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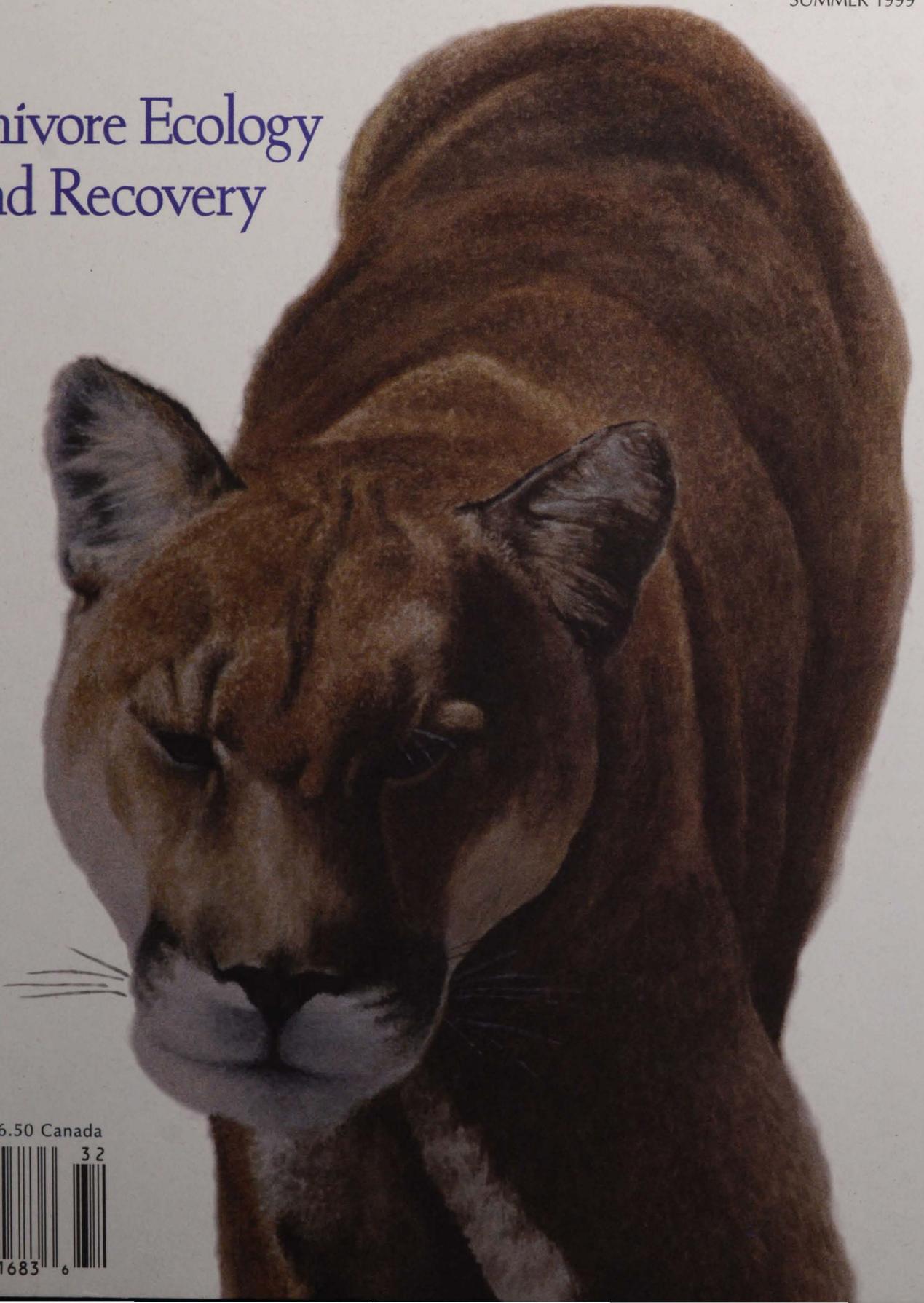
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WILDEARTH



SUMMER 1999

Carnivore Ecology and Recovery



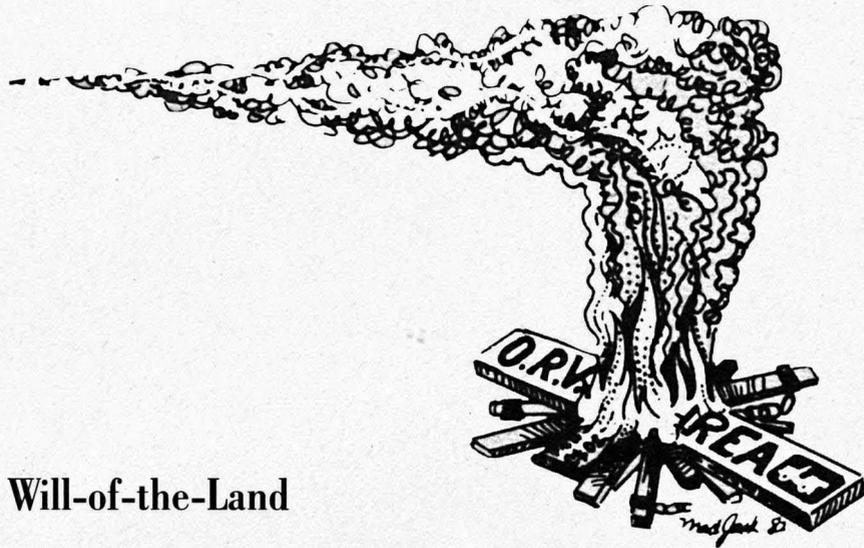
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Around the Campfire

by Dave Foreman



Will-of-the-Land

In our slacker era, when rigor in thought and ethics is too much to ask for, we often get into a snarl with poorly defined words. Bud Man on his motorized tricycle, academic grandees, and just about everybody in between use the word *wilderness* in sloppy ways, thus muddying the wrangle about conservation. According to historian Roderick Nash, the word *wilderness* comes from the Old English *wil-deorness*, which he defined in 1967 as “place of wild beasts.” *Wil*: Wild, or willed. *Deor*: Beast, or deer. *Ness*: Place, or quality.¹

In a 1983 talk at the third World Wilderness Conference in Scotland, philosopher Jay Hansford Vest also sought the meaning of wilderness in Old English and further back in Old Gothic languages. He showed that wilderness means “‘self-willed land’...with an emphasis on its own intrinsic volition.” He interpreted *der* as *of the*, not as coming from *deor*. “Hence, in wil-der-ness, there is a ‘will-of-the-land’; and in wildeor, there is ‘will of the animal.’ A wild animal is a ‘self-willed animal’—an undomesticated animal—similarly, wildland is ‘self-willed land.’” Vest notes that this willfulness is opposed to the “controlled and ordered environment which is characteristic of the notion of civilization.” These early northern Europeans were not driven to lord over Nature; thus wilderness “demonstrates a recognition of land in and for itself.”² Thanks to Vest, we are able to understand that this word, wilderness, is not a coinage of modern civilization; it is a word brewed by pagan barbarians of the Bronze and Iron Ages.

This “self-willed land” definition of wilderness overshadows all others. Wilderness means land³ beyond human control. Land beyond human control is a slap in the face to the arrogance of humanism—elitist or common man, capitalist or socialist, first worlder or third; for those who would dominate Nature, it is something to be feared.

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1. Nash, Roderick, *Wilderness and the American Mind* (Yale University Press, New Haven, CT 1967), pp. 1-2.
2. Vest, Jay Hansford C., “Will of the Land,” *Environmental Review* (Winter 1985), pp. 321-329.
3. Leopold, Aldo, *A Sand County Almanac* (Oxford University Press, Oxford, UK 1989 [1949]), p. 204. Aldo Leopold defined “land” as a community of soils, waters, plants, and animals—in other words as an ecosystem. I use land as inclusive of rivers, lakes, and even oceans, and as a synonym for Nature.

About Wild Earth and The Wildlands Project



Wild Earth is a quarterly journal melding conservation biology and wildlands activism. Our efforts to strengthen the conservation movement involve the following:

- We serve as the publishing wing of The Wildlands Project.
- We provide a forum for the many effective but little-known regional wilderness groups and coalitions in North America, and serve as a networking tool for wilderness activists.
- We make the teachings of conservation biology accessible to non-scientists, that activists may employ them in defense of biodiversity.
- We expose threats to habitat and wildlife.
- We facilitate discussion on ways to end and reverse the human population explosion.
- We defend wilderness both as concept and as place.



The Wildlands Project is the organization guiding the design of a continental wilderness recovery strategy. Through advocacy, education, scientific consultation, and cooperation with many regional groups, The Wildlands Project is drafting a blueprint for an interconnected, continental-scale system of protected wildlands linked by habitat corridors.

Wild Earth and The Wildlands Project are closely allied but independent nonprofit organizations dedicated to the restoration and protection of wilderness and biodiversity. We share a vision of an ecologically healthy North America—with adequate habitat for all native species, containing vibrant human and natural communities.

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Around the Campfire *continued*

I've called Wilderness Areas the arena of evolution. However, Aldo Leopold, as usual, was way ahead of me. Fifty years ago he saw wilderness as the "theater" for the "pageant of evolution."⁴ Evolution is self-willed. The land where evolution can occur is self-willed land (especially so for large species).

The civilized world's greatest embrace of self-willed land comes in the 1964 Wilderness Act in the United States.⁵ This legislation was the product of eight years of discussion and revision in Congress and in public hearings across the nation. It contains at least four definitions of Wilderness, all of which are thoroughly in keeping with self-willed land. The first definition of Wilderness comes in the statement of purpose for the Wilderness Act in Section 2(a):

In order to assure that an increasing population, accompanied by expanding settlement and growing mechanization, does not occupy and modify all areas within the United States and its possessions, leaving no lands designated for preservation and protection in their natural condition, it is hereby declared to be the policy of the Congress to secure for the American people of present and future generations the benefits of an enduring resource of wilderness.

Was Congress, prodded by American citizens, setting up a National Wilderness Preservation System to preserve a mythical past wrapped up in literary romanticism, Manifest Destiny bravado, and Calvinist dualism, as postmodern deconstructionist scholars seem to believe? Well...no. It was much simpler. Wilderness Areas needed to be protected because the remaining backcountry of the United States was threatened with development and industrial exploitation driven by population growth, mechanization, and expanding settlement. Here and throughout the wilderness conservation movement, the motive force has been to protect land from development. Distinguished conservation historian Samuel Hays writes, "Wilderness proposals are usually thought of not in terms of perpetuating some 'original' or 'pristine' condition but as efforts to 'save' wilderness areas from development."⁶ Wilderness Areas, then, are those lands protected from industrial civilization's conquest.

Second, is the ideal definition:

A wilderness, in contrast with those areas where man and his works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammelled by man, where man himself is a visitor who does not remain. Section 2(c).

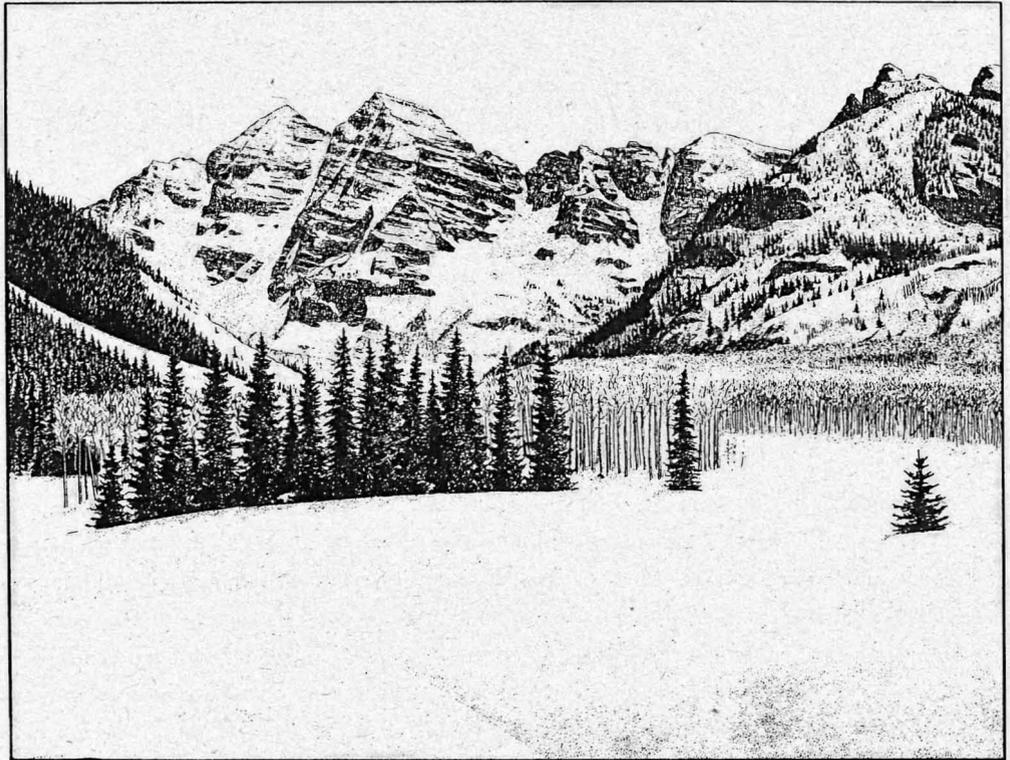
Written by Howard Zahniser of The Wilderness Society, who, as a professional editor and writer, understood the importance of word selection, this definition agrees with the concept of self-willed land. First, wilderness is not where the works of man dominate the landscape. It is not under human will. Second, Zahniser chose

4. *A Sand County Almanac*, p. 199.

5. Public Law 88-577 (16 USC 1131-1136) 88th Congress, Second Session, September 3, 1964. Contained in Watson, Jay, ed. *The Wilderness Act Handbook Third Edition (revised)* (The Wilderness Society, Washington, DC 1998).

6. Hays, Samuel P., "The Trouble with Bill Cronon's Wilderness," *Environmental History* Vol. 1 No. 1 (January 1996), p. 30.

the obscure word “untrammelled” carefully, and not just because it rolls off the tongue pleasantly. A *trammel* is a fish net and also a hobble for a horse, thus a thing that hinders free action. As a verb, *trammel* means to hinder the action of something.⁷ *Untrammelled*, then, means that the will of something is not hobbled; it is self-willed. Untrammelled land is the arena for evolution. (Biologist Michael Soulé calls Wilderness Areas self-regulated, another way of saying self-willed or untrammelled.) Third, humans are only visitors in



Wilderness; there are no permanent human settlements. Many kinds of Wilderness foes especially bristle at this barring of human habitation. However, I believe this lack of long-lasting settlement is key to wilderness. Where humans dwell, we trammel or hinder the willfulness of the land around our living sites and outward. How far? This hinges on the population size and technological sophistication of the group.⁸

The third definition of Wilderness immediately follows the second. It is the specific, practical definition of Wilderness Areas protected by the Wilderness Act and sets out the entry criteria for candidate areas:

An area of wilderness is further defined to mean in this Act an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which 1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; 2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; 3) has at least five thousand acres of land or is of sufficient size as to make

practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value. Section 2(c).

Although in keeping with self-willed land (undeveloped, primeval character and influence, without permanent improvements or human habitation, natural conditions), this is a practical definition that acknowledges that even mostly self-willed land may not be fully pristine (generally appears, affected primarily, substantially unnoticeable). Indeed, the word *pristine* does not appear in the Wilderness Act.

This down-to-earth view of Wilderness answers the often silly question, “What is natural?” It understands that *natural* is not a single point opposed to the single point of *unnatural*. Rather, I think it sees that land falls on a continuum from wholly yoked by human will to altogether self-willed. At some point, land quits being mostly dominated by humans; at some other point, land begins to be controlled primarily by the forces of Nature. There is a wide gray area in between, where human and natural forces both have some sway. After natural forces become dominant, the land is self-willed. Because we humans have limited and differing understandings of ecology and

7. Hoad, T.F., *The Concise Oxford Dictionary of English Etymology* (Oxford University Press, Oxford, UK, 1993), p. 501.

8. George Schaller tells me that when Amazonian tribes were armed only with blowguns and bows, monkeys could be found half a mile from villages. Now, with the arrival of the shotgun, monkeys are not found within five miles of settlements. Jim Tolisano, an ecologist who has consulted for the UN in many remote regions, has told me of similar changes in Papua New Guinea. Tropical ecologist John Terborgh tells me the same. See also Fitzgibbon, Clare D., Hezron Mogaka, and John H. Fanshawe, “Subsistence Hunting in Arabuko-Sokoke Forest, Kenya, and Its Effects on Mammal Populations” *Conservation Biology* October 1995, pp. 1116-1126; Hunter, Malcolm, Jr., “Benchmarks for Managing Ecosystems: Are Human Activities Natural?” *Conservation Biology* June 1996, pp. 695-697; Winterhalder, Bruce and Flora Lu, “A Forager-Resource Population Ecology Model and Implications for Indigenous Conservation” *Conservation Biology* December 1997, pp. 1354-1364.

depths of wisdom, we may find the changeover to self-willed land in different places on this unnatural-natural line. But this does not mean we cannot say, "This place is primarily natural." And let us not fall into the woolly headed trap of thinking that naturalness is merely a human idea. Naturalness exists out there. A falling tree in a forest needs not a human ear to be.

Ecological wounds suffered by the land come from humans trying to impose our will. The severity of these wounds and their full impact settle whether the land is mostly self-willed (affected primarily by the forces of Nature) or not. Some postmodern deconstructionist critics of wilderness falsely believe that conservationists see wilderness as pristine (an absolute word). More traditional anticonservationists, in order to limit protection, argue that places must be pristine in order to qualify as Wilderness Areas. Neither gospel holds water.

If we read Section 2(c) of the law closely, we will see that there are really two definitions of wilderness twined about each other. One is a definition of the human experience in Wilderness Areas (appears, unnoticeable, solitude, a primitive and unconfined type of recreation, educational, historic, scenic). The other is an ecological definition (undeveloped, primeval character and influences, forces of nature, ecological, scientific). Understanding that these descriptions of ecological conditions and values are prominent in the Wilderness Act belies the persistent rap that the Wilderness Act and the National Wilderness Preservation System created by it are only about scenery and recreation. Even some conservationists and scientists have criticized the Wilderness Act for an overwhelming recreational bias. It's important to understand that this is not the aim of the Act, although it is how federal agencies have often managed Wilderness Areas.

The two lessons we need to draw from Section 2(c) are that Wilderness Areas are not expected to be pristine and that ecological values of Wilderness Areas are strongly recognized along with experiential values.

The fourth definition of Wilderness comes with rules for managing land after it comes under the protection of the Wilderness Act:

Except as specifically provided for in this Act, and subject to existing private rights, there shall be no commercial enterprise⁹ and no permanent road within any wilderness area designated by this Act and except as necessary to meet minimum requirements for the administration of the

area for the purposes of this Act (including measures required in emergencies involving the health and safety of persons within the area), there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area. Section 4(c).

(Elsewhere, the Wilderness Act provides for certain exceptions to the above prohibitions, such as for mineral prospecting until 1984, fire fighting, rescue, and livestock grazing, which were all political compromises supporters of the Wilderness Act had to make in order for western members of Congress to allow passage. Thus the Wilderness Act is somewhat flawed and sometimes at odds with itself.)

These use prohibitions try to keep the land untrammelled (self-willed). They are more strict than the entry criteria in Section 2(c). For example, there is no requirement that candidate Wilderness Areas have to be roadless or unlogged, but Section 4(c) holds that they must be managed as roadless after they are placed in the National Wilderness Preservation System. In other words, existing roads must be closed and no further commercial logging allowed after designation of an area as Wilderness. There are many cases of once-roaded or earlier-logged areas in the National Wilderness Preservation System—including some of the classic big Wilderness Areas in the West.

By clearly wording what wilderness means and what the Wilderness Act says, many misunderstandings about wilderness should melt away. However, as we too often find, muddying the meaning of wilderness is not always due to simple ignorance, but is a witting tactic by anticonservationists.

The brawl over conservation is, at heart, about whether we can abide self-willed land.

IN EARLY 2000, THE UNIVERSITY PRESS OF COLORADO WILL publish my novel, *The Lobo Outback Funeral Home*. Watch for the announcement in the fall issue of a special pre-publication sale to benefit *Wild Earth*.

Happy Trails.

—DAVE FOREMAN
Moonwater Draw

"Will-of-the-Land" is taken from my book-in-progress, *The War on Nature*. I hope to be done with it by fall!

9. This prohibition of commercial enterprise includes commercial timber cutting.



Kudos on the winter

Wild Earth and its dedication to "A Wilderness Revival." Well conceived and stimulating, it was much needed, and will be an important reference in the wilderness campaigns ahead.

I particularly enjoyed Dave Foreman's "River Wild" thesis, and appreciated his references to the historical roots of the wilderness preservation ethic. I suggest a needed addition, a headwaters tributary, which I believe to be very important: the early publicists of wilderness values. I am thinking of the early artists, from the Hudson River School to Bierstadt and Moran, the scientific explorers and surveyors, such as Hayden, King, and Powell, and the photographers, an honorable line from Jackson to Ansel Adams.

I believe their contributions were important, even critical. They brought an expansive view and exciting promise to much of the public, particularly the thinking public, the politically active public, that voted and in other ways supported the nation's evolving preservation and wilderness ethic.

Keep up the good work.

TONY RUCKEL

Denver, Colorado

H. Anthony Ruckel is a past president of the Sierra Club.

In his article on heritage forests [winter 1998/99], Ken Rait cites a national poll showing that 65% of Americans support a proposal to stop all timber cutting in roadless wild forest areas. I find it interesting to note that the same polling firm found that an even *greater* number of Americans support ending the timber sales program on National Forests *completely*. I raise this point because it demonstrates that the public is not more supportive of partial measures for protecting their National Forests. They want to see *all* of their public lands protected from commercial exploitation. It is the environmental community's challenge to catch up with the public in this regard. We need to work in the most expedient manner for full protection of public lands. This includes not just the old growth and roadless areas, but all areas. The second growth and nonpristine parts of the National Forests are our best hope if we want to see more wild old-growth forests in the future. That sure isn't going to happen on Weyerhaeuser lands, so we better make sure it can happen on public lands—and soon! An important step in this regard is passage of the National Forest Protection and Restoration Act to end the federal timber sales program and fund ecological restoration.

DOUG BEVINGTON

Doug Bevington is regional organizer with the John Muir Project in Pasadena, California.

Many of the writers in your winter issue discussed the politics of wilderness preservation, but none of them mentioned the millions of dollars that extractive and polluting industries pay Congress every year to protect their interests.

Conservationists generally seem oblivious to the environmental consequences of current campaign finance laws, which legalize bribery of our elected officials.

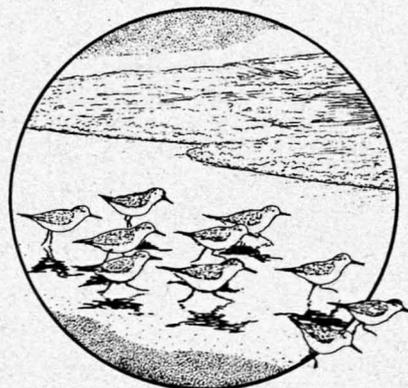
For instance, every poll of Utah's citizens has found about 2:1 support for big, real wilderness. But you would never guess it from our congressional delegation's voting record. They clearly do not represent their constituency on this issue. Why not? They are paid very well by extractive industries to oppose wilderness, and correctly judge that this is not a pivotal issue for most voters in this state.

There is no intrinsic antipathy between conservatism and conservation. In the past, conservation has been a bipartisan issue. (Both Goldwater and Nixon were serious environmentalists.) The problem today is that the Republican Party has (quite legally) sold its soul to industrial interests, and the Democratic Party is headed that way too. Clinton talks a good environmental line, but what has he done?

As long as Congress is for sale to the highest bidder, environmentalists are unlikely to prevail. Our opponents can outbid us every time. Campaign finance reform needs to be recognized as a major environmental issue.

BROOKE JENNINGS

Salt Lake City, Utah



I appreciated Bill Ryerson's article "Political Correctness and the Population Problem" [winter 1998/99] and agree that "urgent and effective action to change the minds and attitudes among very large numbers of people is essential." What I've seen in my past five years of population activism is that while people have a new appreciation for sustainable development and disdain for sprawl and local growth, they are not comfortable discussing population growth. Without a discussion, whether in the media or in our churches, schools, and civic groups, there is inadequate understanding or energy to take action.

People follow their passions and their values. They want a safe, healthy planet for their children and grandchildren. They probably want a healthy planet for all species—but most of us still won't talk about population growth. The media give us more stories of the "miracle" of septuplets than of successes of women in the third world who are becoming better educated, running small businesses, and having smaller families (of their own will—and because of the availability of reproductive health care).

For national organizations working for increased funding for international family planning, there is a tremendous need to engage citizens to urge congressional representatives to vote "right." While there is a core group of concerned citizens, there is a much bigger, often more passionate constituency fighting for the rights of the unborn. Voluntary family planning goals are jettisoned by these zealous and misinformed constituencies. The challenge is to educate and engage grassroots activists so that they understand the impact that population growth is having in the United States and abroad, and

will work for more congressional funding of international family planning and development programs.

The work that Bill Ryerson and others have done using soap operas to reshape attitudes toward family size has been extremely successful in developing countries. How do we build support in the United States for population stabilization here and in the developing nations? How do we get people talking about population? Perhaps recent experience with heat and bad weather will persuade people that they need to take global warming seriously. More accounts of the relationship between carbon dioxide production and global warming, accompanied by stories of economic success through energy efficiency, would help jumpstart a discussion.

We need to feed the press compelling stories that help people make the connections between population growth and other concerns. Smart growth and sprawl have made the news. We must push this news envelope to discuss population growth as one of the causes of sprawl. Vermont Population Alliance (VPA) has encountered discomfort concerning introducing "population education" in Vermont's schools, but the schools are ready to embrace education for sustainability. So VPA provides school programs and teacher workshops that educate for sustainability, including population dynamics, carrying capacity, and land-use issues.

VPA recently conducted a survey of Vermonters' attitudes about population growth. When asked to guess global population, half of the respondents wouldn't even hazard a guess; of the half that answered, 26% guessed that the world had fewer than one billion people, another 26% thought we were

between one and four billion, and 17% thought the world had more than ten billion humans. There's room for education! Despite this lack of knowledge, 88% of the 403 Vermonters polled felt that world population is growing too quickly. Clearly we need much more public discussion about the need and means to slow population growth. It is critical for citizens to think both locally and globally about numbers of people and consumption of natural resources.

BARBARA DUNCAN

Barbara Duncan is executive director of Vermont Population Alliance (P.O. Box 466, Norwich, VT 05055; 802-649-5168; bdpop@valley.net).

It was with delight that I read the summer 1998 *Wild Earth* from cover to cover. I had been unaware of how much park and wilderness land has been preserved as a direct result of private philanthropy. I was also pleased to see that Canadian activities and perspectives were included in your winter 1998/99 edition. Sometimes we forget just how uplifting it is to learn about others who share similar objectives. In 1981 our family purchased 1250 acres of beautiful wilderness in the Lanark Highlands, about sixty miles from Ottawa. The land is being set aside as a wilderness preserve. We continue to inventory and monitor plant and animal life, water levels, and the general health of the land.

We expect to have a clear title to the property by 2005. Of course from time to time we groan as another mortgage payment comes due, but I can honestly say I have never regretted our decision. Each time I sit on a scenic outcropping looking over the mixed forest or see a fox, moose, wolf, bear,



otter, fisher, red-shouldered hawk, or a myriad of other animal and plant life, I know that if I came back a hundred years from now, we have made sure that I would find no development, no ugly scar of timber cutting—that the wilderness would still be here. This thought alone makes it all worthwhile.

We are convinced that the battle can only be won as people become more informed about the need to preserve wilderness areas; to this end we have recently instituted the Alba Wilderness School on the property, offering a variety of courses to pass on the skills, knowledge, and philosophies that help to connect individuals to Nature and wilderness. The comments we receive from high school classes, college students, and from the general public make us feel that we are not alone and that there is growing support for a better “land ethic.”

I note that one of your objectives is to provide a forum for little-known wilderness groups and to facilitate their networking. If any of your readers are engaged in similar pursuits and have ideas and experiences to share, we would value the opportunity to hear from them.

HOWARD CLIFFORD

Alba Wilderness School and Nature Experiences (RR #4, Lanark, Ontario, K0G 1K0)

ERRATUM In Kelpie Wilson's article "The Ark of the Habitat" (spring 1999), the word fractional was erroneously substituted for fractal in the sentence: "The watershed, as a container of life, has ark-like spatial characteristics, making it a fractal rather than a linear unit." Fractals are mathematical constructions derived from attempts to describe the infinite perimeters of objects like snowflakes and coastlines. Used in chaos theory, fractals generate amazingly complex pictures at any scale—a lot like Nature.

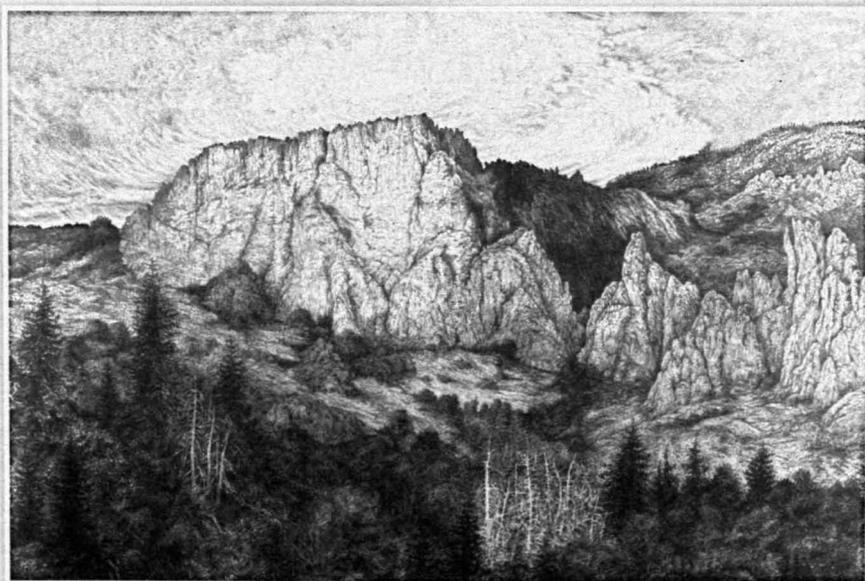
THANKS TO *WE* SUBSCRIBERS WHO RETURNED OUR READER SURVEY AND TO volunteer Nirmala Kamath for compiling the results. We received considerable praise regarding both the look and content of the journal, as well as positive feedback on the balance of theme coverage and regular editorial departments. The tally of replies suggests that typical *WE* readers are well educated (62% have postgraduate degrees), read widely in the conservation literature, and consider themselves wildlands activists (77%). More subscribers learned of *Wild Earth* from friends than any other source, suggesting that grassroots communication is one of our most effective promotional tools.

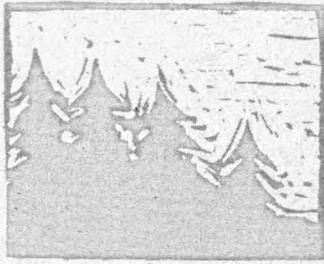
As a nonprofit, we have always relied on our supporters to help raise awareness of our work. This summer, we are offering a beautiful incentive for readers to share the journal with friends, politicians, libraries, teachers, government agencies, relatives, conservation groups, activists, nature lovers, etc. For every gift subscription you send—at a reduced rate of \$20/year—you'll receive an opportunity to win a framed, limited edition Davis Te Selle lithograph. "Table Rock—November," an image of a powerful basaltic outcrop (see below), appeared on the cover of the summer 1997 issue. Contact our office (802-434-4077) for more information or to give us the names and addresses of people who should be reading *Wild Earth*—instead of trashy novels—this beach season.

We appreciate the creative fundraising efforts of Don Parker and the Students for Environmental Action at Colgate University to benefit Buy Back the Dacks, *WE*'s Adirondack land acquisition fund. These Colgate undergraduates generated over \$1500 through direct solicitation as well as an innovative "trade-a-meal-for-wilderness" program in cooperation with Marriot Food Services. Many thanks for their contribution toward protecting a wildlife corridor in the eastern Adirondacks.

Heidi Perkins has recently joined the *Wild Earth* staff as an administrative assistant. A busy student, Heidi is a founding member of the first Sierra Student Coalition in Vermont. She is phasing into full-time work as Jane Gearing phases out to birth and raise a child. Welcome, Heidi; and best of luck in motherhood, Jane.

—JENNIFER ESSER





A Wilderness View

Wildflowers, Warblers, and Wolves

In my family, we have clearly defined responsibilities: My wife studies plants, I watch birds. Our division of labor—although it is hardly laborious to stroll through the spring woods when trillium and bloodroot first appear, and the wood warblers are returning—works well for us because I am botanically challenged. Beyond a few common spring wildflowers, I seem unable to hold the names of plants in my head.

This interest in natural history makes our household, I think, utterly typical, and not only because we are amateurs whose passion for botanizing and birding surpasses our expertise. Millions of other Americans and Canadians share these pursuits, through ornithological organizations, native plant societies, natural history-based tourism, backyard bird feeding, and so on. The phenomenal popularity of birding, especially, has been a point of departure for large numbers of nascent conservationists, who are first exposed to problems of habitat loss and forest fragmentation as they relate to avian conservation.

It seems to me that this wide swath of the body politic could be a promising untapped constituency for carnivore recovery and protection. Why should this be; why should people who like wildflowers and warblers care about wolves?

In his public lectures, Dave Foreman often notes that many people, biologists included, have long thought of the critters occupying the highest trophic level in a food web—the top predators—as being like the maraschino cherry on an ice cream sundae. That cherry may look nice sitting atop the whipped cream, nuts, and hot fudge, but if you flick it off, you've still got dessert. Similarly, humans may have killed off the wolves and wildcats and bears from the land, but we didn't expect the land to change as a result.

There is now, however, a substantial body of evidence to the contrary [reviewed in this issue by John Terborgh et al. in "The Role of Top Carnivores in Regulating Terrestrial Ecosystems"]. When humans perturb ecosystems by extirpating top predators—whether by destroying their habitat or killing them—a host of negative ecological consequences is likely to ensue.

Terborgh and coauthors, using the lexicon of conservation biology, describe the resulting "trophic cascades" as precipitating a rush of "distorted ecological interactions that, in the long run...jeopardize biodiversity." Top predators, then, are wholly unlike that maraschino cherry, which is merely decorative. A more accurate metaphor, and one widely used by biologists, is that they are akin to the keystone in a masonry arch, vital to maintaining structural integrity. Remove them, and the arch collapses.

The symptoms of collapsing ecosystem integrity from top predator elimination include the phenomena of mesopredator and herbivore release: when freed from predation pressure from above, mid-size predators (foxes, raccoons, skunks, opossums, housecats) and herbivores (deer, elk, beaver) become overabundant. Where mesopredator populations are unnaturally large, small mammal and bird populations decline. Where herbivore density is high, vegetative communities may be severely altered.

No wolves, many foxes. Many foxes, fewer birds.

No cougars, many deer. Many deer, fewer wildflowers.

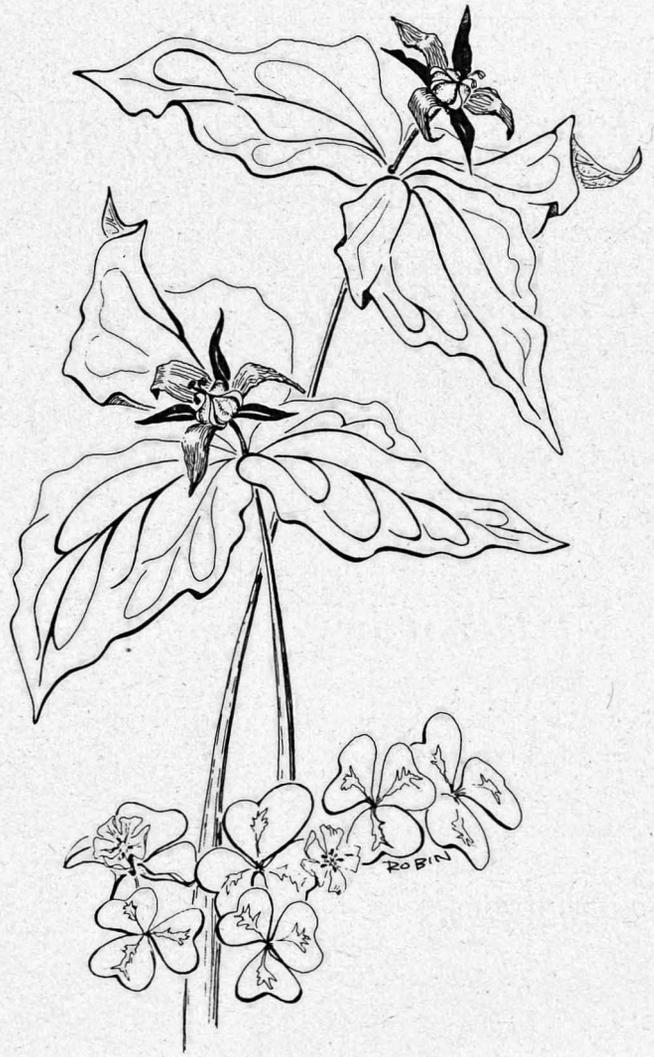
This increasing insight into the critical role of top-down forces to regulate ecosystems has profound implications for continental conservation efforts. Since healthy natural communities require their full complement of native species, we should work to restore extirpated predators to as much of their former ranges as possible. Because large carnivores require expansive habitat and are sensitive to human activities, large ecological reserves and strict limitations on predator persecution outside of reserves will be necessary.

I have no illusion that the growing scientific support for large carnivore recovery will alone overturn entrenched cultural biases. Science rarely trumps politics or economics. (Witness, for instance, the state of political efforts to combat global greenhouse gas emissions or acid rain.) But newer, science-based arguments can be a potent force for carnivore recovery and protection, especially when layered upon existing aesthetic and ethical arguments that have undergirded wildlife protection campaigns since the birth of the American conservation movement.

It is a truism of course, but one that bears repeating, that everything is connected. Indeed, this truth is the heart of an ecological worldview. For wildlands conservationists, it will be our burden to make this case to a broader public, to invite devotees of flowers or birds or butterflies to overcome their balkanization of affection and work for protected landscapes that can support the full diversity of native species. Healthy natural communities—and the continued opportunity to enjoy one's own object of affection, be it wildflower, warbler, or wolf, may depend on it.

LAST SUMMER'S THEME ISSUE DEVOTED TO WILDLANDS philanthropy—the venerable tradition of individual and institutional philanthropists using their wealth to create parks, preserves, and other protected natural areas—has garnered much attention. Formal discussions of wildlands philanthropy's potential to save habitat have taken place at recent meetings of the Environmental Grantmakers Association, the Council on Foundations, and funders' briefings hosted by foundations. We are delighted to have helped stimulate new interest in direct land protection and to see the phrase “wildlands philanthropy,” coined by *WE* staff, now in wide currency.

In this issue, we institute ongoing coverage of this hopeful trend and inaugurate the new editorial department with a profile of early Vermont conservationist Joseph Battell. Battell's philanthropic legacy, while impressive, is yet incomplete, for many acres of the wild forests he bequeathed—and intended to remain forever wild—are still subject to exploitation by timbering and industrial recreation as part of the Green Mountain



National Forest. If conservationists succeed in fully protecting Joseph Battell's former lands, this pioneering wildlands philanthropist's desire to preserve “a considerable tract of mountain forest” and “intact wild lands...as a specimen of the original Vermont forest” may yet be achieved.

WITH THIS ISSUE, THE NAME WENDY O'NEIL NO LONGER appears in the *WE* masthead. A botanist, Wendy was an ardent and effective conservationist throughout her professional life. She worked for The Nature Conservancy in Michigan and New York, was a consulting ecologist, was appointed by former Governor Cuomo to serve on his “Commission on the Adirondacks in the 21st Century,” and at her death this spring was on leave from a position with the Adirondack Council. Although she died too young, Wendy leaves an impressive legacy of wildlands saved. She was an asset to her community (which she defined in the broadest sense), a valued advisor to the *Wild Earth* staff, and a dear friend. She will be missed.

—TOM BUTLER

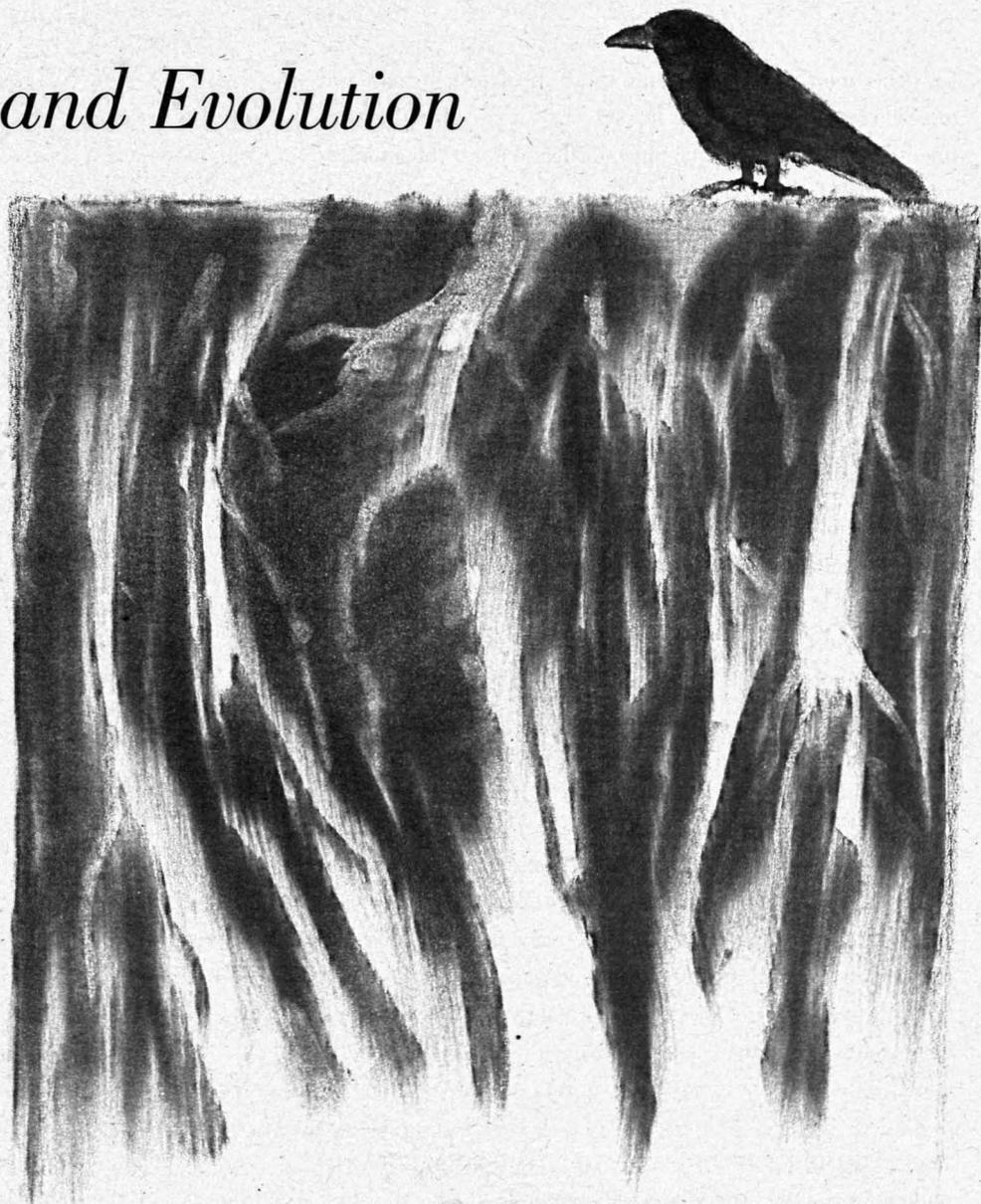
Ecosystems and Evolution

in Light of

Systems

Analysis

by *Bill Willers*



Much work has been going on in the worlds of complexity and chaos theories, cybernetics, and systems analysis that is giving biologists insight into the nature of ecosystems. It's the kind of information that can also empower those who work for the interests of the natural world. Recent developments in these disciplines have been summed up well in Fritjof Capra's 1996 book *The Web of Life: A New Scientific Understanding of Living Systems*.

Living systems, whether one is speaking in terms of individual cells, bodies, or landscape-scale ecosystems, consist of parts that can be understood fully only in context with the overall system. The relationships between and among the parts of any living system are such that the system is greater than the sum of its parts and a distinct entity unto itself. Increasingly, living systems are understood less as mere collections of parts and more as patterns within webs of relationships.

The general pattern of "life" is seen to consist of feedback loops that can self-organize, self-correct, and evolve. Living systems, while they may be organizationally closed, are structurally open with regard to the flow of energy and matter through them. Look at a cell, or at any creature, or consider a simple ecosystem in the form of a pond or a distinct mountain valley: their integrity as natural entities persists even as energy and matter flow through them.

Within the webs of relationships that characterize living systems there are networks of pathways that include many "forks in the road," any of which might be followed depending on a system's recent history or on pressures being exerted from within or without. Internal organizational change can then take place even as a basic weblike structure is maintained. This view of living systems, with its focus on self-organization and self-regulation, allows for an enhanced appreciation of the concept of organic evolution as continuous adaptation.

System analysts have a term—"autopoiesis" (a literal translation would be "self-making")—to describe the vast internal networks of processes that are the end product of a living system's *own* organization and evolution. Living systems are not like predictable Newtonian machines in which excess energy is waste, as described in classical thermodynamics. Rather, that energy becomes a source of novelty, increased complexity, and order when involved in catalytic reactions yielding feedback loops and new properties.

The Gaia Theory of Earth as a living, self-organizing system has suffered much attack; the theory's namesake—a Greek mythological character—alone makes it an easy target. But Gaia theory is based on the best understanding of system function. Whether Earth has any form of sentience or awareness is absolutely beside the point. What is important is that the planet is an intricate network of feedback loops involved in self-regulation and the maintenance of conditions favorable for itself. At the heart of the Gaia Theory is the concept that the living and the nonliving parts of Earth are so closely interwoven that "environment" is not only *for* life, but also *of* life.

Ecosystems, although they are not the best subjects for systems studies (because their boundaries, rather than sharp, are marked by transition zones, or "ecotones"), are nevertheless living systems subject to autopoietic principles, and the key to understanding them, as with any living system, lies in understanding their patterns and processes. Organizationally, an ecosystem may be viewed as a network of nodes in which each organism is a node. When magnified, each of these nodes may be seen as a network of still other nodes in which each node may be an organ—which when magnified may be seen as a network in which each node is a cell...and so on. This contradicts the human tendency to organize and describe hierarchically, with larger systems "above" smaller ones. In living systems, there are no "above" and "below," because the pattern is of networks *nesting* within other networks.

With the foregoing in mind, imagine the implications of industrial and governmental "management" of landscape-scale ecosystems—including such activities as the broad application

of herbicides in order to favor a few commercially valuable tree species; suppression of fire and insects; killing of predators and the selective propagation of favored game animals; use of dikes, dams, and reservoirs to alter natural hydrology; construction of dense networks of roads that increase "edge" and allow for the disappearance of interior conditions and the introduction of exotic life forms. When you consider the effects of "multiple-use" management, which promotes various industrial activities on as much territory as possible, on the myriad internal processes and dense webs of feedback loops, you realize that an original entity has been replaced by what, in principle, is as domesticated and controlled according to human whim and design as any lap dog or suburban lawn. Wildness—that force which gives rise to complexity and innovation—has been extinguished.

Central to scientific endeavor is the "control," that which is maintained as a standard of comparison. Without controls one has no way of assessing the effects of actions and experiments. For land management projects and agendas, the *only* valid controls would be intact ecosystems of the same sort and of the same scale as those being "managed." For the expansive endeavors of contemporary land managers, proper controls would translate into sprawling wildlands with all parts, up to and including top-level predators, present and functioning normally.

But such has not been the case. Instead, the norm has been what "forest science" has given us: experiments done on a few hectares, with controls of a few hectares, and with findings then extrapolated to entire landscapes as if scale were of no significance at all. The predictable result has been the disappearance of wild characteristics of landscape proportion and a complete lack of knowledge on the part of the managers of what they have wrought. When criticized, land managers reply that the objections of wildlands proponents are based on mere emotion and that we must rely on "science"—by which they mean, of course, their own inadequately controlled and highly politicized brand of science.

The findings of systems analysts are providing insights into the inner workings of ecosystems. In so doing, they are placing land managers in a spotlight that reveals practices that are nothing less than shameful. And this is powerful ammunition for wildlands advocates who have the will to use it. ☾

Bill Willers is the founder and board president of Superior Wilderness Action Network (SWAN) and emeritus professor of biology at the University of Wisconsin at Oshkosh. He edited the anthologies Learning to Listen to the Land (Island Press, 1991) and Unmanaged Landscapes, to be published by Island Press in June, 1999.

Habitat Lost

Inbreeding Depression and Extinction

by Leslie A. Pray

When a species becomes imperiled, it's symptomatic of something much greater than genes gone awry. So why are some scientists overly concerned about genes when the extinction crisis is driven by habitat loss and conversion? The growing prominence of genetics in national and world affairs, including conservation and social issues, raises important questions about such a high-tech approach to understanding the world. Is conservation genetics a wayward spin-off of the "academically correct" molecularization of biology? Is it symptomatic of the current trend to look to genes for answers to everything? Does the focus on genetics deflect attention from the social causes of the current extinction crisis? Or is an understanding of the genetics of a wild population essential or helpful in any way to the greater goal of halting anthropogenic extinctions?

Take inbreeding, for example. In nongenetic parlance, inbreeding is the mating of close relatives. As population size decreases, the chances that any two mating individuals are related increases. Thus inbreeding is inevitable in declining, isolated populations of regularly outbreeding species. Because it can have detrimental—sometimes lethal—effects on a population, many conservation biologists think that inbreeding will cause or speed up extinction. But what is the root cause of the inbreeding and other genetic problems associated with small population size?

Just before he died in 1994, renowned Australian wildlife biologist Graeme Caughley wrote a review article for the *Journal of Animal Ecology*, "Directions in Conservation Biology," in which he challenged researchers to think about how their work "has contributed, potentially and actually, to slowing the loss of species." I think Caughley was correct and courageous in his thinking when he argued that studying the biological properties of small populations, such as inbreeding, has "not yet contributed significantly to conserving endangered species in the wild because it treats an effect (smallness) as if it were a cause." We need to reverse our reductionist science-searching, flip the lens, and more seriously examine our own (i.e., human society's) causal role in the current wave of extinctions across the globe.

In April 1998, the international journal *Nature* published a study by researchers at the University of Helsinki, Finland: "Inbreeding and Extinction in a Butterfly Metapopulation." After years of controversy about the exact role of inbreeding in causing extinctions, but with no conclusive empirical evidence, finally a study appeared that tested a direct connection between inbreeding and extinction. In the same issue, in a short opinion piece entitled "Inbreeding Leads to Extinction," two prominent conservation geneticists, Richard Frankham of Macquarie University in Australia and Katherine Ralls at the National Zoo in Washington, DC, argued that "it is hard to escape the conclusion that genetic factors are involved in the extinction of wild populations." Frankham and Ralls suggest that this study should quiet those who "have continued to question the relevance of genetic factors." The butterfly study even attracted front cover advertisement.



But to blame extinctions on genetics is like saying that children who have been drinking contaminated well water are dying from leukemia because they don't have the genes to protect themselves from the effects of being exposed to deadly carcinogens. Yes, in some instances a more inbred population has a greater chance of going extinct, as was shown in the butterfly study, but what leads to the inbreeding in the first place? Habitat loss and fragmentation are the root cause of increased levels of inbreeding in small, isolated populations.

If we examine only the final inbreeding phase of extinction and ignore the greater environmental and societal factors that have led up to it, it's still not clear that inbreeding does in fact "lead" to extinction. The butterfly study is the first to show a clear statistical correlation between inbreeding and extinction in a natural population, but we know from laboratory studies how variable the effects of inbreeding are. In most taxa, inbreeding in and of itself is not a "bad" thing. It's the harmful, sometimes deadly, consequences of inbreeding, collectively known as "inbreeding depression," that are problematic. But inbreeding depression is not an inevitable consequence of inbreeding.

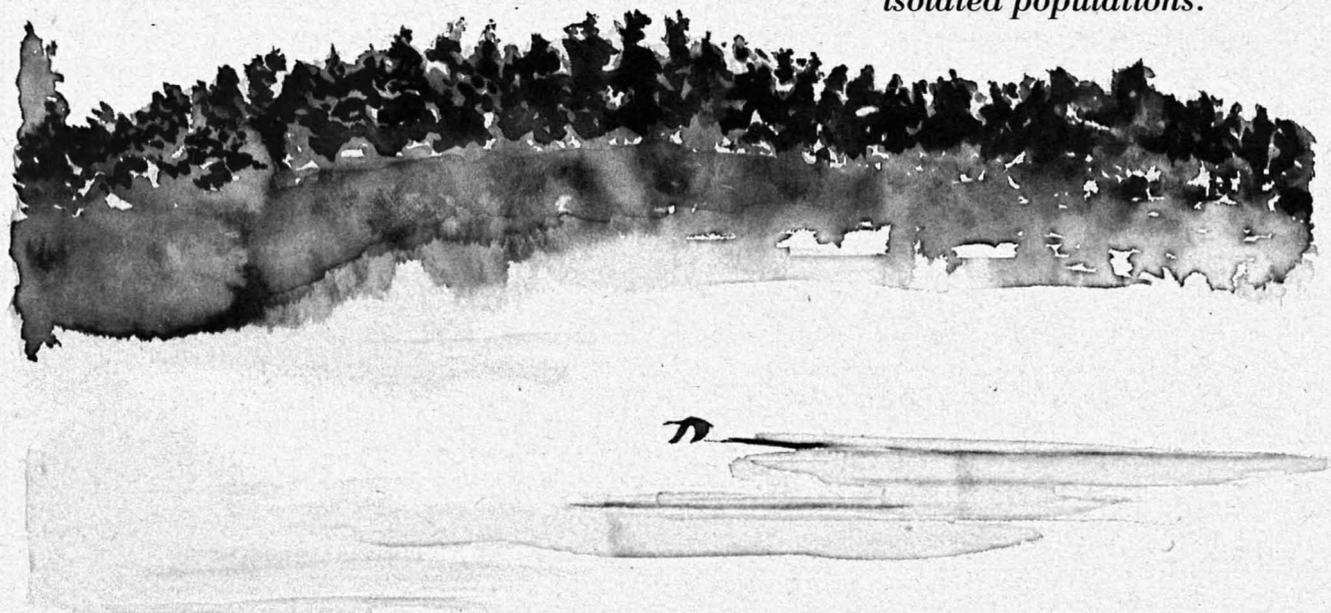
Indeed, inbreeding and inbreeding depression are distinct genetic phenomena, but the two terms are often mistakenly used

interchangeably. Inbreeding is estimated by a quantity called the inbreeding coefficient f , a value that ranges from zero to one. In a completely outbreeding population, i.e., a population consisting of totally unrelated animals, f is defined as zero. As the relatedness of the parents increases, the inbreeding coefficient of their offspring increases. In a completely self-fertilizing population (many plants, for example) the inbreeding coefficient is one. Inbreeding levels in natural populations of regularly outbreeding species (most birds and mammals) range from about zero to 0.01. In genetic parlance, inbreeding depression is defined as the decrease in reproductive fitness in a population that results from an increase in the inbreeding coefficient, f . Most biologists agree that inbreeding depression is caused by deleterious recessive alleles that, when made homozygous as a result of inbreeding, have a noticeable effect on the phenotype of an individual.

Because of inbreeding depression, inbreeding is usually considered a perilous (i.e., perilously close to extinction) situation for any small population that regularly outbreeds. However, it is actually very difficult, if not impossible, to predict what the effects of inbreeding will be in any particular set of circumstances. In my dissertation research on red flour beetles,

Yes, in some instances a more inbred population has a greater chance of going extinct...but what leads to the inbreeding in the first place?

Habitat loss and fragmentation are the root cause of increased levels of inbreeding in small, isolated populations.



Tribolium castaneum, I found that inbreeding depression is severe in some families but mild in others, and sometimes, surprisingly, an inbred family actually shows an *increased* ability to survive and reproduce. Even Darwin, one of the first biologists to adamantly warn of the dangers of inbreeding, reported exceptions to his general rule that “nature abhors perpetual self-fertilization.” He elaborated on the self-fertilized descendants of an *Ipomea* plant that he named “Hero,” arguing that in this unique case “Hero and its descendants have varied from the common type, not only in acquiring great power of growth, and increased fertility when subjected to self-fertilisation, but in not profiting from a cross with a distinct stock.” Researchers continue to report variation on the effects of inbreeding in a variety of taxa, from fruitflies to flowering plants. As the evidence accumulates, pronounced differences even within a single species seem to be the norm, not the exception. If a population does suffer the ill consequences of inbreeding, the severity of inbreeding depression may not necessarily be great enough to warrant concern about extinction.

The Florida panther is one of the more media-popular cases of an Endangered species in the wild believed to be suffering from inbreeding depression, even though it is not clear that the panther is in fact more inbred than expected or, more importantly, that it is suffering from inbreeding depression. One of the most pronounced manifestations of the assumed inbreeding depression in the panther is a condition in males called cryptorchidism, whereby one of the animal’s testes fails to descend from inside the abdomen such that its internal environment is too warm for normal sperm production. In Charles Fergus’s book *Swamp Screamer*, wildlife veterinarian Melody Roelke was quoted as saying, “If all the males in a population have undescended testicles, obviously the population will go extinct in one generation.” But the implications of cryptorchidism and other purported inbreeding-related problems are in fact highly controversial. Wildlife biologist David Maehr, who directed field studies on the Florida panther for ten years, emphasizes the centrality of habitat to the cat’s future in his book *The Florida Panther*:

Diseases, parasites, highways, hurricanes, inbreeding, and heavy metals have all been cited as immediate threats to the panther’s existence [emphasis added]. Yet none of these problems has impaired the panther’s ability to live and reproduce where there is suitable habitat....After 15 years of research, those of us most intimate with the Florida panther are convinced that all of its problems can be traced to landscape management issues....

People sometimes ask me (and I myself often wonder) why I, a geneticist, am advocating shifting the focus away from genetics. But then I remember why I became a geneticist: my love for all things wild and a curiosity about what science—and genetics in particular—could teach us, if anything, about how to allow wildness to flourish. I am still curious. Scientific inquiries into the genetics of inbreeding depression are interesting intellectually, and they provide the promise to aid captive breeding efforts that depend on the careful monitoring of inbreeding. Still, focusing on inbreeding depression in the wild is often a costly diversion from other more crucial, nongenetic consequences of habitat destruction.

Conservationists need to examine more closely the greater environmental and societal problems that cause endangered species to become dangerously close to extinction in the first place—namely humanity’s reckless destruction and fragmentation of natural habitat. Yes, we can argue that inbreeding usually has negative effects and list it as one more reason why we should be providing plentiful habitat and contiguous landscape to support larger populations of organisms. However, conservationists should be aware that the jury is still out on how prevalent inbreeding depression is in Nature and what its role is in the extinction process. But the verdict on whether land should be protected is in, and the bottom line is that protection of wild species doesn’t have much to do with inbreeding depression or any other genetic phenomenon. It has to do with developing a land ethic and a profound love for wildness. Ensuring the survival of the Florida panther will require more than opportunities for outbreeding: the Florida panther simply needs *more land*. ☪

*Leslie Pray is a National Science Foundation-supported Environmental Biology Postdoctoral Research Fellow at Smith College (Clark Science Center, Smith College, Northampton, MA 01063; lpray@sophia.smith.edu). She is currently studying the genetics of *Ambystoma salamanders* that inhabit vernal pools.*

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JOSEPH BATTELL

Once and Future Wildlands Philanthropist

by Jim Northup

The story of Joseph Battell's intended—and partially circumvented—wildlands philanthropy is a rich and complex one that is still unfolding in the hills of Vermont.

24 January 1911

KNOW ALL MEN BY THESE PRESENTS: That I, Joseph Battell of Middlebury, in the County of Addison and State of Vermont, in consideration of One Dollar to me in hand paid and in consideration of the love I bear my native state, do give, grant, bargain, sell, convey and confirm to THE STATE OF VERMONT for a STATE PARK a mountain called CAMELS HUMP....

Trees growing on the land herein conveyed are not to be cut except those which it is necessary to remove in building paths or roads, and the whole forest is to be preserved in a primeval state....

So begins Joseph Battell's deed conveying to the citizens of Vermont some 1200 acres, including the alpine summit of Vermont's fourth highest and perhaps best loved mountain. With this act, he created Vermont's first natural area strictly protected for its wilderness character. Four years later, through his last will and testament, Battell would add to this already extraordinary legacy by placing over 30,000 acres of Vermont's mountain forests in trust forever as "wild lands." Mr. Battell didn't receive even one dollar for this second generosity; he gave the land away purely out of love for the people and forests of his native state.

The story of Joseph Battell's intended—and partially circumvented—wildlands philanthropy is a rich and complex one that is still unfolding in the hills of Vermont. His unorthodox desire "to preserve considerable tracts of mountain forests in their original and primeval condition" perplexed many people, including the trustees of his estate. After all, the norm at the turn of the last century was widespread clearcutting and deforestation—"working" forests run amok. Because people could not fully grasp the ecological, economic, and social benefits of wild forests, they found ways to interpret Battell's will to allow logging and development, in direct contradiction to his wishes, on much of the land he once owned.

The summit of Camel's Hump now stands proudly preserved as forever wild; Battell would be pleased. The other 30,000 acres of Battell's former holdings are another story; most are now owned by the public and managed as part of the 370,000-acre Green Mountain National Forest (GMNF). Unfortunately, the United States Forest Service (USFS) has logged old-growth forests, clearcut large sections of mountainside, and allowed intensive ski area development on the land that Battell intended to be forever wild.

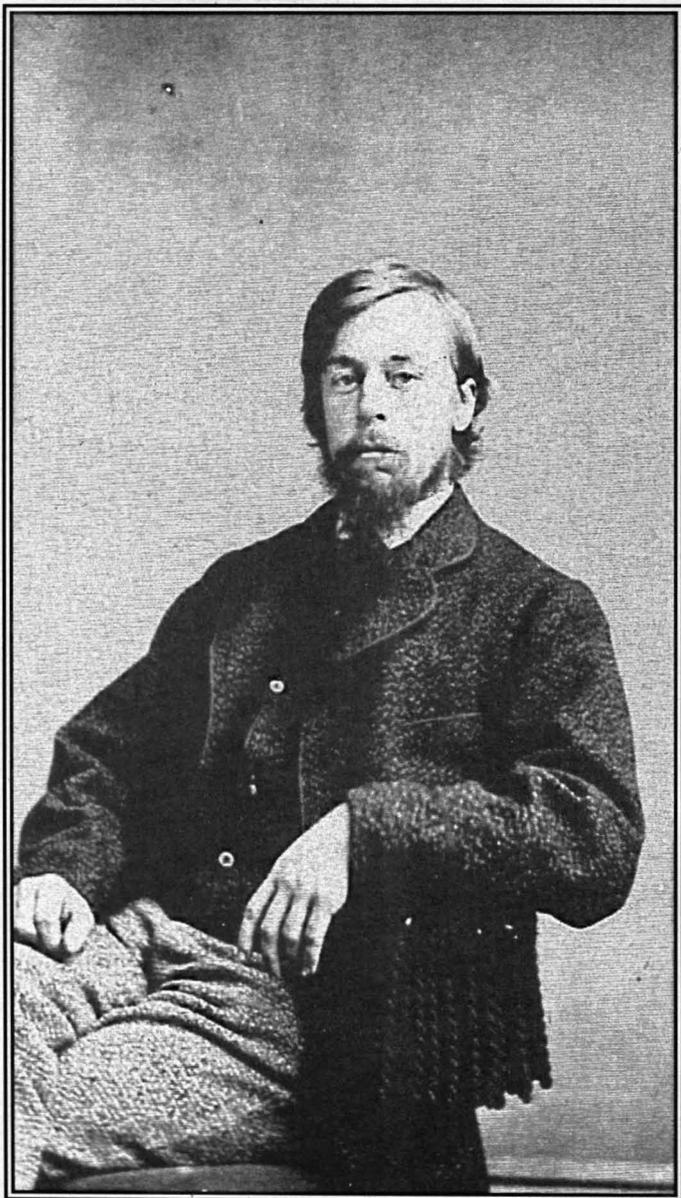
This dark cloud obscuring Battell's wildland vision is not without a silver lining: the 140,000-acre northern unit of the GMNF, including the 22,000-acre Bread Loaf Wilderness, would not exist today if it were not for Battell's foresight and generosity, and it is not too late to make right many of the historical wrongs inflicted by past Forest Service management. Congress can create the Joseph Battell Wilderness out of the heart of Battell's former wild forests, and the USFS can end logging and ski area expansion and restore ecological integrity on the rest of the lands.

Taking the Path Less Traveled

Joseph Battell was born on 15 July 1839 to a wealthy and influential Vermont family. His father, also named Joseph, was a highly successful, Connecticut-born merchant who built the Battell Chapel for Yale University. The elder Joseph Battell and his brother Phillip were distinguished graduates of Middlebury College. The strong family ties to and affection for Middlebury College led young Joseph Battell to enroll there in the early 1860s and likely prompted the lifelong bachelor to name the college as the primary beneficiary of his will.

Battell was forced to leave Middlebury College due to ill health and never completed his degree requirements. He spent the next several years traveling the world before returning to the Middlebury area and purchasing a high-elevation farm in nearby Ripton, Vermont, where, according to his doctor, the clear mountain air would help cure his ailing lungs.

The farm eventually became the Bread Loaf Inn, named for the mountain that looms in the east. Over the years, numerous new buildings, ells, porches, and barns were added in order to accommodate Battell's many friends and guests. The Inn and



In a passionate 1891 speech, Battell called on the Vermont legislature to preserve and protect the state's forests from "timber butchers, lumber merchants and firebugs."

surrounding mountains served as Battell's home, personal sanatorium, and sanctuary for the rest of his long life. Today, the grand, rambling Victorian resort created by Battell is home to Middlebury College's renowned summer writer's school.

In addition to his social and political prominence (Battell owned and edited a newspaper, authored several books, served in the Vermont legislature, and was a Trustee of Middlebury College), Battell was well known for his unconventional philosophies. He expressed disappointment in people's inability to get out and stay out of the conceptual "ruts" that culture and technology create. In the preface of *Ellen or Whisperings of an Old Pine*, his quirky treatise on philosophy and science, he mused:

We are aware that it is very difficult and in some if not many cases impossible for those educated in a system of either politics, science, or religion to relinquish tenets that they have always been instructed in and supposed to be correct.... It is therefore a slow process for the world to leave the paths, however erroneous, in which it has long traveled, and many who succeed will be constantly slipping back. (Battell 1903)*

Battell found the challenges of thinking outside-the-box to be especially true regarding people's concepts of Nature and their relations to the natural world. For instance, he stridently opposed the displacement of pedestrian and equestrian modes of transportation by the automobile and advocated for the preservation of these quiet travelways when building the noisy, new auto routes.

Similarly, he held progressive views on forest protection. At a time when conservation was a concept alien to most people and pioneer conservationists were viewed as misdirected eccentrics, Battell abhorred and spoke against stripping trees from the mountains of New England. In a passionate 1891 speech, Battell called on the Vermont legislature to preserve and protect the state's forests from "timber butchers, lumber merchants and firebugs." An early proponent of eco-tourism, he said, "This mighty rib of old forest that runs through our state is by far the most beautiful bit of scenery we have. Preserved, it would itself attract yearly and for all time thousands of summer visitors."

Quick to speak for forest protection, he was equally quick to act. One account says that when Battell saw clearcutting begin on a mountainside near his beloved Bread Loaf Inn, he feared the magnificent scenery would be ruined, soils would erode, and pristine streams would be impaired, so he bought

*Note in this quotation the possible basis for Robert Frost's poem "The Road Not Taken." Frost was in residence at the Bread Loaf school for many years and undoubtedly read Battell's book—at least the preface.

that mountain on the spot for ten thousand dollars, thus beginning his quest of “preserving the wealth of Bread Loaf scenery for posterity” (Dorn 1965). Perhaps referring to this initial act of land preservation, Battell once said, “Some folks pay \$10,000 for a painting and hang it on the wall where their friends can see it while I buy a whole mountain for that much money and it is hung up by nature where everybody can see it and it is infinitely more handsome than any picture ever painted” (Lee 1936).

Battell went on to purchase over 30,000 acres of forestland within and beyond the view of the Inn. At his death in 1915, he was the state’s largest individual landowner, and he left nearly all of his holdings in trust as “wild land” to “the citizens of the State of Vermont and the visitors within her borders.”

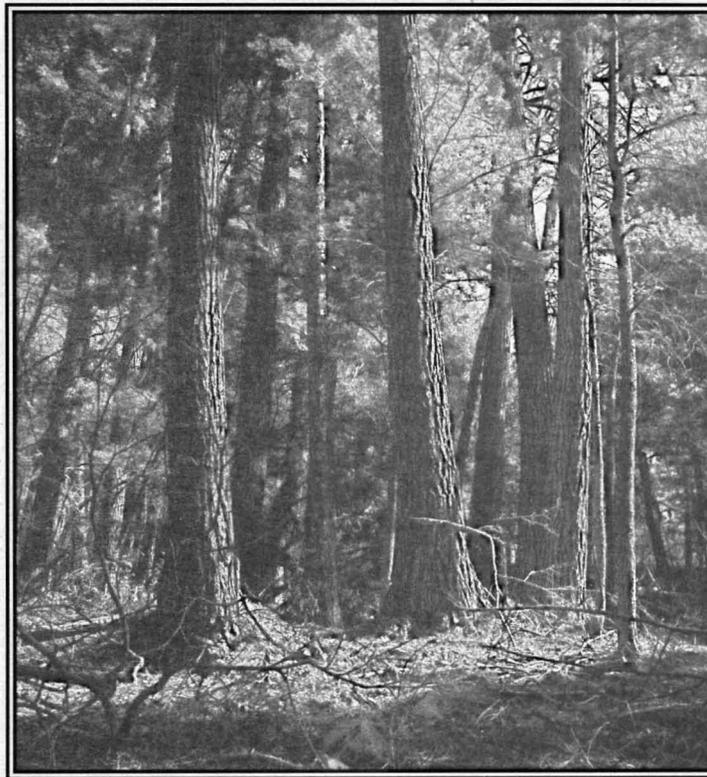
Battell’s Bequest and Its Deconstruction

A 9 June 1915 press release by the Vermont Forestry Department celebrated Battell’s passion for land conservation and noted the impressive wildlands legacy that he left:

It is seldom that the will of a Vermont man has had as far reaching an influence as that of the late Col. Joseph Battell of Middlebury. For many years he had been collecting wild lands, much as a schoolboy collects postage stamps, and like some stamps collected only from sentiment, many of these tracts have become valuable owing to the growing scarcity of timber. These large holdings have now been divided through gift and bequest among Middlebury College, the State of Vermont, and the United States Government.

Battell divided his lands legacy into three main pieces: 1) Camel’s Hump was deeded to the State of Vermont; 2) more than 25,000 acres surrounding the Bread Loaf Inn and the Inn itself were left to Middlebury College; and 3) roughly 5000 acres on the ridge from Mount Ellen to Mount Abraham were willed to the United States Government for a National Park. Since the federal government declined Battell’s gift, this extraordinary tract of primeval mountain forest went also to Middlebury College as part of the “residue” of the estate.

The language of Battell’s last will and testament is impressive in its clarity of purpose and its straightforward directives to the trustees overseeing his charitable gifts (see sidebar). Battell said he wanted “...preservation of a considerable tract of mountain forest in its virgin and primeval state...in trust forever...neither to cut nor permit to be cut thereon any trees whatsoever...it being a principal object of this devise to preserve intact said wild lands...and...considerable tracts of mountain



Old-growth hemlocks on former Battell lands.

forests...in their original and primeval condition....” Unfortunately, the interpretation and execution of Battell’s last wishes were anything but straightforward.

The money managers, lawyers, and foresters who were asked to interpret and implement Battell’s will looked upon truly wild, uncut forests as a wasteful use of land yielding no economic, biological, or social benefits. They were stuck in the conceptual ruts created by their professions and by the dominant societal views of the time and assumed Battell could not have intended what the plain meaning of his words expressed—that essentially no logging should be allowed in order to preserve and create “...considerable tracts of mountain forests...in their original and primeval condition.”

Interpretation of the will generated much discussion and disagreement among Middlebury College’s administrators, trustees, and attorneys. In a 6 March 1916 letter to college president John Thomas, one lawyer said, “I saw plainly that you were disquieted by some suggestions made as to the proper attitude of the College towards the park. I should be disquieted, too, if I thought the College was likely to assume any position with respect to Battell’s bequest which was unsympathetic with the plans and purposes he had in mind” (Partridge 1916). Then as now, finding the proper attitude toward wild land was no easy task.

In the end, the official assessment was that Battell desired to restrict—but not eliminate—logging on most of the land. The will’s interpreters assumed that if the forests were left

Excerpts from Battell's Last Will and Testament

FROM CLAUSE 3: *Being impressed with the evils attending the extensive destruction of the original forests of our country, and being mindful of the benefits that will accrue to, and the pleasures that will be enjoyed by, the citizens of the State of Vermont and the visitors within her borders, from the preservation of a considerable tract of mountain forest in its virgin and primeval state, and believing that the popularity of Middlebury College will be greatly enhanced, I therefore further give and devise to the presidents and fellows of Middlebury College in trust forever, all those portions of wild lands in...Hancock, Rochester and Goshen as are visible in a southerly, southwesterly and southeasterly direction from said Silent Cliff; also all those parts of the mountains visible from the Bread Loaf Inn in easterly, northeasterly, northerly, southeasterly and southerly directions...; also, the wild land...generally including parts of Romance Mountain at the south, Worth Mountain at the east and parts of Bread Loaf Mountain with the arm extending northwesterly from it, at the north; together with the range connecting said mountains.*

And it shall be the duty of said trustees to preserve as far as reasonably may be the forests of said park, and neither to cut nor permit to be cut thereon any trees whatsoever except such as are dead or down and such as it may be necessary to cut in making and repairing needful roads; it being a principal object of this devise to preserve intact said wild lands, especially the Hancock part thereof, as a specimen of the original Vermont forest.

FROM CLAUSE 7 AND CODICIL (SUPPLEMENT) 3: *The lands in the town of Lincoln and Warren in the State of Vermont..., I hereby give and devise to the United States of America for a national park...I make this devise in the hope and belief that the trust hereby established will be so administered as to fulfill the objects mentioned in the third clause of this, my will and that the (trustees) will not allow my desire to preserve considerable tracts of mountain forests (from which Vermont derived her name) in their original and primeval condition, to be defeated by the cutting of trees on said lands or otherwise.*

untouched, insects, disease, and fire would surely destroy them, along with Battell's wish to keep them intact. That is, they believed preservation of forests and scenery *required logging*. They even concluded that logging some of the old growth was acceptable: "While the Committee doubts whether Battell intended to have left untouched all the first growth within the Park, it does seem clear that he intended some...well defined areas should be left in their virgin and primeval state" (Committee on Battell Forest 1925).

A myopic economic view, in addition to ecological ignorance, also shaped the decision to log, and later sell, the land. In his will, Battell talked about the "...benefits that will accrue to, and the pleasures that will be enjoyed by, the citizens of the State of Vermont and the visitors within her borders." He also directed that "...the residuary portions of my estate are to be invested as prescribed in my will and the income used by the trustees." Since the interpreters of his will believed uncut or

unsold forestland could not provide benefits or generate income, they concluded that logging and selling the land would be consistent with Battell's intent.

An advisory report to the Board of Trustees declared:

This cutting limitation in its most literal sense would be well calculated to defeat the object which Battell had in mind and would not be consistent with regard to the land in question or the general purpose, which we now know from the evidence of his associates, he had in mind for the preservation of this land. On the other hand, it could not be said that Battell did not mean anything by the cutting restriction...In this connection it is to be noted that the cutting restriction is made a duty and is not expressed as a condition or command and that it is expressly limited by the words as far as reasonably may be (Committee on Battell Forest 1925).

Wild Lands Lost

Middlebury College began logging the land shortly after receiving it from Battell. Hundreds of thousands of board feet of spruce were sold to the United States government for use in building airplanes for World War I (Rutland Daily Herald 1/11/28). More wood was cut to construct Forest Hall and other campus buildings. When economic hard times hit the nation in the early 1930s, the college decided to sell roughly two-thirds of Battell's forestland.

No private buyers could be found who were both able to pay the substantial sum of money the well-stocked forests were worth and who were willing to honor the trust, even when loosely interpreted, that Battell imposed on the land. The college turned instead to the federal government, the principal buyer of large tracts of forestland during the Great Depression. An official proclamation boundary had been established in 1932 within which purchases of land could be made for the Green Mountain National Forest in southern Vermont; however, this purchase area (now the Manchester District) did not include the land the college wished to sell. A 9 June 1933 "Report to the Board of Trustees on the Proposed Sale of the Battell Forest" said, "In order to put this sale through it would be necessary to persuade President Roosevelt to proclaim a purchase area to include Battell Forest, and for the National Forest Reservation Commission to change its policy regarding the purchase of mature timber—*something that will be very difficult to achieve.*"

Difficult indeed, but Middlebury College succeeded and was able to sell almost 20,000 acres to the US Forest Service in the 1930s and another 10,000 acres to the agency in the 1950s. The Addison County Court of Chancery—a court of equity or conscience, not a typical court of law—was asked to review and approve the second sale to the Forest Service. Among other things, the Court had to determine if the land sale would uphold the public trust duties created by Battell: preservation of the wild forest and public access for recreation.

The Court approved the transaction, believing that landowners must "properly operate" wild forests in order to preserve them and that Middlebury College could no longer afford to do so. The Court said on 28 May 1949, "That unless such sale is authorized and carried out there is grave danger that said trust will fail for...lack of funds and proper facilities with which to properly operate said forests, they may become so impaired or ruined through the inroads of pests and forest fires that they will cease to exist as *a considerable tract of mountain forest in its virgin and primeval state.*"

The land was sold to the USFS conditioned by the public charitable trust created by Battell's will, but without any restric-

tions imposed in the deeds transferring title. Over the years, the agency lost sight of its duties as trustee and developed and heavily logged much of the land once owned by Battell. The Sugarbush Ski Area, under lease from the Forest Service, covers most of the east side and portions of the summit of the ridge Battell wished to be preserved in its "original and primeval condition" as a National Park. The scars of large clearcuts—sanctioned by the agency—are still visible on the western flank of that ridge and elsewhere on the former Battell land.

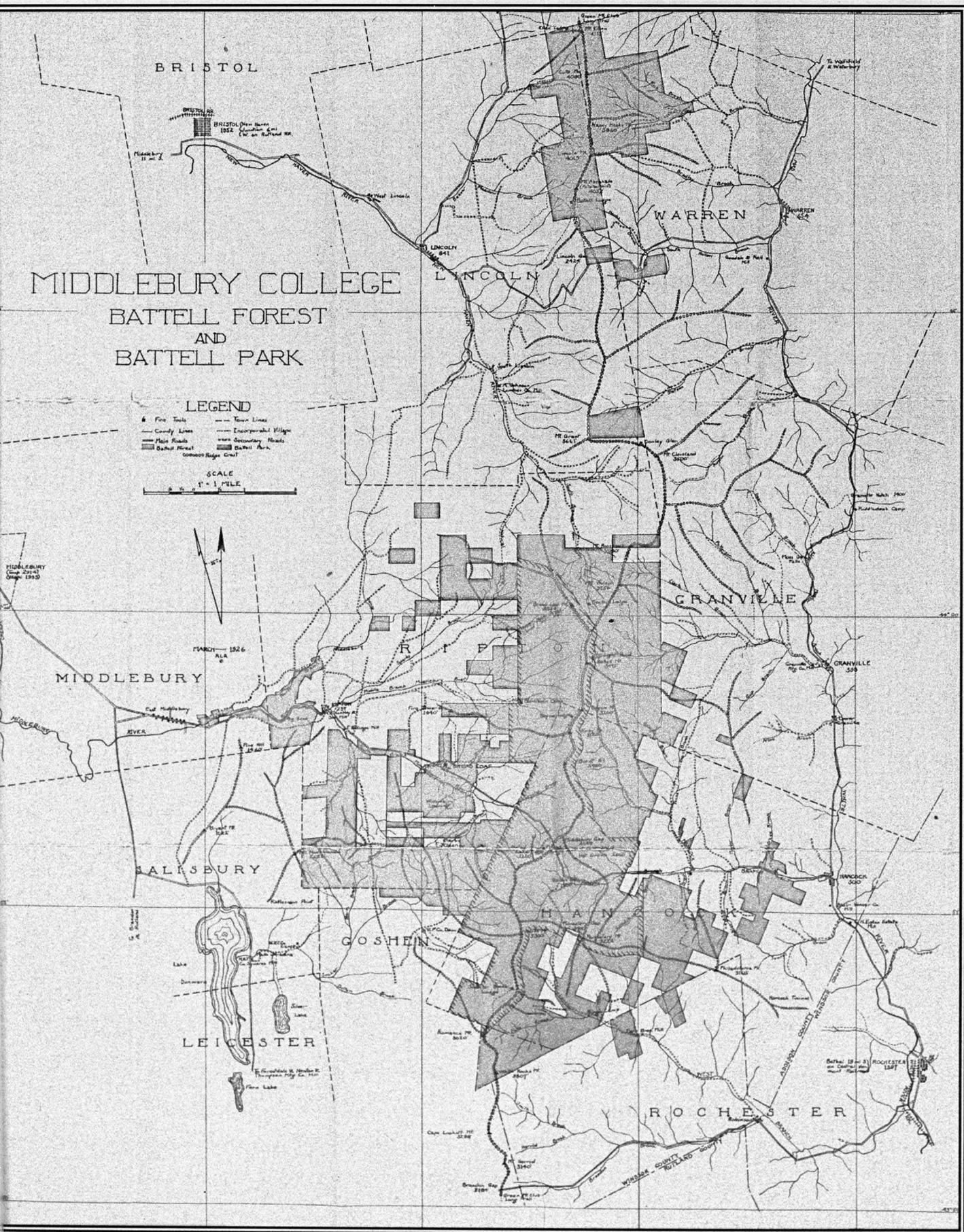
In keeping with his last wishes, but not in direct response to them, the vast tract Battell owned along Bread Loaf Mountain is protected from logging and development by the 1984 Vermont Wilderness Bill's designation of the 22,000-acre Bread Loaf Wilderness. In stark contrast to his wishes, most of the rest of the land he once owned, including the 10,000 or so acres of "...wild lands in...Hancock, Rochester and Goshen," is now being managed by the USFS for timber production. This can and must change. The United States government must substantially reform its management and fulfill its duties as trustee overseeing the forests that Joseph Battell intended to remain forever wild.

Wild Lands Found

The State of Vermont, through a 1969 act of the legislature, formally chose "to maintain the present near-wilderness aspect of the [Camel's Hump] region for present and coming generations and fulfill the original wish of Joseph Battell to see *the whole forest preserved in a primeval state.*" State officials believed that in accepting Battell's gift, "a promise was made"—to the man and to the mountain—and it was the state's duty to uphold it (Vermont Agency of Environmental Conservation 1973).

After a group of Environmental Studies students reminded Middlebury College of its promise to Battell, the trustees promptly passed a resolution on 8 May 1999, ensuring that Battell's wishes would be honored on the few hundred acres of former Battell land that the college still owns:

Be it resolved, that the undeveloped lands within the Bread Loaf Campus area, the lands along the Middlebury River Gorge, and the lands along the Otter Creek Gorge, devised to Middlebury College pursuant to the Last Will and Testament of Joseph Battell be preserved and protected all in accordance with the terms and conditions imposed upon and required by said Article Third of said Last Will and Testament of Joseph Battell and that the trustees of Middlebury College will fulfill its fiduciary duty as trustee of the trust under will of Joseph Battell.



Middlebury College map of former Battell lands, circa 1926

Now it will be up to the students and administrators to keep that promise alive.

Hopefully, these decisive conservation actions taken by the State of Vermont and Middlebury College will inspire the federal government to take similar steps, for it too must live up to the promise made to Battell. While the Forest Service cannot put back the thousands of acres of old growth and other timber it has removed over the years, it can cease all future logging on the Battell lands. And, while it may not be feasible immediately to eliminate the ski lifts, trails, buildings, and parking lots of the Sugarbush Ski Area from the former Battell land, it is possible to prohibit all future development of that land and to initiate reasonable restoration activities, including removal of ridgeline communication towers and abandoned ski lift facilities from the summits.

Joseph Battell knew that the wild forests he cherished were the original home of the human spirit and would need to be preserved where intact—and allowed to recover where diminished—if future generations were to experience and gain wisdom from them. It is only right that visitors to his mountains be able to learn the lessons that wild forests teach and also to learn of Joseph Battell, their benefactor.

In addition to the management actions outlined above, Congress should designate as Wilderness the area of the Green Mountain National Forest that Battell willed to be forever wild—the rugged mountains in Hancock, Rochester, and Goshen that he so loved—plus any adjoining land that would add to the new Wilderness Area's ecological integrity. This fitting act would properly honor the memory of Joseph Battell, would gratefully acknowledge his priceless charitable gifts to the nation, and would officially commemorate his once and future vision of “considerable tracts of mountain forests in their original and primeval condition.” ☾

Jim Northup, a former planner on the Green Mountain National Forest, is executive director of the regional conservation group Forest Watch (10 Langdon St., Montpelier, VT 05602; 802-223-3216; jnorthup@together.net). Forest Watch is working to have Battell's wishes honored by the Forest Service, to protect and restore wild forests, and to reform public land management throughout New England. Visit the Forest Watch website (www.forestwatch.org) to find out how you can help protect Battell's wildlands legacy.

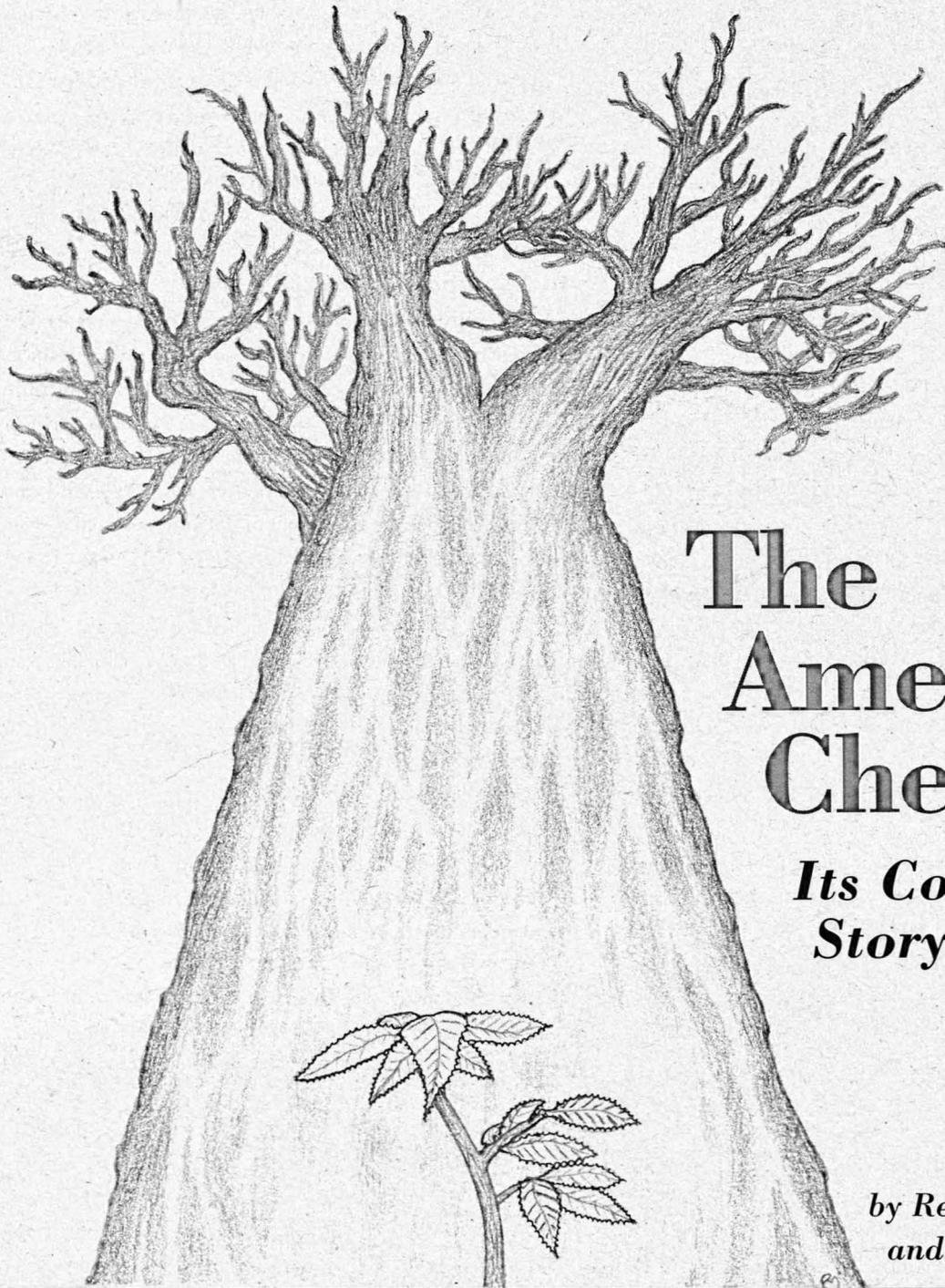


*You'll find his name written in men and women
Who never knew him and may never know him
But who grow bigger in the space he left them.*

—from “Mountains and a Man,
A Glimpse of Joseph Battell”
by Charles Malam

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The American Chestnut

Its Continuing Story

by *Rebecca Parke
and David Vandermast*

Around the turn of the century, Asian chestnuts harboring—but immune to—a virulent fungal disease were brought into the United States as orchard and landscape trees. Evidence suggests that, although first reported in New York, the fungus proliferated from multiple infection centers. In 1904, Herman Merkel of the New York Zoological Park, startled to find strange orange-blushed cankers on the bark of the zoo's American chestnuts (*Castanea dentata*), took action (Newhouse 1990). Nothing—not the pruning of diseased branches from the zoo's infected trees or the eventual cutting of mile-wide swaths of eastern forest,

where the American chestnut grew in regal abundance—could stop the deadly spread of the bark fungus known as *Cryphonectria parasitica*.

By the 1950s, one of the greatest botanical disasters in modern times was in full display. Three to four billion mature American chestnut trees were dead in forests ranging from Maine to Georgia and westward to the Mississippi (Russell 1987). These trees had previously been capable of reaching statures of over a hundred feet with seven-foot diameters and represented 25% of eastern hardwood trees (Zon 1904).

In the remains of this forest today, the chestnut clings to a stubby, curtailed life as a minor understory shrub sprouting from the root systems of dead trees (Newhouse 1990). Out of decades-old stumps, these sprouts rise in gangly clusters. Unless there comes an intervention of grace, their fates are all the same: premature death.

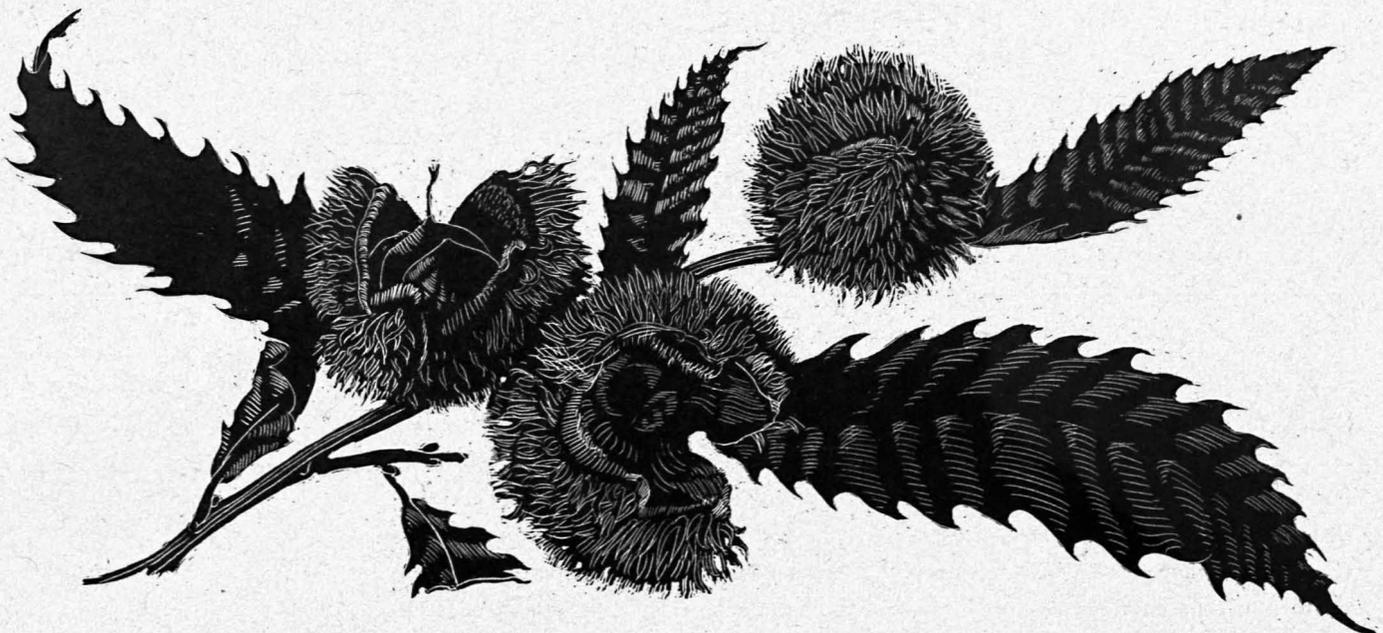
This death occurs when the spores of *C. parasitica* opportunistically enter a tree either through bark that has been scratched or damaged in some way, or at the base of dead branches. The entering spores send filaments, or hyphae, into bark openings. As the hyphae penetrate the inner bark, the threadlike filaments spread into the cambium layer of the tree. The proliferating hyphae of *C. parasitica* then fan out throughout the cambium, girdling the tree and cutting off all exchange of water and nutrients. The tree chokes and dies (Cochran 1990). The stranglehold of *C. parasitica* generally hits the young stump-sprouted chestnuts before they can even produce their first meager crop of nuts.

Killing its major host does not, however, entirely destroy the fungus. Although unable to live in the soil, it can become saprophytic (Newhouse 1990) or subsist in a weak parasitic state on other tree species, especially scarlet oaks (*Quercus coccinea*). This relationship is thought to be long term and does not cause the death of the scarlet oak (Davis et al. 1977).

American Chestnut— An Appalachian Original

Before the arrival of the fungus from Asia, the American chestnut was the most important food and timber tree species in the eastern hardwood forest. Unlike oaks, which drop plentiful nuts erratically, the American chestnut produced large crops every year. People ate the nuts and, in Appalachia, people also ate the animals that ate the nuts: Wild Turkeys, black bears, squirrels, and feral pigs (Cochran 1990). Among the many birds that feasted on chestnuts were Wood Ducks, Ruffed Grouse, and Nuthatches.

The uses of its wood were manifold. Its straight-grained timber split easily and true. Because of its tannic acid content, the chestnut was incredibly rot resistant. The remnant stems which are common even today in Appalachian forests attest to the wood's durability. A vast array of necessary items, from cradles to coffins—and especially anything that had to be highly weather resistant, such as telegraph and telephone poles, railroad ties, cabins, shingles, and fence posts—was best made from chestnut. It was the preferred firewood of all moonshiners and most householders. Chestnut produced an



almost smokeless flame (Cochran 1990). Its ground-up bark, so rich in tannin, supported a vigorous tanning industry wherever abundant stands of the tree existed. It was used as an ever renewable resource, as it grew faster than most other hardwoods (Newhouse 1990).

The economic loss from the chestnut's demise can be counted in the millions of dollars. The blight's trail of mass destruction reached the Appalachian Mountains during the years of the Great Depression. During those years the giant trees dropped in the Tennessee, North and South Carolina, and Georgia mountains, shaking the hollows, bringing the grief of "clear day thunder" into the hearts of the people. The deprivations caused by the loss of the chestnut to the Appalachian people, especially during those difficult times, is beyond the scope of figures to define.

The Discovery of Hypovirulence

Ironically, the beginning of the possible answer to the taming of the blight in America may be the chestnut blight's occurrence in Europe. The blight was first noticed in European chestnut (*Castanea sativa*) orchards in Italy in 1938. As in North America, the disease spread quickly and caused tremendous losses, and by 1967 most chestnut growing areas in Europe were affected (Heininger and Rigling 1994). Europe was the starting point for the search for biological control of chestnut blight disease. Although European chestnuts are susceptible to the disease, they are not as susceptible as the American species; in the 1950s, certain European chestnut orchards were found which, while diseased, appeared generally healthy, continued to produce fruit, and did not die. In 1964 a French mycologist, Jean Grente, took samples from bark cankers of these trees and discovered that the fungus grew differently than the more virulent form. He also found that cankers injected with this less malignant form began to heal. Grente termed this hypovirulence (Miller 1987).

Biocontrol of Chestnut Blight

Biocontrol of chestnut blight is focused on three areas: the search for naturally occurring resistance, strengthening the tree through improved resistance (crossbreeding), and the search for hypovirulent strains of the fungus (Merkle and Brown 1992).

Naturally occurring resistance is found in very few trees; those that have it are being crossbred. There has been only one encouraging crossbreed, called the "Clapper" chestnut, but it is not fertile. According to noted geneticist Charles Burnham, early crossbreeding programs did not work because of the large number of crosses before the first generation hybrid was formed.

THE AMERICAN CHESTNUT FOUNDATION

Beginning in the 1920s and for decades thereafter, the US Department of Agriculture and the Connecticut Agricultural Field Station attempted to breed blight-resistant chestnuts by crossing Chinese and Japanese chestnuts, which are resistant to blight, with the American species. None of the resulting crosses were blight resistant, nor did any closely resemble American chestnuts in nut or timber quality.

In 1980, the eminent Minnesota plant geneticist Dr. Charles Burnham discovered the reasons why: Reviewing the published results of those earlier efforts, Burnham realized that, at most, two or three genes—not the several assumed by earlier researchers—were responsible for resistance, and that therefore the wrong breeding choices had been made in the past. Burnham shared his discovery with several other scientists in 1983, who, agreeing with his findings, established The American Chestnut Foundation (TACF). The mission of TACF is to restore the American chestnut as an integral part of the eastern forest ecosystem.

In 1984, the foundation began using backcross breeding to produce blight-resistant trees.

Starting with a cross between Chinese chestnuts and American chestnuts, TACF staff and volunteers create increasingly American-like seedlings by crossing back to American parents again and again.

Each generation is inoculated with blight, and only the most resistant trees are used in future crosses. After several generations, the result will be trees that are genetically American except for one characteristic: they are resistant to chestnut blight. More than 11,000 trees are in the ground at TACF's two research farms in southwestern Virginia, and programs to breed regionally adapted trees are underway in several states.

For more information on The American Chestnut Foundation's backcross breeding program or on how to join its 3700 members in restoring the American chestnut to its rightful place in our native forests, contact TACF at 469 Main St., P.O. Box 4044, Bennington, VT 05201; 802-447-0110; chestnut@acf.org; www.acf.org.



THE
AMERICAN
CHESTNUT
FOUNDATION



He began his own crossbreeding program in 1982. Burnham believes his third generation hybrid will have 15/16ths of its genetic inheritance from American chestnuts. This is important because the desirable American chestnut traits—growth form, hardiness, competitiveness, and mast production—should be maintained (Merkle and Brown 1992).

Fungi can reproduce in several ways, one of which is vegetative compatibility. Hypovirulence works because infected strains of the fungus can trade genetic material with virulent strains through anastomosis, or vegetative combination. For this to occur, anastomosing strains of the fungus must be vegetatively compatible. As a result of this recombination, the virulent strain gains genetic material, double stranded RNA (dsRNA), which it incorporates into its genome. This new genetic material limits canker growth and allows the tree to produce callous tissue to control the spread of the fungus (Merkle and Brown 1992). Hypovirulence does not prevent a tree from being infected but allows it to grow to maturity and reproduce.

In the middle of this century, hypovirulent strains of the chestnut blight fungus were isolated on European chestnuts in Italy and France. This was a key first step in reestablishing chestnuts as an important forest and commercial tree species. The success of hypovirulence in Europe certainly gave hope to American mycologists but it has never been as successful here (Miller 1987) for several reasons: European chestnuts are not as susceptible to the disease as our chestnuts; the European species has different growth habits (it tends to grow in dense stands where hypovirulent strains can spread more readily); hypovirulent strains in the United States do not spread predictably; and there are far more vegetative strains of the fungus in the United States (Miller 1987).

For biocontrol to be effective, hypovirulent forms of the fungus must be stable over many years. Biological control is associated with the production of superficial cankers. Nonlethal (hypovirulent) infections produce superficial cankers, while lethal (virulent) infections produce nonsuperficial cankers. Superficial cankers do not invade the vascular cambium, leaving a layer of healthy tissue (phloem) between the necrotic inner bark and cambial tissue. The vascular cambium in nonsuperficial cankers is completely diseased. In contrast to the sunken nonsuperficial cankers, superficial cankers are swollen (Griffin et al. 1993).

Hypovirulence has been successful on a limited basis in the United States. It is useful enough that over 300 chestnut trees are being kept alive and used for research in Connecticut. Some of them produce nuts for breeding experi-

ments (Anagnostakis 1992). The best hope for hypovirulence in the US is the native hypovirulent strains found in Michigan in 1976 and subsequently in Pennsylvania, Tennessee, and Virginia (Miller 1987).

Future Possibilities

It is highly unlikely that *Castanea dentata* will ever again duplicate its former prominence in our eastern forests. Vast acreages of the forest itself have disappeared. Forest conditions within the remnant have changed. But a limited resurgence of the American chestnut is a distinct possibility. This possibility centers around the hope that when scientists isolate the factor causing hypovirulence, they will be able to infect the different vegetative strains of the fungus with the factor and introduce it to natural populations. If hypovirulence could become established on a widespread basis in the United States, then chestnut trees could reach maturity and become sexually reproductive. If this occurs, *Castanea dentata* could potentially evolve with the fungus and, at some future point, regain its status as an overstory tree in our forests. ☺

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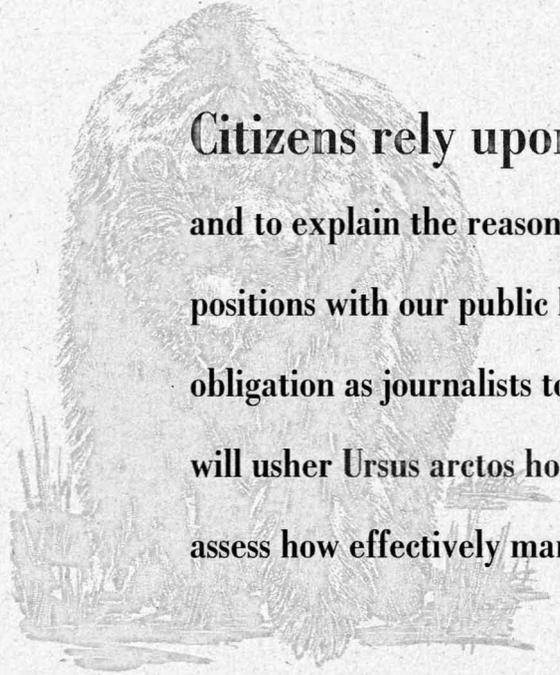
Yellowstone Grizzlies Delisting Dilemma

By Todd Wilkinson



For as long as I've lived in the American West—a span of time that accounts for well over half of my adult life—I have written about Yellowstone grizzly bears. In fact, less than three weeks into my tenure in the Rockies after leaving a journalism post covering violent crime in Chicago, I had my first story: That autumn, a wildlife photographer decided to stalk a Yellowstone grizzly that had become habituated to tourists. The shutterbug got too close. The bruin apparently decided she had had enough hounding. She charged, killed, and partially consumed her human prey, and then park rangers were sent afield to kill the bear.

The story line could not have been more concise. Unfortunately, most plots involving the Great Bear, the wildlife icon of America's first National Park, are far more complicated to grasp, and certainly to write about, than this. And yet the vast majority of newspaper articles we read—most of it flowery fluff—follows a familiar script. Reporters attend seasonal meetings sponsored by the Interagency Grizzly Bear Committee (IGBC) on the status of the bear. (The IGBC, which



Citizens rely upon the media to hold public agencies accountable and to explain the reasons why agencies stake out certain management positions with our public lands. In the case of the Yellowstone grizzly, it is our obligation as journalists to scrutinize the science and policies that ostensibly will usher *Ursus arctos horribilis* back from the edge of extirpation and to assess how effectively managers have spent tens of millions of tax dollars.

is comprised of representatives from various state and federal agencies, oversees management of grizzly bears in the lower 48 states.) At IGBC meetings, the public receives the annual committee statistics provided by the designated bear experts; reporters then write that X number of bears have died in deadly encounters with humans, that X number of cubs were born, that overall the grizzly in Yellowstone is doing better than ever, and then we file the story, go home to have a beer and assume our mission is complete.

I know how the ritual works because for nearly a decade I, too, followed the script. I rarely asked probing questions about the science behind agency pronouncements in hopes of illuminating the real story behind the story. By not doing my job, I believe I let American taxpayers and faithful readers down. Citizens rely upon the media to hold public agencies accountable and to explain the reasons why agencies stake out certain management positions with our public lands. In the case of the Yellowstone grizzly, it is our obligation as journalists to scrutinize the science and policies that ostensibly will usher *Ursus arctos horribilis* back from the edge of extirpation and to assess how effectively managers have spent tens of millions of tax dollars.

I now realize I made a mistake by often opting to write the easy stories when there were obvious signs that a media watchdog was needed. I let anonymous tips that field biologists were being muzzled or intimidated by public land management agencies go unreported. I interviewed the bear bureaucrats, believing on blind faith that the information I received was the complete, unmitigated truth. Not wanting to alienate a contact, I backed off when discerning questions I asked made certain bureaucrats feel uncomfortable. I wrote hopeful, nonprobing sto-

ries that played like broken records, from one year to the next, about how well the griz was doing, even as habitat conditions for the bear in the Yellowstone region continued to decline.

Then I heard about the struggle of David Mattson, the highly regarded scientist assigned to the Yellowstone Interagency Grizzly Bear Study Team whose office in Bozeman was raided and data seized because his superiors did not want him to use it to question government conclusions about the bear's status. Not long after, following a trail of information with no idea where it would lead, I spoke with Charles Lobdell, a senior biologist with the US Fish and Wildlife Service in Idaho who was livid with his agency colleagues for not investigating—and prosecuting—violations of the Endangered Species Act on the Targhee National Forest where overlogging [read: massive destructive clearcutting] occurred in prime grizzly habitat. I also heard about women biologists who were routinely intimidated, harassed, or ordered to rewrite reports when they warned that certain types of business-as-usual resource extraction was harming the bear.

Against the current backdrop of calls for delisting the Yellowstone grizzly from the Endangered Species Act and turning bear management over to the states of Wyoming, Montana, and Idaho, I compiled these tales. Then I wrote a book: *Science Under Siege: The Politicians' War on Nature and Truth* includes a chapter on grizzlies that documents the troubling stories about grizzly bear management in the Greater Yellowstone that were not reaching the newspapers.

For writing it, I suffered the backlash of a bureaucracy in denial and received a glimpse of the intimidation that David Mattson and other biologists have faced to coerce them to follow the script and stop asking questions. I was told that if I wrote

these stories I would lose access. I was told that I should keep my nose out of "personnel" issues. I was told that a certain scientist had branded me an enemy of his agency, with the implication that his staff should not cooperate with me on future stories. Like the whistleblowers in my book who broke the code by publicly questioning the dysfunction of the federal "family," I faced castigation—although I must say that since *Science Under Siege* was published, more people in that family have been calling me with anonymous tips than ever before.

IN A FEW MONTHS, AMERICANS WILL BE ASKED TO REGISTER an unofficial vote. The ballot will have three referenda to consider: (1) Should the Yellowstone grizzly be delisted (taken off the list of federally protected species)? (2) Should the states of Wyoming, Montana, and Idaho—instead of the federal government—be entrusted to look after the welfare of grizzlies? and (3) Should a democratic government be allowed to punish scientists who raise legitimate questions about official government positions on issues?

Citizens will soon be given the opportunity to vote by writing letters to US Secretary of the Interior Bruce Babbitt, as well as one's representatives and senators, when the Fish and Wildlife Service releases its new Grizzly Bear Recovery Plan. This plan will form the basis for the government's decision to remove the Yellowstone grizzly from the federal list of Threatened species. Here are five reasons why I, as a journalist, feel it is incumbent upon the public to scrutinize delisting as proposed by the Interagency Grizzly Bear Committee:

1) How does the IGBC intend to resolve the "grizzly bear paradox"? While no one doubts that numbers of grizzlies have risen since the 1970s and that bears are moving into places they haven't been seen in years, the question is: why? Most conservation biologists and even members of the IGBC paint a grim picture for the Yellowstone grizzly over the long term, as residential subdivisions carve up bear habitat on private land and put more recreational pressure in roadless areas of the National Forests abutting Yellowstone National Park where grizzlies seek seclusion. Traditional land users also see the Endangered Species Act as an impediment to development (logging, mining, oil and natural gas drilling, and livestock grazing) and to sport hunting (some sportsmen have expressed a strong interest in reinstating a grizzly bear hunt). Should the Fish and Wildlife Service move to delist the bear if the animal's short-term prognosis appears favorable but its mid- to long-term outlook appears bleak? Is it worth gambling on the bear's fate by lowering the threshold for habitat protection now and then trying to relist the bear if the grizzly population takes a downturn later?

2) The IGBC estimates somewhere between 400 and 600 grizzlies are now in the Yellowstone region, and thus, the committee reasons, the grizzly should be delisted. (Of course, several prominent conservation biologists say the grizzly's only real hope in the lower 48 is to establish a viable metapopulation of grizzlies, numbering at least 2000 animals and connected through wildland corridors. Some even say that to ensure the Yellowstone population's genetic well being, 2000 grizzlies should be maintained in this ecosystem alone.) At present, there is a high degree of uncertainty not only about what the estimated bear numbers recited by the IGBC mean, but also about the status of secured habitat and natural food sources in the ecosystem. Consider the habitat quotient first. The greater Yellowstone region proportionately has one of the fastest growing human populations in the West with new subdivisions proposed in bear habitat every month. Ski resorts on Forest Service land are expanding, as is pressure from other recreationists, namely off-road vehicle users. There also is pressure to open roadless lands—which provide the highest quality grizzly bear habitat—to logging and mining. Plus, significant numbers of bears continue to die in conflicts with sport hunters.

Add to this the tenuousness of natural food sources. Whitebark pine nuts—a high-nutrition food that many grizzlies seek out in the autumn before their winter slumber—declined in Yellowstone by 25% after the 1988 forest fires. The trees producing these nuts also are threatened by the emergence of an arboreal disease known as blister rust.

In Yellowstone Lake, where dozens of bears gather to feast on spawning cutthroat trout every spring, an expanding population of exotic lake trout, which dwell in deep water and are inaccessible to bears, threatens to decimate cutthroat populations. In the mountains of the Absaroka, army cutworm moths, which gather in high-elevation talus, are vulnerable to pesticide spraying during their migration in the valleys below, and their mountain food source, wildflower nectar, could be affected by climate change due to global warming.

Still another threatened food source is meat. Carcasses of winter-killed bison and elk, which provide an important source of protein for grizzlies just emerging from their dens in the spring, could be reduced. The government currently is considering plans to tightly limit the size of the Yellowstone elk and bison herds to control the possibility of animals infected with the bovine disease brucellosis from coming in contact with cattle herds outside the park. Studies show that Yellowstone grizzlies are among the most meat-dependent bear populations in the world.

According to Mattson, pine nuts, trout, moths, and ungulate meat account for 80–90% of the grizzly's energy needs. What will

the bears do if these food sources plummet? In a *Journal of Wildlife Management* article in 1992, Mattson wrote that in years when the crop of whitebark pine nuts alone has been low, the number of bear fatalities has spiked. Bear researchers know that when concentrated food sources are unavailable, bears will need to roam wider on the landscape—but will they be afforded protection?

Presently, the Forest Service has fiercely resisted efforts to force the agency to comply with legally binding habitat protection, especially in safeguarding roadless areas. Agency officials instead want the discretion to voluntarily apply habitat protection criteria. Further, little has been done to ensure preservation of habitat on private lands other than piecemeal use of conservation easements.

Even the man who oversaw the Yellowstone Interagency Grizzly Bear Study Team for two decades, Richard Knight, has stated his concerns about delisting. "It's too bad that delisting removes all the protection of the Endangered Species Act," Knight was reported as saying in the journal *Yellowstone Science* in late 1997 shortly before he retired. "I can imagine people out there with chain saws and herds of sheep ready to move in when the bear population is delisted, and that scares me. Because I don't know how to protect habitat. We just don't know. You can write some laws, but hell, we couldn't protect the Targhee [National Forest] from widespread clearcutting and roadbuilding in grizzly habitat, even under the Endangered Species Act. You get an administrator who wants to get around a law, and he'll do it."

3) For much of this decade, the Yellowstone subcommittee of the Interagency Grizzly Bear Committee has held numerous meetings, paid for with tax dollars, behind closed doors, with no public announcement, and no record of what was said. The meetings, according to agency officials, were held in "executive session" because of "legal concerns" (i.e., the agencies fear that if the information disclosed in the meetings reaches the public it might be used by conservation organizations to sue the agencies). This rationale not only violates the public's right to know how civil servants manage public agencies, but it also abrogates the spirit of openness central to the function of democracy. To suggest the public is not educated enough to comprehend the management strategy relating to grizzly bears is arrogant and unacceptable.

When biologist Dave Mattson tried to share data collected by the bear study team with outside scientists, his office was raided and he was accused of "stealing" government—that is, public—information. His superiors also sought unsuccessfully to have him censured by professional peers.

The irony of bear managers' decisions to hold closed-door meetings is that it gives the public good reason to be suspicious, and likely encourages the very kind of lawsuits IGBC claims it



is trying to avoid. By shutting out the public, conservation groups often must file Freedom of Information Act (FOIA) requests to find out what rationale was used in the closed-door meetings to reach management decisions. Environmentalists are blamed for being litigious, and the government agencies wash their hands of being labeled clandestine.

4) Since 1975, when the Yellowstone grizzly population was listed as Threatened, tens of millions of tax dollars have been spent running the Interagency Grizzly Bear Committee, yet there has never been significant public oversight of how money is spent or whether the science used to justify management decisions has been sufficiently peer reviewed by outside entities.

The only substantive inquiry into grizzly bear management occurred in 1987, when the Congressional Research Service compiled a report on the Greater Yellowstone Ecosystem and called into question how grizzly bear management had been administered, but there has been no follow-up investigation. As late as 1995, a federal district court judge, who ordered that the latest Grizzly Bear Recovery Plan be rewritten, called the IGBC's methods for counting bears and assessing the quality of bear habitat "arbitrary and capricious."

Independent audits of the financial affairs of the IGBC and its scientific methodology are needed. The charges that some grizzly bear biologists have faced intimidation for dissenting on scientific conclusions also should be thoroughly investigated.

Besides the obvious, why is the lack of oversight a concern? The same body that is funded to study the grizzly devises the research protocols, collects the data, interprets the data, presents the data to the public, and then uses the data as the basis for its public decisions. One could charge that because data is so tightly controlled, and not scrutinized by outside, independent biologists, it could easily be slanted to support predetermined outcomes. Or worse, that research projects could be awarded to those biologists who will produce results favorable to certain points of view held by managers with specific agendas.

The US Office of Management and Budget recently published a memorandum to clarify the mandate of public agencies to make information they gather available for public review. The memo was issued to serve notice upon entities like the IGBC which, critics say, have sought to control and essentially monopolize how information is gathered, used, and disseminated:

Federal agencies are often the sole suppliers of the information they hold. The agencies have either created or collected the information using public funds, usually in furtherance of unique governmental functions, and no one else has it. Hence agencies need to take care that their behavior does not inappropriately constrain public access to government information....Agencies should not attempt to exert control over the secondary uses of their information....In particular, agencies should not establish exclusive, restricted, or other distribution arrangements which interfere with timely and equitable availability of information dissemination products. Statutes such as FOIA and the government in the Sunshine Act establish a broad and general obligation on the part of federal agencies to make government information available to the public and to avoid erecting barriers that impede public access.

A growing and vocal group of independent scientists and conservationists believe that Interior Secretary Babbitt should call upon the Congressional Research Service, the General Accounting Office, and the National Academy of Sciences to conduct an independent review of the government's administration of science pertaining to grizzlies, and investigate alleged abuses of government grizzly bear scientists.

5) The IGBC has demonstrated a clear lack of tolerance for biologists who dissent from the agency status quo. Dissent is a fundamental part of science; without it, we might still think the Earth was flat.

For questioning the assertions that today's higher bear numbers mean the grizzly should be delisted, David Mattson has endured continual threats of censure and isolation, not to mention insinuations that unless he stops answering questions about grizzly bear biology in the press, his government career as a researcher will be destroyed. The hallmark of dialectical science, after all, is subjecting a hypothesis to intense scrutiny. The fundamental issue is: Should a scientist be afraid to question the decisions of superiors when those questions might lead, in the long run, to better results?

At present, there are several biologists who say "off the record" that they disagree with the aggressive stand taken by the Fish and Wildlife Service to delist the grizzly, but they are afraid to dissent for fear of having their reputations or possibilities for career advancement jeopardized. An environment of repression, where civil servants are afraid to speak the truth, has never produced good results for wildlife or people. This must change.

UNTIL INTERIOR SECRETARY BRUCE BABBITT AND Agriculture Secretary Dan Glickman commit themselves to addressing these issues—and resolving the important civil service questions—the American people have good reason to be skeptical about delisting the Yellowstone grizzly. For me, one thing is certain: never again will this journalist simply report on the grizzly bear in blind faith or shy away from asking tough questions just because they make federal managers uncomfortable. I will look deeper, hold them accountable, and so should you. ☾

Todd Wilkinson lives in Bozeman, Montana and is author of the recent book, Science Under Siege: The Politicians' War on Nature and Truth (Johnson Books, 1998).

Wolves for Oregon: MYTHS and

The gray or timber wolf (*Canis lupus*) is native to Oregon and historically ranged throughout the state. Predator control efforts succeeded in extirpating wolf populations by the 1930s. Although there have been a number of “wolf sightings” and other evidence suggesting the species’ movement into the state during recent years, the only documented case was a dispersing individual that migrated from Idaho to Oregon during the winter of 1998–99. The wolf, a young female, took up residency in eastern Oregon’s Blue Mountains and had been successfully hunting elk and other native species when she was captured by the US Fish and Wildlife Service and forcibly deported to Idaho in March of 1999.

Prior to her capture, there was considerable debate over whether Oregon had sufficient suitable habitat to support recolonizing wolves. Some Oregonians had opined that the state could not support wolves for a variety of geographical, biological, and political reasons. I believe these opinions were based on flawed assumptions. There is ample reason to believe that sufficient habitat exists to sustain viable wolf populations, most likely in the Blue Mountains, Southern Cascades, Siskiyou, and some parts of southeastern Oregon.

Undoubtedly, as wolf populations rebound in Montana and Idaho, additional wolves will move into Oregon. Conservationists who welcome the return of these native top carnivores should be ready to rebut the common arguments heard against Oregon wolf recovery. It may be helpful to consider recent events in other states where wolves are recolonizing parts of their former ranges; a comparison with Montana, in particular, is useful for responding to wolf recovery opponents.

MYTH: Oregon has too many people to support wolves. A frequent refrain heard from wolf opponents is that Oregon “has too many people,” and that only lightly populated states like Montana or Idaho can reasonably be expected to support wolves. In fact, Minnesota, Michigan, and Wisconsin—all with much higher human populations than Oregon—already have viable and growing wolf populations.

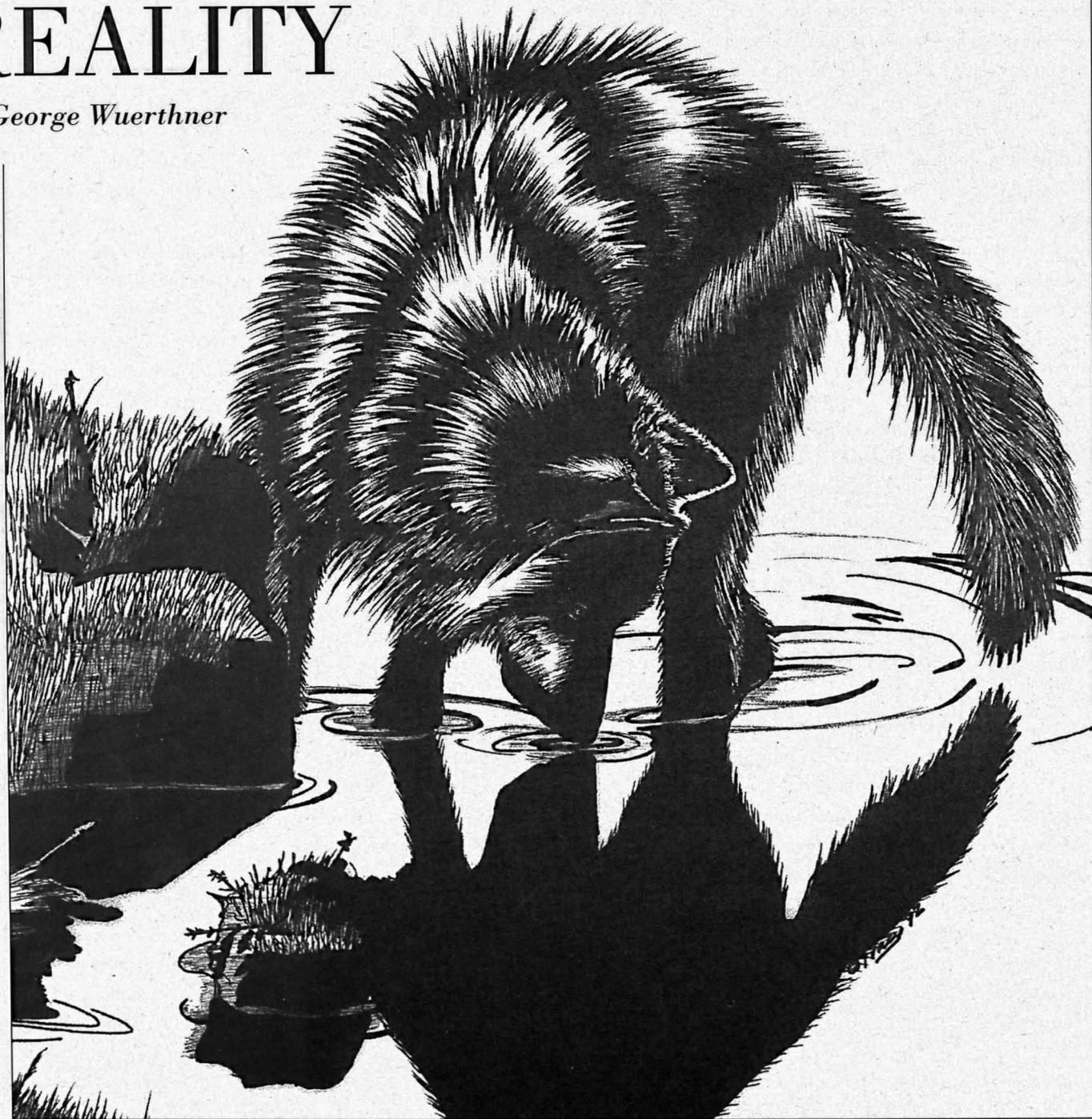
Critiques based on human population density usually fail to account for population distribution. Most Oregon residents are concentrated in the Willamette Valley, with 70% of the total population living in Eugene, Portland, Salem, and other valley urban centers. Much of the state is very sparsely settled, including the regions most likely for initial wolf recolonization.

For perspective, let’s look at the Montana counties with the largest wolf populations: Missoula, Gallatin, Lake, Flathead, and Ravalli are all among the fastest growing counties with the highest current human population densities in the state, yet they support wolves right now. In general, the population density of Montana’s “wolf counties” is far higher than the Oregon counties where wolf restoration efforts would be focused. For example, Missoula County has 30.3 people per square mile, Gallatin 20.1, Lake 17.0, Flathead 11.6, and Ravalli 10.4. Compare these densities with Oregon counties likely to support wolves: Wallowa County contains 2.2 people per square mile, Union 11.6, Baker 5.0, Crook 4.7, and Grant 1.7.

The three counties that make up most of southeast Oregon—Malheur, Lake, and Harney—have population densities, respectively, of 2.6, 0.9, and 0.7 people per square mile. Even the southern Cascades are lightly populated. Deschutes County, which contains the town of Bend, has only 24.1 people per square mile; Klamath County, 9.7. Clearly, much of Oregon is lightly populated, leaving plenty of “unpeopled” habitat.

REALITY

by George Wuerthner



MYTH: *Oregon doesn't have enough public land to support wolves.* Both in total acreage as well as percentage, Oregon actually has more public land than Montana; more than 56% of Oregon (32 million acres) is in public holdings compared to Montana's 30% (29 million acres). Furthermore, on the whole, Oregon's public land base contains more productive, lower-elevation habitats able to sustain prey animals on a year-round basis than does Montana's.

MYTH: *Oregon doesn't have enough Wilderness to support wolves.* Wilderness designation, while relevant to successful wolf restoration (large protected areas can serve as ecological refugia and reduce opportunities for human persecution of sensitive species), doesn't necessarily provide for all wolf habitat needs. The most important criterion for wolf viability is availability of prey—and many Wilderness Areas provide little year-round big game habitat. Typically, past Wilderness design-

nations represented political compromises that excluded most lower-elevation lands where resource extraction was concentrated, and protected mostly scenic "rocks and ice."

Due to these past compromises, a significant percentage of all three current Northern Rockies wolf recovery areas—Northwest Montana (Glacier-Bob Marshall), Greater Yellowstone, and Central Idaho—is high-elevation terrain, which is only marginally useful to wolves. For instance, the million-acre Absaroka Beartooth (AB) Wilderness is part of the 64,000-square-kilometer Greater Yellowstone Ecosystem recovery area, yet this is one of the most mountainous regions in the lower 48 states. More than half of the AB Wilderness is alpine tundra—habitat not typically accessible to wolves most of the year. Only a fraction of this million-acre Wilderness is suitable for effective wolf occupation and use.

Unfortunately, the Montana, Yellowstone, and Idaho recovery areas selected by the FWS were largely based on political—not biological—considerations. The two primary criteria were a lack of livestock production and roadless character. (This decision to give little emphasis to other components of habitat suitability is one reason why some wolf opponents feel betrayed; they were led to believe that wolves would stay in "Wilderness.") In northwest Montana, almost none of the existing wolf packs live exclusively in a park or Wilderness. The majority of their territories lies outside of formally protected landscapes and consists of foothills and valley bottoms.

MYTH: Oregon doesn't have enough prey to support wolves. Prey populations vary from year to year. Presently, however, Oregon has approximately 115,000 elk and 650,000 deer, a sufficient number to support dozens of wolf packs. Although a third larger than Oregon, Montana has only 150,000 elk and less than 750,000 deer. On a per-acre basis, prey density is higher in Oregon than Montana.

MYTH: Most of Oregon has too many logging roads and other development to support wolves. Wolves don't necessarily avoid roaded terrain; rather, they pick habitat based upon prey availability. Not surprisingly, since much of the lower-elevation terrain in Montana is roaded, the actual habitat used by wolves has much higher road densities than is considered "ideal" for wolf recovery. In other words, while the designated recovery areas have significant roadless terrain, wolves don't necessarily use much of it. Road densities, while not meaningless to the success of wolf restoration initiatives, may be less significant than many have been led to believe. Obviously, the best wolf habitat includes both prey and a lack of roaded access, but,

in fact, there is very little overlap between these habitat factors in northwest Montana.

Much of Montana's currently occupied wolf habitat is heavily laced with roads—not significantly different than Oregon's potential wolf habitat. There are four wolf packs now established within fifty miles of Missoula, all with territories that have high road densities due to past logging activity. A wolf pack has successfully resided in the Nine-Mile Valley for ten years, a heavily logged area with subdivisions and ranchettes less than ten miles from Missoula. Road density of key wolf habitat in the Nine-Mile Valley is more than 3.9 miles per square mile, considerably higher than the 0.5 mile of road per square mile figure typically used as a selection factor in determining of suitable wolf habitat. Nevertheless, wolf recovery in both Montana and Oregon could be significantly enhanced by road closures to provide greater security to wolves.

MYTH: Wolves will devastate Oregon's livestock industry. In Montana, the total livestock industry losses reported annually between 1986 and 1991 to all causes has been 142,000 sheep and 86,000 cattle. Of this number, dogs account for 1000–1500 a year; the annual average losses attributed to wolves between 1987 and 1997 has been 6–10 animals.

Losses in Oregon are likely to be even fewer since Montana has more livestock (2.7 million cattle; 430,000 sheep) than Oregon (1.5 million cattle; 230,000 sheep). Even in Minnesota, which is home to more than 2400 wolves, annual livestock losses to wolves number in the low hundreds, typically less than 300 animals a year. Clearly, wolves are not a threat to the livestock industry.

REALITY: As top predators, wolves are vital to maintaining healthy ecosystems and should be reestablished in as much of their native range as possible. Oregon has plenty of potential wolf habitat and could easily support viable populations of *Canis lupus*. Natural recolonization of the state is bound to occur. Rather than discourage this recolonization by capturing and exporting wolves, the US Fish and Wildlife Service should encourage their recovery by fully protecting all dispersing wolves, as well as work with state agencies and the public to design and implement a recovery plan that will return these native canids to their rightful place in Oregon. ☪

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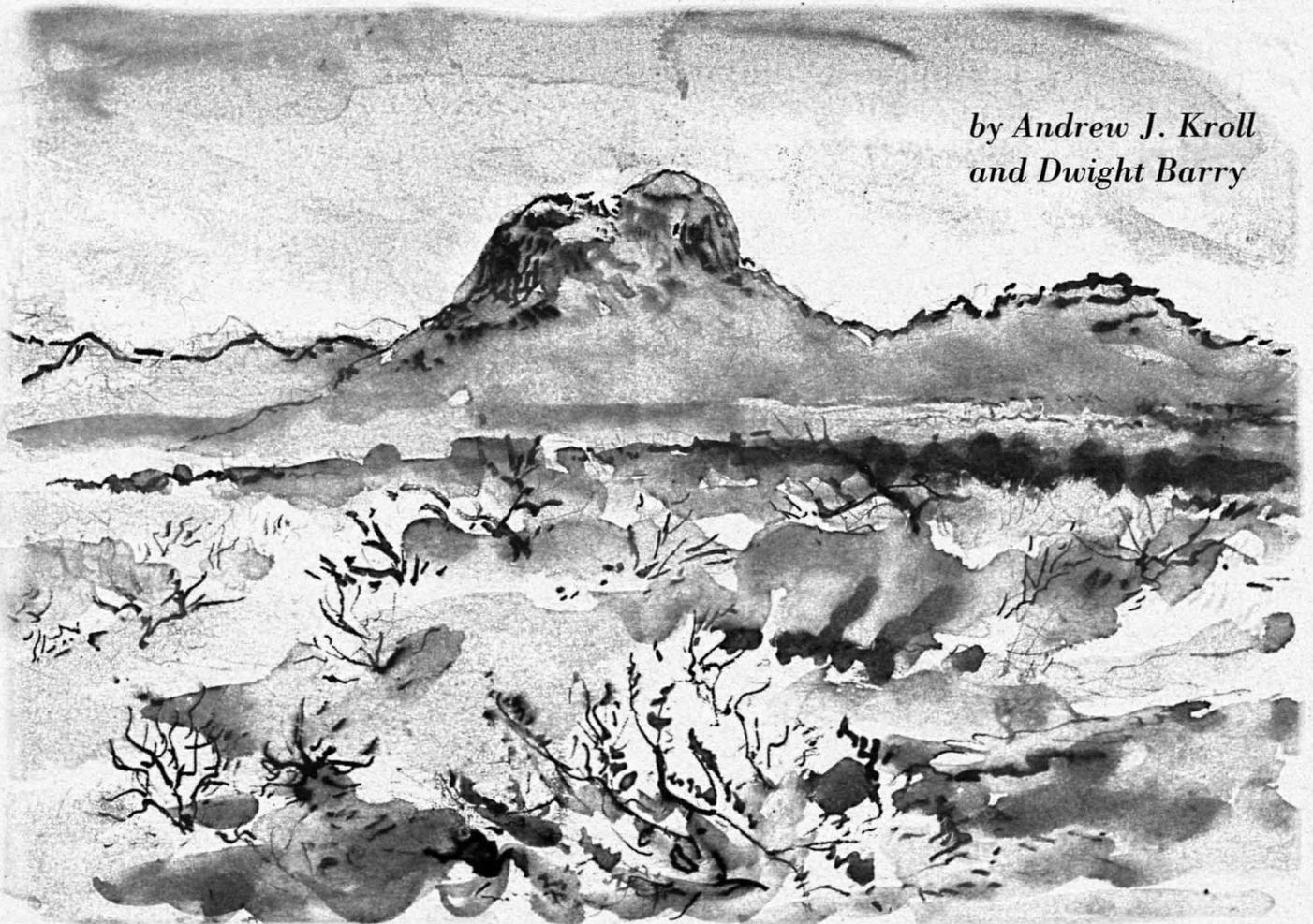
The western third of Texas presents an array of challenges to conservationists. A vast, varied landscape, with a relatively thinly settled human population, the Trans-Pecos and High Plains sections of the Lone Star State represent the last best opportunity to restore extensive, biotically intact ecosystems in our nation's second largest and most ecologically diverse state. If continental-scale plans to protect biodiversity (Soulé and Terborgh 1999) are to succeed, they will need to incorporate wildland reserve systems in Texas.

Unfortunately, only a minute portion of the state is protected in federal and state holdings; in many ways, Texas is a stronghold for the idea of private property and its importance in American democracy. To gain support, conservation plans for west Texas must incorporate the lifestyles and economic needs of local residents, even to the extent that some practices that are decided flashpoints for conservationists, such as cattle grazing (Wuerthner 1998), should be included as formulative elements. We propose here some ideas for a conservation plan that will preserve the human and natural communities of west Texas.

Carnivores in the Caprock

Rewilding the High Plains of Texas

*by Andrew J. Kroll
and Dwight Barry*



The scale of planning in the Caprock must be large enough to include not only self-maintaining populations of bison, elk, and antelope, but also their large predators such as mountain lions and—in the future—wolves.



The Land

Within the broad expanse of west Texas is one of the most biologically and culturally rich regions of the state—the Llano Estacado, the infamous Staked Plains. To the thousands of drivers who hurtle back and forth across the interstate highways, the High Plains of west Texas and eastern New Mexico are a stunning monotony, a vast inland ocean broken only by grain silos, feedlots, and bleak small towns harboring tired cafés and dusty gas stations. Hidden within the insulating patchwork of cotton, wheat, and pasture, however, is a spectacular band of canyons and creeks and prairie, a stretch of country largely unprotected and virtually unknown outside of Texas: the Caprock Escarpment.

Recognized by some as an ecological subregion (the so-called Escarpment Breaks), the Caprock is a multilayered panoply of eroding battlements, badlands and mesas, treacherous rimrock, and steep canyon walls that reveal over 300 million years of history, through six major geologic periods. The lovely vistas and canyons of the Caprock are suggestive of landscapes farther west; it was here that Georgia O'Keefe first realized the remarkable vision that came to define her art. The area's scenic beauty and the geologic history exposed within the canyons were stunning enough to warrant consideration for the establishment of a one-million-acre National Park in the 1930s; unfortunately, the park was never created. (The Park Service decided that after

establishing Grand Canyon, a Caprock Canyons Park would be mere window dressing.) Fortunately, the forbidding topography of the Caprock, paired with the severe regional climate, has allowed a wild character to survive in the canyons while the surrounding plains were settled and cultivated.

The great incision of the Caprock creates an island of diversity encompassed by a sea of grasslands; like the Wichita Mountains to the northeast, the species present in the Caprock signal the end of the East and the beginning of the Southwest (Kroll and Barry 1998). Tufted Titmice and Red-bellied Woodpeckers mingle with Cactus Wrens and Scaled Quail, while Roadrunners chase down Texas horned lizards; the cacti, yucca, and swatches of black grama are precursors of the Chihuahuan Desert lying to the southwest in the Trans-Pecos. In the isolated sanctuary of these canyons, the hiker or horse-packer may discover Bald and Golden Eagles (the latter an infrequent nester), mule and white-tailed deer, Turkey, bobcat, coyote, and aoudad, an exotic goat imported from the Middle East in the 1950s. Pronghorn antelope roam the plains west of the Caprock, although in numbers greatly reduced from historic populations.

The remote stretches of canyon continue to sustain riparian areas that are vital to wildlife populations in this semi-arid region. Perennial creeks and streams are graced by stands of plains cottonwood and plains black willow; springs and seeps

are frequently encountered, although they are greatly reduced in number and flow as a result of the relentless groundwater mining for irrigation, wells, and stock tanks. The more extensive historical occurrence of riparian vegetation, such as cottonwood/willow associations, plum thickets, and Rocky Mountain junipers, indicates that in earlier times, healthier watersheds maintained area streams at higher rates of flow for longer durations (Flores 1990).

Lying along the eastern edge of the Staked Plains, the Caprock was once a heartland for the Comanche, who, newly horseback, began to drive out the resident Apache in the 18th century. Traders called Comancheros, riding east from the Hispanic settlements and pueblos in the Rio Grande Valley of New Mexico, conducted a lively commerce with the "Lords of the South Plains," bartering trade goods for buffalo hides, meat, and the captives the Comanche carried off during their frequent raids. In the late 1800s, the then-mythic Palo Duro Canyon was a final sanctuary for the Comanche, and the site of a major battle in 1874 when over a thousand Indian horses were slaughtered by the US Cavalry to deprive the tribes of their mobility. By 1880, the bands of Comanche and their Kiowa allies were driven onto reservations north of the Red River in Oklahoma; today, there is no longer a Native American presence in the Caprock.

A Different Direction for the Southern Plains

Texans are notoriously independent and obstinate; these qualities have not been diluted on the High Plains where, unlike most of the urbanized regions of Texas, the locals really are local. Their roots reach deep into the historical past, when the barbed wire was first strung and the land put under the plow. They are grounded in their place, and while one may question their beliefs and actions, their commitment to staying on the land must be respected. A conservation plan that will work in west Texas, that is both ecologically and economically viable, will require a foundation in the local conception of a "working landscape."

Although the economic benefits of protecting wildlands and large predators have been documented (Noss et al. 1996), one cannot expect a rural, agrarian culture to accept readily an outside presence such as a government agency or conservation group, no matter how benign or well intended, into their lives. To marginalize locals, whether by design or ignorance, is a disastrous move. Conservation plans, however well researched, documented, and funded, that attempt to reorient human economies have practically no chance of realizing lasting success without local support (Kroll and Barry 1997).

To gauge the interest of local landowners in a proposed reserve system, a simple survey could be distributed that seeks information about lifestyles, economic status, and willingness to participate in efforts to maintain open space, restore wildlife populations, and build a sustainable economy around land protection. In this survey, one might present economic incentives: direct economic aid, income from hunting leases, jobs from ecological restoration efforts and staff positions at new state parks and proposed reserves, and lower taxes when landowners put a conservation easement on their property. Community profiles can be developed from such a survey and through informal interviews with the friendly local residents, who are often willing to talk about any subject (particularly the weather) at a moment's notice (Kroll and Barry 1997). Town meetings should be held, encouraging neighbors to discuss in a public forum the plan's potential beneficial or harmful effects on the economic and societal values of their communities.

In addition, a regional reserve system could serve as a "grass bank" for local cattle ranchers. Ranchers who had sold or donated a conservation easement on their lands would be eligible to graze a portion of their herd on public lands during drought periods in order to minimize losses. An intriguing precedent for this program is occurring in southeastern Arizona, where, in a similar ecological context, the Malpai Borderlands Group is working to preserve open space, maintain populations of endangered species, and earn a living from grazing operations. With assistance from the federal government, which manages grazing leases in the area, as well as landholders with more productive lands, ranchers have struck a balance between the seemingly disparate needs of human and natural communities. Utilizing conservation easements and cooperative management practices, residents appear to have developed methods that will enable them to live on the land while maintaining its ecological health.

When one considers the mercurial cattle and cotton markets, both of which are pillars of the west Texas economy, the idea of a regional conservation reserve may not be as unlikely as it seems: this area faces the consolidation of livestock operations by conglomerates such as Cargill, dire future climatic forecasts, the specter of widespread pesticide and herbicide application, the well-documented drawdown in the Ogallala Aquifer, and the general cultural and environmental deterioration of the Southern Plains. A reserve proposal that is closely suited to the sensibilities of the region would provide a way for people to remain on their land, maintain a traditional lifestyle (if reduced in extent), and help fight the population attrition that has undermined small communities across the Great Plains.

Rewilding the Southern Plains— Cores, Connectivity, and Carnivores

Conservation planning in the West is often aided by the presence of federal holdings that may serve as the backbone of a proposed reserve network. This approach is confounded in Texas, where the paucity of public land is reflected in the state's representation in the National Wilderness Preservation System: Texas has only 85,300 acres of designated Wilderness. By way of comparison, California, a far smaller state in total area yet possessing a greater human population, has nearly 14 million acres of protected Wilderness.

The only significant refugia in the Caprock are Palo Duro and Caprock Canyons State Parks, neither of which is big enough (16,500 and 14,000 acres respectively) to alone sustain populations of large vertebrates. As the foundation for the reserve, we propose a series of core areas in the major canyons—Palo Duro, North and South Prong, Tule, Mulberry, Quitaque, Blanco, Los Lingos, Double Mountain Fork, and Yellow House. These canyons could be connected to one another through a series of protected corridors along the major stream courses (Prairie Dog Town, North, and Salt Forks of the Red, the Little Red, the Pease, the headwaters of the Brazos and the Colorado), as well as by strips of grassland between the canyon mouths. These landscape linkages could be composed of both public and private land, managed jointly for the benefit of local economies and regional ecological health.

An important aspect of rewilding is the reintroduction or augmentation of predator populations (Soulé and Noss 1998). The scale of planning in the Caprock must be large enough to include not only self-maintaining populations of bison, elk, and antelope, but also their large predators such as mountain lions and—in the future—wolves. Black bears were once common in the Caprock (the presence of grizzlies is of some debate, most of it moot as we hardly have a surplus of grizzlies available for shipment to Texas), although the generally drier nature of the canyon bottoms and the disappearance of such crucial resources as the plum thickets does not bode well for their restoration. Lions seem to be recovering from decades of predator control, benefiting from the healthy populations of deer and aoudad, but are infrequent predators of bison. Although the mere mention of wolves in Texas can draw shouts of outrage and haphazard gunfire, they were the main nonhuman predator on plains bison herds (Flores 1991) and thus should be included in conservation plans. The restoration of wolves will be, by necessity, a long-term objective of the project (for an account of wolves in west Texas, see Brown 1983).

Current land-use practices impede the recovery of ecological health in the Caprock: Palo Duro State Park has no bison and cattle (over)grazing continues; Caprock Canyons has only a token herd of twenty bison. The Prairie Dog Town Fork of the Red River (which sculpted the main canyon at Palo Duro) is manipulated by an upstream reservoir that maintains low flow rates and reduces ecologically beneficial flooding. Although prescribed burns are conducted at Palo Duro, their extent and effectiveness are questionable, and controlled burns in semi-arid systems may not necessarily mimic natural fires (Schmutz et al. 1985). Equally troubling are the industrial tourism eyesores in Palo Duro; a summer theater-in-the-round, a general store, and a trail-riding stable all play into the kitschy myths of the Hollywood western.

Recommendations

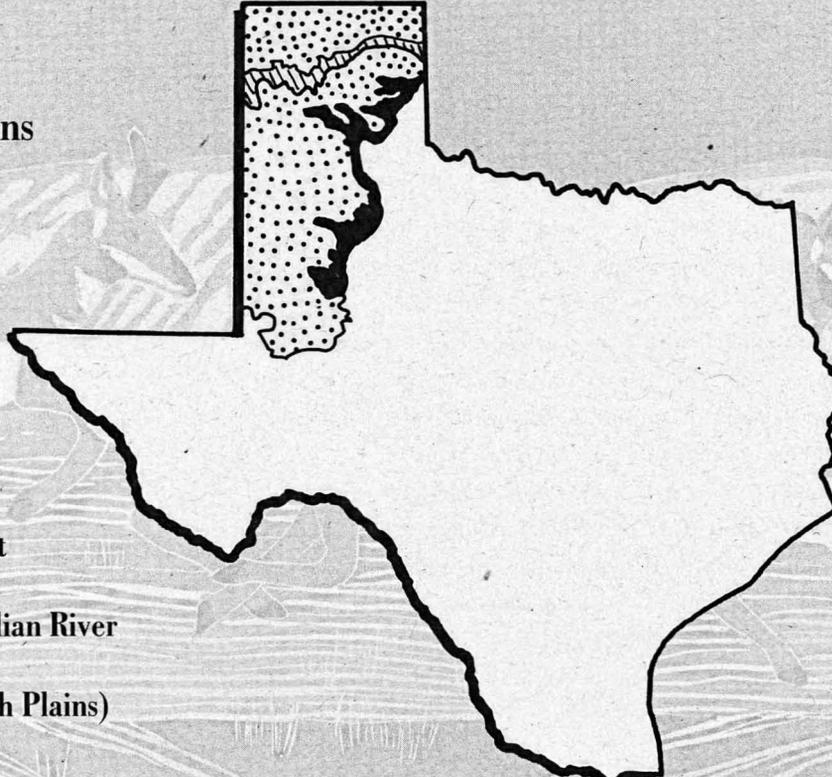
Revising management practices to incorporate this vision will take time and effort, but the seeds of change already exist. To begin, a regional management plan should be developed that:

- 1) focuses on the restoration of natural disturbance regimes (such as wildfires and flooding) (Brinson et al. 1981, Gosz and Gosz 1996);
- 2) allows for natural fluctuations in pronghorn, bison, and elk populations (Shaw and Lee 1997);
- 3) acknowledges the keystone roles of bison (Cid 1991, Hobbs 1996) and smaller vertebrates such as prairie dogs and pocket gophers (Weltzin et al. 1997, Whicker and Detling 1993, Parméter 1997) in the function and trophic structure of short-grass and semi-arid grassland ecosystems (Flores 1991, Miller 1991); and
- 4) provides the spatiotemporal scale necessary to sustain populations of larger carnivores (Soulé and Noss 1998).

This plan should be general enough for application to the entire Caprock and eastern Llanos to provide continuity and ease in management.

Bison herds can be regulated, at first, through hunting and public auction, which can raise funds for land acquisition and bolster the regional economy (local residents could establish guide services for elk and bison hunts). In time, larger herds and the establishment of a reserve system should provide an environment in which the inevitable conflict between wolves and domestic livestock will be minimized. The hunting of bison, elk, and antelope should continue, but be restricted to guided back-country hunts in core and buffer zones, not canned road shoots.

West Texas Bioregions

- 
- Caprock Escarpment
 - Breaks of the Canadian River
 - Llano Estacado (High Plains)

No roads, no pickups: just guns and horses. People will pay top dollar for this experience, providing another source of income to local people.

Grazing by domestic cattle might be allowed to encourage local cooperation, but with the stipulation that stocking rates would be set by a range biologist and are secondary to the maintenance of bison, antelope, and elk herds; however, the eventual elimination of domestic livestock in favor of native grazers should be a component of the conservation plan. In core areas and connecting corridors, domestic livestock should be removed immediately, while buffer areas can remain in grazing leases for the lifetime of the present owner. The “grass bank” idea may help this process; besides offering public lands as a form of grazing insurance, larger ranches that do not stock at full capacity might also be willing to provide lands to the grass bank.

The conservation plan will utilize private ranches close to the core preserves to provide a continuum of habitats from the plains into the canyons for such animals as pronghorns and swift foxes. The mesas extending out between the larger canyons should be targets for public ownership; fee acquisition would be preferable, but at the least, conservation easements that maintain these lands in native grasses should be secured. This part of the process may be facilitated through the involvement of a

land trust that could purchase available ranchlands and anchor the private lands portion of the reserve. (As of November 1998, the historic, 40,000-acre JA Ranch near Palo Duro State Park was for sale. The Nature Conservancy [TNC] has already purchased a sizeable ranch in the Davis Mountains; perhaps TNC would be willing to strengthen its involvement in Texas by adding a holding in the Caprock.)

In addition, we suggest the establishment of a state wilderness system that would provide financial benefits in the form of yearly payments to landowners who participate in the program. The canyons, foremost Tule, could be targeted for public acquisition and managed by Texas Parks and Wildlife for ecological, wildlife, and recreational values. When possible, the riparian corridors also should be brought into the public domain. Where public land acquisition is not possible, the participation of local landowners could be encouraged by offering subsidies for those who place protective conservation easements on their land (such as the Forever Wild Easement idea presented by Smith; see fall 1997 *WE*), “retire” land through the Conservation Reserve Program, or actively participate in ecological restoration by “raising” native grasslands.

These payments could come from state agricultural subsidies and farm programs, would be adjusted yearly for inflation, and might be viewed as another type of agriculture—namely,

raising wildlife. Landowners who commit entire holdings to this program should receive a permanent easement for housing and other uses. In addition, watershed protection will be presented as an ecosystem service provided by the proposed reserve that reduces the need for expensive reservoirs and impoundments and that helps ease the chronic, often disastrous, flooding in Texas. In conjunction with the establishment of reserves along the Caprock, Lakes Tanglewood and Mackenzie, reservoirs lying upstream of the main canyons, should be drained to help restore the hydrologic regime in these core areas.

Finally, following Flores' (1990) suggestion, we propose that Native Americans participate in the reserve program, which might involve demonstrations of traditional cultural practices at such places as Palo Duro or Caprock Canyons (either of which could be designated a state historic park that educates visitors on the history of the Great Plains) or designating a coalition of tribes to serve as managers and cultural stewards of a preserve. This latter option might follow the Sinkyone Tribal Park (Glass 1993), which provides a "teaching" landscape for traditional tribal practices. A yearly portion of the buffalo herd might also be allotted to the participating tribes (Crum 1997) or tribes could become directly involved in the "bison economy" to be developed in the region (Chadwick 1998). The restoration of an active Native American presence in the Caprock and a park that celebrates the once-vibrant commingling of bison and native peoples on the South Plains (*Plains Anthropologist* 1997, Flores 1990) would complement regional ecological recovery efforts.

Conclusion

The decision not to establish a National Park in the Staked Plains was one of the great missed opportunities in American conservation history. However, innovative regional planning and a willingness to redirect subsidies could allow for the future establishment of that park, if in a somewhat altered form. A state and federal wilderness system could reach across west Texas, from the Breaks of the Canadian River to the Big Bend of the Rio Grande, and anchor an archipelago of reserves designed to restore wildness, protect biodiversity, secure landscape connectivity, and join with continent-spanning reserves. The area's enduring paleontological, geological, biological, and cultural values, as well as the stage it provided for some of our nation's most stirring historical moments, make it worthy of a detailed plan that involves local landowners, tribal nations, federal agencies, and conservation organizations committed to preserving the Caprock for future generations. ☪

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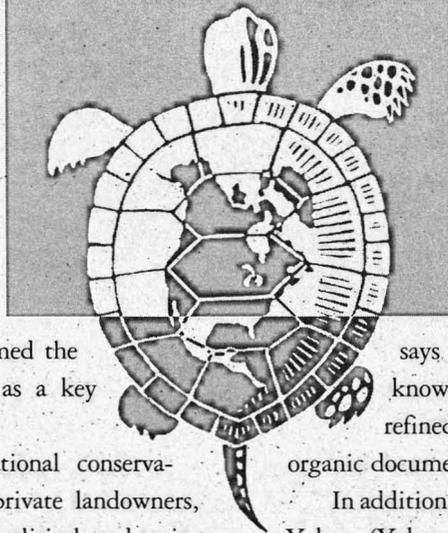
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The Wildlands Project

Update

BY KIM VACARIU



Although the primary focus of The Wildlands Project (TWP) continues to be moving its first regional reserve designs through expert scientific review, the challenge of implementation has also been receiving much attention as an integral part of the conservation planning process. The implementation discussion reached a milestone this past February when TWP hosted an Implementation Workshop. The gathering provided valuable insights regarding on-the-ground creation and protection of reserve systems, and confirmed the necessity of addressing implementation as a key component in reserve design proposals.

Workshop participants—45 international conservationists, land-use planners, economists, private landowners, and social scientists—discussed the legal, political, and socioeconomic challenges associated with physical implementation of large-scale nature reserves. Educational and media outreach, cooperation with federal and state land management agencies, direct work with private landowners and communities, and economic incentives for protecting private lands were examined during the two-day gathering.

The general implementation steps identified at the workshop—which used the Sky Islands/ Greater Gila Nature Reserve Network proposal as a working model—represent a wealth of data that wildlands advocates will find helpful in developing implementation strategies tailored to specific regions and projects. Workshop discussions also helped identify a basic framework for analyzing the economic, social, and political status of each region prior to designing a working implementation plan.

As information and expertise grow, implementation concerns will become better integrated into each reserve design proposal. Formal implementation sections will be included in the Sky Islands/ Greater Gila Nature Reserve Network and the Yukon Protected Areas Strategy reserve proposals, expected to be released to the public later this year. Inclusion of an implementation strategy in these documents, and in other proposals soon to be ready for public release, will reinforce the relationship between ecological reserve planning and on-the-ground habitat protection.

The wildlands conservation plans to be released in 1999 will also showcase the first reserve design proposals to complete expert scientific review. However, even as proposals reach

this initial “completion” phase, they remain essentially works-in-progress; reserve design and implementation strategies must have built-in flexibility to allow for the evolving nature of our ecological understanding as well as the dynamic status of a region’s socioeconomic and political character.

TWP Science Director Michael Soulé notes that even as proposals pass expert review and receive public comment, they cannot be considered final. “These plans will never be completed,” says Soulé. “They will always be changing as knowledge increases, and will continually be refined to reflect new situations. They are truly organic documents.”

In addition to the Sky Islands (Sky Islands Alliance) and Yukon (Yukon Wildlands) proposals, other conservation plans expected to move through expert scientific and social review and enter the public comment phase this year are Klamath-Siskiyou (Klamath-Siskiyou Alliance), Maine (Greater Laurentian Wildlands Project), and Southern Rockies (Southern Rockies Ecosystem Project). ❧

Kim Vacariu is communications/outreach director of The Wildlands Project.

“Conservation Planning: From Sites to Systems”

The Wildlands Project and *Wild Earth* will cohost the 1999 Natural Areas Association Conference from October 12–16 in Tucson, Arizona. Symposia, plenary sessions, keynotes, and workshops will focus on planning for natural areas, from site-based planning to reserve design for integrated networks of conservation lands. Sessions on compatible use, ecoregional planning, focal species, carnivore reintroduction, transboundary initiatives, connectivity, and invasive species, as well as topics relating to the Southwest, will be offered. Field trips will give participants the opportunity to explore the surrounding Sonoran desert and mountainous Sky Islands. For further information, contact the local host, The Wildlands Project, at 1955 West Grant Rd. #145, Tucson, AZ 85745; 520-884-0875; fax 520-884-0962; confreg@twp.org; www.twp.org.



**John Terborgh, James Estes, Paul Paquet,
Katherine Ralls, Diane Boyd-Heger,
Brian Miller, and Reed Noss**

The Role of Top Carnivores in Regulating Terrestrial Ecosystems

Abstract

Top predators are often essential to the integrity of ecological communities. Widespread elimination of top predators from terrestrial ecosystems has disrupted the feedback process through which predators and prey mutually regulate each other's numbers. While it appears that ecosystems are simultaneously regulated from both the bottom and top of the food web, significant evidence points to strong top-down forces. The "Paine effect" provides an empirical foundation, which, along with other experimental and anecdotal evidence, illustrates top-down influence: with the removal of top predators, mesopredators, herbivores, and other consumers may become overabundant, leading to profound disruptions in vegetative communities, and declines in bird and small mammal populations. Ultimately, the loss of top carnivores from their native ranges may cause a cascade of ecological effects that speeds extinction. Conservationists and land managers working to create reserve networks should recognize the keystone role of top predators in regulating ecosystems and maintaining native biodiversity.



THE VAST MAJORITY OF SPECIES inhabiting the Earth today have existed for more than a million years (Stanley 1987, May et al. 1995). Significantly, the last million years have been, climatically, among the most turbulent of the last 500 million years, with major and often abrupt changes in mean temperature, rainfall, glaciation, sea level, and extent of sea ice (Pielou 1991). Notwithstanding the extraordinary climatic instability of the recent past, extinction rates have not been particularly high (Coope 1995). In the absence of human beings, therefore, most plant and animal species are remarkably resilient to natural environmental instabilities of the kinds that prevailed during the Pleistocene era. How can we account for wild species' resilience to extinction? If we knew the answer, it would be of immeasurable help in reducing the rate of extinction in our own time. Extinction rates are acknowledged to be hundreds or thousands of times higher today than they were in the prehuman past (Wilson 1992, May et al. 1995, Ehrlich 1995). Scores of studies have asked why a particular species or population went extinct or became endangered. In some cases—as in the overharvest of the dodo and great auk (Diamond 1982)—the cause is obvious. But in many others, it is hard to distinguish proximate from ultimate causes (Caughley 1994).

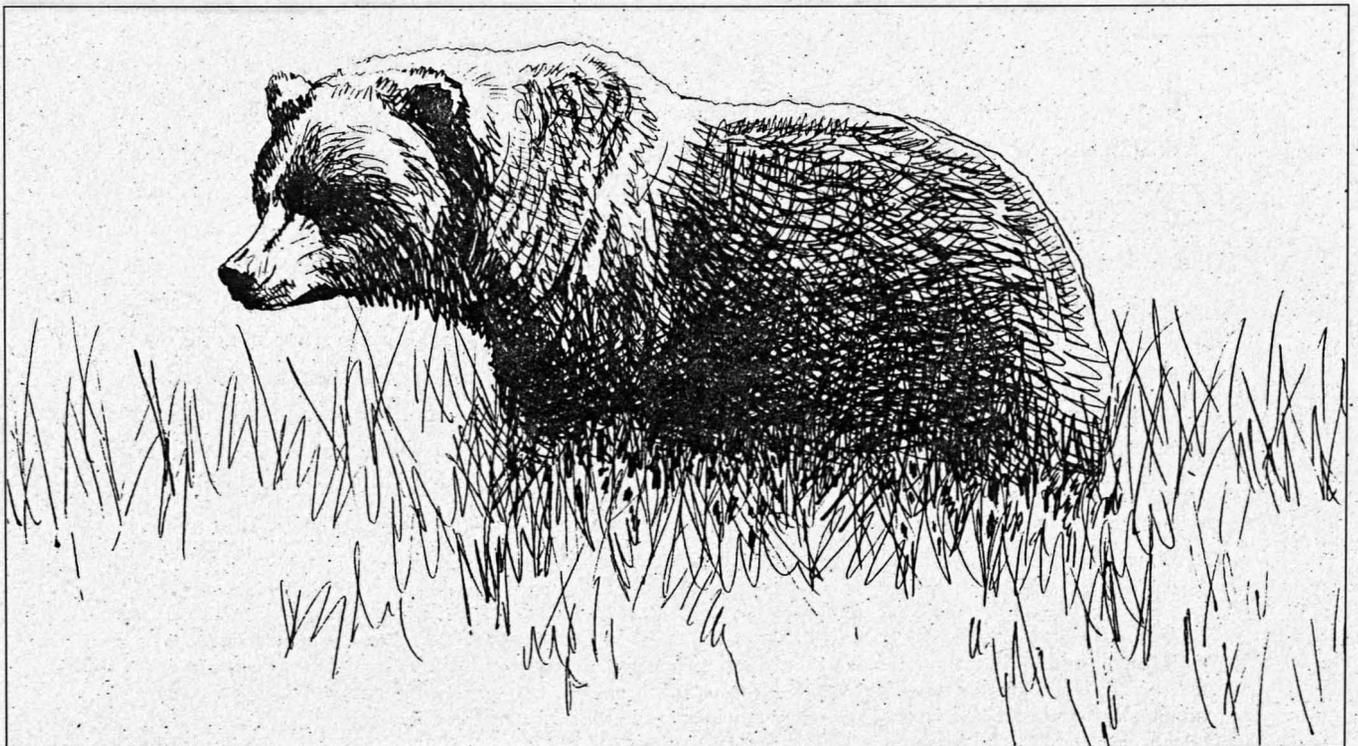
This article appears as chapter 3 in *Continental Conservation: Scientific Foundations of Regional Reserve Networks*, edited by John Terborgh and Michael Soulé, and is reprinted with permission. Recently published by Island Press, this book is the result of a workshop hosted by The Wildlands Project that brought together many of the country's leading conservation biologists to examine the science underlying the design and management of regional-scale reserve networks. Order from Island Press (please quote "Dept. WE") at 800-828-1302; fax 707-983-6414; or visit www.islandpress.org.

Both physical and biological processes are important in preserving biodiversity. An appropriate disturbance regime, for example, is considered essential to maintaining diversity in plant communities (Connell 1978). In a variant on the same theme, natural grasslands often depend on herbivores for opening sites that help plants colonize, but today livestock have widely replaced native herbivores—often with devastating impacts on plant communities. Predation can play an analogous role in reducing inter- and intraspecific competition for resources among prey species. Simple predator/prey models describe feedback processes leading to a stable point or stable limit cycle, in which the numbers of predators and prey come to equilibrium or oscillate within circumscribed limits. But widespread elimination of top predators from terrestrial ecosystems the world over has disrupted the feedback process through which predators and prey mutually regulate each other's numbers.

Here we focus on predation as a key process in the natural maintenance of biodiversity. The role of predation has become a matter of intense interest to conservationists because mounting evidence, as we shall see, points to its pivotal role in helping to preserve the biodiversity of terrestrial communities. On every continent, top predators are now restricted to tiny fractions of their former ranges, so that the integrity of biological communities over large portions of

the Earth's terrestrial realm is threatened by grossly distorted predation regimes. Even where they are present, top predators' population densities tend to be so low, and their behavior so secretive, that sightings are infrequent. Most biologists prefer to study species that are common, small, and easily manipulated. Many academics dismiss field studies of large carnivores as "unscientific" because sample sizes are typically small and controlled experimentation difficult. Carnivore biology has thus been left to a small coterie of hardy devotees whose work, if not ignored, lies well outside the mainstream. The role that top predators play in terrestrial ecosystems, therefore, remains ill defined and contentious. (See Erlinge et al. 1984, 1988, Kidd and Lewis 1987, Terborgh 1988, Hunter and Price 1992, Power 1992, Strong 1992, Wright et al. 1994, Estes 1996.) At the end of a literature review, for example, Polis and Strong (1996) conclude "that trophic cascades and top-down community regulation as envisioned by trophic-level theories are relatively uncommon in nature." Here, after reviewing an overlapping body of literature, we come to the opposite conclusion.

Whether contentious or not, it is crucial to define the role of top predators because the stakes are enormous. If, as we conclude here, top predators are often essential to the integrity of ecological communities, it will be imperative to retain or restore them to as many parts of North America as



practical. Failure to do so will result in distorted ecological interactions that, in the long run, will jeopardize biodiversity across the continent.

Theory

What is at issue in the current debate over "top-down" versus "bottom-up" processes (Matson and Hunter 1992)? "Top-down" means that species occupying the highest trophic level (top carnivores) exert a controlling influence on species at the next lower level (their prey) and so forth down the trophic ladder. The definition can be made operational in a thought experiment. Under top-down regulation, the removal of a top predator (or better, the entire guild of top predators) results in an appreciable population increase in the prey. It is thereby demonstrated that productivity (the food supply available to the prey) was not the proximal factor limiting prey numbers. Conversely, if removal of the guild of top predators does not lead to increases in the numbers of prey, we must conclude that the prey were proximally limited by something else—most likely the food supply.

We can ask parallel questions about the bottom rung on the trophic ladder. Suppose we could increase the long-term productivity of an ecosystem experimentally—let us say by adding water to a desert or nutrients to a barrens (Wedin and Tilman 1993). If the increase in plant growth resulting from the artificial input then led to an increase in the biomass of consumers (herbivores such as rabbits and deer), we could conclude that the consumers were under bottom-up control. If we found no increase in consumer biomass, this would imply that something other than productivity was limiting—plant antiherbivore defenses, or predators, to mention two possibilities (Oksanen 1983). Even by the admittedly simple operational criteria just presented, it should be evident that top-down versus bottom-up is not merely an either/or proposition. If we could add water or fertilizer to an ecosystem, the number of consumers could increase even in the presence of predators—implying bottom-up regulation. Simultaneously, say, in a different experimental plot, consumers could increase in response to predator removal without external inputs such as water or fertilizer—implying top-down regulation (Brett and Goldman 1997).

Both top-down and bottom-up regulation can operate concurrently in the same system. In the presence of predators, herbivores are secretive and act as time-minimizers, thereby maximizing their survival. That is, they endeavor to spend as

little time feeding (when they are exposed to predators) as possible. Most of their time is spent in secure places—in burrows or dense thickets, for example, or in naturally protected spots such as steep mountain slopes or ledges (bighorn sheep and mountain goats). If predators are removed, then the quest for security ceases to be the leading regulator of prey behavior; now consumers are free to feed when and where they want, becoming energy-maximizers, thereby maximizing fecundity. The switch in prey behavior from time-minimizer to energy-maximizer in response to differing levels of perceived predator threat introduces complexity into the system and allows both top-down and bottom-up regulation to operate simultaneously or to varying degrees (see Power 1992, Werner and Hall 1988, Abrams 1993, Werner and Anholt 1993, Englund 1997). Another layer of complexity is added by herbivory-induced plant defenses. Damage to foliage can stimulate plants to increase levels of herbivore-detering chemicals in their tissues—thereby reducing the food supply available to herbivores (a bottom-up effect). It is the extraordinary complexity of trophic interactions that has made the issue of top-down versus bottom-up a matter of so much contention among ecologists.

Top-down effects have been shown to act on communities in two fundamentally different ways. One is through preferential feeding on a prey species that, in the absence of predation, is capable of competitively excluding other species that depend on a limiting resource. Thus, over an intermediate range of predation intensities, species diversity in the prey guild is enhanced over that which occurs in the overabundance or absence of predators. Here we refer to this process as the "Paine effect." A more generalized form of this process, known as the intermediate disturbance model of species diversity, has been demonstrated in a variety of systems (Connell 1978, Sousa 1984).

The second way in which predators influence their communities is through a cascade of interactions extending through successively lower trophic levels to autotrophs at the base of the food web (Carpenter and Kitchel 1993). In trophic cascades, the autotrophs are either enhanced by reduced herbivory or limited by increased herbivory, depending on whether the number of trophic levels is odd or even (Power 1992). The top-down model predicts that each trophic level is potentially limited by the next level up. For intact three-level systems, therefore, predators limit herbivores, thus releasing producers from limitation by herbivory. Since there is little unambiguous evidence from terrestrial systems for trophic cascades involving three or more

levels, a number of studies have looked only at component steps—for instance, evidence that herbivores limit plants when the predators are missing and evidence that herbivores are limited by predators (Estes 1996).

Empirical Foundations: The Paine Effect

If terrestrial carnivores were not so inherently difficult to study, we might have understood their roles long ago. The simpler conditions characteristic of certain aquatic systems have facilitated investigation, however, and the keystone role of predators is now established beyond dispute. Paine (1966) was the first to provide incontrovertible evidence. By removing the predatory starfish *Pisaster ochraceus* from sections of the intertidal zone of the rocky Washington coastline, he showed that the diversity of the attached invertebrates subsequently declined as a superior competitor, the mussel *Mytilus californicus*, gradually occupied all available space, thereby excluding other species from the community. It is important to note that *Mytilus* is the preferred prey of *Pisaster*, so that the action of the predator is selective removal of the dominant competitor—an act that exposes attachment sites that can be exploited by other species. Further studies of sessile intertidal communities have amply supported Paine's result (with some geographical variation and local exceptions). The effect of a top predator is reduced, for example, when it does not feed preferentially on the dominant competitor among the potential prey species (Menge 1992, Menge et al. 1994, Menge 1995). The primary effect of a top predator in the intertidal system is thus seen in regulating the diversity of the prey community. This is the Paine effect.

The presence/absence of a predator influences the productivity and biomass of the intertidal prey community because space (attachment sites) is the limiting resource. The productivity that supports the intertidal community is almost entirely imported from the open ocean—an example of a spatially subsidized food web. Interactive links between sessile intertidal predators and the productivity of the system are thus weak to nonexistent. Terrestrial and aquatic systems involving mobile organisms may show different dynamics, however, because consumers and predators are free to come and go and many of the component species have long lifetimes. And unlike Paine's rocky intertidal system, which can be studied on the scale of a few square meters, terrestrial and open-water aquatic systems must be studied on vastly larger spatial scales because the important predators and consumers may have low population densities and range over large

areas. These daunting obstacles to the careful analysis of mobile predator/prey systems have been major impediments to scientific progress. Now, with results emerging from some long-term studies and the first large-scale predator-exclusion experiments, the time is ripe for a synthesis.

Anecdotal Evidence

In the hope of arriving at some general conclusions, we now review evidence relevant to understanding the role of top carnivores. Our emphasis is on terrestrial ecosystems and large vertebrates, especially mammals. Although open aquatic systems provide many parallels, they are mentioned here only briefly. The evidence can be broadly categorized as anecdotal or experimental, though the dividing line between the two categories is not always distinct. Here we refer to evidence derived from natural perturbations and experiments lacking controls as "anecdotal."

Herbivore release onto predator-free islands.

Sailors of yore introduced herbivores to predator-free islands throughout the Seven Seas to ensure themselves of a supply of meat on subsequent voyages. Horses, cattle, caribou, sheep, goats, pigs, and rabbits are among the animals introduced, singly or in combinations, to countless islands around the world (Carlquist 1974, Bramwell 1979, Coblentz 1978, 1990, Crosby 1986, Vitousek 1988). Few of these introductions were carefully monitored, so they can hardly be considered scientific studies. Nevertheless, in numerous instances (Ascension, Aldabra, Juan Fernández, California Channel Islands, St. Mathews Island, St. George Island) the introduced herbivores increased without check until they devastated the native vegetation of the island—at which point populations of the herbivores themselves often crashed (Klein 1968, Carlquist 1974, Coblentz 1980, Cronk 1980).

Destruction of the vegetation of predator-free islands by herbivores is unambiguously a top-down effect. Herbivores do not ordinarily destroy the vegetation of large landmasses supporting top predators, so it is tempting to attribute their massive impacts on islands to the absence of predators (Hairston et al. 1960). Another interpretation is possible, however, so the conclusion of top-down regulation is not the only one that can be drawn. The vegetation of islands lacking native vertebrate herbivores must experience relaxed selection for antiherbivore defenses and hence might be exceptionally vulnerable to introduced herbivores (Carlquist 1974, Bowen and van Vuren 1997). Without additional information, we cannot distinguish the two

interpretations, but under the right circumstances, both may be correct.

Predator elimination. Humans have eliminated top predators over much of the globe, drastically reducing the geographical ranges of many species, including wolves, bears, tigers, lions, and many less intimidating beasts. Nevertheless, herbivores generally have not overrun predator-free portions of the planet, as we would expect if herbivore populations were indeed under top-down control. The reason in this case appears obvious. Large vertebrate herbivores are also the prey of human beings, and in many places they have been reduced to low densities or extirpated by human overhunting (Redford 1992). In many regions, introduced livestock substitute for missing native ungulates. Untangling the effects of predator removal from those of hunting and introduced livestock is an almost impossible task in most situations.

One common, nonexperimental situation that conforms to the requirements of a proper test of top-down control is increasingly attracting scientific attention. It is found in suburban areas and parklands in the United States from which top predators were eliminated long ago and where hunting is now prohibited. Mammals that would have been part of the prey pool of missing carnivores such as wolves and cougars have, despite high rates of roadkill, become notoriously abundant to the point that some of them are now nuisances: by being road hazards (deer, moose); by browsing ornamental shrubbery (deer); by raiding trash cans (opossums, raccoons); by preying on birds (house cats) and their nests (cats, raccoons); by destroying vegetable gardens (deer, woodchucks, ground squirrels), and by flooding people's yards (beaver; Garrott et al. 1993). The problem of mammalian overabundance in predator-free portions of North America has become so widespread and so severe that it was recently the topic of a major symposium hosted by the Smithsonian Institution (McShea et al. 1997).

If top-down processes, as elucidated by Paine, are important in terrestrial ecosystems, then the removal of top predators must lead to reduced diversity in the next lower trophic level. The obvious experiment to test this proposition was preempted long ago, however, by megafaunal overkill. What is now the eastern United States once supported an impressive galaxy of large herbivores—including elephants, tapirs, ground sloths, capybaras, giant beaver, and others—but today it supports only one or two, the white-tailed deer and moose. Certainly white-tailed deer, raccoons, woodchucks, and beaver have proliferated dramati-

cally in the absence of large carnivores, but it seems highly unlikely that any of these animals could ever drive another to extinction via exploitation competition (depletion of the food supply). Are we to conclude, then, that the Paine mechanism is inoperative on land?

This conclusion is not inevitable. The Paine effect operates through the monopolization of space, not resource competition. The few examples from terrestrial ecosystems that resemble a Paine effect involve small rodents. Small island communities of native rodents are conspicuously vulnerable to invasion and monopolization by a behaviorally dominant species. Small, eighty-year-old islands in Lake Gatun, Panama, are today occupied only by the spiny rat, *Proechimys semispinosus*, even though central Panamanian forests support sixteen species of rodents, at least some of which were presumably present on these islands at isolation (Adler and Seamon 1991). Other examples emanate from predator-free islands where introduced rats, particularly *Rattus rattus*, or mice have replaced other rodent species (Brosset 1963, Berry and Tricker 1969, Lynam 1997). Even on the large landmass of Madagascar, where a wide complement of predators is present, there is mounting evidence that introduced *Rattus* is displacing native rodents (Goodman 1995). Such competitive displacements of several species by one are not true Paine effects, because space is not limiting, but like the Paine mechanism they do occur in the absence of normal predation.

Although biologists have not fully documented the exact mechanism by which a single rodent species can, in the absence of predators, replace a community of other species, some rat species (such as *Rattus rattus*) are aggressive toward other rodents and are known to attack their nests and kill the young. If overt aggression is involved, then the takeover of predator-free islands by an aggressive rodent species would involve a form of spatial monopolization analogous to the Paine mechanism. Under mainland conditions where animals are free to disperse and are at risk of predation, densities of all rodent species might be held to low enough levels to reduce or eliminate interspecific aggression between them, thereby permitting coexistence (Grant 1972).

Thus there is limited evidence that the Paine effect may operate among certain terrestrial consumer guilds, but demonstrating it seems to require rather exacting conditions: predator-free environments and strong interspecific aggression within the guild of consumers. We therefore doubt that the Paine effect has much conservation significance in terrestrial communities except perhaps on predator-free islands where, in many cases, ecological conditions

have already deteriorated beyond repair. As we shall see, the Paine effect may operate more commonly at the producer level of terrestrial and benthic ecosystems through changes in the abundance of consumers.

Predator introduction. Another kind of uncontrolled experiment is performed when predators are intentionally or unintentionally introduced (or reintroduced) into predator-free environments. The recovery of the sea otter from near extinction is a classic example. Sea urchins, abalones, and other benthic grazers had nearly eliminated the kelp forests that once dominated the inshore environment along the Pacific rim of North America in the absence of sea otters. Gradual recovery of the sea otter during the middle portion of the 20th century has led to sharp declines of benthic grazers, accompanied by dramatic recovery of kelp forests and associated fauna (Estes et al. 1978, 1989). Experimental removal of benthic grazers, simulating otter predation, led to rapid growth of benthic algae, followed by progressive domination of a single kelp species, *Laminaria groenlandica*, demonstrating a strong Paine effect at the level of herbivore/plant interactions (Duggins 1980).

The introduction of alien top predators has wreaked havoc in freshwater aquatic systems around the world. Some particularly notorious cases are the introductions of sea lamprey to the Great Lakes, of Nile perch to Lake Victoria in East Africa, of rainbow trout to Lake Titicaca in the Andes, and of peacock bass to Lake Gatun, Panama (see Zaret and Paine 1973, Zaret 1980, Kaufman 1992, Goldschmidt et al. 1993, Mills et al. 1994). In these and countless other well-documented examples, top-down effects have been dramatic and unequivocal—typically with devastating consequences for native fauna.

The introduction of exotic predators to predator-free islands provides additional evidence for the operation of top-down regulation. Mongooses introduced onto islands of the tropical Pacific and Antilles have contributed to the collapse of native faunas (King 1984). Inadvertent introduction of the brown tree snake onto Guam led to a population explosion of the snake and consequent extinction of most of the island's native birds (Savidge 1987). Introduced domestic cats have had strong effects in Australia and on certain temperate islands, as have foxes in boreal to arctic regions (Bailey 1993).

On the North American mainland, the growing gray wolf population has been associated with a concurrent decline in elk and white-tailed deer densities. Most known ungulate mortality in these areas was caused by wolf predation (D.

Pletscher, pers. com.). The recent reinhabitation of the northern Midwest by wolves has reduced the distance from aquatic habitats that beavers can forage—a behavioral modification that in turn reduces the impact of beaver on plant associations (Naiman et al. 1994, Pollock et al. 1995). Similarly, the reestablishment of wolves in other areas has been followed by declines in caribou, moose, elk, and deer (Bergerud 1988, Messier and Crête 1985, Hatter and Janz 1994).

Long-term monitoring of predator/prey interactions. A compelling case for a terrestrial trophic cascade is that of the gray wolf/moose/balsam fir interaction on Isle Royale, Michigan (McLaren and Peterson 1994, Messier 1994). The number of wolves determines the intensity of wolf predation on moose populations on Isle Royale. Growth rings in young fir trees showed depressed plant growth rates when wolves were rare and moose abundant—from which McLaren and Peterson (1994) infer the existence of a wolf-induced trophic cascade. Broad ramifications within the forest ecosystem are suggested from known linkages among moose, microbes, and soil nutrients (Pastor et al. 1988).

The anecdotal evidence cited here is consistent with top-down regulation as a predictable feature of terrestrial and many aquatic communities. But without rigorous controls, anecdotal evidence, by its nature, is open to alternative interpretations. Uncontrolled changes in the quality or distribution of habitats concurrent with predator elimination or reintroduction especially complicates the interpretation of causes and effects that may be separated in time by decades. For these reasons, scientists put greater stock in controlled comparisons and experiments.

Experimental Evidence

Few well-controlled comparisons of prey populations at sites with and without top predators have been made—presumably because the conditions required are so rarely available. The sites being compared must have similar climate and vegetation and differ only in the presence/absence of top predators. Hunting or complicating management interventions must be absent.

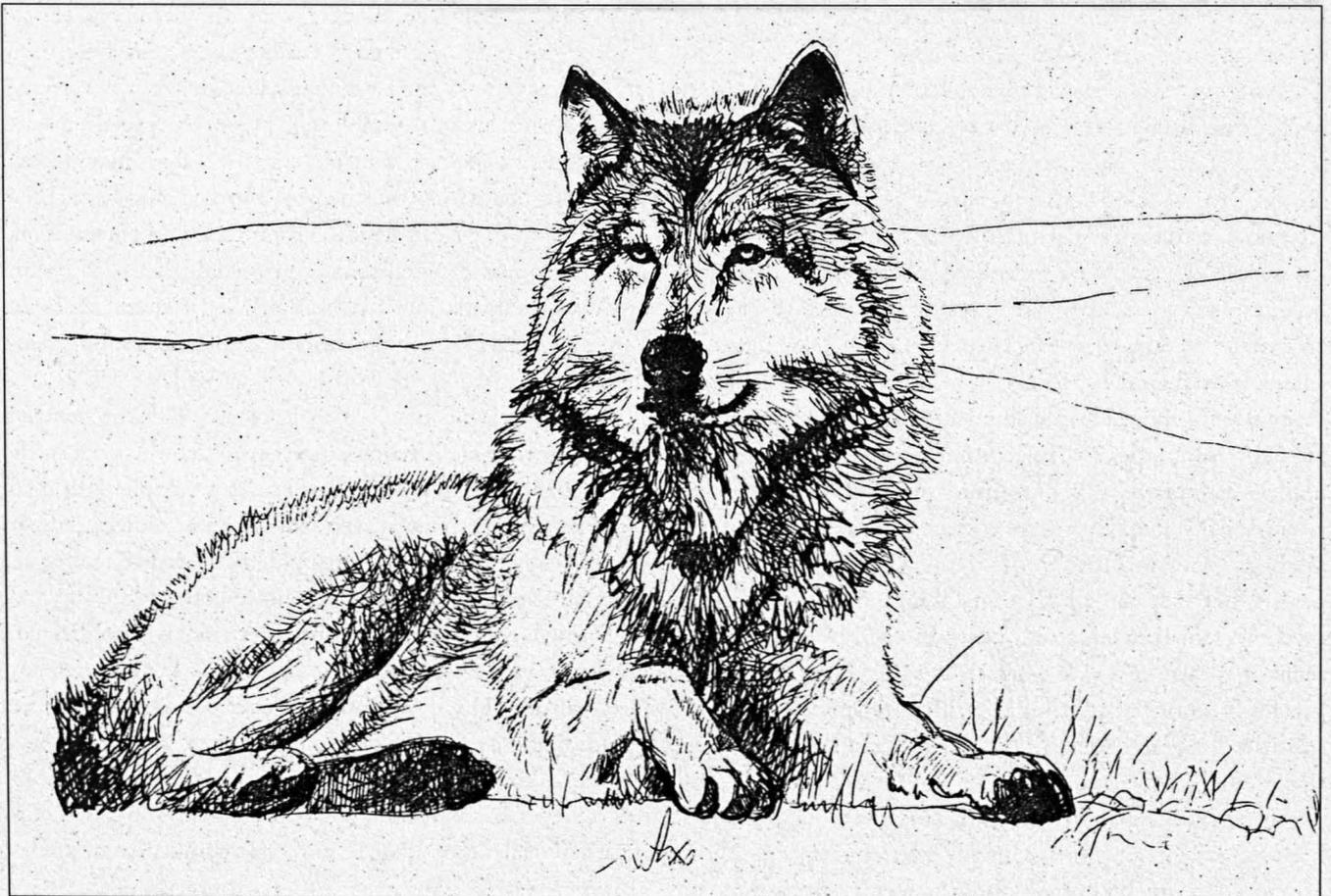
One carefully documented comparison is between two sites in the neotropics: one is Barro Colorado Island (BCI), Panama, a research preserve of the Smithsonian Institution; the other is Cocha Cashu Biological Station (CCBS) in the Manu National Park of Perú. Located respectively at 10° north and 12° south latitude, the two sites have a similar climate and fauna. The dominant habitat at both is primary tropical moist forest. BCI is a 1600-hectare island created by flooding

during the construction of the Panama Canal. It has been isolated since the canal's creation. Due to its limited area, BCI lost top predators—jaguar, puma, and harpy eagle—more than fifty years ago (Glanz 1982). CCBS is located in the heart of a two-million-hectare biosphere reserve that retains an intact flora and fauna, including all top predators.

The terrestrial and arboreal mammals of both BCI and CCBS have been censused on multiple occasions (Glanz 1990, Janson and Emmons 1990, Wright et al. 1994). Counts made by different observers at different times consistently agree in registering higher mammal densities on BCI than at CCBS (Terborgh 1988, 1992, Wright et al. 1994). In several cases, the differences in abundance are striking—exceeding an order of magnitude, particularly for the agouti, paca, armadillo, and coatimundi (terrestrial) and the three-toed sloth and tamandua (arboreal). Differences for other species are less extreme—as for the collared peccary and rabbit (terrestrial) and howler monkey (arboreal)—or negligible (deer, tapir). Whenever there are appreciable differences, they consistently favor BCI.

Differences in abundance are most pronounced in medium to large species that are prey of the top predators missing from BCI. Small mammals (rodents and marsupials weighing less than one kilogram) show similar abundances at the two sites, but these species do not appear in the prey of the top predators (Rettig 1978, Emmons 1987). Instead these animals are prey to small carnivores (ocelot, snakes, raptors) that are well represented at both sites. The higher densities of medium and large mammals on BCI have been interpreted as evidence of a top-down effect resulting from missing top predators (Terborgh and Winter 1980, Terborgh 1988, 1992). This conclusion, however, has been questioned by Wright et al. (1994) who emphasize that other interpretations are possible, including uncontrolled differences in productivity between the two sites.

The only certain way to exclude possible influences of uncontrolled variables is with strictly controlled experiments that include censusing before and after. For terrestrial predator/prey systems, the appropriate spatial scale on which to conduct the critical experiments is that of square



kilometers—a fact that has precluded such experiments until very recently (Englund 1997). There are now two experimental efforts underway that promise to overcome certain weaknesses of correlational analysis and geographical comparisons. One of these efforts employs isolated remnants of a formerly intact landscape; the other uses large (one square kilometer) fenced exclosures to exclude terrestrial predators. For reasons to be explained, neither set of experiments is perfect. But both represent major advances over previous efforts to isolate the effects of predators on terrestrial communities.

The creation in 1986 of one of the world's largest hydroelectric impoundments—Lago Guri—in the Caroni Valley of east-central Venezuela has resulted in the inundation of a hilly forested landscape with the consequent isolation of hundreds of erstwhile hilltops as islands. The impoundment is 120 kilometers long and up to 70 kilometers wide. Islands ranging in size from less than one hectare to more than 1000 hectares are scattered throughout the vast expanse of water—a number of them as far as seven kilometers from the mainland. Small size and isolation by water assure that many of the more remote islands in Lago Guri are free of vertebrate predators except for certain small raptors and, perhaps, snakes.

Systematic surveys of the vertebrate faunas of a dozen Lago Guri islands were conducted seven years after isolation, along with control surveys on the nearby mainland (Terborgh et al. 1997). Roughly 75–90% of the species of terrestrial vertebrates that occupy the same forest type on the mainland were absent from islands between one and ten hectares in size within seven years after isolation. With few exceptions, species that persisted became hyperabundant compared to their densities on the mainland. The absence of many species and the hyperabundance of others has created animal communities unlike any that would ever occur naturally—communities that are grotesquely imbalanced from a functional standpoint. These communities lack vertebrate predators and are deficient in pollinators and seed dispersers; but they contain abnormally high densities of seed predators (small rodents) and generalist herbivores (howler monkeys, iguanas, and leaf-cutter ants). The excess of herbivores is particularly striking, as all three species occur at densities between one and two orders of magnitude above those found on the mainland.

Larger Lago Guri islands (between 100 and 1000 hectares) still retain nearly complete vertebrate faunas (all primates and ungulates known for the region, for example),

lacking only resident populations of the top predators (jaguar, puma, harpy eagle). Mammal densities on the two large islands being monitored have not yet increased conspicuously, but one and perhaps both of these islands are visited regularly by jaguars that swim over from the mainland, so they are not strictly predator-free. As for the smaller, more isolated islands that assuredly are predator-free, the hyperabundance of persistent vertebrates is consistent with the top-down effect of release from predation.

Further support for these observations is the documentation of hyperabundant rodent populations on numerous predator-free islands in both temperate and tropical regions (Adler and Levins 1994, Adler 1996). Nevertheless, the possibility remains of a confounding effect of missing species. The absence of other seed predators and herbivores that are present in the mainland fauna, for example, may have made available additional resources that allowed the persistent species to achieve hyperabundance. As in the previous examples considered here, the findings are consistent with a top-down effect but an airtight case remains elusive.

Finally, we come to the most carefully constructed test of top-down regulation conducted to date. Charles Krebs, Tony Sinclair, and their associates are conducting the experiment in southern Yukon, Canada, where they have been monitoring snowshoe hare populations for nearly a decade in one-square-kilometer plots. Two of the plots are surrounded by electric fencing that excludes mammalian predators but is permeable to hares. Plots have been assigned to five treatments: control, food supplementation, fertilizer, predator exclusion, and predator exclusion with food supplementation (Krebs et al. 1995). Hares exhibited strong positive demographic responses to food supplementation and (partial) predator exclusion while continuing to follow the classic ten-year cycle of abundance. Averaged over the peak and decline phases, hare density was double that of controls under predator exclusion, triple with food supplementation, and eleven times greater under predator exclusion coupled with food supplementation (Krebs et al. 1995). The results strongly implicate both bottom-up and top-down regulation. This interpretation is complicated, however, by the free passage of hares in and out of predator exclosures and by the exposure of hares within exclosures to predation by goshawks and great horned owls. Nevertheless, the effort represents a bold attempt to conduct an experimental test of bottom-up and top-down regulation on an appropriate spatial scale with a natural predator/prey system.

Another series of large-scale experiments has been conducted to test the role of top-down regulation in freshwater aquatic systems (Carpenter and Kitchell 1993). Entire lakes in Wisconsin have been seined free of piscivorous or planktivorous fishes and the respective hauls exchanged between lakes in a series of dramatic whole-lake perturbations (Carpenter et al. 1985, Carpenter and Kitchell 1988). Removal of piscivorous fish (large-mouthed bass, the top carnivore in this system) leads to order-of-magnitude increases in planktivorous fish, decreases in the size and number of zooplankton (cladocerans), and strong increases in the standing crop of phytoplankton in a textbook top-down trophic cascade.

A variety of efforts designed to assess the polarity of trophic regulation in terrestrial and aquatic ecosystems have consistently produced results consonant with strong top-down effects. To date, however, most or all of these efforts have fallen short of making an airtight case because of the overwhelming logistical challenge of removing or excluding only the guild of top predators without altering anything else. Carpenter's studies of Wisconsin lakes provide the most unambiguous evidence. On land, perhaps the closest approximation yet achieved to the ideal experimental condition is found in areas like Barro Colorado Island in Panama and in North American parks and suburbs where mammal communities, complete except for top predators, live under protection from hunting (McShea et al. 1997). In both of these situations, densities of medium and large mammals are much higher than can be considered normal, though other potentially complicating factors preclude drawing an unequivocal link to missing predators.

Admittedly, many questions remain to be answered by future research. Nevertheless, in the spirit of meta-analysis, if one considers the entire collection of controlled and uncontrolled comparisons and experiments cited here, the consonance of the results suggests a much stronger conclusion than a single case standing alone. With so much evidence pointing in the same direction, the conclusion that top predators play a major regulatory role seems inescapable.

Countercurrents

Although the evidence that top predators commonly limit the densities of their prey is compelling, one would be wrong to conclude that predators limit the numbers of all consumers. There are a variety of situations in Nature that allow consumers to escape predation to varying degrees—often to the extent that top-down control by large carni-

vores does not operate. These probable exceptions, as we shall see, include both megaherbivores and herd-forming migratory ungulates. Moreover, one should not assume that because top predators play major roles in regulating prey populations in many ecosystems, they play equivalent roles in all ecosystems.

Prior to the late-Pleistocene and Holocene megafaunal overkill, nearly every terrestrial ecosystem on Earth included very large herbivore species too big (at least as adults) to be killed by the largest carnivores in the system. The prime living example is that of elephants, which were once distributed on all continents (except Australia and Antarctica) and a number of islands. Nearly all the Earth's once abundant megaherbivores have been driven to extinction and only a few survive (Martin and Klein 1984). In Africa there are rhinos and hippos, in addition to elephants, which, as adults, enjoy immunity to lions. In the north, adult moose repel gray wolves; in the neotropical forest, tapirs shrug off jaguars. Elsewhere, Madagascar had its elephant birds, New Zealand its moas, the Antilles their hutias and ground sloths, and the Seychelles, Galápagos and Aldabra Island their tortoises. Lacking any population control from the top, megaherbivores must be regulated from below. But to the extent that megaherbivores regulate vegetation, they too exert a top-down force that is independent of predation (Kortlandt 1984, Owen-Smith 1988). What fraction of the planet's land surface still supports megaherbivores? Ubiquitous and abundant to the point of dominating mammalian biomass over most of the globe for millions of years, megaherbivores have been so systematically persecuted that they have become almost irrelevant to today's ecosystems and conservation concerns, except in dwindling portions of Africa and Asia.

Sheer size enables a few of the world's largest mammals to escape predation. But size is not the only successful antipredator strategy to have arisen through evolution. Some species are able to reduce (but not eliminate) predation through social mechanisms. The list of these mechanisms is long. It includes the formation of herds and flocks, sentinel behavior, and the giving of alarm calls (Bertram 1978, Harvey and Greenwood 1978, Terborgh 1990). Social mechanisms can be very effective at limiting predation. Consider the fabled wildebeest of Serengeti. These antelopes aggregate in huge mixed herds that can be within the territories of only one or two lion prides at a time. Lions are consequently unable to make much of a dent in wildebeest numbers, killing only about eight percent of the population per year (Sinclair and Norton-Griffiths 1979, Sinclair and Arcese

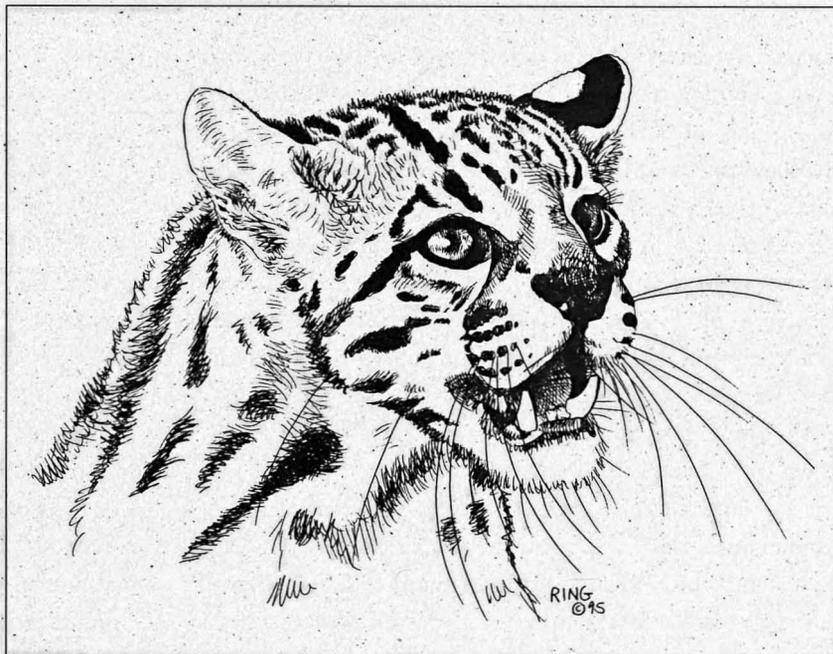
1995). In a bad year, wildebeest die en masse from starvation and malnutrition, as has been convincingly documented by Sinclair and his associates. The conclusion follows that wildebeest—and, by analogy, other herd-forming migratory ungulates—are regulated from the bottom up (Fryxell et al. 1988). But again, how much of today's Earth is occupied by herd-forming migratory ungulates? Not much more than is occupied by megaherbivores. Both of these major agents of top-down forces in terrestrial ecosystems are becoming Pleistocene relics. Hence we should give special attention to top carnivore processes, because it seems likely that they are crucial to preserving what bits and pieces of wild Nature we have left.

Top predators play structuring roles in many ecosystems. Exceptions, however, may be found in extreme environments, such as deserts or barrens, where low plant productivity or chemical toxicity of foliage limits large herbivores to such a degree that predators are unable to exploit them. Other factors, such as a severe disturbance, can temporarily upset normal trophic relationships. A stand-replacing fire, for example, may result in lowered herbivore densities and a switch from top-down to bottom-up regulation until the vegetation recovers (McLaren and Peterson 1994). In the world at large, however, productivity-limited (pure bottom-up) systems appear to be rare. Moderate to strong top-down regulation appears to be the norm for terrestrial ecosystems.

Indirect Effects and Trophic Cascades

Having made a case for top-down regulation as a nearly ubiquitous force in terrestrial ecosystems, we now ask about the role played by top predators in maintaining ecosystem integrity. From a conservation perspective, we are concerned about the destabilizing forces that are unleashed in ecosystems from which top predators have been eliminated. It is a concern that extends over the large fraction of the Earth's surface from which we have diminished or expunged the influence of these key animals. If there are no predictable ecological consequences of predator loss, we need not be concerned. But we have already reviewed convincing evidence to the contrary, so we know there are consequences. What are these consequences and how severe might they be?

The intellectual groundwork for studying "indirect effects" or "trophic cascades" in terrestrial ecosystems was



laid in the 1970s and 1980s by James Brown and Diane Davidson in a major series of enclosure experiments conducted in the Chihuahuan Desert of southeastern Arizona. Experimental enclosures were open to aerial predators and certain mammals (coyotes) but closed to certain terrestrial predators (snakes) and to the movements of small rodents. Treatments included open and enclosed control plots, plus food supplementation and removal of rodents, ants, and both rodents and ants (see Brown and Davidson 1977; Brown et al. 1986; Heske et al. 1994). Rodents and ants live at the same trophic level: both subsist on the seeds of desert plants.

Partial exclusion of rodent predators led to increased densities of rodents, but not of ants. Selective removal of rodents or ants (or both) resulted in changes in the abundance and species composition of annual plants. In short, manipulation of a guild of consumers, in this case seed predators, resulted in large and often unanticipated changes in the composition of the plant community. Integrity of plant communities is essential to preserving biodiversity, so the Brown and Davidson experiments raised an early warning flag to conservationists. Perhaps other changes in consumer guilds mediated through top-down effects could have similarly drastic consequences.

In many parts of North America, extirpation of dominant predators has resulted in a phenomenon known as "mesopredator release" in areas supporting small to mid-sized predators (foxes, skunks, raccoons, opossums, feral and domestic housecats; Soulé et al. 1988, Palomares et al. 1995). In such areas, mesopredators act by default as surro-

gate top predators. This has resulted in modified niche exploitation, altered diversity, and other ripple effects in the population structure of the community. Local elimination of coyotes, for example, allows the guild of mesopredators to increase in number, thereby imposing added predator pressure on the prey. Widespread reduction of ground-nesting birds, such as quail, pheasants, grouse, ducks, nightjars, and certain warblers, has been attributed to mesopredator release (Côté and Sutherland 1997). Mesopredator release has also been blamed for the decline or disappearance of gamebirds, songbirds, and other small vertebrates from a number of North American terrestrial ecosystems—including scrub habitats (Soulé et al. 1988), grasslands (Vickery et al. 1994), prairie wetlands (Sovada et al. 1995, Garrettson et al. 1996a, 1996b), and eastern deciduous forest (Wilcove 1985, Faaborg et al. 1995, Peterjohn et al. 1995).

Reintroduction or recolonization of predators influences the composition and structure of carnivore guilds as well. Wolf recovery in the Rocky Mountains has resulted in interference and exploitation competition among intraguild carnivores, resulting in changes in behavior, abundance, and distribution of affected species (Cohn 1998). As a rule, generalized predators, like the wolf, can be expected to exert stronger top-down effects than specialists like the fisher and pine marten or omnivores such as bears.

Extirpation of top predators has released herbivore populations in parts of the United States with consequences that are just beginning to come to light. Overbrowsing by white-tailed deer is decisively altering the pattern of tree regeneration in some eastern forests and is threatening certain endangered plants with extinction (Alverson et al. 1988, 1994, Miller et al. 1992, McShea et al. 1997, Rooney and Dress 1997). Elsewhere in North America, introduced ungulates, especially Eurasian boar (*Sus scrofa*), have increased to such a degree that they are destroying wildflower beds and altering tree regeneration patterns in forests (Abramson 1992). It hardly needs to be emphasized that rapid, large-scale, and unpredictable changes in forest composition represent a chilling threat to biodiversity.

For another case, let us return to Lago Guri in Venezuela, where recently created islands in a hydroelectric impoundment are experiencing cataclysmic biological change. In a predator-free environment, three generalist herbivores have each increased in abundance by more than an order of magnitude. Howler monkeys on some islands have attained densities equivalent to 500 per square kilometer whereas mainland densities are typically between 20

and 40 per square kilometer (Crockett and Eisenberg 1986). Densities of iguanas and leaf-cutter ants have similarly exploded (Terborgh et al. 1997, Rao 1998).

Ongoing studies of forest regeneration on these islands reveal little successful reproduction of canopy trees. On some islands fewer than five species are represented by saplings in the understory, despite the presence of sixty to seventy species in the canopy. The mechanisms by which tree reproduction on these islands is being suppressed are currently under investigation. Preliminary results suggest the simultaneous involvement of several mechanisms: deficiencies of pollination and seed dispersal; excessive seed predation; decimation of seedlings by leaf-cutter ants; and repeated defoliation of canopy trees by howler monkeys, iguanas, and leaf-cutter ants (Terborgh et al., unpublished results). In the absence of "normal" biological interactions, the remnant ecosystems of these islands have spun out of control. It seems inevitable that most of the plant and animal species that survived the initial contraction in area will be extirpated within one or two tree replacement cycles.

Vegetation change in the Lago Guri islands and in portions of the United States occupied by hyperabundant populations of white-tailed deer and Eurasian boar offer startling examples of trophic cascades—examples that mirror findings from deserts (Brown et al. 1986), lakes (Carpenter and Kitchell 1993), and Pacific kelp forests (Estes et al. 1989). To prevent ecosystems all over North America from experiencing similar convulsions brought about by trophic cascades, the full spectrum of ecological processes that operates to perpetuate biodiversity—especially predation—must be widely maintained.

Where top predators have been extirpated and their reestablishment is impractical, can trophic cascades be avoided? Perhaps worst-case scenarios can be avoided through interventions of various sorts. But no human effort can accurately simulate the effects of real predators, because these animals have impacts on many prey species simultaneously and interact with prey populations in complex ways that are seldom understood. Nevertheless, the worst consequences of trophic cascades might be forestalled or ameliorated through the hunting of herbivores and trapping of mesopredators. The most severe impacts of hyperabundant mesopredators and consumers appear in localities where predators are absent and hunting and trapping are prohibited.

A contrasting situation arises in countries lacking enforced game laws, where all medium and large birds and mammals are systematically overhunted (Redford 1992).

The resulting "defaunation," like hyperabundance, results in distorted or disrupted plant/animal interactions—including seed dispersal, seed predation, and herbivory. Little is known about the consequences of wholesale defaunation, though preliminary evidence from Mexico points to highly aberrant patterns of plant regeneration (Dirzo and Miranda 1991).

Predators prevent prey populations and mesopredators from exploding into hyperabundance while rarely, if ever, driving prey to extinction. Prey species, such as seed dispersers, seed predators, or herbivores, are thereby regulated within definite upper and lower bounds. The operation of such feedback mechanisms can be likened to "a balance of Nature." Nature stays in balance so long as a fauna remains intact and the full suite of ecological processes operates unhindered. It is when Nature falls out of balance—when there are too many consumers and mesopredators (or not enough)—that species begin to disappear and humans begin to notice. But what humans notice is only that some favored species or another has disappeared. Hidden in the workings of a Nature we are only beginning to understand, the cause remains obscure.

Another Key to Biodiversity

Despite the complexity of food web linkages, interactions across trophic levels define a subset of these links that are of particular importance to the functioning of natural ecosystems. In terrestrial ecosystems, top-down and bottom-up processes operate simultaneously. This seemingly contradictory statement results not only from the complexity of food web structure but from flexibility in the behavior of individual species—such as the tendency for prey to act as time-minimizers in the presence of predators and the ability of plants to increase their investment in antiherbivore defenses in response to herbivory.

Although megaherbivores (those large enough to be invulnerable to predators) and herd-forming migratory ungulates tend to be regulated from the bottom up, megaherbivores concurrently exert top-down forces through their effects on vegetation. Both groups of species may have been prominent over much of the Earth's surface prior to megafaunal overkill, but they have been reduced by human persecution to a tiny fraction of their former geographical occurrence. What remains nearly everywhere else are drastically truncated mammal communities that are regulated largely through top-down processes.

The evidence reviewed here overwhelmingly supports the strong top-down role of large carnivores in regulating prey populations—and thereby stabilizing the trophic structure of terrestrial ecosystems. Loss of top predators results in hyperabundance of consumers playing a variety of trophic roles (herbivores, seed dispersers, seed predators) and in mesopredator release. Hyperabundance of consumers and mesopredators, in turn, results in trophic cascades that lead to multiple effects—including the direct elimination of plant populations from overbrowsing/grazing, reproductive failure of canopy tree species, and the loss of ground-nesting birds and probably other small vertebrates.

In sum, then, our current knowledge about the natural processes that maintain biodiversity suggests a crucial and irreplaceable regulatory role of top predators. The absence of top predators appears to lead inexorably to ecosystem simplification accompanied by a rush of extinctions. Therefore, efforts to conserve North American biodiversity in interconnected megareserves will have to place a high priority on reestablishing top predators wherever they have been locally extirpated. If steps are not taken in the interim to restore the full gamut of natural abiotic and biotic processes that maintain biodiversity, efforts to halt extinction through legislated mechanisms (such as the Endangered Species Act) will be overwhelmed by irresistible biological forces. It is only by providing the conditions that allow Nature to remain in balance that biodiversity can be perpetuated over the long run. ☪

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Learn from the BURN

Research
Natural Areas
for Habitat
and Science

by *Timothy Ingalsbee*

The Warner Burn stands on the brink of permanent protection as the nation's first Research Natural Area devoted to fire disturbance and recovery processes.

On October 10, 1991, arsonists ignited the Warner Creek Fire in the Compach Inventoried Roadless Area on the Willamette National Forest in Oregon. This site was part of a large Habitat Conservation Area (HCA) for the northern spotted owl (*Strix occidentalis caurina*), an area where further commercial logging was supposed to be prohibited. In response to the first large wildfire to burn inside the newly created HCAs, the Forest Service reacted with a "Fire Recovery Project" that proposed to salvage log 40 million board feet of trees across 1200 acres. The agency's rationale was that severely burned stands no longer provided suitable habitat for spotted owls; moreover, the numerous fire-created snags and logs posed a threat of spreading another "catastrophic wildfire" into adjacent unburned owl habitat stands. At that time, a fire salvage timber sale had never been seriously challenged before, but the agency's arson-salvage plan threatened all other HCAs by providing an incentive for copycat light-it-and-log-it schemes. Thus, the Warner Salvage Sale sparked a firestorm of controversy among conservationists. The resistance included a group of citizen-scientists who proposed designating the Warner Burn as a fire ecology Research Natural Area (RNA). The RNA proposal effectively subverted the agency's salvage logging Environmental Impact Statement, and inspired a year-long road blockade in which nonviolent activists braved the Cascadian winter snows to keep the salvage saws out of marked clearcut units. In the face of this uncompromising activist opposition and a nationwide outcry over the Salvage Rider, the Warner Salvage Sale was withdrawn by presidential decree in 1996 and relegated to the ash heap of history. Now the Warner Burn stands on the brink of permanent protection as the nation's first Research Natural Area devoted to fire disturbance and recovery processes. In reviewing some of the history of the struggle to save the Warner Burn from salvage logging, we offer a few valuable lessons and a new strategy for protecting fire-affected roadless wildlands.

The Warner Creek Fire

Arsonists ignited the Warner Creek Fire at the end of a long drought when fuel moistures were at record-breaking low levels, and not a cloud was in the sky. The fire was set at the end of a logging road at the bottom of the steep, south-facing slope of Bunchgrass Ridge. Over 2500 firefighters and an armada of tankers, dozers, bombers, and helicopters battled the blaze for ten grueling days, at a total cost of \$10 million. One afternoon the wildfire surged across 3000 acres in a tsunami of flame that left towering Douglas-fir and Western hemlock trees charred black from ground to crown. When a heavy snowfall finally put out the flames, the perimeter contained nearly 14 square miles

of public wildlands, making the Warner Creek Fire the second largest and costliest wildfire in the history of the Willamette National Forest.

Warner Creek was the first large wildfire to occur inside the newly created HCAs, and raised important, ongoing issues concerning the need for proper fire-management planning and appropriate suppression responses for sensitive areas such as spotted owl nest groves and roadless areas. Even though resource advisors were assigned to flag spotted owl activity centers and offer tips on "light-hand" firefighting, the lack of an adequate pre-fire plan led to crisis-decisionmaking that resulted in significant environmental impacts. For example, planes dropped retardant chemicals in streams, timber fallers dropped dozens of trees along a scenic hiking trail, a mile-long dozerline was plowed deep inside the Roadless Area, and hundreds of gallons of flaming diesel fuel were spilled to light backfires which accounted for an estimated one-third of the total burned acreage. Fortunately, resource advisors talked the fire boss out of running a bulldozer through the Black Creek bog. Years later, university scientists discovered that the bog has a near-perfect record of natural charcoal and pollen deposits going back several millennia, and now represents a vital "anchor point" for paleoecological research to reconstruct the area's fire and vegetation history. This research site would have been ruined had the bulldozer run its course. Consequently, one of the major objectives that prompted the Warner RNA proposal was to develop a fire-management plan that would prevent future firefighting damage by managing most ignitions as prescribed fires. If and when suppression would be necessary, only minimal impact suppression techniques would be permitted, and some tactics (e.g., bulldozers in bogs) would be explicitly prohibited.

Fire Effects on Spotted Owls and Owl Habitat

Although it was ignited and spread by unnatural human sources—arsonists and firefighters—the effects of the Warner Creek Fire resulted in a classic landscape mosaic pattern that mimicked the natural fire regime of the westside middle Oregon Cascades. Nine spotted owl core habitat activity centers were located within the Burn, and from aerial surveys the agency determined that 2060 acres of spotted owl habitat were severely burned. The Forest Service described these stands as "not currently considered" suitable habitat, which fueled suspicions among conservationists who wondered whether this definition of unsuitability was a political decision (i.e., refusal to consider), a scientific uncertainty (i.e., not currently known), or an ecological fact. Most troubling for timber managers eager to

get out the salvage cut was the fact that all the resident owls continued to inhabit and successfully reproduce in the Warner Burn. The Forest Service was forced to admit that there was little information available on how wildfire affects suitable spotted owl habitat since the agency had systematically salvage logged nearly all burned owl habitat stands located outside of designated Wilderness.

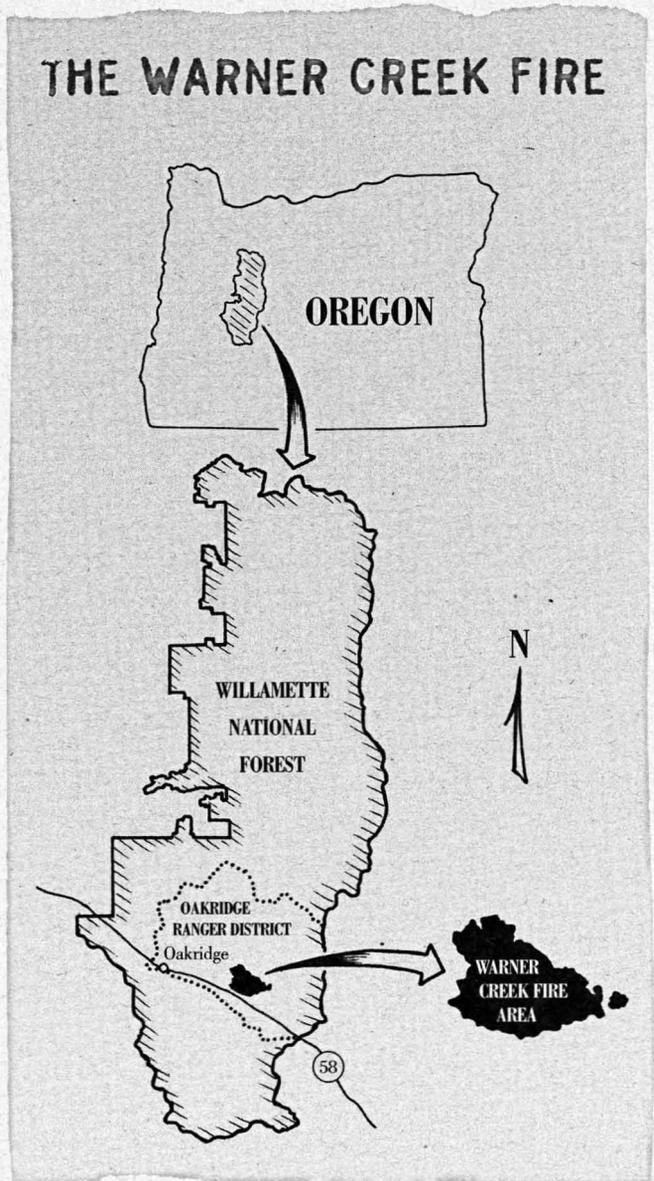
Beyond the mystery surrounding the spotted owls' continued inhabitation, the vegetative response was truly astounding. Natural tree regeneration ranged from 18,000 to 530,000 seedlings per hectare, and elk herds and woodpeckers flocked to the Burn. In the face of this remarkable natural recovery of native flora and fauna, which conservationists hailed as a "miracle of Nature," the Forest Service had a difficult time justifying to the public their need to do any kind of managed recovery. Indeed, the native biodiversity that continues to thrive in the Warner Creek Burn makes a convincing case for selecting the "No Action" alternative in other Forest Service fire recovery projects.

The Warner Fire Recovery Project

The agency's stated purpose and need for the fire "recovery" project (and its massive salvage timber sale) was twofold: to recover spotted owl habitat affected by the wildfire, and to increase knowledge about owl habitat and owl habitat recovery. Since all hitherto existing owl habitat was produced by natural processes that took centuries to unfold, and most occupied owl nest sites showed evidence of past fires, a fundamental question was raised as to what—if anything—could (or should) human beings do to "recover" burned owl habitat. The Forest Service opened the door to intensive management by simply defining recovery as "protection from future large-scale fire disturbances." Thus, the agency proposed salvage clearcutting to reduce heavy fuel loads and construct fuelbreaks in order to (and I quote) "lower the Resistance to Control." The Warner Fire Recovery Project was one of the first timber sales of the 1990s to use the now-prevalent rationale of logging-for-firefighting. Agency managers hardly caught the irony of proposing new commercial logging as a "recovery tool" for a species threatened with extinction by the effects of past commercial logging.

Alternative EF: Ecology of Fire

Conservationists were appalled but not surprised at the agency's 1992 draft recovery plan to log 40 million board feet of trees from 1200 acres of the Roadless Area. In response to the Draft EIS, a group of citizen-scientists drafted their own alternative recovery plan which they called "Alternative EF: Ecology of



Fire." Alternative EF proposed managing the entire Warner Burn for research and restoration of natural fire recovery processes, with the goal of establishing a fire ecology Research Natural Area sometime in the near future. Dubbed the "Know Action" alternative, it distinguished itself from the agency's "No Action" alternative by proposing various management activities to facilitate wildfire protection, owl habitat research, and ecosystem restoration.

Alternative EF strove to subvert the agency's fuelbreak strategy by means of "eco-aikido," redirecting the agency's theme of wildfire protection by steering it toward fire restoration rather than fire exclusion. Thus, instead of clearcutting 250-foot-wide fuelbreaks to aid standard firefighting operations, Alternative EF proposed creating a ridgeline trail system to pro-

vide access for prescribed underburning, natural fire monitoring, ecological field research, and if necessary, firefighters applying minimal impact suppression techniques. The main strategy of Alternative EF was to research habitat development and restore fire processes as the primary means of recovering and protecting owl habitat.

The authors of Alternative EF solicited input and endorsements from prominent scientists throughout the Pacific Northwest, many of whom wrote personal letters to the Forest Service encouraging the inclusion of Alternative EF into the Recovery Project. Hundreds of citizens toured the Warner Burn on weekend fire ecology hikes and annual field conferences organized by the Cascadia Fire Ecology Education Project, and sent in a steady stream of supportive letters long after the official comment period had ended. The student governments of Oregon's two largest universities passed official resolutions in favor of Alternative EF and sent these to Forest Service Chief Jack Ward Thomas. The Forest Service's Pacific Northwest Research Station determined that the Warner Burn had high potential as an RNA. Finally, inspired by the Warner Creek Fire and Alternative EF, the Oregon Natural Heritage Advisory Board recommended a new kind of RNA devoted to natural landscape disturbances and dynamic successional processes.

After months of lobbying at different levels of the Forest Service and the Clinton Administration, the Willamette National Forest finally relented and allowed Alternative EF to be fully developed, analyzed, and published in the Final EIS. Conservationists took great delight in seeing the letters "EF" (no exclamation point) appear hundreds of times in the Final EIS. Knowing the widespread popularity among the research community (including Forest Service scientists) for Alternative EF's RNA strategy, the Willamette Forest Supervisor included a 4200-acre "Natural Succession Area" in his final recovery plan. This "NSA" was allegedly set aside for possible future designation as an RNA; however, it would be surrounded by salvage clearcuts and sliced up into six sections by fuelbreaks. Fortunately, neither scientists nor conservationists were fooled by the token green blob plopped in the middle of the agency's salvage logging map.

Three separate times over the course of four years the Warner Salvage Sale was thwarted, and in a case of "three strikes and you're out," the Forest Service has recently declared that due to public demand (an understatement) it has no intention of logging inside the Warner Burn in the foreseeable future. The Warner Fire Recovery Project has essentially been abandoned, and into this management void, the citizen-scientists' RNA proposal has been given renewed hope and opportunity.

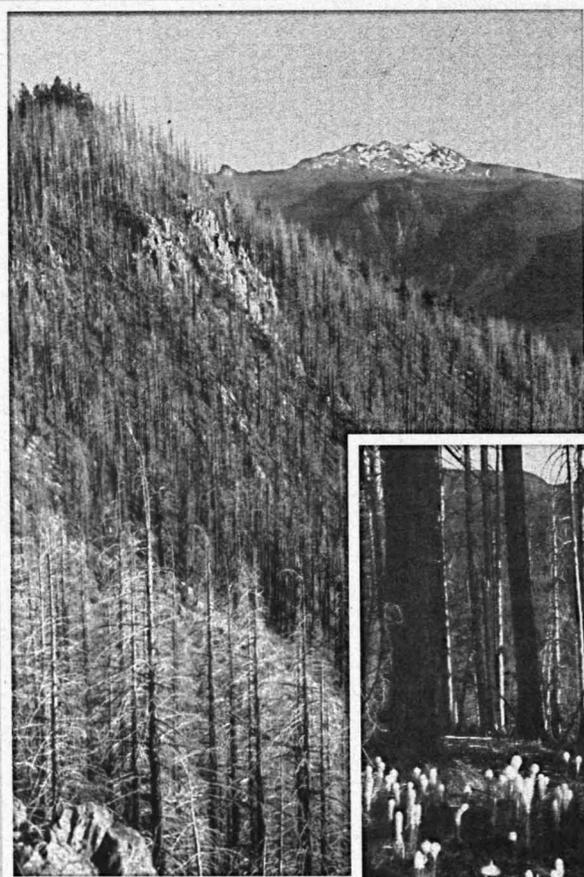
The Warner Fire Process RNA Proposal

The average size of an elemental Research Natural Area is 700 acres, but in the westside Cascades, fire patterns, processes, and frequencies occur at vast spatiotemporal scales; therefore a fire process RNA requires a much larger land base. Unfettered by the former Recovery Project that restricted management ideas to the area within the wildfire perimeter, a new, expansive RNA proposal was formally submitted to the Pacific Northwest Research Station in fall of 1997. Known as the "WARNER" proposal, it uses conservation biology principles to link together five Inventoried Roadless Areas and associated wildlands into a 44,000-acre RNA that would directly adjoin two Wilderness Areas comprising 336,000 acres. At the core of the fire process RNA is the Warner Burn. It is one of the rarest forest landscapes in the Cascadia bioregion: a largely unmanaged, roadless, mid-elevation, recently-burned landscape containing both young natural stands and high-mortality old-growth stands. The relatively large area of the Burn (and its larger fire process RNA proposal) includes a diversity of environmental, vegetational, and disturbance intensity gradients, making it conducive to a broad variety of research projects.

As vital as it is to protect the entire 8973-acre Warner Burn, it is also important to protect an equal or greater amount of adjacent unburned land for comparative studies and replicated research sites with data sets needed for valid statistical analyses. In addition to the need for a large territory, a fire process RNA must have its boundaries determined by topographic features such as ridgelines, talus slopes, creek beds, or even existing roads, so that future fires may be confined without the need for aggressive suppression. Aggressive firefighting of the sort waged during the Warner Creek Fire could adversely affect research sites. Fortunately, the Wilderness Areas along the Cascade Crest recently developed a natural prescribed fire program, which should dovetail nicely with the Warner RNA's fire research-restoration management plan. Moreover, the appropriate use of management-ignited prescribed fires to create more defensible boundaries should also be considered in the design of the RNA, since this could serve both research and restoration goals.

Time to Learn from the Burn

The size and scope of the Warner RNA proposal has revealed some paradoxes that could pose challenges to reaching consensus among land managers, fire scientists, and forest conservationists. For example, most of the Warner Burn is now a Late-Successional Reserve (LSR) under the Northwest Forest Plan; however, the Forest Service currently manages all Westside



photos: Tim Ingalsbee

FIRE ROILED UP the south slope of Bunchgrass Ridge (left), allowing Bear Paws to bloom (below). Diamond Peak wilderness is in the background.



LSRs as total fire exclusion zones. The Warner Fire Process RNA may necessitate a modification of this policy in this LSR. Recurring low-intensity fires may enhance the development of habitat structures and multi-storied canopies favored by spotted owls, but another high-intensity fire may retard spotted owl habitat development. This issue raises the prospect that fire imposes some trade-offs between scientific and conservation goals for the RNA.

Perhaps the most controversial aspect of the Warner RNA proposal is the fact that the area contains logging roads and plantations, and a RNA would affect land-use allocations for future timber extraction. The Oregon Natural Heritage Advisory Board determined that if ten percent or less of the reserve's land-base has been affected by past management, then the research and ecological values are still valid for a fire process RNA. The

28 plantations that were utterly consumed by the Warner Creek Fire attest to the fact that fire is marvelously effective at rewilding landscapes, but old roads and clearcuts may alter the pattern and process of some fire events, and thus affect scientific data. An idea worth exploring is whether or not restoration activities such as road obliteration, noncommercial thinning of plantations, and prescribed underburning are suitable "research" activities within a RNA. Also under discussion is whether special buffer zones for limited commercial extraction of firewood and nontimber products (e.g., mushrooms) would be acceptable in the RNA; such provisions would likely make RNA designation more politically palatable.

Conservation objectives for the Warner Burn have evolved beyond the focus on a single Endangered species to include protection for an array of native flora and fauna and their ecological

relationships with fire processes. Despite the absence of any formal protection, the Burn continues to be a center of research and educational activities. Nearly 100 study plots have already been established by Forest Service ecologists and students from Oregon State University, the Cascade Science School, and the Northwest Youth Corps. Guided fire ecology hikes occur on a monthly basis, allowing people to witness with their own eyes the incredible beauty and bounty of life in the Burn. Indeed, numerous first-time visitors often undergo a dramatic "Gestalt switch" whereby they suddenly perceive forest fires as agents of rebirth and renewal rather than death and destruction. These research and educational activities continue with the anticipation that formal RNA protection will be forthcoming, allowing future generations an equal or better opportunity to "learn from the Burn."

Strategic RNA Proposals as Trailblazing Conservation Tools

Inspired by the remarkable success of the citizen-scientist RNA proposal for the Warner Fire Recovery Project, there is growing interest among conservationists in using RNA proposals to protect fire-affected roadless wildlands threatened by salvage logging sales. Most RNA proposals have been declared "dead on arrival" at the decisionmaker's desk, with the pat response that

design fire prescriptions for Alternative EF. In developing and using RNA proposals as a successful—rather than merely symbolic—conservation tool, one must be prepared to engage in similar organizing and collaborative work with nontraditional allies. The RNA proposal was the vehicle used to fuse an alliance between the research and conservation communities, and was a major factor in the successful campaign that stopped the salvage sale even during the lawless Salvage Rider.

RNA proposals hold much appeal because the idea of protecting land in perpetuity as a living learning center for ecological research and ecosystem restoration is a far more compelling, progressive vision than typical run-of-the-mill salvage timber sales. Conservationists can make several valid scientifically based arguments: RNAs are reservoirs of biological and genetic diversity; refugia for Sensitive, Threatened, and Endangered species; control areas for comparing with quasi-experimental intensive management treatments elsewhere; and benchmarks for measuring broad environmental change. But there are also socioeconomic reasons why RNA proposals are attractive to a wide spectrum of people. Whereas the precise quantity of salvage logging and milling jobs can be fairly predicted, these jobs are finite in number and duration. On the other hand, there is almost no limit to the number and duration of direct employment oppor-

WHEN THE STAKES ARE FRAMED as science vs. salvage, or students vs. stumps, we discovered a powerful new alliance can be built between the research and conservation communities that is capable of saving burned forests from the salvage saws.

they are "outside the scope" of the given fire recovery project. This happened to Alternative EF, too, but a small group of grassroots organizers mobilized an alliance of scientists, educators, students, conservationists, and sympathetic employees from the Forest Service and other land management agencies to push for inclusion of the RNA alternative in the Final EIS. Some scientists nervous about engaging in "lobbying" of the agency or administration were won over by the activists' argument that given the government's attempts to politicize science, it was time for scientists to get political! If anything, scientists need to stand up and speak out for their own interests in scientific research, making themselves a new kind of "user group" (to speak the agency's language) in need of unmanaged landscapes.

Likewise, Earth First! activists who had long careers protesting against Forest Service management were convinced to work collaboratively with agency resource specialists to

tunities for researchers, educators, restorationists, and managers over the next century or two managing an RNA.

Of course, these jobs would not be funded through commodity resource extraction but rather through appropriated funds, grants, endowments, and other similar sources. To the question, "Where will this money stream come from?" the response should be, "From the boondoggles to which it now flows." Deficit timber sales, wildland fire suppression, military adventurism, and a host of corporate welfare scams waste federal funds that could instead go to research and restoration projects. Research Natural Areas are an investment in knowledge creation that the present generation gives to future generations. The "payoff" of such knowledge may be difficult to quantify in dollars, but who can predict the socioeconomic benefits if that elusive secret to forest ecosystem sustainability with natural fire disturbances were discovered?

Finally, the concept of RNAs protecting ecosystem processes more accurately reflects current ecological science, and rectifies conservationists' dilemma of advocating for "preservation" of dynamic, continually evolving landscapes. Natural process RNAs provide for the land's needs following past/present disturbances, and prepare society to welcome—rather than fear—future natural disturbances. However, the Warner Fire Process RNA alone will not provide all we need to learn about fire disturbance and recovery processes in forest ecosystems; instead, we need a network of similar process RNAs for all natural disturbance mechanisms (e.g., floods, windstorms, insects and diseases, etc.) distributed in all ecoregions across the continent. Those roadless wildlands affected by these natural disturbances should be studied, not "salvaged" or "sanitized" with commercial logging and roads.

The RNA strategy fits well into the goals of The Wildlands Project for protecting and rewilding landscapes. Importantly, RNAs and Wilderness are not mutually exclusive; indeed, some Wilderness areas presently contain RNAs. Wilderness designation requires an act of Congress, while RNA establishment merely needs the stroke of a Regional Forester's pen; thus, in some places it may be more politically feasible to propose a RNA. The potential socioeconomic benefits of managing RNAs may also provide effective arguments for people unswayed by ecocentric reasons for land protection.

With citizen-initiated fire process RNA proposals, conservationists now have another tool for advocating for wildlands protection, particularly for recently burned or fire-prone landscapes. Fire process RNA proposals offer a positive alternative management plan for so-called fire recovery projects—one that avoids the false choice between salvage logging and No Action. When the stakes are framed as science vs. salvage, or students vs. stumps, we discovered a powerful new alliance can be built between the research and conservation communities that is capable of saving burned forests from the salvage saws. ☪

Timothy Ingalsbee is the director of the Western Fire Ecology Center for the American Lands Alliance. A frequent speaker and writer on fire-management issues, Dr. Ingalsbee was a wildland firefighter for the US Forest Service and National Park Service in the 1980s. He received Oregon's Conservationist of the Year Award in 1993 for his innovative activism that helped prevent salvage logging of the arson-burned spotted owl sanctuary in Warner Creek. The Western Fire Ecology Center (P.O. Box 51026, Eugene, OR 97405; 541-302-6218; fire@efn.org) does research, analysis, education, and advocacy on fire-related forest management issues.

ADDENDUM

IN LATE APRIL 1999, THE FOREST SERVICE HOSTED A roundtable discussion at Oregon State University on designing and managing Fire Process Research Natural Areas. Scientists from various universities, federal and state agencies, and private organizations throughout Oregon, Washington, and British Columbia attended. Notably, Forest Service scientists made several eloquent arguments for establishing expansive RNAs to study fire processes affecting whole watersheds.

Out of a free-flowing discussion, some general points of consensus emerged about Fire Process RNAs: 1) they have significant scientific and ecological merit for their research and conservation values; 2) they must be relatively large in size—on the scale of 30,000 acres or more—in order for scientists to research and manage fire ecology processes at the scale at which they function in the westside Oregon Cascades; 3) they need to include adjacent unburned and burned areas for comparative research and monitoring; 4) in the face of impending rapid climatic change, they should be designed and managed to include future fire events and ecological processes as well as successional processes from past fire events; and 5) no single RNA site will suffice, but rather, a network of Fire Process RNAs should be established to represent fire-dependent/fire-adapted ecosystems in other bioregions.

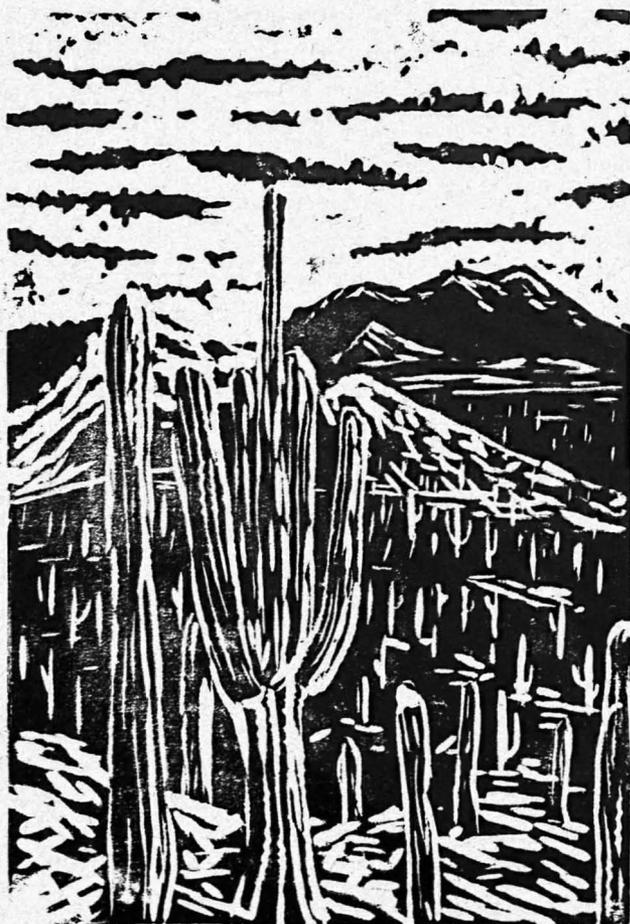
Proponents of the Warner RNA who were invited as silent observers were delighted at the results of the day-long discussion, for it gave further legitimacy to the WARNER proposal. Unfortunately, the Forest Service prohibited discussion of site-specific RNA proposals from the symposium, and omitted any mention of Warner Creek from the scientists' informational packets or the meeting agenda. Ironically, the original purpose of the symposium was to give the agency more information so they could proceed with a formal public process to establish the Warner RNA. However, following the symposium, grim-faced managers from the Willamette Supervisor's Office announced that they had no timeline, budget, or assurance for proceeding with the Warner RNA proposal. In response to this new bout of stonewalling by Willamette Forest managers, local activists have decided to pursue a legislative strategy to get Congress to authorize the Warner Fire Process Research Natural Area.



State of the ECOSYSTEM Reports

A Tool for Wildlands Advocacy

*by Andrew Holdsworth,
John Talberth, and
Bryan Bird*



In recent years, conservationists have adopted a new strategy for promoting wildlands recovery—preparing State of the Ecosystem Reports (SERs). These reports, like politicians' state of the union and state of the state speeches, present an overview of current affairs and articulate policy solutions to problems. For wildlands activists, the status quo is woefully irresponsible management of native biological diversity by federal, state, and private landowners throughout the nation. We envision the principles of conservation biology applied to land management—in time not only to prevent extinction, but also to maximize opportunities for reestablishment of native plants and animals to a significant portion of their historical ranges. By clearly articulating the problems that need fixing in current natural resource management, SERs can play an important role in laying the political groundwork for widespread support of wildlands recovery proposals once they are released to the public.

Wildlands Project cooperators have produced State of the Ecosystem Reports that vary significantly in content, tone, style, and purpose. In this article, we describe core elements of SERs and the time and funding needed to produce them. We draw on the approach used by Forest Guardians in its "State of the Southern Rockies: San Juan-Sangre de Cristo Bioregion" report, as well as the perspectives of SER authors from four other bioregions: Sonoran Desert, Southern Rocky Mountain, Grand Canyon, and Yellowstone to Yukon. Executive summaries of two of the five SERs discussed here accompany this article; summaries of the remaining three SERs will appear in a future issue of *WE*.

Core Elements

A fundamental purpose of all SERs should be to promote our vision of wildlands recovery to the public. To make wildlands initiatives politically feasible, a broad cross-section of people must accept the idea that such strategies hold the promise of resolving long-term natural resource management conflicts. To fulfill this role, SERs should lead the reader from an overview of native ecosystems and how those ecosystems are at risk, to an acknowledgment of key threats to those ecosystems, to a recognition that ecological reserve networks can help eliminate those threats and restore degraded ecosystems for perpetuity in an economically, culturally, and politically acceptable manner. We suggest the following specific components and analyses be included in SERs:

1. Profile of Native Ecosystems and Indicator Species.

This section should provide an overview of terrestrial and aquatic ecosystems, their associated wildlife species, and the importance of natural processes such as fire, floods, and pathogens to

long-term ecosystem stability. The overview should identify general ecosystem types, constituent plant communities within these ecosystems, and profiles of focal species that represent the health of each ecosystem type. Such profiles should contain information on taxonomy, range, population levels, and habitat. They should link each species, if possible, to essential structural components, processes, or conditions (e.g., seral stage) of the ecosystems they inhabit. For example, within forested communities, focal species should include species associated with large snags and downed woody material, since these elements exist only in relatively healthy, unmanaged stands.

In this section, also include maps of key ecological communities, as well as analysis indicating the distribution of these communities among major landowners.

2. Endangered Ecosystems or Ecosystem Components.

SERs should identify ecosystems or their components that are especially vulnerable to degradation. The methods used to identify these "endangered" ecosystems and ecosystem components may include: (a) a comparison between historical and current ecosystem distribution and extent; (b) an analysis of the relative number of Threatened, Endangered, and Sensitive species within ecosystems; (c) an analysis of the degree of human impact by ecosystem type. From these analyses, native terrestrial and aquatic ecosystems that represent a fraction of their historical extent, are highly fragmented, support multiple federally listed species, and are intensively developed will arise as imperiled and worthy of extra attention in the context of wildlands recovery strategies.

3. The Economic and Cultural Significance of Native Biological Diversity.

The SER should describe, and where possible provide quantitative information regarding, the economic value of wildlands protection and recovery. These values range from increases in the quantity and quality of recreation and tourism to enhanced "ecosystem services" as degraded lands heal and ecological processes are allowed to function naturally across the landscape. The SER should compare the relative economic benefits of extraction versus ecosystem protection; for example, a cost-benefit analysis might be included contrasting the threat of catastrophic flooding in a deforested versus a rehabilitated watershed.

In many parts of the country, wildlands recovery strategies affect lands occupied by indigenous peoples. The traditional land uses of indigenous cultures provide a good source of information about sustainable land management practices and the historical use of native plants and animals. Preserving cultural resources

and indigenous knowledge of native biological diversity is an important justification for regional conservation planning and should be featured prominently in SERs, where applicable.

4. Ongoing Threats to Native Ecosystems. The SER should describe two types of threats to native ecosystems: (a) systematic threats that stem from a fundamental disconnection between existing land use and principles of conservation biology, and; (b) specific threats from particular land management activities. Systematic threats include the widespread failure of existing protected areas to represent all native ecosystems and the predominate use of "single species" management. Specific threats vary from bioregion to bioregion, but include urban sprawl, logging, mining, grazing, agriculture, dams, water diversion, power lines, industrial recreation, and proliferation of exotic species.

Supporting graphics for this section may include gap analysis maps showing gaps in native ecosystem representation in protected areas; maps depicting the extent of human impacts, such as roads; and maps, photos, or graphics illustrating the adverse effects of specific land uses on native biological diversity.

5. An Overview of the Proposed Wildlands Recovery Strategy. SERs may present the ecological, economic, and cultural justification for a proposal that is already in draft or final form, or recruit involvement in the process of designing the plan. Either way, the final chapter in a SER should (a) provide an overview of the proposed strategy or process being used to develop the strategy; (b) identify the potential components of the strategy, and; (c) discuss how the strategy will be implemented and what help is needed from legislators, agencies, scientists, and the general public.

Supporting maps and graphics may include maps of the draft or final land designations; tables of proposed management prescriptions within each major designation; tables indicating the number of acres of each major vegetation community in each proposed designation; and a chart of implementation opportunities.

Variations on the SER Theme

In some bioregions, conditions might favor a different approach than the one outlined above. For instance, the Sonoran Desert SER covers a region that spans two US and three Mexican states. Significant data gaps in the biodiversity inventory for this region forced the authors to concentrate on known threats rather than complete a comprehensive biodiversity assessment. The report used a survey of field scientists and land managers in both countries to rank regionwide and specific biotic community threats,

highlight key sites for protection, and draft a list of focal species. While it did not offer a specific reserve design strategy, the Sonoran Desert SER was produced quickly and inexpensively, was incorporated into many conservation activities in the region, and catalyzed the drafting of a reserve design strategy.

Some current SERs are designed to set the stage for reserve design and invite participation in the process while leaving the specific components of design and implementation to a later document. In taking this approach, the Grand Canyon SER was able to include a more detailed description of the region's ecology and threats, as well as prehistorical, historical, and paleoecological perspectives often overlooked by conservationists. On the other hand, SERs that combine information on the proposed reserve design with supporting scientific, economic, and cultural documentation have the advantage of providing the reader with a logical connection between the two parts. This approach can advance the reserve design process more quickly. Choosing an approach is a tactical decision that depends on the political circumstances in the bioregion and needs to be made very early in the SER planning process.

Who Do SERs Reach?

Well-designed SERs not only integrate disparate information in one place, they also synthesize ideas and information in compelling ways for the benefit of wildlands protection. Thus, they should have wide distribution. Forest Guardians distributed its report to over 400 individuals, lawmakers, land and resource managers, nonprofit organizations, planning departments, and libraries throughout the bioregion. The release was accompanied by a media campaign that led to coverage of the report in most regional newspapers. The Southern Rockies Ecosystem Project has similar distribution plans, and also expects to conduct a series of public meetings throughout the ecoregion. To reduce printing and distribution costs, the Grand Canyon Wildlands Council plans to focus on distribution to individuals and groups who will be most involved in the reserve design process.

Cost and Staffing of SERs

Production costs of the SERs discussed here varied widely. The primary factors affecting cost were the type and sophistication of analyses and the design and printing quality of the report. For a report that features the five major elements discussed above with GIS analysis and mapping (like the San Juan-Sangre de Cristo and Southern Rocky Mountain publications), total cost from research to distribution averaged about \$100,000. SERs of this magnitude have required two to three years of part to full-time work for three people, up to five short-term contractors, and sev-

eral interns. Two co-editors worked a total of six months over two years to produce the Grand Canyon SER from seven contributed chapters. Largely because this SER relied so much on outside contributors, the anticipated cost is \$35,000. The Yellowstone to Yukon Atlas required one and a half years of work for two part-time coordinators/editors, a project director, a part-time graphic artist, and additional contractors. Including honoraria to the 12 contributors, the total cost was \$84,000. The Sonoran Desert SER, which did not include the detailed analyses, was written and edited by two people working half time over six months and cost only \$7500. Even within this large range of total costs, printing costs for each copy of these SERs still averaged \$10–25 US, so it is helpful to make SERs available on web sites.

Conclusion

State of the Ecosystem Reports are valuable public education tools for advancing wildlands recovery strategies. To be most effective, we offer the following tips for those beginning the SER process:

- 1) Form a clear vision of what you would like to accomplish with the SER: Who will your audience be? What types of data, resources, and expertise are necessary and available to attain your goals? What bioregional issues need to be addressed? What kinds of analysis, maps, and graphics will be needed to effectively communicate your vision?
- 2) Identify a coordinator with sound project management skills to shepherd the project from beginning to end.
- 3) Hire an editor early in the project (especially for SERs using contributed chapters).
- 4) Decide early on what quality of graphic design and printing you want or can afford. Get many references for the design company.
- 5) Do not skimp on data collection and interpretation. Your organization's credibility will depend on solid data and analyses.
- 6) Have the SER reviewed by outside scientists and independent experts before publication.

State of the Ecosystem Reports are useful documents that have accelerated wildlands reserve design processes in several bioregions. They can bolster an organization's visibility and credibility; reports produced so far have been well received by funders and agencies. In response to the San Juan-Sangre de Cristo report, a Forest Service biologist said, "We need to think



about managing at large scales; this is a good starting point, this is something that's good to read just to be exposed to those ideas." Most Wildlands Project cooperators live by these ideas, but State of the Ecosystem reports allow us to communicate these concepts to a much larger audience. By doing so, we greatly increase the chances that our wildlands recovery strategies will be embraced as solutions to ongoing battles over natural resource management policies. ☺

The authors sincerely thank Kelly Burke, Doug Shinneman, and Louisa Willcox for their contributions to this paper and Hillary Oppmann for editing earlier drafts.

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John Talberth is the principal author of Forest Guardians' "State of the Southern Rockies: San Juan-Sangre de Cristo Bioregion" and serves as executive director of Forest Guardians (1411 Second Street, Santa Fe, NM 87505).

Bryan Bird co-authored the "State of the Southern Rockies: San Juan-Sangre de Cristo Bioregion" and is conservation biologist for Forest Guardians.

State of the SOUTHERN ROCKIES

San Juan-Sangre de Cristo Bioregion *by John Talberth*



At the southern end of the Rocky Mountain chain, a cluster of Wilderness Areas, roadless wildlands, white water rivers, and open spaces represents one of the last opportunities to preserve functioning ecosystems on the continent. This area, called the San Juan-Sangre de Cristo bioregion, is the focus of Forest Guardians' recently released "State of the Southern Rockies" report. This document, the culmination of three years of mapping and research, calls for collaboration on a bioregional conservation strategy that will help resolve the day-to-day conflicts over natural resource management and allow for the recovery of ecosystem health across the region.

The San Juan-Sangre de Cristo bioregion encompasses a diverse mixture of desert, forest, grassland, dunes, and tundra that totals over 20 million acres. Sensitive species such as cutthroat trout, Goshawk, bighorn sheep, river otter, and Willow Flycatchers persist, although their habitats face increasing threats. If an interconnected network of reserves and corridors is established here, the San Juan-Sangre de Cristo (SJSDC) bioregion can be a model for ecological recovery, serve as a wildlife refuge and source for recolonizing populations of wildlife extirpated elsewhere in the West, and a showcase of native biological diversity that draws visitors from around the globe.

The "State of the Southern Rockies" report builds the scientific, political, and economic case for regional wildlands recovery; it reviews the distribution and status of major ecological communities in the SJSDC bioregion, the economic and cultural significance of native biological diversity, and major environmental threats as we head into the 21st century. The report concludes with an overview of a proposed wildlands strategy that involves all major stakeholders.

Critical Ecological Resources at Stake

"State of the Southern Rockies" includes a review of the extent, distribution, ownership, and condition of major terrestrial and aquatic ecosystems in the SJSDC. Specific findings include:

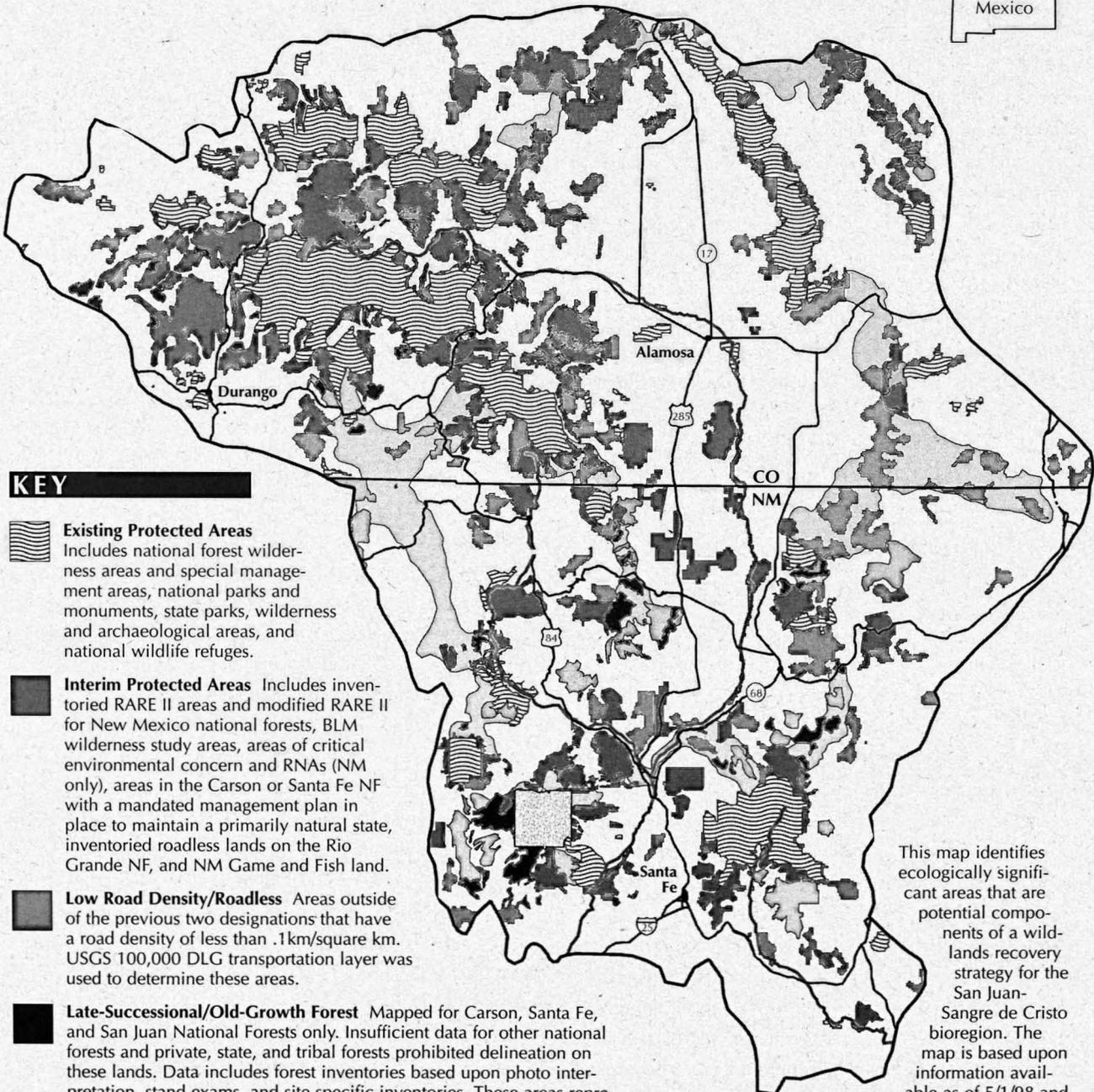
- Although the federal government manages nearly 50% of the landscape, the 50% in private and state hands contains a rich assortment of native ecosystems and species, many of which are imperiled.

- Six priority natural resources of critical environmental concern include (1) alpine tundra and subalpine meadows; (2) unroaded wilderness; (3) montane old-growth forest; (4) wild rivers; (5) lowland riparian areas and wetlands, and; (6) low-elevation grasslands.

- At least 509 native vertebrate species inhabit the bioregion, including 348 birds (68%), 90 mammals (18%), 32 reptiles (6%), 28 fish (6%), and 11 amphibians (2%). Of these, roughly one hundred are important indicators of the health of forest, grassland, shrubland, and aquatic ecosystem communities.

POTENTIAL COMPONENTS OF A WILDLANDS RECOVERY STRATEGY

San Juan-Sangre de Cristo Bioregion



KEY

- 
Existing Protected Areas Includes national forest wilderness areas and special management areas, national parks and monuments, state parks, wilderness and archaeological areas, and national wildlife refuges.

- 
Interim Protected Areas Includes inventoried RARE II areas and modified RARE II for New Mexico national forests, BLM wilderness study areas, areas of critical environmental concern and RNAs (NM only), areas in the Carson or Santa Fe NF with a mandated management plan in place to maintain a primarily natural state, inventoried roadless lands on the Rio Grande NF, and NM Game and Fish land.

- 
Low Road Density/Roadless Areas outside of the previous two designations that have a road density of less than .1km/square km. USGS 100,000 DLG transportation layer was used to determine these areas.

- 
Late-Successional/Old-Growth Forest Mapped for Carson, Santa Fe, and San Juan National Forests only. Insufficient data for other national forests and private, state, and tribal forests prohibited delineation on these lands. Data includes forest inventories based upon photo interpretation, stand exams, and site specific inventories. These areas represent clusters of late-successional/old-growth forests, so they include some younger stands.

- 
Occupied and Potential TES species Habitat Areas for threatened, endangered and sensitive wildlife were mapped with data provided by the Forest Service and BLM for numerous listed or sensitive species.

- 
Potential Landscape Linkages

- 
Proposed Jemez Mountains National Park

This map identifies ecologically significant areas that are potential components of a wildlands recovery strategy for the San Juan-Sangre de Cristo bioregion. The map is based upon information available as of 5/1/98 and is not necessarily inclusive of all ecologically significant tracts. The map displays potential components in a prioritized sequence as defined by the order in which land classifications are listed in the key. As a result, any particular tract of land may contain some or all of the values associated with land classifications that appear below it on the key.

The Economic and Cultural Significance of Native Biological Diversity

Through the millennia, native cultures have utilized wild plants and trees, game, and clean water sources for subsistence living and dryland agriculture. After a period of industrialization that lasted nearly a hundred years, the economy now increasingly depends upon intact wildlands. We have found that:

■ Throughout this century, extractive industries have declined, and now represent a small fraction of the SJSDC's economy. The economic value of recreation on National Forests, for example, was over 200 times that of timber in 1996.

■ Healthy ecosystems and the "ecosystem services" they provide—which include water filtration, flood control, pollination, pest control, and carbon sequestration—are the foundation of a sustainable economy. The economic value of these services has recently been estimated at over \$33 trillion globally each year.

Ecological Threats to the San Juan-Sangre de Cristo Bioregion

A litany of ecological threats undermines the status of the SJSDC bioregion as a world-class concentration of healthy ecosystems. Our major concerns include:

■ While 25–80% of tundra, dunes, and spruce-fir forests are included in Wilderness Areas, National Parks, and National Monuments, only 1–12% of habitats with higher biological productivity such as riparian zones, ponderosa pine, pinyon-juniper woodlands, and grasslands are protected.

■ Logging, corporate grazing and agriculture, energy development and minerals extraction, industrial recreation, water storage and diversion, exotic plants and animals, road-building, and urban sprawl and development are among the most serious threats to the SJSDC's native ecosystems.

Proposed Wildlands Recovery Strategy

A wildlands recovery strategy will alleviate growing conflicts over natural resource management by "zoning" the SJSDC bioregion into an interconnected system of reserves, habitat linkages, and critical watersheds that are necessary for protection and restoration of native species. Key conclusions from the State of the Ecosystem Report include:

■ An ecologically sufficient wildlands strategy must include terrestrial and aquatic ecosystem protection components, and a restoration strategy.

■ Potential terrestrial ecosystem reserve components in the SJSDC bioregion include (1) additions to existing protected areas; (2) lands that are free from roads or nearly so; (3) clusters of late-successional and old-growth forest; (4) clusters of habitat



for imperiled native species; (5) rare or under-represented vegetation types, such as grasslands, and; (6) landscape linkages that tie reserve components together, providing migration corridors for vegetation and wildlife.

■ Roughly 38% of the bioregion's 20 million acres exhibits characteristics important to a bioregional wildlands strategy.

■ Potential aquatic ecosystem reserve components in the SJSDC bioregion include a system of key watersheds, which serve as refugia for native aquatic species such as cutthroat trout, and riparian reserves along the 100-year floodplain of streams and rivers.

■ An ecologically sound restoration strategy will require widespread use of prescribed fire and flooding; reintroduction of top predators including the grizzly, gray wolf, and lynx; and aggressive replanting of native riparian vegetation.

By distributing "State of the Southern Rockies" to all major stakeholders in the region, we hope to jumpstart the process of developing a bioregional wildlands strategy that will pass on a rich endowment of native biological diversity to future generations who will inhabit this spectacular mountain region. ☺

John Talberth is the executive director of Forest Guardians (1411 Second St., Santa Fe, NM 87505; 505-988-9126; suwild@fguardians.org). Copies of the "State of the Southern Rockies: San Juan-Sangre de Cristo Bioregion" may be ordered from Forest Guardians.

State of the SONORAN DESERT BIOME

by Gary Paul Nabhan and Andrew Holdsworth

Picture a hyperarid horseshoe surrounding a hypersaline sea, the Gulf of California. Imagine a relatively frost-free landscape—the dream of any horticulturist—but in a region with not one, but two chances for drought each year that may cause crop failure. Consider a place for tropical plants to grow in the worst of all soil media: infertile sands, alkaline tale, or burning volcanic cinder heaps. These are some views of the most tropical of the North American deserts, the Sonoran Desert of the southwestern United States and northwestern Mexico.

This area is the focus of “State of the Desert Biome: Uniqueness, Biodiversity, Threats and the Adequacy of Protection in the Sonoran Bioregion,” a report that highlights 1) the uniqueness of the Sonoran Desert bioregion with respect to its organisms, ecological interactions, and landscapes, and 2) the threats to this region’s biological diversity. It is based on the compilation of surveys of 54 field scientists who average twenty years of field experience in the region.

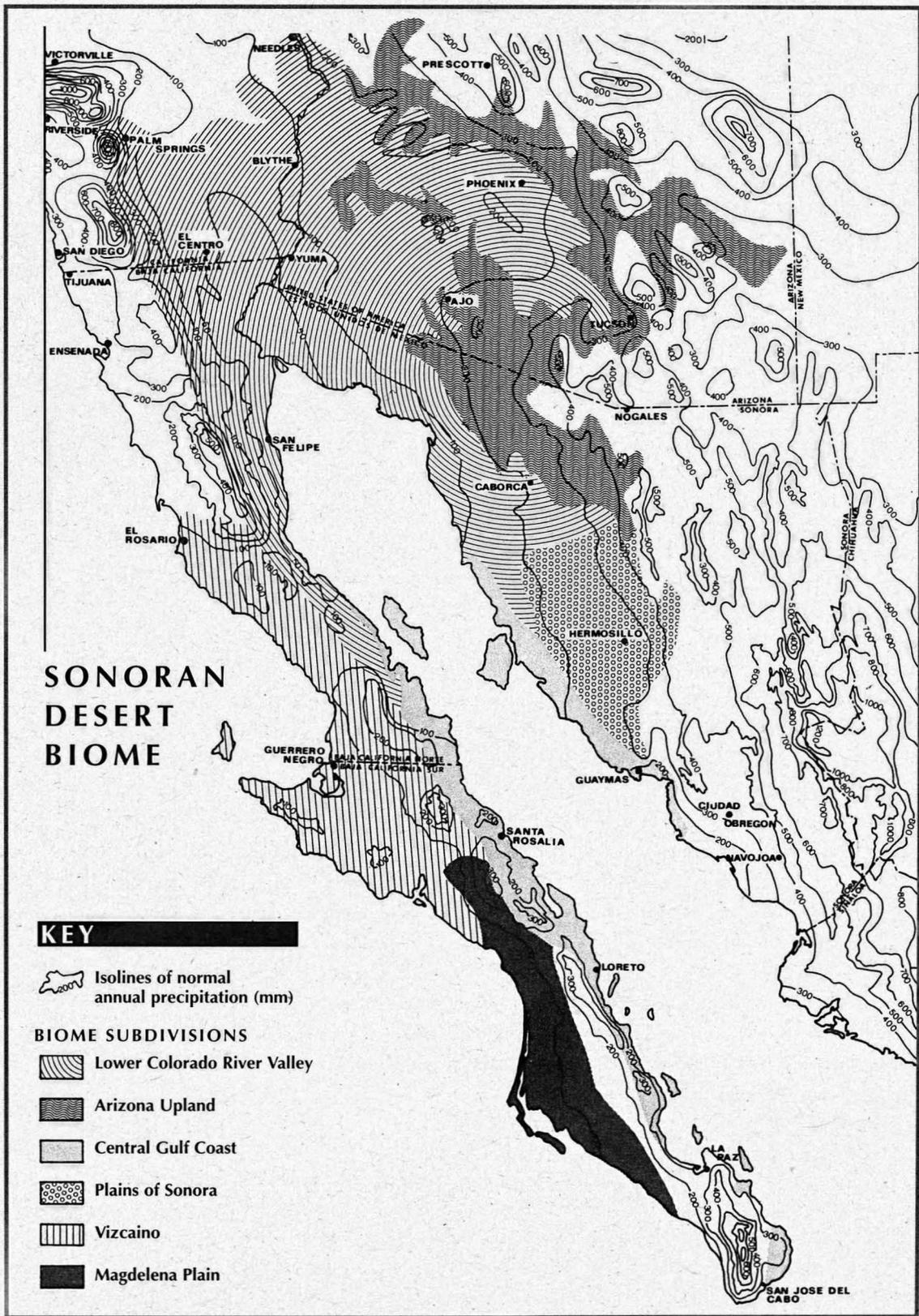
The Sonoran bioregion has distinctive biotas in each of its subregions as a result of geographic isolating factors. Most obvious is the Gulf of California, which has fostered high levels of endemism—unique sets of species—of plants, reptiles, and small mammals on its 21 islands and on peninsular Baja California. Estimates of plant species richness in the Mexican state of Sonora alone may be as high as 4500 species, or 20% of Mexico’s total flora in an area of less than ten percent of the country. Reptile and riparian breeding bird diversity are also notable. The overall pollinator diversity of the Sonoran region’s bees, butterflies, and bats is remarkably high compared to other areas of North America. The extant cultural diversity of indigenous communities is as high as any region north of the tropics.

Threats to Biodiversity

Based on the surveyed scientists’ observations since 1975, the top ten threats are:

- 1) Urbanization;
- 2) The high rate of human migration to the region;
- 3) Surface water impoundment and diversion;
- 4) Inappropriate livestock grazing;
- 5) Aquifer mining and salinization;
- 6) Lack of planning for growth;
- 7) Exotic grass planting;
- 8) Conversion of natural habitats to farmlands;
- 9) Recreational impacts;
- 10) Biological invasions.





From *Biotic Communities: Southwestern United States and Northwestern Mexico*, edited by David E. Brown. ©1994. Permission to reprint courtesy of the University of Utah Press.

Since World War II, the Sunbelt of the US Southwest and Northwest Mexico has witnessed the largest in-migration in human history. A century and a half ago, indigenous communities still outnumbered European colonial communities, both in number and in the amount of land and water they managed.

Today, the economic activities of the region are dominated by individuals who have lived in the region for less than a decade. The region's population nearly doubled (+98%) to 6.9 million between 1970 and 1990. Currently, there is no sign that population growth will taper off during the next few decades.

Between 1940 and 1990, the populations of Arizona, Baja California Norte, and Sonora shifted from being one-half to two-thirds rural, to over three-quarters urban. The effects of this urbanization on biodiversity are many and mutually reinforcing, and include: direct habitat loss; channelization or disruption of riparian corridors; proliferation of exotic species; wildlife mortality by automobiles, toxics, and pets; and the fragmentation of remaining patches of natural vegetation into smaller pieces that are unable to support viable populations of native species.

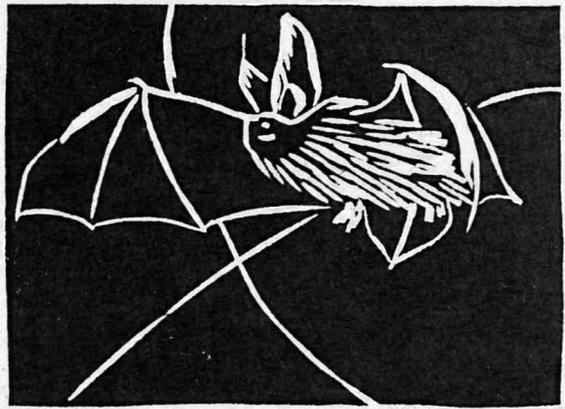
Forty-one major dams and associated irrigation canals have impounded and diverted water flows from virtually all of the region's major rivers. Among US Federal Register notices listing plants and animals as Endangered species, water impoundment and diversion are among the most frequently cited threats. Thirty-six of the 82 breeding bird species that formerly used riparian woodlands have suffered population declines in the bioregion. Together, water diversion and groundwater pumping have affected nearly all river valleys in Arizona's portion of the Sonoran Desert.

Overgrazing still continues on public and private lands in Arizona and Mexico. Two to five times the recommended stocking rates regularly occur on the Sonora side of the border. The cattle-related introduction and intentional sowing of African grasses has not only affected the biotic composition of semi-desert grasslands, but has profoundly changed vegetation structure, fire intensity and frequencies, and migratory wildlife corridors within several subregions of the Sonoran Desert.

Adequacy of Current Protection Measures

We have witnessed more areas decreed as "protected" in the last decade than any other in the history of the Sonoran bioregion. In addition, there are now more resource managers working on both sides of the border than there were a decade ago, although many more need training to better manage areas for biodiversity instead of for single species or recreation.

Most surveyed scientists felt that managers of protected areas are still allowing biodiversity-depleting activities. However, it is a hopeful sign that over one-quarter of the respondents see fewer harmful activities occurring today than before the decree of recently protected areas or before 1975. A notable portion of the scientists thought that grazing was finally being addressed sufficiently in discussions between resource managers, ranchers, and scientists. However, a majority of the scientists believed that virtually no ecological threat is being adequately addressed anywhere in the Sonoran biome where these biologists have worked. For each Sonoran subregion, vulnerable species and areas, and areas that merit protection, are listed in the State of the Desert Biome report.



Emerging Conservation Needs and Priorities

When field experts were asked what should be the number one priority for conservation, they responded in a variety of ways, noting policy issues, research and education needs, as well as earmarking species, habitats, or landscapes in critical need of conservation. The extensive list ranges from the need to shift away from social and economic systems that reward consumptive behaviors and short-term gain while damaging natural systems, to the need to manage irrigation tailwaters and sewage effluent for restoring the wetlands of the Colorado River delta.

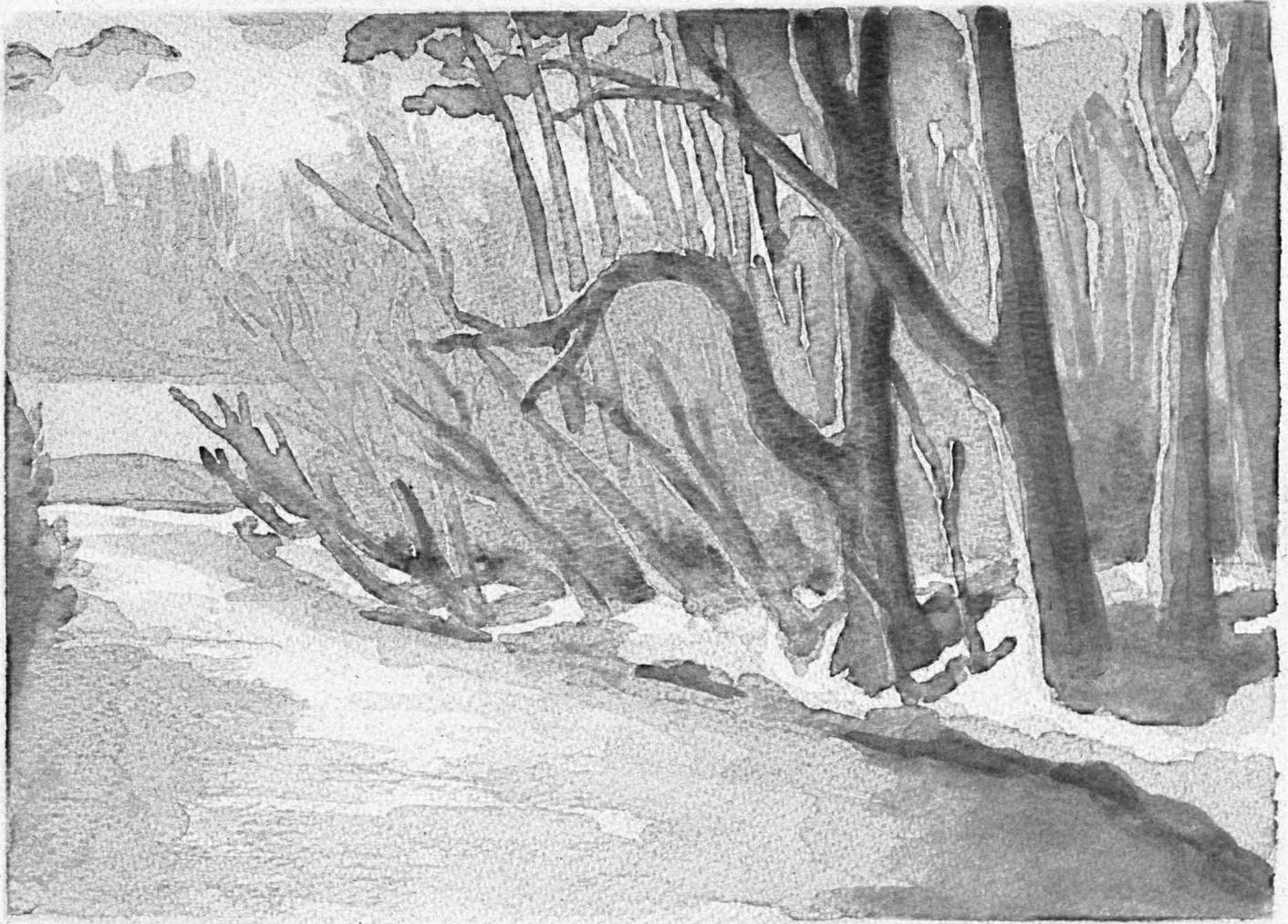
What's Next?

There are four pressing issues identified that require considerable discussion and conservation action:

- 1) The need to restore habitat connectivity, both via urban planning and agricultural lands restoration, that will allow wildlife movement through areas where it is currently blocked.
- 2) The need to guarantee river flow into coastal lagoons and estuaries of the Gulf of California to ensure nutrient and fresh water flow essential to nursery grounds for invertebrates, fish, and waterfowl.
- 3) The need to redirect the management of critical habitats in state parks, wildlife refuges, and national monuments away from recreation or protection of single species or features, to shift the focus to overall biodiversity and the integrity of habitats, so that the interactions between species and natural communities persist.
- 4) The need for planning that reduces impacts of coastal and island development in the Gulf of California where endemism is the highest. ◻

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The Not-So-Great Wilderness Debate..

by David W. Orr

“Something will have gone out of us as a people if we ever let the remaining wilderness be destroyed; if we permit the last virgin forests to be turned into comic books and plastic cigarette cases; if we drive the few remaining members of the wild species into zoos or to extinction; if we pollute the last clear air and dirty the last clean streams and push our paved roads through the last of the silence, so that never again...can we have the chance to see ourselves single, separate, vertical, and individual in the world, part of the environment of trees and rocks and soil, brother to the other animals, part of the natural world and competent to belong in it.”

—Wallace Stegner

It is odd that attacks on the idea of wilderness have multiplied as the thing itself has all but vanished. Even alert sadists will at some point stop beating a dead horse.

In the lower 48 states, federally designated Wilderness accounts for only 1.8% of the total land area. Including Alaskan Wilderness the total is only 4.6%. This is less land than we've paved over for highways and parking lots. For perspective, at 27,000 acres, Disney World is far larger than many of our Wilderness Areas, roughly one-third of which are less than 10,000 acres in size (Turner, 619). Outside the United States there is little or no protection for the 11% of the Earth that remains wild. It is to be expected that attacks on the last remaining wild areas would come from those with one predatory interest or another, but it is disconcerting that in the final minutes of the 11th hour they also come from those who count themselves as environmentalists. Each of these critics claims to be for wilderness, but against the *idea* of wilderness. This fault line deserves careful scrutiny.

In a recent article, for example, novelist Marilynne Robinson concludes that "we must surrender the idea of wilderness, accept the fact that the consequences of human presence in the world are universal and ineluctable, and invest our care and hope in civilization" (Robinson, 64). She arrives at this position, not with joy, but with resignation. She describes her love of her native state of Idaho as an "unnameable yearning." But wilderness, however loved, "is where things can be hidden...things can be done that would be intolerable in a populous landscape." Has Robinson not been to New York, Los Angeles, Mexico City, or Calcutta, where intolerable things are the norm? But she continues: "The very idea of wilderness permits...those who have isolation at their disposal [to do] as they will." Presumably there would be no nuclear waste sites and no weapons laboratories without wilderness in which to hide them. She ignores the fact

exactly resemble failure." So with a few successes under their belt, unnamed conservationists propose to establish a global "environmental policing system" and serve in the role of "missionary and schoolmaster" to the rest of the world. But we cannot legitimately serve in that role because we, in the developed countries, "have ransacked the world for these ornaments and privileges and we all know it." Accordingly, Robinson concludes that wilderness has "for a long time figured as an escape from civilization," so "we must surrender the idea of wilderness."

I have omitted some details, but her argument is clear enough. Robinson is against the idea of wilderness but she does not tell us whether she is for or against preserving, say, the Bob Marshall or Gates of the Arctic, or whether she would give them away to AMAX or Mitsubishi. She is against the idea of wilderness because it seems to her that it has diverted our attention from the fact that "every environmental problem is a human problem" and we ought to solve human problems first. Whether environmental problems and human problems might be related, she does not say.

The environmental movement certainly has its shortcomings. There are, in fact, good reasons to be suspicious of movements of any kind. But there is more at issue in Robinson's argument. The recognition that governments sometimes use less-populated areas for military purposes hardly constitutes a reason to fill up what's left of Idaho with shopping malls and freeways. Her assertion that abolition and environmentalism have produced ironic results is worth noting. But does she mean to say that we ought to ignore slavery, human rights abuses, toxic waste dumps, biotic impoverishment, or human actions that are changing the climate because we might otherwise incur unexpected and ironic consequences? Yes, rich countries have "ransacked the world," but virtually the only voices of protest have been those of conservationists aware of the limits of the Earth.

And what could she possibly mean by saying that "we are desperately in need of a new, chastened, self-distrusting vision of the world, an austere vision that can postpone the outdoor pleasures of cherishing exotica...and the debilitating pleasures of imagining that our own impulses are reliably good"? Are we to take no joy in the Creation or find no solace and refuge in a few wild places? Who among us imagines their impulses to be reliably good? Would she confine us to shopping malls and a

Continued

that the decisions to desecrate rural areas are mostly made by urban people and support one urban interest or another. Robinson then comes to the recognition that history is not an uninterrupted triumphal march. There have been, she notes, a few dips along the way. The end of slavery in the United States produced a subsequent condition "very much resembling bondage." Now "those who are concerned about the world environment are the abolitionists of this era" whose "successes quite

The title of this essay is borrowed loosely from the book The Great New Wilderness Debate, edited by J. Baird Callicott and Michael P. Nelson (University of Georgia Press, 1998).



If we intend to influence our age in the little time we have, we must focus more clearly and effectively on the large battles that we dare not lose. The time and energy invested in our “great debates” should be judged against the sure knowledge that while we argue among ourselves, others are busy bulldozing, clearcutting, mining, building roads, and, above all, lobbying the powers that be to ensure that these destructive activities continue.

kind of indoor air-conditioned introspection? Finally, Robinson seems not to have noticed that the same civilization in need of “rehabilitation” has done a poor job of protecting its land and natural endowment. Is it possible that human problems and environmental problems are reverse sides of the same coin of indifference and that we do not have the option of presuming to solve one without dealing with the other?

Marilynne Robinson’s broadside is only the latest salvo in a battle that began years earlier with articles by Ramachandra Guha (1989), Baird Callicott (1991), and William Cronon (1995). The issues they raised were, to some extent, predictable. Professor Guha, for example, believes that the designation of wilderness in many parts of the world has led to “the displacement and harsh treatment of the human communities who dwell in these forests” (273). His sensible conclusion is simply that “the export and expansion [of wilderness] must be done with caution, care, and above all, with humility” (277).

Philosopher Baird Callicott’s views and their subsequent restatement raise more complex and arcane issues. Callicott begins, as do most wilderness critics, by asserting that he is “as ardent an advocate” of wilderness as anyone and believes bird-watching to be “morally superior to dirtbiking.” The idea of wilderness may be wrong-headed, he thinks, “but there’s nothing whatever wrong with the *places* that we call wilderness” (587). He is discomforted by what he terms “the received concept of wilderness” inherited from our forebears who were all white males like Ralph Waldo Emerson, Henry David Thoreau, John Muir, Theodore Roosevelt, and Aldo Leopold. Callicott is unhappy with “what passes for civilization and its mechanical motif” that can conserve Nature only by protecting a few fragments. He proposes, instead, to rescue civilization by “shift[ing] the burden of conservation from wilderness preservation to sustainable development” (340). He proposes to “integrate wildlife sanctuaries into a broader philosophy of conservation that generalizes Leopold’s vision of a mutually beneficial and mutually enhancing integration of the human economy with the economy of nature” (346). This does not mean, however, “that we open the remaining wild remnants to development” (346).

The heart of Callicott’s argument, however, has to do with three deeper problems he finds in the idea of wilderness. It perpetuates, he thinks, the division between humankind and Nature. It is ethnocentric and causes us to overlook the effects tribal peoples had on the land. And, third, the very attempt to preserve wilderness is misplaced given the continual change that is characteristic of dynamic ecosystems. Callicott’s critics, including philosopher Holmes Rolston, have responded by saying “tain’t so.” Humans are not natural in the way Callicott supposes. There

are, in Rolston's words, "radical discontinuities between culture and nature" (370). The effects of eight million or so tribal people living without horses, wheels, and metal axes had a relatively limited effect on the ecology of North America. After the initial colonization ten thousand or more years ago, the effects they did have, such as burning particular landscapes, did not differ much from natural disturbances such as fires ignited by lightning. As for the charge that conservationists are trying to preserve some idealized and unchanging landscape, Rolston asserts that "Callicott writes as if wilderness advocates had studied ecology and never heard of evolution...wilderness advocates do not seek to prevent natural change" (375). To his critics, Callicott's dichotomy between wilderness preservation and sustainable development, as if these are either/or, makes little sense.

The dispute over wilderness went public in 1995 with the publication of an excerpt from William Cronon's essay "The Trouble with Wilderness, or, Getting Back to the Wrong Nature" in the *New York Times Magazine*. Cronon did not add much that had not already been said, but he did give the debate a post-modern spin and the kind of visibility that lent considerable aid and comfort to the "wise use" movement and right-wing opponents of wilderness. Remove the scholarly embellishments, and Cronon's piece is a long admonition to the effect that:

We can[not] flee into a mythical wilderness to escape history and the obligation to take responsibility for our own actions that history inescapably entails. Most of all, it means practicing remembrance and gratitude, for thanksgiving is the simplest and most basic of ways for us to recollect the nature, the culture, and the history that have come together to make the world as we know it. (90)

Like Callicott, Cronon hopes that his readers understand that his criticism is "not directed at wild nature *per se*...but rather at the specific habits of thinking that flow from this complex cultural construction called wilderness" (81). In other words, it is not "the things we label as wilderness that are the problem—for nonhuman nature and large tracts of the natural world *do* deserve protection—but rather what we ourselves mean when we use that label." That caveat notwithstanding, he proceeds to argue that "the trouble with wilderness is that it...reproduces the very values its devotees seek to reject." It represents a "flight from history" and "the false hope of an escape from responsibility." Wilderness is "very much the fan-

tasy of people who have never themselves had to work the land to make a living" (80). It "can offer no solution to the environmental and other problems that confront us." Instead, by "imagining that our true home is in the wilderness, we forgive ourselves the homes we actually inhabit" which poses a "serious threat to responsible environmentalism." The attention given to wilderness, according to Cronon, comes at the expense of environmental justice. Further, advocacy of wilderness "devalues productive labor and the very concrete knowledge that comes from working the land with one's own hands" (85). But Cronon's "principle objection" is "that it may teach us to be dismissive or even contemptuous of...humble places and experiences," including our own homes.

Cronon concludes the essay by describing why the "cultural traditions of wilderness remain so important." He asserts that "wilderness gets us into trouble only if we imagine that this experience of wonder and otherness is limited to the remote corners of the planet, or that it somehow depends on pristine landscapes we ourselves do not inhabit" (88). He admonishes us to pay attention to the wildness inherent in our own gardens, backyards, and local landscapes.

"The Trouble with Wilderness" later appeared as the lead chapter in *Uncommon Ground: Toward Reinventing Nature* (Cronon 1995). The authors' collective intention was to describe the many ways the concept of Nature is socially constructed and to ask: "Can our concern for the environment survive our realization that its authority flows as much from human values as from anything in nature that might ground those values?" The book is a slightly irritating collage of the obvious, the fanciful, the occulted,* and disconnected postmodernism contrived as part of a University of California-Irvine conference on "Reinventing Nature." The contributors were asked to summarize their thoughts in an addendum at the end of the volume titled "Toward a Conclusion," suggesting that they had not reached one.

In an insightful retrospective, landscape architect Anne Whiston Spirn, author of the best chapter in the book, lamented the fact that the discussions were "so abstracted from the 'nature' in which we were living...the talk seemed so disembodied." She wondered "how different our conversations might have been if they had not taken place under fluorescent lights, in a windowless room, against the whistling whoosh of the building's ventilation system" (448). Indeed, the entire exercise of "reinventing Nature" had the aroma of an indoor, academic,

* The word is one used by Gary Snyder describing the "Reinventing Nature" conference, "an odd exercise" he thought. See Gary Snyder, *A Place in Space* (Washington, DC: Counterpoint, 1995), p. 250.

The debate over wilderness has illuminated the fact that we will need larger—not smaller—ideas about land, Nature, and ourselves. We will need more, not less, ecological imagination.



résumé-building exercise. And the key assumption of the exercise—that Nature can be reinvented—works only if one first conceives it as an ephemeral social construction. If Nature is so unhitched from its moorings in hard physical realities, it can be recast as anything one fancies.

Not surprisingly, wilderness critics have received a great deal of criticism (Foreman 1994, 1996, 1998, Rolston 1991, Sessions 1995, Soulé and Lease 1995, Snyder 1995, 1996, and Willers 1996/7). After the dust has settled a bit, what can be

said of “The Great New Wilderness Debate”? First, on the positive side, I think it can be said that, under provocation from Callicott, Cronon, and others, a stronger and more useful case for wilderness protection emerged (Foreman 1995, Grumbine 1996/97, Noss 1998, Waller 1998). The conjunction of older ideas about wilderness providing spiritual renewal and primitive recreation with newer ones concerning ecological restoration and the preservation of biodiversity offers a better and more scientifically grounded basis to protect and expand remaining

Wilderness Areas in the 21st century. It is clear that we will need to fit the concept and the reality of wilderness into a larger concept of land use that includes wildlife corridors, sustainable development, and mixed-use zones surrounding designated Wilderness or ecological reserves. But the origin of these ideas owes as much to Aldo Leopold as to any contemporary wilderness proponent. And, yes, environmentalists and academics alike need to make these ideas work for indigenous peoples, farmers, ranchers, and loggers. The development of conservation biology, low-impact forestry methods, and sustainable agriculture suggests that this is beginning to happen. For these advances, wilderness advocates can be grateful for their critics.

On a less positive note, the debate over wilderness resembles the internecine, hair-splitting squabbles of European socialists between 1850 and 1914. Often the differences between the various positions of that time were neither great nor consequential. Nonetheless positions hardened, factions and parties formed around minutiae, and contentiousness and conspiracy became the norm on the political left. As a result, by 1914 the left had coalesced into ideologically based factions, firmly and irrevocably committed to one impractical doctrine or another. It was a great tragedy that in the early decades of the 20th century, when the world needed far better ideas about the organization of property, government, and capital, it had few from the left. Instead, socialists of whatever stripe gave the strong impression to mainstream society that they had nothing coherent or reasonable to offer. Their language was obscure, their proposed solutions often entailed violence, their public manners were uncivil, and their tone was absolutist. It was in this environment that Lenin and his Bolsheviks concocted the odd brew of socialism, intolerance, brutality, messianic pretensions, and ancient czarist autocracy that became known as Marxism-Leninism. And the rest of the story, as they say, is history.

The world now more than ever needs better ideas about how to meld society, economy, and ecology into a coherent, fair, and sustainable whole. The question is whether environmentalists can offer practical, workable, and sensible ideas—not abstractions, arcane ideology, spurious dissent, and ideological hair-splitting reminiscent of 19th century socialists. In this regard, the most striking thing about the ongoing “great wilderness debate” is the similarity that exists between positions that have been cast as either/or. There is no necessary divide, for example, between protecting wilderness and sustainable development. To the contrary, these are complementary ideas. And there are some issues, such as the old and unresolvable question about whether and to what degree humans are part of or separate from Nature, that are hardly worth arguing about over and over again. Nor do we need

to hear truisms that wilderness must be adapted to the circumstances, culture, and needs of particular places. These are obvious things that deserve to be treated as such. Finally, since all participants profess support for the place called Wilderness, as distinct from the idea of it, we are entitled to ask: what is the point of the great wilderness debate? If we intend to influence our age in the little time we have, we must focus more clearly and effectively on the large battles that we dare not lose. The time and energy invested in our “great debates” should be judged against the sure knowledge that while we argue among ourselves, others are busy bulldozing, clearcutting, mining, building roads, and, above all, lobbying the powers that be to ensure that these destructive activities continue.

Third, the effort to find common ground by “reinventing Nature” along postmodernist lines seems to me to have the same foundational perspicacity as, say, the effort to extract sunbeams from cucumbers for subsequent use in inclement summers—a project of the great academy of Lagado described by Jonathan Swift. Most surely we see Nature through the lens of culture, class, and circumstance. Even so, it is remarkable how similarly Nature is in fact “constructed” across different classes, cultures, times, and circumstances. This is so because gravity, sunlight, geology, soils, animals, and the biogeochemical cycles of the Earth are the hard physical realities in which we live, move, and have our being. We are free to describe them in different symbols and wrap them in different cultural frameworks, but we do not thereby diminish their reality.

The idea that we are free to reinvent Nature is, I think, an indulgence made possible because we have temporarily created an artificial world based on the extravagant use of fossil fuels. But that idea will not be particularly useful for helping us create a sustainable and sustaining civilization, however useful it may be as a reason to organize conferences in exotic places and for keeping postmodernists employed at high-paying indoor jobs. “Reckless deconstructionism,” in the words of Peter Coates, “cuts the ground from under the argument for the preservation of endangered species” (185). More broadly, it prevents us from taking any constructive action whatsoever. The postmodern contribution to environmentalism has privileged (in their word) an arcane, indoor, and ivory tower kind of environmentalism with more than a passing similarity to views otherwise found only on the extreme political right. Separated as it is from both physical and political realities—as well as the folks down at the truck stop—postmodernism provides no realistic foundation for a workable or intellectually robust environmentalism.

Looking ahead to the 21st century, the debate over wilderness has illuminated the fact that we will need larger—not

smaller—ideas about land, Nature, and ourselves. We will need more, not less, ecological imagination. We certainly need to be mindful of the “otherness” in our backyards, as Bill Cronon reminds us, but that reminder is a small idea that comes at a time when we must cope with global problems of species extinction, climatic change, emerging diseases, and the breakdown of entire ecosystems. We need a larger view of land and landscape than is possible where “It’s mine and I’ll do with it as I damn well please” is the prevailing philosophy. As Aldo Leopold pointed out decades ago, we need well-kept farms and home places, well-managed forests, and large Wilderness Areas. None of these needs to compete with any other. Of the four, wilderness protection is by far the hardest to achieve. It is a societal choice that requires an ecologically literate public, political leadership, economic interests with a long-term view, and above all, the humility necessary to place limits on what we do. Until we have created a more far-sighted culture, the conjunction of these forces will always be rare, fragile, and temporary.

THE BATTLE OVER WILDERNESS WILL GROW IN COMING decades as the pressures of population growth and alleged economic necessity mount. There will be, someday soon, urgent calls to undo the Wilderness Act of 1964 and release much of the land it now protects to mining, economic expansion, and recreation facilities. At the same time it is entirely possible that much of our affection for wilderness, rural areas, and wildness will decline if we continue to become a tamer and more indoor people. In *Brave New World* (1932), Aldous Huxley described the effort to “condition the masses to hate the country” while conditioning them “to love all country sports.” This process is already well underway and we are the less for it. As D.H. Lawrence put it:

Oh, what a catastrophe for man when he cut himself off from the rhythm of the year, from his unison with the sun and the earth. Oh, what a catastrophe, what a maiming of love when it was made a personal, merely personal feeling, taken away from the rising and setting of the sun, and cut off from the magical connection of the solstice and equinox. This is what is wrong with us. We are bleeding at the roots. (quoted in Bass, 1996, 21)

In the century ahead, the battle over wilderness will become a part of a much larger struggle. We have entered a new wilderness of sorts, one of our own making, consisting of technology that will offer us a “virtual reality” (an oxymoron if there ever was one), fun, excitement, and convenience. Caught

between the ugliness that accompanies ecological decline and the siren call of a phony “reality” cut off from soils, forests, wildlife, and each other, we will be hard pressed to maintain our sanity and the best parts of our humanity. The struggle for wilderness and wildness in all of its forms is no less than a struggle over what we are to make of ourselves. For my part, I believe we need more wilderness and wildness, not less. We need more wildlands, wildlife, wildlife corridors, mixed-use zones, wild and scenic rivers, and, even urban wilderness. But above all, we need people who know in their bones that these things are important because they are the substrate of our humanity and an anchor for our sanity. ☺

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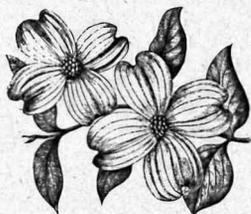
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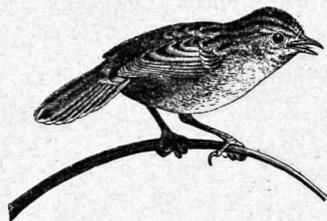
Revitalizing



Natural



History



by Thomas L. Fleischner

What is natural history? Although the term is as old as Christianity, you'd get a different answer depending where, when, and whom you asked. Modern Euro-American natural history traces its roots back centuries—to Aristotle and Linnaeus attempting to make sense of Nature's diversity, to Darwin on the *Beagle*, to English parsons chasing butterflies and painting wildflowers. Naturalists unraveled the "history of nature" by examining fossils, comparing them with their living counterparts, and drawing conclusions that shook the world. The foundation of natural history across the centuries has been careful observation. Observation leads naturally to description and identification, and then to comparison. Our systems of classifying the natural world—biological taxonomy, classification of rock types—are based on the observations, descriptions, and comparisons of these early naturalists. Natural history asks the most basic questions: What is this? Where am I?, and then penetrates deeper into the questions that connect us with all beings: Who are you? Who am I? How do we fit together in this world?¹ All cultures seek answers to these questions. (Natural history, as discussed here,

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is a product of Western culture. Other traditions, such as Native American and Asian,² offer interesting alternatives and parallels to the development of natural history in the West. They deserve full treatments of their own, and will not be addressed here.)

Although natural history undergirds several modern sciences, contemporary scientists are often muddled about its meaning. Natural history predates the sciences of geology, ecology, and anthropology, all of which bit off pieces of natural history, specialized them, and guarded them by creating their own vocabularies. The Oxford English Dictionary notes that the definition has narrowed from the branch of science dealing with all natural objects—animal, vegetable, and mineral—to the study of living organisms, especially animals. Further, the dictionary suggests that “natural history” now connotes material “presented in a popular rather than strictly scientific manner.” How did this narrowing of definition occur? How did the most inclusive of sciences become relegated to quaint triviality?

Unraveling the lineage of natural history takes us back to Aristotle, whose appetite for understanding the world was unfettered by intellectual boundaries as we would see them today. His works ranged from philosophy to biology to metaphysics.³ Generally credited with being the father of biology and natural history,⁴ Aristotle was “a cataloger extraordinaire of natural plants and animals.”⁵ He wrote the *Historia Animalium*, which described the anatomy and habits of native Greek animals.⁶ When studying animals, Aristotle declared, we should investigate all of them, however insignificant they might seem, for “in not one of them is Nature or Beauty lacking.” He set a precedent for a comprehensive approach to natural history: “In natural science it is the composite thing, the thing as a whole, which primarily concerns us, not the materials of it....”⁷ Furthermore, he pointed the way toward another powerful aspect of natural history—the cross-pollinating relationship between natural science and philosophy. His metaphysics grew out of his biology⁸—that is, his understanding of the nature of the world was grounded in reflection upon the nature of Nature.

The term “natural history” was probably first used shortly after the death of Christ, when the Roman writer Pliny the Elder entitled his masterwork *Historia Naturalis*. (It is worth noting that the term *natural history* predated the word *scientist* by 18 centuries.⁹) Pliny explained his purpose as the study of “the nature of things, that is, life”; he simultaneously invented natural history and the encyclopedia. *Historia Naturalis* collected, edited, and arranged an enormous amount of material into 37 “books” that covered cosmology, astronomy,

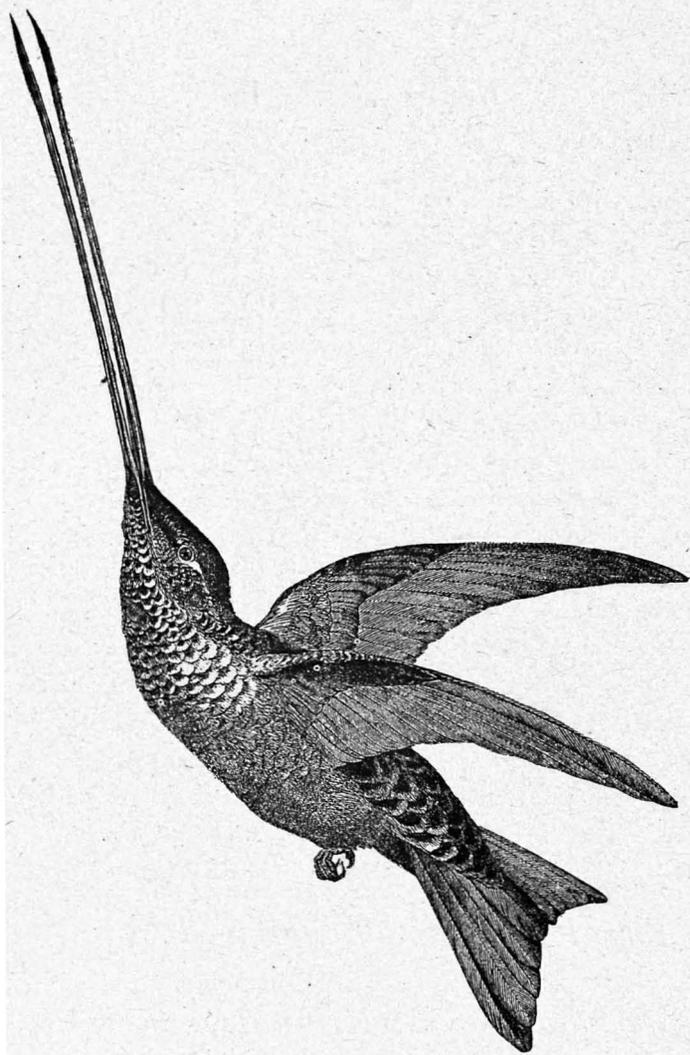
geography, zoology, botany, agriculture, medicine, and minerals. Pliny’s all-inclusive approach to natural history influenced naturalists for at least 1500 years. Gonzalo Fernandez de Oviedo, a Spaniard who followed Columbus to the Americas, was well versed in Pliny’s work, and sought to extend it with his *Natural History of the West Indies* in 1535.¹⁰

After the collapse of Rome, natural history fell on hard times. The Church held Western culture together, but at the expense of squelching independent thinking and directing attention away from the nonhuman world. Following the Middle Ages, Nature was rediscovered, and people again felt free to express “delight in birds and flowers.”¹¹ Still, natural history was peripheral to the cultural surge that transformed the Medieval Era into the Modern. Francis Bacon, in the late 16th century, declared that natural history was merely the compilation of copious data—descriptions of plants, fossils, and the like.¹²

During the 18th and 19th centuries, new generations of naturalists avidly pursued the discovery, description, and naming of new plants and animals.¹³ Not coincidentally, this was a time of global exploration, and travelers continued to bring stories and specimens home to European museums. The Linnean revolution in taxonomy in the mid-18th century stimulated a boom in descriptive natural history in the 19th century. Linnaeus’s binomial system provided a simplified and orderly framework for naming new discoveries, and also offered a convenient mechanism by which naturalists could claim lasting credit for their work.¹⁴ After more than a dozen centuries of inattention, it became a full-time job for natural historians simply to describe what was out there. Description, classification, and naming became the standard operating procedures of natural history.

The German natural scientist and philosopher Alexander von Humboldt explored Latin America as the 18th century turned into the 19th. His natural history works influenced subsequent generations of European naturalists in several important ways. His writings extolled the “excitement of the scientific adventure, the need for a wide integrative view, and the geographical approach to botany.” Historian Donald Worster notes that “all of Alexander von Humboldt’s writing was marked by an effort to arrive at a holistic view of nature.”¹⁵ David Douglas explored the Pacific Northwest’s flora two decades after Lewis and Clark explored its geography.¹⁶ The following decade, a young naturalist by the name of Charles Darwin, whose zeal for scientific exploration was ignited by his reading of Humboldt,¹⁷ set out on a five-year voyage to South America. During the following two decades





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another English naturalist, Alfred Russel Wallace, explored the Amazon basin and Malaysia. Natural history study led both men independently to an identical revelation—the idea of evolution through natural selection.¹⁸ At the tail end of the 19th century, an American natural historian, C. Hart Merriam, applied natural history study to Arizona's San Francisco Peaks and emerged with an important contribution on the relationship between species and their habitats.¹⁹

By the beginning of the 18th century, two streams of natural history had begun to emerge. Historian Donald Worster has called the streams *arcadian* and *imperial* ecology. The former advocated a humble life for humans, in hopes of restoring peaceful coexistence with other lifeforms, while the latter sought to use modern knowledge of Nature to establish dominion over it.²⁰ Each of these streams was typified by one man—the arcadian attitude by the English parson-naturalist Gilbert White, and the imperial by Linnaeus. These 18th century contemporaries shared a pious attitude toward Nature, but diverged from there. White wrote *The Natural History of Selbourne*, a lyrical tribute to the flora and fauna of his native village, while Linnaeus, who “had an unusually intense passion for the delights of arrangement,”²¹ devised our system of biological taxonomy and described dozens of species. Both men lived and worked in the afterglow of the scientific revolution—on the heels of great advances in astronomy, mathematics, and physics (exemplified by the work of Galileo, Descartes, and Newton). The intellectual zeal of the times pointed toward mechanistic, mathematical explanations of the world—Nature as a machine became the prevailing metaphor of the age.²² Linnaeus's ordered approach fit the life sciences neatly into this new way of looking at the cosmos. Soon, natural history became a matter of finding new species, labeling them with a Linnean name, and filing specimens away in a drawer.

Imperial ecology inherited much of its impetus from the physical sciences—an attempt to explain the workings of Nature by a set of mechanistic, quantifiable laws. Natural history began to be demoted in the eyes of some scientists because it was overly descriptive and insufficiently theoretical. Ernst Mayr, in *The Growth of Biological Thought*, notes that a well-known historian of Isaac Newton was dismissive of Darwin because the theory of evolution was developed largely on the basis of Darwin's field observations: “The naturalist is indeed a trained observer, but his observations differ from those of a gamekeeper only in degree, not in kind; his sole esoteric qualification is familiarity with systematic nomenclature.” Mayr, however, repeatedly asserts the crucial—and underappreciated—contribution of natural history to modern evolutionary biology. “Anything,” he

said, "that contributed to a flowering of natural history is part of the history of evolutionary biology."²³

While Linnaeus's work catapulted him from humble, rural origins to an insider in the royal councils of Sweden, Gilbert White died largely unknown. *The Natural History of Selbourne* lay unread for half a century. But when it was discovered around 1830, readers flocked to its pages. In fact, it became one of the best-loved books in the English language (by the mid-20th century it had appeared in over a hundred editions), helping establish the literary genre of the natural history essay in the process. By the middle of the 19th century Selbourne had become emblematic of a simpler, halcyon time when parson-naturalists gleefully bounded after life's simple pleasures—the observation and description of birds, butterflies, and flowers. As the Romantic movement was transplanted across the Atlantic, it came to fruition, especially in the person of Henry David Thoreau, who both pointed the way to a deeper-rooted philosophy of wild Nature, and further developed the nature essay as a mode of exploring it.²⁴

Confusion About "Nature"

Studying the history of Nature implies a clear understanding of what "nature" means. But people have never been clear about the meaning of this word, and the lack of clarity has led to conceptual confusion—with profound implications. The word "nature" derives from the Greek *phusis*, which referred to what a thing is like ("the nature of something"). Because *phusis* was employed in the questioning of the entire creation, it came to be equated with *cosmos*—the universe, or "everything." This larger meaning as the entire universe was eventually transferred to "nature." C.S. Lewis suggested that a coterie of Greek thinkers essentially *invented* nature ("Nature with a capital"). He referred to "nature in the dangerous sense," because it was the word most frequently used where not needed—the opposite of "everything," after all, is a vacuum. But the creation of this "conceptual container" for the entire world was the necessary precursor to a dualistic view of humans as separate from the rest of creation. Environmental philosopher Neil Evernden likened it to a fish discovering the concept "ocean"—for the first time the fish could conceive of itself as distinct from its medium. In the same way, "nature" allowed humans to stand back and feel apart from everything else in the world. In time, Nature came to mean the nonhuman world, as distinguished from the concerns and activities of people.²⁵

Postmodern deconstructionists, led by historian William Cronon, offer a contemporary twist to this confusion. Nature, they assert, is simply a cultural construction of the Euro-



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American elite. As such, it is undeserving of special consideration: why protect wilderness when it doesn't really exist? A chorus of rebuttals has sounded from other thinkers. Poet and essayist Gary Snyder, for example, confessed to "getting a bit grumpy about the dumb arguments being put forth by high-paid intellectual types in which they are trying to knock Nature, knock the people who value Nature, and still come out smelling smart and progressive." This seemingly academic issue becomes highly politicized when the deconstructionists denounce wilderness preservation, on the grounds that wilderness is an invalid intellectual fabrication. This argument provides a cloak of academic respectability for economic interests that would love to open more of the North American landscape to exploitation. If prominent environmentalists disagree about the value of Nature and wilderness, who can justify its preservation?²⁶ At the center of this debate lies this simple question: Is Nature something real, or just the contrived product of intellectuals? Of course, it is both. Natural history, with its focus on empirical observation, description, and comparison, offers a path out of this mental quagmire, a way to distinguish between living world and cultural artifact.

Honing a Definition

But just what *is* natural history? One would think that a clear meaning would have emerged during its two millennia lifetime. In fact, though, the term is only infrequently defined—and then somewhat inconsistently. Confusions about "nature" aside, the parameters of natural history remain fuzzy. Recall Pliny's original definition—the study of "the nature of things, that is, life." A contemporary museum director says natural history is "the study of nature over time."²⁷ One thing is clear: natural history is descriptive (both qualitatively and quantitatively) and based on direct observation. The subject of its description varies among natural historians, however.

The general historical trend has been a narrowing of the scope of natural history. In its earliest incarnations, natural history examined everything—organic and inorganic, human and nonhuman—that existed on or could be seen from planet Earth. Pliny's *Historia Naturalae* included people, bugs, gemstones, and stars. While some modern works²⁸ take a similar comprehensive approach, most focus on plants and animals, or some subset of these groups. Humans, regrettably, have been largely dropped from the realm of natural history. As with the word "nature" centuries earlier, humans were separated from the rest of creation.

It is instructive to look at recent books that describe themselves as works of natural history. Of the 15 contemporary natural history books I surveyed, only three bothered to define it. Richard Pimentel stated "natural history is the study of a single thing, nature.... Whether it is normally a science or an art is a matter of debate, but there is no doubt about its tremendous scope: all living and nonliving things, their activities, and interrelationships...."²⁹ Mammalogist David Armstrong said, "Natural history is history in an old-time sense, not history as chronology but history as stories, in this case natural stories, the stories of nature mostly and not stories about people and their artifacts."³⁰ Allan Schoenherr simply states that "a natural history is an account of natural phenomena." Ever since the days of Aristotle and Pliny, he adds, "the expression 'natural history' has been used to refer to a description of living organisms, their habits, and how they relate to the environment."³¹ Marston Bates viewed natural history as an important subset of biology. He defined it as "the study of life at the level of the individual—of what plants and animals do, how they react to each other and their environment, how they are organized into larger groupings like populations and communities."³² Landscape ecologist Monica Turner observed that "ecology and natural history have a long tradition of interest in the spatial patterning and geographic distribution of organisms."³³ Works on particular biotic groups³⁴ share the following common characteristics: classification, geographic distribution, physical description, habitat, reproductive ecology, and, for animals, feeding relationships. Works on the natural history of particular places³⁵ cover a similar set of concepts, some organized taxonomically and others ecologically.

As the definition of natural history narrowed, its relationship to ecology became murky. In the late 19th and early 20th centuries, scientists in quest of a new level of credibility wanted to distance themselves from the museum-stuffing habits of natural historians. One observer in the late 19th century commented that "natural history is encumbered by multitudes of facts which are recorded only because they are easy to record."³⁶

In the wake of Newton, such mundane work couldn't pass muster as rigorous science. Nevertheless, in 1927 Charles Elton began one of the first books on ecology with these two sentences: "Ecology is a new name for a very old subject. It simply means scientific natural history."³⁷ Similarly, Aldo Leopold, in 1938, proclaimed that "modern natural history deals only incidentally with the identity of plants and animals, and only incidentally with their habits and behaviors. It



deals principally with their relations to each other, their relation to the soil and water in which they grow, and their relations to the human beings who sing about 'my country' but see little or nothing of its inner workings. This new science of relationships is called ecology, but what we call it matters nothing."³⁸

But a patronizing attitude toward natural history among some modern ecologists is palpable. According to one science historian,³⁹ Darwin's ideas "stimulated a *more rigorous* approach to natural history" in the late 19th century (emphasis added). Another notes that by the beginning of the 20th century, practitioners of natural history often preferred to call themselves biologists, and that "the word *naturalist* was often used in a derogatory sense, usually prefixed with the word *old-fashioned*."⁴⁰ Today, says one biologist, natural history "is *maturing* to become ecology"⁴¹ (emphasis added). Even more striking, though, is how most modern ecologists act as if natural history never even existed. Recently, I checked ten standard ecology texts⁴²—not one even mentioned natural history. Similarly, neither *The Concise Oxford Dictionary of Ecology* nor *The Encyclopaedia of Ecology and Environmental Management* have entries for it.

One of the more useful frameworks for understanding the relationship between natural history and ecology was put forth by James Halfpenny and Roy Ozanne.⁴³ They describe ecology as a five-tiered pyramid, with a descriptive approach the foundation, and comparative, causal, experimental, and theoretical approaches, respectively, resting atop this base. According to Halfpenny and Ozanne, the lower two rungs (description and comparison) comprise natural history, while ecology is the entire pyramid. One of the values of this model is that it demonstrates that ecology is, in part, natural history. A limitation of the model is that it neglects the human element of natural history. Also useful is Paul Colinvaux's characterization of ecology as "the science that reasons why."⁴⁴ Natural history, by such a reckoning, asks "who," "what," "where," and "how many" questions. Without these, the "why" questions of ecology cannot even be conceived. Although this may be an artificial dichotomy, we see again that natural history is the foundation of ecology—the latter simply cannot exist without the former.

I would offer as a model a set of four partially overlapping circles, with natural history being the center circle and zone of overlap between three less inclusive circles—ecology, geology, and cultural anthropology (and the parent of all three). There is a proud tradition of a descriptive, comparative approach to studying humans and Nature as an integrated whole. Practitioners of natural history such as Charles Darwin and Alfred Russel Wallace did exactly

this sort of work. Great creative and scientific breakthroughs, such as the idea of natural selection proposed by these two men, derive more easily from a broad natural history approach than from a narrow experimental focus. Jacob Weiner points out that natural history is far from being soft science—in fact, most theoretical breakthroughs in ecology have been made by practitioners skilled in field natural history.⁴⁵

Rebraiding Two Fibers

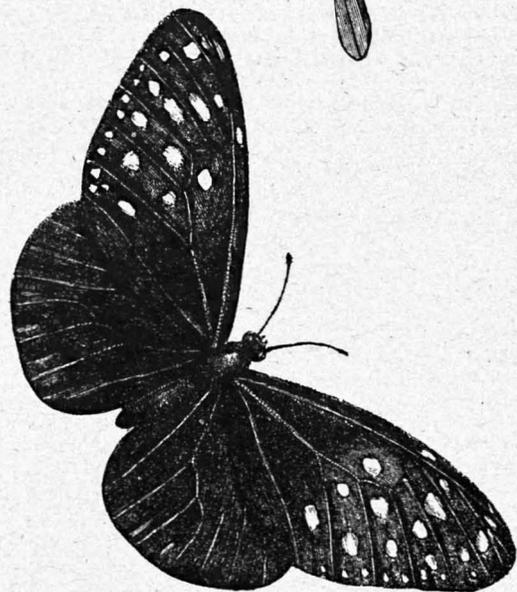
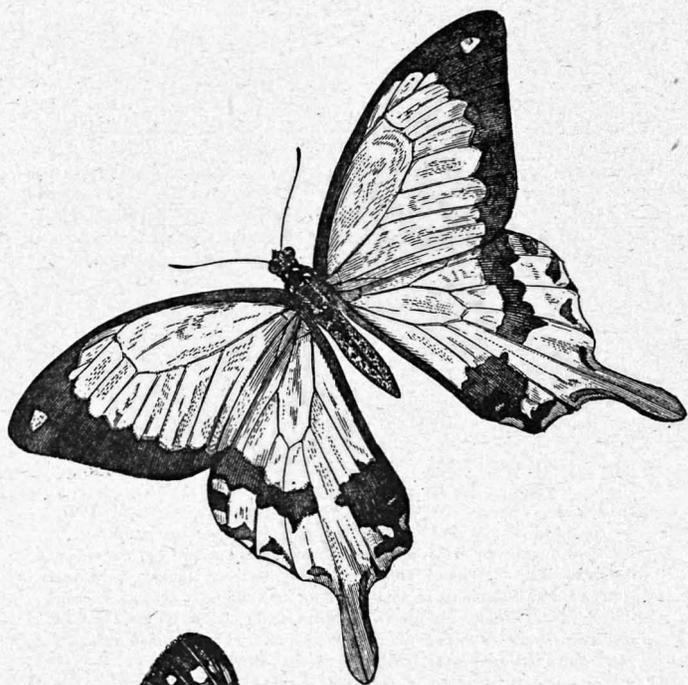
Worster's two streams of ecology, imperial and arcadian, that began to diverge in the 18th century, yielded separate streams of natural history—scientific and literary. Scientific natural history became increasingly obsessed with cataloging biodiversity (a term not yet invented), and eventually metamorphosed into the newly labeled science of ecology. Meanwhile, a popular, literary version of natural history found a more artistic outlet. Beginning with Gilbert White and then Henry Thoreau, a people's natural history was given voice.⁴⁶

Literary nature writing blended three primary dimensions, in varying proportions: natural history information, personal responses to Nature, and philosophical interpretations of Nature.⁴⁷ In so doing, it became "a way of seeing the unseen."⁴⁸ As Thomas Lyon has observed, "a distinguishing mark of the nature essay...is precisely the attempt to harmonize fact knowledge and emotional knowledge."⁴⁹ Literary naturalists in the 19th century, however, tended to write with an excess of "middle-class, middlebrow Euro-American" perspective, and "a rhetoric of beauty, harmony, and sublimity."⁵⁰ Writer Joyce Carol Oates famously criticized contemporary nature writing for similar sins, saying it still "inspires a painfully limited set of responses in 'nature writers'—reverence, awe, piety, mystical oneness."⁵¹

Unfortunately, literary and scientific natural history grew further and further apart during the past two centuries; as they split apart, both camps forfeited vigor. What had made natural history vibrant was the integration of science, art, and philosophy—a unified approach to understanding and expressing Nature's ways. Literary natural history lost scientific grounding, while scientific natural history drifted away from an honest acknowledgment of its subject's impact on human emotion. As literary naturalists became more flowery, the scientific natural historians seemingly sped to distance themselves from anything resembling literary grace, and instead emphasized more dry and analytical descriptions of natural processes.

Richard Nelson, cultural anthropologist and award-winning nature writer, reflected that reading the accounts of early 20th century





Natural history is the honest and honorable practice of learning as directly and expansively as possible from Nature.

naturalists was “a striking reminder of how desiccated and mechanical most scientific literature has become.” These earlier naturalists, he noted, “not only wrote differently from the way biologists do today, they also had different goals. It was their purpose to observe nature as meticulously as possible, to acquire knowledge through direct experience, to rely principally on their senses as the source of information, and to publish their results in richly descriptive field reports.”⁵² As scientific natural history, and its offshoot, ecology, focused increasingly on statistical analysis and lifeless prose, it lost its capacity to move the hearts and minds of ordinary readers.

We need to revitalize this venerable tradition of natural history, by going beyond a focus on mere cataloging and naming, and to once again allow natural history to be used as a basis for philosophical interpretation, as Aristotle did. To consciously seek a holistic view of Nature, as Humboldt did. To keep the broad, holistic approach to understanding Nature—including the living and nonliving worlds, the human and the nonhuman. To reunite literary and scientific natural history—to seamlessly stitch information, scientific interpretation, and human emotional response in an engaging package. To again recognize that natural history is the honest and honorable practice of learning as directly and expansively as possible from Nature.

Increasingly, laments for the loss of natural history can be heard. Reed Noss, for example, expressed concern in the professional journal *Conservation Biology* that “middle-aged biologists of today may be the last generation...to have been taught serious natural history as part of their professional training.” He worried, “Will the next generation of conservation biologists be nothing but a bunch of computer nerds with no firsthand knowledge of natural history? Does it follow that they will have no personal emotional ties to the land?”⁵³ Judging from the gush of affirmative letters in response—one of the largest outpourings in the history of the journal—Noss is not alone in this concern.

It is noteworthy that Aldo Leopold, the intellectual godfather of conservation biology, frequently deplored the loss of traditional natural history study. In 1938, he delivered an address at the University of Missouri on “Natural History—the Forgotten Science.”⁵⁴ He criticized the new wave of science that increasingly took things apart, but failed to explain how they were connected. He bemusedly observed that, should we drop in “on a typical class in a typical zoology department, we [would] find these students memorizing the names of the bumps on the bones of a cat.” It is important to study bones, he continued, “but why memorize the bumps?”⁵⁵ Curt Meine, Leopold’s biographer, notes that he objected to the way science “relegated natural history to the dusty backroom at a time when society needed it most.”⁵⁶

Two things are worth noting here. First, that six decades after Leopold made his comments on the forgotten science of natural history, it remains forgotten. Society's need for a revitalized natural history—a fusion of natural science and philosophy, propelled by literary grace—is more pressing than ever. And second, Leopold would never have exerted such towering influence had he not spent so much effort not only on science, but also on the craft of writing.⁵⁷ In the person of Aldo Leopold, scientific and literary natural history merged into a more powerful whole. More such mergings are urgently needed in these days of ecological crisis.

Poet and essayist Gary Snyder recently called for a “new nature poetics.” Speaking to literati, he insisted that nature writing must become *nature literate*—that is, “know who’s who and what’s what in the ecosystem”—and *place literate*, “informed about local specifics on both ecological-biotic and sociopolitical levels” as well as social and environmental history.⁵⁸ The reverse could be seen as equally true: that scientists have a responsibility to communicate with clarity and passion, with heart as well as head. Whole stories of landscapes must be told. The tellers must be grounded in science and fluent in their native tongue. ☺

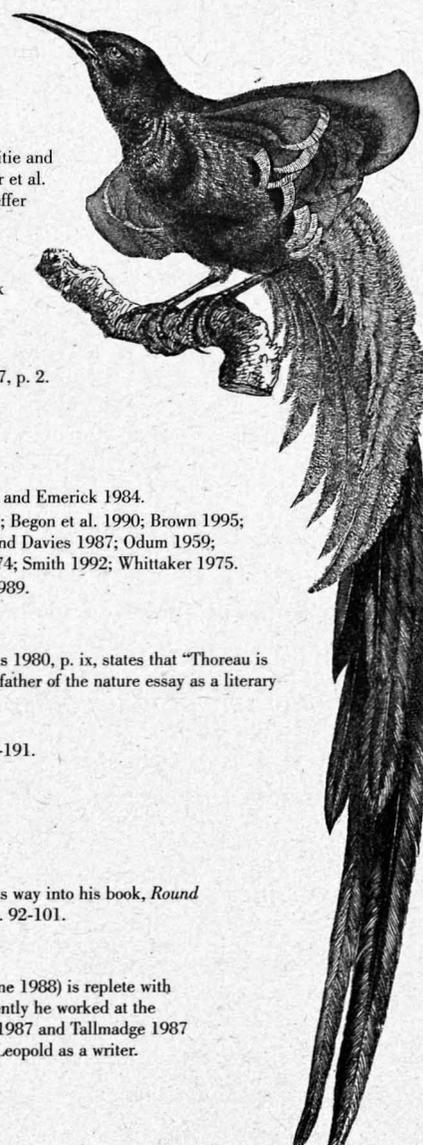
My thanks to Walt Anderson, Tom Butler, Ellen Cole, Ed Grumbine, Joe Meeker, Gary Nabhan, Reed Noss, David Orr, John Tallmadge, and Saul Weisberg for their helpful feedback on these ideas.

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NOTES

1. Fleischner and Weisberg 1992.
2. Hughes 1983 and Callicott and Ames 1989 provide good starting points for looking at Native American and Asian approaches, respectively, to Nature.
3. Kerferd 1967; Glacken 1967, pp. 46-49.
4. Coonen 1977.
5. Oelschlaeger 1991, p. 59.
6. Aristotle 1965.
7. Glacken 1967, p. 47.
8. Durant 1961, p. 69.
9. The word “scientist” was coined in 1840 by the English philosopher and mathematician William Whewell, and “suggested a growing professional consciousness.” See Worster 1977, p. 130.
10. H. Evans 1993, p. 2.
11. Mayr, p. 317; see, in general, Tarnas 1991, pp. 91-221.
12. Berman 1981, p. 30.
13. H. Evans 1993, p. 10.
14. H. Evans 1993, p. 263.
15. Worster 1977, pp. 133-138; quotes are from pp. 133 and 135.
16. H. Evans 1993, pp. 62-64.
17. Mayr 1982, p. 397.

18. Mayr 1982, pp. 394-425; see George 1964 and McKinney 1972 for insight into Wallace's contributions.
19. Worster 1977, pp. 195-197, refers to Merriam's approach as “that critical step from one kind of geography to another”—from a simple catalogue of species to an attention to the habitats that largely prescribe where the species dwell. Phillips et al. 1989 (and most modern ecology textbooks) point out that this relationship is not as tidy as Merriam proposed. Nevertheless, his work made a lasting contribution to natural history and ecology.
20. Worster 1977, pp. 2-55.
21. Worster 1977, p. 31.
22. Tarnas 1991, pp. 248-323; Collingwood 1960.
23. Mayr 1982, pp. 14-15, 317.
24. Oelschlaeger 1991, pp. 133-171; Worster 1977, pp. 59-76.
25. See Evernden 1992, pp. 18-20 and 88-90; see also Collingwood 1960, pp. 43-44. Evernden's entire book is essential reading for penetrating this issue of “the social construction of nature.”
26. The opening salvo by the deconstructionists was Cronon 1995. A flurry of responses have followed—see Soulé and Lease 1995; Rothenberg 1996; Worster 1997; and the theme issue of *Wild Earth* on “Opposing Wilderness Deconstruction.” Especially noteworthy in this issue are Sessions 1996; Snyder 1996 (the source of the quote); Waller 1996; and Willers 1996. This controversy, largely in the hands of humanities scholars, has an analogue in the more scientific debate concerning the role of indigenous North Americans in unraveling pristine Nature. Here, too, revisionists argue that because there is no such thing as pristine Nature, land preservation strategies are misguided. See C. Kay 1994.
27. J. Mary Taylor, Director of the Cleveland Museum of Natural History, in Kempthorne-Snow 1995.
28. Palmer and Fowler 1975, Pimentel 1963.
29. Pimentel 1963, p. vii.
30. Armstrong, p. v, in Mutel and Emerick 1984.
31. Schoenherr 1992, p. ix.
32. Bates 1990, p. 7.
33. M. Turner 1989.
34. P. Evans 1987; MacGinnitie and MacGinnitie 1968; Maser et al. 1984; Peattie 1953; Scheffer 1976; Findley 1987, Forbush and May 1955.
35. Burns 1960; Mathews 1988; Mutel and Emerick 1984; Schoenherr 1992; Storer and Usinger 1963; Trimble 1989.
36. Miall 1897, in Elton 1927, p. 2.
37. Elton 1927, p. 1.
38. Leopold 1991, p. 99.
39. Kingsland 1991.
40. H. Evans 1993, p. 263.
41. Armstrong, p. v, in Mutel and Emerick 1984.
42. Allen and Hoekstra 1992; Begon et al. 1990; Brown 1995; Colinvaux 1993; Krebs and Davies 1987; Odum 1959; Ricklefs 1997; Smith 1974; Smith 1992; Whittaker 1975.
43. Halfpenny and Ozanne 1989.
44. Colinvaux 1978, pp. 5-9
45. Weiner 1995.
46. Lyon 1989a, p. 24; Brooks 1980, p. ix, states that “Thoreau is generally considered the father of the nature essay as a literary form.”
47. Lyon 1989a, p. 3.
48. Tallmadge 1997, pp. 190-191.
49. Lyon 1989b, p. 3.
50. Snyder 1995, p. 163.
51. Oates 1986, p. 236.
52. R. Nelson 1991, p. 161.
53. Noss 1996.
54. This speech later found its way into his book, *Round River*—Leopold 1991, pp. 92-101.
55. Leopold 1991, p. 96.
56. Meine 1988, p. 383.
57. Leopold's biography (Meine 1988) is replete with descriptions of how diligently he worked at the craft of writing. Ribbens 1987 and Tallmadge 1987 also provide insight into Leopold as a writer.
58. Snyder 1995, p. 171.



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Lions in Paradise

by P.J. Ryan

The seasonal National Park Service ranger and crime novelist Nevada Barr drew a mild bit of criticism due to an interview in the *Bloomsbury Review* in which she inferred that if push came to claw, she would not be adverse to mountain lions eating some of the excess citizenry, *even the children as we have plenty of them and not many lions*, or words to that effect.

Liberals were on the horns of a dilemma, as animal rights are sacred, but so are the rug rats. Is there any possibility that mountain lions could be converted to vegetarianism? (Maybe in a parallel universe, but not this one, Martha.)

My interest in this matter is not entirely journalistic, as I am president of the Montgomery County Friends of Large Felines (MCFLF). The large feline that MCFLF is friendly toward is of course, *Felis concolor*, the mountain lion. Mysterious as a bureaucrat, secretive as a lobbyist, nocturnal as a President, unpredictable as a Supreme Court Justice, stealthy as a congressman, and deadly as a major market reporter, the mountain lion is the perfect symbol for Washington, DC.

MCFLF seeks to nurture this wonderful creature's return to Montgomery County, a bedroom suburb next to Washington, DC and, of course, my home.

Now buckaroos, I am the first to admit to an ulterior motive in my admiration for mountain lions. I must further state that I have no soppy liberal sentimental attachment to the inane idea that "We are all one with Nature." (If you've ever had a mosquito in your tent, you know in your heart of hearts that one of you must die that night!)

The problem at hand is whitetail deer (*Cervus virginianus*). At the beginning of the 20th century, these antlered locusts were verging on extinction in the northeastern United States. Along came Teddy Roosevelt, the Boone & Crockett Club, Field & Stream, and a plethora of legislated killing seasons and habitat management programs. As late as the 1950s a successful New Jersey deer hunt was cause for front page news in the local paper: "LOCAL MAN SHOTS DEER IN NEW JERSEY," complete with photo of the proud Elmer Fudd standing beside his trophy, as if he just knocked down a rhino. Today, the annual bag limit per hunter in New Jersey is 27 deer (if one takes advantage of all seasons: bow and arrow, black powder, etc.). If you think about it, it's easier to be a subsistence hunter in New Jersey than Alaska, especially if being close to a liquor store or deli is one of your criteria.

Anyway, the Eastern deer herd boomed out of all possible historical records. Whitetail deer are prolific, adaptable, and opportunistic, quick to exploit favorable conditions. Suburbs, with their broken patches of woods, shrubs, and gardens, were far more favorable deer habitat than the virgin forest of John Smith and Pocahontas. (The Indians hunted deer, but they mainly grew corn as they didn't fancy starving to death waiting for the deer to show up.)

All that has changed. No more deer shortage. At first, the suburbanites thought it charming

to have Bambi & Co. hanging around. Then they noted the deer eating, constantly eating. Not God's shrubbery, mind you, but the shrubbery and flowers of the suburbanites.

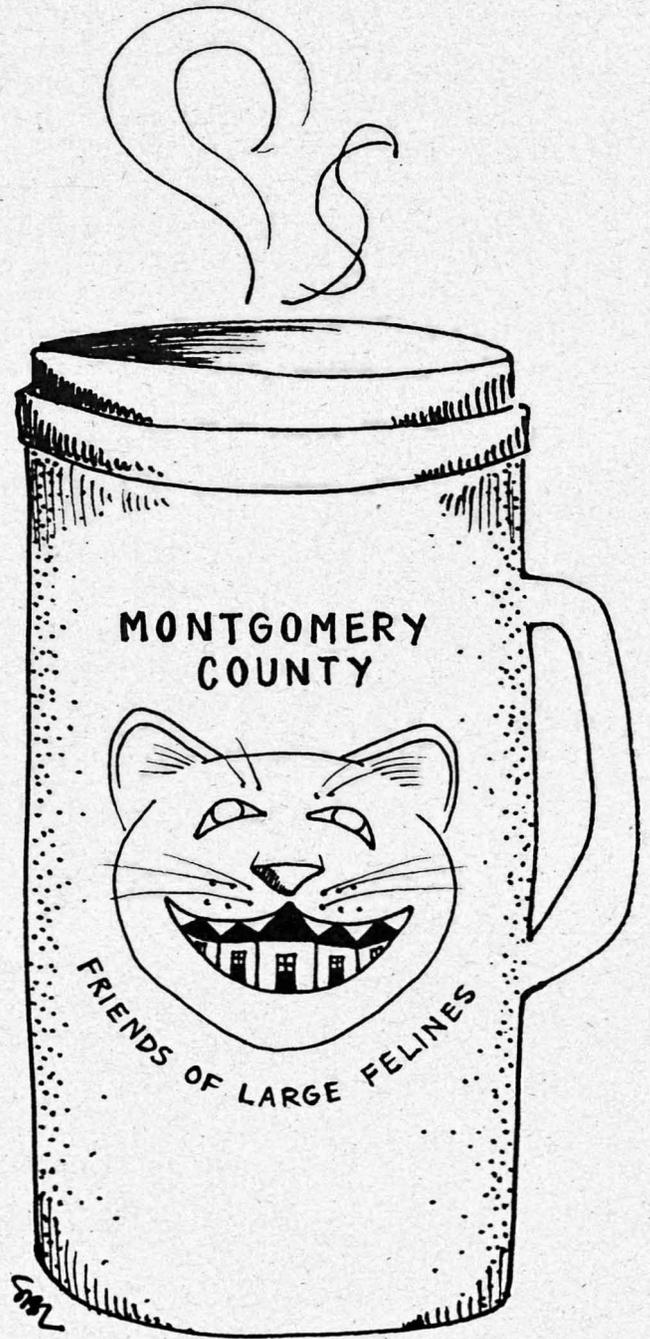
The deer ate all my tulips. Then they ate \$12,000 worth of tulips at nearby Brookside Gardens. The county built a \$100,000 ten-foot fence around the garden. Deer are very adaptable. They simply get behind someone going through the swinging gate and go through with them. (What are you going to say, "You can't come in, we're prejudiced against deer?" Deer are large animals.) At present, the Ryan herd, which hangs out in my backyard (abutting the 3500-acre Wheaton Regional Park), consists of seven insolent animals who don't shoo away very easily. Though I have long campaigned for a bow and arrow season in Montgomery County, there are enough liberal animal rights fanatics hereabouts to prevent that worthy activity.

Fortunately, it looks like at least one and (hopefully) two mountain lions have moved into the county in the last few months—the first in more than two centuries. Understandably, this has caused some fear among my fellow suburbanites (which is the reason for the creation of the Montgomery County Friends of Large Felines—to promote understanding of these valuable animals).

"Is it true that mountain lions will eat Republicans? or even Episcopalians?" is a frequently asked question. The answer is "yes" on both counts. Another question is: "Will mountain lions eat Minority Group Members (MGMs)?" The answer here generally is "no."

Now you might ask, "Why are mountain lions so politically correct?" Actually, buckaroos, politics has nothing to do with it. It is all a matter of ecology and habitat. You see, MGMs often have the privilege of living in neighborhoods that have been blessed with toxic waste dumps, polluting factories, no trees or greenery of any kind, and no wildlife beyond rats and pigeons. The MGM is protected by his/her environment from mountain lion attack; no deer, no mountain lions. Therefore, Republicans and Episcopalians are at greater risk, living as they do in leafy, deer country and (now) lion country. It is a risk that is supportable, neighbors, and a certain portion of your *Thunderbear* membership will be used to finance the educational efforts of the MCFLF. We look forward to your continuing support! ☺

P.J. Ryan works for the National Park Service and publishes Thunderbear, "the oldest alternative newsletter in the federal government" (P.O. Box 2341, Silver Spring, MD 20915, \$14 per year). This essay is adapted from the July, 1998 issue.



Book Reviews



Reviewed
in this issue

Elkheart

An Appalachian Tragedy

Perverse Subsidies

The Religion of
Technology

Progress Without People

Elkheart: A Personal Tribute to Wapiti and Their World

by David Petersen; Johnson Books (1880 South 57th Court, Boulder, CO 80301); 1998;
\$27.50 hardcover, \$16 paper; 224 pp.

For author, hunter, woodsman, and “hard-core, out-and-amongst-’em...serious wildlife watcher” David Petersen, elk are more than just an interest, hobby, or even a passion—they are a religion. If books had to have subtitles that reflected their deeper message, Petersen’s newest book, *Elkheart: A Personal Tribute to Wapiti and Their World*, might be subtitled, “A Neanderthal Runs Through It”:

For all but the last ten millennia or so of our multi-million-year run as Homo, hunting and gathering were all we did. Hunting filled our days with challenge and action, our nights with story. Hunting inspired our dreams and art and myths and religions, helping significantly to shape what we are today, for better and for worse. (144)

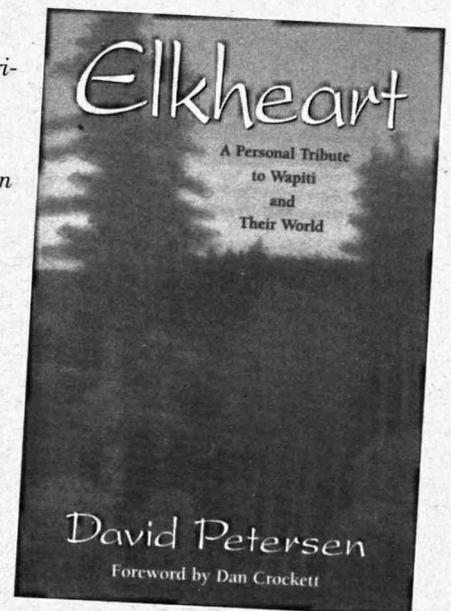
While on the surface another book about the West’s most majestic antlered animal, at its heart *Elkheart* is an exploration of the spirit of the hunter. Despite his love for elk—or, more accurately, *because* of that love—Petersen defiantly defends the hunting of those wild creatures. This may be Petersen’s finest and most-needed contribution to Western nature writing: not only is he a quality naturalist, but here is—at last!—a writer, philosopher, and storyteller for ethical hunters.

Through four decades of intimately personal experience, I’ve evolved an unshakable belief that the essence—and thus the moral justification and greatest reward—of so-called ‘sport’ hunting lies in challenge, in woodcraft, in humility, in respect (if not love) for the animals we hunt and the country we hunt them in, evidenced by an eager willingness to protect and propagate both. (146)

This is familiar turf for Petersen. Perhaps best known as the editor of Edward Abbey’s journals, Petersen has authored four other books of natural history and a collection of essays. He also edited *A Hunter’s Heart*, a controversial anthology on the ethics of hunting that earned him national recognition as a “hunting ethicist.”

Elkheart may be Petersen’s best work yet. This is a rare gem of nature writing—a natural history book that is unusually informative, entertaining, and opinionated thanks to Petersen’s weaving of quality research and personal experience with personality, philosophy, humor, and downright furious rants against some trends that he considers dangerous to wildlife and wilderness. In this part of the book, Petersen unleashes his strongest tirade against the exploding elk ranching industry, which in Colorado alone has grown fiftyfold since the mid-1980s.

Elk ranches are “disease and genetic contamination factories” (162) that work “against the long-term interests of wildlife and democracy” (164), Petersen charges. In states with elk



ranches, wildlife agencies report problems with disease and parasites, the privatization and poaching of public wildlife to stock herds, habitat loss due to fencing, and a tarnishing of hunting's image by the ranches' unethical and unchallenging trophy hunting.

The only force that can stand up to the various types of profiteering that threaten big game animals and the habitat they need (along with elk ranching, Petersen cites road-building for logging, poaching, real estate development, predator control, and public lands livestock grazing as particularly damaging) is love. And he challenges all wildlife advocates to match the love and activism of hunters.

"No one, biologists notwithstanding, knows or cares more about the natural histories and daily dramas of animals in the wild, no one is a more attentive student of animal spoor, no one more deeply and honestly loves wildlife and wild lands and freedom and dignity, than the hunter," Petersen says, reserving that praise for what he calls "the *true* hunter," that is, ethical, gadget-free hunters.

It is this hunter's spirit that drives Petersen, and ethical hunting is his sacrament. This spirit, for better or worse, is the best hope of saving wildlife and the wild habitat they need to survive, he argues, for only a love for and kinship with wild animals can overcome the greed encroaching on their homes.

Elkheart is a good place to get a foothold in that spirit.

Reviewed by **KEN WRIGHT**
(Wright_K@Fortlewis.edu), author of *A Wilder Life: Essays from Home*, and editor of *Inside/Outside Southwest*, an alternative monthly covering the Durango/Four Corners Area

An Appalachian Tragedy: Air Pollution and Tree Death in the Eastern Forests of North America

edited by Harvard Ayres, Jenny Hager, and Charles E. Little; photographs by Jenny Hager; Sierra Club Books (85 Second Street, San Francisco, CA 94105); 1998; \$45; 216 pp., index.

In June of 1997 I was among a group of conservationists on a hike led by Harvard Ayres on Mt. Rogers, the highest mountain in Virginia and centerpiece of Mt. Rogers National Recreation Area. Ayres, then Chair of the Sierra Club's Southern Appalachian Highlands Ecoregion Task Force, had brought us out to see firsthand the evidence of tree death he had long been observing in the region; Mt. Rogers, at 5729 feet, offered a range of Southern Appalachian forest communities in which to find it. All of us had been seeing unusual numbers of dead and dying trees in our own parts of the mountains for years, and had read of studies linking them to pollution and other stressors. But that midsummer day's outing would vividly illustrate the problem's magnitude. With Ayres to guide us, we saw that not merely the Fraser firs (victims of the balsam woolly adelgid), not merely the oaks (favorite food of the gypsy moth), not merely all *species* of trees, but *almost all mature trees* above the 4500-foot elevation were either dead or visibly sick. By the time we returned to the trailhead, soaked by one of the mountain's sudden and, we now realized, poison-bearing rains, we were immersed also in the reality of the Appalachian forest crisis.

With *An Appalachian Tragedy*, Harvard Ayres does for readers what he did in person for us hikers. Indeed, in his foreword he declares that his pur-

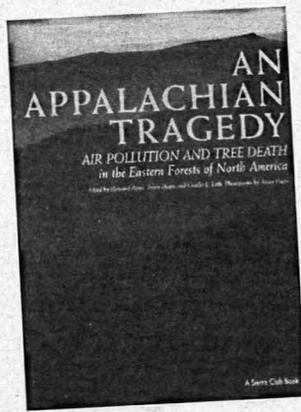
pose is "to take the reader on a kind of field trip." Along with co-editors Charles E. Little, author of *The Dying of the Trees*, and photographer Jenny Hager, he has assembled a collection of essays and images into a coffee-table book of the unsettling sort pioneered by Bill Devall's *Clearcut: The Tragedy of Industrial Forestry* (Sierra Club Books, 1994). Its thesis is simple: that airborne pollutants—from power plants, heavy industry, and automobiles—are quickly killing the forests of the Eastern mountains. "Public perception lags behind reality," writes Ayres, "because the reality is unbearable." *An Appalachian Tragedy* forces us to confront that unbearable reality.

The book is, nonetheless, a work of surprising beauty, in both its text and illustrations. Neither the essayists nor Jenny Hager with her magnificent photographs forget that the Appalachian Forest is a place of magical beauty and abundance, even when that beauty and abundance are threatened. The essays are not mere laments, and the pictures not mere records of industrial facilities and dead trees. In particular, the contributions of T.H. Watkins ("The View from Brasstown Bald"), Chris Bolgiano ("Communities in Crisis"), and Mary Hufford ("Weathering the Storm: Cultural Survival in an Appalachian Valley") present the Appalachians as above all a place worth saving, for both its natural and human richness.

Ecologist Orie Loucks's essay, "In Changing Forests, A Search for Answers," is the scientific heart of the book, and a more thorough summary of research on the effects of acid rain, ozone, and nitrogen enrichment than one might expect in such a work. Readers seeking even more information will be led to it by Bill Grant's

comprehensive bibliography, but most lay people will be persuaded by Loucks's case that "there is little doubt that air pollutants, in different combinations for different species and areas, are the critical factors explaining changes in the Appalachian forests." Absolute certainty in such matters is impossible, Loucks explains, and to delay action until the proof is indisputable—the common request of polluters—is grossly irresponsible. "We do have compelling scientific evidence already. A decision to act now on that evidence seems mainly a matter of whether to care about posterity."

This declaration is taken up in Philip Shabecoff's concluding essay, "After Decades of Deception, A Time to Act." Shabecoff, a veteran environmental journalist, gives a brief history of air quality regulation in America and of the delay, denial, and compromise that have characterized it from the start. His account of the National Acid Precipitation Assessment Program (NAPAP) of the 1980s shows how bureaucrats could spend ten years and hundreds of millions of public dollars to arrive at non-conclusions, while independent researchers like Gene Likens, Orié Loucks, and Robert Bruck were accumulating solid evidence linking tree death to acid rain. Even the Clean Air Act passed by Congress in 1990, with its goal of cutting total sulfur emissions in half by the end of the century, has proven to be too little, too late to reverse the decline of Appalachian forests. Shabecoff offers a two-pronged solution: first, improve air quality through a radical reduction in the use of fossil fuels, and second, redirect the Appalachian economy away from the



exploitative, environmentally damaging industries of mining, timbering, and dirty manufacturing toward the gentler businesses of tourism and recreation.

Some conservationists have argued for a careful separation of "conservation" (the defense of wild places and organisms) from "environmentalism" (concern for air and water quality, usually as they affect human health). *An Appalachian Tragedy* suggests such distinctions are often meaningless, at least in the crowded East. Air pollution is as great a threat to our forests and the life they support as logging, road-building, or other development. Equally misguided, in this region, is any effort to dissociate conservation from progressive politics. The region's people and land are victims of the same corporate greed, and their defenders are natural allies. In the words of the late John Flynn, longtime forest activist and dedicatee of the book, "The shrewder, money-minded people control the destinies of those whose values are of a higher order." Or as Philip Shabecoff puts it, more hopefully: "People who are poor usually lack the political power to resist the polluters, the resource exploiters, the degraders of the land. Over the long haul, the Appalachian landscape cannot be protected unless there are decent jobs for the workers, adequate housing for their families, good schools for their children, and communities that encourage their residents to care about their fellow citizens and the land they inhabit together."

Reviewed by JAY KARDAN,
writer and conservation activist from
Palmyra, Virginia

Perverse Subsidies:

Tax \$\$ Undercutting Our Economies and Environments Alike

by Norman Myers with Jennifer V. Kent; *International Institute for Sustainable Development* (161 Portage Ave. East, 6th floor, Winnipeg, Manitoba R3B 0Y4 Canada); 1998; \$20; 230 pp.

With classic British understatement, author Norman Myers remarks in the acknowledgments section of *Perverse Subsidies*: "This has been the most complex and challenging of all 15 'big picture' assessments I have undertaken in the past quarter century." Even a cursory scan of the book provides evidence to support this statement. Every page is packed with information, despite a caveat that the database from which the authors chose the 1600 papers was deficient and those selected papers rarely tackled the question of perverse subsidies directly. As a consequence, this book almost certainly understates the social and ecological problems exacerbated by tax-funded government subsidies.

In perhaps the book's most telling paragraph, the authors address the magnitude of the costs involved:

The perverse subsidies total approaching \$1.5 trillion is larger than all but the five largest national economies in the world. It is twice as large as global military spending per year, and almost twice as large as the annual growth in the world's economy. It is larger than the top 12 corporations' annual sales. It is three times as much as the annual cash incomes of the 1.3 billion poorest people, and three times as much as the international narcotics industry. Were just half of these perverse subsidies to be phased

out, just half of the funds released would enable most governments to abolish their budget deficits at a stroke, to reorder their fiscal priorities in fundamental fashion, and to restore our environments more vigorously than through any other single measure. (p. xix)

Myers and Kent are quick to note that not all subsidies have deleterious effects on economies and the natural world (e.g., education subsidies). Uncertainties are identified forthrightly. Although it is not easy to introduce current literature when a book nears completion without creating discontinuities, a number of recent references—quite a few from 1997 and some from 1998—are included.

Despite the formidable problems identified, this volume is not a gloom and doom book. Recent progress—including the phaseout of agricultural subsidies in New Zealand starting in the early 1980s, reductions in subsidies for fossil fuels in various countries, and changes in US farm policy—is highlighted.

However, despite enormous benefits (such as \$4000/year for the typical US taxpayer if perverse subsidies were eliminated), there are still substantial obstacles—in particular, the special-interest groups fighting to obtain or retain subsidies. For perspective, in Washington, DC there are 90,000 lobbyists with 60,000 lawyers for backup—or 280 for each member of Congress.

The bulk of *Perverse Subsidies* is devoted to the principal sectors of the economy: Agriculture, Fossil Fuels/Nuclear Energy, Road Transportation, Water, and Fisheries, followed by an Overview Assessment. The volume concludes with Policy Options and Recommendations. A variety of policy options are refer-



enced. I couldn't resist checking out a few particularly intriguing titles and found that the information has been accurately conveyed and the most important points (in the context of this book) skillfully identified. The diversity of sources is impressive, as is the synthesis that the authors have achieved. The references alone are worth the price of the book.

The final chapter provides a nice framework for the more detailed principal sectors. The particular areas are difficult to summarize because they are packed with information but are easy to read. Most problems that are of interest to biologists—such as habitat fragmentation and loss, biotic impoverishment, toxicants in the environment, alteration

of the hydrologic cycle, depletion of fisheries stocks, and increased greenhouse gases—are markedly influenced by perverse subsidies.

The book provides persuasive evidence that eliminating perverse subsidies would significantly improve environmental conditions. In some cases, however, policy options are less clear; for example, producing 1 kg of corn takes 1000 kg of water. Thus, a shipment of corn to an arid country (e.g., Israel) from a water-rich country (e.g., Canada) involves a water subsidy. Whereas agriculture uses an estimated 65% of the total water supply in developed countries, in many developing nations it uses as much as 90% of the total water supply. A water subsidy to developing nations in the form of grain may discourage more efficient use of water, although the humanitarian benefits are quite clear.

The book is packed with such information, and thus notes various ethical dilemmas related to subsidies. Authoring this book required self-confidence because it will hit the pocket-book nerve of well-funded lobbyists. Since Norman Myers is no stranger to contentious debates, he is doubtless prepared for the counterattack that seems inevitable. Although somewhat technical in nature, *Perverse Subsidies* is a good read. The flow of ideas and evidence is systematic and orderly. It may even become a classic! For those wishing to leave a habitable planet for their descendants, this book is essential reading.

Reviewed by **JOHN CAIRNS JR.**
(Department of Biology, Virginia Tech,
Blacksburg, VA 24061)

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American Institute of Biological Sciences.

The Religion of Technology

by David F. Noble; *Knopf* (201 East 50th St., New York, NY 10022); 1997; \$27.50 hardcover, \$14.95 paper; 304 pp.

Progress Without People

by David F. Noble; *Between the Lines* (720 Bathurst St., Suite 404, Toronto, ON Canada M5S 2R4); 1995; \$17.95; 166 pp.

As conservationists, we know technology is important—it greatly enhances the ability of humans (some more than others) to alter and degrade the natural world. Technology allows us to disrupt, simplify, even destroy ecosystems, and extirpate species we find inconvenient. Sometimes it seems our technological creations have become our masters—we are slaves to the clock, the machine, the email. Yet, we embrace these creations nonetheless, even take pride in them. Why? Although a historian chiefly concerned with the plight of working people, David Noble in his book *The Religion of Technology* offers some explanations of interest to conservationists, especially concerning our society's deeply rooted faith in technology.

Critics of technology sometimes deride its boosters by saying that it is their religion: they worship their machines rather than the God they claim to believe in. Noble argues that for medieval Europe and for modern Europe and North America, the world of spirit and technology have been closely linked—sometimes implicitly, but until recent times mostly explicitly. The development of the “useful arts” was long seen as central to spiritual growth, closely tied to notions of salvation. For Noble, this linkage is key to

understanding how our societies deal with technological change and its effects today. Only by understanding this peculiar faith can we fathom why so many who suffer injuries to themselves and the natural world continue to support technological innovation.

Most remarkable about Noble's book is his examination of the way these religious views of the useful arts influence three major technological projects of the 20th century: space travel, artificial intelligence, and genetic engineering.

From the early days of the Army missile program to NASA, religiosity has permeated the space program. Werner Von Braun spoke of taking the gospel to other worlds; astronauts have described space flight as bringing them closer to God. Noble cites Lewis Mumford, who observed that “Only a mixture of adventurous impulses and religious convictions of the deepest sort would persuade normal warm-hearted human beings, such as many astronauts seem to be, to take part in such a life-denying ritual.”

Noble has it right as far as he goes, but *The Religion of Technology* would be stronger if his historical sense extended beyond the human community. The astronomer Timothy Ferris was asked recently why he thought people supported the space program. His answer: people feel lonely—they want to find other life in the universe. Lonely? For other life? We are not alone. We are surrounded by millions of other species. If we feel alone it is because we have separated ourselves from other creatures, commodified them—at great cost to ourselves—and even greater cost to them.

Although the effort to create a thinking machine is not, in Noble's view, explicitly religious the way the space program has been, it is nonetheless imbued with similar attitudes. Here, humans seek to remove that last fetter

limiting our godlike essence: stripping away the animal body and leaving only pure reason. The struggle to realize this Cartesian pipe dream drives much of the artificial intelligence work. Noble quotes Danny Hill of MIT: “...what's good about humans is the idea thing. It's not the animal thing.”

Here, Noble's book would be stronger if it acknowledged the work of Paul Shepard, Morris Berman, and others who have explored crippling effects of the mind-body dualism that emerged with agriculture and pastoralism. The denial of the body is also a denial of the Earth, of reality, and of other creatures' lives. The experience of the body is the foundation of all other grounded knowledge, of empathy, of connection. Like us, other creatures live for a time and then die—their deaths are as real and final as ours. (Noble might also have explored the green religious movement, which, while not necessarily transcending the dominant dualism in its theology, nonetheless regards God's creation as good, not fallen; humans may find meaning—and serve God—in caring for creation, not in trying to control or “improve” it.)

Finally, Noble offers us a view of genetic engineering. Here, human beings come face to face with their divinity. Genetic engineering is the opportunity, some practitioners claim, to share with God the direction of creation—to become co-creators of life. Understanding the language of the gene is God's gift, moving us closer to the garden, allowing us to redeem ourselves by reprogramming the haphazard programming of evolution. Since humanness (= divineness) resides in the soul, rather than the body, and genetics cannot alter the soul, nothing can go wrong here. The religiosity in genetics is usually more implicit than explicit, but the

OTHER RECOMMENDED TITLES

The Florida Panther: Life and Death of a Vanishing Carnivore

by David S. Maehr; *Island Press* (1718
Connecticut Ave. NW, Suite 300, Washington,
DC 20009); 1997; \$19.95 paper; 259 pp.



David Maehr's interesting book blends personal accounts of his field work—including panther encounters—with a reformative assessment of panther habitat, the animal's biological condition, and the politics of its survival. Maehr's research corrects the debilitated image of the Florida panther; he asserts that the animal is not a biological lost cause, but an extremely adaptive creature that has "weathered a century's worth of attempts to eradicate it, as well as two decades of misdirected efforts to save it." The decades-long debate over the cat's welfare may well continue. But from Maehr's work, one conclusion becomes clear: the Florida panther's chance of survival rests precariously on protecting its dwindling habitat. —CHERRIE NAMY

continuity in themes is unmistakable. There is a hubris, an alienation, a desire for escape from the body, from the Earth, from that which has fashioned us.

At the root of our culture's worship of technology is a desire for control that has become both institutionalized and thoroughly internalized. Ultimately, the desire for control is about fear, and while there are things in life worth fearing, basing a social order or one's life on fear is a catastrophe. One is left, at the end of *The Religion of Technology*, thinking of Paul Shepard's observation that alienation truly exists when the mania for control is interpreted as mature experience.

IN PROGRESS WITHOUT PEOPLE,

a book of essays published two years before *The Religion of Technology*, Noble asks a provocative question about the latest wave of technological development (albeit from the standpoint of labor rather than conservation, but there are lessons for us as well): Where is the mass resistance of previous epochs? Where are the Luddites? The latest technological wave has dislocated millions of people—put many out of work while others work longer hours for less pay, with less security and less power. But unlike the industrial revolution, it has precipitated much less organized resistance.

People, Noble argues, have been socialized to accept a new fatalism: Technology is progress, a power in itself—it cannot be stopped. Moreover, even if we as individuals suffer from its development and application (loss of a job, loss of power on the job), we must support it because if we don't stay competitive through innovation, we'll all become poor. Noble notes that the labor movement leadership has largely accepted such arguments, against the

expressed discontent in their own rank and file. Without articulate opponents possessing a substantive critique based on experience, there can be no effective opposition or alternative vision. The elites have learned that if you convince your opponents to accept your version of the story, you need not fight them. It's much cheaper that way.

The reality is far different than the story of glorious progress for all. Technological innovation and its application benefit those who make the investment decisions, the people who own and control the technology, and the experts who work for them. The elites seek greater wealth and the perpetuation of their own power through technological development, be it at enormous cost to other people and other species and sometimes even to themselves. Technological development is neither mystical nor inherently rational or inevitable. It is driven by the self-perceived needs of an elite—needs that others in society have come to accept as their own.

Noble's goal is a call to arms for labor—it is essential, he believes, for the working class to see technology for

what it is, rather than wallow in fatalism. Conservationists, if not labor, recognize the need for an alternative vision. A positive agenda for an ecologically healthy and wild North America is a needed strategic element to slow, halt, and reverse existing trends. Our critique of technology comes from that perspective. Noble, in revealing the ties between technology and religious faith, reminds us how deeply anchored the technological juggernaut is—not just in our economic system, but in people's minds and hearts. Ultimately such a faith conflicts with valuing the lives of wild things, a point that conservationists must confront. This does not mean we need to invent a new faith—religious change is usually a matter of reinterpretation. With people's faith in technology, there is also great unease, in large part because technology worship ultimately is unfulfilling and conflicts with the most basic tenet of most religious frameworks—at least rhetorically—that all life is sacred.

Reviewed by **DAVID JOHNS**, *Wild Earth* and *The Wildlands Project* board member and political science teacher

ANNOUNCEMENTS

Conference Celebrates 50th Anniversary of Leopold's *Almanac* On October 4–7, 1999, the Wisconsin Academy of Sciences, Arts, and Letters will sponsor "Building on Leopold's Legacy: Conservation for a New Century" in Madison, Wisconsin. To mark the 50th anniversary of the publication of Aldo Leopold's conservation classic *A Sand County Almanac*, this conference will consider American conservation history and future prospects. Several simultaneous local and regional conferences are also being planned. For further information on registration and opportunities for off-site participation via an enhanced interactive website, visit www.wisc.edu/wisacad/landethic/ or contact the Wisconsin Academy at 608-263-1692.

National Forest Reform Rally The Wild Utah Forest Campaign, a project of American Lands, will cohost the 13th Annual Forest Reform Rally with the Forest Reform Network from September 10–12, 1999. The rally will be held in the midst of an old-growth spruce/fir forest on the Wasatch-Cache National Forest (north of Salt Lake City) on the border of the High Uintas Wilderness Area. Forest activists from across the country share information, gain inspiration, formulate policies, and develop forest protection strategies at this annual forum. An offshoot of this year's event will be a follow-up to the first annual Intermountain Forest Activists Conference held last year in Salt Lake City. Contact Susan Ash at the Wild Utah Forest Campaign, 165 S. Main Street, Suite #1, Salt Lake City, UT 84111; 801-539-1355; fax 801-539-0631; wufc@xmission.com.

Protecting Utah's Redrock Wilderness The Southern Utah Wilderness Alliance announces the release of *America's Redrock Wilderness: Protecting a National Treasure*. The book, with more than 50 color photographs, text by Frederick H. Swanson, and an afterword by Terry Tempest Williams, combines images of Utah's spectacular natural desert wilderness with explanations of the threats to this landscape. A companion document, "Facts About America's Redrock Wilderness," explores Utah public lands issues and advocates for passage of the Citizens' Proposal for America's Redrock Wilderness. The 56-page book with the 48-page supplement is available for \$18 postpaid from the Southern Utah Wilderness Alliance, 1471 South 1100 East, Salt Lake City, UT 84105; 801-486-3161; fax 801-486-4233; suwa@suwa.org; www.suwa.org.

Rally '99 in the Rockies The Land Trust Alliance will hold its 12th National Land Trust Rally October 14–17, 1999 in Snowmass, Colorado. The Rally is the only national conference for land trusts and those involved with private land protection efforts. Participants will have the opportunity to attend pre-conference seminars; explore a part of Colorado on a field trip; and choose from more than 100 educational workshops. Early registration (by August 13) is \$250 for qualified LTA members and \$350 for others. Lodging is available for an additional fee. For registration information, contact the Land Trust Alliance, 1319 F St. NW, Suite 501, Washington, DC 20004-1106; 202-638-4725; www.lta.org.

Defenders of Wildlife Report *Science-Based Stewardship: Recommendations for Implementing the National Wildlife Refuge System Improvement Act* is a 36-page report that synthesizes the findings of a panel of six prominent scientists who examined and formulated recommendations for implementing the 1997 Refuge Improvement Act. Workshop participants focused on four key areas: 1) maintaining biological integrity, diversity, and environmental health; 2) inventorying and monitoring; 3) expanding the refuge system; and 4) instituting comprehensive conservation planning. Order a copy (\$10) from Defenders of Wildlife, 1101 Fourteenth St. NW, Suite 1400, Washington, DC 20005; 202-682-9400; fax 202-682-1331; www.defenders.org.

Ecological Society of America Annual Meeting Over 4000 scientists are expected to attend the Ecological Society of America's 84th Annual Meeting in Spokane, Washington from August 8–12, 1999. This year's conference will be held in conjunction with the North American Chapter of the International Society for Ecological Modeling. Plenary, symposia, and workshops will focus on "Landscapes, Legacies,

and Limits: Bridging Borders." Contact the Ecological Society of America at 2010 Massachusetts Ave. NW, Suite 400, Washington, DC 20036; 202-833-8773; fax 202-833-8775; esahq@esa.org; www.esa.sdsc.edu.

International Conference of the Society for Ecological Restoration The Society for Ecological Restoration's 11th Annual International Conference will be held at the Presidio of San Francisco from September 23–25, 1999. This year's conference will consider large, cooperative restoration efforts. Numerous workshops, field trips, and technical symposia will be offered, along with three plenary symposia: Restoration of Public Lands; Watershed Politics and Management; and Community, Connections, and Stewardship. Contact the Society for Ecological Restoration at 1207 Seminole Highway, Suite B, Madison, WI 53711; 608-262-9547; fax 608-265-8557; ser@vms2.macc.wisc.edu; www.ser.org/ser99.htm.

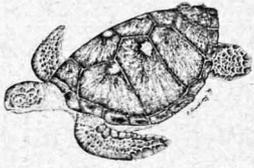
Deep Ecology on the Air The *Deep Ecology for the 21st Century* radio series is, in the words of Florence Shepard, "a treasury of ecological thought as well as road map into the next millennium." The series, which features Dave Foreman, Stephanie Mills, Gary Snyder, Arne Naess, Julia "Butterfly" Hill, and others, is free to public radio stations. Ask your local station to carry *Deep Ecology for the 21st Century*. For more information, call 707-467-1100 or visit www.newdimensions.org. The 13-hour series is also available on cassette tape with the 25-page resource guide for \$99.95 (9.95 for single cassettes); call 800-935-8273. Discounts are available for multiple copy orders.

Wild Rockies Rendezvous Alliance for the Wild Rockies will host the "Wild Rockies Rendezvous, Connecting People and Places" September 17–19 at Montana Snowbowl near Missoula. Join conservationists from throughout the region and learn strategies for protecting wild country. Program highlights include a keynote address by Martha Marks, president of Republicans for Environmental Protection; informative panels and hands-on workshops; and live music. Registration is \$10. For more information, contact AWR's Bob Clark at 406-721-5420; bobclark@wildrockies.org; www.wildrockies.org/awr.

Oregon Wilderness Conference The Oregon Natural Resources Council will host the Oregon Wilderness Conference on September 26 and 27 at Mt. Hood Community College in Gresham, Oregon. ONRC staff members and wilderness advocates will present a weekend of discussion, entertainment, and hikes to unprotected wilderness areas. For more information, contact Diane Valentine at 503-283-6343, ext. 224 or dv@onrc.org.

Natural History Field Camp Reed Noss will give the opening keynote talk at the East Siskiyou Natural History Field Camp on Sunday August 29, 1999. The Field Camp, which runs through September 4th, is held at the rustic Dakubetede Wilderness Campus, an hour's drive from Ashland, Oregon. Six days of workshops vary from on-campus sessions to hiking in the adjacent (proposed) Dakubetede Wilderness and along the Siskiyou Crest. Optional academic credit (graduate or undergraduate) is available through Antioch University. Cost for the Field Camp is \$150–\$300 sliding scale (\$125 if registered by August 1), or \$45 per day (\$30 for students, \$20 for children age 7–12, under 7 free), including meals, workshops, entertainment, and walk-in wilderness riverbank camping. Tuition for five university science credits is an additional \$375 (\$450 for graduate level). For details, contact Dakubetede Environmental Education Programs, P.O. Box 1330, Jacksonville, OR 97530; 541-899-1712; deep@mind.net.

Blues Artists Benefit Earthjustice A new CD benefits the Earthjustice Legal Defense Fund's Fish-Trees-Water campaign to safeguard and restore the Great Northwest. *Fish Tree Water Blues* features performances by J.J. Cale, John Lee Hooker, Ani DiFranco, Branford Marsalis, Etta James, and others. Find the CD in music stores or order from Rounder Records at 1-800-768-6337; www.rounder.com. Contact Earthjustice Legal Defense Fund at 180 Montgomery St., Suite 1400, San Francisco, CA 94101-4209; 415-627-6700; fax 415-627-6740; www.earthjustice.org.



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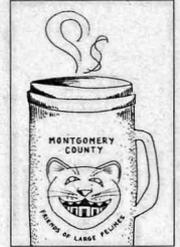


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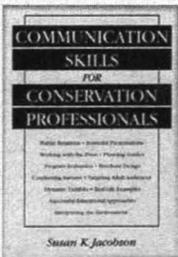


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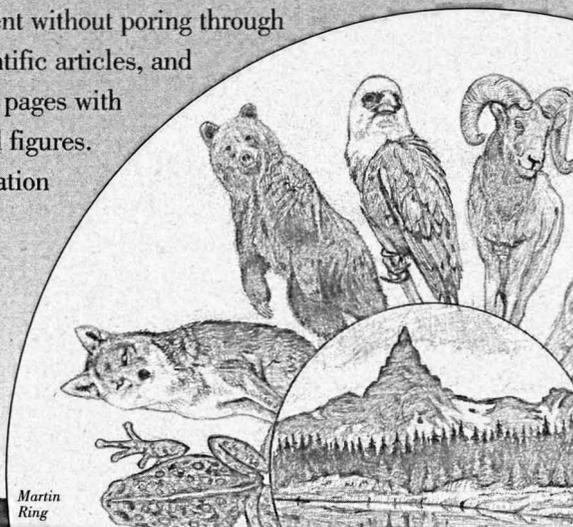
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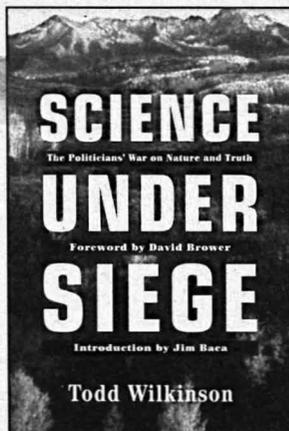
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BACK ISSUES

1/Spring 1991 • Ecological Foundations for Big Wilderness, Howie Wolke on The Impoverished Landscape, Reed Noss on Florida Ecosystem Restoration, Biodiversity & Corridors in Klamath Mtns., Earth First! Wilderness Preserve System, GYE Marshall Plan, Dolores LaChapelle on Wild Humans, and Bill McCormick's Is Population Control Genocide?

2/Summer 1991 • Dave Foreman on the New Conservation Movement, Ancient Forests: The Perpetual Crisis, Wolke on The Wild Rockies, Grizzly Hunting in Montana, Noss on What Wilderness Can Do for Biodiversity, Mendocino NF Reserve Proposal, Christopher Manes on the Cenozoic Era, and Part 2 of McCormick's Is Population Control Genocide?

3/Fall 1991 • SOLD OUT (but photocopies of articles available). The New Conservation Movement continued. Farley Mowat on James Bay, George Washington National Forest, the Red Wolf, George Wuerthner on the Yellowstone Elk Controversy, The Problems of Post Modern Wilderness by Michael P. Cohen and Part 3 of McCormick's Is Population Control Genocide?

4/Winter 1991/92 • Devastation in the North, Rod Nash on Island Civilization, North American Wilderness Recovery Strategy, Wilderness in Canada, Canadian National Parks, Hidden Costs of Natural Gas Development, A View of James Bay from Quebec, Noss on Biologists and Biophiles, BLM Wilderness in AZ, Wilderness Around the Finger Lakes: A Vision, National ORV Task Force

5/Spring 1992 • Foreman on ranching, Ecological Costs of Livestock, Wuerthner on Gunning Down Bison, Mollie Matteson on Devotion to Trout and Habitat, Walden, The Northeast Kingdom, Southern Rockies Ecosystem Protection, Conservation is Good Work by Wendell Berry, Representing the Lives of Plants and Animals by Gary Paul Nabhan, and The Reinvention of the American Frontier by Frank and Deborah Popper

6/Summer 1992 • The Need for Politically Active Biologists, US Endangered Species Crisis Primer, Wuerthner on Forest Health, Ancient Forest Legislation Dialogue, Toward Realistic Appeals and Lawsuits, Naomi Rachel on Civil Disobedience, Victor Rozek on The Cost of Compromise, The Practical Relevance of Deep Ecology, and An Ecofeminist's Quandary

7/Fall 1992 • How to Save the Nationals, The Backlash Against the ESA, Saving Grandfather Mountain, Conserving Diversity in the 20th Century, Southern California Biodiversity, Old Growth in the Adirondacks, Practicing Bioregionalism, Biodiversity Conservation Areas in AZ and NM, Big Bend Ecosystem Proposal, George Sessions on Radical Environmentalism in the 90s, Max Oelschlaeger on Mountains that Walk, and Mollie Matteson on The Dignity of Wild Things

8/Winter 1992/93 • Critique of Patriarchal Management, Mary O'Brien's Risk Assessment in the Northern Rockies, Is it Un-Biocentric to Manage?

Reef Ecosystems and Resources, Grassroots Resistance in Developing Nations, Wuerthner's Greater Desert Wildlands Proposal, Wolke on Bad Science, Homo Carcinomicus, Natural Law and Human Population Growth, Excerpts from *Tracking & the Art of Seeing* and *Ghost Bears*

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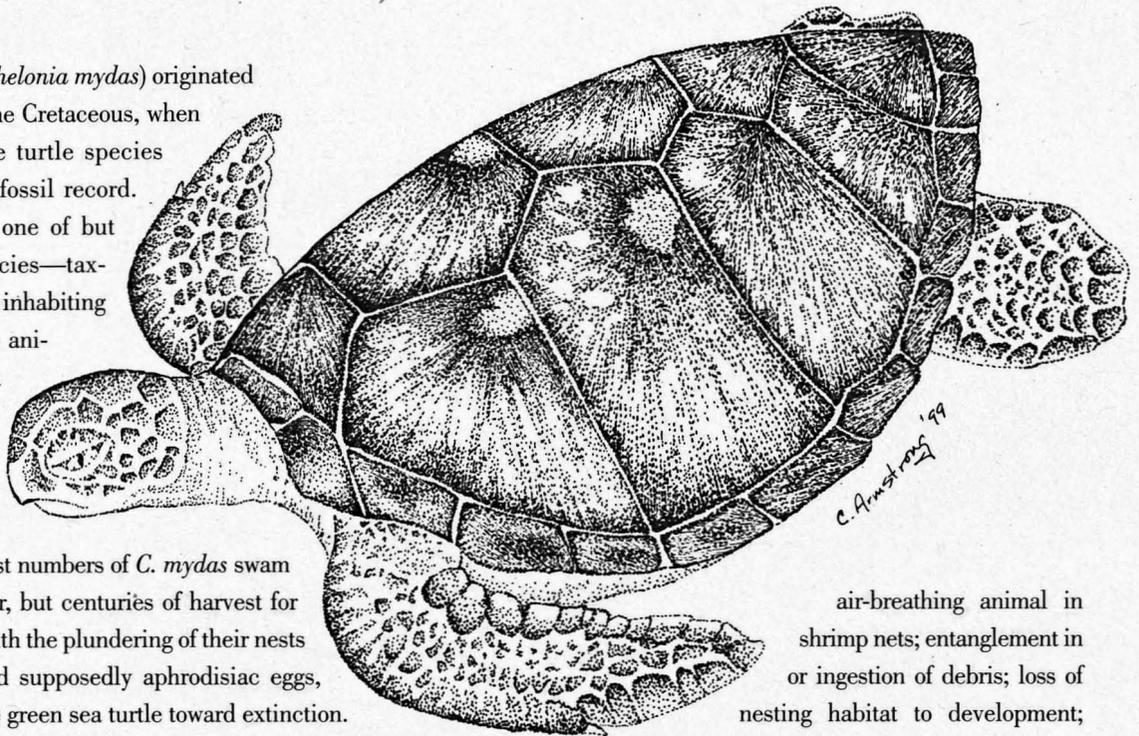
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The green sea turtle (*Chelonia mydas*) originated as a species during the Cretaceous, when a plethora of marine turtle species are known from the fossil record. Today, the green is one of but seven or eight species—taxonomies differ—still inhabiting the seas. Neither the animal's leathery skin nor its hard shell are truly green; rather, its common name is inspired by the tint of its body fat. Once, vast numbers of *C. mydas* swam oceans the world over, but centuries of harvest for meat and oil, along with the plundering of their nests for the nutritious and supposedly aphrodisiac eggs, have helped push the green sea turtle toward extinction. Now classified as Endangered by the World Conservation Union, the US Fish & Wildlife Service recognizes the species as Threatened, except for populations in Florida and New Mexico, which the USFWS labels Endangered.

Although younger turtles feast on jellyfish and other small sea animals, the adult green stands apart from other sea turtles by maintaining a largely herbivorous diet of sea-grasses and algae. The age at which wild green turtles become sexually mature is undetermined—estimates range from 15 to 50 years—but their reproductive behavior is something of a marvel: a turtle may roam thousands of miles of open ocean to forage between breeding seasons, but to nest, the female will almost certainly return to the vicinity, if not the very beach, where she first crawled out of the sand as a hatchling years before.

Threats to the green turtle's survival include continued harvesting of meat and eggs (which is still legal in some countries, and, although outlawed by the Endangered Species Act in 1973, a modicum of this activity persists in the US); drowning of the



air-breathing animal in shrimp nets; entanglement in or ingestion of debris; loss of nesting habitat to development;

disorientation of phototropic hatchlings on excessively lit shorelines; and a rise in fibropapillomatosis, a mysterious disease characterized by grotesque tumors that can appear both internally and externally. Although the tumors themselves are benign, they may exceed ten centimeters in diameter and cause blindness, kidney failure, intestinal obstruction, or other maladies resulting in death.

It must be emphasized that piecemeal protection will not preserve the genetic diversity of *Chelonia mydas*. Mitochondrial DNA studies have shown that each colony of nesting green sea turtles is genetically distinct: immigration of females between nesting populations is effectively nil. Therefore, a dying rookery in a poorly managed region cannot rely on the recruitment of new females from populations in protected areas for revival. Additionally, in the course of a lifetime each green turtle relies on foraging and breeding habitats in disparate locales. The sea turtle recognizes no political borders; to ensure the species' survival, conservation strategies will have to transcend those borders as well. ☺

Green Sea Turtle

illustration by
Cynthia Armstrong
text by Kelly Samek

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