Pines were the tallest of all eastern trees, sometimes exceeding 200 feet. Often considered part of the northern hardwood forest, these forests were mostly destroyed in the late 19th century by heavy selective logging and subsequent slash fires. Only about 2000 acres, or 0.05% of the original 4 million acres, remains of intact mature and old-growth Red and White Pine in Michigan. Red and White Pine forests have declined by about 86% in Minnesota, and much of what remains is in Red Pine plantations. As with many eastern forest losses that occurred decades or more ago, the consequences of this devastation were not documented.

Old-growth Ponderosa Pine Forests

Ponderosa Pine has a wide range across the West and occurs in many different biological communities. Yet, across this range, old forests of Ponderosa Pine—like the Longleaf Pines of the Southeast—are characteristically open and park-like, maintained by frequent, low-intensity ground fires. Ponderosa Pine forests have been heavily affected by logging, both clearcutting and selective cutting. An even more severe threat is fire suppression, which has resulted in crowded stands dominated by small trees and highly susceptible to drought, disease, and insect attack. Recent research and revisitation of research done earlier this century suggest that livestock grazing may play an equal and complementary role with fire suppression in degrading Ponderosa Pine stands. Fire suppression has also allowed invasion of Ponderosa Pine stands by Douglas-fir, true firs, and other woody plants less tolerant of fire but more tolerant of shade. Although range-wide losses of old growth have not been reliably estimated, an analysis of three National Forests in eastern Oregon showed 92-98% losses of old-growth Ponderosa Pine. Some 60-70% of remaining Ponderosa Pine in Idaho is considered degraded due to fire suppression, and the more accessible areas have been high-graded. White-headed Woodpeckers and Flammulated Owls seem to be among the species that are declining as a result of these changes.

Midwestern Wetlands

Most statistics on wetland losses lump many diverse plant communities into one category, even though some kinds of wetlands are at far greater risk than others. Nevertheless, the declines reported are alarming. For example, summary statistics for wetland losses in the Midwest between the 1780s and 1980s, compiled by the US Fish and Wildlife Service, show total losses of 90% in Ohio, 89% in Iowa, 87% in Indiana and Missouri, 85% in Illinois, 50% in Michigan and Minnesota, 49% in North Dakota, 48% in Kansas, 46% in Wisconsin, and 35% in Nebraska and South Dakota. Some other sources cite higher losses, for example, 99% in Iowa and Illinois. Statistics on specific wetland communities include a 65-77% loss of fens in Iowa, 80% loss of southern tamarack swamp in Michigan, 60-70% loss of coastal marsh in Michigan, >99% loss of sedge meadows in Wisconsin, 90% loss of eastern Nebraska saline wetlands, and a 60-65% loss of prairie potholes in the upper Great Plains. The major factor in these losses has been draining for agriculture, followed by woody plant invasion (often related to fire suppression), livestock grazing, mining, and urban development.

Southern Forested Wetlands

Included in this group are the bottomland hardwood forests of the South and several other imperiled communities, notably Atlantic White-cedar swamps. Bottomland hardwood forests have declined by approximately 80% as a result of logging and damming and channelization of the river systems that support them. Most of the remaining stands have been logged of their huge cypress and other valuable trees. Atlantic White-cedar swamps originally stretched from southern New England to Mississippi, with the greatest concentration in the Great Dismal Swamp of Virginia, where this community has declined by some 98-99%. The Ivory-Billed Woodpecker, one of the inhabitants of southern forested wetlands, is now extinct in the US and on the verge of extinction in Cuba, its last home. Many rare species, including the Louisiana Black Bear, depend on the forested wetlands that remain.

Every region, every ecosystem, every natural area, every species, and every population in its native habitat is precious.

PROTECTING ENDANGERED ECOSYSTEMS

What can activists working on wildlands-type projects do with information on endangered ecosystems? A basic premise of The Wildlands Project is that each and every region, every ecosystem, every natural area, every species, and every population in its native habitat is precious. Selecting priority areas through any kind of conservation evaluation is only a way to minimize the losses of biodiversity as we struggle through the long-term process of regaining harmony with the living world around us. Conservationist Rosalie Edge once said that the time to save species is while they are still common. Yet no serious conservationist questions the practical necessity of identifying endangered species before they slip over the brink to extinction. These species have one last chance; without our help many of them will perish. Because humans drove species to this perilous state, we have the responsibility of helping them recover.

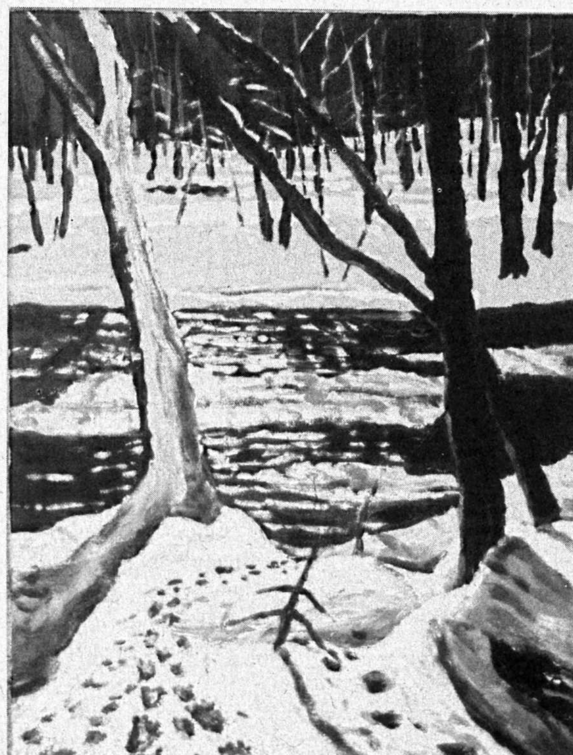
Similarly, identifying endangered ecosystems and sites of high conservation value is necessary because we can't, in the short term, protect every acre of habitat. Endangered ecosystems are those that, if not protected, will soon be gone, along with the species that are uniquely associated with them. Protecting endangered ecosystems does not mean we ignore other types of habitats, but those other areas have a little more time in their favor. Thus, conservationists in the northern Rocky Mountains, Alaska, or Maine may be dismayed to find their regions missing from the priority list of endangered ecosystems. Instead they should be happy. Their regions will come out as high priorities when ranked by other criteria (for example, roadless areas, potential for recovery of large carnivores), but at least their losses of natural communities, so far, have been low compared to other regions.

The Wildlands Project methodology uses multiple indicators for weighing the relative conservation value of sites: under-represented habitat types, concentrations of rare species, roadless areas, important watersheds for anadromous fish, key habitat linkages for large mammals, and many others. Endangered ecosystems—defined by such criteria as extent of decline, rarity, risk of further decline, and number of imperiled species associated with them—should be one of the key data layers to be mapped and overlaid with others to determine priorities for core areas in reserve networks. The various sites and landscapes in a region can be evaluated and ranked by many criteria, and the criteria can be weighted differently to reflect the interests of the evaluator. In some regions, there may be no highly endangered ecosystems, so this criterion would be weighted low.

A fundamental difference between the endangered ecosystem criterion and many others is that highly degraded sites may be mapped as top priorities if they are among the only or best remaining examples of a particular natural community that has suffered massive declines. Other sites in more pristine condition, but containing habitat types that are still relatively common and not at immediate risk of loss, may be ranked lower. For example, sites containing low-elevation forests and grasslands that have been high-graded and grazed may come out as higher priorities than high-elevation roadless areas that remain wild. This apparent absurdity may anger and confuse some conservationists, especially those from a wilderness protection background. Unfortunately, such situations do tend to pit the two guiding concepts of The Wildlands Project—wildness and biodiversity—against each other. What to do? One must take a "big picture" view and weigh the relative risks in the short term versus the potential for recovery in the long term. It may be that the low-elevation, degraded site can wait a few years for protection, as its condition won't get much worse over that time, but the high-elevation site is threatened by a timber sale. Alternately, the high-elevation site may have low timber value and not be at immediate risk, whereas the low-elevation site contains populations of species that face a high probability of going extinct soon unless their habitat conditions are improved quickly.

Protection alone does not do much for endangered ecosystems. Restoration is always a necessary element of the conservation strategy for these systems. Ecological recovery takes time. It may require decades or even centuries for a landscape to regain its natural character with healthy populations of all native species. But in many cases human actions can greatly accelerate the healing process. For example, roads can be ripped, slopes recontoured, and roadbeds revegetated. Tree plantations can be thinned, providing opportunities for many native species to colonize the site. Streams can be dechannelized; though expensive, this is being done in some areas, such as Florida's Kissimmee River. Because many of the most highly endangered terrestrial ecosystems are fire-dependent and have declined as a result of fire suppression, prescribed burning is an effective restoration technique. Degraded grasslands, savannas, and pinelands often come back beautifully after fire treatments. Populations of threatened and endangered species respond positively as their habitat conditions improve. It is crucial that conservation biologists, restoration ecologists, and wildlands activists learn to work together to identify priority restoration projects and then implement them.

The information I have been able to obtain on endangered ecosystems is spotty and, in many cases, anecdotal. Because there has been no systematic national survey of the status and trends of biodiversity, especially at the ecosystem level, all lists of endangered ecosystems are preliminary. Needed now are detailed comparisons between maps of vegetation prior to European settlement and today. Unfortunately, there is no national map of vegetation as it existed before European settlement (the closest approximation, Kuchler's map of potential natural vegetation, has many flaws because he assumed climax conditions and an absence of fire and other disturbance). Until the NBS state gap analyses are completed, there will be no national map of present vegetation either. Case studies on a regional scale, however, are achievable and can be very instructive. For example, Jim Strittholt, staff ecologist for The Wildlands Project, mapped present and presettlement vegetation for the Edge of Appalachia region in southern Ohio, as part of his Ph.D. dissertation project. Strittholt was able to identify particular vegetation types, such as mesic and wet hardwood forests, that have suffered disproportionate declines since settlement. This information was used in making explicit reserve acquisition recommendations to The Nature Conservancy. Of course, maps alone do not tell us everything we need to know to accomplish ecological recovery. A map of presettlement vegetation is just a snapshot in time, and vegetation is continually



An appealing rule is that not one more acre of any diminished ecosystem type be destroyed; that is, stop all logging of old-growth forest, all development in southern California coastal sage scrub, all cutting of Longleaf Pine, and all dams.

Solstice Noon, Paseco *acrylic painting by Bill Amadon* changing. Therefore, information on the processes (fire, hydrology, predation, etc.) that keep ecosystems functioning healthily is essential.

I will close with a few summary suggestions for incorporating information on endangered ecosystems into wildlands recovery efforts. Most important, conservation of ecosystems must address the factors that have caused ecosystems and their associated species to become endangered in the first place. Ecosystem impoverishment occurs when distinct habitats and plant and animal communities are diminished in area, fragmented into small and isolated pieces, or degraded in quality. Much of the degradation can be traced to alteration of essential ecological processes such as fires, floods, and predator-prey relationships. As ecosystems decline in area or quality, the species that compose them and depend on them also decline. Thus, an inevitable consequence of ecosystem degradation is an ever expanding list of endangered species. This impoverishment can only be stopped by reversing the specific trends that led to it—by enlarging and connecting protected areas, closing roads, controlling exotics, applying fire, removing dams and diversions, restoring the natural meanders of streams, and so on.

An appealing rule is that not one more acre of any diminished ecosystem type be destroyed; that is, stop all logging of old-growth forest, all development in southern California coastal sage scrub, all cutting of Longleaf Pine, and all dams. This rule is unlikely to be followed in the near future. Thus, conservationists are often forced to "write off" small, degraded examples of some ecosystems as lost causes; chances are, the populations of sensitive species in those areas will not survive anyway. Although I am uncomfortable with writing off any natural or even semi-natural area as a lost cause, it is true that certain sites—for instance, a small patch of prairie or scrub surrounded by residential development—are not biologically viable and not, in the foreseeable future, restorable. Therefore, with our limited time and money, we will be most successful putting our efforts into protecting large, restorable patches or stretches of endangered ecosystems.

The following guidelines for conserving and restoring ecosystems may be helpful:

1. Base priorities for ecosystem conservation on three complementary objectives: a) protect immediately all remaining, potentially viable examples of the most highly endangered ecosystems; b) protect multiple, viable examples of all native ecosystems, regardless of current rarity or threat, and c) identify long-term conservation, management, and restoration needs for all major ecosystems.

2. Give most urgent attention to the most highly endangered ecosystems. Otherwise, the opportunity to save them may soon be lost.

3. Supplement data from ecological inventories at various scales (gap analysis, heritage programs, etc.) with detailed studies of the status and trends of particular ecosystem types. These studies should include, for each ecosystem type: a) quantitative assessments of present area compared to area prior to European settlement; b) land ownership and protection status of remaining occurrences (i.e., a detailed gap analysis); c) focused studies of ecological relationships and requirements of the ecosystem type; d) identification and assessment of specific threats to the viability of remaining occurrences; e) specific protection, management, restoration, and research needs.

4. Use information from ecological inventories and detailed studies to revise the priority list of endangered ecosystems. The list should be continually updated on the basis of the most current and defensible information.

5. Support efforts to map the vegetation and physical habitats of every region, including gap analysis projects (which map vegetation in the US at 1:100,000 scale) and higher-resolution projects (e.g., 1:24,000 scale). The highest priority endangered ecosystems recognized on the basis of available data should be mapped in detail, with specific parcels in need of protection clearly delineated.

6. Draft or support legislation aimed at ecosystem-level conservation. National, state, or local legislation designed to protect ecosystems should include at least three components: a) endangered ecosystems, focusing on those ecosystems that have declined most and are at greatest risk of further decline; b) representative ecosystems, including attention to conservation of ecosystem types that are still common; and c) ecosystem inventory, research, and monitoring (see my article on a Native Ecosystems Act in *Wild Earth*, Spring 1991).

7. Support adaptation of existing law to conservation of ecosystems. For example, amendments to the Endangered Species Act and revisions of regulations implementing the Act should emphasize multi-species listing and recovery efforts. As a case in point, the nearly 100 candidate species associated with the Longleaf Pine-Wiregrass ecosystem in the Southeast could be listed together in one package. Multi-species recovery plans could be devised for them and for the 27 species associated with this ecosystem that are already listed as Threatened or Endangered. Specific recovery actions would then involve groups of these species that occur together in particular places. Ecosystem-based, multi-species efforts will result in a more efficient and cost-effective Endangered Species Act, which should please even political conservatives.

8. After identifying landscapes that contain endangered ecosystems and ecosystems that are currently under-represented in reserves, protect them. The model of reserves embedded in a multiple-use landscape managed under the guidance of ecological principles is widely accepted. Core reserves, the most strictly protected areas, should be located and designed to capture the highest quality examples of each ecosystem type, the sites most sensitive to human disturbance, and the sites harboring the greatest concentrations of rare and sensitive species. Less sensitive sites can be relegated to other zones.

9. Restore and protect natural processes. Conservation at the ecosystem level is not simply a matter of setting aside examples of ecosystem types. Ecosystems remain viable only when their processes—nutrient cycling, energy flow, hydrology, disturbance-recovery regimes, predator-prey dynamics, etc.—continue to operate within their natural range of variability. In fragmented landscapes and other areas with a long history of human use, active management is often necessary to substitute for natural processes that have been disrupted. Prescribed burning, for example, is a useful management tool for vegetation types adapted to frequent fire. In landscapes that have lost their large carnivores, herbivores such as deer often become overabundant and require control.

10. Whenever possible, design management and restoration strategies for *landscapes*, which are mosaics of many communities, rather than for specific communities or habitats. The various habitats and communities in a landscape are functionally linked by ecological processes, and many terrestrial animals require a mosaic of plant communities to meet their life history needs. Furthermore, the integrity of aquatic ecosystems is directly linked to the condition of the landscapes around them. ∎

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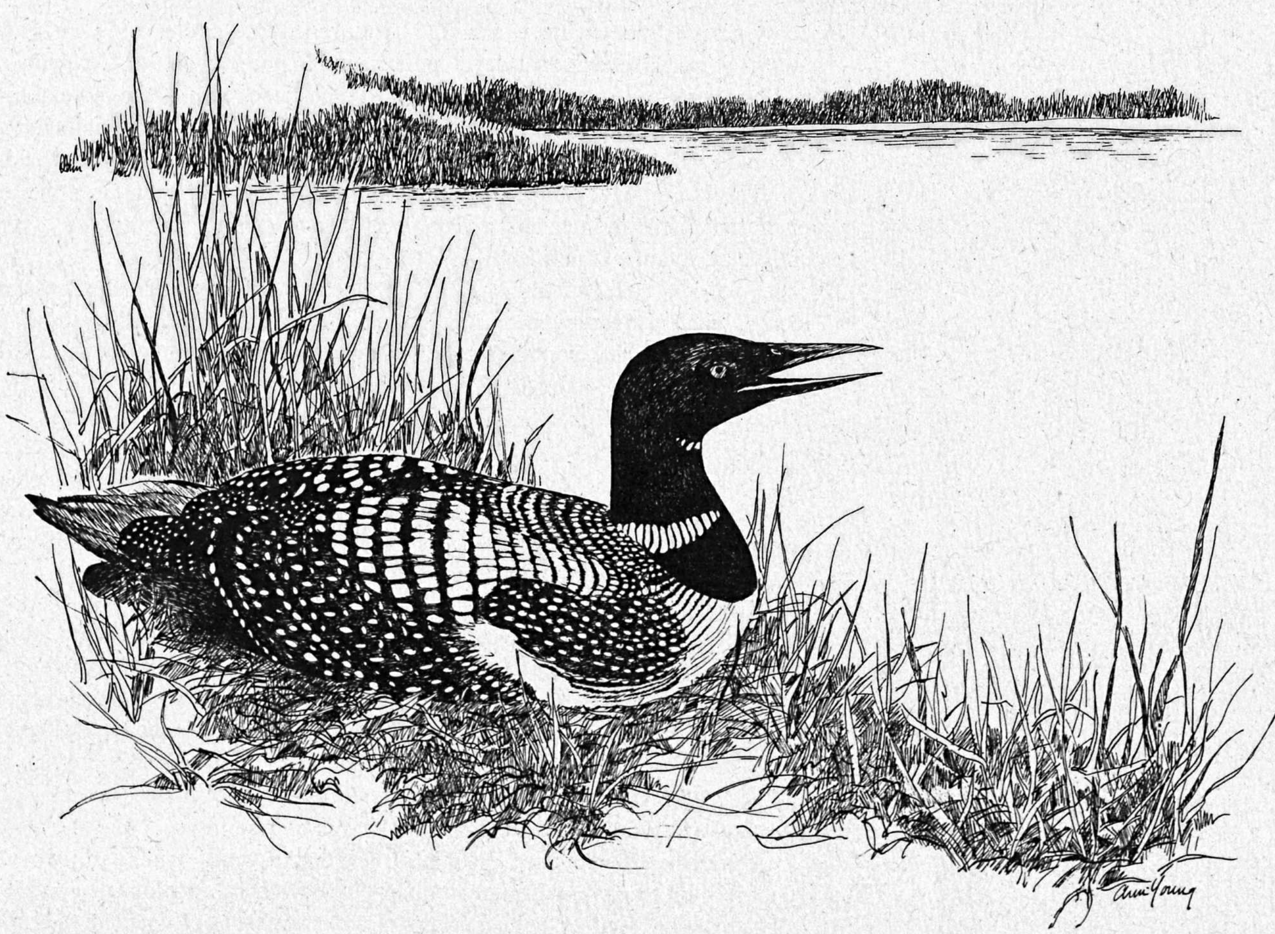


illustration by Ann Young

Mapping Reserves Wins Commitment

The Southern Rockies Ecosystem Project

by Roz McClellan

THE SOUTHERN ROCKIES ECOSYSTEM PROJECT (SREP) is working to map a reserve system for the Southern Rockies, extending from Caspar, Wyoming, to Santa Fe, New Mexico, that would preserve a full range of species and ecosystems native to the region. SREP is collaborating on this with the Colorado Environmental Coalition (CEC).

The time frame for creating the reserve plan is being outpaced by the rate of ecosystem destruction, however, as the areas needed for the reserve system are eaten away by roads, recreational development, and logging. Many of Colorado's last roadless lands are succumbing to motorized trails, jeep roads, and a wave of timber sales expedited by the new salvage logging law. Many roadless area timber sales in Colorado are being classified as salvage sales and are now exempt from appeal.

This is a time for painstaking on-the-ground vigilance and dug-in commitment on the part of environmentalists. SREP has found that mapping a reserve system can enlist that kind of commitment.

For the past three summers, SREP's regional mapping coordinators have trained local volunteers to survey roads, roadless areas, old growth and other features of their National Forests. The mapping has proved to be an irresistible draw for new activists who like the idea of getting out into the mountains, promoting visionary concepts, and influencing the Forest Service all at the same time.

On-the-ground mapping appeals to people's innate love of exploring, giving ordinary weekend hikes a sense of adventure and mission.

Scores of new volunteers across the state are combing the landscape each summer for old growth stands, riparian areas, signs of wildlife, roads needing closure, and other data necessary for reserve design. The reserve proposals in turn are used to pressure the Forest Service into adopting biologically sound management plans.

SREP recruits local volunteers through slide shows, public service announcements, and local networking. New volunteers are trained to identify simple vegetation types, old-growth characteristics, range conditions, road usage and other ecological factors pertinent to wildlife. Equipped with basic naturalist training, survey forms and maps, the volunteers are then assigned specific areas to survey. This past summer, for example, volunteers used road survey forms taken from Road RIP [see Road RIP article this issue] to analyze road densities in sensitive ecosystem types on the Rio Grande National Forest. Data collected by the volunteers are transposed onto map overlays which are then used in designing reserve proposals.

Through hard experience, SREP has found that surveying is more effective when volunteers are groundtruthing already mapped data rather than using open-ended survey forms. For example, volunteers now field check maps of potential old-growth stands developed by SREP's interns from Forest Service timber stand data.

In responding to site-specific threats such as timber sales, SREP also uses a mapping technique developed by the Forest Conservation Council in Santa Fe. Overlays of topography, vegetation, administrative boundaries, old growth, natural heritage sites and other variables are combined to identify the cumulative impacts and geographical constraints of a particular timber sale.

Although lacking in the scientific rigor that will come when GIS is acquired, SREP's and CEC's preliminary reserve maps have been adopted by three National Forests thus far to be evaluated in the forest plan revisions among a range of management alternatives. Even though the Forest Service has not selected any of them as its preferred alternatives, the reserve plans have had the effect of getting the agency to incorporate into its draft plans the concepts of habitat fragmentation and landscape connectivity. The reserve maps also serve as a focus for rallying public input to the Forest Service. Thus, in addition to setting high scientific standards for the Forest Service, reserve mapping is helping reanimate Colorado's environmental movement.

On-the-ground mapping appeals to people's innate love of exploring, giving ordinary weekend hikes a sense of adventure and mission. SREP's volunteers enjoy the naturalist training, learning to identify forest types, old growth, and wildlife in general. The concepts of conservation biology make sense to new activists, who find the idea of large, connected reserves inspiring and motivating at a time when it is difficult for environmentalists to find hope. Conservation biology gives new credence to what people know instinctively but previously could not explain. People also take satisfaction in knowing their mapped observations will be used to good purpose and tied into something bigger. Basically, SREP has found that people love maps!

Reserve mapping also gives conservationists a greater stake in the land. Public lands politics these days tend to be swayed by groups with a direct economic interest in the land, such as logging or livestock grazing. Similarly, the Forest Service seems to be listening to well-organized groups such as the off-road vehicle users who go out in groups to maintain motorized trails.

Conservationists have been less adept at expressing their less tangible, if equally strong, investment in the land. Ecosystem mapping gets people into the backcountry, giving them the on-the-ground knowledge they need to establish credibility with the Forest Service and other decision-makers. Once volunteers are invested in public lands, they have a stake in the legislation affecting these lands. Indeed, SREP's mapping network also serves as a Congressional phone network.

A comprehensive reserve plan for the Southern Rockies may not be in the offing tomorrow. However, the mapping process itself is holding the line meanwhile, maintaining environmental commitment, countering threats to roadless areas, keeping the Forest Service accountable, and building the data needed for reserve design. In the current (and temporary, we may reasonably hope) age of darkness, ecosystem mapping provides a ray of hope and a thread of continuity for embattled conservationists. ∎

Roz McClellan is a founding member of TWP and coordinates ecosystem mapping in Colorado.

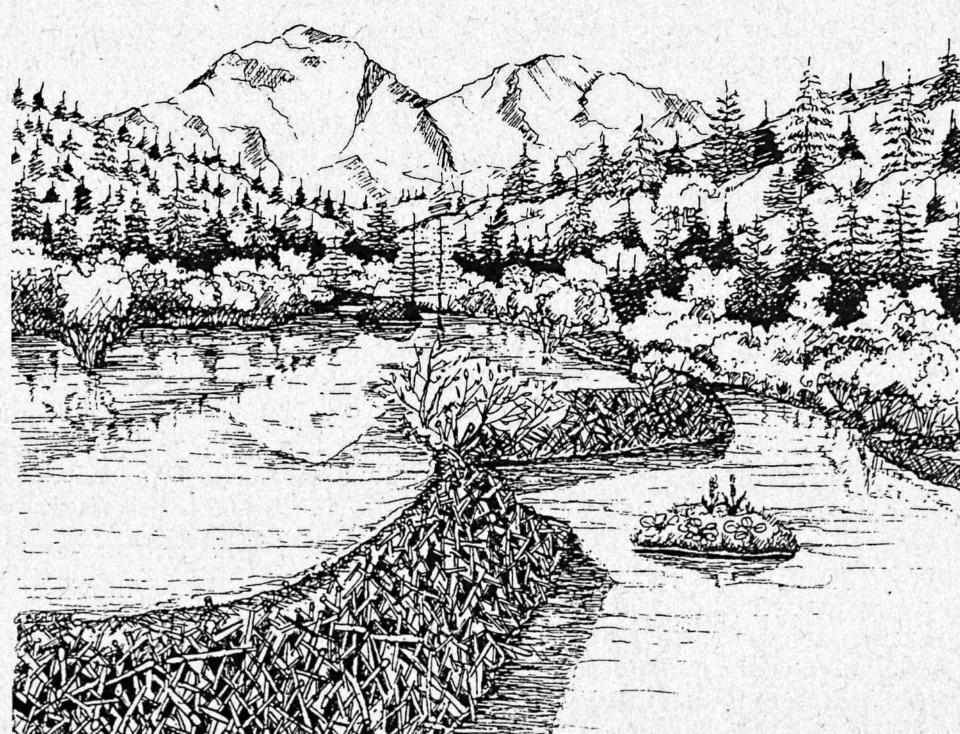


illustration by Gary Bentrup

Getting from Here to There

An Outline of the Wildlands Reserve Design Process

by David Johns and Michael Soulé

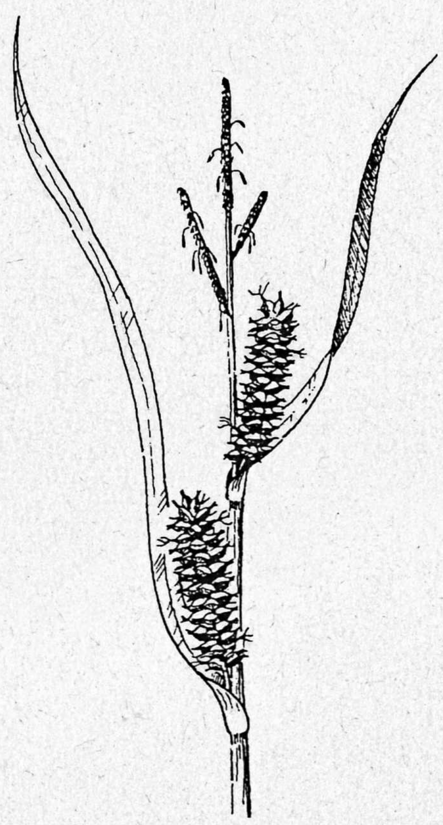
Turning back the assault on the natural world is a monumental and complex task; even the first step—planning a network of reserves—is an enormous undertaking. This paper is intended as a general guide to the steps needed to produce a regional proposal for a Wildlands reserve system. It is based on an assessment of work underway in some regions, and extensive discussion with regional groups throughout the continent. The process will change with experience. Each region of North America is unique biologically and culturally, so for each region the process of developing a reserve system will vary. Think of the outline below, then, as a preliminary check list of important elements in the process and of what you and Wildlands staff may bring to the process.

In the following, you will note several important themes. One of these is *scientific credibility.* Our vision for recovery and protection of wildness and diversity is based on conservation biology and related principles. Our reserve designs must be based on the long-term needs of wolves, salmon and many other creatures. Our designs must consider the life history requirements, demographic dynamics, genetic viability, dispersal behavior, and other aspects of their fitness. Our proposals must stand up to review by outside scientists. They need to be as "bullet proof" as possible.

Another important theme is *broad-based support.* Being morally and scientifically right is not enough. Policy-makers ignore what is right all the time. Both the conservation community and the public must understand and support Wildlands proposals for them to be successful. This means people need to be involved in the process, not just have a completed proposal presented to them. It means thinking about who our potential allies are and bringing them on board sooner rather than later. It means ideas flow *both ways*, not just from activists and scientists to the public. It does not mean we relinquish our values.

Indeed, we must keep our *values* in the forefront. We are talking about creating a new vision for North America: one based on biological health; one that says "yes" to the web of life and all of our co-voyagers. Most human beings feel connected to the earth and appreciate that all life should be free to follow its evolutionary path. We must deepen and inform that feeling, try to make clear what must be done to protect that freedom.

Professionalism is important. Along with good scientists, we need organizers, fundraisers, public speakers, community leaders, artists, writers, mappers, and others. We need to identify people with these skills and bring them in. The generalist grassroots activist remains the backbone of our effort, but we need specialist skills as well.



Beaked Sedge (Carex rostrata) *by Gary Bentrup*

Finally, there is *funding*. Creating Wildlands reserve networks will not happen without funds. While The Wildlands Project cannot fund the regional reserve design process, staff can help with fundraising. Developing a strategy to secure financial support for regional reserve design must be a priority.

In reading the outline and the sections below that accompany each item in the outline, please keep in mind the variability of regional contexts—ecologically and culturally, as well as in terms of how much reserve design work activists in the region have already done and what resources they (you) have. Some regional groups have nearly completed the early steps listed in the table; others are just beginning. Wherever you are in the process, the Project has material that may help you with reserve design, including sources of biological information, descriptions of others' experiences designing reserves, and lists of experts. Please contact the Tucson office for such information. Also please keep us informed about your work so we can share it with others.

FUNCTION (U — Undertake; S — Provide support, advice)	suggested TWP responsibilities	suggested regional responsibilities
▮ Hold initial workshop	U	U
▮ Identify or establish organizational structure for wildlands reserve planning, including non-profit status, directing, monitoring & review of work	S	U
▮ Develop work plan describing steps regional players will take to produce a reserve design covering each element: • Science/mapping strategy • Grassroots mobilization • Funding strategy	S	U
▮ Implement funding strategy	S/U	U
▮ Develop community relations strategy for important groups in the region (landowners, agencies, others)	S	U
▮ Locate and obtain existing biological information	S	U
▮ Identify information gaps; gather information to fill gaps	S	U
▮ Identify ecosystem types and key species	S	U
▮ Analyze biological information	S/U	U
▮ Develop preliminary map and narrative	S	U
▮ Conduct preliminary joint review and revision	U	U
▮ Peer review	U	U
▮ Publish drafts for wider community review; hold community meetings	S	U
▮ Analyze economic impact of reserve proposal	S	U
▮ Revise reserve design based on initial community comment, economic analysis and other input	S	U
▮ Publish "final" proposal	U*	U
▮ Develop and implement campaign strategy, including goals for first ten years; hold press conference to launch campaign	S/U	U
*(*Wild Earth*)		

Hold initial workshops.

Initial meetings should bring together key people in the region and Wildlands staff. A good size is 30-40 people. This is not a place to debate the need for the vision—participants should already be committed. Workshops will assess biodiversity in the region and threats to it, the status of conservation work, and how Wildlands reserve design can build upon existing efforts.

Without making the meeting unwieldy in size, workshops should include activists and skilled committed professionals. It is important to reach out and be responsive to those interested. Wildlands reserve design excites people, but the excitement wanes if we do not have ways for people to participate.

Among potential key players in each region are:

- grassroots wilderness, conservation, and wildlife groups, including those from indigenous communities
- recreation groups (hikers, boaters, hunters, etc.)
- chapters of national and international groups like Sierra Club, The Nature Conservancy, The Wilderness Society
- scientists, chapters of the Society for Conservation Biology, Society for Ecological Restoration, the Wildlife Society; university biology, zoology, botany, ecology, wildlife departments
- staff from natural resource and conservation agencies
- individuals with a wide range of skills who have a strong commitment to wilderness and biodiversity, including lawyers, economists, media people, and business people
- potential funders

Identify or establish an organizational structure for wildlands work.

One of the products of the initial meeting(s) needs to be an organizational structure that can oversee planning in the region. Such a structure may utilize existing groups for legal or non-profit status, but should have a coordinating committee focused exclusively on Wildlands reserve design. This committee should represent the various constituent groups in the region who are committed to wildlands goals, including those just listed. Geographic areas within the region should all be represented if possible, as should important skills such as organizing, fundraising, public relations, and field biology. The coordinating committee, and possibly its staff, will be the ones primarily working with Wildlands staff.

Develop regional work plan for reserve design.

The coordinating committee should develop an action plan for reserve design in the region, to be approved by groups participating in the process. The plan should outline who will do what and by when. It should address three broad areas: gathering and analyzing biological information and mapping reserves based on this information; involving various organized groups and the public in the process at the appropriate times; and identifying the resources needed to complete reserve design and begin a campaign to obtain these resources. Some of the major elements in each of these areas are noted below.

The plan should also make clear how and when progress will be assessed. Plans must be open to revision. Priorities and objectives should be revisited periodically.

Implement funding strategy.

Identify potential sources of support for Wildlands work, including foundations, major donors, membership, and events. Usually these sources will be different from support received by local or regional groups for ongoing efforts. Project staff can provide recommendations on potential sources of support. Consider joint fundraising efforts between cooperating regional groups and The Wildlands Project. Funders like to see groups working together.

After finding potential funding sources, write grant proposals, contact major donors, and plan events. Develop a budget that demonstrates to funders how support will be spent, what the product will be, and why it is important. (A budget is also an essential part of the work plan, and provides us one means of gauging progress.) Plan funding events around milestones in the design process.

Combine outreach and education with fundraising. If people support us, they will open their wallets. If they don't open their wallets, their support is not deep and we need better ways to reach them.

Identify important groups in the region.

Who should be involved in the process and when? Identify and reach out to various sectors of the community that are likely supporters or neutral. The wildlands process should be as inclusive as possible without compromising our principles and goals. To have a broadly understood and supported vision for a reserve network, people must be involved in the process. A product produced behind closed doors can alienate potential friends. On the other hand, it's not possible to involve everyone from the very beginning. It is useful to hold a community meeting to display a draft product, and invite people to improve it.

A community relations strategy also needs to anticipate criticism and its sources, and develop creative ways to preempt or respond to it. See publishing section below for additional ideas on public outreach.

Locate and obtain existing biological information.

A first step in the reserve design process is to obtain needed biological information. Important kinds of information for reserve design include existing and historic vegetation and soils, existing and historic distribution of animal species, ownership and current protection, watersheds and hydrography information, ecoregions, and disturbance regimes. More detailed recommendations are available from project staff.

A warning: Don't become a data junkie. An overwhelming amount of information is available—more than we can ever assimilate and use. We must choose what information to compile, keeping in mind our limited budget and timeframe.

Identify information gaps and fill them.

Conduct or sponsor research to fill gaps in biological information. Verify information received from other sources, since it is often out of date. This is an excellent opportunity to involve volunteers in efforts to check, for example, information on old-growth stands; or to have people verify animal movement corridors across roads or other obstacles. Gathering needed biological information can also be done as Ph.D. projects undertaken by graduate students. Here again, we must be realistic about resources and time frames. We are trying to complete regional reserve designs in a three-year period. Our goal is to have a draft plan for North America by 2000.

Identify ecosystem types and key species.

Because our approach emphasizes wilderness and the ecological roles of large animals, we must consider their past and present distribution individually. These species include, depending on the region, River Otter, Beaver, Alligator, turtles, Grizzly Bear, Black Bear, Gray Wolf, Cougar, Bobcat, Lynx, Coyote, Kit Fox, Wolverine, Fisher, Marten, Musk Ox, Bison, Caribou, Pronghorn, Elk, Moose, Bighorn Sheep, Mountain Goat, salmon, Marbled Murrelet, cranes, raptors and others. In addition, we are concerned about biodiversity in the broader sense of viable populations of all native species and perpetuation of all natural processes. Accordingly, we aim to classify ecosystem types and ensure enough of each type of ecosystem is included in protected areas to restore it to health and allow it to retain its diversity.

The Wildlands Project is currently working with World Wildlife Fund and others to complete an ecosystem classification for North America. It is largely complete for Canada and Mesoamerica, but must be finished for Mexico and the US. This information will be provided to groups when available.

Analyze biological information.

Analyze biological information on key species and ecosystems to determine what areas must be strictly protected, where corridors should be, how much needs to be protected and where, what are the compatible uses in buffers, and so on. Answers to these questions involve making judgments and will vary by region. It is important to take into account ecosystem succession in reserve design.

Information should not simply be analyzed by a small elite group. The knowledge, skills and experience of ecologists and biologists will play a big role, but the values and experience of activists and other non-scientists are central. Make information accessible to non-scientists and encourage wide-ranging discussion.

Develop preliminary map and narrative.

The objective is to map reserves, corridors, and buffers based on analysis of the biological information, and to explain that map and information underlying it in narrative form. The maps should show what is needed to achieve our four fundamental goals of maintaining all native species, ecosystems, ecological processes, and resilience. Maps should set priorities as well—here is what we want to protect in 5, 10, 50 and 100 years. Narratives may need to be produced for both a scientific audience and the general public. Narratives need to be clear about our values and goals, and the way in which creating protected areas helps realize these goals.

Keep preliminary maps straightforward. Maps have great power, but can easily be made too complicated. Initially most maps will be at 1:500,000 or 1:250,000 (1:1,000,000 for parts of Canada) and detail may be lacking. Issues of scale and detail are important and we will need to work together to resolve them.

A word on Geographic Information Systems (GIS) or computer mapping: increasingly, much information is only available in computer format. Sharing, reproducing, and changing maps is easier in computer format. Linking maps to underlying information is most easily achieved in this way as well. Computer mapping can be very expensive and intimidating, but there are knowledgeable people in almost every part of North America

THE WILDLANDS PROJECT staff has compiled a selection of papers that we have dubbed the "Reserve Design Framework Package." We will make this information available to cooperating organizations and individuals upon request. This and future updates will be mailed from the Tucson office and any solicitations should be made directly to Tucson.

The framework package will help answer the many important questions surrounding the reserve design process. The material will come to you "handsomely bound" in a three-ring binder which can be expanded as new elements are added.

We would prefer to send this out free of charge, but much of the content is made up of booklets and copied papers that cost the Project in actual cash outlay and in staff time. So we are asking that those interested in the package donate $25 to help defray mailing, handling, and material costs. For more information and a detailed accounting of content and cost, please contact Rod Mondt at The Wildlands Project, POB 5365, Tucson, AZ 85703; (520) 884-0875.

A partial list of contents* for the Framework Package, soon to be available from TWP:

Conservation Strategy

"The Wildlands Project Land Conservation Strategy," by Reed Noss
"How to Design an Ecological Reserve System," by Stephen Trombulak
Marine reserve design guidelines
Articles from *Wild Earth* and other sources on reserve design process: North Cascades, Columbia Mountains, Sonoran Desert/Gulf of California, Yukon, Yellowstone to Yukon, Alaska, Florida, Southern Appalachians, Maine Woods.
Guidelines for undertaking ecosystem representation analysis
"Maintaining Ecological Integrity in Representative Reserve Networks," by Reed Noss
"Endangered Ecosystems of the United States: A Preliminary Assessment of Loss and Degradation," by Reed Noss et al.
"A Protected Areas Gap Analysis Methodology: Planning for the Conservation of Biodiversity," by Stan Rowe et al.
Ecosystem representation analysis in Mexico, by David Olson and Eric Dinnerstein
Reference sheet for protecting Canada's endangered spaces by Monte Hummel et al.
Guidelines for identifying key species, terrestrial and marine
"Large Carnivore Conservation in the Rocky Mountains," by Paul Paquet and Arlin Hackman
Society for Conservation Biology presentations by Paul Paquet and Tim Clark
Corridor design model, by Steve Minta

Mapping

Guidelines for mapping, including data layers, scale, record keeping, mapping standards, by Jim Strittholt
List of GIS labs where services can be obtained
Sources of biological information, strategies for acquisition, by Jim Strittholt and David Johns
Ground-truthing strategies
Mapping marine reserves
Remote sensing, by Jim Strittholt
Case studies of mapping reserves
Guidelines for preparing proposals for peer review and integrating responses from review, by Reed Noss and Jim Strittholt

Political Strategy

Guidelines for involving various groups (conservation, environmental, community, scientists, agencies, etc.) at early stages to ensure broad support without compromising goals
Who are our friends, who are our enemies; who are potential friends, potential enemies; who should we focus outreach on?
Preparing media and outreach materials
Use of The Wildlands Project name in regional work, by David Johns
Conducting economic analysis
List of economic consultants
Community relations strategies
List of community relations consultants
Klamath-Siskiyou community relations strategy, by Kelpe Wilson

Implementation of Reserve Networks

Reference Sheet for *Preserving Family Lands*
"Using Conservation Easements in Creating Regional Reserve Systems," by Brian Dunkiel
List of land trusts
"UN Biodiversity Convention and Existing International Agreements," by Chris Wold

References and resource lists on biodiversity, mapping, corridors, sources of materials (e.g., base maps)

Contacts from other regions
"Non-Profit Organizations, Public Policy, and the Process: A Guide to the Internal Revenue Code and Federal Election Campaign Act," by B. Holly Schadler
"Putting on a Conference: Checklist of Tasks." Originally compiled by the CU Environmental Center, revised by TWP
"Becoming a Better Media Resource," by The Wilderness Society

*Not listed here but also to be included in the framework package are many articles from this and previous editions of *Wild Earth* who can help. Paper and mylar are not extinct, but they are threatened; nonetheless, a great deal can be accomplished with them. Lack of access to GIS should not halt those who want to go forward with mapping.

Conduct preliminary joint review and revision.

Before a reserve proposal is taken to a broader public or sent out for scientific review, it should be reviewed internally. All participating groups and individuals should be part of discussions on the proposal: does it meet our goals; have we done our homework; does it tie in to reserve design work in adjacent regions? Wildlands staff will also offer comments, and try to ensure that the proposal is consistent with other efforts, that the science is rigorous, and that it enjoys regional support. Based on comments and identified shortcomings, the proposal can be revised. Such review will be ongoing, as regional groups, local people, and project staff interact throughout the process of reserve design.

Peer review.

Review by outside scientists is important. It will point out problems in our reserve proposal, enabling us to improve its rigor and credibility. One way to obtain peer review is through the publication process of major biological journals. Before acceptance in such journals, manuscripts are critiqued by experts in the field, and revised to accommodate or respond to criticisms. Another means of review is to simply ask scientists with expertise to review the proposal. In either case, review can take several months. So that the proposal can be properly reviewed, keep good records on sources of biological information, its verification and analysis, and the steps from information to maps.

Publish drafts for wider community review.

At the same time as, or following, peer review, take the draft proposal to the wider community. One way to do this is through a series of community meetings. These may be informal, where members of regional groups invite people to their homes to discuss it. Consider also civic or service club meetings. Calling public meetings may also be useful.

In organizing these meetings, get the help of community relations experts. For meetings early in the process, keep control of the venue: shouting matches with wise-use types are not educational. The goal of these meetings should be to present our findings and ask people how we can improve our conservation proposals. We have to make clear the product we're bringing to people is a draft, not final. The more people who hear about our proposal from us, rather than from the opposition, the better.

Think of the process as creating an ever expanding circle of people who understand and support wildness and biodiversity: networks of people defending networks of land and water.

Analyze economic impacts.

After completing a draft proposal, have an economic impact analysis done. The strongest objections to protection proposals will come from the extraction industries and people who love or make their living from motors. Economic analysis of wilderness and improved protection in the US Pacific Northwest has shown that areas are economically healthier the less dependent they are on extractive industries and the more biologically intact they are. Expose the subsidies extractive industries receive and the other tolls they take on our lives and the lives of other species. Often industries paint conservationists as outsiders to a region, when in fact the companies are multinationals, making their decisions thousands of miles away for the good of wealthy stockholders, not for the good of the community. Show how our proposals will improve the quality of life in the region.

Revise reserve design based on initial community comment, economic analysis and other input.

Revise the proposal to incorporate suggestions that help us better reach our goals. The revision process is not about compromise or backing away from our goals. We need to put before the people of North America an alternative vision, of a biologically healthy continent. Self-censorship would be self-defeating.

Publish "final" proposal and launch campaign.

As the final proposal is put together, including maps, pamphlets, narratives—perhaps also slideshows, videos, press packets—a campaign strategy for implementation should be developed. Address immediate goals for implementation and the means (private lands incentives, changes in management of lands, public land purchase, education). Launch the final proposal at local and regional press conferences attended by important scientists, community leaders and others. Provide materials such as maps, press releases with quotable quotes, *Wild Earth,* and regional publications, recognizing the differing needs of television and print media. Be sure materials are available for the general public as well. Most important, be sure a structure is in place to take advantage of people's desire to do something on behalf of what they love. The public relations strategy should include plans on how to rapidly respond to disinformation campaigns.

Love of nature, boldness of vision, sound organization, and prudential planning will triumph. ▮

David Johns and Michael Soulé are co-founders of TWP. David currently serves as Executive Director of TWP and also teaches political science at Portland State University. Michael is chair of TWP board of directors and is also a co-founder of Society for Conservation Biology, chair of University of California at Santa Cruz's Environmental Studies Department, and author or editor of numerous publications in the field of conservation biology.

A Second Chance for the Northern Forests

8-Million Acre HEADWATERS Wilderness Reserve System Proposed for Northern Maine, New Hampshire, and Vermont

by Jamie Sayen

The Northern Forest Forum (volume 3 #5), publication of the Northern Appalachian Restoration Project, recently proposed the establishment of an 8-million acre network of HEADWATERS Wilderness Reserves in the uninhabited region known as the "industrial forest" of northern Maine, New Hampshire, and Vermont. (For a copy of the Headwaters proposal, write the *Forum*, POB 6, Lancaster, NH 03584.) Calling for "A Second Chance for the Northern Forests," the *Forum*'s proposal offers a blueprint for a 75-year *transition strategy* to sustainable natural and human communities of the Northern Forests.

The proposal outlines a strategy for economic revitalization that would build a locally-controlled economy within the context of protected wildlands to replace the unsustainably exploited industrial forest. The "Second Chance" proposal also outlines strategies for cultural and political restoration for the Headwaters region's communities.

The proposed Headwaters Wilderness Reserve System is a network of 16 reserves stretching from Vermont's Northeast Kingdom across northern New Hampshire and western and northern Maine. It encompasses the wild and remote sections of the headwaters of the region's major rivers: the Connecticut, Androscoggin, Kennebec, Penobscot, St. John-Allagash-Aroostook, and Saco.

The Headwaters proposal calls for incorporating existing public lands—such as Baxter State Park, the Allagash Wilderness Waterway, the White Mountain National Forest, Nash Stream State Forest, and Victory Bog State Forest—into the wildlands system. Almost all of the remaining lands—approximately 7 million acres—are currently owned by a small number of multinational paper corporations, heirs of 19th century timber barons, pension funds, or real estate speculators.

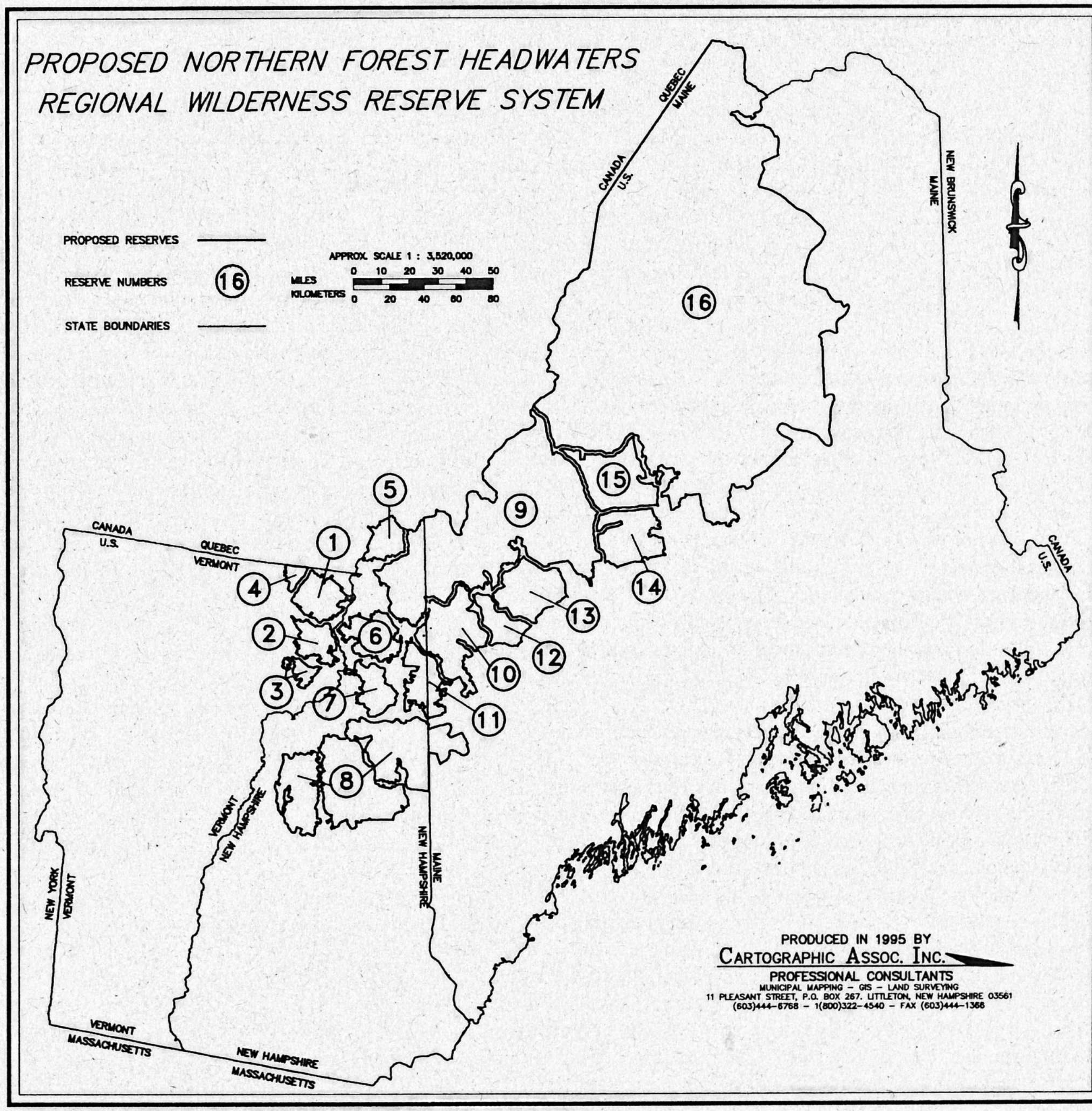
The lands proposed for the Headwaters Wilderness Reserve System have no year-round residents. No one would be thrown off his or her land by the implementation of this proposal.

The lands of small woodlot owners who live on their property are *not* included in the Headwaters proposal. The property rights of local residents are not only respected, but actually enhanced by the possibility of a stronger, more sustainable, locally-controlled, regional economy.

For two decades, ownership patterns have been volatile in this region. More than half of the land in the proposed Headwaters Wilderness Reserve System has been sold since 1980.

The cost of acquiring 7 million acres for publicly-owned wilderness reserves is surprisingly low—approximately $2 billion, or about $100 million a year for 20 years, of capital investment in our environmental infrastructure. To put this into perspective, recall that the Pentagon admitted in May 1995 that it had "misplaced" more than $14 billion. Right now Congress is trying to spend money on the B-2

Furbish Lousewort (Pedicularis furbishiae) *by D.D. Tyler ©1983*



1—**Nulhegan Reserve** (100,000 acres)
major watersheds: Nulhegan River, Connecticut River

2—**Paul Stream Reserve** (70,000 acres)
major watersheds: Paul Stream, Connecticut River

3—**Victory Bog** (25,000 acres)
major watershed: Moose River

4—**Hurricane Brook Reserve** (25,000 acres)
major watershed: Coaticook River

5—**Indian Stream Reserve** (100,000 acres)
major watersheds: Hall Stream, Indian Stream, Perry Stream, Connecticut River

6—**Nash Stream Reserve** (110,000 acres)
major watersheds: Upper Ammonoosuc, Connecticut River, Androscoggin River

7—**Kilkenny Mountains Reserve** (65,000 acres)
major watersheds: Upper Ammonoosuc, Connecticut, Androscoggin

8—**White Mountain National Forest** (600,000 acres)
major watersheds: Pemigewasset River, Saco River, Swift River, Gale River, Androscoggin River, Baker River

9—**Boundary Mountains Reserve** (1,200,000 acres)
major watersheds: Connecticut, Magalloway, Dead River, Moose River, Upper Kennebec

10—**Umbagog, Richardson, Mooselookmeguntic Lakes Reserve** (220,000 acres) major watershed: Androscoggin

11—**Mahoosuc Reserve** (110,000 acres)
major watershed: Androscoggin

12—**Tumbledown Mountain Reserve** (80,000 acres)
major watersheds: Androscoggin, Kennebec

13—**Sugarloaf/Mt. Abraham Reserve** (170,000 acres)
major watersheds: Kennebec, Androscoggin

14—**Moxie Pond Reserve** (160,000 acres)
major watersheds: Kennebec, W. Branch Pisquatiquis

15—**Kennebec Headwaters-Misery Ridge Reserve** (200,000 acres)
major watersheds: Kennebec, W. Branch Pisquatiquis

16—**Thoreau Reserve** (4,900,000 acres)
major watersheds: Upper Kennebec, Moose River, West Branch Pleasant River, Allagash, Upper Aroostook, St. John, West Branch Penobscot, East Branch Penobscot

(Stealth) Bomber (which cost more than $750 million each), despite statements from military leaders that we do not need the B-2. Clearly, money is available, even in these tight budgetary times. What is lacking is the political leadership to spend it on our life-support system (the environment) and on behalf of future generations.

The Headwaters proposal represents the first step in developing a region-wide Wilderness Reserve System. To protect the biological diversity and ecological integrity of the entire region will require a second phase which establishes a network of buffered, connected reserves extending from the large wilderness reserves of the Northern Forest Headwaters to the Atlantic Ocean, southern New England, New York's Adirondack and Taconic regions, and eastern Canada.

The area south of the Northern Forest Headwaters is much more developed. Ownership is much more highly fragmented. There are no sizable roadless areas. For these reasons, core reserves will likely be much smaller than the wilderness reserves proposed for the Northern Forest Headwaters (Phase I), and the cores will likely be more isolated from each other.

To assure the integrity of isolated, small reserves, core areas must be buffered from developed areas, and connections between cores must be identified and protected. As a general rule, small, isolated cores require more buffering and connections to other reserves than larger cores that are closer together. Thus, design and establishment of buffers and connecting corridors will play a more critical role in the development of Phase II than in Phase I. Also, the manner in which the landscape outside the reserve system is managed will help determine the size and management options of the buffer zones. If private lands are managed in a truly sustainable manner, buffers generally can be smaller than if the surrounding landscape is intensively exploited. Buffer zones can enlarge a core area by capturing key ecological elements such as rare species habitat not included in the core area. Buffer zones can be either publicly or privately owned.

Ideally, core areas would be connected to other cores by multiple linkages. Corridors should, where possible, be both terrestrial and aquatic. Candidates for corridors include existing migratory routes and trails of terrestrial animals along riparian corridors and ridgelines. A general rule is: the longer a corridor, the wider it should be, with a minimum width of about one-half mile.

Data necessary for the design of Northern Forest Watershed Phase II Reserves include:

1) Locations of rare, threatened, and endangered species and populations;
2) Locations of rare, threatened and endangered natural communities and seral stages such as old-growth forests, wetlands, and spawning grounds (all should be protected);
3) Distribution of natural ecosystems in the region;
4) Existing public land (federal, state, and municipal);
5) Existing private conservation land (The Nature Conservancy, Audubon Societies, land trusts, etc.);
6) Inventory of roads, categorized by type (primary, secondary, trail);
7) Soil types;
8) Travel routes of species (important for core reserve design and vital for design of corridors that connect core reserves; road kill data, sadly, is the best source of information for large vertebrates);
9) Watershed boundaries (a core reserve must be located in each primary watershed, and each core should include an entire secondary or tertiary watershed);
10) Historical distribution of locally-extirpated species;
11) Ranges of wide-ranging species.

Some of the above data sets are available today (existing public and private conservation lands, soil types, roads, watershed boundaries). Other data sets are very incomplete (locations of rare, threatened, and endangered species, populations and communities; travel routes of many species). It is imperative that research fill critical gaps in our data sets as swiftly as possible. *However, we have adequate data to begin the process of reserve design for Phase II today.*

Time-frame for Phase II:

Begin immediately to assemble known data. Conduct research on the highest priority data gaps; begin to manage existing public and private conservation lands for the goal of protecting and restoring biological diversity and ecological integrity; begin to acquire critical lands from willing sellers; develop and enforce sustainable forest management practices.

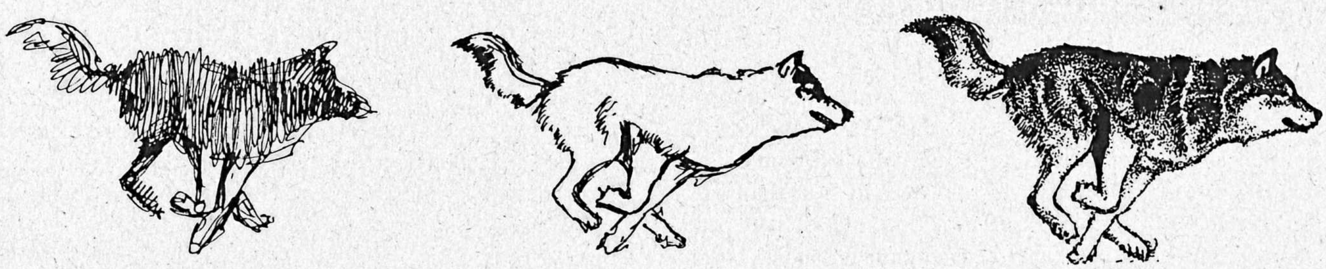
Within 10 years, many reserves should be established and the job of buffering and connecting them should be progressing. More land acquisition and research, restoration, and monitoring are vital during this period.

Within 25 years, the Phase II Reserve System should have been clearly identified and much of it should already be in the initial to intermediate stages of implementation. Monitoring should indicate the success of the reserve design, and should lead to adaptive management to compensate for experiments that have not succeeded.

In 75 years, the Phase II Reserve System should be essentially in place. ▮

Jamie Sayen is the editor and publisher of The Northern Forest Forum, *and a board member of The Wildlands Project.*

Help establish Headwaters Wilderness Reserves. Please consider making a donation to the Northern Appalachian Restoration Project. Contributions are tax deductible. Checks should be made payable to Earth Island Institute and sent to: NARP, POB 6, Lancaster, NH 03584.



Beyond the Big Outside

by Mike Biltonen

CALL IT HERESY, but I would argue that strict issue oriented environmental activism plays right into the hands of those who destroy what we try to protect. Scarce resources are utilized to fight battles that do not result in recovery of wildlands or significant protection of ecosystems. Of course, fighting specific threats should always be part of our work; but doing so without a broad, proactive vision has resulted and will result in compromise and back-pedaling.

In 1993 I embarked on a project to provide a viable basis for protecting native biodiversity and put the Minnesota Ecosystems Recovery Project (MERP) in the proverbial driver's seat, forcing our opponents to expend their energy and resources countering our actions. MERP's flagship project is the Minnesota Biosphere Recovery Strategy (MBRS).[1]

Enlarging the Big Outside

Dave Foreman and Howie Wolke's book *The Big Outside* (1989) explained why roadlessness is the primary criterion for evaluating wilderness and described the roadless areas of the lower 48 United States. The Boundary Waters-Quetico region of northern Minnesota and southern Ontario was listed as the third largest at 1.1 million hectares. In short, wilderness in our own backyard had maintained its own.

Shortly after reading their historic book, I wondered how many smaller roadless areas remained in Minnesota and what could be done to recreate larger ones. More important, what was their value to biodiversity? After poring over dozens of maps and drawing general boundaries, we were pleasantly surprised to find over 2 million ha of roadless and lightly roaded areas greater than 2000 ha (5000 acres, or roughly 2000 hectares, is the minimum size definition for Wilderness designated under the Wilderness Act of 1964). Our Minnesota Roadless Lands Inventory and Analysis results were the basis of a preliminary Minnesota Biosphere Recovery Strategy (Figure 1) published in the spring 1995 issue of *Wild Earth* magazine.

Minnesota's potential for increasing wild lands and waters exceeds many people's wildest dreams. If rehabilitated and protected, areas identified in the MRLIA would represent the largest statewide wildlands reserve system in the lower 48 United States and allow the natural recovery of the Gray Wolf, Wolverine, Canada Lynx, Cougar, Woodland Caribou and other species sensitive to human activities.

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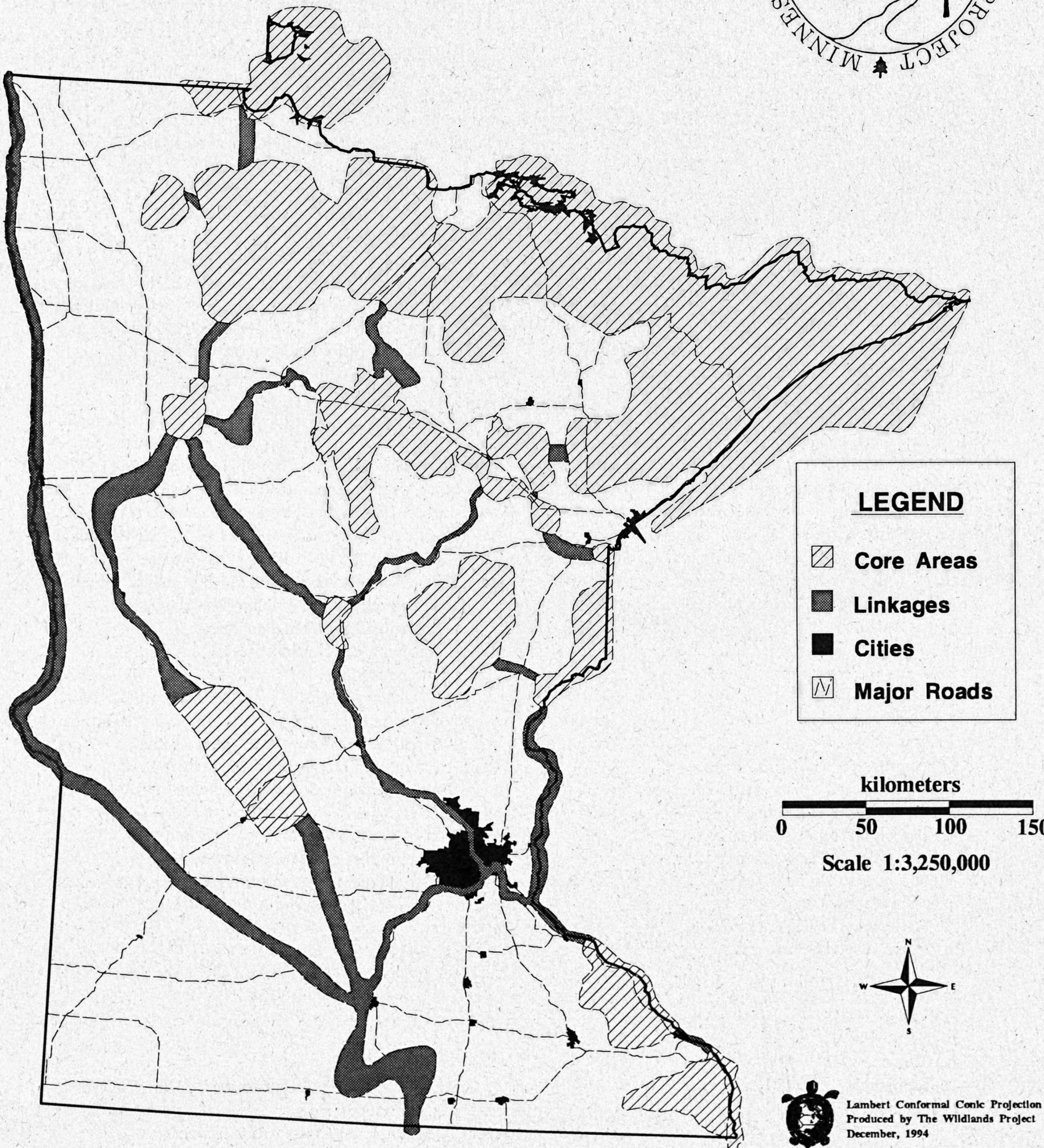
[1] We do not use the term 'biosphere' in its classic sense. Instead, it refers here to all native biotic and abiotic elements associated with the environment of the state of Minnesota.

illustration by Sarah Lauterbach

Figure 1. Preliminary Minnesota Biosphere Recovery Proposal



MRLIA Results by County

County	Hectares
Saint Louis	524,416
Koochiching	394,368
Lake	388,352
Beltrami	313,088
Cook	243,456
Aitkin	78,208
Lake of the Woods	76,032
Itasca	67,328
Cass	29,440
Mahnomen	26,688
Roseau	23,552
Morrison	20,480
Crow Wing	12,544
Mille Lacs	12,032
Totals	2,209,084

Although not necessary for all wildlands proposals, we've chosen to utilize Geographic Information Systems (GIS) in our mapping. GIS provides the accuracy and precision needed for mapping a scientifically defensible proposal. It will be especially important as we piece together habitat fragments of the Eastern Broadleaf and Prairie/Parkland biomes of the state. Important information we found available for GIS enthusiasts included databases managed by the state Natural Heritage Program (NHP), the US Forest Service, Minnesota Department of Natural Resources, and The Nature Conservancy. Continued access to this information will require a good rapport with managers. By maintaining scientific rigor as we design the MBRS, we inspire confidence and enhance our credibility.

In our article on the MBRS, several data layers deemed important were mentioned. Since then the list has been changed and divided into three main categories: biological, physical, and cultural. The important data layers by category are as follows:

Biological

1) Old-growth and old forest remnants
2) Threatened and endangered element occurrences
3) Protected areas of biological or ecological significance
4) Roadless and lightly roaded areas
5) Critical home ranges, areas of identified significance, and special environments
6) Native ranges of extirpated species
7) Presettlement vegetation patterns
8) Current vegetation patterns

Physical

9) Watersheds
10) Geology
11) Climate
12) Topography
13) Ecological Classification System (ECS)

Cultural

14) Protected areas of unknown biological or ecological significance
15) Minnesota transportation network
16) Land use designation
17) Population centers
18) County and township boundaries

The Next Steps

Eight of the above data layers will be included in a site ranking scheme for identifying Class I and Class II core reserves and wildland recovery areas. A final criterion will be applied after preliminary site ranking: natural disturbance regimes. If an area is large enough to contain varying degrees of natural disturbances such as fire, it will receive additional points. Core reserves should be able to contain large natural disturbance events. The remaining data layers will help identify overlooked priority conservation sites or help in the establishment process. A full description of these data layers plus design methodology is included in our working guidelines for designing a reserve system in Minnesota (available upon request).

Although design of a wildlands reserve system is important, it is only a first step. Landscape-level wildlands protection requires that the proposal be implemented. Reserve design will be the easy part; winning over community support will be much more difficult. Educating and including local citizens at all levels of the process is imperative to its success. Although MERP fully recognizes two distinct phases to the MBRS, the hurdles we will surely encounter during its establishment will not affect the design phase. Tailoring a strategy to ensure establishment will only result in the status quo.

Wildlands Project plans likely will prove difficult to get started, but comparatively easy to keep going. Wildlands recovery will take a great deal of patience and effort, but truth is on our side. Commitment, organization, professional acumen and vision will go a long way to so grand an end. To be sure, vision is the most important, for without it we have no yardstick by which to judge our personal activities and daily lives. As Wendell Berry once wrote:

> *...the care of the earth is our most ancient and most worthy and, after all, our most pleasing responsibility. To cherish what remains of it, and to foster its renewal, is our only legitimate hope.*

Let's get on with it. ∎

Mike Biltonen is the executive director of MERP (POB 293, Red Wing, MN 55066). He invites persons interested in helping restore Minnesota's ecosystems to contact him.

Preliminary Results of a Biodiversity Analysis in the Greater North Cascades Ecosystem

by Peter Morrison, Susan Snetsinger, and Evan Frost

THE GREATER NORTH CASCADES ECOSYSTEM (GNCE), a region over ten million acres in size spanning the Washington–British Columbia border, has been the focus of major conservation efforts over the last five decades. While substantial progress has been made, the current system of protected areas does not include the full array of biological communities and is not sufficiently large and connected to maintain important ecological processes or viable populations of sensitive wildlife. The task of protecting the ecological integrity of the GNCE remains incomplete.

To strengthen the scientific foundation for future conservation efforts in the GNCE, the Northwest Ecosystem Alliance undertook a cooperative project with the Sierra Biodiversity Institute to 1) conduct a regional biodiversity analysis to identify areas with high conservation value, and 2) using the results of this analysis, draft a proposal for a network of new and existing reserves, restoration areas, and linkage zones.

Our assessment of regional biodiversity made use of the powerful analytical capabilities of geographic information systems (GIS). As the first step in this project, we assembled data themes based on landscape-level biological and environmental variables correlated with biodiversity. This involved acquiring digital data from various agencies in both the US and Canada, crosswalking their attributes, and merging them into uniform region-wide data sets. In some cases, digital information from the agencies was updated with more recent information from hardcopy maps. Many data themes (such as species distribution and abundance) could not be used in the final analysis because full ecosystem coverage did not exist. The following basic region-wide data themes were assembled and used in the final analysis:

- Existing and potential vegetation (series level)
- Forest cover, including canopy cover, successional stage, age or size class
- Elevation
- Rivers and streams
- Wetlands
- Road systems

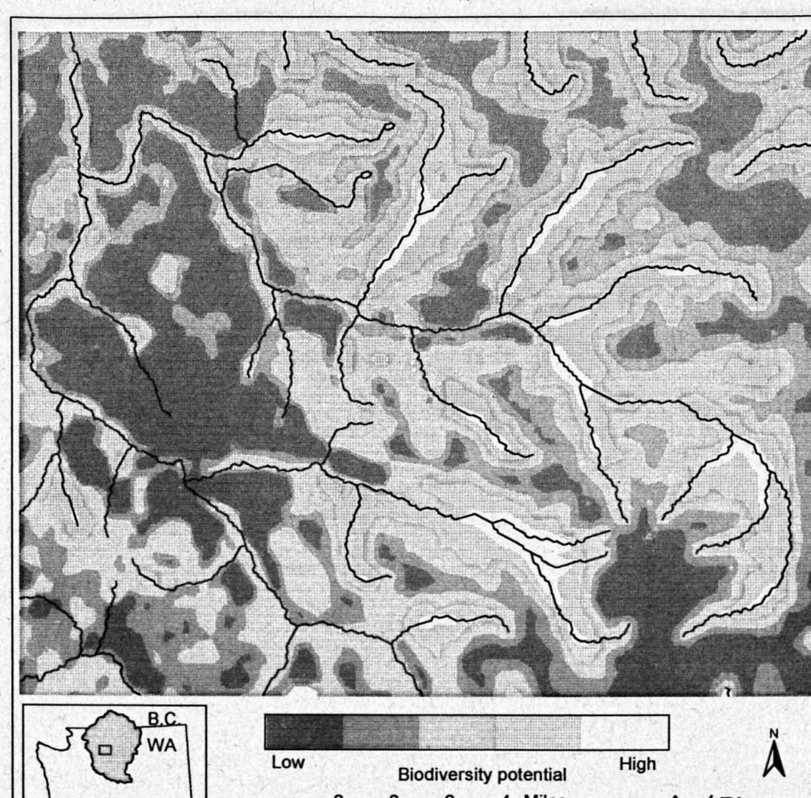


Figure 1. Example of biodiversity value model.

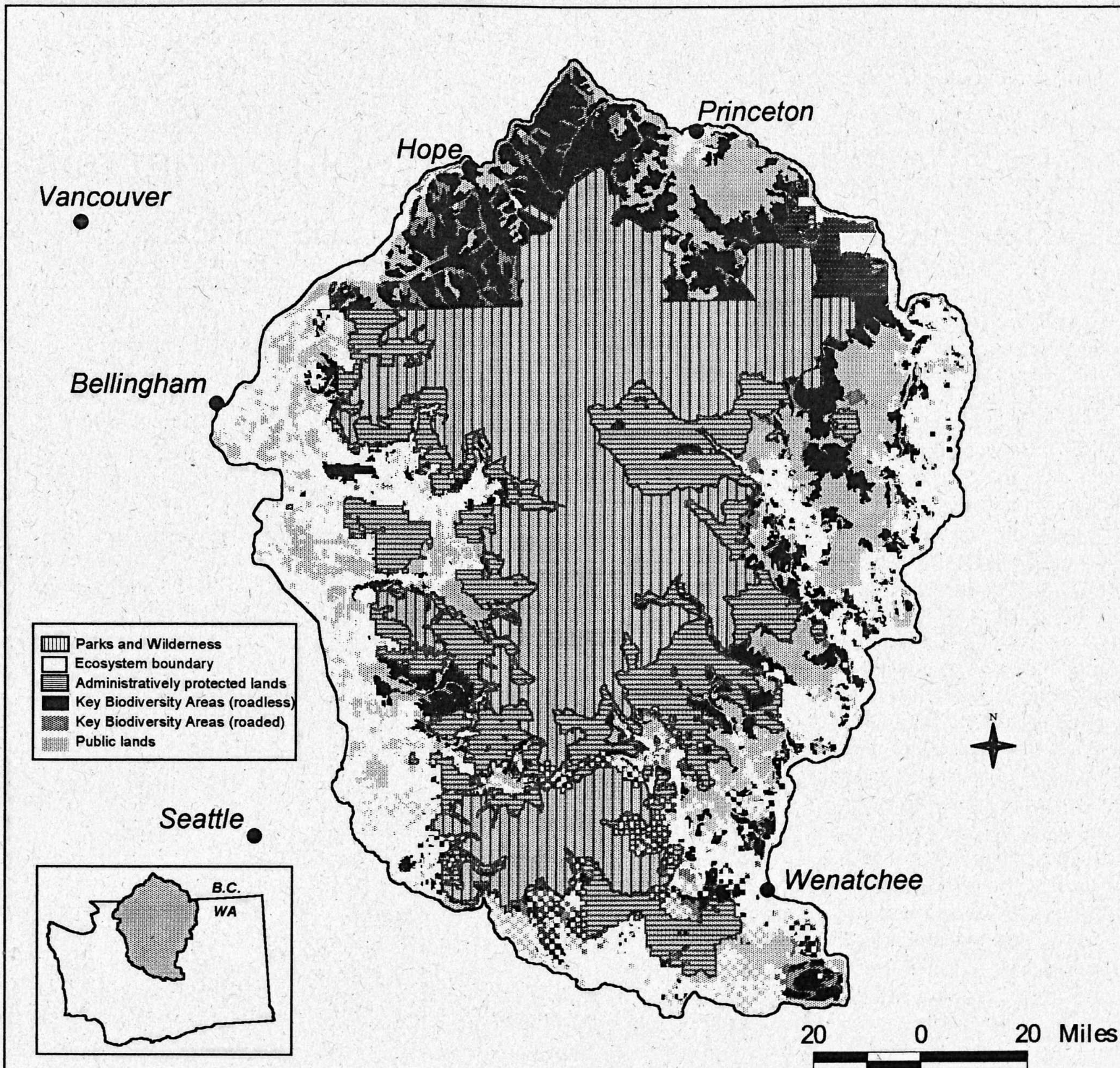


Figure 2. Key Biodiversity Areas on public lands in the Greater North Cascades Ecosystem.

From these data themes, the following additional layers were derived for use in subsequent analysis:

- Presence/absence of wetlands
- Degree of late-successional forest development
- Index of size, configuration, and connectivity of late-successional forest patches
- Rarity of vegetation types with respect to overall abundance in the GNCE and current protected status
- Density and proximity of roads
- Distance from major streams and rivers
- Index of size of roadless/unmanaged regions

For each data theme, a weighting algorithm was developed, with higher values indicating greater biodiversity potential. For example, large, connected patches of late-successional forest with small perimeter to area ratios received a higher value than small, isolated patches with convoluted shapes.

All of these derived data themes and their relative values were then integrated into an ARC/INFO grid-based model to evaluate the cumulative biodiversity potential. Values for all data themes were summed for each 1 hectare grid cell, across the entire region. High values in the resulting grid model represent areas with high biodiversity potential and conservation value. Low values in this model represent areas with low biodiversity potential, such as those degraded by past management (Figure1).

Overall biodiversity values were then averaged for watershed units (1000-5000 ha in size) and all roadless regions greater than 400 hectares (roughly 1000 acres) in size. Watershed units and roadless regions with relatively high overall scores were identified as "Key Biodiversity Areas" for the GNCE (Figure 2). This map of Key Biodiversity Areas has been used by a consortium of US and Canadian conservation groups (the Cascades International Alliance) to delineate boundaries for a proposed Cascades International Park. Key Biodiversity Areas that are unprotected and roadless have been proposed as new reserves or "Conservation Areas." Watersheds with high biodiversity scores that are unprotected and roaded have been proposed as "Restoration Areas." Linkage zones were also delineated in order to connect proposed Conservation and Restoration Areas with the existing system of protected areas.

Maps depicting all proposed Conservation and Restoration Areas were circulated to conservation activists in the region and evaluated by a group of conservation biologists. Some changes suggested in this review process have since been incorporated into the final proposal. The results of the GNCE biodiversity analysis will have long-term utility, serving as building blocks for future regional conservation efforts.

For information and written materials about the International Park campaign in the GNCE, contact the Northwest Ecosystem Alliance. Contact the Sierra Biodiversity Institute for a more detailed report on this project. ▮

Northwest Ecosystem Alliance	Sierra Biodiversity Institute
PO Box 2813	POB 298
Bellingham, WA 98827	Winthrop, WA 98862
(360) 671-9950	(509) 996-2490

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Peter Morrison and Susan Snetsinger are Research Director and GIS analyst of the Sierra Biodiversity Institute's research station in Winthrop, WA. Evan Frost is a staff conservation biologist with NWEA and lives in Twisp, WA.

ὕβρις

Linnaeus wrote
"The first step
of science is to know
one thing from another"

but taking the world apart
demands
the even greater τεχνη
of putting it
all together again

which is
the creative μυθος
of poet • dancer • worldmaker

in his last years
Linnaeus suffered a stroke
& it is said
he who named
& classified all the known
species flora
& fauna of his day

forgot
even his own name

—Lone Cone Free Poem

Note: the borrowings are from Attic Greek.
ὕβρις • hubris • fateful pride
τεχνη • techne • skill, technique
μυθος • mythos • myth

illustration by Jim Nollman

Life Zones at Risk

Gap Analysis in Costa Rica

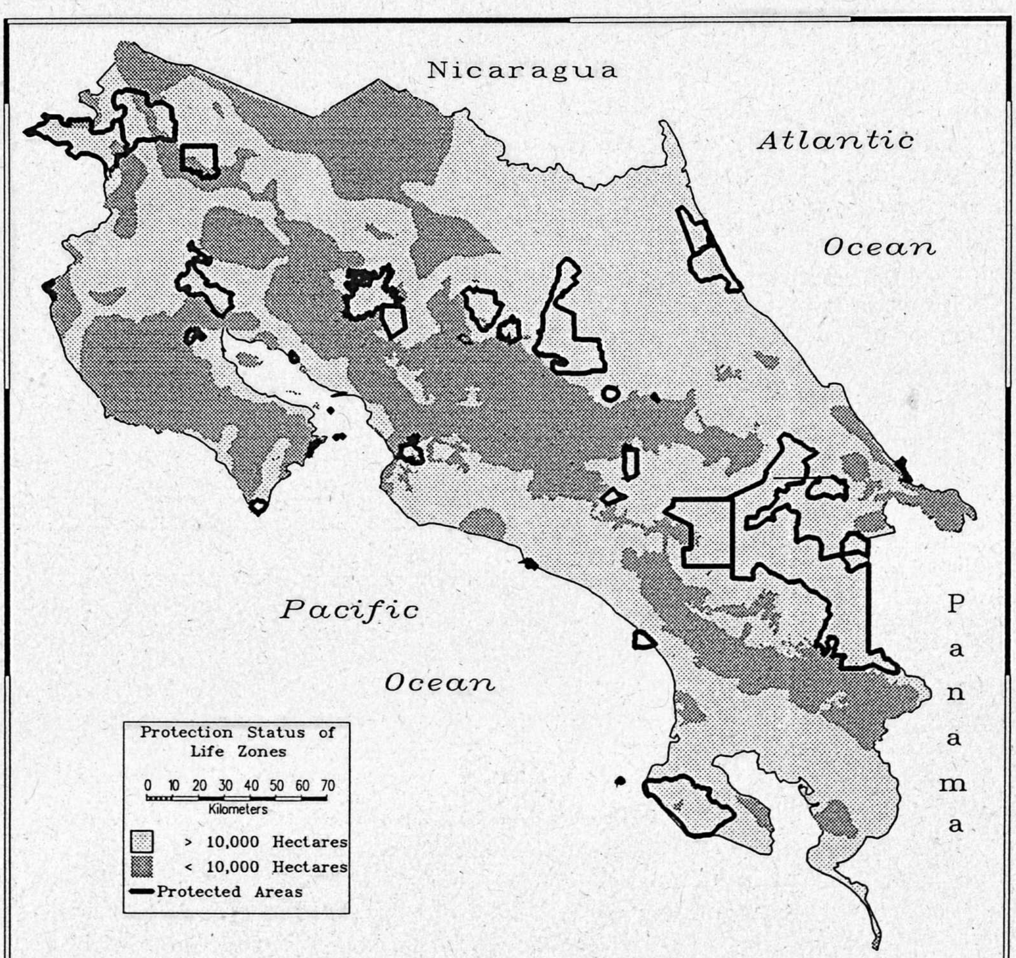
by G.V.N. Powell, R.D. Bjork, M. Rodriguez S., and J. Barborak

EXECUTIVE SUMMARY

We analyzed the adequacy of existing protected natural areas (national parks and biological reserves) in Costa Rica with respect to their protection of that country's biodiversity by comparing the distribution of protected areas with major vegetation communities as indicated by the Holdridge Life Zone System. That analysis indicated that 98% of the protected area represents only 10 of the 23 life zones or major transitional life zones in the country, leaving most zones with little or no protection. From this we concluded that a significant portion of the country's biodiversity is at risk.

On the basis of this analysis, we propose a two-step approach to developing a system of protected natural areas that will provide for the long-term stability of Costa Rica's biodiversity. We propose the expansion of eight existing protected areas and the establishment of three new ones so that the resulting system will incorporate at least 10,000 hectares each of the majority of the 23 life zones. That action would increase the coverage of absolute protected areas from the current 12% to about 18% of the country. About half of all the proposed expansion areas already have some level of government protection, which would facilitate upgrading them to absolute protec-

Figure 1



This article is based on a presentation at the annual meeting of the Society for Conservation Biology, June 1994

tion. Second, we propose the establishment of an extensive network of linkage zones that will maintain ecological connectivity among the protected areas. Within these zones, existing natural habitats would be protected and gradually upgraded into anastomosing networks of continuous natural habitat.

INTRODUCTION

Costa Rica's system of protected natural areas, which now covers 12% of its surface area, has been established over the past several decades in an effort to guarantee long-term stability for the country's tremendous biodiversity. While the amount of area protected is impressive, the preponderance of highland protected areas (above 1000 meters) or lowland sites (below 50 meters) and near absence in middle elevation sites lead us to question whether the effort will fulfill its objective once remaining forests outside of the protected areas are all but eliminated and the protected areas are completely isolated, a situation that is expected to occur within the next decade. Will the protected natural areas, as designed, contain sufficient acreage and distribution to allow all of Costa Rica's ecosystems to remain viable in perpetuity, or are there gaps in coverage that should receive high priority for expansion of the protective network? As a step toward that evaluation, we have completed a preliminary gap analysis that uses life zones as the indicator of biodiversity. Following that, we have begun identifying priority areas that should be included to eliminate deficiencies identified by our analysis.

Table 1. Current coverage of life zones in Costa Rica's system of protected natural areas and distribution of protected and unprotected forest with respect to life zones. Only 7 of 23 zones have more than the minimum considered to be sufficient (>10,000 hectares) for long-term protection of biodiversity.

	LIFE ZONE	ZONE NUM	COUNTRY TOTAL	AMOUNT PROTECTED		PROTECTED FOREST	UNPROTECTED FOREST
			hectares	hectares	%	hectares	hectares
PISO BASAL	bosque seco-Tropical (bs-T)	1 *	94,350	9,456	10.02	9,456	2,343
	bs-T (trans a humedo)	2 **	29,060	790	2.72	790	0
	bosque humido-Tropical (bh-T)	3 *	723,500	9,390	1.30	9,390	65,782
	bh-T (trans a seco)	4 **	114,340	2,100	1.84	2,100	1,441
	bh-T (trans a perhumedo)	5 **	156,430	1,030	0.66	1,030	11,792
	bh-T (trans a Premontano)	6 **	76,150	640	0.84	640	5,725
	bosque muy humido-Tropical (bmh-T)	7	843,520	153,300	18.17	153,300	0
	bmh-T (trans a premontano)	8	260,070	75,410	29.00	75,410	0
PISO PRE-MONTANO	bosque humido-Premontano (bh-P)	9 **	86,970	0	0.00	0	699
	bh-P (trans a Basal)	10	468,850	51,370	10.96	51,370	0
	bosque muy humido-Premontano (bmh-P)	11 *	436,360	8,130	1.86	8,130	69,600
	bmh-P (trans a Basal)	12	698,420	16,120	2.31	16,120	0
	bmh-P (trans a prehumedo)	13 **	75,890	0	0.00	0	24,522
	bosque pluvial-Premontano (bp-P)	14	437,240	122,460	28.01	122,460	0
	bp-P (trans a Basal)	15 **	7,560	0	0.00	0	2,396
PISO MONTANO BAJO	bosque humido-Montano Bajo (bh-MB)	16 **	23,800	0	0.00	0	294
	bosque muy humido-Montano Bajo (bmh-MB)	17 **	112,490	3,990	3.55	3,990	34,200
	bmh-MB (trans a humedo)	18 **	1,440	0	0.00	0	0
	bosque pluvial-Montano Bajo (bp-MB)	19	352,040	153,900	43.72	153,900	0
PISO MONTANO	bosque muy humido-Montano (bmh-M)	20 **	1,610	50	3.11	50	133
	bosque pluvial-Montano (bp-M)	21	116,990	64,700	55.30	64,700	0
	bp-M (trans a Montano Bajo)	22 **	823	260	31.59	260	565
PISO SUBALPI	Paramo pluvial-Subalpino (PP-SA)	23	4,330	4,330	100.00	NA	NA
	* < 10,000 hectares protected ** < 5,000 hectares protected	TOTALS (sum)	5,122,233	677,426	13.23		219,492

Table 2. Representation of life zones in Costa Rica's system of protected natural areas, current and following expansions. Adequacy of representation is indicated by + (>10,000 hectares), * (< 10,000 ha) and ** (<5,000 ha).

LIFE ZONE	Life Zone Number	Current Protection Adequacy	Currently Protected hectares	Priority Expansion hectares	Resulting Protected hectares	Secondary Expansion hectares	Resulting Protected hectares	Adequacy After Expansions (total in country)
bosque seco-Tropical (bs-T)	1	*	9,456	21,091	30,547		30,547	+
bs-T (trans a humedo)	2	**	790		790	29,059	29,849	+
bosque humido-Tropical (bh-T)	3	*	9,390	39,853	49,243		49,243	+
bh-T (trans a seco)	4	**	2,100	14,198	16,298		16,298	+
bh-T (trans a perhumedo)	5	**	1,030	2,360	3,390	6,990	10,380	+
bh-T (trans a Premontano)	6	**	640	16,363	17,003		17,003	+
bosque muy humido-Tropical (bmh-T)	7	+	153,300		153,300		153,300	+
bmh-T (trans a premontano)	8	+	75,410		75,410		75,410	+
bosque humido-Premontano (bh-P)	9	**	0	5,001	5,001		5,001	*
bh-P (trans a Basal)	10	+	51,370		51,370		51,370	+
bosque muy humido-Premontano (bmh-P)	11	*	8,130	64,822	72,952		72,952	+
bmh-P (trans a Basal)	12	+	16,120		16,120		16,120	+
bmh-P (trans a prehumedo)	13	**	0	8,785	8,785		8,785	*
bosque pluvial-Premontano (bp-P)	14	+	122,460		122,460		122,460	+
bp-P (trans a Basal)	15	**	0	4,967	4,967		4,967	*
bosque humido-Montano Bajo (bh-MB)	16	**	0	1,497	1,497		1,497	*
bosque muy humido-Montano Bajo (bmh-MB)	17	**	3,990	44,623	48,613		48,613	+
bmh-MB (trans a humedo)	18	**	0	123	123		123	(1,440 ha)
bosque pluvial-Montano Bajo (bp-MB)	19	+	153,900		153,900		153,900	+
bosque muy humido-Montano (bmh-M)	20	**	50	0	50		50	(1,610 ha)
bosque pluvial-Montano (bp-M)	21	+	64,700		64,700		64,700	+
bp-M (trans a Montano Bajo)	22	**	260	455	715		715	(823 ha)
Paramo pluvial-Subalpino (PP-SA)	23	100%	4,330		4,330		4,330	(4,330 ha)
Adequacy of Representation: + greater than goal of 10,000 ha; * < 10,000 hectares protected; ** < 5,000 hectares protected		TOTALS	677,426	224,138	901,564	36,049	937,613	
		Percent in Country	13	4	18	1	18	

METHODS

The System of Protected Natural Areas: Costa Rica's system of protected natural areas affords two basic levels of protection. Level 1 areas consist of 31 national parks and biological refuges and three relatively large private biological reserves, all of which theoretically provide absolute protection for organisms contained within. These areas cover 12% of the country. An additional 14% of the country falls within areas that receive symbolic protection as forest reserves, priority wetlands, or protection zones. These are level 2 areas, functionally little more than paper parks as they allow uses contradictory with the conservation of biodiversity. Because level 2 areas do not provide meaningful habitat protection, we have limited this study to an analysis of level 1 protected areas.

Study Design: In the tropics we still lack sufficient species level distributional data to allow species level gap analyses. Therefore, we selected to use habitats delineated by the Holdridge Life Zone System as our indicator of biodiversity. That system uses gradients of temperature, precipitation relative to evapotranspiration, and elevation to form a theoretical framework that delineates major plant communities. In Costa Rica, the system delineates 23 life zones or transitional zones. Virtually all these zones are naturally forested; they range from

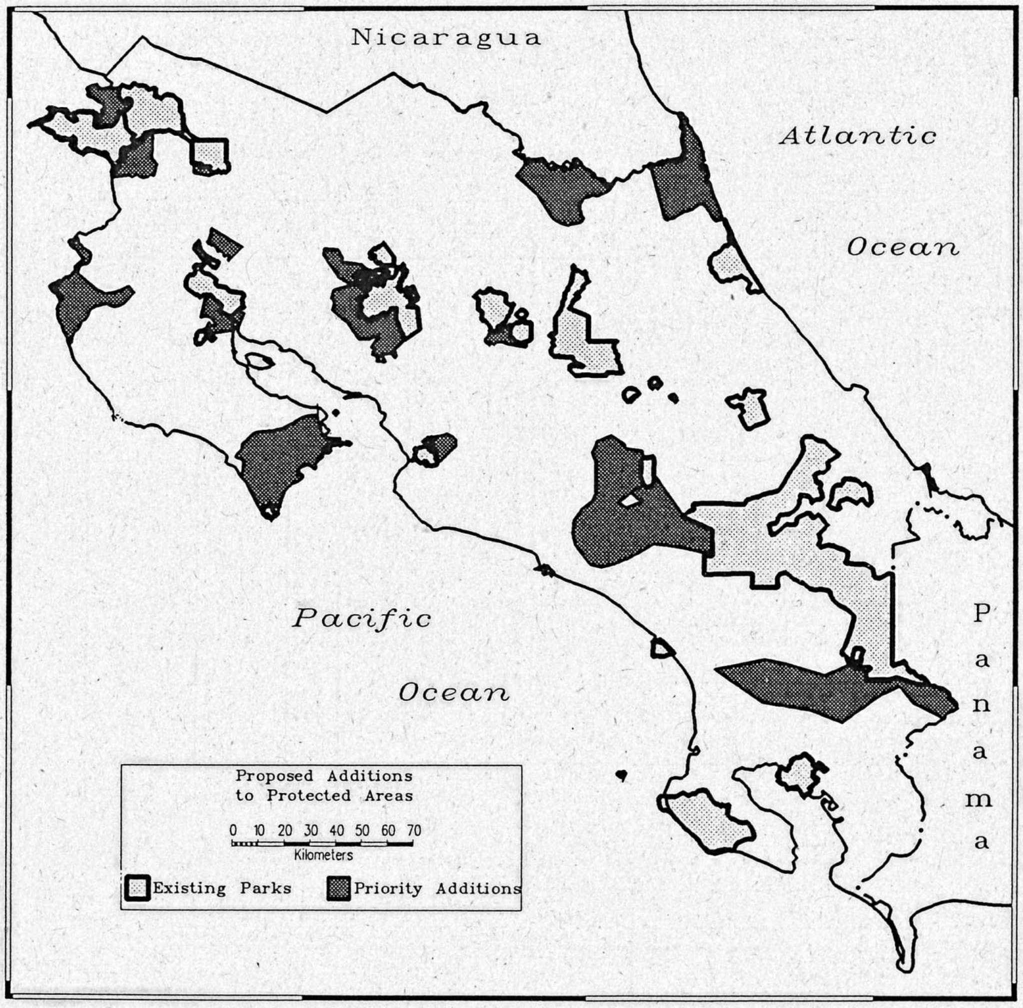


Figure 2

seasonally dry on the Pacific lowlands, to montane cloud forests in the highlands, to continually wet rainforests on the Atlantic slopes and lowlands. Several studies have indicated that plant communities within life zones are composed of unique assemblages of species with a large proportion of species endemic to a single life zone or two to three adjacent zones or transition areas. Most faunal distributions have not been studied with respect to life zones. Perhaps the best data are available for birds. These data indicate that the distributions of many species do conform to life zones at least during the breeding season. Recent studies indicate that many birds migrate to different life zones, still within the tropics, during the non-breeding season, which means that these species are dependent on more than a single life zone and that those zones are consequently ecologically linked. Most mammal distributions clearly transcend multiple life zones; this means that life zones are not valid measures of mammalian biodiversity. An exception to that generalization is bats, and perhaps small rodents, which tend to have more restricted ranges that conform more closely to life zone demarcations. Unfortunately, we do not have sufficient information on distribution patterns of the largest faunal group, arthropods, to assess the effectiveness of life zones as a biodiversity indicator for those taxa. With this group we can assume only that because arthropods tend to depend on individual or limited groups of plants as hosts for larval stages or as sources of food for adults, many are likely to be limited in range to one or a small number of adjacent life zones at least during parts of their life cycles.

In short, for most faunal groups as well as floras, we are likely safe in our assumption that conserving the full suite of major plant communities or life zones is requisite to protecting biodiversity. However, that assumption can be supported only if consideration is given to the maintenance of habitat linkages among life zones which many tropical forest taxa require. Furthermore, the life zone categories do not separate areas with unique microclimates that result from unusual soil types or poor drainage (e.g., wetlands), nor do they distinguish geographic species differences within life zones such as endemics in different mountain ranges. Because of these deficiencies, we must consider the gap analysis using life zones as incomplete and as an intermediate step between the ecoregion approach that the World Wildlife Fund is developing for Latin America and a species-focused gap analysis that might be developed in the future.

What constitutes adequate country-wide coverage of a life zone or tropical ecosystem we could discuss all day and probably never reach consensus on. For this analysis, we used a figure of 100 sq km or 10,000 hectares, recognizing that this size would not be sufficient on a stand-alone basis, but that it could be considered sufficient in the context of conglomerates of life zone blocks in large protected natural areas.

Computer Analysis: We used the geographic information processing software CAMRIS to quantify the representation of each of the 23 life zones in the coverage of level 1 protected natural areas. CAMRIS is a menu-driven, vector-based software that allows user-friendly access to the intimidating world of GIS. The life zone data were digitized from 1/200,000 scale maps produced by Rafael Bolanos et al. in 1993.

RESULTS

Current Status of Protection: Our gap analysis revealed that coverage of the life zones in Costa Rica is highly variable in the area and percentage of each life zone represented in the protected areas (Table 1). Protection of life zones ranges from

0 to 100% and from 0 to 150,000 hectares. Only 7 of the 23 life zones are sufficiently represented in the protected natural areas for sustained viability according to our criterion of 10,000 hectares.

Those 7 areas account for 94% of the protected area in the country, but only 48% of its total surface area. Adding the protected areas in 3 additional life zones that have between 5000 and 10,000 hectares of coverage accounts for about 98% of the area protected. Thus, the 13 remaining life zones account for only 2% of the protected area. We hasten to add that 5 of those 13 zones are limited in distribution within the country and thus probably have depauperate floras and faunas. One, the transitional Premontane to Basal Rain Forest, occurs on 7500 hectares country-wide, while each of the 4 others covers less than 5000 hectares. However, with the exception of the Paramo (life zone 23) which has 100% of its 4300 hectares protected, and the most limited zone, transitional Montane to Lower Montane Rain Forest, which has 260 of its 823 hectares protected (32%), these life zones are receiving little or no protection (0 - 3.5%). Again, though one would expect the ecosystems represented in these life zones to be depauperate because of their limited size and isolation, they are likely to support extensive unique genetic diversity that should be protected to the greatest extent possible.

We conclude on the basis of this analysis that 11 life zones are critically under-protected (less than 5000 hectares protected) and 3 additional zones have inadequate protection (more than 5000 but less than 10,000 hectares protected). As we discussed above, it is difficult to precisely interpret these findings in terms of conservation of Costa Rica's biodiversity because little is known about the level of fit between the theoretical life zone distributions and the distribution of organisms. However, it is probably safe to conclude that the complete absence or minimal protection for more than half of the life zones in Costa Rica is indicative that a large proportion of the country's biodiversity is at risk over the longterm as remaining unprotected forests are eliminated.

The under-protected zones represent a range of habitats distributed throughout the country but generally concentrated in two areas, the northwestern lowlands and the middle-elevation Pacific slope (Figure 1). The zones on the Pacific slope coincide with the areas best suited for traditional agricultural crops, particularly coffee, and for the dairy industry. Consequently, these zones have been largely converted to agriculture and tend to be heavily populated. The northwestern lowland habitats were early sites for the development of cattle ranching, and more recently, for sugar cane and rice plantation.

The revelation that major gaps exist in the protection of Costa Rica's biodiversity leads us to the next step of attempting to identify priority areas, the protection of which would eliminate the deficiencies in current protection. Toward this end, we have incorporated two additional data sets into the analysis: forest cover and human population. Our goal is to use these data sets in conjunction with the life zone map to

Recent studies indicate that many birds migrate to different life zones, still within the tropics, during the non-breeding season, which means that these species are dependent on more than a single life zone and that those zones are consequently ecologically linked.

Quetzal *by Sarah Lauterbach*

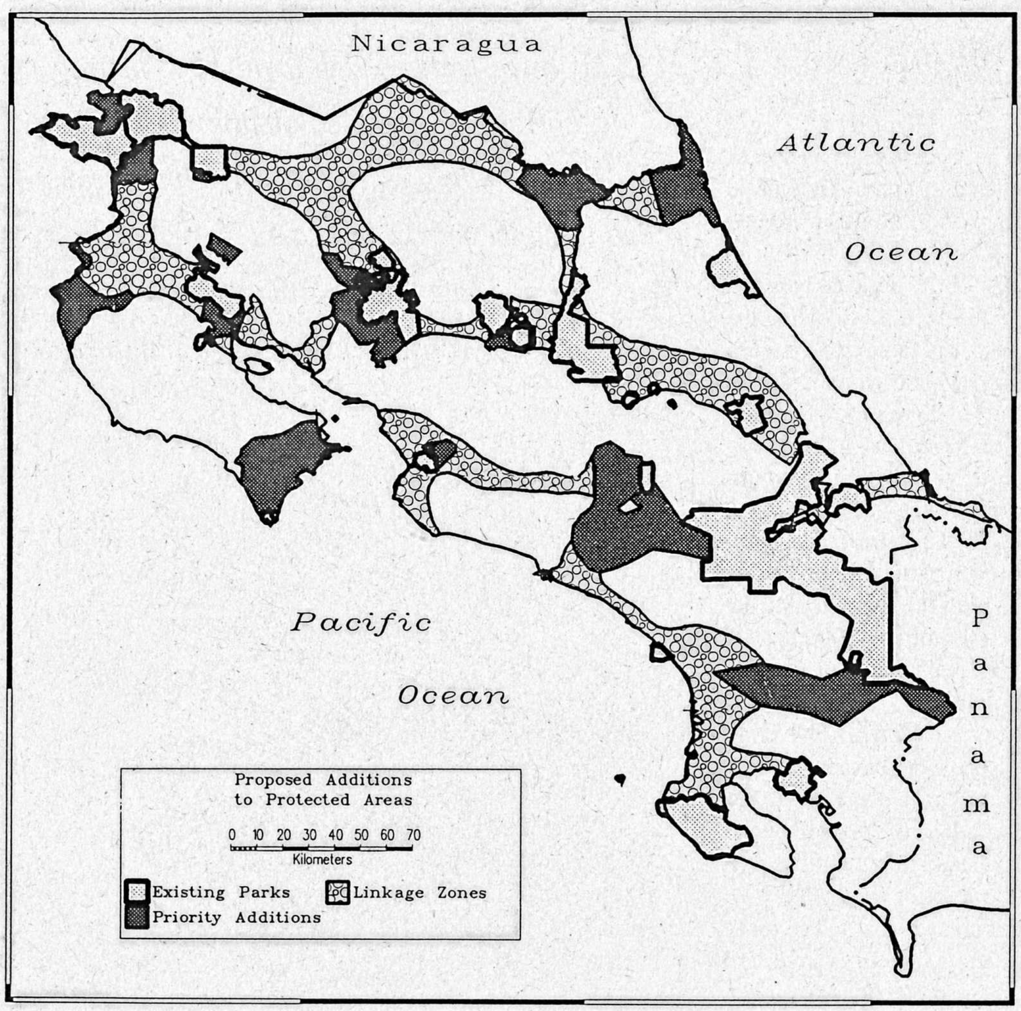


Figure 3

Recognizing the importance of altitudinal migrations, we emphasized linkages among poorly represented middle elevation Pacific slope habitats and existing higher elevation protected areas. Furthermore, because northwestern and southeastern montane environments are not equivalent in Costa Rica, we attempted to include representation of a full range of zones in both regions. This forced us to select some areas, such as the Pacific slope of the Tilaran Mountains, even though remaining unprotected habitats are fragmented and degraded. Following the identification of priority areas, we reanalyzed the protection of life zones through CAMRIS to redetermine the adequacy of protection according to our criteria.

optimize protection of the under-protected life zones. The human population data were derived from a 1992 population census and converted to density as a function of the area of the municipalities by which they were reported. The distribution of forest coverage was digitized from maps produced by the Costa Rican Forest Service from 1989 TM satellite imagery. In addition, we have taken into consideration ecological linkages known to be critical for the maintenance of many species that migrate among tropical habitats, particularly along altitudinal transects; failure to account for those linkages in the design of protected areas would ultimately result in an extensive loss of biodiversity.

Recommendations to Eliminate Gaps: To take the next step of recommending specific additions to the country's system of protected areas, our procedure was to examine each of the under-represented life zones and identify principal areas with remaining unprotected forest. We then attempted to link the best remnants with existing protected areas and/or other intact under-represented habitats while avoiding human populations as much as possible. We also took into consideration the distribution of second level protected areas because their presence could facilitate conservation efforts since the government still holds title to many of those lands.

Quantifying forest remnants from the satellite images revealed that substantial unprotected forest does exist for some life zones; but for others, remaining forest is extremely limited. The analysis of the distribution of the unprotected forest, by life zone, revealed that for most zones, the remaining forest is fragmented and for some it is widely scattered. Consequently, protecting representative samples of biodiversity will often require experimentation with ways of restoring forest habitats.

On the basis of our analysis, we determined that by expanding 7 existing protected areas as a first priority and creating 3 new ones as second priority (Figure 2), it would be possible to increase the number of adequately protected life zones from the present 8 zones (including the limited Paramo which is 100% protected) to at least 17 (Table 2). In the process, about 260,000 hectares would be added to the system of national parks and biological reserves. About half of the proposed expansion falls within second level protected areas. With this relatively modest increase in protected area, which would increase the total area of the country protected from about 12% to 16%, representation of biodiversity theoretically more than doubles. The 6 remaining life zones are so tightly aligned with human distribution, largely on the fringes of the heavily populated Central Valley, that it would be difficult to significantly expand protection in those zones without great cost and displacement of large numbers of people.*

*Science Ed. note: Conservationists need, however, to recognize long-term restoration potential. —*RFN*

Recommendations for the Long-term Stability of Biodiversity: It is important to note that this gap analysis is not all-inclusive of conservation needs. For example, as mentioned above, it does not identify wetlands, either open marsh habitats or swamp and mangrove forests, or other localized habitat types that are products of site-specific characteristics. It deals only superficially with the question of linkages required by seasonal migrants or species that apparently require large areas to sustain their populations (e.g., Jaguars, White-lipped Peccaries, Harpy Eagles, Great Green Macaws). Finally, it does not deal with the more long-term issues of dispersal, reestablishing and maintaining linkages for gene flow, and recolonization after local extinctions (a recurrent process in tropical habitats). Therefore, in addition to the recommended additions to the park system, which will protect biodiversity for the shortterm, we have taken a step toward an inclusive conservation plan that will conserve biodiversity over the longterm (Figure 3).

In this exercise, we propose the creation of linkage zones as a third category of additions to the system of protected areas (beyond priority and secondary extensions). We recommend that the linkage zones be established as a longterm strategy for interconnecting the protected areas. (We suggest these landscapes instead of the potentially misinterpreted term 'corridor.') The linkages are patterned after those of The Wildlands Project and supersede the more focused Paseo Pantera and Mesoamerican Corridor projects, which focus on connecting existing protected areas with corridors. Initially at least, the linkages would functionally be buffer zones with networks of natural habitats in landscapes dominated by human-modified habitats. For each area it will be necessary to initiate local participation in the design and implementation of strategic plans that combine the purchase of critical forest fragments with private conservation action thereby allowing the restoration and long-term protection of habitat continuity. Gradually, as a better understanding of minimum requirements for the conservation of tropical ecosystems dictates and financial resources permit, the zones would take on a greater aspect of absolute protection. The result will be an integrated system of protected natural areas that protects the full array of habitats and allows for the continuation of ecological processes critical to long-term maintenance of biodiversity. ▮

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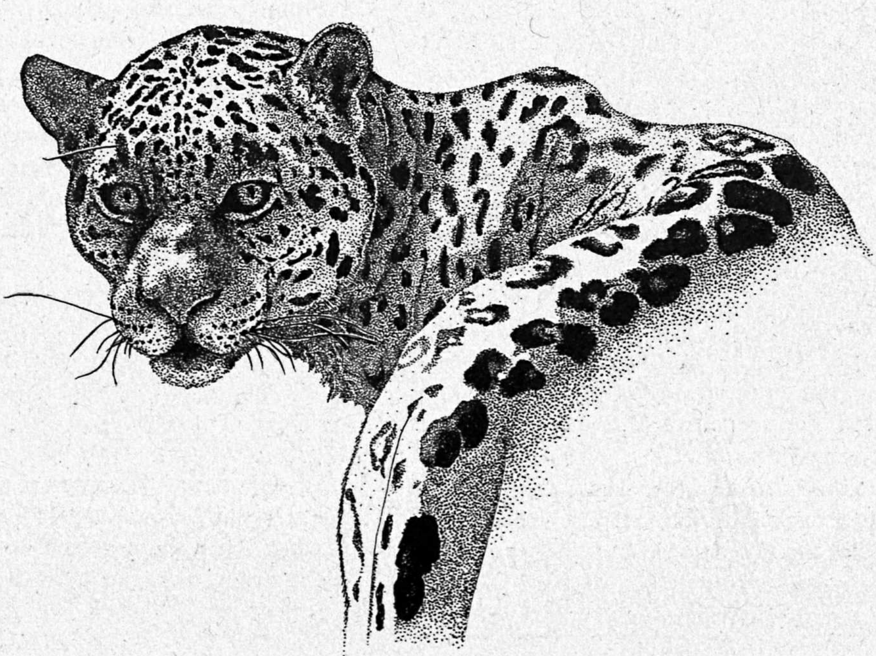


Jaguar *by Sarah Lauterbach*

A Biodiversity Conservation Plan for the Klamath/Siskiyou Region

A Progress Report on a Case Study for Bioregional Conservation

by Ken Vance-Borland, Reed Noss, Jim Strittholt, Pam Frost, Carlos Carroll, and Rich Nawa

Reserve selection and design, like most areas of conservation biology, are rapidly evolving. Methods for designing reserve networks that were considered innovative in the mid-1980s or even early 1990s (for example, Noss's [1985, 1987, 1993] work in Florida and the Oregon Coast Range) would generally not be considered scientifically defensible today. And what is not scientifically defensible is unlikely to be taken seriously. The Wildlands Project seeks to be in the forefront of applied conservation biology by applying the most advanced techniques and approaches to landscape conservation. Efficiency, accuracy, and comprehensiveness of methods enhance their scientific defensibility and make them more useful in protecting land. Furthermore, methods must be user-friendly enough that activists with basic computer skills and biological knowledge can apply them to their own regions. Thus, we continually refine and upgrade our approaches to reserve selection and design.

This article describes work in progress in the Klamath-Siskiyou region of northwestern California and southwestern Oregon, an area extremely rich in biodiversity and becoming heavily assaulted by commodity producers. Our work there is a long-term, team effort directed by Reed Noss for the Siskiyou Regional Education Project and The Wildlands Project. We consider it a pilot project or case study for bioregional conservation, and hope that techniques developed in this study can be transferred elsewhere. The first phase of the research, emphasized in this article, is a physical habitat analysis conducted by Ken Vance-Borland, a graduate student of Noss at Oregon State University. Several other phases of research, described briefly here, have been initiated or will soon follow. Our work will go beyond reserve selection and design and will culminate in a biodiversity conservation strategy for the entire region. This research, however, constitutes only the scientific portion of the overall conservation effort. Just as important to the success of efforts to maintain the ecological integrity of the Klamath/Siskiyou region will be public education, socio-economic studies and projects, direct activist involvement, fund-raising, and many other activities. We emphasize also that biodiversity analyses and reserve de-

illustration by Martin Ring

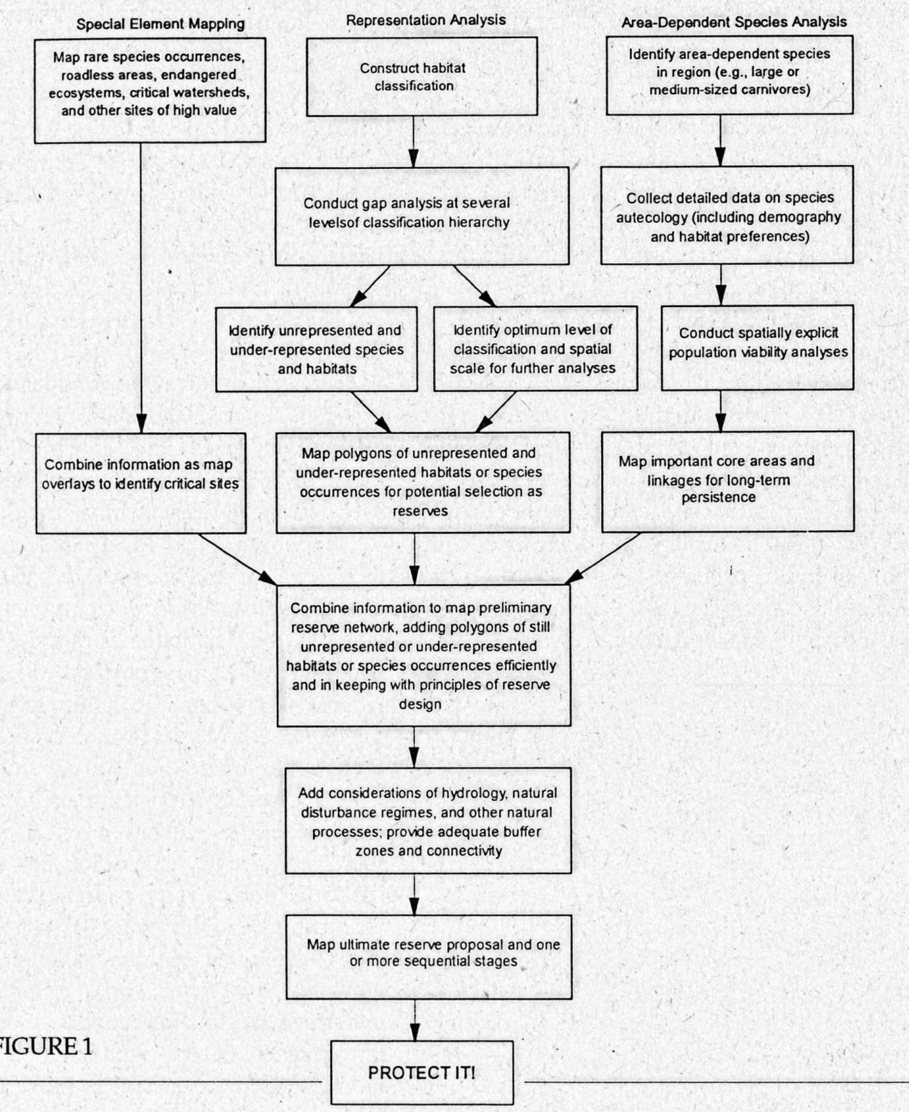


FIGURE 1

signs do not need to be as sophisticated technically as this one in order to serve the purposes of The Wildlands Project. Nonetheless, we do hope to provide a model that other regions, funds and expertise permitting, can follow without much trouble.

The general goals of this research are 1) to develop a biodiversity conservation plan for the Klamath/Siskiyou region, and 2) to develop and demonstrate conservation planning methods transferrable to other regions. What is most unique about this research, and what makes it so difficult at this preliminary stage of development, is that we are trying to combine in one analysis three types of conservation planning: special element mapping, representation or gap analysis of habitats, and population viability analysis for area-dependent target species (Fig. 1). It's easy enough to say that conservation strategy should consider both species and ecosystems, but combining them in a scientific analysis is technically and conceptually challenging. In this case study we are moving down all three streams of Fig. 1, but so far, we are only in the first or second pool in each of the streams.

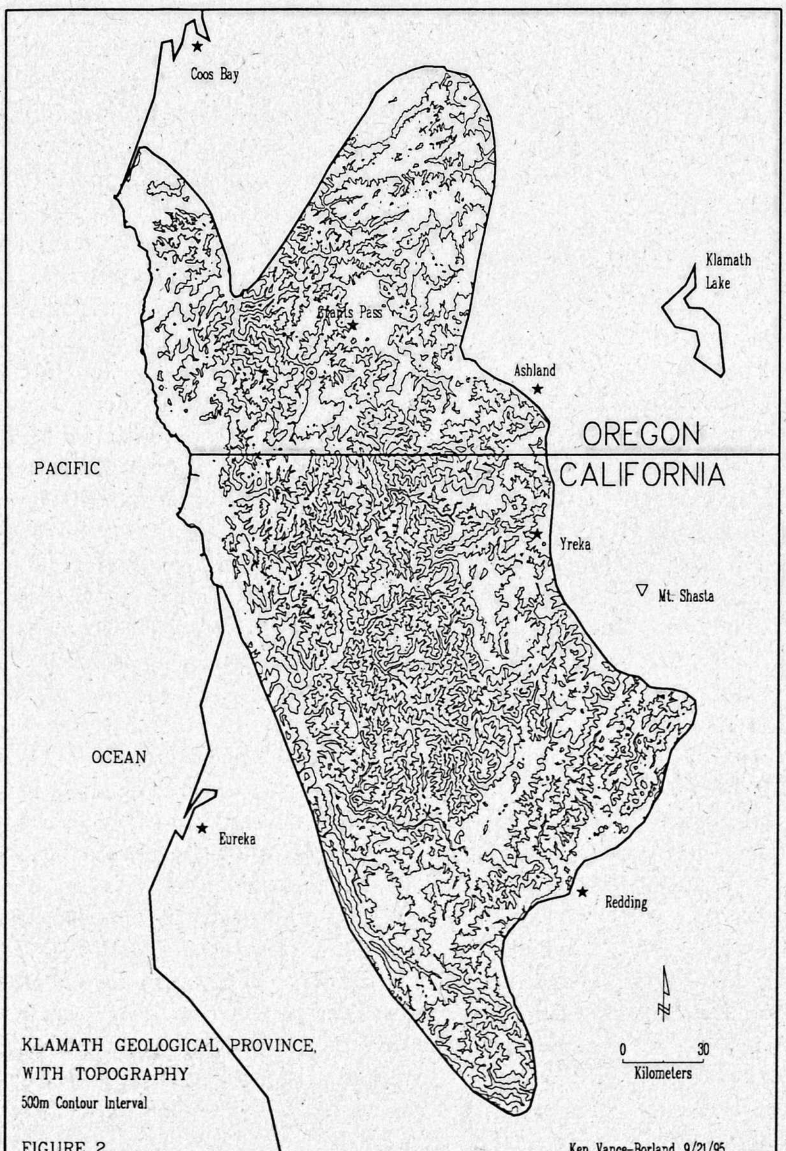
The Klamath Geological Province (Diller 1902) is an area of approximately 4 million hectares on the west coast of North America, about 1/3 in southwest Oregon and 2/3 in northwest California (Fig. 2). The Klamath/Siskiyou region (hereafter, the Klamath region) is considered a global center of biodiversity (Wallace 1992). About 3500 plant taxa have been recorded, 280 of which are endemic to the region, including over 90 on serpentine soils. There are 30 conifer and 45 hardwood tree species, more than in either the Cascade or the Sierra Nevada ranges, and possibly more conifer species than in any other area of comparable size in the world. Seventeen conifer species were once counted within a one-square-mile area of the Russian Wilderness in the center of the region (Wallace 1992). The IUCN has declared the Klamath region an area of Global Botanical Significance, one of 7 in North America and 200 worldwide. The region is also being proposed as a World Heritage Site and a UNESCO Biosphere Reserve by the Siskiyou Project and other groups.

One reason for the high diversity of the Klamath region is that it lies at the junction of several physiographic or biogeographic provinces (Whittaker 1960). To the north are the Oregon Coast Range and the Cascades Range, to the east is the Great Basin, and to the south are the Sierra Nevada Range, the California Central Valley, and the California North Coast Province. Many plant species reach their southern, western, or northern limits in the Klamath Region. A strong moisture gradient from the coast inland also influences the diversity of the region. At the coast annual rainfall can be as high as 120 inches per year, giving rise to lush temperate rainforests including such conifers as Redwood and Port Orford Cedar. The latter, an endemic, is threatened by a fatal root fungus that is spread by logging, road-building, and other human activities. Interior portions of the region may get less than 20 inches of rain per year, promoting dry-mesic plant communities such as Black Oak savanna. The Klamath region is extremely heterogeneous in geology and soils. The interior of the region consists mostly of steep and deeply cut mountains. Geologists have called this area 'the Klamath Knot' (Wallace 1983) to reflect its tangled complex of rugged mountains (Fig. 2). Because access to humans was difficult, this region was one of the last in the West to be heavily exploited for timber and other resources, but the remote character of the Klamath is changing rapidly. The threat of increased exploitation is a primary reason the Siskiyou Project contacted Noss to undertake this research.

As shown in Fig. 1, our research will include 1) performing a physical habitat diversity (representation) analysis and 2) a biodiversity (special element) analysis for the region; 3) selecting a set of sites that fully represent the physical and biological diversity of the region; 4) identifying additional areas needed to maintain viable populations of key species in the region; and 5) designing a reserve network encompassing those sites and based on principles of conservation biology. The reserve design will include guidelines for ecological management of various zones, such as suggestions for vegetation management and restoration and identification of likely compatible and incompatible human uses. At the time of this writing the first objective is well under way, the second has begun, and the other three are in planning phases. Vance-Borland is doing the physical habitat diversity analysis for his M.S. project at Oregon State University. Strittholt, Noss, Carroll, and Nawa will do the biodiversity analysis. Carroll will conduct a population viability analysis of the Pacific Fisher in the region for his M.S. degree at Oregon State. All of us will contribute to the site selection process, and Noss will be in charge of the final reserve design and management plan.

Physical habitat diversity is important to consider in reserve design for a number of reasons. Gap analyses may use physical habitats or vegetation to assess representation (Scott et al. 1993, Noss 1995, Iacobelli et al. 1995). Physical habitats can be defined and classified on the basis of climate, geology, soils, topography, and other physical features. These features largely determine which organisms can live on a site and how abundant they will be. Thus, basic to any biodiversity analysis relying on physical habitats is the assumption that species distributions reflect these physical variables (Richerson and Lum 1980, Murphy et al. 1990). Data on physical variables such as elevation, climate, and soils are often available where biological data are not (Davis et al. 1990). Thus, physical environmental data supplement biological data for full biodiversity representation (Kirkpatrick and Brown 1994). Inclusion of the full range of environmental variability within a reserve network may act as a buffer against climate change by providing a range of habitats with different microclimates for organisms to move into (Hunter et al. 1988). The plant ecologist Robert Whittaker (1960) found that plant communities in the Siskiyou Mountains were associated with distinct areas of the landscape defined by elevation and topographic-moisture gradients. However, substrate was also an important influence, as shown by the unusual vegetation associated with serpentine soils. The high habitat diversity of the Klamath region may explain why so many relictual species have persisted there for long periods, despite dramatic changes in global and regional climate.

Initial data on physical variables we have acquired for the entire region include USGS 90m digital elevation models and USSCS STATSGO soils data, both at a scale of 1:250,000.[1] The STATSGO soil types are quite generalized, as soil scientists from the SCS have grouped as many as 21 similar soil series together into major soil types (Lytle et al. 1993, Soil Sur-



KLAMATH PROVINCE WILDERNESS AREAS

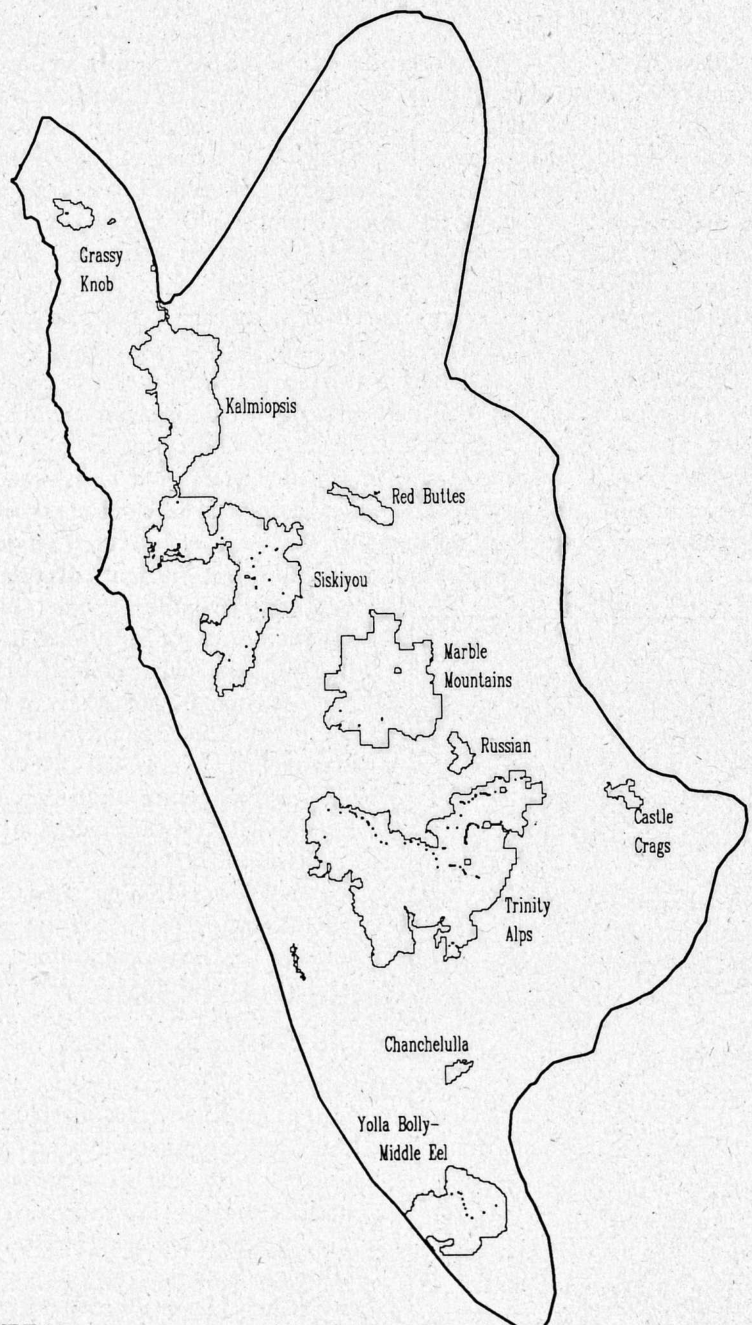


FIGURE 3

vey Staff 1992). The STATSGO soil classification was meant to be used for multi-county, regional or interstate planning such as ours. The STATSGO data for Oregon were available at Oregon State University (OSU) and the California STATSGO data were acquired by anonymous file transfer protocol (ftp) from the National Center for Geographic Information Analysis in Santa Barbara.

Most of our representation analysis will be for the entire region at scales of 1:100,000 to 1:250,000 (Klijn and Udo de Haes 1994). We will do some subregional analyses at scales of 1:24,000, for example to check samples of actual vegetation or to assess actual road density. It is beyond the resources of this study to analyze the entire 4 million ha region at the 1:24,000 scale, or work at the local site level at scales larger than 1:24,000. We are using the workstation version of ARC/INFO (ESRI 1992) for our GIS analysis (Sample 1994, Goodchild et al. 1993) both at OSU and at The Wildlands Project's GIS lab.

Based on the initial elevation and soils data and available literature on the plant ecology of the region (e.g., Whittaker 1960, Franklin and Dyrness 1973), a simple physical habitat model was developed consisting of six 500m elevation bands, a south aspect (from 75 to 325 degrees) and a north aspect (from 325 to 75 degrees) and the STATSGO soil classes, of which there were over 100 across the region.[2] There are over 550 distinct physical habitat types across the region in this simple model at this level of classification. Only about 1/3 of these physical habitat types are represented in the ten congressionally withdrawn protected areas in the region (Fig. 3). This level of representation does not adequately protect biodiversity in the region. Full representation of habitats in protected areas is an accepted conservation goal (see Pressey et al. 1993, Noss and Cooperrider 1994). However, the level of classification hierarchy (i.e., lumping versus splitting habitat types) may strongly affect representation analyses (Pressey and Logan 1994, 1995). For example, if we recognized 50 instead of 500 habitat types, far more than 1/3 would probably be represented in existing reserves. We will conduct our final representation assessment at several levels in the habitat classification hierarchy, in order to address this problem.

Having built this simple model of physical habitat classes we were interested in assessing how well it corresponded with actual vegetation patterns in the region. So we acquired additional data, including digital actual vegetation maps at a scale of 1:24,000 for 28,000 ha in the Salmon River watershed, part of the Klamath National Forest in northern California. The Salmon River study area is near the center of the Klamath region, and at 28,000 ha represents less than 1% of the total area of the region. The headwall of the south fork of the Salmon River lies below Grizzly Peak in the Trinity Alps. There are over 2000 polygons and 69 vegetation types in the Forest Service vegetation map of this area, and 75-80% of them have been visited at least once by Forest Service personnel checking the accuracy of the classification.

We are still searching for an appropriate method of comparing our model of physical habitat categories to the model of vegetation categories. We assessed the influence of several continuous physical variables on the distribution of vegetation in the Salmon River study area using principal components analysis (PCA) in the GRID module of ARC/INFO GIS, and generalized linear modeling, generalized additive modeling, and classification tree analysis using the statistical software S-PLUS (Chambers and Hastie 1993).[3] The results of the four methods of analysis indicated that elevation was a highly significant influence on the distribution of vegetation in the sample area, soil type was also highly significant, aspect was significant in some models, insolation was marginally significant in some models, and slope was not significant in any model.

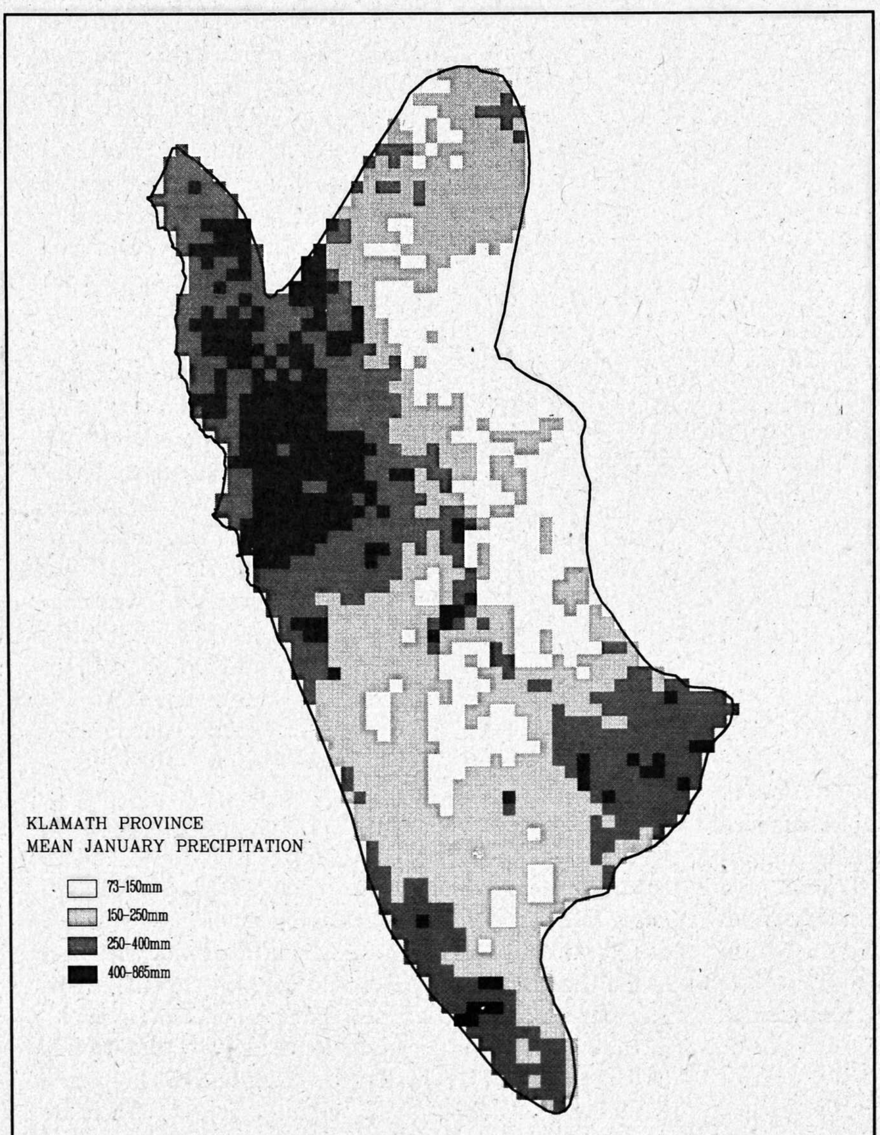


FIGURE 4

We emphasize that these are preliminary results based on only one small sampling of vegetation in the Klamath region. Additional work on this physical habitat diversity analysis will include use of precipitation (Fig. 4; Daly et al. 1994)[4] and temperature models, testing with additional vegetation data from around the region, combining similar soils polygons to reduce complexity (Host et al. 1995), an error/accuracy assessment (Goodchild 1993, Goodchild and Gopal 1989), and classifying the entire region by physical habitat classes, at several hierarchical levels.

The biodiversity or special elements analysis is also underway. Criteria being considered include roadless areas in various size classes, rare species occurrences, areas of high species richness, imperiled natural communities, watersheds of high value, and sites sensitive to development or adjacent to other important sites. We have acquired Forest Service data on late successional/old-growth areas, designated conservation areas for the Northern Spotted Owl, and key watersheds for endangered fish runs (Fig. 5). These public domain data were requested from the Forest Service Region 6 office in Portland and were transferred to us on 8mm tape as ARC/INFO coverages in tape archive format at no cost. From the USGS we acquired a Digital Line Graph (DLG) (U.S. Geological Survey 1985) of roads in the region, which we will verify in the field in selected watersheds. The Oregon and California Natural Heritage Programs have provided, for a fee, data on rare species occurrences, which we have mapped in ARC/INFO GIS (Fig. 6). All of these special elements will be considered in the final reserve selection and design and will be represented by map layers which, when overlaid, will illustrate areas of high conservation value.

Further special element assessment will include an analysis of vegetation change based on satellite remote sensing data and an analysis of road density in the region. Volunteers from the Siskiyou Project and other groups in the region will help with the roads assessment and with other field verification. The first step in that analysis will be to identify locations outside of Wilderness Areas having low road density according to the USGS DLG. Volunteers will then visit several of those areas looking for roads not shown on the official maps. These analyses will help identify roads that should be closed to better protect biodiversity (aquatic and terrestrial) in the region.

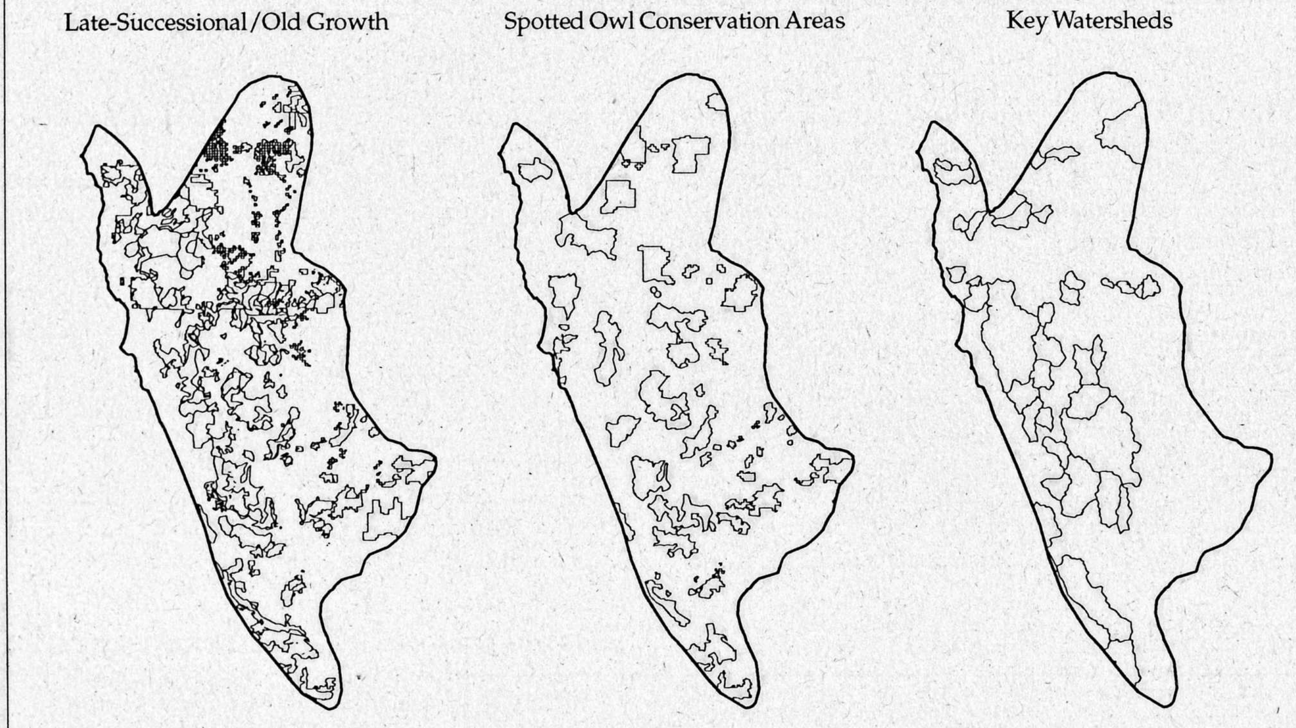


FIGURE 5

Selection of sites for protection will proceed when the physical and special element assessments have been completed. We are working with an operations researcher at Oregon State University trying to develop a method of using integer programming for optimal site selection. These mathematical algorithms are useful in selecting a set of reserves from potential sites in the most efficient manner.[5]

Although analyses of representation and special element occurrences, followed by use of mathematical selection algorithms, are useful in locating areas important to protect, the design of reserve networks requires additional information on species sensitive to human activities. Reserve size and connectivity are two considerations that can be addressed only by examining the autecology of particular target species. The Pacific Fisher is a fragmentation-sensitive subspecies associated with late-successional forests and a candidate for federal listing. The Klamath region may be the last population stronghold of the Fisher in the Pacific states, yet even here the animal is in danger of extinction. We will use the Fisher as a target species for reserve and linkage design. Carlos Carroll is researching this species in the Klamath region as part of his M.S. work at Oregon State University. His study will include modeling and mapping suitable habitat and performing a spatially explicit population viability analysis (Dunning et al. 1995) for the Fisher. Volunteers with the Klamath Forest Alliance will survey for Fishers using baited track plates; this information will help refine habitat suitability models. We will use the FRAGSTATS program (McGarigal and Marks 1994)[6], which characterizes landscape fragmentation with over 30 indices, to assess habitat conditions for Fisher and other wide-ranging animal species on a landscape scale. Information on optimal habitat areas for Fisher will be added as map layers to the reserve design. The needs of other area-dependent species, including the Wolverine (very rare in the region), Gray Wolf and Grizzly Bear (both extirpated from the region), will be considered qualitatively when designing reserves, buffer zones, and linkages in the region.

The reserve network design and management recommendations, the final part of our conservation planning exercise, will be based on the goals of regional conservation plans proposed by Noss (1992) for The Wildlands Project: represent all ecosystem types across their natural range of variation, maintain populations of all native species in natural patterns of distribution and abundance, maintain ecological and evolutionary processes, and leave room for change. Management guidelines will identify human uses that are compatible with these goals in each of the proposed conservation zones, as well as uses that are incompatible. The reserve design and management plan will probably have the general form of the proposal by Noss (1993) for the Oregon Coast Range. However, the Klamath / Siskiyou analysis is far more sophisticated and the final plan may take the form of a UNESCO Biosphere Reserve proposal. Provisions will be made for habitat connections between the Klamath region and adjacent regions and future research needs will be identified. We see this conservation plan as continually evolving and always open to revision as new information becomes available, but we hope that a near-final plan will be completed in 1996 or 1997.

We close by restating the goals of our research, which are to develop a biodiversity conservation plan for the Klamath/

Siskiyou region—a globally significant center of biodiversity—and to develop and demonstrate conservation planning methods transferrable to other regions for The Wildlands Project. We hope that the methodologies developed in this case study will be adapted, refined, and applied across the continent. ▮

Acknowledgments

This work is a cooperative venture of the Siskiyou Regional Education Project, The Wildlands Project, and several other interested organizations and individuals. It is funded by the W. Alton Jones Foundation, the Foundation for Deep Ecology, and The Wildlands Project. Additional funding for the Fisher population viability analysis is coming from the USDA Forest Service and U.S. Fish and Wildlife Service (through Dr. Bill Zielinski at the Redwood Sciences Lab in Arcata, California, who is supervising the analyses conducted by Carlos Carroll). Ken Vance-Borland (kenvb@fsl.orst.edu) is a masters student in the Department of Fisheries and Wildlife at Oregon State University (OSU, Corvallis OR 97331); Reed Noss (nossr@ucs.orst.edu) is editor of *Conservation Biology*, science editor of *Wild Earth*, and science director of The Wildlands Project; Jim Strittholt (stritt@earthdesign.com) and Pam Frost are staff ecologists and GIS analysts for The Wildlands Project; Carlos Carroll (carrollc@ucs.orst.edu) is a masters student in the Department of Fisheries and Wildlife at OSU, and Rich Nawa is a fisheries biologist with the Siskiyou Regional Education Project (POB 220, Cave Junction, OR 97523). Klamath Forest Alliance can be contacted at POB 820 Etna, CA 96027.

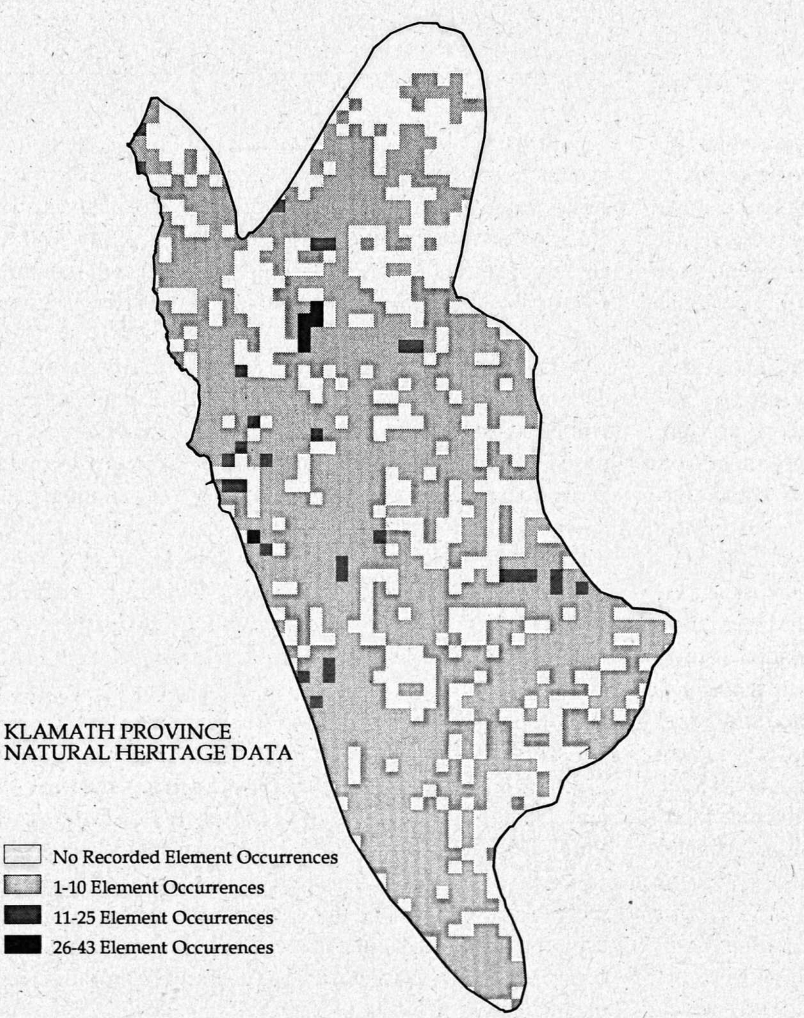


FIGURE 6

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FIGURES

Fig. 1. Building a reserve network of optimal scale. The flow chart shows the steps in data analysis, reserve selection, and reserve design that lead to a defensible reserve network that will have a high probability of meeting Wildlands Project conservation goals. From Noss (in press).

Fig. 2. The Klamath Geological Province, used to delimit the Klamath/Siskiyou study region. Topography is shown with 500 m contour intervals.

Fig. 3. Designated federal Wilderness Areas in the Klamath region. Preliminary results indicate these 10 areas represent only about 1/3 of the physical habitat diversity in the region.

Fig. 4. Mean January precipitation for the Klamath region, showing the west to east gradient.

Fig. 5. Late successional/old-growth forests, Spotted Owl conservation areas, and key watersheds, from federal databases (USDA Forest Service, Forest Ecosystem Management Assessment Team).

Fig. 6. Natural heritage program data, shown on a 5-km grid by number of recorded element occurrences.

ENDNOTES

1. Digital elevation models (DEMs) are available by anonymous file transfer protocol (ftp) at edcftp.cr.usgs.gov (cd/pub/data/DEM/250) or from the World Wide Web at http://edcwww.cr.usgs.gov/glis/hyper/guide/1_dgr_dem.
2. The elevation and aspect classes were generated in ARC/INFO using a program called TERRACLASS, available by anonymous ftp from glinda.kbs.ukans.edu.
3. We performed a PCA on the continuous variables elevation, aspect, slope, and March 21 solar insolation (a program called SOLARFLUX that calculates solar insolation for an area based on a DEM is available by anonymous ftp at glinda.kbs.ukans.edu.). Although soil type was not included in the principal components analysis because this is a categorical variable, the results of PCA are otherwise indicative of what we found with the other methods: the first principal component, accounting for 88% of the variation, was dominated by elevation; the second principal component, accounting for only 6% of the variation, was dominated by aspect; the third principal component, accounting for 5% of the variation, was dominated by insolation; and the fourth principal component, accounting for only 1% of the variation, was dominated by slope.
4. The PRISM precipitation model (Daly et al. 1994), covering the entire US, is available by anonymous ftp at fsl.orst.edu.
5. For an introduction to the problem of reserve site selection see Bedward et al. (1992), Belbin (1993), Cann et al. (1994), Cocks and Baird (1989), Noss and Cooperrider (1994, chapter 4), Pressey et al. (1993), and Underhill (1994).
6. Available by anonymous ftp at fsl.orst.edu.

Fisher Tracks in Snow, Alternating Walk *by Heather K. Lenz*

Wilderness Areas and National Parks

The Foundation for an Ecological Nature Reserve Network[1]

by Dave Foreman

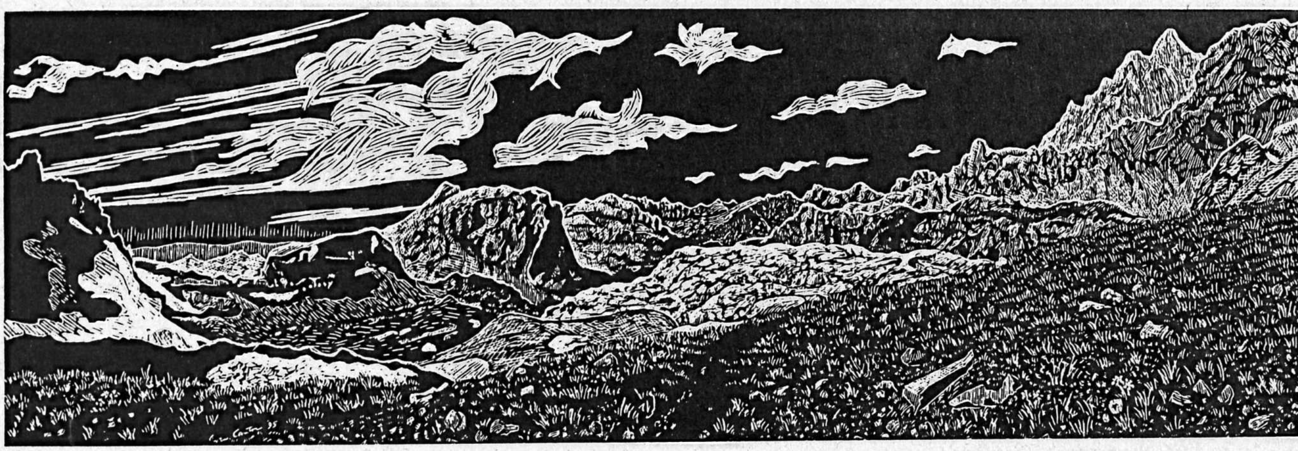
Some conservationists are worried about The Wildlands Project. With all our chatter about using conservation biology principles to design nature reserve networks, they're fidgeting like that cat on the hot tin roof. When we talk about how National Parks and Wilderness Areas have not protected the diversity of life in North America, they start hopping just as that cat would if it *sat* on the hot tin roof. They want to know where existing Wilderness Areas and National Parks fit into our scheme.

They can rest assured. The Wildlands Project comes not to bury Wilderness Areas and National Parks, but to praise them. Nonetheless, I understand how some of our statements might cause a whole lot of fidgeting. A basic purpose of The Wildlands Project is to apply the science of conservation biology to nature reserve design, designation, and management. Implicit in that purpose is a criticism of existing nature reserves, particularly of the National Wilderness Preservation System (NWPS) and the National Park System (NPS), and a recognition that they have not adequately protected biological diversity, from species to ecosystems to ecological processes. (See my article in this issue, "Wilderness: From Scenery to Nature.") In a nutshell, The Wildlands Project argues that Wilderness Areas and National Parks have not protected the full biological heritage of the United States because they have been chosen primarily for their scenic and recreational values, not for their ecological value or even for their wildlife value. As a result, Wilderness Areas and Parks are too small and isolated; and many ecosystems and the habitats for many species are not represented in the protective systems (see Reed Noss's article "What Should Endangered Ecosystems Mean to TWP?" in this issue).

In many if not most regions, existing Wilderness Areas and National Parks and roadless or lightly-roaded areas on the public lands are the building blocks for an ecological nature reserve network.

You can easily see why some conservationists are fidgeting. I'm even fidgeting a tad because of two dangers in our argument. First, it is easy to overstate this argument, ignoring the many species and ecosystems that have been relatively well protected in Parks and Wilderness Areas. Second, opponents of the Wilderness/National Park idea—ranging from certain deep thinkers on the left and their ostensible opposites on the right, to shills for extractive industry—have seized upon our criticism to argue against protection of specific areas and for humbuggeries like "ecosystem management" and "new forestry."

[1] In this article I deal primarily with nature reserves in the United States. My argument is applicable to reserves in the other North American countries, more so for Canada, less so for Mexico and some of the Central American nations.



Avalanche Divide looking north; Grand Teton National Park *by Evan Cantor*

So let me ice down that tin roof before any of us get burned. Criticism by The Wildlands Project and conservation biologists is not directed at Wilderness Areas and National Parks, but at the political process that has shaped them over the last century. In many if not most regions, existing Wilderness Areas and National Parks and roadless or lightly-roaded areas on the public lands are the building blocks for an ecological nature reserve network. Far from tossing aside existing protected areas and the NWPS and NPS, conservation biologists and The Wildlands Project want to expand such areas and connect them. Nor do we see traditional wilderness recreation as incompatible with a nature reserve network.

In this article I want to show why the NWPS and NPS[2] are the basis for the kind of nature reserve network TWP advocates. First though, let me identify the specific weaknesses of existing Wilderness Areas and National Parks, so we can see that the shortcomings are not inherent to the Wilderness/Parks idea but rather are results of politics and history.

• As spelled out in my companion article, most National Parks and Wilderness Areas have been selected primarily for their monumental scenery and their opportunities for non-motorized recreation instead of for their ecological or wildlife habitat values.

• The political power of cut-and-run industries and local boomers has meant that relatively few areas of rich forests, fertile valleys, or flowing grasslands have been protected. This has led to the "rocks-and-ice" situation: We have done a pretty good job of protecting alpine, subalpine, and some harsh desert ecosystems, but not good at all with ecologically more productive ecosystems.

• Because of the historic patterns of settlement and the give-aways of public land to lumber corporations, railroads, and land speculators, many ecosystems were gobbled up into private ownership and were not available for protection as National Parks and Wilderness Areas when such lands began to be withdrawn out of the public domain. Most eastern deciduous forests, Longleaf Pine/Wiregrass ecosystems, tallgrass prairies, lush river valleys in the West, and the grandest forests of the Pacific Northwest became private and corporate land before they could be protected.

• Through habitat destruction, persecution of large carnivores, and wasteful market hunting, many species were eliminated or had their populations depleted before Wilderness Areas and National Parks could be established (and some wildlife destruction, especially of predators, has continued even in protected areas). Such species include Passenger Pigeon, Carolina Parakeet, Bison, Grizzly Bear, Gray Wolf, Red Wolf, Mountain Lion, Lynx, Jaguar, prairie dogs, Bighorn Sheep, Woodland Caribou, Elk, Pronghorn, California Condor, Gopher Tortoise, Desert Tortoise, sea turtles, West Indian Manatee, American Crocodile, and Sea Otter. These species, now extinct, locally extirpated, or depleted in numbers, all play important ecological roles in their ecosystems. Their loss degrades the ecological integrity of National Parks and Wilderness Areas.

• Our lasting failure to understand the dynamics of natural fire and the resulting cult of Smokey Bear has degraded fire-dependent ecosystems. Zealous fire-fighting in National Parks and Wilderness Areas has led to changes in forest and grassland species composition, loss of habitat for plants and animals associated with fire, and accumulation of fuels that leads to unnaturally destructive fires.

• Seventy years ago, Aldo Leopold wrote about the ecologically destructive effects of cattle and sheep grazing in the Southwest. Livestock grazing in National Parks and Wilderness Areas before and after establishment has wrecked streams and riparian forests, degraded grasslands, changed forest com-

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[2] I consider the National Wilderness Preservation System and the National Park System, though different in management, as the nature reserve system for the United States. In this sense, Wilderness Areas on federal National Forests, National Parks, National Wildlife Refuges, and Bureau of Land Management (BLM) lands; National Parks not yet designated as Wilderness; and Wilderness Areas on state lands like New York's Adirondack Preserve and California's Anza-Borrego State Park make up our basic nature reserve system. I don't include all National Wildlife Refuges, only those designated or proposed as Wilderness, because many NWRs are little more than duck farms and others are open to logging, grazing, and other abuses.

Mt. Massive Wilderness, Colorado *by Evan Cantor*

position, and harmed wildlife through habitat destruction (Southwestern Willow Flycatcher), competition for forage (Elk), transmission of exotic diseases (Bighorn Sheep), and predator "control" (Gray Wolf and Mountain Lion).

The interplay of these factors has resulted in a Wilderness/Park system that has failed to protect representatives of all ecosystems, all native wildlife, and ecological processes. *However, the fault is with American land-use history and the political process of designation, not with the idea of Wilderness Areas and National Parks as means of protection.* The biodiversity crisis is not caused by a reliance on Wilderness Areas. If these areas have not protected biodiversity, it is because of the political forces working at every step of the way to weaken and pare away such reserves. The biodiversity crisis is worsening partly because *not enough land has been protected as Wilderness Areas and National Parks.*

The Wildlands Project's vision of designing and protecting a nature reserve network begins in many cases with existing National Parks and Wilderness Areas as core areas. The next step is protection of roadless areas and biologically important habitats on the public lands as additions to core reserves and as connections between core reserves. Yes, we need careful scientific mapping and data analysis to identify biodiversity hot spots, unrepresented ecosystems, habitats of rare or imperiled species, and likely restoration areas on both public and private lands; but designated and de facto wilderness on the public lands is where we begin. Let me just outline some of the reasons why Wilderness Areas and National Parks are at the heart of The Wildlands Project:

1. In the United States, over 100 million acres is protected in the National Wilderness Preservation System (about half of this is outside Alaska), and 90 million acres is protected in the National Park System (about a third of this is outside Alaska). (These figures do not add up to a grand total of 190 million acres, by the way, because 40 million National Park acres are also protected as Wilderness. So the total acreage protected is about 150 million acres.) This acreage is already publicly owned, it is generally managed for its ecological integrity, and it is off-limits to most commercial exploitation. A pretty good foundation for protecting biodiversity, I'd say—except of course, for those bioregions that have few or no Parks or Wilderness areas.

2. Despite their smallness and isolation and the rocks-and-ice factor, Wilderness Areas and National Parks do protect areas of great value for biological diversity. For example, designated Wilderness Areas and National Parks on the Pacific coast safeguard the low-elevation ancient forests of the Suiattle River in the Glacier Peak Wilderness Area, French Pete Creek in the Three Sisters Wilderness Area, and the Hoh and Quinalt valleys in Olympic National Park. These are probably the finest remnants of old-growth forest. Conservationists fought hard for these places for ecological reasons and won over the strident opposition of the timber industry. The finest and most natural old-growth Ponderosa Pine forest in the world is protected in New Mexico's Gila Wilderness. State and federal Wilderness Areas and Parks in the East hold most of the old-growth forest there and much of the best recovering forest. Some of the best remaining wetlands and even a few sizable grasslands are preserved in Wilderness Areas and National Parks. Also, Wilderness Areas and National Parks protect prime habitat (though not enough of it) for imperiled and sensitive species like Wolverine, Fisher, Grizzly Bear, Gray Wolf, Mountain Lion, and Bighorn Sheep. If it were not for these areas protected through the blood, sweat, and tears of *recreational* Wilderness conservationists, these species would be in much more danger today than they are—if they existed in the lower 48 states at all. Moreover, Wilderness Areas and National Parks are prime areas for reintroduction of extirpated species—Gray Wolf, Red Wolf, Bighorn Sheep, Mountain Lion, Woodland Caribou, California Condor, and soon Mexican Wolf.

3. In many regions, existing protected areas can be linked together with other public lands, many of them roadless or near-roadless. Such areas of de facto wilderness already have a strong and knowledgeable constituency. Conservation groups, inspired by The Wildlands Project, are generally eager to modify their long-standing Wilderness Area proposals for such lands with ecological criteria. In many areas of the United States, a wilderness recovery network designed for large carnivores and herbivores can be largely established on existing federal and state lands.

4. Despite their weaknesses, National Parks and Wilderness Areas are the only proven effective nature reserves. Remember all those highfalutin Spotted Owl reserves and old-growth conservation areas in Clinton's plan for Northwestern forests? Many of them are being clearcut today. Wilderness Areas and National Parks, in contrast, are still off-limits to commercial logging.

5. In this era of budget-cutting and belt-tightening, money for conservation will be harder and harder to come by. With the growing din from property-rights fanatics, protection of private land becomes more difficult. Even the staid old Nature Conservancy has been rattled by these extremists. Thus, practicality is important. If, by modifying existing Wilderness Area proposals on public lands to better meet ecological criteria, we can protect much of Nature, this is more practical than primarily focusing on private land. (Of course, to protect many ecosystems and species, The Wildlands Project will need to work on currently private land.)

6. Conservationists and hikers already know the public lands, often better than do agency managers or university biologists. Where do rare birds nest? Ask your local bird watchers. Where are the remaining native forests? Train some local hikers and they'll find them. What are the existing uses, where are the roads, where are the proposed timber sales? Check with the local conservation group. Wilderness recreationists know the public lands and are usually willing to help protect their hiking areas. Outdoors people represent a tremendous resource for public lands protection, which is not available for other lands.

7. Similarly, wilderness conservationists are a mobilized, effective, and knowledgeable group of political advocates. Such a constituency is absolutely necessary for the political process of establishing a nature reserve network. If we leave these folks' proposed Wilderness Areas out of Wildlands Project reserves, however, we can kiss our political support bye-bye.

8. We have National Parks and Wilderness Areas because conservationists have been able to sell the idea of Wilderness and Parks to the American public. The dusty old arguments of natural beauty, physical challenge, spiritual inspiration, wildlife protection, and *wildness* resonate deeply in the American soul. The concept of biodiversity does not yet have that power. Those of us who wish to protect the diversity of life need to figure out how to market it. Piggybacking onto the popular wilderness preservation movement is one way to do it.

I hope I've chilled off that hot tin roof, and all you cats are cool. ▮

Dave Foreman is chairman of The Wildlands Project, publisher of Wild Earth, *and a member of the Sierra Club board of directors.*

The Salmon Go All the Way to Death

They are fish. They live in the cold ocean,
breathe water, eat other fish.
They in turn are eaten. What do they know?
They know they are salmon and where
they were born. They live in the cold ocean,
but when it is their turn to die, when it is their turn
to return, they know what to do.
They remember where they were born,
exactly where it is they need to go.
And they go. The female salmon stop
roaming the ocean, eating other fish.
They leave the endless deep and turn
toward the land to find the river mouth
that spit them forth. They enter the mouth,
go upriver. The female salmon travel together.
And the male salmon leave the cold ocean,
the eating of other fish. They seek the land,
find the mouth that spit them forth
from the land's constriction, and enter.
They go back guided by the memory.
They go to make the memory
continue in their way. They go to make
the salmon continue in the old way.
They swim upriver, leap the falls.
The river narrows. Swimming is harder.
The salmon push between the rocks, against the water.
They must find the shallows where they were born.
They go to the heart of the land. There they meet
and agree. The female waves her body and lays her eggs
and moves off. And the male waves his body,
sprays his seeds to fertilize the eggs and moves off.
Then the female and the male salmon die.
In the shallows, having given birth
to eggs and seeds, a promise to their memories,
they die. The salmon go all the way upstream.
The salmon go all the way to death.

—*Anna M. Warrock*

illustration by Sarah Lauterbach

ROAD-RIP and The Wildlands Project

Making the Connection

by Kraig Klungness and Katie Alvord Scarborough

ROAD-RIP HAS A VISION of a North American wilderness without roads—wilderness unbroken by asphalt or gravel or bare stripped earth, uninvaded by industrial machinery or recreational motor vehicles; a wilderness where Cougar and Elk and conifer and fern live undisturbed in a matrix of biological richness.

Preserving and restoring roadless landscapes is at the heart of ROAD-RIP's mission, and we do this in conjunction with The Wildlands Project's North American wilderness recovery goals. ROAD-RIP, which grew out of The Wildlands Project vision, has the same ultimate goal as TWP: big wilderness as home for the unimpeded evolutionary journeys of North America's myriad native species.

To establish and expand the system of reserves and corridors envisioned by The Wildlands Project, large roadless areas are needed throughout the continent. Road density (miles of road per square mile of land) in connecting corridors needs to be as low as possible (with impact mitigation where roads do exist). For viability, connectivity is key. And what bigger disrupter of connectivity is there than a road?

In fact, road density is one of the most accurate indicators of a region's ecological health. The lower the road density, the more likely you are to find a healthy representation of native species. The lower the road density, the more likely you are to find Gray Wolves, Wolverines, Canada Lynx, Pine Marten, Grizzly Bears, Woodland Caribou, Ferruginous Hawks, Northern Goshawks, Spotted Owls, Bull Trout, Wood Turtles, and deep woods indigenous plants. The best road density goal for maintaining and restoring ecological and evolutionary processes is ZERO—NO ROADS AT ALL. And what we call a road includes everything from interstate highways down to two-track logging roads, off-road vehicle trails, and snowmobile routes. They are all swaths of ecological destruction.

Almost any kind of disruption of wild habitat begins with road construction. We frequently quote Dave Foreman and Howie Wolke on this topic: "The army of wilderness destruction travels by road"—by logging road, by mining road, by jeep road, and by roads built for other industrial, commercial, and residential developments.

The very existence of such roads splits the landscape into tiny pieces and barricades individuals of road-averse species into smaller and smaller islands of road-bordered habitat. Meanwhile, the roads allow people both individual and industrial access, further reducing habitat quality as poaching, noise, housing development and other types of encroachment increase. The natural dispersal, and therefore genetic viability, of wide-ranging species is undermined; the sensitive habitats of deepwoods flora are lost. Biological diversity declines. This pattern of impoverishment, with roads eating away wilderness, today pervades most of the contiguous United States and much of Mexico, Canada, and Alaska.

That's why a program like ROAD-RIP is essential to the ultimate success of The Wildlands Project. In order to assure the connectivity that TWP envisions, we need to close roads—lots of roads—and we need to close them first where it will do the most good.

Every road revegetated means habitat reconnected, a more expansive wild landscape restored.

ROAD-RIP's primary focus for road elimination is US public lands. These lands contain much of the best roadless habitat left and many of the best opportunities for ecological restoration through road removal. At the same time, they are under assault from massive publicly financed road-building and road-maintenance schemes for the benefit of logging, mining, oil, and ORV interests. The US Forest Service alone maintains 370,000 miles of road and continues to build more each year.

To conserve biodiversity, wildland advocates need to fiercely protect roadless habitats, and minimize road densities on already roaded public wildlands by getting roads obliterated and revegetated. Several federal environmental laws provide activists the opportunity to do this. They not only require that federal land management agencies comply with environmental standards regarding the existence and construction of roads (agencies are frequently out of compliance), they allow concerned citizens to petition for road removal and challenge road construction proposals.

ROAD-RIP helps activists who want to get roads closed. We've compiled a series of road ripper's guides that spell out the administrative and legal nuances of working with public agencies on road removal. At this writing, we have three guides, with two more in preparation.

The Road-Ripper's Guide to the National Forests, by road-fighting veteran Keith Hammer, is a revised and expanded version of Keith's original *A Road Ripper's Guide to the National Forests* (1990). The new guide contains updated research, updated Forest Service directives, and a more detailed discussion of road density. It shows how to debunk Forest Service fudging on road density, explains what constitutes an effectively closed road, and outlines making a case for removing or preventing a road. "Six Steps to Close a Road" are presented, along with road closure ground-truthing forms, sample letters and a comprehensive flow chart of the entire road-closure process.

All this is presented from the perspective of an author who has ample experience with his subject matter. Keith has been hammering the Flathead National Forest for years about its road system and has gotten the Forest Service there to remove or commit to remove over 1000 miles of road.

The strength of *The Road-Ripper's Guide to the National Parks*, authored by environmental attorneys David Bahr and Aron Yarmo (Bahr and Stotter Law Offices), is—as you might ex-

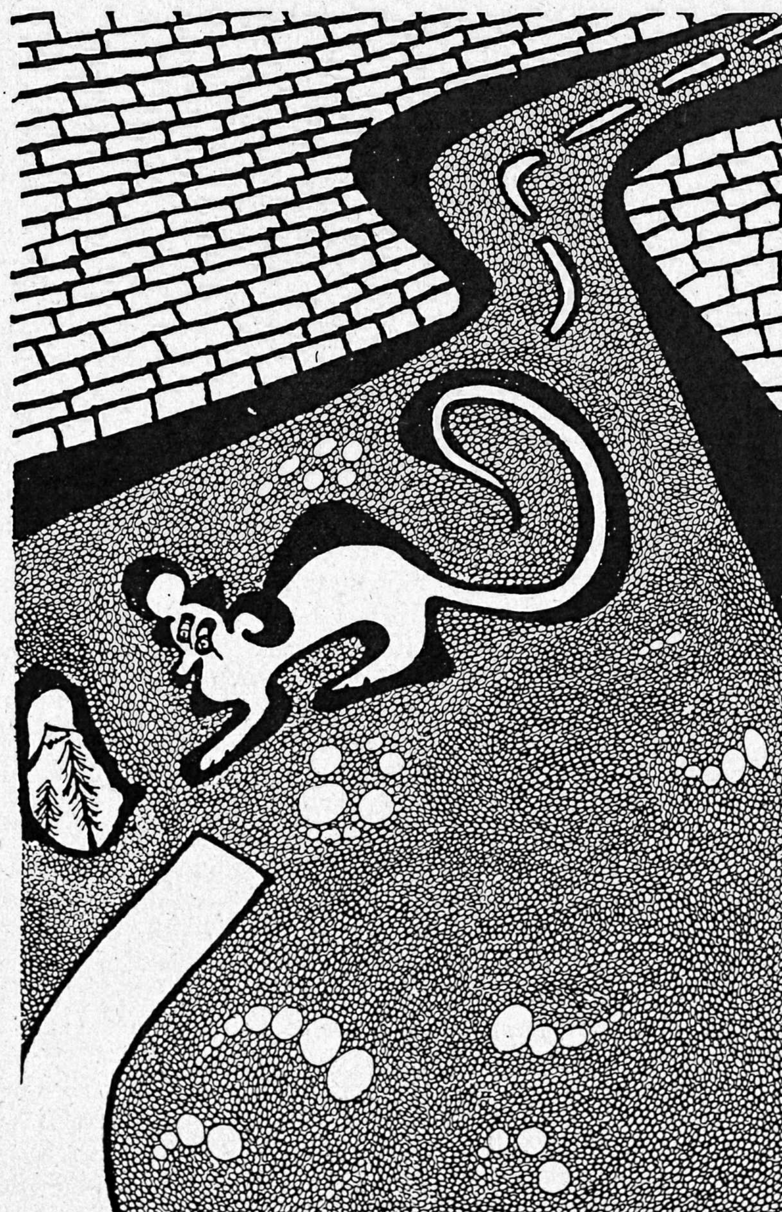


illustration by Jim Nollman

Twelve Terrible Roads

- Bisecting Big Cypress Nature Preserve, **Interstate 75** from Naples to Fort Lauderdale, Florida (better known as **Alligator Alley**) is one of the most ecologically devastating roads in the country. Alligator Alley disrupts water flows and severely fragments Florida Panther and Eastern Indigo Snake habitat. Alligator Alley also provides access to over 1400 miles of ORV trails, 900 of which are in Big Cypress Nature Preserve.
- **Forest Road 600**, on the highest ridge of the Talladega Mountains in Alabama, passes through some of the state's last old-growth stands and separates the Cheaha Wilderness from three other proposed Wilderness Areas. The streams in the area contain several federally listed snail and mussel species. The Forest Service has plans to turn this jeep track into a scenic highway—closing it now would stop that threat in its tracks.
- **Corridor H** is a proposed 100-mile, four-lane highway from Elkins, West Virginia to Strasburg, Virginia. Routed through two National Forests, Corridor H would cause extensive environmental damage—crossing more than 40 rivers and streams, fragmenting wetlands, and exposing acid mine drainages.
- Piercing into Adirondack Park's largest wilderness area, the **South Meadow Road** provides access to a heavily-overused portion of the High Peaks region. The road concentrates hikers into the sensitive alpine zone where fragile vegetation is easily damaged by trampling. Frequent human disturbances threaten the population viability of recently reintroduced Lynx. Closing this road would reduce threats to carnivores and assist in successful recovery of the park's 85 acres of alpine vegetaton.
- **Minnesota State Highway 116** splits the northern and southern sections of the Boundary Waters Canoe Area Wilderness. As this highway crosses the Superior National Forest, Lake Jeanette State Forest, and some private land, it fragments Eastern Timber Wolf, Wolverine, Woodland Caribou, Canada Lynx and Moose habitat.
- The Greater Yellowstone Ecosystem is a symbol of wilderness to the American people. The **Ashton/Flagg Ranch Road** (Forest Road 261) on the Targhee National Forest separates Yellowstone and Grand Teton National Parks, disrupting migration corridors for wide-ranging species such as bears and Elk. Closing the road from Flagg Ranch to Ashton would help protect this treasured ecosystem.
- Cutting through the heart of the Selway/Bitterroot ecosystem, the **Magruder Corridor** divides the largest potential roadless areas in the lower 48 by separating the Frank Church River of No Return and the Selway Bitterroot Wilderness Areas. Closing this road would ensure undisturbed habitat for Elk, Grizzly Bears, Gray Wolves, Bull Trout, salmon and uncountable additional animal and plant species.
- In the midst of one of the wildest areas in Oregon, the Forest Service proposes to pave **Overlook II**—a dirt road along the west rim of Hells Canyon of the Snake River. Upgrading the existing road would imperil Elk, Bighorn Sheep, Wolverine and Lynx populations in the area. The road destroys scarce flat land that is crucial for Elk calving and spring feeding. It also creates dangerous hazards for animals as they migrate from the Wallowa Mountains to Hells and Imnaha Canyons.
- High within the steep slopes of the Cascade Crest is the **Schoheim Jeep Trail**. This dirt track fragments the Soda Mountain Wilderness Study Area in southern Oregon and is part of an effort by ORV user groups to create a Mexico-to-Canada "Pacific Crest Trail for ORVs." As an ecotone between four ecosystems, the area serves as a crucial link for plant and animal species in these zones.
- Orange County California is looking to expand urban sprawl into undeveloped coastal sage scrub habitat by building the **Southern Foothills Transportation Corridor**. This 17 mile long road would abut the Cleveland National Forest and act as a catalyst for developing tens of thousands of houses. Several endangered species in the area would be further threatened if this development occurs.
- Located in the San Juan National Forest, the **Upper Piedra Road** separates the Weminuche Wilderness from the Piedra Wilderness Management Areas in southwestern Colorado, disrupting a migration corridor for Elk between winter and summer ranges. The road runs through the headwaters of the Piedra River—a proposed Wild and Scenic River. The area may harbor the only remaining Grizzly Bears in the region, and is considered prime habitat for wolf reintroduction.
- The **Dalton Highway** (also referred to as the Haul Road) was built along with the Alaska North Slope Pipeline. It is the maintenance access to the pipeline and was closed to public access until summer 1995. Cutting over 300 miles across taiga and arctic tundra, the Haul Road extends from Fairbanks to the Beaufort Sea. Opening this road to the public poses an unacceptable risk to native people's traditional lifestyles and to wildlife habitat for Caribou, Musk Ox, Moose, Grizzly Bears, wolves, Peregrine Falcons, Gyrfalcons and the many other species who still find refuge in the wild country of northern Alaska.

—Bethanie Walder and Marion Hourdequin, codirectors, ROAD-RIP

pect—its excellent coverage of laws that apply to the presence, construction, and use of roads in National Parks. Beginning with a brief overview of the founding legislative acts for the National Park Service, it shows how to use the laws affecting NPS road administration and the General Management Plan process to challenge NPS roads. Widespread use of this guide to counter the growing trend of more convenient motorized access to National Parks will benefit their native inhabitants, and help end the use of the parks as a marketing gimmick for automobile sales.

Almost all categories of public lands have been abused as recreational areas for off-road vehicles. Driving an ORV across sensitive habitat is a form of road-building. Because ORV trails have all the same ecological effects as roads and then some, ROAD-RIP decided that stopping the ORV juggernaut is integral to our mission. We asked a smart and motivated TWP intern named Dan Wright to author *The Road-Ripper's Guide to Off-Road Vehicles*.

Dan's comprehensive compilation of the strategies, laws, regulations and tactics applicable to stopping ORV abuse of public lands includes a discussion of the lessons learned from the Barstow-to-Vegas motorcycle race and a thorough bibliography. The guide's preface notes that since ORVs are at odds with the ecological needs of the land itself and with almost every other form of enjoying public lands, it is reasonable to ask that these lands be altogether off-limits to ORV use.

Coming soon are *The Road-Ripper's Guide to the Bureau of Land Management* and *The Road-Ripper's Guide to National Wildlife Refuges*. The guides are all part of the binder-format *Road-Ripper's Handbook* which also includes a "Road Impact Assessment Guide," a copy of Reed Noss's classic article "The Ecological Effects of Roads," information on the Freedom of Information Act (FOIA), contact addresses, and a recommended reading list.

We use the *Road-Ripper's Handbook* as a text at workshops that teach how to petition public agencies to close roads on public lands. These workshops, being held regionally around the country, provide activists with basic information about the ecological effects of roads, the role of road closures and stopping road construction in establishing conservation reserves, and administrative and legal tools to use in road closure efforts.

Sound science is a key component of TWP's efforts, and ROAD-RIP also provides activists with solid scientific information on which to base their road-closing efforts. This year, a crew of bibliographers headed by Reed Noss compiled a computer database for us that includes over 6000 citations for scientific literature detailing the ecological effects of roads. We can provide activists with access to this information by doing literature searches and preparing bibliographies on such topics as fragmentation or Grizzly Bear habitat viability or the effects of road noise on songbirds.

For example, the bibliography currently contains 112 citations on the topic of roads and habitat fragmentation; we can print out a bibliography listing those citations, or create one more specific, such as fragmentation's effects on various bird species. Activists can use this information to find papers supporting their road removal efforts. Often this scientific documentation is key in gaining legal road removal.

ROAD-RIP is using TWP vision maps in its choice of the most critical roads to work on closing. The vision maps and associated biological inventories and species status reviews provide a basis for prioritizing habitat conservation efforts. Genetic viability for all endemic species, natural dispersal of wide-ranging species, and species restoration are the fundamental goals. Road removal priorities parallel the habitat conservation priorities for large-scale North American wilderness recovery. We have formulated a list of Twelve Terrible roads that activists will target for closure. (See Terrible Twelve sidebar.)

We are about to begin working with local groups to get each of these 12 roads closed. We will also use the Terrible Twelve list as the basis of a broader public education campaign, showing how road closure can restore native ecosystems and speed ecological recovery.

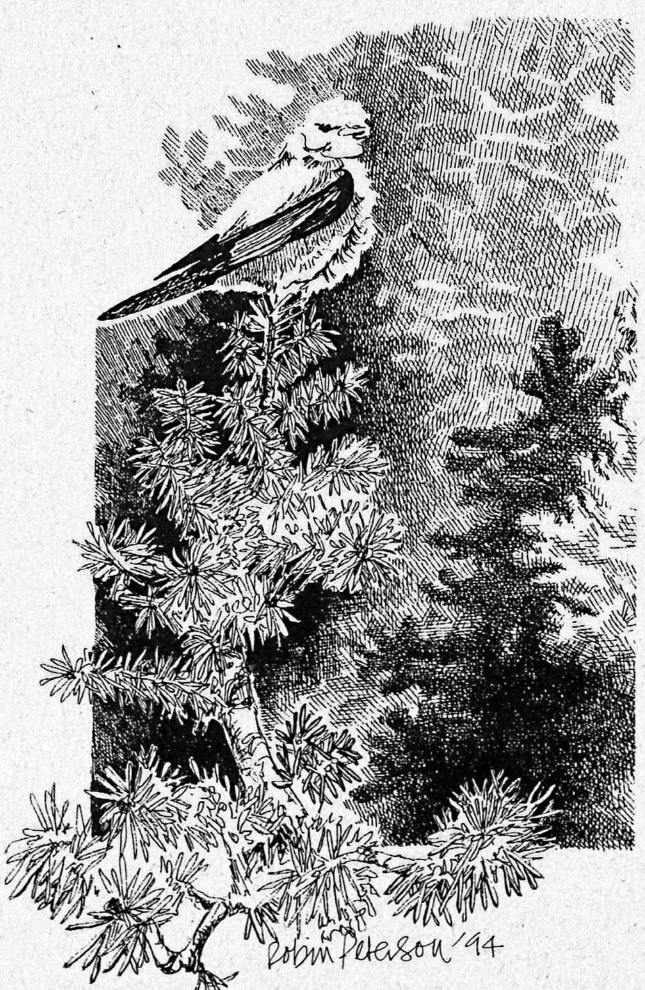
We will publicize the Terrible Twelve in the same way we spread the word about various specific road-closing efforts, in our newsletter. Given funding, we'll also conduct a media campaign, including press releases, ads, radio spots, and regional events to call critical attention to particular roads.

ROAD-RIP's work is very focused, oriented toward the specific details of getting roads removed and revegetated. Every road revegetated means habitat reconnected, a more expansive wild landscape restored. And that's critical for The Wildlands Project's big picture of big wilderness. ROAD-RIP will help make the grand vision of The Wildlands Project a reality, piece by roadless, interconnected piece. ∎

Kraig Klungness and Katie Alvord Scarborough co-founded ROAD-RIP (the Road Removal Implementation Project) and now serve on its steering committee. ROAD-RIP and its current codirectors, Bethanie Walder and Marion Hourdequin, can be reached at POB 7516, Missoula, MT 59807; (406) 543-9551.

Real Work and Wild Vision

Highlights of Wildlands Network Design



by Rod Mondt

IN THE FIRST *Wild Earth* special issue, The Wildlands Project offered a short list of organizations from around North America that were "leading the way" toward an ecologically sound vision for the continent. Today, three years later, these groups and a passel of other grassroots organizations and individuals have taken several more steps toward North American wilderness recovery. They have started the complicated process of mapping the first iteration or the "rough cut" regional reserves, and the equally complicated process of building organizations and structures that will maintain the vision and the energy needed to see the work through to the end. Using the goals, methods, and general direction of Wildlands Project staff and supporters, these organizations are working together to produce a vision of an ecologically vibrant North America. Here we offer just a few examples of wildlands efforts already underway.

Last year at our annual meeting, TWP board agreed on what we all knew in our hearts. As much as we want to cover every ecosystem, it is impossible to concentrate on the entire North American continent with a small staff. We need to focus our energy and resources. With this admission came the concurrent realization that the regional concept was, in some cases, too unwieldy for our mapping purposes. In order to remedy this situation, the staff and board decided to temporarily divide and prioritize the regions. However, we want to be very clear that this ranking does not mean we are abandoning the other regions or subregions. It means we will be working at different levels, with different time frames, depending on the status of reserve proposals already drafted, organizational structures, mapping, and other key elements of functional reserve design. We will continue to work with any individual or organization that shares our goal of biodiversity protection and rewilding through design and implementation of a core/buffer zone/corridor reserve system.

This report is intended to highlight the accomplishments of some of the individuals, groups, and coalitions that

illustration by Robin Peterson

have taken a hard look at our planet and decided to spend at least part of their precious time, energy, and money on long-range, scientifically based planning. It is not meant to take anything away from the thousands of other groups and individuals working on the everyday fights. The Wildlands Project is all too aware that in our current political climate, a Wolverine-like defensive posture is also vital, and will be needed so long as the onslaught of ecological destruction continues.

This report, then, is merely a reflection of *some* of the more advanced work taking place around the continent. For information about other wildland affiliates and regions not mentioned here, contact The Wildlands Project office in Tucson, Arizona. Also read the individual project progress reports in this issue.

Canadian Parks and Wilderness Society
National Office
Suite 380, 401 Richmond St. W.
Toronto, Ontario M5V 3A8
Canada
(800) 333-WILD
(416) 979-3155
Contact: Mary Granskou

Canadian Parks and Wilderness Society (CPAWS) has been working in many regions and with many different groups to advance the wildlands vision in Canada. Their Boreal Forest campaign involves cooperation with World Wildlife Fund—Canada's Endangered Spaces program, Alberta Wilderness Society, and Friends of the Northern Rockies, as well as Yukon Wildlands and the Yellowstone to Yukon connection. (See Y to Y article by CPAWS president Harvey Locke in *Wild Earth* winter 1993/94.) Much of the information in our upcoming framework package is based on the work of these organizations. CPAWS hopes to complement its Y to Y campaign in the West with an A to A campaign in the East: Algonquin to Adirondacks.

Yukon Wildlands
30 Dawson Rd.
Whitehorse, Yukon Y1A 5T6
(403) 668-6321
Contact: Juri Pepree

Together with the Alaska Conservation Foundation, Alaska Rainforest Campaign, and Sierra Club activists, CPAWS and TWP affiliate Yukon Wildlands is busy converting black flies, Caribou and a predominately wild matrix into the beginnings of a northern addition to the Yellowstone to Yukon effort being mapped by their neighbors to the south. Working with First Nations peoples, Yukon Wildlands has already garnered tremendous support for large ecological reserves in the Yukon.

Alliance for the Wild Rockies
POB 8731
Missoula, MT 59807
(406) 721-5420
Contact: Mike Bader

The Alliance has been advocating ecosystem-wide habitat protection for about as long as any one group. Their efforts have helped raise the level of conservation activism in the Northern Rockies; and their experience in dealing with the political and cultural barriers to reserve design should help cushion the blow for others attempting to implement cross-border ecologically based plans.

American Wildlands
6551 S. Revere Pkwy., Suite 160
Englewood, CO 80111-6410
(303) 649-1211
Contact: Sally Ranney

The "Corridors of Life" program foreshadows a strengthened relationship between The Wildlands Project, American Wildlands, and other organizations working on mapping and planning for the Rocky Mountain region as a whole.

California Wilderness Coalition
2655 Portage Bay East, Suite 5
Davis, CA 95616
(916) 758-0380
Contact: Ryan Henson

The California Wilderness Coalition has taken the role of regional coordinating group for The Wildlands Project. Notwithstanding their ongoing string of forest plan appeals, wilderness oversight, and other defensive work, they are helping organize TWP mapping meetings. The first took place in Santa Barbara. There, with the help of the local Patagonia outlet and the Environmental Defense Center, CWC impelled activists to commence mapping and organizing to implement The Wildland Project's vision in California's central coast range.

Sky Island Alliance
1639 E. 1st Street
Tucson, AZ 85719
(520) 323-0547
Contact: Susie Brandes or Dale Turner

SIA has been working to put together a working group to map a reserve design for the Mogollon Highlands, Gila country, and Sky Islands of southeastern Arizona and northern Mexico. SIA hopes to be the catalyst for other organizations, such as Life Net and the Southwest Center for Biological Diversity, and a host of activists in engendering a far-reaching plan for this region.

RESTORE: The North Woods
POB 440
Concord, MA 01742
(508) 287-0320
Contact: Michael Kellett

RESTORE has offered one of the bolder park proposals of recent years. Its Maine Woods National Park proposal has earned it the enmity of the Sportsman's Alliance of Maine (SAM, an affiliate of the NRA), the Maine Forests Products Council, and Maine Audubon Society (not an affiliate of National Audubon Society), and has received notable coverage in a variety of places. RESTORE's proposal should soon connect with other proposals from the Greater Laurentian Region Wildlands Project (and is encompassed by the Northern Headwaters Reserve proposal, outlined in this issue), as well as with proposals by Penns Woods Alliance to the south and Maritime Canada groups to the north.

Minnesota Ecosystems Recovery Project
POB 293
Red Wing, MN 55066
(612) 385-7512
Contact: Mike Biltonen

While Mike Biltonen has been mapping and organizing in the Minnesota portion of the Great Lakes basin, Northwoods Wilderness Recovery in Michigan (POB 107 Houghton, MI 49931), Superior Wilderness Action Network in Wisconsin (c/o Biology Dept., University of Wisconsin-Oshkosh, Oshkosh, WI 54901), and Friends of the Boundary Waters in northern Minnesota and Quebec (1313 Fifth St., SE, Suite 320, Minneapolis, MN 55414) have offered guidance on other subregions in the Great Lakes Northwoods region. (See Mike's article in this issue.)

Southeast Wildlands Project
Route 3 Box 24-H
Hawthorne, FL 32640
(904) 481-9922
Contact: Susan Marynowski

The Southeast Coastal Plain group will use a cooperative steering committee model to cover the Gulf and Atlantic Coastal Plains from Mississippi to North Carolina. Their work will dovetail like a finely crafted armoire with that of the Alabama Wilderness Association, the state of Florida, The Nature Conservancy, the Coastal Plains Institute and eventually with the more distant Southern Appalachian Biodiversity Project. (See AWA proposal in *Wild Earth* summer 1993; SABP proposal in *WE*/TWP special issue #1.)

Heartwood
Box 402
Paoli, IN 47454-0402
(812) 723-2430
Contact: Andy Mahler

This core group of Ozark forest lovers and Heartwood activists is striving to integrate the use of geographic information and wildlands criteria into their ongoing battle to restore and protect our heartland's hardwood forests. Heartwood's area of concern is huge—encompassing the whole Central Hardwoods region from the Appalachians to the Ozarks—and their work should help tie together the efforts of the Coastal Plains group, SABP, and Central Appalachian activists (Virginians For Wilderness, Rt. 1 Box 250, Staunton, VA 24401).

Southern Appalachian Biodiversity Project
34 Wall Street, Suite 408
Asheville, NC 28801
(704) 258-2667
Contact: Brownie Newman

Mapping in the Southern Appalachians of North Carolina and Tennessee was initiated by the Southern Appalachian Biodiversity Project and the Southern Appalachian Forest Coalition. Now being added is the work of Virginians For Wilderness in the north and the Southeast Wildlands Project in the south.

Rod Mondt is the Outreach Director for The Wildlands Project.

illustration by Suzanne DeJohn

Land Ownership, Private and Wild

A Proposed Strategy

by Eric T. Freyfogle

WHEN EUROPEAN SETTLERS arrived on the east coast of North America four centuries ago they found a continent rich and mostly wild. From the early days of colonization, wilderness helped form the new Euro-American culture. But in rapid succession, axes and plows cut into those American wilds, watershed by watershed, as nature gave way to colonization and one of its key cultural components—private property. To own land privately, settlers believed, was to tame it, to put it to use raising annual crops and feeding immigrant livestock. Though colonists had many excuses for seizing lands from natives, among the most potent was their arrogant claim that Native Americans did not really own the land. They didn't own it because they didn't "use" it; they didn't clearcut the trees, erect fences, and replace native life forms—the usual if not essential hallmarks of private land possession.

The Wildlands Project seeks to recover important parts of that now lost American wilderness: to preserve what little is left; to restore where no wilderness remains. Among the many obstacles that loom ahead is the entrenched institution of private land ownership, American style. But how sizable an obstacle is private property, as myth and as reality? Is there, as early settlers assumed, a sharp dichotomy between wild and owned? Does open warfare lie ahead on this issue? Or might there be ways to defuse this strain, ways even to enlist the understanding of some of today's proud carriers of the private property banner?

For opponents of environmental regulation, private property has become a rallying cry these days. Americans, to be sure, want a clean environment, but they hold private property every bit as dear. The noisy "wise use" movement has grabbed hold of this private ownership issue, and gotten good mileage out of it. Yet, it would be a grave mistake for environmentalists to view the private-property crusade as merely a front for extractive industries. The property-rights movement is more popular and wide-spread than this. It has arisen with little or no prompting, its energetic workers moved by a cause they hold dear. In truth, Americans are inordinately fond of private property, especially private land. Those who have it want to keep it; those who don't have it want to get it.

As Wendell Berry reminds us, the word "property" shares its etymological root with such words as proper, appropriate, and propriety.[1] Thus, embedded in the word, if not in today's version of the institution, are certain, seemingly inescapable ideas—of rightful scale and proportion, of balance and order, of personal responsibility. To make something one's own—to transform it into one's property—is to make it part of one's life, an extension of one's person and character; it is to bring the thing within the fold of one's individual care and duty. Do these ethical ideas, we might wonder, lurk somewhere beneath the surface of American property law? If so, is it possible that friends of biodiversity might tease them out, in a way that makes ownership law more ecologically sound?

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THE REALITY BEHIND THE MYTH

When anthropologists study a particular culture they pay close attention to ownership norms. What they find is that ownership schemes come in a wide variety of forms and types. Rights are defined, limited, and allocated to community members in a nearly endless array of ways, each devised to meet the values of a given society. Private property isn't an inert object, something that a society buys off the shelf, bells and whistles in place. It is an organic institution that grows within a culture, responsive to the evolving needs and hopes of each particular society and influenced for good or ill by its technology and power structure.

A common American myth is that property rights in America began in absolute form, and only deviated from that form in the twentieth century (degenerated, some would say), with the advent of zoning rules and environmental controls. But Americans are rarely good in history, and such popular tales about property's past are no more accurate than other American stories. When the first settlers spread out over the Massachusetts landscape in the 1630s, many new towns placed firm limits on the use and transfer of private lands.[2] Town leaders wanted to promote neighborly watchfulness and cohesive communities, so they often barred families from building homes on their farmlands, requiring instead that they live in town. Because the identities and morals of community members were so important, towns often barred land sales to outsiders unless the communal leadership first gave its approval. Many early settlers came from regions in England that practiced open-field farming methods whereby farmers shared fields and farm tasks, working their lands collectively. Arriving in the New World, they naturally continued their old collective ways, at least for a time. Owning land meant belonging to a community.

Among the American colonies, Puritan Massachusetts was perhaps most prone to embrace land-use restraints, yet restrictions on private land use have confronted all generations of Americans in all places. Writing in the mid-eighteenth century, legal scholar Sir William Blackstone might wax poetically about property as "that sole and despotic dominion that one man claims and exercises over the external things of the world, in total exclusion of the right of any other individual in the universe,"[3] but his comments are easily misread when taken out of context. Blackstone spoke of property as myth, the *idea* of property "that grips the imagination" as he put it, not property as real-life institution, which was a far different thing. When James Madison and Thomas Jefferson a few decades later added their own paeans to private property, they too were familiar with a system of ownership that contained what owners could do.

The surprising truth—sadly missing from today's private-property debate—is that land-use norms in America's early years displayed a remarkable environmental sensitivity.[4] Farming supplied the paradigm land use in 1790, the baseline of entitlement when conflicts among users arose. When early industry began throwing off sparks and disrupting finicky hens, the sensitive, traditional land use enjoyed protection; the more noisy, intensive industrial use had to give way. Under the prevailing theory of water law, a railroad or textile mill could use water only if it did not alter the natural flow of the river, either in quantity or quality—which meant no consumptive water uses, no diversions, no pollution. In states like Illinois that embraced the civil-law rule for surface water run-off, a farmer could not drain a wetland if the drainage disrupted a neighbor. Only later did ownership norms shift to allow more noise and ecological disruption, as Americans became prouder of their industrial growth and big business grew in power. In time, riparian landowners gained the right to consume and pollute water so long as their actions were "reasonable" under the pro-growth norms of the day. In time, farmers could drain

illustration by Davis Te Selle

their wetlands if their actions amounted to "good husbandry" as newly defined in the steam-shovel era.

In American land law, owners have never had the right to engage in unreasonable land uses that cause harm, either to neighboring landowners or the public at large. William Blackstone embraced this idea of limited land ownership; so did James Madison and Thomas Jefferson. And so too do most Americans today.

HARMFUL LAND USES IN THE AGE OF ECOLOGY

Although American land-use law has long banned many land uses that are unreasonably harmful, the idea of harm has not stood still. It has been, in fact, little more than a shell concept waiting to be filled with meaning, its inherent vagueness giving rise in practice to almost limitless definitional flexibility. Each community and generation has faced the task of deciding whether particular land uses are or are not harmful. Over time, their answers have varied.

Today there is little dispute about whether landowners can engage in unreasonably harmful land uses—there simply is no such right. But what a trained ecologist considers harmful can differ widely from the opinions of less knowing observers—including observers in high places. In the closely watched Supreme Court case from 1992, *Lucas v. South Carolina Coastal Council*,[5] South Carolina's coastal planners sought to ban further construction on a fragile barrier island, knowing the dangers that such construction posed. Sadly, many members of the Supreme Court—particularly the decision's author, Justice Scalia—simply could not or would not appreciate the harm that was involved. As best Scalia could grasp, the state's aim was simply to promote tourism or create some type of public park. Landowner David Lucas simply wanted to build a home, Scalia proclaimed. What land use could be more appropriate than homebuilding? What use could be less harmful?

South Carolina lost *Lucas*, not because the institution of private land ownership is inflexibly slanted toward development, but because of a failure of ecological education. Not enough members of the Court were able to understand the ecosystem disruptions that come from building on ecologically sensitive lands. Regrettably, with the *Lucas* decisions now as precedent, more and more landowners have filed suit demanding compensation when their development plans are frustrated, most commonly when they can't fill their wetlands.[6] And some are getting that compensation, largely because the ecological harms of altering sensitive lands are simply beyond the ken of too many judges. As judges size up cases—and, indeed, as many rank-and-file Americans size up land-use disputes—the decisive question is relatively simple: does a land-use rule ban an activity that is harmful? Or instead does it ask a landowner to shoulder what really should be a public burden, to use her lands in a way that will specially benefit the public at large? A rule that bans a harm is valid, with no compensation. A rule that asks a landowner to confer a public benefit goes too far; the payment of money to the owner is only right and fair.

This harm-benefit distinction may sound clear, but its simplicity is deceptive. Whether a rule bans a harm depends on the viewer's knowledge and sensitivity. If people can't see a particular harm—if it is subtle, long-term, or indirect—community sentiment can easily shift to the landowner's side. Formal logic alone cannot tell us whether a land-use law bans a harm or solicits a public benefit; to draw that distinction we need an external standard of conduct to use as a gauge. The place for lawmakers to find that standard—the only place, really, to look for it—is right in the community itself, by referring to the values of the people and to the community's sense of right and wrong.

Today's paramount need, without question, is ecological education, helping landowners to see the harms they cause, helping legislatures and judges to see how one land parcel is inevitably linked to the next and how the ripples of a given land use can spread far and wide. The definition of land-use "harm" has always evolved with the times as human numbers and knowledge have increased and as communal values have shifted. Today, conservationists, biologists and others must work to continue that evolution; they must talk, act, and push hard so that the governing idea of harm comes to recognize a wide range of ecologically disruptive land uses. This is a daunting, often infuriating task, confronting as it does a mass of people whose attention is tuned almost, but not quite, exclusively to other matters. Yet no task is more central. If we can redefine harm to include substantial ecological disruption, thereby pushing such land uses outside the bounds of protected ownership rights, private ownership then becomes a much smaller obstacle in the path ahead.

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How, then, might this come about? How might we plant and nourish a new vision of land ownership, one that obligates a landowner to respect ecosystem processes, one that limits land uses to those consistent with (as Aldo Leopold phrased it) the "integrity, stability, and beauty of the biotic community"?[7]

NATURAL LAND USES?

In 1972 the Supreme Court of Wisconsin handed down a ruling that stands today as the most eloquent call for a new vision of land ownership, a vision based on natural integrity and respect for the limits of the land. In *Just v. Marinette County*[8] the court dealt with a local ordinance limiting the alteration of wetlands. As it weighed the competing interests, the court had little trouble upholding the land-use ordinance, despite its direct clash with the plaintiff-landowner's hope for monetary gain. "An owner of land," the court announced, "has no absolute and unlimited right to change the essential natural character of his land so as to use it for a purpose for which it was unsuited in its natural state." While cognizant of the sharp drop in the land's market value, the court was unconcerned about lost value "based on changing the character of the land at the expense of harm to the public."[9] The just-compensation requirement simply didn't protect such hypothetical gains.

In the years since this ruling was handed down in 1972, several other states have embraced *Just* as a precedent and drawn on its almost lyrical language. Sympathetic legal scholars have quoted it often, for it appears to supply the attitude needed to bring land degradation to a halt, or at least to remove constitutional protection from abusive land uses so that, when governments do build up the courage to impose regulatory restraints, compensation need not be paid.

While *Just v. Marinette County* has gained devoted legal admirers, however, the decision's language has brought fear to other fronts. It has added fuel to the erroneous claim that conservation and environmentalism are fundamentally at odds with private ownership and individual rights. So potent is the language and reasoning of *Just*, a doubtful reader might conclude that it could justify more or less any land-use limit adopted in the name of ecological health. The fear is that, drawing on *Just*, governments could enact almost any draconian restraint, draining private land of all of its market value and depriving individuals and families of their accumulated savings. In an insightful essay, Professor Joseph Sax has explained how Justice Scalia's opinion in *Lucas* is aimed in no small part at warding off just this possibility—warding off the possible growth of an ecological ownership idea, an idea, Scalia apparently feared, that might vest governments with almost limitless power to halt intensive land uses without any compensation to the owner.[10]

As appealing as the reasoning of *Just* might be on the surface, ecologists know that the natural blends into the unnatural by the smallest of steps. Any human land use will alter a surrounding ecosystem, thereby in at least some small way "changing the character of the land." Who is to say when a change becomes legally significant?

Aside from this biological difficulty is a legal one. Property law needs to apply broadly, in a manner that is fair among landowners and doesn't single out a few for harsh treatment. A government agency simply cannot in fairness brand one land use as "unnatural," while allowing the same land use to occur on ecologically similar lands elsewhere; if a given land use is harmful, the overriding concept of equal protection demands that a restrictive regulation apply to all similarly situated landowners.[11] Ardent environmentalists may see little reason to fear when governments impose land-use limits. But to the mass of Americans, suspicious of government conduct and motives, private property stands as a much-needed bulwark against a meddlesome, overreaching state. To serve this role, property laws must contain broadly applicable norms that protect individual landowners against disparate treatment; if the government wants to single out particular landowners for more restrictive treatment, it should pay for what it takes.

In the end, the language of *Just* is better understood, and better used, as long-term vision rather than as operative legal test. A government cannot escape paying compensation simply by alleging that a particular landowner's activity is "unnatural." More proof is needed, a showing that a specified land use is ecologically harmful within the meaning of governing norms that apply broadly and fairly to all similarly situated lands. American property law is familiar with the idea of harm, and easily able to incorporate evolving conceptions of harm: Harm is a communal judgment, a shared, democratic decision that a particular land use conflicts with communal expectations. The law is far less familiar with the idea of "natural" land uses. Who's to say what is natural? Conservation biologists? Restoration ecologists? Office-bound government officials? The answer is unknown, and part of the anxiety that *Just* arouses is due to this uncertainty.

A PROPOSED STRATEGY

In light of private property's firm roots in American culture, in light of the suspicions aroused by decisions such as *Just v. Marinette County*, how might proponents of The Wildlands Project respond to the champions of private property rights? How should they talk about private land and the meanings of private ownership? How can private ownership be shaped so as to reduce the cost and shorten the timetable for implementing the Project?

1. Support for private property. As a first step, *wildlands advocates have ample reason to support the institution of private ownership, and to make this support clear*. Property is a flexible institution, as potentially useful as it is obstructive. Rather than attack the institution, the more prudent strategy is to bend it, to reshape it so that land uses become more ecologically sensitive. In the end, whether land is owned privately or publicly makes little difference—the central issue is how the land is used. Government landowners can be, and often are, less ecologically sensitive than responsible private owners. Indeed, private ownership can have positive virtues, helping instill a sense of place and helping empower people to resist nearby activities that threaten destruction. Moreover, support for private property is by no means inconsistent with a claim that we need far more acres in public hands.

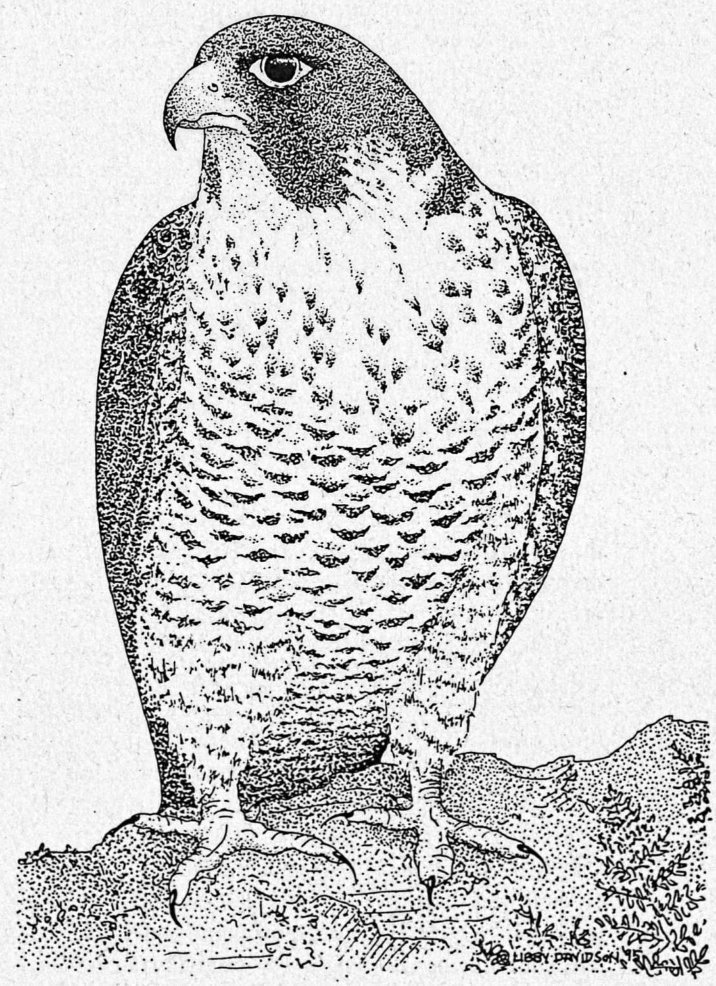
2. New definitions of harm. As Americans have become more aware of environmental degradation they've become more receptive to laws that halt environmental harms. *Friends of biodiversity can and should push hard to expand this list of land-use harms*, even while they openly embrace the institution of private ownership. Timber harvesting on steep slopes, mining in stream beds, denuding riparian corridors—these actions and many others like them can all be addressed by widely applicable rules aimed at halting harms, on private as well as public lands.[12] Over time, the overriding notion of harm will likely shift—to include harms that are more subtle, diffuse, and indirect; to accept less demanding burdens of proof so that governments can act in the face of uncertainty, without waiting for undeniable proof; to encourage longer time-frames for planning, allowing actions now to divert long-simmering hazards; to embrace the idea that impermissible harm includes harm to the privately owned land itself, not just harm to neighboring lands. With any luck society will also come to see, as did Aldo Leopold decades ago, that the land includes not just the soils but waters, plants, and animals.

Property law can recognize these harms without undercutting private ownership as an institution, but only to the extent that communities come to perceive ecological harms and understand their significance. Generations ago we knew little about how ecosystems functioned and how humans and their food sources were linked to other life forms. Now that we know more, it is only right that our cultural institutions reflect that new knowledge.

In short, wildlands proponents can embrace private property at the same time that they push hard to change it. Today's environmental messes arise less from the broad idea of private ownership than from the culturally contingent, pre-ecological norms that still carry such weight. If we can adequately redefine what it means to own, private ownership can stay. Land ownership can become, not the right to exploit a commodity, but the opportunity to participate in a community. Once reframed along these lines, ownership law will recognize rights the owner has against other humans, not rights held against the land itself.

We abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect.

—Aldo Leopold



Peregrine Falcon *by Libby Davidson*

Once Americans understand the ecological roles of particular lands—as they largely do in the case of wetlands—they can support new land-use limits.

3. Due compensation. Before The Wildlands Project is fully implemented, a good deal of public tax money will need to go for the purchase of private property, both fee interests and conservation easements. We can expect individual owners to use their lands in ways that cause no harm, ecological or otherwise; but many needed land-use limits will go well beyond that point, particularly limits imposed on core wilderness areas, wildlife corridors, and inner buffer zones, where few human uses are allowed.

One principle on which The Wildlands Project should be based is this: *Landowners must use their lands only in ways that cause no harm, and regulations that ban particular harms should not necessitate compensation.* Beyond that, land-use regulations can be drafted so that landowners who are restrained also gain benefits from the restrictive rules—much like the urban dwellers whose land is limited to single-family use but who benefit because surrounding lands face identical limits. When land-use rules give rise to this type of "average reciprocity of advantage," again no compensation is needed. In the many other cases, however—where a rule does not apply broadly to ban a land-use activity considered harmful, and where it does not result in an average reciprocity of advantage—compensation will typically be fair.[13]

More so than in the past, proponents of The Wildlands Project need to express their support of private property as a general idea. They need also to express their support, loudly and clearly, for compensation when individual landowners are singled out to shoulder burdens that owners of ecologically similar lands are not expected to bear. The more vocal this support, the fewer the fears that will arise. The fewer the fears, the more feasible it will be to undertake the vitally needed project of long-term ecological education. Once Americans understand the ecological roles of particular lands—as they largely do in the case of wetlands—they can support new land-use limits. Step by step, they can embrace new ownership norms. Without that education, without that knowledge, ownership norms will remain in a pre-ecological age.

4. The right to exclude. When Americans think of private ownership one of the first ideas that comes to mind is the right to exclude, to keep other humans at bay. Cases from the Supreme Court support the centrality of this idea, for while the Court has sanctioned many land-use controls, it has consistently rejected efforts to tamper with the right to exclude.[14] Why this right is so fundamental is far from clear: Other nations often allow hikers to wander freely over private lands, so long as they cause no physical damage or disruption. Nonetheless, the Supreme Court has been adamant, and the issue for now is resolved.

From the perspective of The Wildlands Project the right to exclude is a property limit easy to live with, given that exclusion means excluding *people*, not other forms of life. Hikers might bemoan the loss of new trails, but recreational access does not enhance ecosystem health. Indeed, recreational use can become disruptive in core wilderness areas, however much it stirs the defensive passions of visitors. For those focused on biodiversity and land health, *one of the most useful strategic steps today would be a loud and clear denial of any aim to open private lands to public use without the payment of compensation*.

5. The flexibility of easements. When private lands are needed to create core wilderness reserves, governments should take full title to the property and pay for it accordingly. On the other hand, when private lands fall in other planning categories, in buffer zones of one type or another, the interests purchased by the public can take the form of conservation easements, imaginatively shaped and drafted so as to allow those uses, and only those uses, that are compatible with ecosystem planning goals. *An early aim of the Project should be to flesh out the types and intensities of land uses permitted in the various buffer-zone or limited-use areas, and then to translate these use rules into the language of new types of conservation easements*. States should then be asked to enact statutes that authorize the creation, acquisition, and protection of these new forms of easements. Negative easements—easements that restrict how a landowner can use her lands—can take more or less any form, allowing particular uses and restraining others. In drafting statutes that authorize such easements, the flexibility is more or less limitless: Biodiversity planners should take advantage of it.[15]

As more and more privately owned acres become subject to land-use restrictions and conservation easements, the line between private land and public land will diminish in importance, and rightly so. On public lands today, ranchers, timber companies, and miners all have such extensive powers that public control is at best partial. In years to come shared control will likely become more common on private rural lands, as it already is in many cities. What counts ultimately is not whose name is on the deed, but how the land is put to use, and who makes the land-use decisions.[16]

"CONSERVATION IS GETTING NOWHERE," Aldo Leopold observed in the introduction to his *Sand County Almanac*, "because it is incompatible with our Abrahamic concept of land. We abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect."[17]

Leopold wrote these words, not just as an ecologist, but as a private land owner. More than his colleagues, he knew that conservation could not be bought with government programs and tax dollars, although both at times would be needed. It required public education and more mature individual ethics, including ethics that showed up, as he put it, on "the back forty," on private land subject to private control. As Leopold's personal case shows, private landowners can help the conservation cause when they use land wisely. And private land today can play a major role in The Wildlands Project, if like Leopold's Wisconsin River farm it begins to enjoy the rule of sensitive owners.

Too often environmentalists have allowed themselves to be boxed into the corner, accused of being socialists or statists, enemies of one of America's most hallowed institutions. In the long run, however, private property is flexible and communally responsive, able to bend to the values of the people, able to restrict actions that cause unreasonable harm, even new types of ecological harm. Proponents of wild lands and wild life need not hesitate in supporting private property; neither should they hesitate to give the institution the swift kick forward that it so very much needs. Brought into the age of ecology, private ownership can become a vital ally. ▮

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REFERENCES AND NOTES

1. Wendell Berry, "Whose Head is the Farmer Using? Whose Head is Using the Farmer?," in Meeting the Expectations of the Land 19, 30 (Wes Jackson et al. eds, 1984). I consider Berry's thought in "The Dilemma of Wendell Berry," 1994 University of Illinois Law Review 363-385.
2. See Eric T. Freyfogle, "Land Use and the Study of Early American History," 94 Yale L.J. 717 (1985).
3. 2 William Blackstone, Commentaries *2.
4. See Morton J. Horwitz, The Transformation of American Law 1780-1860, 32-47, 74-76, 85-87, 101-05 (1977).
5. 112 S. Ct. 2886 (1992).
6. I consider the wetlands takings cases in "The Owning and Taking of Sensitive Lands," 43 U.C.L.A. Law Review 77 (1995), which explores in detail the various ideas mentioned in this essay.
7. The quotation, of course, is from the ultimate phrasing of Aldo Leopold's land ethic, in A Sand County Almanac and Sketches Here and There 224-25 (1949). I assess Leopold's ethical ideas in "The Land Ethic and Pilgrim Leopold," 61 Colorado Law Review 217-256 (1990).
8. 201 N.W.2d 761 (1972).
9. 2201 N.W.2d at 768, 771.
10. Joseph L. Sax, "Property Rights and the Economy of Nature: Understanding *Lucas v. South Carolina Coastal Council*," 45 Stanford Law Review 1433 (1993).
11. In deciding whether landowners are similarly situated, careful attention must be paid to the ecological peculiarities of their land parcels. In the past, property law largely ignored the unique natural features of land parcels and gave landowners more or less equal rights, despite natural differences in their lands. Now that we know more about how ecosystems function, natural differences among land parcels need to gain legal recognition. If two parcels are ecologically different, the rights of the owners can properly vary. Aside from this point, property law has long distinguished between land uses already in place and land uses that are merely proposed, offering far less protection to the latter. In the law, a wetland that is already drained is not the same as a wetland that is undrained; a land-use restraint could treat these parcels alike, but it need not.
12. This is not to suggest that standards on public lands should not be more protective of the land's health than those that apply to private lands, nor that use-limits in buffer zones, corridors, and core wilderness areas might not vary considerably in the levels of protection that apply.
13. In applying this rule it will obviously become important to determine whether two land parcels are or are not ecologically similar. Because no two tracts are identical, distinctions at first glance would seem easy to justify—perhaps too easy. In practice, however, it will be the duty of lawmakers to explain the ecological criteria on which they have distinguished among lands. So long as the proffered criteria are plausible and offered in good faith, courts should allow legislators considerable latitude in establishing them. Courts should uphold challenges only when criteria are implausible or seemingly offered not in honest justification, but in an effort to defend distinctions made on other grounds.
14. For instance *Nollan v. California Coastal Commission*, 483 U.S. (1987); *Loretto v. Teleprompter Manhattan CATV Corp.*, 458 U.S. 419 (1982).
15. One risk here is that the flexibility of conservation easements can also aid extractive land users in that easements can be structured in such a way that the owner of the underlying land retains too-extensive rights to alter the land. The problem is one of political power, not any inherent bias in property law itself. Rightly drafted conservation easements can significantly aid the land's health; poorly drafted they can cost taxpayers greatly with little benefit to ecological integrity.
16. Given space constraints I must save for another time comments on the long-term desirability of shifting away from private ownership toward more communal ownership schemes. That shift is already discernible, for example, in the rising popularity of condominiums and the rising amount of land controlled by homeowners' associations. Beyond that, it is discernible whenever and to the extent someone other than the nominal owner plays a role in deciding how land is used. As noted in the text, the important issue is how the land is used and who decides that use—not whose name is on the deed. Even Native American tribes before the European invasion commonly employed forms of private land ownership; they simply defined use rights and allocated them to individual tribal members in ways far different from those the Europeans employed. See, e.g., Eric T. Freyfogle, "Land Use and the Study of Early American History," 94 Yale L.J. 717 (1985), discussing William Cronon, Changes in the Land: Indians, Colonists, and the Ecology of New England (1983).
17. A Sand County Almanac and Sketches Here and There viii (1949).

Endangered Interrelationships

The Ecological Cost of Parasites Lost

by Donald A. Windsor

The biosphere is not just an assembly of millions of species living together—like a giant zoo or an enormous barnyard. It is a highly intricate organized system of multidimensional interrelationships among organisms of every kingdom and phylum. These interrelationships anchor upon many unifying axes, but the most prominent are habitat, predation, and symbiosis. These axes interweave phylogenies such that relatively unrelated, as well as closely related, species are amalgamated together into a cohesive matrix, often so tightly compressed and so deceptively mysterious that it cannot be discerned nor its many components resolved. Nevertheless, we try. Not looking for a needle in a haystack, as it were, but more like dissecting gossamer threads from huge blobs of cotton candy on a hot humid day in poor light. And, unfortunately, just as we are beginning to understand a few of these flimsy threads, the biosphere faces the imminent danger of a catastrophic melt down.

Describing species was the first stage of modern biology. Unraveling their numerous interrelationships is the next, even though the first stage is not yet finished. Although we may indeed be the generation documenting the end of the world, there is some hope that we may be able to document a better story. To obtain our bearings we tend to draw upon our own personal interactions with nature. However, since we all spring from diverse backgrounds and have different experiences, there may not be adequate commonalty upon which to start. Fortunately, we all share an affection for certain historical figures and that may serve to unite us. So, let us turn to one of them, a revered hero of yesteryear.

Collectively, parasites form a pervasive matrix of interrelationships within an ecosystem which tends to hold it together, acting almost as a glue.

When Aldo Leopold bought a woodlot back in the 1930s, he soon realized: "I bought almost as many tree diseases as I had trees. My woodlot is riddled by all the ailments that wood is heir to. I began to wish that Noah, when he loaded up the Ark, had left the tree diseases behind. But it soon became clear that these same diseases made my woodlot a mighty fortress, unequaled in the whole county" (Leopold 1949). He went on to describe how these diseases actually enabled a diverse assembly of wildlife to live there. Throughout his writings, Leopold refers to various parasites and recognizes them as essential parts of nature. His insight is a good lesson for us all. In his classic book *Game Management* (Leopold 1933), he devotes an entire chapter to wildlife diseases and ascribes four major roles to diseases: controlling predators, limiting geographic ranges, regulating population densities, and controlling sex ratios and fertility. It took (and unfortunately is still taking) considerable time and effort to turn around most people's mindset against predators. Converting people to appreciate the benefits of parasites is even more difficult. Not all parasites cause a full blown disease, yet just the thought of sharing one's body with a creepy crawly critter from another phylum is repugnant—even to parasitologists. Humanity has always admired and feared predators; eagles and lions as symbols of power have deep roots in our history. But worms, arthropods, and microbes have always disgusted people. Plague and pestilence are seen as curses, scourges to be eliminated. Cute and cuddly, parasites are not; but necessary they are. Aldo Leopold called the Prothonotary Warbler the "jewel of my disease-ridden woodlot" (Leopold 1949). Perhaps this is a good strategy; camouflage the parasites under the banner of the cute and cuddly. Show the warbler; show the woodlot; but do not show the underlying pathology that makes it all possible.

Collectively, parasites form a pervasive matrix of interrelationships within an ecosystem which tends to hold it together, acting almost as a glue. All species have parasites. Moreover, many parasites have several hosts, often in different phyla. A diagram of all the parasitic life cycles in even a small woodlot would make the food web for the same place look simple. Parasitism and predation are somewhat similar, in that nutrition is gained—from the host, for parasites; from the prey, for predators. However, in parasitism, the host is also the habitat. The food web tends to be fast moving and volatile, whereas the parasitic web, because of its habitat in the hosts, exerts a cohesive drag on the ecosystem which can serve to dampen drastic swings of populations and enables a dynamic natural equilibrium to persist within certain bounds. Not only do parasites regulate their hosts, but hosts regulate their parasites. This is especially evident in population dependent relationships, where host population increases can result in more infections and host population decreases can result in reduced transmission of parasites. Just as parasites and their hosts coevolved, so too did their mutual coregulation.

Furthermore, by preventing some organisms from becoming too plentiful, parasites foster biodiversity, as Aldo Leopold realized. I speculate that if not for parasites appearing very early in evolutionary history, the enormous biodiversity we witness today would not have evolved. Instead, just a few very successful species would have taken over Earth long ago. Computer simulation models tend to show this. Monocultures of anything do not last long in nature; human agricultural attempts to force monocultures on the earth are met with bio-rebellions. It takes a huge amount of fossil fuels to preserve monocultures, because the forces of predation and parasitism simply oppose uniformity.

When parasitism is viewed in its larger category, symbiosis, the unifying force is seen as even more comprehensive. Symbiosis, or living together, is usually subdivided into four major categories. *Commensalism* is living together where one species benefits and the other neither suffers nor benefits from the relationship. Barnacles living on oysters are thought to be an example. *Phoresis* is the living together where one species benefits by being transported by the other: barnacles on turtles, for example. *Mutualism* occurs when each species benefits from the other, nature's win-win situation. Mammals and their colonic microorganisms are good examples. The microbes obtain a nutrient-rich habitat protected from the outside world and in exchange help perform some of the mammals' digestive functions for them. *Parasitism* is the situation where one species benefits at the expense of the other. Most parasites do not kill their hosts, but some do. Those that do as a routine course of their life cycle are called "parasitoids"; the parasitic wasps are examples, for the wasp larvae eat their host as *in situ* predators. As might be expected, some of these dividing lines are rather arbitrary and deeper layers of subcategories abound.

*fruiting bodies of Shoestring Root Rot (*Armillariella mellea*), scratchboard by Suzanne DeJohn*

Symbiosis is a hallmark of biodiversity, as can readily be attested by just going outdoors and picking up a specimen of any living organism. Whether a blade of grass, a leaf, an earthworm, a fly, or a squirrel—none of these are only what they appear to be. Each is not just a single organism but an association of several species in symbiosis. When you are walking through a field and a deer pops up, how many species do you see? You may see one, the deer. I see several dozen, from all the bacteria and protozoa in its gut, to the ticks, mites, and flies on its integument, to the fungi on or in its hooves. Also it may suffer from larger helminth parasites, such as brainworm.

The same analysis can apply to other creatures. That oak tree behind it may harbor several mushrooms, mosses, and lichens, as well as insects galore. Whether or not we can see the mushrooms (fungal fruiting bodies), its roots are functioning with the benefits of mycorrhizal fungi. A blade of grass may have insects, protozoa, and mites. Theoretically, if the deer or the oak tree were suddenly rendered invisible, you could still see where they stood because all their symbionts would be disclosed. If every species we look at is really multiple species, then our biosphere is certainly much more complicated than we can imagine. Each species is, in effect, a Noah's ark; forsake it and you may lose the whole boat load. So, when the promulgators of management plans for forests or range lands or wetlands (or even entire ecosystems!) explain how they will manage these areas, they arrogantly ignore that these areas are already being managed, taken care of by the astronomical number of species whose interactions at the moment happen to rule. Fundamental to such self-management are geological and atmospheric forces, predator/prey relationships (including those of carnivore and herbivore), and symbiotic associations (including parasitism).

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Since the parasitic aspect is the least commonly recognized, it deserves further explanation. Our typical attitude is that parasitism is an evil, a disease, a situation to be avoided, or once contracted, cured. From the point of view of a hapless host, yes of course. But this is a human attitude, not a nature-oriented one. Nature abhors a vacuum and an uninfected host is an empty niche opportunity which some other species will exploit. The proof is that every species has other species which parasitize it. A species acclaimed not to have any parasites is a species not adequately studied. Because parasites coevolve with their hosts, they can become extinct with them. Studying nature without studying parasites is like studying chemistry without studying chemical bonds. Sure, substances can be mixed together and color changes or explosions can be witnessed, but the underlying mechanisms that lead to syntheses and analyses are absent. Yet, this kind of alchemy is brought into ecology by biologists who ignore parasites, worse yet, by ecosystem managers who condemn them.

Since the prevalent attitude holds the parasite to be a pathogen, it may be valuable to examine a few situations where the parasitism does not involve killing or weakening the hosts. However, here is where the generalization has to stop and we could become drenched in particulars. Parasitology is often a never-ending cataloging process whereby an overwhelming roster of unique interactions floods the literature. Perhaps we can just highlight a few of them.

Life Cycles.

Parasites can stay within a single species, as with many of our human diseases; but many parasites spend parts of their lives in hosts of altogether different species. The protozoa causing malaria spend part of their life cycle in the mosquito and part in their vertebrate host. The canine tapeworm spends part of its life cycle in the canine flea. The ovine liver fluke spends part of its life in a snail; and so on. The unifying generality is that parasite life cycles can cut across phylogenetic trees.

A particularly amazing life cycle is in a small order of folded-winged wasps, the Strepsiptera, which, as larvae, parasitize other insects (Askew 1971). Not only do the male and female have a very different morphology, they infect hosts in different orders! Myrmecolacinae larvae developing in ants (Hymenoptera) become males, whereas in

Orthoptera they become females. One can only marvel at how this curious circumstance could possibly have evolved. Yet, there are about 200 described strepsipteran species, 60 in North America. Their obscurity is undoubtedly due to their strange life cycles and minute sizes. This lack of attention may change, because the notorious fire ant, *Solenopsis invicta*, an alien that has plagued the southern states since the 1940s, has become parasitized by one of these strepsipterans, *Caenocholax fenyesi*, itself an alien from Brazil (Kathirithamby et al. 1995). The natural parasites of the fire ant are phorid flies, which are absent here, thus creating a parasite vacuum. Nature did not let this vacuum go unfilled for long.

Matchmaking.

Some parasites serve ecosystems by acting to bring other species together. The rust fungus *Puccinia monoica* inhibits flowering in its host mustard plants, *Arabis* species, and induces them to produce elevated clusters of infected leaves that look like flowers of another species (Roy 1993). These pseudoflowers attract insects which fertilize the rust. However, because these pseudoflowers are so attractive, they enhance insect pollination of the nearby flowering plants. Here, then, is a situation where a parasite plays a cupid role and many species are then affected by a complex set of interactions.

Chaperoning.

Some parasites serve ecosystems by keeping other species apart. Hybrid cottonwoods are more susceptible to aphid parasites than are their parent species, *Populus fremontii* and *P. angustifolia* (Whitham 1989). Consequently, most of the aphid population is concentrated in the hybrid zone between the parents. This aphid sink has a double-edged effect; it discourages the aphids from adapting to the more numerous parents and it keeps the parents as separate species.

Vectors for Other Parasites.

Like other species, parasites have parasites. Ectoparasites, such as ticks, can be parasitized by microbes and can transmit those germs to their hosts. Lyme disease and Rocky Mountain spotted fever are famous examples.

Promoters of Disposable Nests.

Some parasites are specific for certain hosts and infest their nests, forcing the hosts to avoid reusing the same nest again. The environmental effect is that nesting sites or materials are in heavier demand. The larvae of the blood sucking blowfly *Protocalliphora sialia* in Eastern Bluebird nests is a well known example (Zeleny 1976). On the other hand, because of species specificity in parasitic relationships, the abandoned nest of one species can often be used by another species, for example a Great Horned Owl using a Red-tailed Hawk nest, or small passerine birds nesting in active Osprey nests.

Foisting on Foster Parents.

Some species do not raise their own offspring but instead pawn the job off on some other species. The Brown-headed Cowbird is the most notorious example, laying its eggs in the nests of other birds. Forest fragmentation is enabling the cowbirds to invade more nests and is thought to be a major factor in the decline of many neotropical migrants. Since many neotropical migrants are primarily insect eaters, the total effect on insects and on the plants they eat could be enormous.

Aiding Succession.

Some parasites direct the movement of other species of plants and animals, acting as gatekeepers, determining which organisms can enter a given area and even when they can. Ungulates avoid parasites by avoiding their vectors. Caribou favor the ocean front lands during summer so that sea breezes stave off pesky flies and mosquitoes, a factor contributing to the controversy regarding oil exploration along the Arctic coast. Some of the movements of plants are more subtle. Beach sand dunes are constantly shifting and the succession of plant species tries to keep pace. Along northwestern European coasts, the normal succession is Marram Grass, *Ammophila arenaria*, followed by the fescue *Festuca rubra*, Sand Sedge, *Carex arenaria*, and climaxing with the Sea Couch, *Elymus athericus*, and Sea Buckthorn, *Hippophae rhamnoides*. Soil nematodes and fungi are pathogenic for both Marram Grass and the buckthorn, causing them to degenerate. Successors, who are tolerant of these parasites, can move in. However, since Marram Grass is the initial beach stabilizer, its pathogens cannot be too virulent or else no succession would take place. (Van der Putten 1993). Here is a case where the reigns of some species can be regulated by parasites so as to let other species participate.

Behavior Modification.

Some parasites change the behaviors of their hosts so that the hosts are more apt to be eaten by their predators. Scientists already know many examples of this and are discovering ever more. Here are three. The terrestrial isopod *Armadillidium vulgare* is normally found under leaf litter, where moist and dark conditions prevail. However, when this isopod is infected by the acanthocephalan *Plagiorhynchus cylindraceus* it lingers on light colored substrates in exposed areas, making it more vulnerable to birds. Intermediate host behavior has been modified so as to enhance transmission to birds, the acanthocephalan's definitive hosts (Moore 1983). This behavioral modification of a host so as to push it beyond its preferred niche forges an ecological link between two species that may not otherwise be connected. The European Starling is a definitive host of *P. cylindraceus* but does not normally eat the isopods, giving rise to the speculation that this parasite was brought over to America by the starling. Since the starling has only been here for about a century, the adaptation by the parasite has been rapid, if this scenario is true; and it nicely illustrates that the species you see is not necessarily the only one you get—a point to remember when dealing with aliens. Another isopod, this an aquatic one, *Caecidotea intermedius*, is an intermediary host for the acanthocephalan *Acanthocephalus dirus*. This isopod is normally eaten by the Northern Creek Chub, *Semotilus atromaculatus*, which serves as the definitive host for *A. dirus*. Infected isopods do not display their normal antipredator activities. Instead of hiding under leaves, they loiter in the open, even as the number of chubs increases (Hechtel 1993).

The trematode *Gynaecotyla adunca* is a parasite of shorebirds which passes through two intermediate hosts, the snail *Ilyanassa obsoleta* and one of several crustaceans, the amphipod beach hoppers *Talorchestia longicornis* and *T. megalopthalmia*, and the fiddler crab *Uca pugilator*. Uninfected snails follow receding tides back, keeping under water and out of the range of the semiterrestrial beach crustaceans. However, infected snails remain stranded on the beach releasing cercariae as sporocysts, which get into the crustaceans (by a yet unknown mechanism) where they become metacercariae ready to infect shorebirds who eat them (Curtis 1987). Since the fate of the beached infected snails is not known at this point, the full ecological consequences of this parasite driven behavior remain to be discovered.

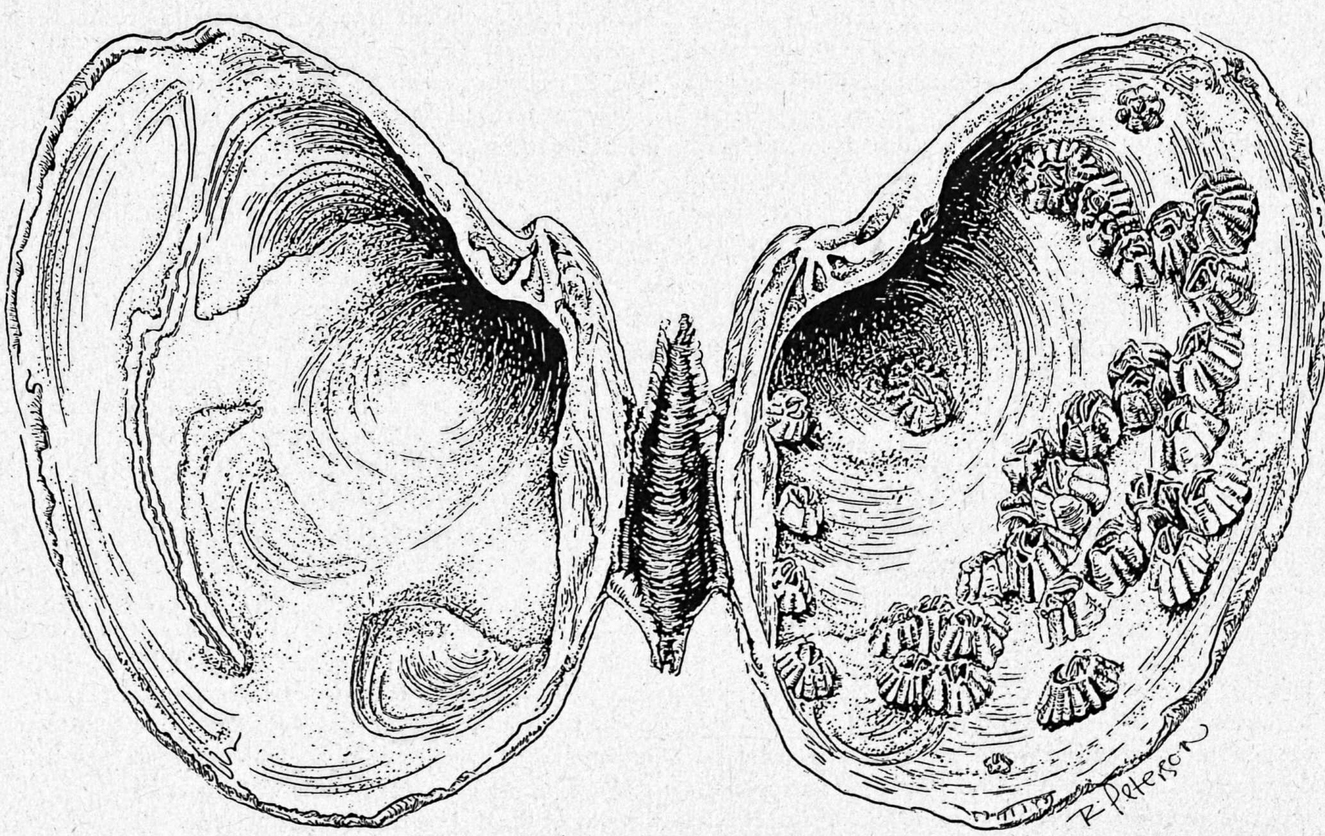
Promoters of Biodiversity.

Some parasites actively manage for biodiversity. A good example is in Northeastern forest successions, where the White Ash is a very abundant tree after disturbed land is left alone, yet older ashes are sparse and scattered. Ash Yellows, a bacterial parasite, is credited as being a natural tree thinner and may even accelerate forest development (Castello et al. 1995). As is often the case, however, the pathogen acts not alone in its role as thinner of forests, but together with drought and with several landscape features. Attempts to thwart the pathogen may have unintended or even very undesirable results.

Integrated pest management, mainly an agricultural practice to maintain monocultures without heavy inputs of pesticides, is an attempt to use parasites and predators to control undesirable plants and animals. Its application to managing ecosystems is being advocated (Haack 1993). Passive use would be welcomed, but an aggressive approach could wind up as large-scale meddling, especially if alien biological agents are introduced.

Mutual Aid.

Some plants, when assaulted by herbivores, such as caterpillars, emit chemicals that attract parasitic and predatory arthropods to attack the herbivores. This squeeze play is a win



barnacles on Thin-shelled Littleneck *by Robin Peterson* for the plant and a win for the parasites but a loss for the herbivore. This kind of mutual aid (plant gets protection; parasites get hosts) has evolved in several unrelated species (Turlings et al. 1995). Human interference, as by the use of biocides, not only endangers such intricate relationships, but also interferes with other interactions these affected species may have with yet other species.

MORE WORK NEEDS TO BE DONE

This battle cry of science is certainly appropriate when it comes to understanding parasitic relationships. Parasites do not simply regulate their hosts; they do so under the influence of other factors, acting almost like very complicated servo motors in complex machines. The ciliate *Lambornella clarki* infects larvae of the mosquito *Aedes sierrensis;* in turn, the mosquito larvae are predators of the ciliate. Both regulate each other in their tree cavity pools. When food for the larvae is sufficient, mortality from the ciliate reduces the number of emerging adult mosquitoes. But when food is in short supply, the mosquitoes eat more ciliates, thereby retarding their ability to infect, and so more adult mosquitoes emerge (Washburn et al. 1991). Although the parasite is regulating the host population, it does not always induce a reduction; in this case it can actually allow an increase. Such reaction indicates a true regulator and not just a cut-off valve.

CONCLUSIONS

If a single message jumps out from all the myriad details of parasitology, it is that the complex interrelationships among parasites and their hosts are essential to the natural functioning of ecosystems. Furthermore, since we have just begun to discover them, there is a great danger that many interrelationships will be disrupted or destroyed before we even find out about them. We have the Endangered Species Act to help us preserve species, but we have enacted nothing comparable to help preserve interrelationships among species. Clearly needed is an "endangered interrelationship" law. However, since the possibility of getting one is too remote to plan around, the best step is to preserve the habitat itself, while resisting the temptation to introduce alien parasites to "control" alleged pests. Parasites can adapt to new habitats and to new hosts and can form interrelationships that cannot be predicted. Perhaps the most salient admonition is the "law of unintended consequences" (Seligman 1995). Although devised by the social scientist Robert Merton in the 1930s, this "law" seems particularly applicable to the management of ecosystems. It states that no matter how worthy and well-intentioned a human action may be, some of its unforeseen consequences may be not only unintended, they may be contrary to the original intent. There is a correlation with politics here. Just as liberals want more government and conservatives want less, the environment seems buffeted by a similar dichotomy. Some environmentalists want more management by humans and some want less. Nature will ultimately decide. Just as parasites regulate their hosts, hosts regulate their parasites. We humans have become parasitic on the Earth. We take at the expense of our host planet. Indeed, we are becoming parasitoids. We are killing our host. We are overdue for some regulation.... ▮

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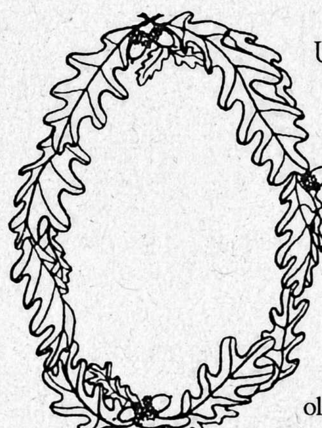
Obstacles to Implementing The Wildlands Project Vision

by Steve Trombulak, Reed Noss, and Jim Strittholt



OUR PRIMARY GOAL in this presentation is to identify some of the barriers we see to implementing The Wildlands Project vision. There are three good reasons for ending *Wild Earth*/Wildlands Project Special Issue #2 on such a pragmatic note. First, recognizing the barriers and understanding how to deal effectively with them are important for the conservation activists who will play central roles in the design and implementation of wilderness recovery strategies throughout North America. Second, we believe the scientific and technical barriers are challenges that, once recognized, can be solved as biologists and geographers work to develop analytical and theoretical approaches to designing ecological reserves. Third, we think it important to indicate to the scientific and conservation communities that The Wildlands Project is well aware of these barriers even as we advocate the creation of a system of ecological reserves to protect and restore biological integrity in North America. So as not to sound unduly pessimistic, however, we also want to highlight some of the solutions we see emerging to overcome the barriers.

Of course, this discussion is not really restricted to the efforts of The Wildlands Project, but is relevant to any program that involves the use of information on the geographic distribution of biological and geological features to achieve conservation goals. Some of the work of The Wilderness Society and the Sierra Club and much of The Nature Conservancy's work fit within these parameters. Therefore, our remarks should be interpreted in the context of landscape-scale conservation efforts in general, rather than only The Wildlands Project's.

Such efforts have really set for themselves two broad tasks: mapping, or using information to identify exactly where conservation efforts should be targeted, and implementation, or turning the maps into reality. Both of these tasks have unique sets of barriers that can broadly be divided into those scientific and technical and those social and political.

This paper is based on a talk delivered in the symposium "The Wildlands Project: Underlying Ecological Principles" at the 9th Annual Meeting of the Society for Conservation Biology, Ft. Collins, Colorado, 7-11 June 1995.

illustration Mary Elder Jacobsen

We have identified seven important scientific and technical barriers to mapping.

1. Availability and acquisition of information.

We don't want to be overly negative here. A lot of data is available, and more is becoming so every year. Yet the perfect data set remains elusive for all regions in North America. For example, much of the data necessary for conservation planning is available only on paper maps and only at very small scales. Such data sets present challenges in developing maps accurate enough to guide decisions at the local level, where the work of implementation will have to occur. An increasing amount of data is now available in digital form, the kind used by geographical information systems (GIS), but many of these data sets, such as soil types, are incomplete within a region. Further, some agencies and organizations have possessive views of their digital data and are unwilling to consider even selling the information to another group if their political goals do not match. Finally, much important information, such as the distribution of soil organisms and precise migration patterns of most species, has simply not been gathered.

We believe that these barriers will begin to fall over the next few years or decades as more data sets are digitized from paper maps by a wider array of research groups, as the costs of GIS and powerful microcomputers drop (and hence the market for digitized data rises), and as the ability to share data sets over computer networks, such as the Internet and World Wide Web, increases.

2. Quality of data.

Of more serious concern is the *quality* of the data being used to develop conservation strategies. Several issues emerge under this concern. The most important, of course, is the accuracy of the data, both in terms of the classification and absolute position of a location. Data collected by remote sensing, for example, is generally considered "accurate" if error checking of images reveals a 15% chance or less that a given location is incorrectly classified. Also, data classifications are strongly influenced by the operational definitions used at the time of data collection. For example, maps of wetlands are influenced by the definition of a wetland used at the time the maps were made. Maps also represent conditions at a given point in time. The longer ago a map was produced, the more likely it is to be out of date, and hence provide an inaccurate picture of current reality.

The resolution of the map also influences its quality. The points or cells on a map represent some kind of average value over the area. The size of that area will determine how useful the average is; knowing that the dominant forest type in an area 20 meters by 20 meters is spruce-fir is a lot different from knowing the same thing for an area 1 kilometer by 1 kilometer. Yet for many data sets, such as forest types in the US, 1 km by 1 km resolution is the best available. In such cases, the dominant forest type may indeed be spruce-fir, but other communities such as small meadows and wetlands may be embedded in that matrix and not show up on the map.

Related to resolution is the issue of map scale. All maps reduce the actual size of a represented area so that it can be placed conveniently on a piece of paper or computer screen. A small-scale map—such as one with a scale of 1:1,000,000—involves a great deal more reduction and generalization than a large-scale map, such as one at 1:24,000, and therefore is of lower quality for developing detailed conservation strategies.

With respect to conservation strategies, the relevance of a data set must also be considered. For our purposes, data sets on landfill sitings, grazing potential, and recreational visitor use are often not needed.

Solutions to these barriers are numerous and depend on the commitment of the mapper to doing the job right. Especially vital are the tasks of developing a comprehensive system for ground truthing and revising the data sets used, using maps with the largest scale possible, and evaluating the methodology used to collect data through inspection of the metadata (the data about the data) that should accompany all data sets. The mapper must be prepared to make revisions as better information becomes available.

3. Data management.

The amount of data that must be organized and manipulated increases dramatically with the size of the project region, the types of information used, the frequency of data revisions, and the desire to test analytically the proposed maps against alternative proposals. Some of this management is greatly simplified through the use of a geographic information system. Yet GIS itself creates barriers. Most GIS software packages are not "user friendly." GIS takes time and commitment to learn well enough to use effectively, and currently only scaled-down versions are available for use on personal computers. The complete packages that handle lots of data in lots of ways still require large, expensive computer workstations.

This barrier will come down when some software developer recognizes the large market for a powerful, user-friendly GIS that runs on a personal computer, when personal computers become more powerful, *and* when the folks who issue contracts for GIS work, such as municipal governments, expand the range of software packages they are willing to use. These conditions will stimulate competition and creativity in the software development field, which will be to the benefit of the users.

4. Levels of data classification.

Determining whether or not a particular conservation goal is achieved by a particular map will depend on the precision used in classifying the data sets. In particular, whether "representatives of all ecosystem types" are protected by a given system of reserves depends on how ecosystems are delineated. For example, the "Eastern deciduous forest" biome includes several distinct forest types, such as "Northern hardwood forests" and "Southern hardwood forests." These in turn can be subdivided many times into more precise forest classes. As a general rule, more levels of classification are better, but one quickly reaches limits associated with the cost of acquisition, storage, and analysis of the data. The confidence one can place in a proposed ecological reserve system would be greatly improved by empirical evidence of how many levels within an ecosystem or soil classification scheme, or how many categories within data sets like land use or roads, are optimal for conservation planning.

5. Time frames.

Maps of ecological reserve systems serve as targets for the establishment of real, on-the-ground conservation strategies. But targets for when? Over what time period is the strategy to be implemented? Anything is possible if the implementation target is 10,000 years from now. Very little is possible if the target is next week. Some intermediate, but identifiable, time frame is necessary if the strategy has any real chance of being implemented within the context of the existing culture of a region and in a length of time short enough to make a meaningful contribution to promoting biological integrity.

The Wildlands Project advocates a tiered approach to implementation. We seek to develop a strategy that can be implemented in stages, with goals set for 10 years, 20 years, 50 years, and 100 years from now, recognizing that complete recovery may, in some cases, require 200 to 500 years.

6. Making decisions based on the data.

Eventually one must make the leap from mapping data points to making decisions about what conservation tactics should be pursued in what areas. The Wildlands Project, for example, seeks to promote the establishment of a system of connected and buffered ecological reserves in a matrix of areas more intensively used by humans for resource extraction and development.* Where should the reserves be? In what areas should ecosystem management, sustainable development, or intensive extraction be promoted? Of course, making such decisions is not unique to The Wildlands Project or, indeed, any conservation organization. Classifying desired land and water use through zoning, taxes, and promotional campaigns is common to many groups, including local governments.

Notwithstanding the generality of the problem, it is still challenging. Theoretical models are weak for many aspects of the design of conservation strategies: What is the best design for a connectivity zone when not all of the target organisms are known? What is the optimal design for a riverine or marine ecological reserve? Under what conditions are small, unconnected ecological reserves most appropriate? These questions are among those most in need of research in this field.

Until more definitive answers are available, those developing conservation strategies must work to circumvent this decision-making barrier by constantly keeping their basic conservation goals and the scientific principles that relate to conservation in mind, and constantly testing alternative strategies for their ability to better achieve the goals.

7. Consistency among participating groups.

Since regional residents (many of them non-scientists) are often the best qualified for developing regional conservation strategies, it is likely that a continent-wide system of ecological reserves will be mapped and described by many independent groups, each contributing a part to the overall whole. The ability of that whole map to achieve the overall goal, however, is related to how well the parts connect, which is in turn influenced by how similar the approaches taken by the different groups are. Yet the value in prescribing a single approach to mapping would be offset by its danger. Each region has a unique set of opportunities and limitations that make flexibility and initiative essential. Perhaps the best solution is for all regional groups to be working from the same set of general guidelines, such as those described in Noss and Cooperrider (*Saving Nature's Legacy*, 1994, Island Press) and Trombulak ("How to design an ecological reserve system," in press, *Wild Earth* Research Report 1), and adapting them as necessary.

These seven scientific and technical barriers pose serious challenges to those who would design a comprehensive conservation strategy in their region. Moreover, simply designing a strategy does not bring it into being. The barriers to implementation are less technical than they are political and social. The scientific barriers are challenging but can be overcome with a little effort. It is the political and social barriers that most people think of when they debate the potential for the realization of a landscape-scale reserve system for ecological protection and restoration. Our experience in promoting the Wildlands vision over the past few years has made us aware of four general barriers of this type.

1. Approaches to implementation.

What is the best way to implement a plan for any system of reserves? Political and cultural sensitivity as well as economic constraints dictate that such a conservation strategy will be most successfully implemented if done over a period of time as a series of coordinated projects. The escalating destruction of natural habitat in many regions dictates, however, that a comprehensive system be implemented immediately. Since social constraints cannot be ignored, the goals of conservation must necessarily be compromised in the short term. Similarly, efficiency argues that the strategy be designed, enacted, and managed by a single group. But again, social traditions, prevailing political climates, and the need to be creative guarantee that

*** Editor's note: In landscapes with low human population densities (such as much of Alaska, Maine, northern Canada, and the arid West), a converse situation may be most desirable—with human population centers connected by travel routes and set within a wild matrix. —JD**

any comprehensive system will be made of several different reserves, each administered by different groups with different approaches. Even the development of a *single* reserve may occur in stages, with land acquisition, road closures, and changes in land-use regulations occurring over time as funds and opportunities arise.

"It sounds like a scheme by two mad scientists to force their radical ideas on the landowners of the Northern Forest Lands and eventually the whole world."

2. Funding.

Where will the money for all of this mapping and land acquisition come from? We really don't know for sure, but public allocation, private donations, and major foundation support will all be needed or this entire approach to conservation is doomed. But of course, not all land need be acquired fee simple. Conservation easements and management agreements with landowners can often be effective.

3. Lies and misunderstandings.

Several vocal special interests are opposed to the development of a large-scale ecological reserve system in North America. Their reasons for this are diverse, but their attacks on such systems are never based on scholarly critiques of the science behind such strategies; rather they are based on ignorance or campaigns of self-serving disinformation. A few examples serve to illustrate this point.

The first comes from the recent story surrounding the Northern Forest in the northeastern US. In January of 1993, at the invitation of the Northern Forest Lands Council, Mac Hunter of the University of Maine and Sharon Haines of International Paper Company wrote a briefing paper on the subject of ecological reserves and their applicability to the Northern Forest debate. This was a well-written paper, describing in clear and concise language concepts that have been generally discussed and widely accepted in the conservation biology community for years. From a scientific standpoint, their paper was sound and not controversial.

Yet not all of the people who chose to review the paper agreed. For example, Fred Huntress, in an open letter to the executive director of the Northern Forest Lands Council, responded thus:

"It sounds like a scheme by two mad scientists to force their radical ideas on the landowners of the Northern Forest Lands and eventually the whole world. [Wildlife biologists] had to displace the foresters from the land before they could have their own empire. Now, with such new words as biodiversity and ecosystem they have convinced the gullible public that they can lead us to salvation. They have become the cult leaders of the environmental movement."

illustration by John Jonik

Ask yourself whether in 1993 it was politically realistic to suggest that Nelson Mandela would be freely elected president of South Africa without a bloody civil war first raging throughout the country.

❍

Scientific and political reality are not equivalent. Indeed, we will go so far as to say that there is no such thing as political reality.

Now, this critique is so obviously ridiculous that it is tempting to dismiss Mr. Huntress merely as someone who cannot be bothered to look in a dictionary or basic textbook to gain the most rudimentary understanding of a concept before he attacks it. But that would give an incomplete picture of the story. Despite his blatant ignorance of ecological concepts, he was a member of the Council's Biological Diversity Workgroup. As such, his opinion on this subject was given equal weight to those of people with an education in the field. When the "ecosystem" concept itself is so poorly understood, misinformation is a barrier not just to the development of comprehensive conservation strategies, but to the very discipline of ecology.

The Wildlands Project, too, has experienced direct attacks based on falsehoods and misperceptions. For example, a map was published last year (29 September 1994) in an Oregon newspaper, the "Wallowa County Chieftain," that depicted about 80% of the northwestern US (Washington, Oregon, Idaho, Montana, and Wyoming) within a system of buffered core reserves. The map was prominently labeled "Wildlands Project," leading the casual reader to think it was a map proposed by the Project. In small print in the lower right corner, however, the more careful reader saw that the map was copyrighted by Environmental Perspectives, Incorporated. EPI is the creation of Dr. Michael Coffman, a retired forestry professor who currently advises companies and landowners on how to counter the work of environmental groups. One would think that the concept of "truth in advertising" would require Dr. Coffman to more clearly indicate that the map was his own creation, not The Wildlands Project's. One is left to wonder who is served by such fabrication. Yet Dr. Coffman, like Mr. Huntress, has served on scientific roundtables organized by the US Forest Service and has participated in meetings organized by groups such as the Natural Resources Council of Maine, where his opinions are given the same weight as those of more reputable scientists.

Such misrepresentations sadly are increasingly common. Following the symposium on The Wildlands Project at the Society for Conservation Biology's annual meeting in 1993, a news article appeared in *Science* magazine. Intending to report on the symposium, the article was titled "The high cost of biodiversity," although the actual cost of protection was little discussed. Similarly, the caption on the map of a proposed ecological reserve system in the Oregon Coast Range that was presented in the symposium described the core reserves as "off limits to humans" even though it was clearly stated during and after the symposium that core reserves would be closed to human exploitation but *open* to benign human recreation. Again, who is served by such misrepresentation?

A frightening example of the propaganda against the Project is the following statement by Al Schneberger, Executive Director of the New Mexico Cattle Growers' Association, speaking at the 1994 conference "Oregon Private Property and Public Lands," as quoted in "Wallowa County Chieftain":

"Let's evaluate [The Wildlands Project] right now. Extrapolate it out, and if people have to choose between people and grizzlies, then are people going to choose wilderness? If grizzlies need 1,000 square miles of wilderness, people are going to say the grizzlies are going to have to go the way of the dinosaurs or live in zoos. The Wildlands Project people are violently anti-human, and see themselves acting on behalf of nature, and we aren't part of that, other than managing us for wildlife's benefit. You'll probably have to get a permit to leave the city."

The final two sentences are so incoherent as to barely deserve rebuttal. They are not based on anything anyone connected with The Wildlands Project has ever said or implied, and can only be intended (albeit clumsily) to provoke fear and distrust among the very people who stand to gain the most from the long-term recovery of ecological health. What is most worrisome is the first part of the paragraph, which in places borders on coherence. Mr. Schneberger implies in this and other statements paraphrased in the article that we should take the concept of a large ecological reserve system, "extrapolate it out," subject it to peer review right now, and if we don't like what we see, drop the idea. Too bad if this runs counter to our constitutional right of free speech. The implication is that the will of "the people" should determine which ideas are acceptable to express and which are not: the tyranny of the majority problem taken to an extreme.

The real danger in this is not that The Wildlands Project might be suppressed but that if this philosophy were applied uniformly it would logically become open season on *all* controversial ideas that someone doesn't like. Let's "extrapolate out" the consequences of overgrazing on public land. Don't like what you see? Then let's forbid grazing. Why bother trying to reform grazing practices so that all components of nature, including human societies, can get what they need, both economically and ecologically? Extrapolate out the consequences of human overpopulation. Don't like that future? Then let's forbid having children. This approach to public discourse has never been acceptable in this country, and never will, we may hope. To callously suggest that the democratic process be used to justify censorship of ideas is unworthy of anyone.

4. Perceptions of impracticality.

We end our paper with this particular barrier because, frankly, it is the one we hear most often, especially within conservation and scientific circles. "The goals of the Project are valid," it is commonly said, "but not politically realistic." How short and selective our memories are; how confident that we can accurately discern practicality! We should all ask ourselves whether in the spring of 1989 we would have thought it practical to suggest that one night the people of Berlin would simply go out into the streets and tear down the Wall. Ask yourself whether in 1993 it was politically realistic to suggest that Nelson Mandela would be freely elected president of South Africa without a bloody civil war first raging throughout the country. Almost all of us would answer "no" to both of these questions. Yet both of these events occurred, even though neither idea was practical or politically realistic. As a people we should have learned by now that perceptions of political reality are grossly inaccurate predictions of the future. In fact, the concept of political reality is, by-and-large, invented by those in power to help maintain the status quo and their position in it by creating an air of inevitability and permanence.

There is nothing rigid about political reality, not in the way that we think of when we talk about scientific reality. Scientific and political reality are not equivalent. Indeed, we will go so far as to say that there is no such thing as political reality. What we really mean when we say "political reality" is "political tradition," and as the former Soviet Union and eastern European countries have learned, political traditions change even as scientific reality remains the same.

So, we were given the task in this paper of talking about the dark side of The Wildlands Project. Given all of these barriers, the obvious question becomes "Why bother?" The answer is simple. We believe that the goals of conservation are right, and that the science behind the strategy is the best we have and is getting better. We firmly believe that these barriers, like the Berlin Wall, will come down. ▮

Steve Trombulak is a professor of biology and environmental studies at Middlebury College in Vermont and science director for the Greater Laurentian Region Wildlands Project. Reed Noss is the science director for The Wildlands Project, editor of the journal Conservation Biology, *science editor of* Wild Earth, *and adjunct faculty member in the Department of Fish and Wildlife at Oregon State University in Corvallis. Jim Strittholt is an ecologist and GIS specialist for The Wildlands Project and co-founder of Earth Design Consultants in Corvallis, Oregon.*

illustration by Gerry Biron

Language and Experience

I consistently confuse the marsh frog
with the purple pitcher plant.
Maybe it's because each alike makes
a smooth spine of the light, a rounded
knot of forbearance from mud.

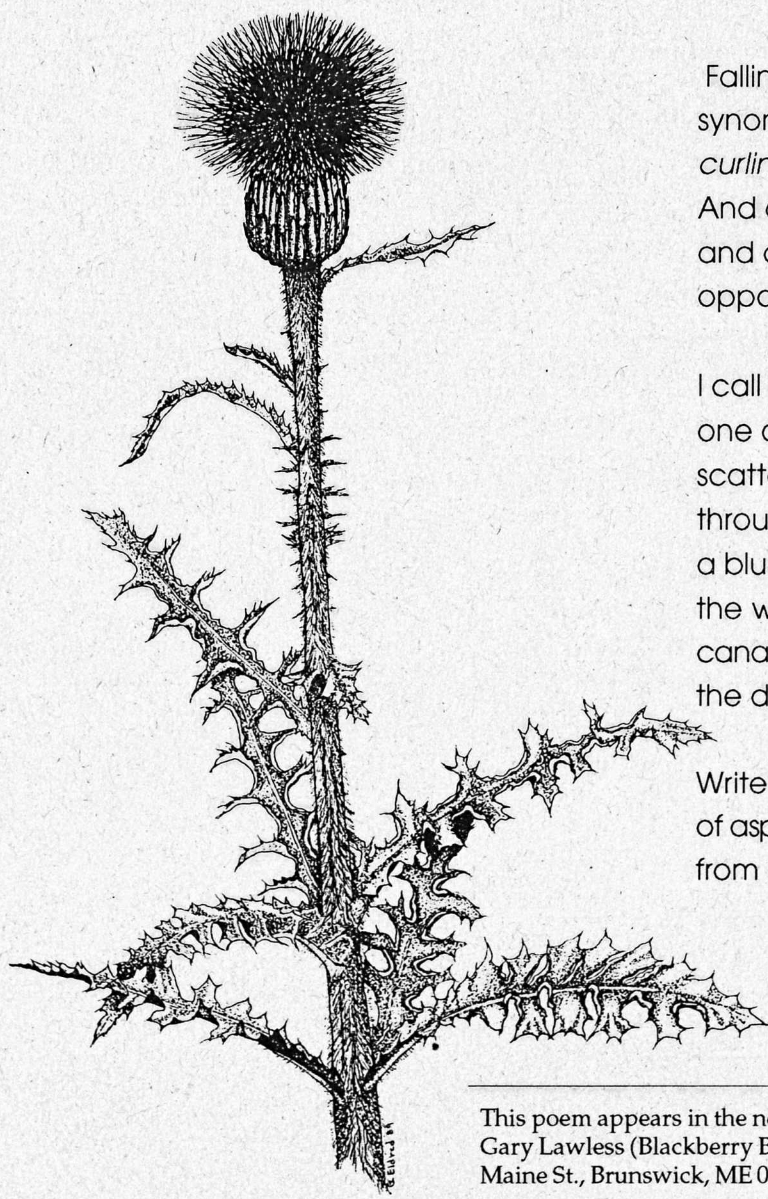
And which is blackbird? which prairie thistle?
They both latch on, glean, mind their futures
with numerous sharp nails and beaks.

Falling rain and water fleas are obviously
synonyms, both meaning *countless*
curling pocks of pond motion.
And aren't seeding cottonwood laces
and orb weavers clearly the same—clever
opportunists with silk?

I call field stars and field crickets
one and the other, because they're both
scattered in thousands of notches
throughout the night. And today I mistook
a blue creekside of lupine for *generosity,*
the way it held nothing back. O reed
canary grasses and grace—someone tell me
the difference again.

Write this down: my voice and a leaf
of aspen winding in the wind—we find the sun
from many spinning sides.

—*Pattiann Rogers*



This poem appears in the new collection *Poems for the Wild Earth*, edited by Gary Lawless (Blackberry Books); available from Gulf of Maine Books, 134 Maine St., Brunswick, ME 04011; 207-729-5083.

Hill's Thistle (Cirsium Hillii) *by Gary Eldred*

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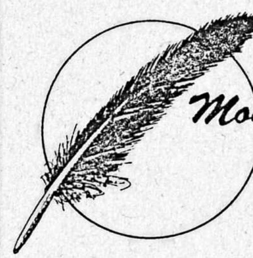

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2 • **Summer 1991** The New Conservation Movement, ancient forests on trial, Grizzly hunting in Montana, killing the coasts, what wilderness can do for biodiversity. Ski development in White Mountain National Forest, an Ancient Forest Reserve proposal for the Mendocino National Forest, and exploring Chile's rainforest. Howie Wolke's Wild Rockies, and Part 2 of "Is Population Control Genocide?"

3 • **Fall 1991** SORRY, THIS ISSUE IS SOLD OUT.

4 • **Winter 1991/92** Devastation in the North: Canadian deforestation, threatened northern rivers, Hydro-Quebec vs. James Bay, natural gas development.... The BLM in Arizona, the Finger Lakes of New York, and the North American Wilderness Recovery Strategy. Saving Yellowstone, tallgrass prairie, and the White Pine. Roderick Nash's vision of an "Island Civilization," and "Biologists, Biophiles, and Warriors" by Reed Noss.

5 • **Spring 1992** SORRY, THIS ISSUE IS SOLD OUT.

6 • **Summer 1992** Endangered species crisis, Perdido Key Beach Mouse, speleomanders and trogloherps, Eastern Hemlock, and fungus. Civil obedience, the cost of compromise, "wise use" lies, deep ecological practicality, the language of owning, metaphor in science. Japan's beech forest, Shenandoah National Park, Monongahela wildlands.

7 • **Fall 1992** Earth Summit, Endangered Species Act, Grandfather Mountain. Radical environmentalism, a wilderness work ethic, the dignity of wild things. Lynx, Woodland Caribou, tarantula, Sugar Maple, woodpecker wilderness, Adirondack old growth. Southern California biodiversity, Texas's Big Bend Ecosystem. Max Oelschlaeger's "Mountains that Walk."

8 • **Winter 1992/93** Patriarchal management, Supreme Court setbacks, "natural law" and human population, planetary oncology, grassroots resistance in developing countries. Coral reefs, jellyfish, wild fossils, the Eastern Indigo Snake, and zoos. A Greater Desert Wildlands Ecosystem proposal, Colorado River delta. Howie Wolke's "Bad Science Lacks the Visceral Connection."

• **Special Issue #1: The Wildlands Project: Plotting a North American Wilderness Recovery Strategy**. TWP Mission Statement, preliminary proposals for the southern Appalachians, northern Rockies, Adirondacks, and Paseo Pantera. "A Vision for the Meantime" by Michael Soulé, "TWP Land Conservation Strategy" by Reed Noss, "Developing a Regional Wilderness Recovery Plan" by Dave Foreman, "Coming In To The Watershed" by Gary Snyder .

9 • **Spring 1993** The power of hope, primitivism, avian activism, mitigation scams. Hydro-Quebec, Pacific Rim forest, tropical biodiversity (Part 1). A proposal for a park without fences: Adirondacks, the Ozarks, and the Oregon Coast Range. "In Defense of Wildlife and Open Expression" by Michael Frome. "The Breadth and Limits of the Deep Ecology Movement" by Arne Naess.

10 • **Summer 1993** The Zero-Cut solution, ozone depletion, topophilia, organic archeology, immigration. Wildlife contraceptives, predator eradication, bear wisdom. The Greater Salmon/Selway Project, deep ecology in the Former Soviet Union, tropical biodiversity (Part 2). Threats to Southern Appalachia, Alabama proposal, Eastern forest recovery. "Arizona, The Floating Desert" by Gregory McNamee.

11 • **Fall 1993** Biodiversity, caves, ecological economics, land management lingo, legal standing in environmental litigation. Atlantic Salmon, imperiled Gorillas, Kittatinny Raptor Corridor. The Selkirk Mountains, Wild and Scenic Rivers, wildland restoration. "The Rhizome Connection" by Dolores LaChapelle and "Crawling" by Gary Snyder.

12 • **Winter 1993/94** Overworking the North Woods, the Tuliptree, Sutter Buttes, freedom of information, consensus vs. independent activism. Bats, endangered invertebrates, exotic pests. The evolving Wilderness Area model, Rocky Mountain National Park reserve system proposal, Yellowstone to Yukon proposal, South African population stresses.

13 • **Spring 1994** Wilderness Land Trust, Sea Shepherd, environmental education, bonding with the wild, whole-tree logging, ozone depletion, the anatomy of a burn, Spruce-fir Moss Spider. Mohawk Park, Nova Scotia, southern Utah, nuclear dump in the Mohave Desert, Brookhaven irradiated forest, Southern Appalachian National Forest mismanagement, Vermont wilderness. "Saving Aquatic Biodiversity" by Allen Cooperrider and Reed Noss, and "The Enemy" by Edward Abbey.

14 • **Summer 1994** Wilderness Watch, "experimental, non-essential" populations, building a legal file, bioregional mapping, silvicultural fiction, a road-fighting strategy. Hanford's sage-steppe, the impact of logging on songbirds; Bald Eagles, Gila Trout, serpentine rock, hemp. Eastern old growth, butchering the Salmon-Selway, regenerating bush and soul in Australia, Great Plains restoration (Part 1). "A Walk Down Camp Branch" with Wendell Berry and William Catton on carrying capacity.

15 • **Fall 1994** Environmental lawyers, biocentric broadcasting, resisting mining, historical records in mapping. Red-cockaded Woodpecker, wombats, seabird restoration, fish stocking. Central Appalachian forests, the Algoma Highlands, old-growth Acadian hardwoods, Pacific Coast wilderness, Thoreau Regional Wilderness Proposal, Great Plains restoration (Part 2). "The Cornucopia Scam, Part 1" by Sandy Irvine.

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❑ *Wild Earth*'s first special issue on The Wildlands Project

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16 • **Winter 1994/95** Locking up wildlands, bureaucratic jargon, biophilia vs. technophilia, natural fire, road removal. Urban Peregrine Falcons, snails, cryptogamic soils, the Red Maple. Wisconsin timber law, restoring Lebanon, Great Lakes biodiversity, and "The Cornucopia Scam, Part 2." Dave Foreman, Reed Noss, and J. Baird Callicot debate the idea of Wilderness.

17 • **Spring 1995** Grassroots vs. nationals, Free Market Environmentalism, and community-serving economics. Prairie dog ecosystems, wild to domestic animal ratios, wildlife biologist Susan Morse, India's threatened mangroves, Species Requiem Day proposal, vernal pools. Palouse Prairie, Banff, Hoosier forests (Part 1), Minnesota recovery, and "The Cornucopia Scam, Part 3." J. Baird Callicot's retort, and "Wilderness Does Work" by Michael Frome.

17• **Summer 1995** Logging and wildfire, great trees of the Great Smokies, wetlands, the environmental consequences of being born in the USA. Gulf Sturgeon, bumblebees, illegal wildlife trade, grazing issues. Utah wilderness, Nevada biodiversity, a conservation plan for the Columbia Mountains, and Hoosier forests (Part 2). "Loss of Place" by Howie Wolke, "Health Implications of Global Warming and the Onslaught of Alien Species," by Michael Soulé, and a journey to Bristol Cliffs Wilderness with John Elder.

18• **Fall 1995** Sustainable silviculture, SLAPPs, conservation easements, global warming and The Wildlands Project. Cow Cops, Spirit Bears, Buffalo Commons, the Black Birch. Eastside forest restoration, old growth in the Adirondacks and Catskills, Hoosier forests (Part 3), Gila River-Sky Island Region proposal. "Private Property and the Common Wealth," by Wendell Berry and "Scenes on a Round River," by Rick Bass.

Wild Earth and The Wildlands Project

For some of you new to *Wild Earth (WE)* and The Wildlands Project (TWP), a brief explanation could help you better digest the contents of this special publication. *WE* and TWP are both represented by these pages but are also both much more than you'll see in these pages. Briefly, the quarterly journal *Wild Earth* is a forum for the many grassroots wildlife advocacy groups comprising the New Conservation Movement, a vehicle for making accessible to conservation activists the teachings of conservation biologists, and the publishing voice for TWP. TWP is the group guiding the design of a continental wilderness recovery strategy, as explained in the preceding pages. *Wild Earth* and The Wildlands Project are closely allied but independent non-profit organizations. Each invites your inquiries, assistance, and donations.

- *Wild Earth*, POB 455, Richmond, VT 05477
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STATEMENT OF PURPOSE

Wild Earth is a non-profit periodical serving the biocentric grassroots eleme within the conservation movement. We advocate the restoration and protec of all natural elements of biodiversity. Our effort to strengthen the conserva movement involves the following:

- We provide a voice for the many effective but little-known regional and ad ho wilderness groups and coalitions in North America.
- We serve as a networking tool for grassroots wilderness activists.
- We help develop and publish wilderness proposals from throughout the continent.
- We are working with The Wildlands Project to complete, and subsequently publish in book form, a comprehensive proposal for a North American Wilderness Recovery Strategy.
- We render accessible the teachings of conservation biology, that activists may employ them in defense of biodiversity.
- We expose threats to habitat and wildlife, and offer activists means of combat the threats.
- We facilitate discussion on ways to end and reverse the human population explosi
- We defend wilderness both as *concept* and as *place*.

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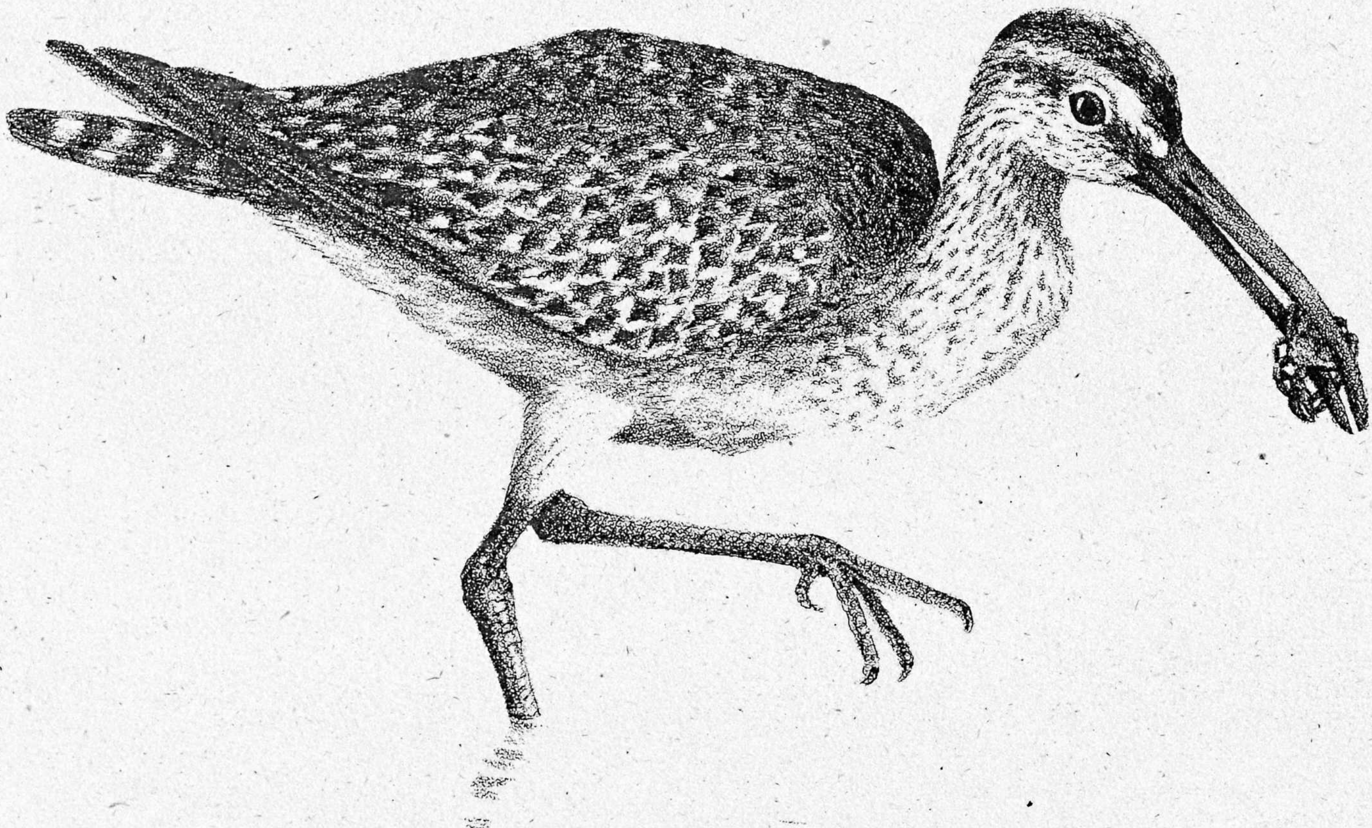
Species Spotlight

The Whimbrel as Symbol



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*Whimbrel (*Numenius phaeopus*) by D.D. Tyler*

The Whimbrel (*Numenius phaeopus*) well symbolizes several desiderata central to The Wildlands Project. Together with its curlew cousins, the Whimbrel represents cross-continental connections, migrating yearly from Arctic breeding grounds to winter in South America, affirming efforts to restore and maintain habitat connectivity across the Americas. Likewise, the Whimbrel, a coastal feeder, links marine and terrestrial habitats, even as The Wildlands Project envisions and works to realize an ecological reserve network that encompasses marine and coastal in addition to terrestrial habitats. More abstractly yet equally importantly, this swift messenger between remote habitats in the far north and the far south symbolizes health, wildness, and hope. —*JD*

Maine artist Diana Dee Tyler (whose work also appears on p. 37) is well known for the scientific accuracy she brings to her artwork. Her many book illustration credits include Bears in the Wild, Keepers of the Animals, *field guides, and several children's books (three of which received Outstanding Science Book awards). D.D. and Hank Tyler operate Tyler Publishing (POB 243, Augusta, ME 04332), which distributes D.D.'s natural history posters, prints, bookmarks, notecards, and postcards.* —TB

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