
WILD EARTH
Citizen Science
looking to protect nature
The Journal of the Wildlands Project
FALL/WINTER 2001–2002
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WILDLANDS PROJECT

reconnect restore rewild

WE ARE AMBITIOUS. We live for the day when grizzlies in Chihuahua have an unbroken connection to grizzlies in Alaska; when wolf populations are restored from Mexico to the Yukon to Maine; when vast forests and flowing prairies again thrive and support their full range of native plants and animals; when humans dwell on the land with respect, humility, and affection.

Toward this end, the Wildlands Project is working to restore and protect the natural heritage of North America. Through advocacy, education, scientific consultation, and cooperation with many partners, we are designing and helping create systems of interconnected wilderness areas that can sustain the diversity of life.

Wild Earth—the quarterly publication of the Wildlands Project—inspires effective action for wild Nature by communicating the latest thinking in conservation science, philosophy, policy, and activism, and serves as a forum for diverse views within the conservation movement.

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white pine (detail), serigraph by David Hunsberger, ©1997

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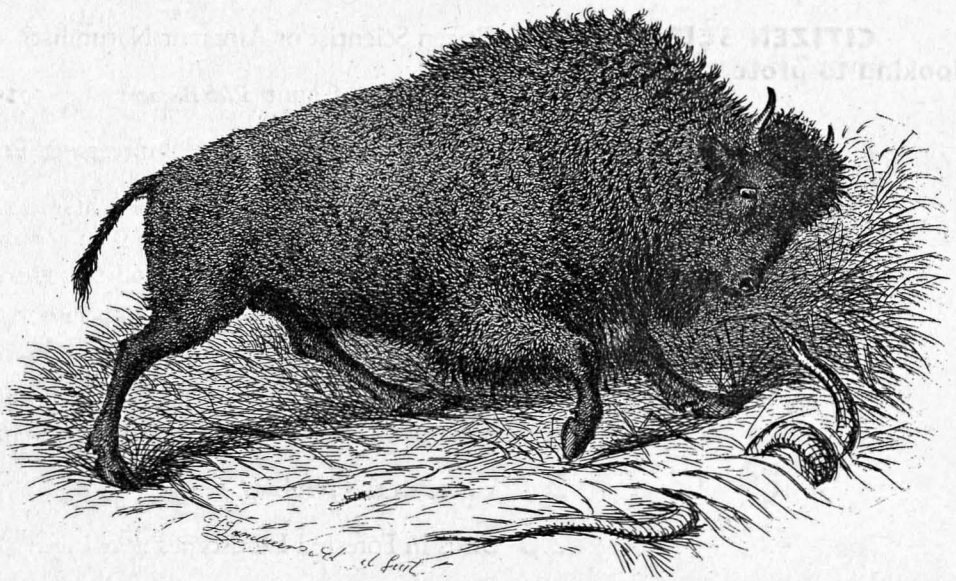


Early Awareness of Extinction

ALTHOUGH EXTINCTION has been going on for as long as there has been life on the planet, humans have only recently become aware of it. We first began to understand what fossils were only 200 years ago. Even after educated people accepted that fossils were the remains of long-dead creatures, they were reluctant to believe that such creatures were extinct. At the end of the eighteenth century, biological theory was wrapped in the idea of the Great Chain of Being, which argued that by removing one link (species) the whole chain could break. Thomas Jefferson, after studying the fossil of a giant ground sloth dug up in western Virginia (which he misidentified as a lion), wrote in 1799, "If this animal has once existed, it is probable on this general view of the movements of nature that he still exists."[1] He asked Meriwether Lewis and William Clark to be on the lookout for living counterparts to the fossil animals being found.

At the time of Jefferson's writing, French scientist Georges Cuvier was convincing most natural historians that the fossils being unearthed in Europe were of extinct animals. Religious scientists thereupon revised earlier theories to allow for extinction in God's perfect plan. The evidence for extinct mammals grew as more fossils were dug up and described. By 1825, for example, ten extinct North American vertebrates had been described.

After scientists settled on the reality of extinction, the "how" remained to be answered. Suggested mechanisms for extinction depended on whether one was a catastrophist or a uniformitarian. Cuvier proposed localized catastrophes to explain extinctions, while others, led by William Buckland of England, looked to Noah's flood as the universal catastrophe that accounted for extinct species. Swiss geologist and biologist Louis Agassiz, who emigrated to the United States and became one of the foremost American scientists of his era, argued for mass glaciation as the cause of past extinctions. Buckland went over to Agassiz's glacier theory in 1842.[2]

English geologist Charles Lyell was the "early champion of slow, natural changes across the surface of the earth as a cause of Pleistocene extinctions." According to Donald Grayson, Lyell believed that "the extinction of species is a predictable, natural, and ongoing phenomenon, one that can be expected to occur slowly during the course of ages."[3] Although the reality of extinction of species was well accepted before mid-century by both catastrophists and uniformitarians, Lyell and other advocates of gradual, natural extinctions had a hard time explaining what the actual mechanisms of extinction were.

In both North America and Europe, other scientists, including France's Jean-Baptiste de Monet de Lamarck, suggested that humans had caused past extinctions. Lyell rejected human causation because he believed the extinctions occurred before humans were present. However, by the 1860s, the great French bone digger Jacques Boucher de Perthes changed the minds of Lyell and others. Boucher de Perthes's careful, stratigraphic excavations in the Somme River valley proved that early man and the extinct great beasts were contemporaries. After visiting Boucher de Perthes's diggings in 1859, Lyell wrote, "That the human race goes back to the time of the mammoth and rhinoceros (Siberian) and not a few other extinct mammals is perfectly clear...." In 1860, British anatomist Richard Owen acknowledged extinction of the fossil beasts by the "spectral appearance of mankind on a limited tract of land not before inhabited."

Alfred Russell Wallace, intrepid explorer and codiscoverer with Darwin of natural selection, believed in catastrophic glaciation and thus rejected human causation even after Lyell, Owen, and Darwin accepted it. Finally, after the turn of the century, Wallace accepted that glaciation had not been so widespread as he had believed, and, in concert with climatic changes, "the extinction of so many large Mammalia is actually due to man's agency...."[4]

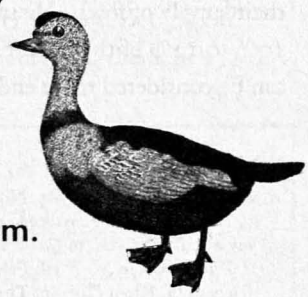
Based on the evidence in the ground, by the last half of the nineteenth century educated people recognized that prehistoric extinctions had occurred and that it was likely that Stone Age humans had a hand in them. During that same period, some began to turn their eyes to evidence that new extinctions were then taking place and that humans were again responsible. In 1832, nearly three decades before he accepted Boucher de Perthes's views that humans had hunted extinct beasts, Lyell wrote that "the annihilation of a multitude of species has already been effected, and will continue to go on hereafter, in a still more rapid ratio, as the colonies of highly civilized nations spread themselves over unoccupied lands."[5]

It was not long after Lyell's warning that many hunters and naturalists in North America called for an end to the mass slaughter of bison, passenger pigeon, and waterfowl then taking place. Civilizations, in fact, have recorded extinctions since 80 A.D., when the European lion became extinct.[6] In 1914, famous naturalist William T. Hornaday of the New York Zoo delivered a stirring series of lectures on wildlife conservation at the Yale School of Forestry, which were published as a widely read book, *Wild Life Conservation.* He listed 10 species that had become "totally extinct in a wild state between 1840 and 1910":

> Great auk,
> Labrador duck,
> Pallas cormorant,
> Passenger pigeon,
> Eskimo curlew,
> Carolina parrakeet,
> Cuban tricolor macaw,
> Gosse's macaw,
> Yellow-winged green parrot,
> Purple Guadaloupe macaw.[7]

The magnitude of the extinction crisis, however, remained invisible, even to most conservationists and biologists, through much of the twentieth century. Extinction was a problem that conservationists sought to stay, but its enormity—that the modern extinction event was of the magnitude of the dinosaur extinction event—was unimagined. However, in 1936, leading American conservationist Aldo

Based on the evidence in the ground, by the last half of the nineteenth century educated people recognized that prehistoric extinctions had occurred and that it was likely that Stone Age humans had a hand in them.



bison and Labrador duck engravings by Georges Cuvier, ca. 1800

Leopold, after a trip to inspect German forests, wrote in *Bird-Lore* that "the most pressing job in both Germany and America is to prevent the extermination of rare species."[8]

In 1963, British conservationist Colin Bertram reviewed the status of wildlife in the British nature journal *Oryx* and expressed his fear: "Even the minority, the preservationists and conservationists, in my opinion, have as yet failed to see in full the awful vividness of the red light before them." He warned that "without sufficient [human] fertility control, we lose inevitably and for ever most of the remaining larger mammals of the world, very many of the birds, the larger reptiles and so many more both great and small."[9]

University of Wisconsin botanist Hugh Iltis spoke on the first Earth Day in 1970 at the University of Michigan. He warned that we were "pushing, prematurely, tens of thousands of species of plants and animals toward the abysmal finality of *extinction* by destroying their habitats, by decimating their numbers, by interrupting their life cycles and ruining their supply of food." He said, "Today, 10% to 12% of the mammalian taxa can be considered to be endangered, and birds are faring no better."[10]

The dawning awareness that we were witnessing an extinction event to rival or surpass that of the dinosaurs became widespread in the 1970s with the rapidly accelerating destruction of tropical forests. Geneticist Michael Soulé, a cofounder of the Society for Conservation Biology and the Wildlands Project, credits British botanist and tropical conservationist Norman Myers with being the first to publicly say we were in a mass extinction. In 1978, The Wilderness Society excerpted in their magazine a Worldwatch Institute report by Erik Eckholm summarizing the latest thinking on worldwide extinction by Myers, Peter Raven of the Missouri Botanical Garden, tropical ecologist Thomas Lovejoy, David Ehrenfeld, and other biologists. Eckholm warned:

> Within sight is the destruction of plant and animal species, and of the genetic heritage of eons they embody, on a scale that dwarfs the combined natural and human-caused extinctions of the previous millions of years. Should this biological massacre take place, evolution will no doubt continue, but in a grossly distorted manner. Such a multitude of species losses would constitute a basic and irreversible alteration in the nature of the biosphere even before we understand its workings—an evolutionary Rubicon whose crossing Homo sapiens would do well to avoid.[11]

More than 20 years ago, then, the conservation movement had every reason to be fully aware of the crisis. By 1980, Soulé and Bruce Wilcox had edited a state-of-knowledge book on the crisis and possible solutions—*Conservation Biology.*[12] In the foreword, Lovejoy wrote, "Hundreds of thousands of species will perish, and this reduction of 10 to 20 percent of the earth's biota will occur in about half a human life span....This reduction of the biological diversity of the planet is the most basic issue of our time."[13] Soulé and Wilcox wrote, "There is simply no precedent for what is happening to the biological fabric of this planet and there are no words to express the horror of those who love nature."[14]

~ Dave Foreman

Bosque del Apache, New Mexico

This is an excerpt from my forthcoming book, The War on Nature. *In my next column, I'll outline the causes of extinction—both natural catastrophes in the deep reaches of the past and the seeming juggernaut of species eliminations that we humans have unleashed in recent decades.*

NOTES

1. Donald K. Grayson, 1984, Nineteenth-century explanations of Pleistocene extinctions: A review and analysis, in *Quaternary Extinctions: A Prehistoric Revolution,* ed. Paul S. Martin and Richard G. Klein (Tucson: The University of Arizona Press), 6. Grayson's chapter in *Quaternary Extinctions* is an excellent summary of how scientists came to accept the reality of past extinction, 5–39.
2. Grayson, 6–12.
3. Grayson, 13.
4. Grayson, 20–30.
5. Grayson, 21. Lyell, of course, used unoccupied in the sense of unoccupied by civilized societies.
6. Erik Eckholm, 1978, Wild species vs. man: The losing struggle for survival, *The Living Wilderness* July/September 1978: 12.
7. William T. Hornaday, 1914, *Wild Life Conservation* (New Haven: Yale University Press), 12. The spelling of the species is Hornaday's.
8. Aldo Leopold, 1936, Naturschutz in Germany, *Bird-Lore* 38.2: 102.
9. Colin Bertram, 1969, Man pressure, in *The Subversive Science: Essays Toward An Ecology Of Man,* ed. Paul Shepard and Daniel McKinley (Boston: Houghton Mifflin Company), 210–215.
10. The talk was later reprinted in Hugh H. Iltis, 1971, Technology vs. wild Nature: What are man's biological needs? *Northwest Conifer* (Pacific Northwest Chapter of the Sierra Club newsletter), May 22. Among his many accomplishments, Iltis discovered the wild ancestor of corn in Mexico.
11. Eckholm, 1978, Wild species vs. man: The losing struggle for survival, 11.
12. Michael E. Soulé and Bruce A. Wilcox, eds., 1980, *Conservation Biology: An Evolutionary-Ecological Perspective* (Sunderland, MA: Sinauer Associates, Inc.).
13. Thomas E. Lovejoy, 1980, Foreword, in *Conservation Biology,* ix.
14. Michael E. Soulé and Bruce A. Wilcox, 1980, Conservation biology: Its scope and its challenge, in *Conservation Biology,* 7–8.

The opinions expressed in Campfire are my own, and do not necessarily reflect official policy of the Wildlands Project. —DF

JAY TURNER'S "Wilderness East: Reclaiming History" (spring 2001) was a fine synopsis of the evolution of the wilderness concept in modern political context. To know where to go, one must know where one has been. Turner effectively relates the plausible future of eastern wilderness to its complex past.

I have one gripe with the article. Though critical of wilderness deconstructionists such as Baird Callicott and William Cronon, Turner's piece and others in *Wild Earth* over-indulge and thus help to legitimize these fellows and others of their ilk. Their anti-wilderness revisionism is seen primarily by a small cadre of true-believer urban leftist readers of publications such as *The Nation*. These arcane writers typically set up their opposition by misrepresenting ideas that they can then shoot down. Enough! *Wild Earth* and its fine contributors should stop giving these people free publicity. Stop fueling a debate that lacks merit.

True conservation is neither leftist nor rightist; nor is it about endless academic debate that bears no relation to the real world of the big outside. It's about saving and restoring wild native life on Earth and the wild habitat upon which it depends. Toward that end, *Wild Earth* is a valuable educational tool. Too valuable to waste space on whiny pseudo-intellectuals who don't know wilderness from a miniature French poodle. Don't censor; edit. Utilize the red felt tip when good writers legitimize self-important anti-wild lefties who otherwise would find themselves among a long list of wannabe pundits stuck in the well-deserved muck of well-earned obscurity.

Howie Wolke
Darby, Montana
Howie Wolke is a wilderness guide and author of *Wilderness on the Rocks.*

JAY TURNER'S excellent article "Wilderness East, Reclaiming History" (spring 2001) evoked many memories of those days of struggle over the nature and shape of an eastern wilderness bill in the early 1970s, and I wanted to share a few of them.

I was director of the Sierra Club's Washington, D.C., office and its principal lobbyist for the bill during its ups and downs in those last critical years, 1973–74. Even though I was the Sierra Club's Northwest Representative before that (1967–73; Doug Scott became my successor there, in 1974),

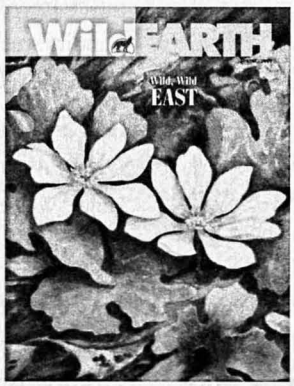
A decade of work for the wild

As many Wild Earth *readers know, we're celebrating ten years of on-the-edge writing, wildlands mapping, and conservation activism here at the Wildlands Project. To mark the decade, we published a retrospective anniversary booklet this past fall. If you haven't seen one, or would like another copy to give to a friend who may be interested in joining the Wildlands Project, please contact us. We'll be happy to send one along.*

We're also excited about this special combined fall/winter issue of Wild Earth. *With an updated style and an expanded line-up of articles and columns, we think it sets a good course for the next ten years. Look for your next, regular issue in spring—and let us know what you think of this edition!*

I grew up in Ohio and had spent much time in the East until I graduated from law school. I was also one of the speakers and strategists at the Club's Wilderness Conference in September 1971, which Turner rightly mentions as a seminal event.

As the article alludes several times, wilderness politics in the West subsequent to passage of the Wilderness Act in 1964 was very much a factor in the eastern wilderness battle. This context is important because it goes far to explain, I believe, the Forest Service's obsession with "purity," and our vehement opposition to this notion—East, West, or anywhere. Granted, there were a few individuals inside the Forest Service who perhaps really did believe that "purity" was the right thing for a wilderness system; Bill Worf, Recreation Forester for Region I in Missoula, comes to mind. But the real reason for its support across nearly all the rest of the agency was because a purist approach was the most certain way to keep large tracts of land from being included in the system.



Throughout those years, and far more than today, the Forest Service was overwhelmingly in the logging business. Those of us who had explored and come to love the great ancient forests of the Pacific Northwest were particularly dismayed about the fate that the agency had in mind for all, repeat *all*, of the magnificent forests that were not protected in some way: they were going to be logged. Period.

This was an era when no one outside the scientific community had ever heard the words "biodiversity," "ecosystem," or "endangered species." We had no functioning (yet) Endangered Species Act, or any of the other tools that activists now enjoy. Our weapons of choice—indeed just about the only weapons available to rescue the places we loved—were designation as national parks or wilderness areas. That was it. I remember this most poignantly, because I was one of the major actors in the struggles of those days to protect the *de facto* wilderness of the North Cascades, Oregon Cascades, and Northern Rockies.

Conversely, the best way for the Forest Service to prevent such protection, especially for forestlands that they and their industry allies coveted, was to oppose us (which they did, every single time in the Northwest), while claiming to be concerned about the "purity" of the National Wilderness Preservation System.

As Doug Scott points out in his article in the same issue of *Wild Earth* ("Congress's Practical Criteria for Designating Wilderness," spring 2001), there was a larger long-term game at work here, in the whole purity issue, which first surfaced in the battles to add acreage to Oregon's Eagle Cap Wilderness and pass wilderness legislation for the Mission Mountains in Montana. We had realized that if the Forest Service could win in the East on their "less-than-pure, two-systems" concept, it would reinforce their arguments in the struggles yet to come over unprotected low-elevation forested valleys across the West. This is where the big trees that the timber industry wanted were located, far more than in the East. We could be certain that in these places, the Forest Service would go out of its way to find some "impurity" in any proposed wilderness area.

After some internal debate, the conservation community rallied around the idea of "One Wilderness System." In the end, there was strong support for this approach within the Sierra Club, and I had the privilege of working and lobbying with Ernie Dickerman and the rest of the crew at The Wilderness Society until we passed the Eastern Wilderness Areas Act.

Of course the battle to protect the ecological integrity of public lands still rages today. *Except,* from my perspective, our weapons, our numbers, and our political support are so much greater now. Having lived through both RARE I and RARE II [the Forest Service's roadless area review and evaluation processes for making wilderness recommendations], I never thought I would live to see the day when there could even be serious debate about saving the *whole thing* in one Roadless Rule—much less such overwhelming support for it. I think I can now die happy!

Brock Evans

Washington, D.C.

Brock Evans is executive director of the Endangered Species Coalition.

We welcome your comments. Please send them to us at P.O. Box 455, Richmond, VT 05477 or e-mail to letters@wild-earth.org. Published letters may be edited for length and clarity.

THE VASTNESS OF THE EAST

i'm sure montana cowboys
all sit around and boast
of the vastness of montana
as compared, say, to the coast—

yet i am looking forward
to the day we can, at least,
step out and bid them welcome
to the vastness of the east.

unbroken forests of white pine,
200 years or more;
hurricanes that thunder
on the stark and rocky shore;

hardwoods, a painter's palette's-worth,
all glorious in the fall;
and in the swamps, the woodpecker's
and alligator's call.

the pumas slipping stealthily
along a leafy stream;
bears fishing for salmon
in the waters bright that gleam;

a rustic dogwood in full bloom,
wearing its finest dress;
and miles and miles of—no one;
its heart the wilderness.

where once there were great cities
wildflowers now will dance,
today's decay grown over
by a wilderness of plants;

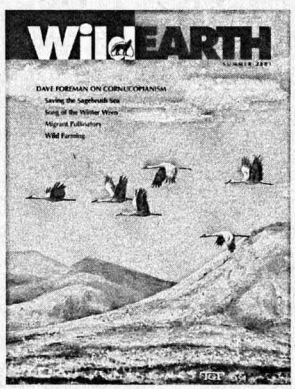
buried will be the garbage
that we now see everywhere,
and industry will be replaced
by water and clean air;

the freeways that now scar the land
be nowhere to be seen,
and everywhere the roving eye
beholds a sea of green.

the people, few and far between,
will gladly throw a feast—
the day montanans come to see
the wild, wild east!

Dennis Fritzinger
Berkeley, California

THE LETTER by Brant Mannchen (summer 2001) typifies one side of the debate over wilderness restoration we explored in our article "Naturalness and Wildness" (winter 2000/2001). While we share Brant's assertion that "the very essence of wilderness, what makes it different, is its wildness" we also believe that wilderness provides one of the best opportunities for naturalness, a place where evolution can occur unfettered by our human desires and egos. The essence of wilderness management, the point of our paper, and the heart of this debate, is to determine how to protect and preserve wildness *and* naturalness.



Contrary to Mannchen's letter, we never proposed or implied altering either the words or intent of the 1964 Wilderness Act. All legislation, including the Wilderness Act, needs to be interpreted because of uncertainties in the wording of the legislation itself, as well as novel situations that weren't envisioned by the authors of the legislation. In their article "Wilderness, Keep it Wild!" (summer 2001), Nickas and Macfarlane point out several such situations. We assert that interpretation is necessary in these situations to *implement* the Wilderness Act, not alter it.

Also contrary to Mannchen's letter, we never stated or implied that wilderness should be manipulated to restore natural conditions. In our paper we showed that there are at least two disparate views about wilderness restoration, explored how these views are rooted in philosophical beliefs, and examined how actions taken to exclusively support one view will trammel the other view. Moreover, we concluded that management decisions in these situations must strongly weigh public beliefs and attitudes towards wilderness, more so than in situations where a purely technical analysis might be sufficient.

It is relatively easy to say that wilderness should be just wild or just natural. The point of our paper was to show that choosing one over the other is a false dichotomy in which wilderness loses, and we reject this "either/or" choice. It is much harder to engage in thoughtful discussion to craft meaningful solutions that protect both wildness *and* naturalness. We implore wilderness advocates, with their commitment to the ideals of the Wilderness Act, to contribute to this discussion.

Peter Landres
Missoula, Montana

Mark W. Brunson
Logan, Utah

HAS "WILDERNESS" become a religious issue with some environmentalists (Letters, summer 2001)? I'm interested in the ongoing debate covered in recent issues of *Wild Earth* (winter 2000/01, summer 2001) about ecological restoration, and what sort of human management impairs wilderness or violates the spirit of the 1964 Wilderness Act.

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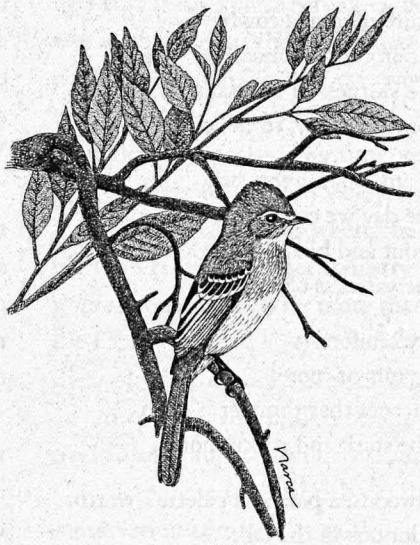


Hope is the thing with feathers
That perches in the soul,
And sings the tune without the words,
And never stops at all...

EMILY DICKINSON

Optimism and Hope

THROUGH THE YEARS, a number of writers in *Wild Earth,* most notably Dave Foreman and Sandy Irvine, have critiqued the cornucopian mindset. From Dr. Pangloss, Voltaire's famous character in *Candide* (who insisted, despite plain evidence about him, that this was the best of all possible worlds), to today's marketing gurus and political pundits, the rosy worldview has long been popular.

But is it rational? Hardly. The techno-industrial optimists certainly gussy up their prognostications with the sheen of reason and glossy veneer of expert opinion. But their boundless optimism generally ignores ecological and social reality: the worldwide biological holocaust as natural habitats are degraded, the rising tides of famine, ethnic warfare, and political instability. The optimists display an irrational exuberance for technological novelty; while the lyrics change—from 1950s nuclear power advocates pitching plants that would be "too cheap to meter" to next week's corporate press releases purporting to serve this or that societal need through the magic of biotech—the tune remains the same. At root, the cornucopian worldview places unwavering faith in humanity's capacity to solve complicated social and ecological problems.

To be sure, propagandists for an ever-expanding global industrial economy have sold their product well—but then again, magic elixirs, cure-all tonics, and perpetual motion machines have often had brisk sales. Everybody loves a bargain, the win/win solution, the invention that's almost too good to be true (remember "cold fusion"?). And if only it *were* true—if this really were the best of all possible worlds, if ever-higher technology and global trade truly did hold the promise for a world without poverty, disease, ethnic strife, and ecological collapse. If only our problems were simply failures of engineering, subject to a technological fix. Of course they are, to some degree, but our fundamentally unsustainable exploitation of Earth's natural capital isn't just a design problem: it rests on even shakier foundations, namely failures of imagination, ethics, political courage, and hope.

A dilemma has long faced conservationists who recognize the basic instability of the status quo; we want to be honest about Nature's long-term needs, but credible when offering politically reasonable, short-term solutions to conservation problems. It can be risky to be too forthright about the emperor's nakedness when critics of the industrial growth economy—even thoughtful, conservative, polite ones—are dismissed as misanthropes, naysayers, doom and gloomers.

Perhaps one useful way to counter these epithets is to keep poking fun at the cornucopians' irrational exuberance, and begin drawing the distinction between optimism and hope. For those of us who love wilderness and wildlife, and have even a rudimentary knowledge of the current global extinction crisis, I'd suggest that there is precious little cause for optimism. The trends in biodiversity loss, deforestation, human population growth, poverty, and social chaos are

northern beardless-tyrannulet, pen-and-ink by Narca Moore-Craig

chilling. Moreover, human history is instructive about our species' tendency toward violence.

But—there is cause for hope.

Hope transcends reason. It is a country apart from logic, data, and prediction. Hope is a wild country. It's natural. Like biophilia, it may be a fundamental human trait. It perches in the soul.

I am no authority on human evolution, and my musings here may be naive. It seems to me, however, that the capacity for hope—an ability to conjure a mental picture of a better day tomorrow and yearn for that day—would have been a key trait for natural selection to reinforce in early humans. Prior to the Neolithic Revolution, a central fact of existence for many gathering-and-hunting-dependent peoples would have been the boom and bust nature of daily life. If the hunt was successful or seasonal food resources plentiful, one ate. If the hunters were unlucky, the fishing poor, or the season wrong, one would go hungry.

Today, the power of hunger is largely unknown to us who have grown up in relative affluence. What would it be like, I wonder, to withstand the uneven cycles of food gathering common to indigenous cultures? Would not hope have been rich food for the psyche during lean times? Would not the capacity for hope, translated to one's kin and social group through songs, stories, and dances, have been a powerful tool for survival?

I think so, and believe that to be hopeful is to be human. But that doesn't necessarily mean one need be particularly optimistic about humanity's prospects to reverse current trends, or have a rosy view of human nature. It's good to remind ourselves, however, that hope is a wholly *natural* phenomenon which can give us strength to keep working on the vexing problems facing natural and human communities.

In recent weeks, as the world has weathered dark times, as friends and family have coped with personal tragedies, I've been making a mental checklist of reasons for hope. That list is too long for these brief notes, but I'll highlight a couple here:

PARKS AND WILDERNESS. *Wild Earth*'s editorial focus is, of course, on wilderness recovery and protection, and particularly the ecological, evolutionary, and intrinsic values of self-willed lands. But we also celebrate the historical foundations of the wilderness movement—scenic beauty, primitive recreation, and spiritual renewal. That final argument for conserving wildlands resonates with new power since September 11. Shortly thereafter, I hiked with a friend in the Adirondack Park's Pharaoh Lake Wilderness. The colorful leaves and loonsong rippling over misty waters were the perfect antidote to despair. My inclination to seek the calm of wild Nature likely represents a universal tendency. It seems that natural areas, including public parks and privately owned wildlife sanctuaries, saw increased visitation this autumn. A staffer of Massachusetts Audubon reported that the increase in families enjoying that organization's system of preserves was especially noticeable.

On a November day, I also witnessed this phenomenon while walking in California's Muir Woods National Monument; throngs of visitors of diverse ethnic backgrounds admired the towering coast redwoods. A Park Service employee told me that visitor traffic had dipped immediately after September 11, then rebounded and increased. In unsettling times, we find comfort in wild lands and waters protected for future generations, human and wild.

CITIZEN ACTIVISM. As we put together this special combined fall/winter issue of *Wild Earth,* it was impossible not to be hopeful about the trend of citizen science projects blossoming across North America. For birds and bees and butterflies—and all manner of wildlife—amateur naturalists are monitoring population trends, identifying critical habitats, and engaging policymakers about protecting the wildlife they love.

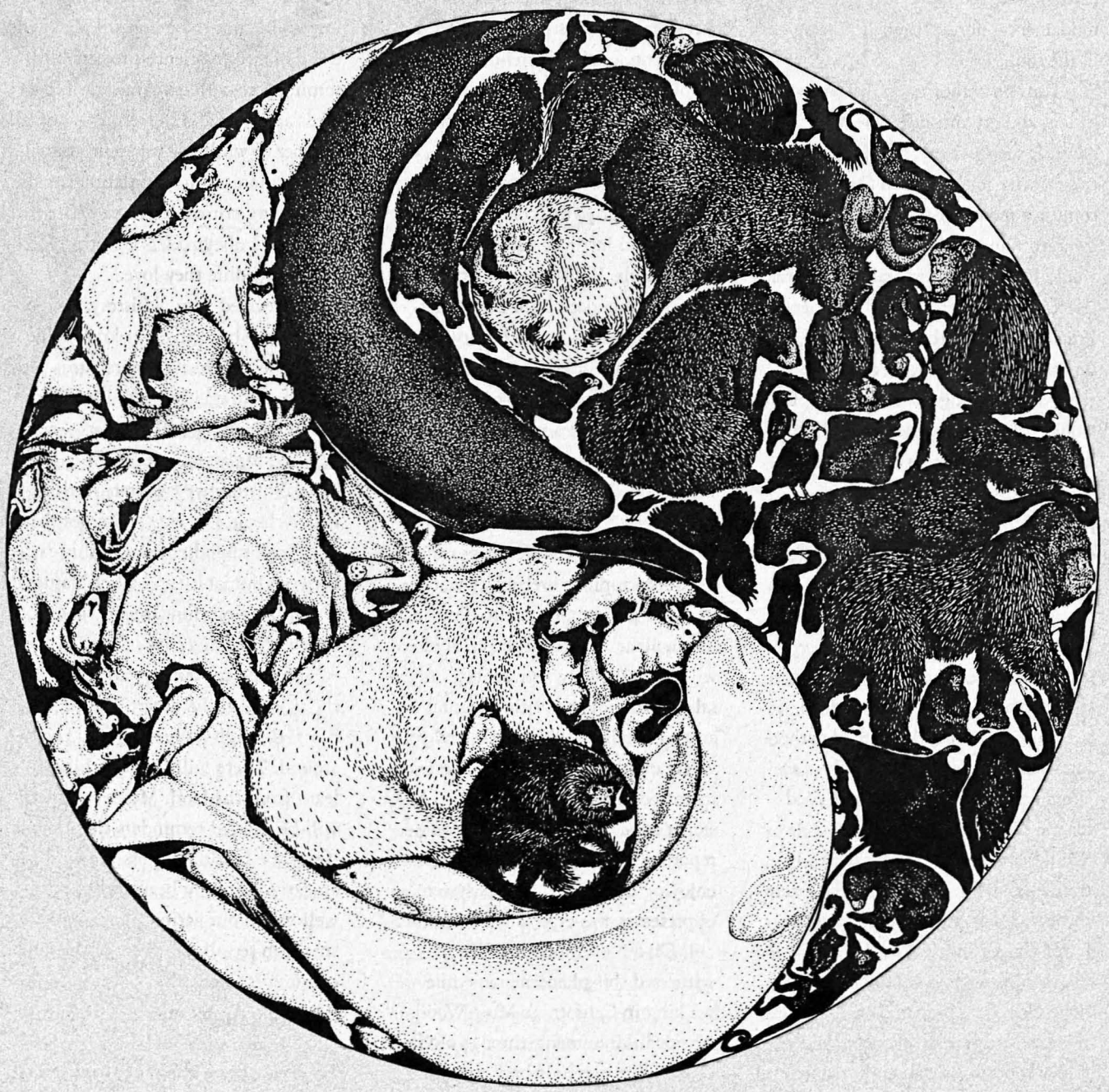
A revived natural history, invigorated by the hope that our knowledge of Nature may foster natural areas protection, is an exciting prospect. Hope truly is the thing with feathers—and fins, and fur, and flippers. The engaged natural history we celebrate in this issue's theme coverage embodies that hope for a rekindled relationship between humanity and all of Nature, recognizing our fundamental connection with the diversity of life.

If you can, take a walk today in the woods, in the desert, by the seacoast, through an urban park. Look around. There will be something to learn from the land. Moreover, there will be myriad reminders that ours is, if not the best of all possible worlds, an extraordinarily beautiful one—well worth our actions, large and small, to see all members of the land community flourish.

~ Tom Butler

For stimulating my thinking on cornucopianism and hope, I am indebted to my colleagues Dave Foreman and Josh Brown, whose insights on these matters are more keen than mine.

Natural History and the Spiral of Offering



BY THOMAS LOWE FLEISCHNER

pen-and-ink by D. D. Tyler

NATURAL HISTORY—a practice of intentional, focused attentiveness and receptivity to the more-than-human world,[1] guided by honesty and accuracy—is one of the oldest continuous human traditions. Simply put, there have never been people without natural history. Through the long millennia of paleolithic times people engaged in this oldest pattern of paying attention because their lives depended on it. Where particular food plants grew and when they reached the proper stage for harvest; when the migration of food animals could be expected to pass through which corner of the home terrain; source locales for tools (dogbane for cordage, chert for arrowheads): all would be known, and must be known. This pragmatic knowledge led to seeing more subtle relationships; a hunter, for example, might come to recognize a correlation between a particular blue of the sky and hunting success to come.

Natural history represents a search for patterns. It is an untidy process, a constant oscillating between landscape-scale views and minute biological details, and also between seeing what is right in front of us and conjecturing about what might be missing or otherwise unseeable. A naturalist weaves insight gleaned from direct experience with the gift of lore handed down in books and journals by predecessors. Reading a landscape involves three interrelated activities: actively observing, asking questions, and interpreting. Observation, questioning, and interpretation interpenetrate to become one life project—trying to learn from, and understand, this world.[2]

As humans became agricultural (interestingly enough, at roughly the same time in both the old and new worlds—a little over 10,000 years ago), different phenomena gained significance and so natural history attention focused on different subjects. By and large, this meant a narrowing of the field of view as people gained greater control over their livelihoods. Farmers discovered natural history nuances of a few species, but began to ignore many more. Attention was focused on smaller slices of biodiversity and geography. Agriculture allowed—indeed required—people to gather together into larger, more sedentary communities that saved more stuff: seeds, tools, bounty from the earth and trade. Communities grew into societies, with social hierarchies and specialization of labor. As millennia passed, these societies grew ever more specialized, and natural history—which was fundamental for hunting and gathering peoples—gradually diminished as the foundation for daily life.

NATURAL HISTORY IS THE PARENT OF SEVERAL MODERN sciences: ecology, anthropology, geology, and paleontology.[3] In addition to being the root of natural science, it can be seen more broadly as the root of psychology, with its careful attentiveness to the relationship between inner and outer worlds. (In conversation the other day a psychologist friend concurred: "psychology is just another branch of natural history.") Literature, too, stems from such attentiveness. As Jane Hirshfield has pointed out, poetry "begins...in the body and mind of concentration...a particular state of awareness: penetrating, unified, and focused, yet also permeable and open."[4] Similarly, meditation and other reflective spiritual practices derive from a common tradition with natural history. Zazen and other meditative disciplines offer practice at attentiveness, sometimes called mindfulness.[5]

I suggest that there are several qualities embodied in the successful practice of natural history:

1) *Attentiveness*. According to the poet John Haines, "passionate attention to the world—an attention to which the least detail has its instructive significance—is perhaps the most telling and important trait in our inheritance. Without it there is no art, no love, no possibility of domestic or political harmony. On it alone may rest our prospects for the future."[6]
2) *Receptivity.*
3) *Expression*. That which is received is interpreted and given back to the community.
4) *Vision*. One task of naturalists, whether literary naturalists or research ecologists, is "to see the unseen."[7] What species is no longer here? What did this place look like in the Pleistocene? What will it look like next month? What could it look like if people lived to their potential?
5) *Accuracy*. Honesty and accuracy are hallmarks of natural history. Charles Darwin declared that "the soul of natural history is accuracy." To see what is really there, rather than what we think is there, keeps us from projecting the image of our own consciousness onto the rest of the world—which leads to...
6) *Humility.*
7) *Affirmation*. We who engage with the more-than-human world regularly tend to find hope more routinely than those who dwell in a house built of human mirrors.
8) *Gratitude.*

The concept of gratitude leads back to my title. What is meant by "the spiral of offering"? The Oxford English

Dictionary tells us that *offering* denotes "something offered in tribute or as a token of esteem; something presented to a deity in devotion." What sense, then, can we make of natural history as a form of offering?

We naturalists—scientists and activists, professionals and amateurs—undertake the practice of natural history in tribute to the world, as a token of esteem for the world, in gratitude for the gift of living in a world that is inestimably more diverse and gorgeous than it might have been. All natural history is informed and motivated at some level by this sense of gratitude and awe.

When we pay respectful attention to the living world, thus getting to know it, the world is served in the pragmatic and limited world of human politics—for a known and loved world has more effective advocates than one that's ignored. Terry Tempest Williams has referred to a naturalist's practice as one of service. She adds, "if you are in the service of something, you are receptive, open, you are a student."[8] One group of naturalists declared that "the study of natural history is the first step in repaying our debt to the earth."[9] One of the forms this offering can take is overtly political. Gary Nabhan has referred to naturalists as "the antibodies of our society." They bolster our immunity to "the ills and indulgences of our own culture and species," guarding against ethnocentrism and anthropocentrism. Without naturalists, he concludes, "our society would be incapable of reading the signs that we have irreparably damaged our life-support system."[10]

But what makes natural-history-as-devotion particularly compelling is that the offering moves in both directions. We not only offer, but receive.

I have a close friend who is a fiction writer, not a naturalist. In her work, close observation and attentiveness has been reserved for human stories. A year ago, though, she went through the heart-rending experience of watching her father die as she sat by his side. Since his death, she told me recently, she feels closer to all living things. Natural history is something that has been offered up to her. It was always there, she realizes now, but before this emotional searing, she told me, she "just wasn't aware, just wasn't open to the wonder." Since then she has spent dozens of hours in her backyard tracking the growth of a family of whiptail lizards. At an island retreat her attention was drawn to a pair of nesting wrens more than to the waves on the beach. Until recently she wouldn't have paid heed to the drab little birds, nor bothered to identify them. But in her heightened state of awareness, the tiny motions of the two birds transfixed her so completely that she cried when she had to leave their company. This attention to the more-than-human world has buoyed her up, that she might feel her very real human sadness in a fuller context, feel her father's death embedded within a network of births and living. As another friend put it, "sometimes the voices inside drown out the voices outside." Natural history keeps us listening to the voices outside, and they often provide context and perspective on our own internal concerns.

Each spring I teach an intensive field natural history course; the past two years I asked students on the final day to reflect on what natural history had given them. Their responses have included such things as: *what it means to be patient; how to open my mind; how to trust myself; a reawakening of my senses; a sense of the larger-than-life slow movement of time.* Natural history, said one, is "a way of cultivating awareness." Note that these offerings from the world to the naturalist comprise some of the goals of other, more human-centered quests. Think of the therapist bills that could be saved by more natural history study! Much of the self-help bookshelf could be replaced by direct consultation with the larger ecological self of the outer world.

And so we offer gratitude and attentiveness to the world, and the world rewards this attentiveness with an awareness of its grace that opens us to all sorts of gifts. But natural history has never involved just passively taking *in:* rather, a naturalist, whether an etcher on a stone wall or a watercolorist, a storyteller around a tribal fire or a research scientist, attempts to make sense of what she or he has witnessed, and to translate it for others to understand. This role for natural historians as communicators is another turn in the spiral of offering: naturalist paying close attention to the world, feeling gratitude for glimpses of transparency between self and non-self; Nature offering peace and insight back; and naturalist offering translations back to human community. As the word "history" implies, natural history involves telling stories. These stories are refracted through different prisms—science, art, literature—but in all cases, the belief is that these stories are worthy teachers. As Badger reminds us, in Barry Lopez's fable *Crow and Weasel,* "sometimes a person needs a story more than food to stay alive."[11]

As human beings concerned with the future, and, particularly, with the fate of the Earth's biological diversity, it is our responsibility to reclaim allegiance with our ancient tradition of natural history, in its most expansive sense—including art, science, and the relationship between the two. Our society provides no formal system of devotion to the living, breathing world around us. The closest the status quo comes, perhaps, is graduate school. But few schools overtly honor the

tradition of natural history, and fewer still would be comfortable with the notion that their acolytes were there to consecrate their sense of devotion to a higher power. But to be a naturalist you needn't have fancy letters after your name. In fact, hope for the future of the world will increase in direct proportion to the percentage of regular folks who practice natural history—the oldest form of human attentiveness, requiring the skill and humility to examine something larger than ourselves. The offering back and forth between Earth and naturalist spirals on, in an ever-deepening relationship. ☾

This essay is based on an address given to the gathering, "The Essential Naturalist: The Role of Natural History Education in Saving the World," hosted by North Cascades Institute. My appreciation to this organization that embodies a whole approach to natural history. This essay benefited from comments by Melanie Bishop, Tom Butler, Edie Dillon, Tim Jordan, and an anonymous reviewer.

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NOTES

1. This useful term comes from David Abram, 1996, *The Spell of the Sensuous: Perception and Language in a More-than-Human World* (New York: Pantheon).
2. See Thomas Lowe Fleischner, 1999, *Singing Stone: A Natural History of the Escalante Canyons* (Salt Lake City: University of Utah Press), 40, 70.
3. For a more thorough recounting of the history of natural history, see Thomas L. Fleischner, 1999, Revitalizing natural history, *Wild Earth* 9(2): 81–89.
4. Jane Hirshfield, 1997, *Nine Gates: Entering the Mind of Poetry* (New York: HarperCollins), 3.
5. See, for example, Robert Aitken, 1982, *Taking the Path of Zen* (San Francisco: North Point Press); Jack Kornfield, 1993, *A Path with Heart: A Guide Through the Perils and Promises of Spiritual Life* (New York: Bantam); and Thich Nhat Hanh, 1976, *The Miracle of Mindfulness* (Boston: Beacon Press).
6. Comments on the dust jacket of Thomas J. Lyon, ed., 1989, *This Incomperable Lande: A Book of American Nature Writing* (Boston: Houghton-Mifflin).
7. The notion of "seeing the unseen" has been put forth by literary scholars such as John Tallmadge, 1997, in *Meeting the Tree of Life: A Teacher's Path* (Salt Lake City: University of Utah Press), 190–191, and research ecologists Chris Maser and James M. Trappe, 1984, who titled a government monograph "The seen and unseen world of the fallen tree" (General Technical Report PNW-164, Portland, Oregon: Pacific Northwest Forest and Range Experiment Station, USDA-Forest Service).
8. Edward Lueders, ed., 1989, *Writing Natural History: Dialogues with Authors* (Salt Lake City: University of Utah Press), 62.
9. Rita M. O'Clair, Robert H. Armstrong, and Richard Carstensen, 1997, *The Nature of Southeast Alaska: A Guide to Plants, Animals, and Habitats, Second Edition.* (Anchorage: Alaska Northwest Books), 8.
10. Gary Paul Nabhan, 1993, Introduction: Diversity in desert wildlife writing, in *Counting Sheep: Twenty Ways of Seeing Desert Bighorn*, ed. G. P. Nabhan (Tucson: University of Arizona Press), xvi.
11. Barry Lopez, 1990, *Crow and Weasel* (San Francisco: North Point Press), 48.

In Your Hands

When we watched him net
the wild cranes, banding them
in colors, ringing them in,

I celebrated their closeness even
as I mourned their capture.
To save them

must we know them so well?
And when we unhooded that head
and its great sienna eye

looked us over, and when
its wings rested
in your hands,

did you see the wild sky
unfold beneath you? Was flight itself
in your hands?

Having never been so near
to heaven, I tried
to memorize those feathers, that

surprising lightness, that *closeness*
to not being there
at all.

But I could not. Wildness retreats
when we insist on capture.
If we want it at all,

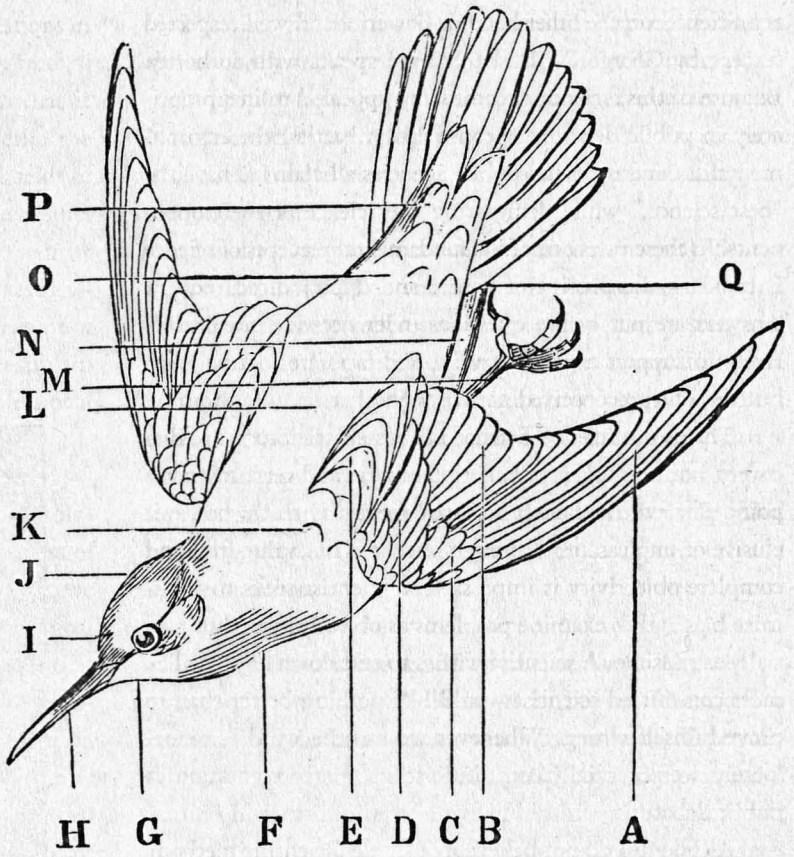
we must go to its marsh,
sit quietly for one or two
lifetimes, and wait

until the cranes
hear our silence singing
and return the call.

~ **Mary Mercier**

"In Your Hands" was first published in Poetry & Prose: Selections from the 129th Annual Conference of the Wisconsin Academy of Sciences, Arts and Letters *(©1999, Wisconsin Academy of Sciences, Arts and Letters). The poem will also be included in a chapbook to be published in the fall of 2002 by Parallel Press.*

CITIZEN SCIENCE
looking to protect nature



Citizen Scientist or Amateur Naturalist?

by Reed Noss

"CITIZEN SCIENTIST" HAS A RING TO IT. It suggests a noble path: the self-educated common citizen, armed with the tools of science, penetrating the unknown and contributing to the advancement of knowledge. There are such people. And there are other people—amateur naturalists—who love Nature and want to learn all they can about it, but not necessarily in all the technical detail and with all the ponderous methodology of science. In chasing after butterflies, counting birds, and amassing lists of wildflowers, amateur naturalists contribute much of the basic data upon which the generation and testing of scientific hypotheses depend. Some of these people are indeed scientists. Others have little or no formal scientific training. Nevertheless, if collected carefully, their data are no less important to the scientific enterprise than the data contributed by certified professionals.

I hope I do not sound elitist in suggesting that the distinction between scientist and naturalist is meaningful. It bothers me that one must be called a scientist, rather than a naturalist, to have credibility. It saddens me that natural history has little appeal in our high-tech, progress-oriented soci-

snowy egret, acrylic by Todd Telander / engraving ca. 1870

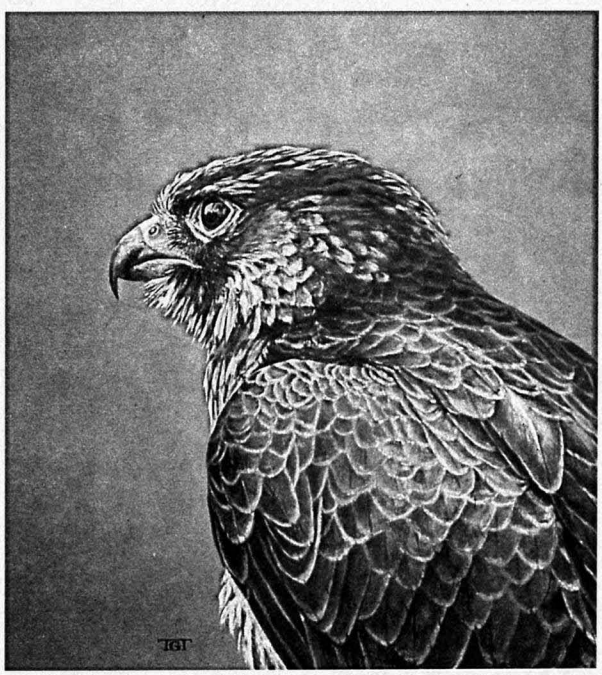
ety. Science, on the other hand, is powerful and well respected (except by George W. Bush). Science speaks with authority. Because of this, science is commonly appealed to inappropriately in public debates. In conservation battles, the environmentalists, industry, and public agencies all claim to have the "best science," while denigrating the science of their opponents. In these cases one of the fundamental precepts of science is broken—the precept of honest and unprejudiced inquiry. Answers are put before questions, references are cited selectively to support a point of view, and facts are marshaled to buttress one preconceived notion or another.

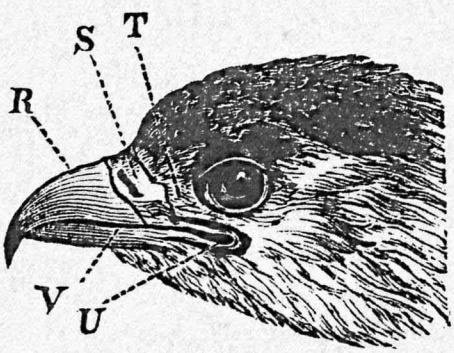
This is not science. Science is a systematic process of discovery, not a simple accumulation of facts and certainly not a point of view. An honest scientist seeks the truth, however elusive or unpleasant. Although science is not value-free, and complete objectivity is impossible, a scientist seeks to minimize bias and to examine problems as objectively and impartially as possible. A scientist wishes to tear down dogma. The most committed scientist would like nothing better than to prove himself wrong. Whenever we use the word "science" loosely, we potentially contribute to its misrepresentation in public debates.

Although I do not believe in a single "scientific method" (i.e., the one we all memorized in eighth grade), accepted standards of scientific methodology exist and must be upheld. Let's consider two analogous fields, conservation biology and medical research. Conservation biology and medicine are both problem-solving sciences. Comparable to medical researchers who seek solutions to problems concerning human health, the conservation biologist seeks to solve problems of biotic health (e.g., anthropogenic mass extinction and global homogenization). In practice, the best that medical scientists usually can do is reduce the incidence of disease and the severity of suffering. Similarly, the best that conservation biologists can do is offer strategies and tactics for reducing the rate of extinction until society confronts the ultimate problems of human overpopulation and excessive resource consumption. But such limitations hardly make these two fields useless—without them, the suffering of humans and non-humans, respectively, would be considerably worse.

In pursuing their studies, neither medical researchers nor conservation biologists seek to support the status quo. Indeed, the status quo is often the source of the problems they want to solve. In challenging the status quo, these scientists con-

Although natural history and science overlap, and some people pursue both with excellence, for the most part we should view these as distinct but complementary pursuits.





immature peregrine falcon, acrylic by Todd Telander / engraving ca. 1870

duct research designed to answer explicitly stated questions in a way that is as free as possible of confounding factors. Moreover, their work must be fully documented, so that it could be repeated by others. Although values underlie the recognition of problems and research questions in all fields of science, the methods and the interpretation of the results must not be prejudiced by whatever solution the scientist finds most attractive intellectually, emotionally, or aesthetically. Through the peer review process and the engagement of professional societies, scientists are remarkably successful in policing their field and upholding standards of professional integrity and rigor.

CLEARLY I THINK the scientific approach to problem-solving is a worthy one. But then why can't we all, regardless of our formal training, aspire to be citizen scientists? Well, we certainly can, but we must recognize that achieving this goal requires an enormous amount of study and devoted attention to the standards of scientific methodology. Some amazing scientific discoveries—for example, John Muir's interpretation of the glacial history of the Sierra Nevada—were made by self-trained scientists who were careful and insightful observers. Some such discoveries are still being made today, but proportionately fewer than in the past. For better or worse, science is more specialized today than ever before. It takes many years of concentrated training and practice in any given specialty to obtain proficiency and justifiably be considered an expert. Few people can afford that level of involvement in their spare time. And we have more than enough self-proclaimed experts. The inescapable conclusion is that, today, true citizen scientists are rare.

But what of the naturalist? Is this person's role less significant to the human enterprise than that of the scientist? I don't think so. Indeed, the best natural scientists (e.g., botanists, zoologists, geologists, hydrologists) I have met are also excellent field naturalists. This should not be surprising, as Nature is an infinite source of hypotheses and data. Moreover, contact with Nature grounds the scientist in the real world. In today's high-tech science, fewer practicing scientists do their research in the field; more research is done on the computer. Nevertheless, leisure time spent in Nature can compensate somewhat for this deficiency. For example, in contrast to the ecosystem modeler who never goes outside, the modeler who regularly hikes, snorkels, or birdwatches has both a deep source of inspiration and a reality check on his or her computer models. As naturalists, such people may be amateurs, but their contact with Nature enriches and validates their work. Their inspiration is of the intuitive kind, and intuition deserves more appreciation in science.

Finally, what of the purely amateur naturalist—the field naturalist with no training or inclination in science? I submit that these folks remain an indispensable source of observational data, provided that their observations are accurate and carefully documented. Breeding bird surveys and atlases, Christmas bird counts, fossil collections, butterfly and wildflower watches, and other such pursuits are performed primarily by amateurs, yet they are commonly relied on by professionals to test hypotheses in theoretical and applied science.

Even if the data he or she collects are never used, the amateur naturalist is a better citizen of the planet. After all, an amateur is someone who loves what they do (the word is derived from the Latin *amator,* which means lover). Especially when pursued from a Darwinian perspective, the practice of natural history inspires feelings of kinship with other living things, empathy for the different but equally respectable lives of other creatures. Love really is the best word to describe the feeling that naturalists have for Nature. Because of this love, the amateur naturalist, if called on, will be there to defend Nature. Unfortunately, the same cannot be said for all scientists, some of whom have carried the ideal of dispassionate study too far.

The concept of citizen scientist, then, must be applied cautiously. Science must be held to rigorous standards or it is of little value. Natural history also has its standards, but they are more forgiving. Natural history is every bit as honorable as science and should need no justification. Although natural history and science overlap, and some people pursue both with excellence, for the most part we should view these as distinct but complementary pursuits. Let science and natural history each fulfill its path of discovery. ☾

Reed Noss, *science editor for* Wild Earth *and a board member of the Wildlands Project, is a consulting conservation biologist. He is the author or editor of several books, including (most recently)* The Redwood Forest: History, Ecology, and the Conservation of the Coast Redwoods *(Island Press, 2000).*

Observations Count

While collecting data to help science, citizens sharpen natural history skills

by Rick Bonney

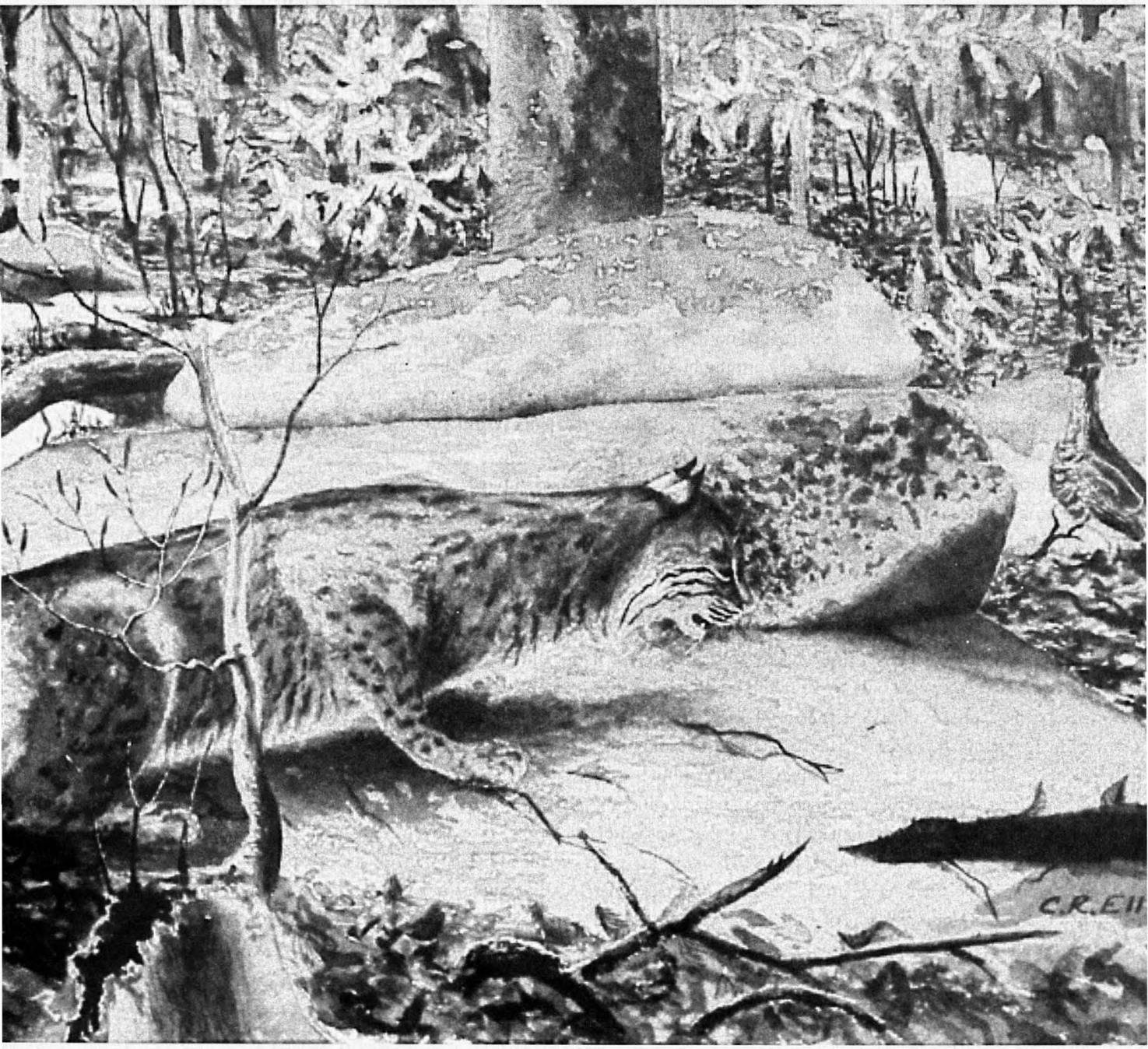
CITIZEN SCIENCE IS A TERM THAT, as far as I know, appears in no dictionary. However, a search for the words "citizen science" on the Internet yields hundreds of web pages dedicated to the concept of public involvement in organized research. From breeding bird atlases to aquatic insect counts, from frog-watching projects to reef fish surveys, thousands of individuals across North America are engaging in the scientific process.

But while the term citizen science may be new, the idea that any person can participate in scientific research—regardless of background, training, or political persuasion—is as old as Aristotle. After all, science is merely systematized knowledge derived from observation, study, and experimentation, which most people are capable of conducting. While some branches of science do require years of study to comprehend, other fields, especially the natural sciences such as botany and zoology, can be understood and even advanced by anyone who carefully observes and records information about the world around them.

Indeed, as North America was engulfed by European settlers over the last couple of centuries, most discoveries about the continent's ecology were made by "amateur" scientists, whose names are familiar to students of the conservation movement—names like Henry David Thoreau, John Muir, and John Burroughs. These folks generally had to be self-directed, because their lives predated most of the formal natural science programs that exist at colleges and universities today.

Even after such programs began to flourish early in the twentieth century, however, significant contributions to the natural sciences, particularly in the field of ornithology, continued to be made by people unschooled as scientists. One example is Margaret Morse Nice (1883–1974), about whom animal behaviorist Niko Tinbergen once said: "An American housewife was the greatest scholar of them all." (It turns out that Nice bristled at being labeled a housewife; she had earned a master of arts from Clark University in 1926.) She had no degree in ornithology, no formal academic affiliation, and no grants. Yet, by carefully watching the song sparrows in her Ohio backyard, she made a major breakthrough in the methods of studying animal behavior. In 1937, she published her research in a now-classic book, *Studies in the Life History of the Song Sparrow,* which remains a model for life-history studies today.

Another distinguished amateur scientist is Harold Mayfield of Toledo, Ohio, the only person who has served as president of all three of ornithology's largest professional organizations.



bobcat stalking partridge, watercolor by Bob Ellis

Before his retirement, Mayfield worked nine-to-five as a leader in the field of industrial relations. Avocationally, he was and still is an ornithologist *par excellence.* In 1960, he published a book called *The Kirtland's Warbler,* the definitive work on that species, which one year later received the Brewster Award, the highest honor in American ornithology. Mayfield also developed the Mayfield Method of measuring bird nesting success, a technique that has been used by hundreds of researchers.

Even today, the person who may well possess the greatest current knowledge of North American bird movements and distributions, and who has written two of the best field guides to birds—Kenn Kaufman—is a self-trained ornithologist who was too busy watching birds to bother finishing high school.

Citizen science therefore springs from a long tradition of amateur contributions to science. However, while some amateurs still dedicate their lives to making important scientific discoveries, the citizen science movement today finds power in numbers. Most citizen science projects merge the observations of thousands of people into databases that can be analyzed to answer important questions about the abundance, distribution, movements, behaviors, and natural history of various plants and animals. This movement is fueled by the understanding that large-scale questions about environmental change can be answered only by combining the observations of citizen scientists* across the continent—and the hope that people who engage in large-scale studies will become proficient in identifying their local plants and wildlife, will acquire the skills of patient observation, will imbibe the process of scientific observation, and will gain the satisfaction of furthering scientific knowledge.

Generally, citizen science initiatives focus on a particular plant, animal, group of plants or animals, or water body, and are developed and managed by an organization with a direct interest in the data. Most projects supply basic instructions, data sheets, and summaries of the data that participants collect. In some projects the data are barely used, usually because the organization lacks the resources to analyze them and publish the results. In more successful projects, data are analyzed, reported in popular and scientific publications, and used for population monitoring and conservation planning.

One excellent example is the National Audubon Society's annual Christmas Bird Count, which takes place at hundreds of locations throughout the United States and Canada. The Christmas Bird Count is conducted by various birding groups, often bird clubs. Each group breaks into smaller teams and spends one day (sometime between December 20 and January 3) counting birds in its local count circle. After each count, team totals are compiled at festive gatherings where competitive spirit runs high and reports of rarities receive intensive scrutiny. After compilation, counts are sent to the National Audubon Society through its BirdSource website. Because the count started in 1900 as an alternative to Christmastime bird hunting, and because most of the count areas have remained the same from year to year, the annual counts now provide a huge body of information that can be analyzed to detect changes in abundance and distribution of wintering birds. For example, Christmas Bird Count data have clearly shown the expansion of the tufted titmouse (*Parus bicolor*) population into the upper mid-Atlantic states, New England, and Canada between 1901 and 1997, probably aided by regular supplies of food that people have provided in feeders.

Another example of a successful project is the Breeding Bird Survey, sponsored each June by the United States Geological Survey's Patuxent Wildlife Research Center and the Canadian Wildlife Service. For this count, about 2,000 participants from every state and province count birds along specified 25-mile routes. Surveyors are chosen by regional coordinators and must be familiar with all birds' songs in their area. Each survey takes about five hours, and the exact count day is determined by the individual participant. Data from the Breeding Bird Survey provide the best available information on North American breeding bird distributions, and have been used to identify species of conservation concern across the continent.

Cornell as case study

At the Cornell Lab of Ornithology, where I am director of education, we take citizen science very seriously. In fact, the lab's mission is to "interpret and conserve the earth's biodiversity through research, education, and citizen science focused on birds." The goal of our citizen science program is

* Note that at one level, applying the term "citizen scientist" to someone who confines their scientific activities to collecting data is creating a misnomer. To be a true scientist in the manner of Nice or Mayfield, a person, whether amateur or professional, must be trying to answer a specific question by collecting, compiling, and carefully examining data using accepted analytical techniques. Thus, someone who collects data on bird movements and then submits the information to a central database is, technically speaking, a scientific field assistant as opposed to a scientist in the most restrictive sense of the word.

Citizen science springs from a long tradition of amateur contributions to science. However, while some amateurs still dedicate their lives to making important scientific discoveries, the citizen science movement today finds power in numbers.

barred owl, watercolor by Bob Ellis

to engage the public in professional research with two objectives: 1) to collect and analyze data that can answer large-scale scientific questions and that can be used for habitat conservation, and 2) to increase environmental awareness and science literacy among the public.

Citizen science enjoys a long tradition at the Cornell Lab, starting in 1929 when our founder, Arthur A. Allen, began soliciting bird watchers' sightings to construct a comprehensive database of the birds of central New York's Cayuga Lake Basin. In 1965, our Nest Record Program became one of the first North American projects to seek volunteer-collected data in an organized fashion. However, the coming-of-age for citizen science at the lab arrived in 1987 with the start of Project FeederWatch, which at that time was a joint project of the lab and the Long Point Bird Observatory (now Bird Studies Canada).

Unlike earlier Cornell Lab projects—which supplied rudimentary instructions, used data forms that had to be keypunched by project staff, and provided limited feedback to participants—FeederWatch employed a "Research Kit." This included a written project rationale, complete instructions for setting up an observation area and collecting data, computer-scannable data forms, and a project newsletter providing detailed feedback on FeederWatch data analyses. The scannable data forms were an important breakthrough, because project staff could feed them directly into a computer database. A scanner program, written by Cornell Lab scientists, examined the data for out-of-range sightings, numbers that seemed inappropriate (for example, 30 blue jays at one feeder when the participant meant to report only 3), and other potential errors. With editing time reduced to a minimum, scientists could quickly report on the data, and participants could read about project findings just a few months after submitting their counts.

FeederWatch soon proved to be a treasure trove of data for population biologists at the lab. By 1992, after just five years of project operation, coordinator Erica Dunn wrote in the annual report:

> Before Project FeederWatch began, incredible as it may seem, no one knew exactly which bird species visited feeders in the greatest numbers. Information from the western part of North America was particularly sparse. We are now the continent's experts on the topic of feeder bird numbers, and we have used our data to track annual changes in bird numbers and winter distribution. In addition, we have collected the data needed to meet a second goal: showing how habitat, the type of foods offered, and weather can affect the numbers of birds present at feeders.

Another milestone for citizen science came in 1992, when the lab received a grant from the National Science Foundation for a project called Public Participation in Ornithology. Until then, we had considered our citizen science projects—at that time called "cooperative research projects"—to be primarily scientific endeavors. That is, the projects were designed by scientists to answer scientific questions, and any educational impact that might accrue to project participants was considered a bonus. But in our National Science Foundation proposal, we wrote:

> The condition of science education in the United States is cause for national concern. The American public is also increasingly concerned about the effects of humans on our environment. How can informal science education address these concerns? One approach is to provide the public with the opportunity to participate in environmental research. Such participation should increase public understanding of scientific procedures and environmental issues, and should motivate action on those issues.

In short, we were beginning to see the potential of a powerful partnership between citizen science and conservation activism.

Our idea was to provide project participants with explicitly educational experiences through instruction booklets describing the scientific process, explaining how each project was developed, and showing how the data would be analyzed; bird identification posters and tapes; project reference guides; and other educational aids. Through this grant, we were able to enhance Project FeederWatch and to launch two new projects that continue today, Project PigeonWatch and Project Tanager (which evolved into "Birds in Forested Landscapes" in 1998).

Today, our citizen science program includes eight projects designed to answer a range of scientific questions. Most of the projects now employ online data submission and retrieval, which offers significant advantages even over scannable data forms: data can be instantly edited (that is, if a participant enters a bird count that seems suspicious for his or her reporting location, a message asks for verification, so many mistakes are caught before they enter the database), and project results can be quickly reported back to the public. For example, in our annual Great Backyard Bird Count, cosponsored each February with the National Audubon Society, online results are updated every hour.

Is citizen science useful?

While the joy of watching birds is priceless, maintaining our citizen science program is expensive. (In fact, many of our projects charge an annual subscription fee.) The time, cost, and effort of running the program therefore leads to some obvious questions: Are the projects collecting useful data? If so, are the data being used? Are project participants learning anything or changing their behaviors through their labors?

Obtaining definitive answers to these questions will take some time, as many of our projects are still in their infancy. However, the initial response to all three questions seems to be yes.

Scientists at the Cornell Lab and partner organizations have analyzed citizen science findings to uncover previously unknown patterns in bird numbers, distributions, habitat relationships, and the spread of infectious disease. FeederWatch data have shown that populations of painted buntings are decreasing in Florida; Birdhouse Network data have revealed that the orientation of nest box holes can affect the breeding success of the birds using the box; Project Tanager data show that the effects of forest fragmentation on the presence or absence of tanagers in a given area are dependent not only on the size of a forest fragment, but also on its degree of isolation from other fragments; and data from the House Finch Disease Survey have shown that the pathogen *Mycoplasma gallisepticum* is reducing house finch populations in many parts of the East.

Scientists are also steadily publishing articles based on citizen science submissions. For example, papers published by Lab of Ornithology staff in 2001 include "Site Reoccupation in Fragmented Landscapes: Testing Predictions of Metapopulation Theory" published in the *Journal of Animal Ecology,* and "Host Range and Dynamics of Mycoplasmal Conjunctivitis among Birds in North America," published in the *Journal of Wildlife Diseases*.

In addition, citizen science data have been used to develop management recommendations for bird habitat. For instance, "A Land Manager's Guide to Improving Habitat for Scarlet Tanagers and Other Forest-Interior Birds," a booklet published by the Cornell Lab in 2000, has been distributed to hundreds of private and government land managers through the Partners in Flight program. The lab plans to prepare similar guidelines for additional species over the next few years.

The questions of whether participants are learning about birds and ecological processes, whether they are becoming more scientifically literate through participation in citizen science, or whether project participation is leading to greater commitment to conservation action are harder to assess. We have addressed them with several techniques, including written surveys, telephone surveys, pre- and post-project questionnaires, online surveys, analyses of project listservs, and analyses of unsolicited participant comments. So far we've learned that project participants do gain knowledge of specific biological information, and they do feel that their observation skills are increased. In some cases, participants appear to be thinking scientifically about the way that they are collect-

ing data. As Deborah Trumbull and I wrote in a recent paper published in *Science Education:*

> For many people, participation [in citizen science] triggered thinking that fits various aspects of systematic inquiry. Those who participated...generally did not follow a prescribed protocol in a mindless manner. They took the project seriously enough to make it work, using their knowledge of birds and bird behavior. Many participants made additional observations about the microecology of their feeding sites or about animal behavior. Some were interested enough to formulate and write out careful hypotheses, and some made suggestions for modification of the experimental design. Therefore, for these people, the process of participating in this citizen science project contributed to their thinking about biology and the scientific process.

We also take heart from the words of hundreds of project participants who write to us about the ways in which the projects are affecting their lives. For example, one young participant who spent an afternoon counting pigeons with her scout troop told us, "If I could study birds more, I could become a scientist."

We feel certain that we're on our way toward our goal of getting project participants to actually become scientists and conservationists—to look past their screens and out their windows, to observe the natural world and wonder about what they see, to seek answers to their questions, and then, just maybe, to join the Thoreaus, Muirs, Burroughs, and Nices of the world. ☾

Rick Bonney *may have coined the term "citizen science" (in a grant proposal to the National Science Foundation). He directs the education and citizen science programs at the Cornell Lab of Ornithology, where he has worked since 1983. His research focuses on best methods of incorporating inquiry-based science education into classrooms nationwide, and on the social and educational impacts of citizen science participation.*

RECOMMENDED READING AND SOURCES

Most information on citizen science is best accessed on the World Wide Web. A good starting point for ornithological studies is the Cornell Lab of Ornithology's citizen science home page, which has links to all the lab's projects, including results (http://birds.cornell.edu/whatwedo_citizenscience.html). Other useful websites are BirdSource, a citizen science site operated jointly by the Cornell Lab and the National Audubon Society (www.birdsource.org), and the Patuxent Wildlife Research Center's Bird Population Studies site (www.mbr-pwrc.usgs.gov).

Several papers analyzing citizen science data have been written by lab researchers in recent years. For analyses of data from Project Tanager that examine the relationships between forest fragmentation and the presence or absence of scarlet tanagers, see Hames et al. 2001 and Rosenberg et al. 1999. For an online version of "A Land Manager's Guide to Improving Habitat for Scarlet Tanagers and Other Forest-Interior Birds," see http://birds.cornell.edu/conservation/tanager. For analyses of general data from Project FeederWatch, see Wells et al. 1997, and for an example of how FeederWatch data can describe population demographics for a single species, see Hochachka et al. 1999. Comprehensive papers about conjunctivitis in house finches include Hartup et al. 2001 and Hochachka and Dhondt 2000. Results from Birds in Forested Landscapes, the Birdhouse Network, and Project PigeonWatch are presently best accessed from their websites, which are linked to the lab's citizen science home page. Finally, some results of the educational impact of citizen science participation are found in Trumbull et al. 2000 and Bonney and Dhondt 1997.

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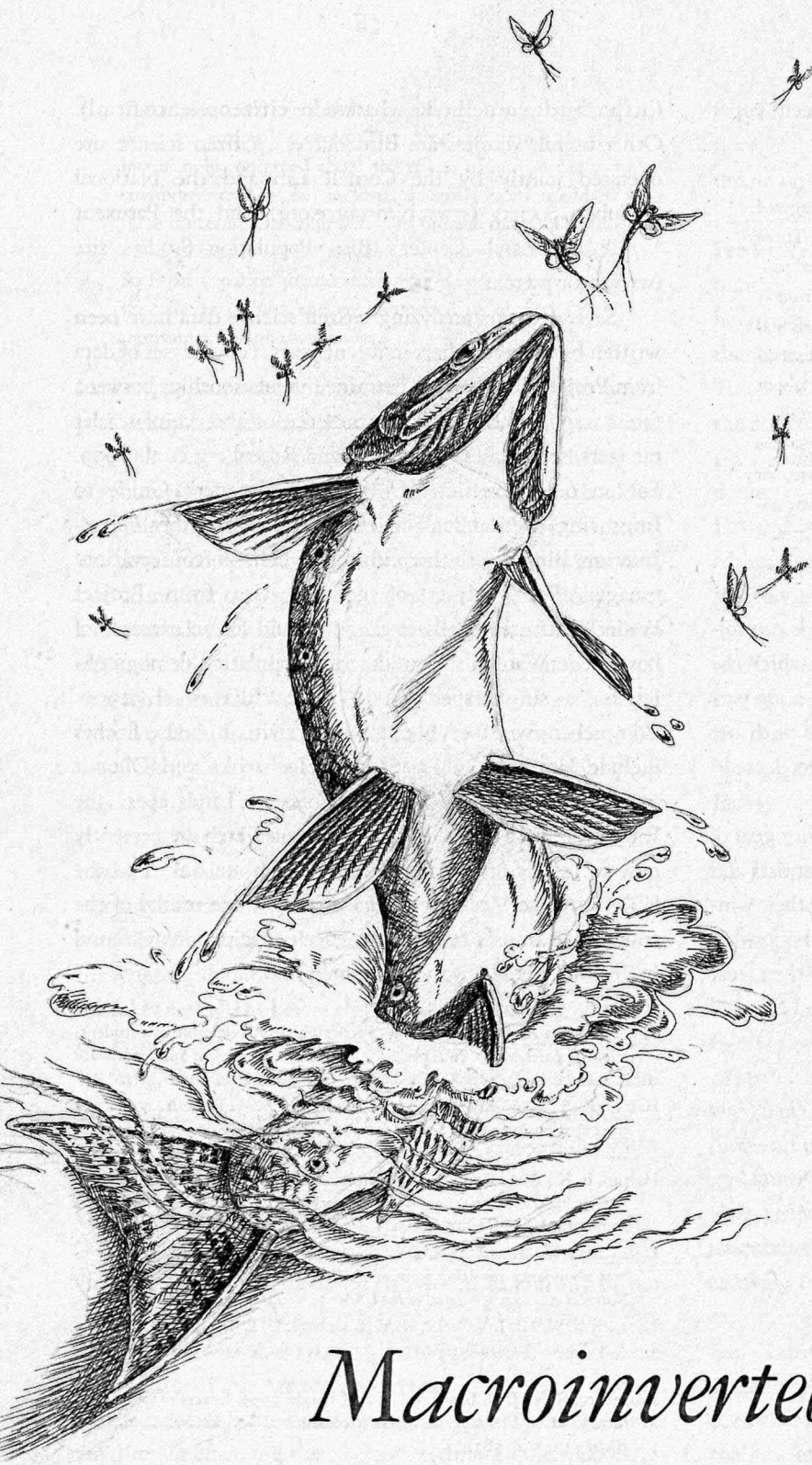
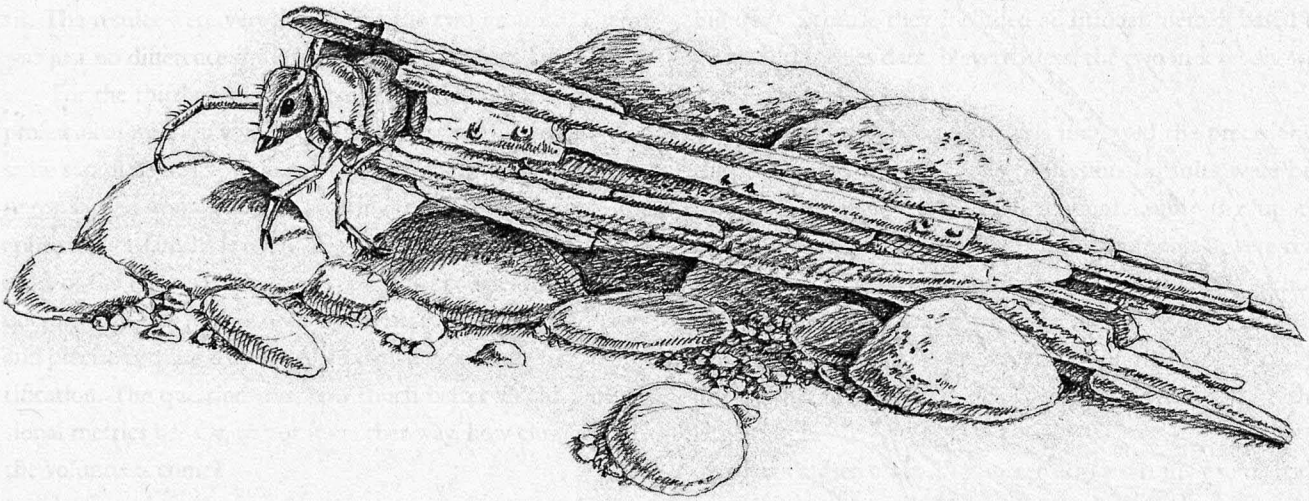


by Eleanor Ely

Macroinvertebrate Data

VOLUNTEERS VS. PROFESSIONALS



BECAUSE OF HER EXPERIENCE with macroinvertebrates, Leska Fore is frequently invited to make presentations to volunteer groups monitoring streams and watersheds in the Seattle area. This she is happy to do. "Macroinvertebrate monitoring is a wonderful tool for volunteers," she says. "It's scientifically tested, it's used by agencies to monitor freshwater biology under the Clean Water Act, and it's simple to use and understand." Besides, Fore loves talking about "bugs" with such a receptive audience.

But through talking with the volunteers, Fore became aware of a problem: "The volunteer groups told me they were meeting a lot of resistance in trying to get their data used," she says. Fore, by profession a statistical consultant specializing in biological monitoring, reasoned that a scientifically designed parallel-testing study comparing volunteer and professional data would help volunteer groups establish their credibility. She asked Kit Paulsen, then coordinator of Bellevue Stream Team, and Kate O'Laughlin, who was coordinating several volunteer monitoring programs for King County Department of Natural Resources, if they'd be willing to help carry out such a study, and both of them agreed.

The comparison study was done in 1997, with funding from King County and the participation of 77 volunteers from a variety of Seattle-area monitoring programs.

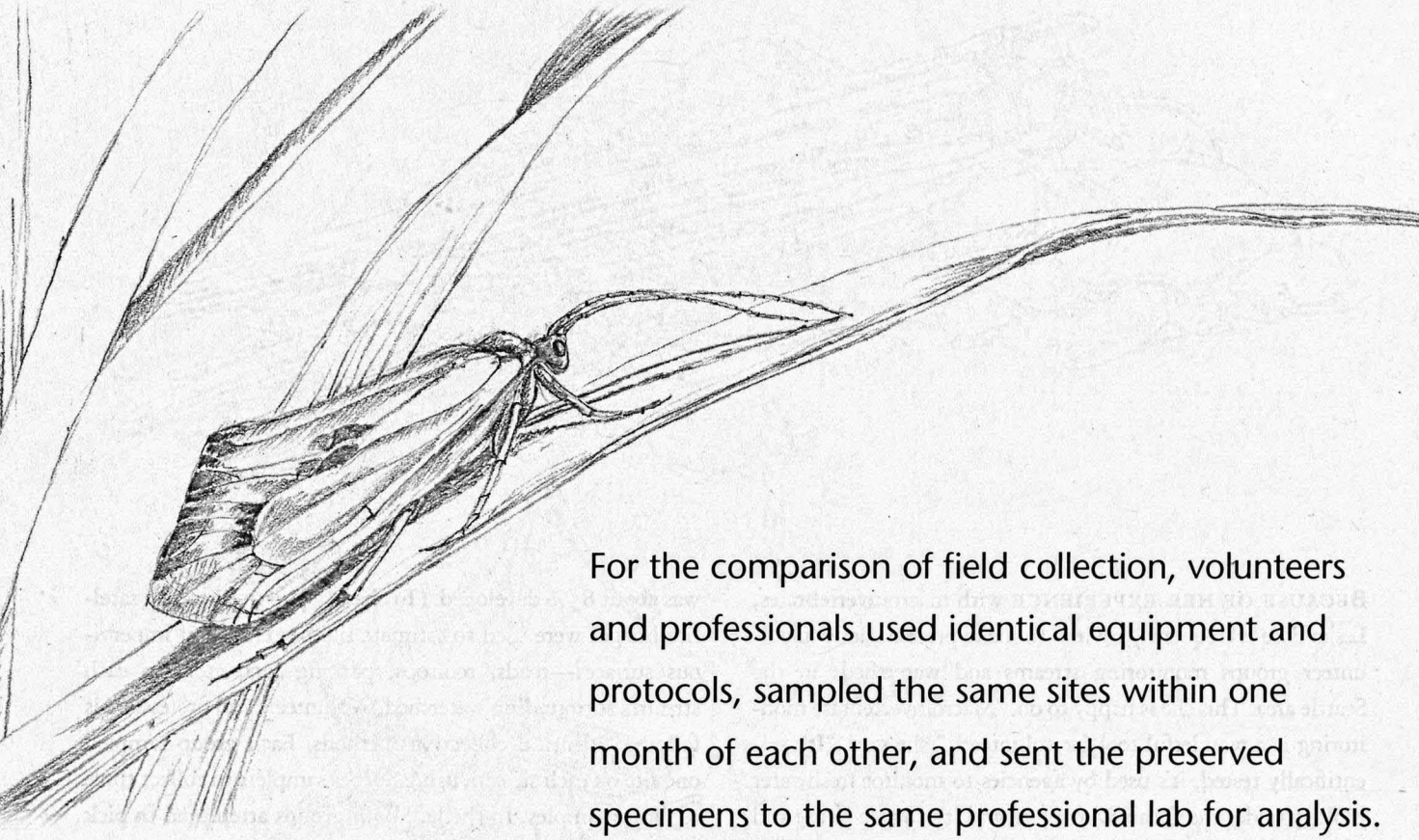
FORE CHOSE SEVEN STREAMS for the study, ranging from a relatively undisturbed stream whose watershed was about 90% forested to a highly impacted stream whose watershed was about 85% developed. (To characterize the streams, satellite images were used to estimate the percentage of impervious surfaces—roads, rooftops, parking lots, etc.—in each stream's surrounding watershed.) Volunteers and professionals followed identical collection methods. Each group sampled one site on each stream, using Surber samplers to collect three replicate samples. In the lab, both groups attempted to pick all the animals in each preserved sample. For the volunteers, this came to an average of 400 per sample (or 1,200 per site).

"The field collection was easy as pie," says Fore, "but the identification was harder and took longer than any of us expected." Part of the problem was logistical. "We were using a high school lab," she explains, "and we had to bring in all our equipment—sorting pans, dissecting scopes, books, preserved specimens, even tweezers and alcohol—every night. People were working from 7 to 10 P.M. in uncomfortable chairs, with bad light and poor microscopes, looking at itty-bitty bugs."

In spite of the difficult conditions, the volunteers not only stuck it out but, says Fore, "they were really interested. They loved learning about the bugs—all the weird body parts and what each one is used for."

THE VOLUNTEERS LEARNED to identify the major orders of stream insects—mayflies, stoneflies, caddisflies, beetles, and true flies. From this point, volunteers used a "morphological sorting" method to subdivide the mayflies, stoneflies, and caddisflies into groups based on obvious differences such

trout and mayflies (left) and caddisfly larva, graphite by David M. Carroll



For the comparison of field collection, volunteers and professionals used identical equipment and protocols, sampled the same sites within one month of each other, and sent the preserved specimens to the same professional lab for analysis. The results were very similar for the two groups.

as head shape, gill shape, or gill position. Since the sorting was based on many of the same characteristics scientists use to distinguish families, the result was roughly equivalent to identification to family level. Volunteers did not attempt to carry the classification to genus or species level, as a professional taxonomist would.

Volunteers calculated five metrics: mayfly taxa richness, stonefly taxa richness, caddisfly taxa richness, total taxa richness, and percent dominance. A metric is a biological attribute that is an indicator of stream health. Taxa richness is the number of different types of organisms present, and percent dominance is the percentage of animals belonging to the most abundant group.

A healthy stream typically is home to a diverse population of macroinvertebrates. As stream disturbance increases, diversity declines. Thus, as urbanization increases, taxa richness tends to decrease and percent dominance tends to increase.

THE VOLUNTEERS' PERFORMANCE was evaluated in three different ways: correlation of volunteer data with urbanization in the watershed; comparison of volunteer and professional field collection; and correlation of volunteer and professional metrics. The answer to the first question—Would volunteer data provide a good indication of the degree of human disturbance?—was yes. All five of the volunteer metrics were strongly correlated with intensity of human disturbance in the watershed. As urbanization increased, the four taxa richness metrics showed a steady decline while percent dominance increased—exactly the results one would expect. Figure 1 shows the results for one of the five metrics, total taxa richness.

For the comparison of field collection, volunteers and professionals used identical equipment and protocols, sampled the same sites within one month of each other, and sent the preserved specimens to the same professional lab for analy-

caddisfly, graphite by David M. Carroll

sis. The results were very similar for the two groups. "There was just no difference in the field collection," says Fore.

For the third evaluation, comparison of volunteer versus professional metrics, volunteers and professionals analyzed the same samples (which were collected by volunteers). The volunteers used morphological sorting to identify insects to approximate family level, while the professionals identified most of the insects to genus or species. Of course, the metrics obtained by the professional biologists were more sensitive and precise because they were based on a more complete identification. The question was, how much better would professional metrics be? Or, to put it another way, how close would the volunteers come?

In fact, the volunteers came impressively close. Metrics obtained by volunteers and professionals were highly correlated, with correlations between 92 and 99%. "I was amazed at how well the volunteers did," says Fore. "They were really conscientious in their labwork."

As Fore is quick to point out, the excellent volunteer results don't mean that volunteer assessments are equal to professional assessments. The volunteers identified many fewer taxa, for two reasons. First, when picking invertebrates from the samples, they tended to miss the smaller insects (they found about 85% of the invertebrates the professionals found). Second, they did not identify to genus or species.

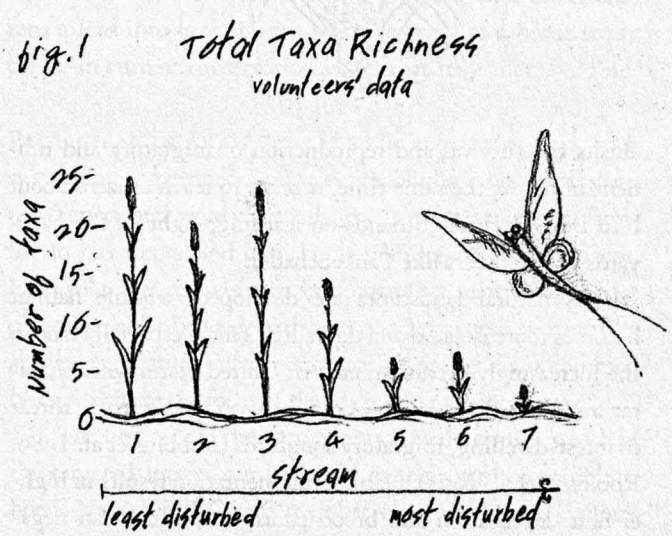
In addition to comparing the individual metrics, Fore combined metrics to calculate a multimetric index for each group's data. The professional index values were higher (see Figure 2) because they included additional metrics based on genus and species data. Nevertheless, the two indexes showed a 98% correlation.

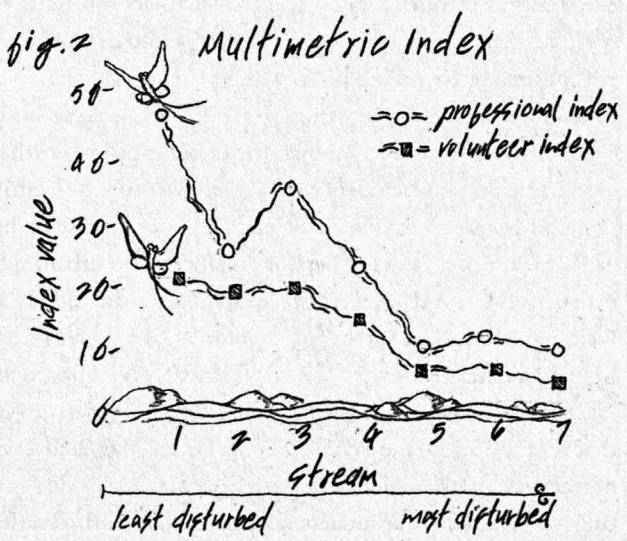
Overall, professional analysis increased the precision of the assessment by 13%. The professional results were better—but by a relatively small amount. Summing up the results, Fore says, "For field collection, volunteers were really comparable to professionals. In the lab, with the methods we used, they probably wouldn't be able to distinguish small differences between streams. But they could clearly distinguish the sites in the study, which represented a rather large range."

Kit Paulsen adds, "Volunteer data are really useful at the 'reconnaissance' level. Volunteers can put a stream into a major category—good, medium, degraded. For fine precision, you need professional data."

"The volunteers really exceeded my expectations," says Fore, "and I had high expectations to begin with." ☾

Eleanor Ely *(ellieely@earthlink.net) edits* The Volunteer Monitor, *a national newsletter of volunteer watershed monitoring. For a free subscription, contact River Network at 503-241-3506; for the online version, visit www.epa.gov/owow/volunteer/vm_index.html.* ⇦ *A detailed scientific report on this study, "Assessing the Performance of Volunteers in Monitoring Streams," was published in the* Journal of Freshwater Biology *(2001) 46: 109–123. For more information, contact Leska S. Fore at Statistical Design (136 NW 40th St., Seattle, WA 98107; leska@seanet.com).*

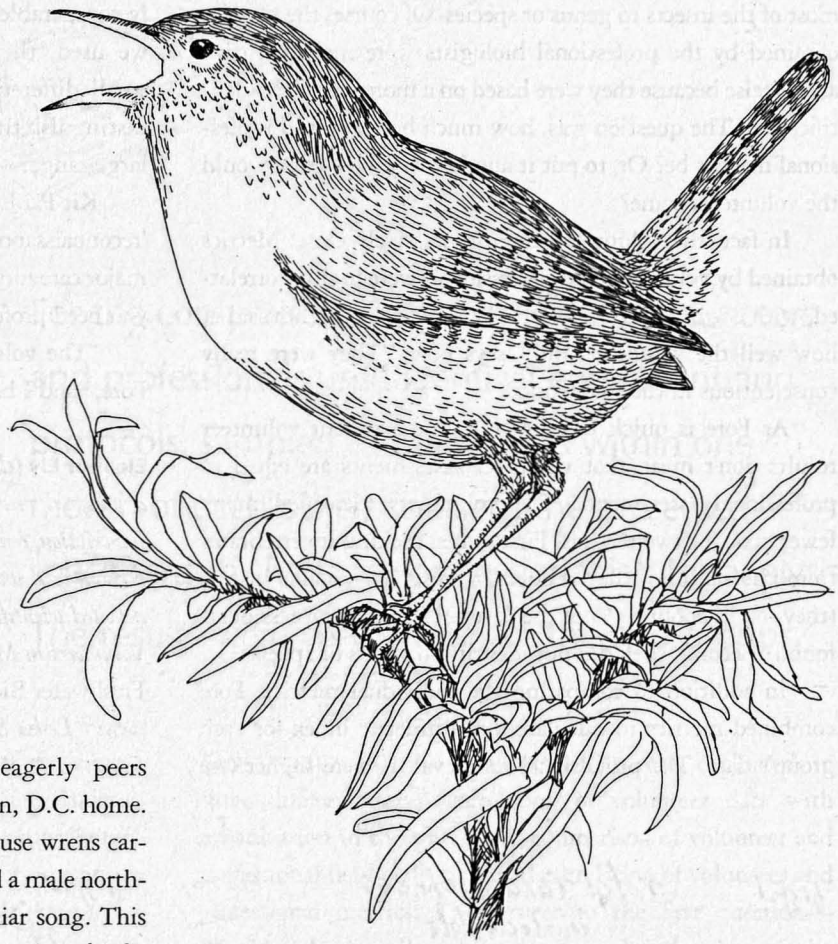




graphs by Todd Cummings

NEIGHBORHOOD NESTWATCH

Science in the City



by Peter P. Marra and Robert Reitsma

BIRD ENTHUSIAST PAULA SCHAFFER eagerly peers through the kitchen window of her Washington, D.C. home. She sees gray catbirds foraging on the lawn, house wrens carrying nesting material into their nest boxes, and a male northern cardinal, crest raised, bolting out his familiar song. This year, however, there's something different about these birds. They all have unique combinations of color-bands on their legs, identification bracelets that will allow Paula to identify these birds year after year. Paula and the birds that share her yard are part of a growing network of about 200 urban, suburban, and rural backyard study sites included in Neighborhood Nestwatch, a program of the Smithsonian Environmental Research Center (SERC). Neighborhood Nestwatch is a part-science, part-educational outreach project that encompasses the Washington, D.C., Maryland, and northern Virginia region. Nestwatch uses the backyard setting to heighten our understanding of how urbanization affects the survival and reproduction of migratory and resident birds. At the same time, it seeks to teach citizens about bird biology through hands-on learning, right in the backyards of volunteers like Paula Schaffer.

As natural landscapes are developed, wildlife habitat becomes more isolated and degraded. This is especially true in the increasingly urbanized eastern United States where habitat fragmentation has long been recognized as a major threat to forest-dwelling, migratory songbirds (Robbins et al. 1989, Robinson et al. 1995). Habitat fragmentation results in higher nest depredation and brood parasitism, which can nega-

house wren, pen-and-ink by Susan Sawyer

PHOTO: A backyard cardinal receives a leg band from Neighborhood Nestwatch founder Peter Marra (left) and a volunteer.

tively impact bird populations. Although some species persist, many species of migratory and resident birds have already been extirpated from humanized areas.

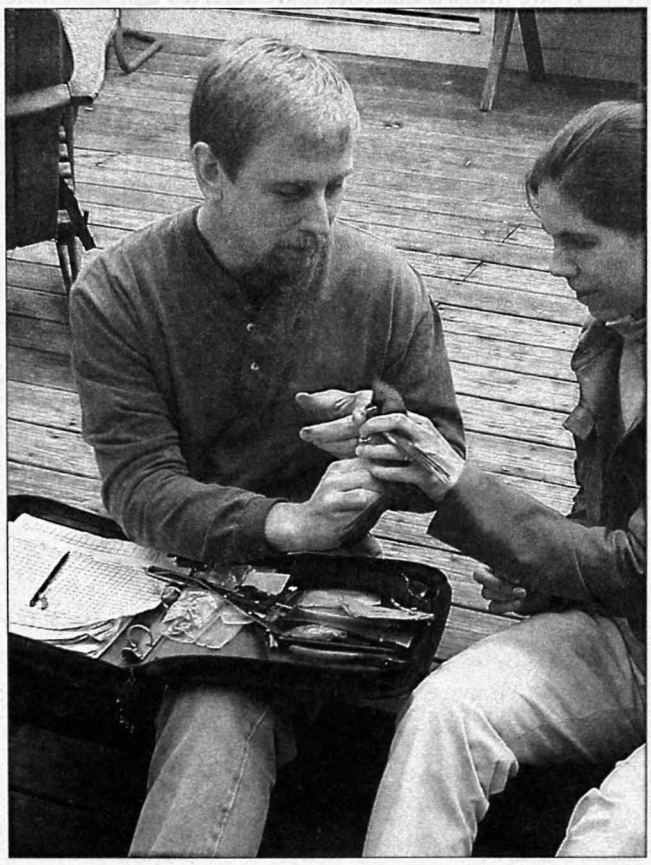
Ironically, we know alarmingly little about the biology of these species, even though they are literally in our backyards—probably because ecologists prefer to study birds in more undisturbed settings, and also because of the difficulties posed in attempting to access backyards and other types of private property for a typical scientific study. The research objectives of Nestwatch focus on two important ecological questions. First, how well do species that live along an urban/suburban/rural land-use gradient reproduce and survive? Second, what elements of the local (for example, shrub density and number of trees) and regional (for example, impenetrable surface area, forest cover) landscape best explain variation in reproduction and survival of birds living within urban and suburban environments?

People living in areas of increasing urbanization and habitat destruction seem to feel more detached from Nature. Their opportunities to experience wildlife on a day-to-day basis become increasingly difficult and are often limited to occasional glimpses of raccoons, skunks, gulls, and crows. This increased isolation from Nature may serve to reduce concern for the environment and reinforce more economic development that is ecologically destructive. One approach to this problem is to bring citizens into contact—literal, physical contact—with birds in their backyard, and to teach them how to monitor the activities of these birds year after year. To accomplish this, we created Neighborhood Nestwatch, a research-based, mentored learning program that offers citizens a lens into how science works, as well as a home study course in current conservation issues that may affect wildlife.

PARTICIPANTS ARE RECRUITED in a variety of ways, such as speaking engagements, our website, blurbs in newsletters and newspapers, and word of mouth. Participants range from families to girl scouts, and from home-schoolers to senior citizens. Each volunteer receives a packet containing information about observing color-banded birds, nest-finding, nest monitoring, and general natural history information on the eight common birds which are the focus of the study (see table next page).

The first task of the participants is to determine which of the targeted species can be found in their yard or neighborhood. Next, a SERC staff member visits the house, explores the yard with the participant, conducts a bird census, and decides where to place a mist net to capture as many target species as possible. Mist nets are made of fine, almost transparent nylon mesh stretched between two poles, and are approximately six feet in height; they can harmlessly catch a flying bird. On the ground near the middle of the net, we place a stuffed bird on a stick, and a speaker wired to a tape recorder about 15 or 20 feet away. Because all of the Nestwatch study species defend their territories against individuals of the same species, they can be lured by a broadcast of their song and duped into the net when they start attacking the intruder (i.e., the decoy on a stick). Nestwatch participants help with the entire process.

Once birds are captured, they receive a unique color-band combination on their legs composed of one U.S. Fish and Wildlife Service aluminum band and two colored bands. This allows participants to identify each individual bird so it can be re-sighted in the future. We measure a leg, a wing, and the bill, then we weigh the bird and check for reproductive activity. A small blood sample is taken to test



COURTESY OF NEIGHBORHOOD NESTWATCH

for West Nile virus. As the visit ends, the backyard study site is geographically referenced using a Geographic Positioning System (GPS) so that vegetation and landscape variables obtained from a Geographic Information System (GIS) database can be assigned to that exact location. Every step of the way, the SERC staff member describes the scientific methods of the project and answers questions, thus establishing a dialogue with the participant that often continues by phone and e-mail; additional information on the ecology of each Nestwatch species and "backyard biology" are also provided on our website. After the visit, "Nestwatchers" continue to make observations on "their" color-banded birds, find nests, monitor nest success, and search for their banded birds the following spring.

JUDY SEIDLING AND HUSBAND STEVEN from Silver Spring, Maryland, enthusiastically describe the soap opera they have just witnessed between three house wrens. "The female with the red band over the blue band on the left leg and an aluminum band on the right leg successfully raised three young with a banded male. We observed that same male copulate with an unbanded female on our back deck and they are now building a nest in our other nest box. I never thought I would learn so much about the birds in my neighborhood. Participating in this project has opened my eyes to parts of a bird's life I never would have [otherwise] experienced."

Observations such as this by Nestwatch volunteers are common and often lead into more sophisticated discussions about extra-pair paternity and other behavioral traits found in birds. The high degree of direct contact between participant, scientist, and study animal makes Neighborhood Nestwatch unusual among citizen science projects. First, citizens identify with individually color-banded birds year after year, adding a sentimental flavor to participation. Second, this project relates data on specific individuals, such as reproduction and survival, to landscape-level features in human-modified environments, providing insight into the mechanisms that underlie population change. Finally, Nestwatch is a community-based effort involving citizens from varied backgrounds and skill levels, and represents an effective way to engage the public in natural history observations with a direct link to scientific research. ☾

Peter Marra *(marra@serc.si.edu) is a senior scientist and* **Robert Reitsma** *a research technician at the Smithsonian Environmental Research Center in Edgewater, Maryland (P.O. Box 28, Edgewater, MD 21037; 443-482-2224).* *For more information on the Smithsonian Environmental Research Center, visit www.serc.si.edu. For more information on Neighborhood Nestwatch, visit www.nestwatch.si.edu.*

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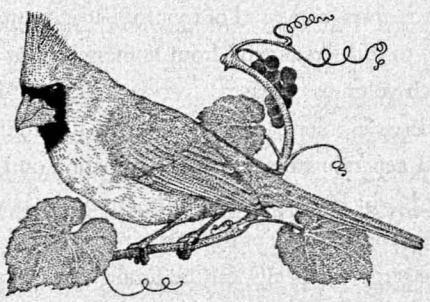
NEIGHBORHOOD NESTWATCH STUDY SPECIES

Common Name	Scientific Name	Migratory Status
Carolina chickadee	*Poecile carolinensis*	year-round resident
Carolina wren	*Thryothorus ludovicianus*	year-round resident
house wren	*Troglodytes aedon*	short-distance migrant
American robin	*Turdus migratorius*	short-distance migrant
gray catbird	*Dumatella carolinensis*	long-distance migrant
northern mockingbird	*Mimus polyglottos*	year-round resident
northern cardinal	*Cardinalis cardinalis*	year-round resident
song sparrow	*Melospiza melodia*	short-distance migrant

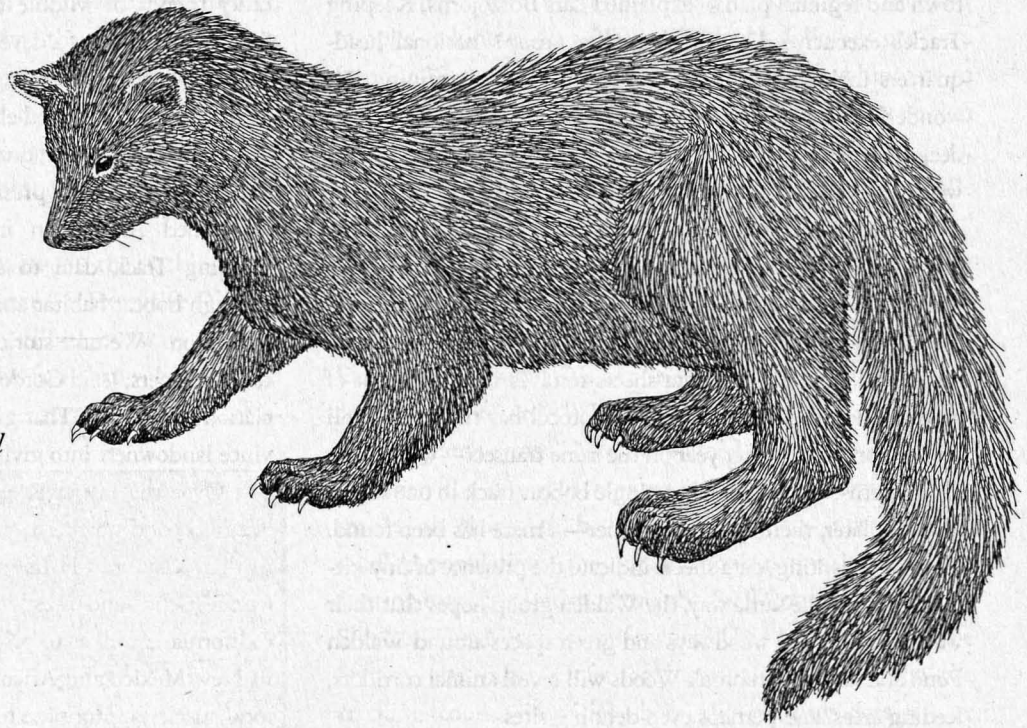


northern cardinal, pen-and-ink by D. D. Tyler

KEEPING TRACK

In step with bears, bobcats, and other beasts

by Joshua Brown



But when I consider that the nobler animals have been exterminated here—the cougar, panther, lynx, wolverene, wolf, bear, moose, deer, the beaver, the turkey, etc., etc.—I cannot but feel as if I lived in a tamed, and, as it were, emasculated country.... Do not the forest and meadow now lack expression?...

HENRY DAVID THOREAU
Selected Journals

HENRY DAVID THOREAU MIGHT BE SHOCKED to stand on the banks of Walden Pond today: the low roar of cars, the pounded maze of dirt trails, triathletes in wetsuits sneaking past the designated swimming area to take long laps from end to end. He might be just as bewildered to see the hayfields, pastures, and scattered woodlots of his day covered by a resurgent forest, more extensive than anytime in the past 200 years; his open-space-loving meadowlarks replaced by tree-dwelling birds and wide-ranging forest animals.

Of course, commuters on nearby Routes 126 and 2, inbound to Boston 15 miles away, rushing past Walden Breezes trailer park, may also find it hard to believe that they are traveling through the terrain of bobcats, mink, fishers, otters, coyotes, black bears, and even the occasional lost moose.

Lydia Rogers hopes that these mammals can continue to travel through the historic landscapes of eastern Massachusetts. As the coordinator of Walden Keeping Track, she is part of Keeping Track, Inc.'s national effort to give citizens the tools to find tracks and signs of wildlife in their regions. "In this very suburban setting we are used to seeing the landscape in terms of people activities—like where your car can go," she noted. "But when you start looking at animal sign, you start seeing how the animals are moving through the landscape: how they find suitable forest cover, how they are using edge, how they are using the waterways, how they are coping with the roads and highways. It's a different way of looking."

Keeping Track trains volunteers in this way of looking. Rogers' group of 19 trackers—including a high school teacher, aeronautical engineer, conservation commissioner, piano teacher, principal, painter, environmental consultant, poet, and student—spent six days over the course of a year with Susan Morse, Keeping Track's founder and expert track-

fisher, pen-and-ink by Susan Sawyer

er. They followed tracks across snow and mud; they searched for other wildlife sign like bear "mark trees"; they sniffed for a pungent tomcat smell on rocks and branches, the signal of a bobcat's recent passage; they peered at spraints, the mucous-covered, twisted grass mounds made by otters.

"Our basic purpose is to get wildlife information into town and regional plans," explained Lars Botzojorns, Keeping Track's executive director, from the group's national headquarters in Huntington, Vermont. "While our training is a wonderful way to improve natural history skills, we have a deeper mission: that conservation commissions and others will use this information to protect habitat."

Armed with a clipboard, specialized ruler, camera, field guides, and gumption, Rogers' volunteers mark each positive identification on a standardized form accompanied by documentary photographs. As other Keeping Track chapters have discovered, this stack of data sheets resolves into a portrait of wildlife movement. "Because our protocol has trackers out all four seasons—year after year on the same transect—we see crucial patterns," Morse noted. A single bobcat track in one season is noted; later, there are two together—a mate has been found. Then in the spring, data sheets indicate the presence of tiny kitten tracks. In the same way, the Walden group hopes that their walks through the woodways and green spaces around Walden Pond and nearby Estabrook Woods will reveal animal corridors, feeding areas, and perhaps even denning sites.

Rogers is optimistic: "There have been very reliable sightings of bobcats in Lincoln, plaster casts of moose print going right into the Concord River, black bears spotted in Great Meadows. We have tons of fisher and river otter. In all seasons I see their spraint mounds." Working closely with the Natural Resources Commission in Concord and the Lincoln Conservation Commission, their data may translate into landscape-scale planning that protects the paths of mustelids as much as minutemen.

A DESIRE FOR BETTER PLANNING was the genesis of Keeping Track in 1994. "I was very frustrated as a planning commissioner," explained Morse from her home at Wolf Run in Jericho, Vermont. "I felt our information was woefully inadequate (and still is) to make appropriate decisions regarding land use." She didn't see precise wildlife maps coming from state or federal agencies. Nor did other conservation groups seem to be taking on the task of making connections between general habitat data and the actual animal occupants of specific places. How can a rural planning commission make informed choices if it doesn't know who is living on the land?

Beginning with a large wedge of programs in Vermont and New Hampshire, Keeping Track has been giving conservationists, hunters, school groups, retirees, landowners, and other friends of wildlife the skills to address this question. Standing in front of a development board or regional planning hearing with maps—saying "bears feed on spring plant growth in this proposed wetland elimination" or "buying this land will protect a riverway for otters"—can make global abstractions about habitat loss pressing and real. The Piscataquog Watershed Association in New Hampshire recently used Keeping Track data to stop a proposed snowmobile trail through bobcat habitat and to relocate a proposed trash transfer station. "We take stories of what [wildlife] was found back to landowners," said Gordon Russell, one of the watershed association's founders. "That gives us the additional punch to convince landowners into giving conservation easements."

Over the last five years, trainings have taken Keeping Track beyond northern New England to Pennsylvania, New York's Cayuga Hills and Adirondacks, northeastern Connecticut, and west to greater San Diego County in California as well as to programs with the Sky Island Alliance in New Mexico and Arizona. Each program picks a group of focal species appropriate to their region. Morse is particularly excited about a new program launched in Florida, where volunteers track the Florida panther. In some more remote parts of the continent, Keeping Track has trained groups to look for signs of cougars, grizzly bears, wolverines, lynx, and wolves.

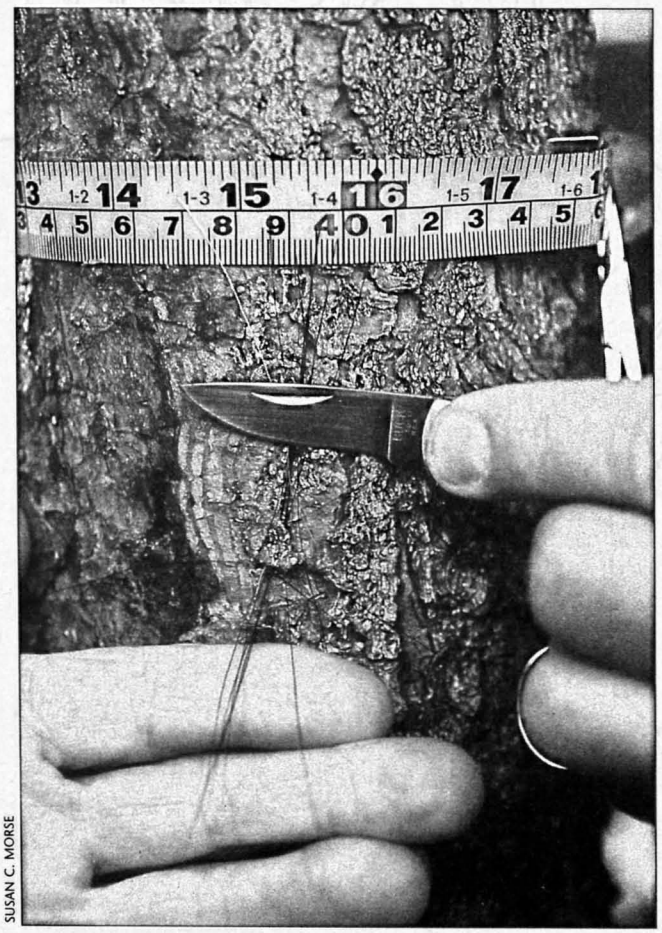
Keeping Track's method rests on the idea that the consistent presence of wide-ranging animals is one indicator of healthy land. Of course, spotting the tracks of a bobcat or bear is not a complete measure of biodiversity, but positive records of area-sensitive mammals give reason for hope. Rogers and her group are aware that eastern Massachusetts is a likely population sink for many roamers and top predators—they may travel through, or try to immigrate, but it is unlikely that the area by itself can maintain a viable population. Nevertheless, the presence of these animals suggests at least a few remaining strands of habitat connectivity to core breeding areas to the north and west. "When you know that these critters are using so much of the landscape, even though we can't see them, it creates a different sense of stewardship. We can't afford to just

PHOTO: Bear hairs, trapped in tree bark, are one of many wildlife signs recorded by Keeping Track volunteers.

preserve parks," Rogers noted, because disconnected parks are often genetic and ecological islands in a sea of people.

Standing near Walden Pond, on the margin of Route 2, Rogers can imagine the impact of a recent proposal to erect Jersey barriers along the whole road. "This is absolutely horrendous for wildlife," she said, watching a constant stream of cars. "You can see gray fox crossing, you can see deer crossing, and there is mink road-kill. We hope that we can document how much and where in particular the animals are crossing." Not only could this information be of use in developing wildlife underpasses, it could also spark drivers to a new awareness of who else is moving through the landscape.

BUT ARE VOLUNTEERS REALLY UP TO the tracking task? "It's not rocket science, but it's science," is Executive Director Botzojorns's reassuring reply. "We still have a ways to go to have some scientists appreciate the fact that volunteers can collect data and it's good data. In terms of baseline information you can't beat it. How are you going to get a bunch of Ph.D. candidates combing the landscape for fisher sign?"



SUSAN C. MORSE

Not surprisingly, trackers-in-training are repeatedly reminded not to fill out a data sheet unless they are sure. Trained trackers set out in groups of three and as they comb their 60-foot-by-2-mile transects, heads are often put together studying a mark, checking a reference book, gathering hair samples, taking photos. "When in doubt, follow it out" is a favorite Keeping Track mantra that reminds volunteers to backtrack along an animal's path, looking for the aggregation of crisp tracks, signature scats, favorite habitats, distinct gaits, or strong smells that makes a positive identification. "While there is a scientific mission here, there is a lot of fun too," Rogers said. "How can you study a bear pile with two friends and not make a few scatological jokes?"

Despite volunteers' best efforts, they make mistakes (just like the professionals)—but Keeping Track's science staff reviews each record. "With photos measured to scale, we're going to catch errors," Morse explained. "If there is not 100% certainty, the record is rejected." Although Keeping Track makes no claims to be creating complete inventories of wildlife populations, the organization's national database is starting to gather statistical weight. Staff from the U.S. Forest Service, The Nature Conservancy, U.S. Fish and Wildlife Service, and other professional naturalists have taken the tracking course; inquiries about the pending data-set are starting to come in from academic and agency researchers.

Like many citizen science efforts, Keeping Track is part of a back-to-natural-history impulse that is moving through the biological sciences. If nothing else, their data can provide a tool for scientists and planners who "want a real sense of what is out there—as opposed to relying on generalized maps or projections of habitat," Botzojorns notes. "The power of our information is that it is ground-truthed."

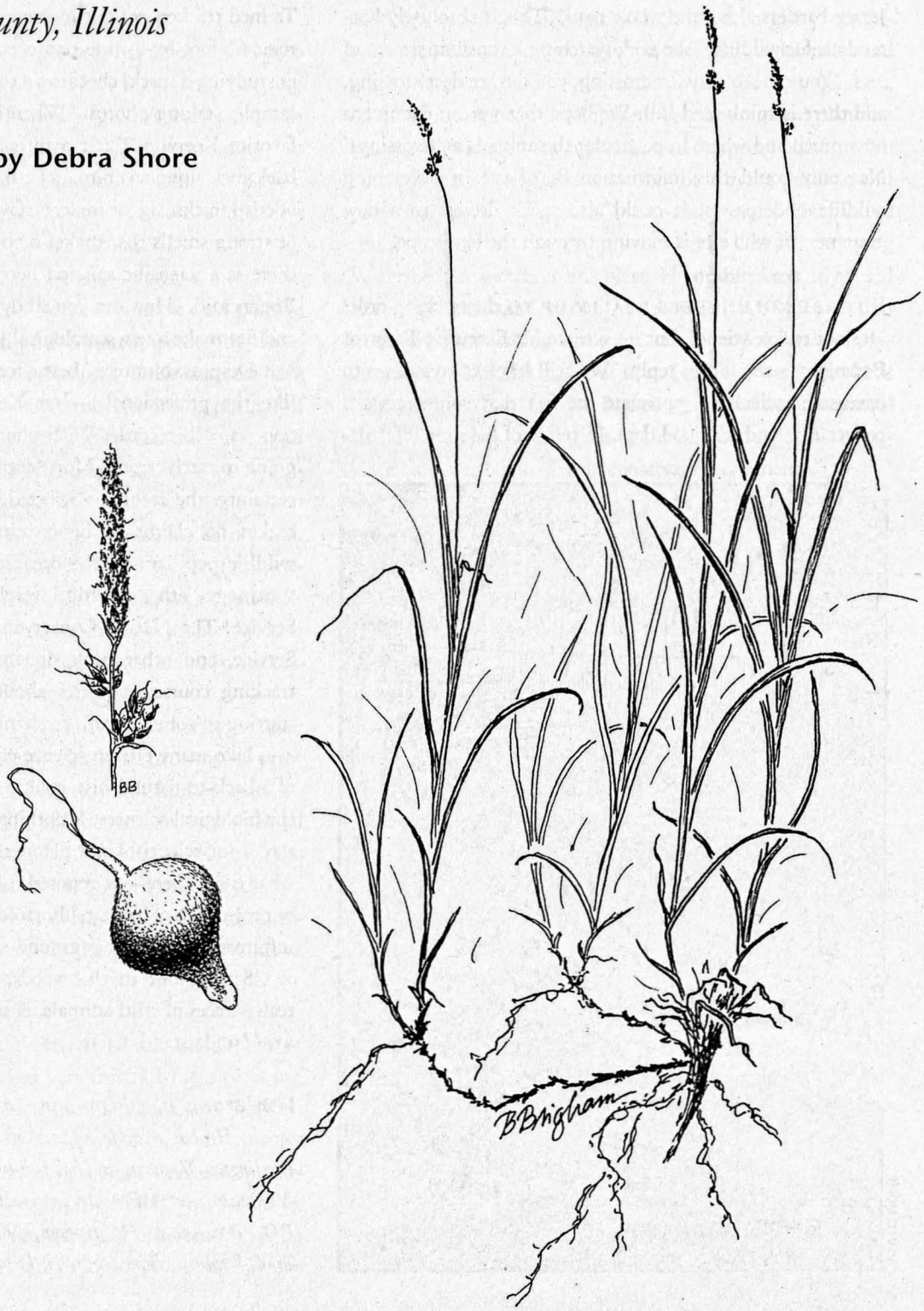
Setting out in the woods, carried by the quiet—but real—traces of wild animals, is something Thoreau probably *would* understand. ☾

Josh Brown *is assistant editor at* Wild Earth *and a freelance writer. He has credible evidence of skunks in his neighborhood in Burlington, Vermont, and has seen bobcat tracks in the nearby Green Mountains.* ⇝ *For more information, contact Keeping Track Inc., P.O. Box 444, Huntington, VT 05462; 802-434-7000; info@keepingtrackinc.org; www.keepingtrackinc.org.*

AN INVENTORY OF NATURE

Citizens Conduct Land Audit in Cook County, Illinois

by Debra Shore



Pennsylvania sedge, pen-and-ink by Betsy Brigham

TWO HEADS LEANED OVER to peer at the quadrat. One, belonging to a retired naturalist, called out plant names. "Let's see, looks like we have bracken fern here. That one's wild quinine and that's porcupine grass," he said, pointing to various species. His partner, a neophyte botanist but willing data recorder, wrote the plant names on a data sheet. After every third quarter-meter sampling plot, spaced 10 meters apart, the team conducted "point/quarter surveys" of the nearest and biggest trees within 30 meters. "That's a pin oak, that one's a black oak, and there's a sassafras."

They were in Zanders Woods in southwestern Cook County, Illinois, a 440-acre site that is part of the 68,000 acres comprising the Forest Preserve District of Cook County. This crew was one of more than 30 such crews—all volunteers—fanning out to 100 randomly selected sites in the forest preserves last July to conduct an inventory of the vegetation of these protected areas. "Basically, we are auditing the 'nature' of the land," said survey director Wayne Lampa, himself a retired ecologist from a neighboring county.

The Forest Preserve District of Cook County, the nation's first such county-wide agency, was established in 1915 with a noble goal: "...to protect and preserve the flora, fauna and scenic beauty within such district, and to restore, restock, protect and preserve the natural forests and said lands together with their flora and fauna, as nearly as may be, in their natural state and condition...." Since its founding, the district has acquired 11% of the land in populous Cook County. Over the years, the district has sought to maintain 80% of its holdings in a natural state and 20% as recreational development, namely picnic groves, trails for hiking and biking and skiing, golf courses, and the necessary parking lots.

Some parcels are considered to be ecologically rich, containing some of the best remaining examples of native midwestern prairies, woodlands, oak savannas, and wetlands. But much of the district's holdings has become severely degraded—invaded by aggressive weeds and brush, suffering from lack of fire and changes in hydrology. Compounding these problems, the district doesn't have a comprehensive assessment of the condition of the lands under its care.

In stepped Friends of the Forest Preserves, a nonprofit advocacy group formed two years ago to support the district and its mission. Friends decided to help the understaffed, underfunded district by designing and conducting a quick "land audit" to determine the condition of the district's natural assets, much as recent fiscal audits have uncovered substantial budget deficits. (Friends has been joined in this effort by Friends of the Parks, Audubon, and the Sierra Club.)

"We want to come away with statements like 'based on our sampling, 10% of the land is highly degraded,'" Lampa noted, "or...'10% of the land is high quality,' etc. We also want to be able to make statements as to what indicates degradation and quality. And we want to start looking at trends."

For instance, the point/quarter tree counts will give researchers a sense of the understory—are the ancient canopy oaks regenerating or disappearing? Lampa explains that the types of large trees identified and their size and spacing give scientists an idea of what the ecosystem was like hundreds of years ago, and the small trees indicate whether this ecosystem is regenerating itself. "Box elder, ash, elm, and buckthorn are not the forest trees of this region," Lampa said. Studies elsewhere in the region have shown that oak woods need to be managed by fire, and the district is already using fire on a few hundred acres.

"This study will provide important information that can help guide the discussion about managing our public lands," Lampa added.

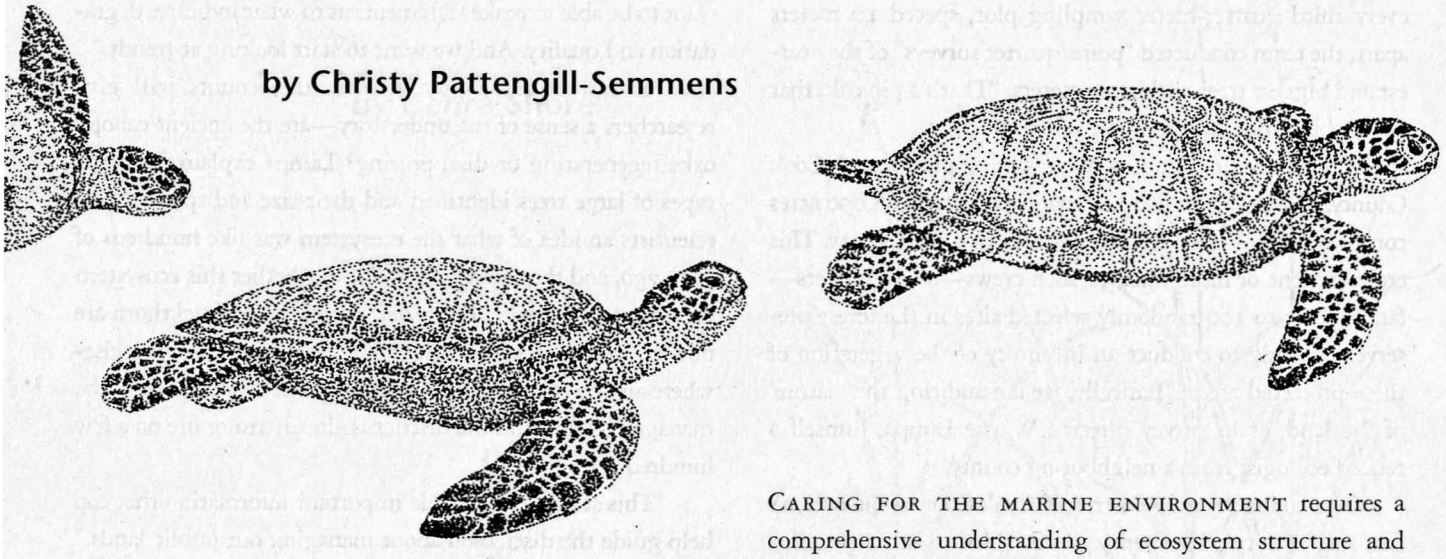
Karen Glennemeier, science coordinator for Audubon–Chicago Region, has assembled a group of ecologists, botanists, and area land managers to review the data. Glennemeier, who also serves as staff for the Chicago Wilderness Habitat Project, said, "As we grapple with the daunting task of evaluating land management on a regional scale, this study can serve as an organizational model. How do we assess the health of the 200,000 acres of protected natural land in the Chicago Wilderness region, as pressures and restoration efforts increase over the next 10, 20, 50 years? This land audit is a really exciting example of a group of dedicated citizen scientists collecting large amounts of very important data in a short amount of time. A review of the data by some of the region's most respected ecologists, botanists, and land managers will help us to refine monitoring protocols and data analysis to meet the needs of Cook County and the other land managers in the Chicago Wilderness region." ☾

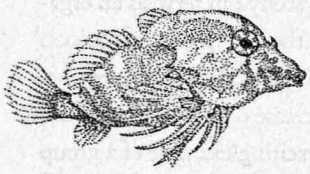
Debra Shore *is editor of* Chicago WILDERNESS, *a quarterly magazine that celebrates the collaborative conservation efforts of more than 130 public and private organizations working together to preserve, protect, restore, and manage the natural communities of the Chicago region.*

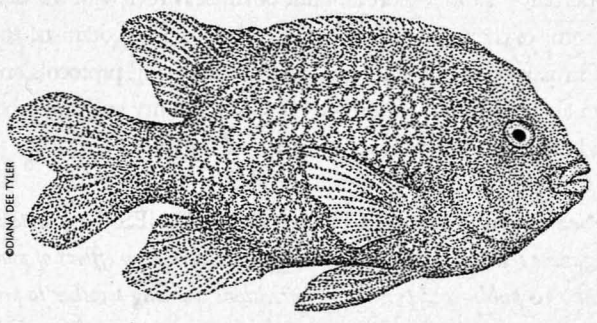
DIVING FOR DATA

The REEF Fish Survey Project

by Christy Pattengill-Semmens







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CARING FOR THE MARINE ENVIRONMENT requires a comprehensive understanding of ecosystem structure and function. It is only through concerted and persistent data collection that researchers and managers are able to understand the ebb and flow of life off the shore. The monumental task of surveying, recording, and cataloging an immense liquid wilderness is insurmountable without help. Help, in this case, comes from thousands of recreational divers and snorkelers who visit coastal areas each year. The Reef Environmental Education Foundation's program enlists those divers to provide meaningful information while enabling them to learn how to really see underwater.

The Reef Environmental Education Foundation (REEF) was founded in 1990 out of growing concern about the health of marine ecosystems, and the desire to provide the scuba-diving community a way to contribute to the understanding and protection of marine populations. REEF achieves this goal primarily through its volunteer fish monitoring program, the REEF Fish Survey Project, developed with support from The Nature Conservancy and guidance from the Southeast Fisheries Science Center of the National Marine Fisheries Service. The Fish Survey Project allows volunteer scuba divers and snorkelers to collect and report information on marine fish populations. The data are collected using a standardized method and are housed in a publicly accessible database on REEF's website.

green sea turtles, grunt sculpin, and garibaldi, pen-and-ink by D. D. Tyler

PHOTO: Slate boards in hand, recreational scuba divers take note of fish species in a coral reef as part of the Reef Environmental Education Foundation's survey program.

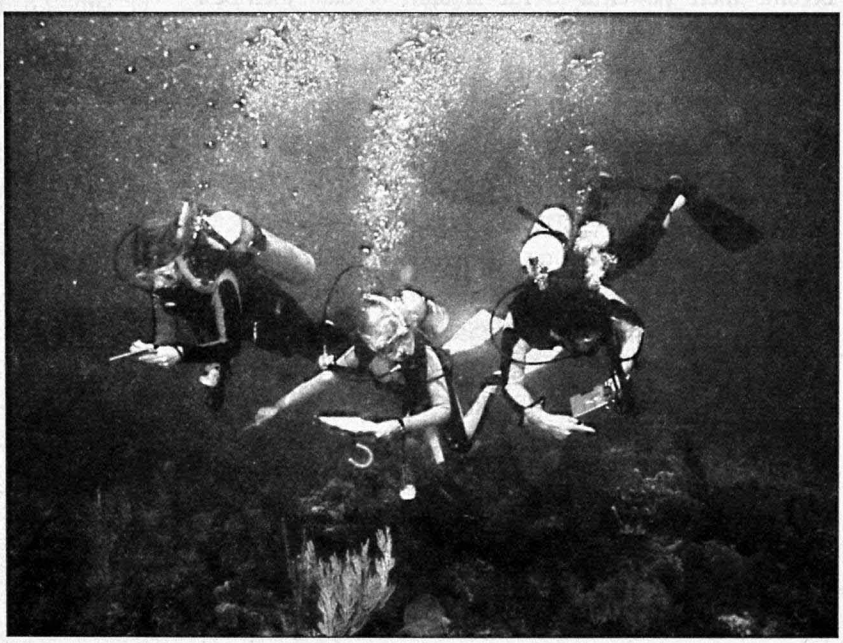
To collect data for the project, REEF volunteers use the Roving Diver Technique, a visual survey method specifically designed for volunteer data collection. The only materials needed are an underwater slate and pencil, a scantron form available at no charge from REEF, and a good reference book. During a survey, divers swim freely throughout a dive site and record every fish species that can be positively identified. The "hunt" for fishes begins as soon as the diver enters the water. The goal is to find as many species as possible, so divers are encouraged to look under ledges and up in the water column. At the conclusion of a survey, each recorded species is assigned one of four abundance categories based on how many individuals were seen throughout the dive (single [1], few [2–10], many [11–100], and abundant [>100]). Following the dive, each surveyor records the species data on a region-specific scansheet and returns it to REEF headquarters, where it is processed and entered into the database.

The Fish Survey Project started in Florida in 1993 and has expanded to include the entire tropical western Atlantic (Florida, Caribbean, Bahamas, and Gulf of Mexico), southern Atlantic states (Georgia and South Carolina), the Northeast (Maine through North Carolina), the West Coast of the United States and Canada (California, Oregon, Washington, and British Columbia), the tropical eastern Pacific (Gulf of California to the Galapagos Islands), and most recently the Hawaiian Islands. This year, sea turtle sightings have been added to the program, as well as an invertebrate monitoring protocol for the Pacific Northwest. By the end of 2001, over 40,000 surveys had been conducted by REEF members throughout the world.

REEF'S PROGRAMS contribute significantly to the task of acquiring information on one of the most important aspects of the marine ecosystem—fish community structure. Data collected through this project have been used in many scientific publications and symposia, by resource managers in the Florida Keys and other marine managed areas, by the State of Florida's artificial reef program, and by the National Oceanic and Atmospheric Administration's (NOAA) Biogeography Office among others (see sidebar next page).

In 2001, REEF also began working on a Fish Species Distribution Atlas for the tropical western Atlantic. This atlas will map the distribution and estimated abundance of all fish species documented during REEF surveys. (The exact location of each survey is known and can therefore be placed on a map.) The spatial resolution of the database along with the wide geographic coverage and large amount of field time put in by REEF members all lend themselves to the creation of an atlas. The distribution atlas will provide basic but novel information on where fish species are found and will be used to measure rarity and distribution changes over time, thus contributing to the understanding and conservation of western Atlantic reef fishes. Similar atlases will be produced for the other project areas as data collection continues.

In addition to the usefulness of the data, REEF's educational contributions are valuable. Participation in REEF's survey program enhances a diver's ability to discern details about the marine environment. For divers that have no training as naturalists, areas often blend together and the attitude that "it's just another coral reef" or "one more kelp forest" can take hold. The excitement of finding a rare fish can be appreciated only if one knows it's rare. By learning identification techniques and recording their fish observations, REEF surveyors become keen observers, and become better naturalists.



COURTESY OF REEF

Divers and snorkelers are not required to attend any specific training program to participate in the Fish Survey Project, and many of them have become adept at fish identification through continued practice and self-education similar to many birdwatchers. However, REEF does offer several educational opportunities to get people started and to further their knowledge. REEF produces a standardized training curriculum for introductory fish identification and has modules for all of its project areas. These courses are taught through dive shops, dive clubs, educational institutions, and public aquaria. Ten to twelve Field Surveys—week-long trips led by REEF staff and featuring daily seminars and survey dives—are also offered each year, and serve as an opportunity for divers to get started in fishwatching and for experienced REEF surveyors to hone their skills.

A broader outreach effort is achieved through the Great American Fish Count. In collaboration with NOAA's National Marine Sanctuary Program, REEF coordinates this annual event each July as a way to promote awareness about marine resources, to encourage budding naturalists, and to encourage divers to take up REEF surveying as a regular diving activity. Free fish-identification seminars and survey dive opportunities are offered leading up to and during the event.

THE SCIENTIFIC AND MANAGEMENT applications of REEF's volunteer-generated database are expanding and will become more powerful as the amount of data increases. Regardless of the data applications, the awareness that comes from becoming a more skilled naturalist provides REEF surveyors continued benefit. REEF's cofounder, Paul Humann, describes fishwatching as "a passionate hobby within a hobby: it gives purpose to a dive, anyone can take it up and have an instant good time." And benefits extend beyond enhancing an individual diver's underwater experience. The sense of stewardship that arises from involvement in citizen science programs such as REEF's Fish Survey Program raises the public's awareness of and involvement in conservation issues. By empowering volunteers, REEF gathers the scientific data and helps build the constituency necessary for protecting and restoring marine ecosystems. ☾

Christy Semmens *is the scientific coordinator of the REEF program and is based in Seattle, Washington.* *For a complete list of projects and papers that have used REEF data, visit www.reef.org/data.*

A THREATENED SPECIES AIDED

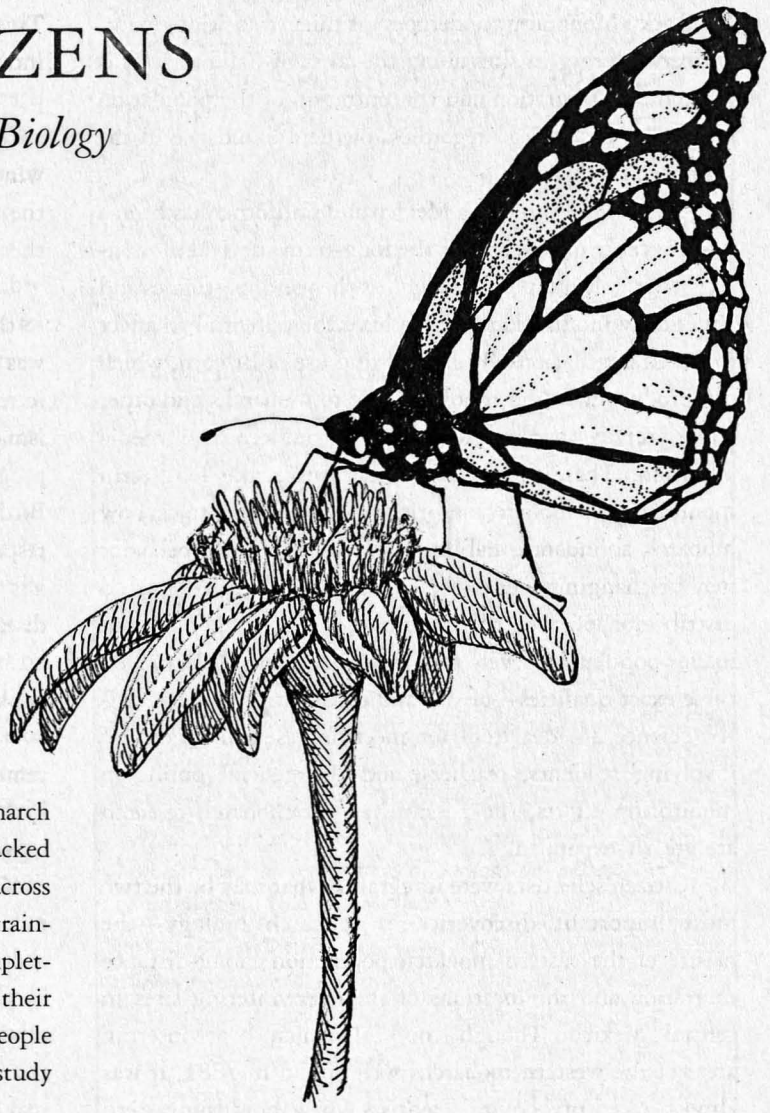
After the number of goliath grouper (jewfish, *Epinephelus itajara*) dropped to significantly low numbers in the 1980s, the species was protected from all harvest in Florida waters in 1990. Populations have staged a gradual comeback, but there has been an increasing lobby to remove their protected status. Without fish catch numbers, resource agencies turned to the REEF database to help decide this critical management decision. Based on distribution maps of goliath grouper sightings from REEF surveys that were developed by Florida's Fish and Wildlife Conservation Commission and the National Marine Fisheries Service, the Gulf of Mexico Fisheries Council determined that it would not be prudent to reopen the goliath grouper fishery now. (See "Species Spotlight," inside back cover, this issue.)

PROVIDING INSIGHT INTO FISH ASSEMBLAGES IN THE FLORIDA KEYS NATIONAL MARINE SANCTUARY

Encompassing over 9,000 square kilometers, the coral reefs of the Florida Keys represent the third largest barrier reef in the world. To date, over 8,000 REEF surveys have been conducted within the sanctuary; these data have provided a foundation for several papers and reports. Chris Jeffrey, a researcher with NOAA's Biogeography Office, recently used REEF data in conjunction with benthic habitat maps to investigate relationships between fishes and habitats in a geographic information system (GIS). A multi-site multi-species trend analysis was also recently completed by University of Washington graduate student Brice Semmens, adapting an analysis method originally developed for Breeding Bird Survey data. REEF data collected over seven years from 21 sites throughout the national marine sanctuary were used in the analysis, which highlighted sites that represented potential management concerns based on negative population trends across a large proportion of the species.

A MEETING OF MONARCHS AND CITIZENS

Volunteers Discover Butterfly Biology



by Michelle Prysby

EACH YEAR, HUNDREDS OF THOUSANDS of monarch butterflies are counted, metableasured, tagged, and tracked by an extraordinary team of researchers working all across North America. Most of these people have no formal training in scientific methodology; many have not even completed high school yet. Almost none of them are paid for their work. Sometimes called "citizen scientists," they are people from all walks of life who are participating in efforts to study monarch biology.

Monarchs (*Danaus plexippus*) and citizen science are clearly intertwined. Professional scientists who study monarchs have used citizen science as a research tool for the past 50 years. Currently, the monarch is a focal organism for at least nine citizen science programs in Canada, Mexico, and the United States (see sidebar). Participants in these programs aid in research on monarch population ecology, phenology (the study of cyclical and seasonal natural phenomena), and migratory behavior, and on the quality of monarch breeding and overwintering habitats. Dedicated volunteers ranging from elementary school students to senior citizens have made significant contributions to our understanding of this unique butterfly.

The monarch is one of few species that are both highly abundant and the focus of major conservation efforts. Each spring and summer, the eastern population of monarchs in North America is cosmopolitan, breeding over all of the eastern United States and southern Canada. At this stage, most of the population utilizes common milkweed (*Asclepias syriaca*), a very abundant host plant species that can grow in habitats ranging from native prairies to cultivated cornfields. But each fall, the population undergoes a long-distance migration, mostly funneling south through Texas to spend the winter in a few tiny patches of a remnant forest ecosystem in the transvolcanic mountains of central Mexico. These butterflies trav-

monarch butterfly, pen-and-ink by Susan Sawyer

el up to 3,000 miles, surviving for six to nine months on stored fat reserves. The western population, breeding west of the Rocky Mountains, undergoes a similar transition, mainly overwintering in sites along the coast of California. This phenomenal migration and concentration of the population puts monarchs at risk, regardless of their abundance in the summer months.

Deforestation in both Mexico and California has been a leading cause of concern for the long-term survival of monarchs; agricultural practices such as the use of pesticides and genetically modified crops also have the potential to affect monarch populations. The increasing use of Bt corn, which can produce wind-born pollen toxic to monarchs and other lepidopterans, has received intense research and media attention. These conservation concerns make long-term monitoring of monarchs a priority as we try to track how monarch abundance, habitat use, and migratory behavior may be changing over time. The large size and widespread distribution of both the eastern and western populations make population-level research challenging. However, these exact qualities—of size and distribution—make citizen science an ideal tool for meeting research needs. By involving students, teachers, and the general public in monitoring efforts, the possibilities for monarch research are greatly expanded.

Citizen scientists were integral to what may be the two most important discoveries in monarch biology—the nature of the eastern monarch population's long-distance migration and the locations of the overwintering sites in central Mexico. Though the Californian overwintering areas of the western monarchs were found in 1881, it was almost a century before scientists knew how the eastern monarchs coped with the harsh winter climate. In 1952, Dr. Fred Urquhart of the University of Toronto launched the Insect Migration Association, a program dedicated to discovering how and where monarchs were migrating in the fall. Participants from all over the United States and Canada assisted Urquhart in capturing, tagging, and reporting monarch sightings until 1994. The participation of more than 3,000 volunteers (whom Urquhart called "research associates") allowed Urquhart to trace the migration of the monarchs and finally, in 1975, to pinpoint the overwintering grounds in central Mexico (previously known only to the local Mexicans). In fact, the volunteers played a particularly direct role; it was a citizen scientist who had tagged the first marked monarch found at the site. This monarch, tagged in Minnesota, provided proof that individual butterflies were migrating from the northern part of their range all the way to central Mexico. This discovery has been critical: without knowledge of the overwintering locations, conservationists would be unaware of the threat to monarchs from habitat destruction occurring there and unable to take action to halt its progress.

Urquhart's program also made important contributions to the development of citizen science as a research tool. His was one of the first programs to focus on answering a specific research question, rather than simply monitoring organism abundance (as in the case of other early citizen science programs such as the Breeding Bird Survey or the Christmas Bird Count). In addition, Urquhart truly recognized and respected citizens' contributions. Many amateur lepidopterists sent in observations of monarch densities, parasitism, disease, and behavior. Urquhart took these observations seriously, using them in his own work and publishing them in books and journal articles.

Perhaps due to the example that Urquhart set, monarchs remain a flagship organism for citizen science today (see sidebar). Volunteers continue to tag and report sightings of tagged monarchs, now under the direction of the University of Kansas's Monarch Watch. Although we now know where monarchs are going in the fall, many questions still remain about the nature of their migration and how it is influenced by factors such as weather. Tagging the number of monarchs needed to obtain a statistically significant number of tag recoveries would be very difficult for scientists to do alone, making the continued participation of citizens vital.

Similarly, the thousands of participants in the Journey North program provide data on monarch phenology that could not be gathered solely by professional scientists. Now in its seventh year, Journey North is an internet-based education program that involves students in tracking spring migrations. Through Journey North, students and teachers report their first sightings of monarchs each spring, as the monarchs migrate back from Mexico and recolonize the United States and Canada in successive generations. Scientists are using these data to predict the number of generations monarchs produce in a given year and to investigate the capacity for monarch populations to rebound after years of lower densities.

Citizen scientists are studying other stages of the monarch life cycle as well. For example, the Monarch Larval Monitoring Project involves volunteers in monitoring monarch egg and larval densities and milkweed habitat in the U.S. and Canada. Project participants watch habitats such as old fields, prairies, roadsides, and gardens on a weekly basis each spring and summer, recording densities of monarch eggs and larvae and measuring milkweed characteristics. These data allow scientists to determine how monarch populations vary from year to year and among different habitats and geographical regions. They also can use the data to identify hotspots of monarch reproduction that may be particularly important to conserve.

These programs are typical citizen science projects, in which volunteers participate mainly in the data collection step of the research process, following a set protocol. But some monarch citizen scientists are doing independent research, and their findings also have been important. The Monarchs in the Classroom program, directed by Dr. Karen Oberhauser at the University of Minnesota, teaches students and teachers to ask their own research questions about monarchs and to design and carry out studies to answer them. While some of these studies are not important for conservation efforts (e.g., How does rock music affect monarch metamorphosis?), many are of keen interest to monarch scientists and conservationists. For example, students and teachers in Texas have carried out a multi-year study of the reproductive status of monarchs migrating through Texas in the fall. They have found that many of these butterflies are reproductively active. This finding challenges the idea that migrating monarchs are not mating or laying eggs, and it is causing scientists to re-think the theory that migration and reproductive diapause (a state of arrested development) are coupled in the species.

Asking questions, collecting data, and drawing conclusions are only part of the scientific process. Sharing findings with the scientific community and the public is also important; citizen scientists have been active in this area as well. In fact, citizens may do a better job than many traditional scientists at sharing their findings with the general public. Many of them give presentations for classrooms, local nature centers, and garden clubs. Some students doing monarch-related research present their results at school and community science fairs, and others publish their research on the Web.

Citizens also have been a significant presence at the last

MONARCH BUTTERFLY–RELATED CITIZEN SCIENCE PROGRAMS IN NORTH AMERICA, INCLUDING PARTICIPANT ACTIVITIES

Journey North www.learner.org/jnorth
Report first sightings of monarchs and other species each spring.

Monarch Watch www.monarchwatch.org
Tag monarchs each fall to track migration.

Monarchs in the Classroom
www.monarchlab.umn.edu
Conduct independent research on many facets of monarch biology.

Monarch Larval Monitoring Project
www.monarchlab.umn.edu/MP/mp.html
Monitor monarch egg and larval densities in milkweed patches.

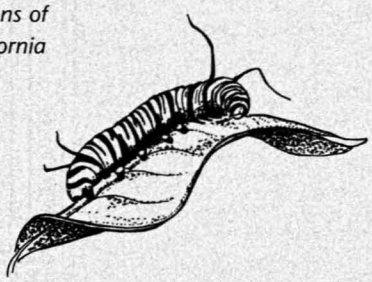
The Monarch Program
e-mail: monarchprg@aol.com
Monitor monarch abundance at overwintering sites in California.

The Migratory Pollinators Project
www.desertmuseum.org/conservation/mp/mp_index.html
Monitor monarch nectaring and migratory behavior in the southwestern U.S. and Mexico.

The Fourth of July Butterfly Count
www.naba.org/4july.html
Count adult monarchs in a one-day census.

Texas Monarch Watch
www.tpwd.state.tx.us/nature/education/tracker/monarch/
Report sightings of monarchs as the fall migration passes through Texas.

Monarch Alert Project
http://bio.calpoly.edu/BioSci/MonarchAlert/
Report aggregations of monarchs in California each fall.



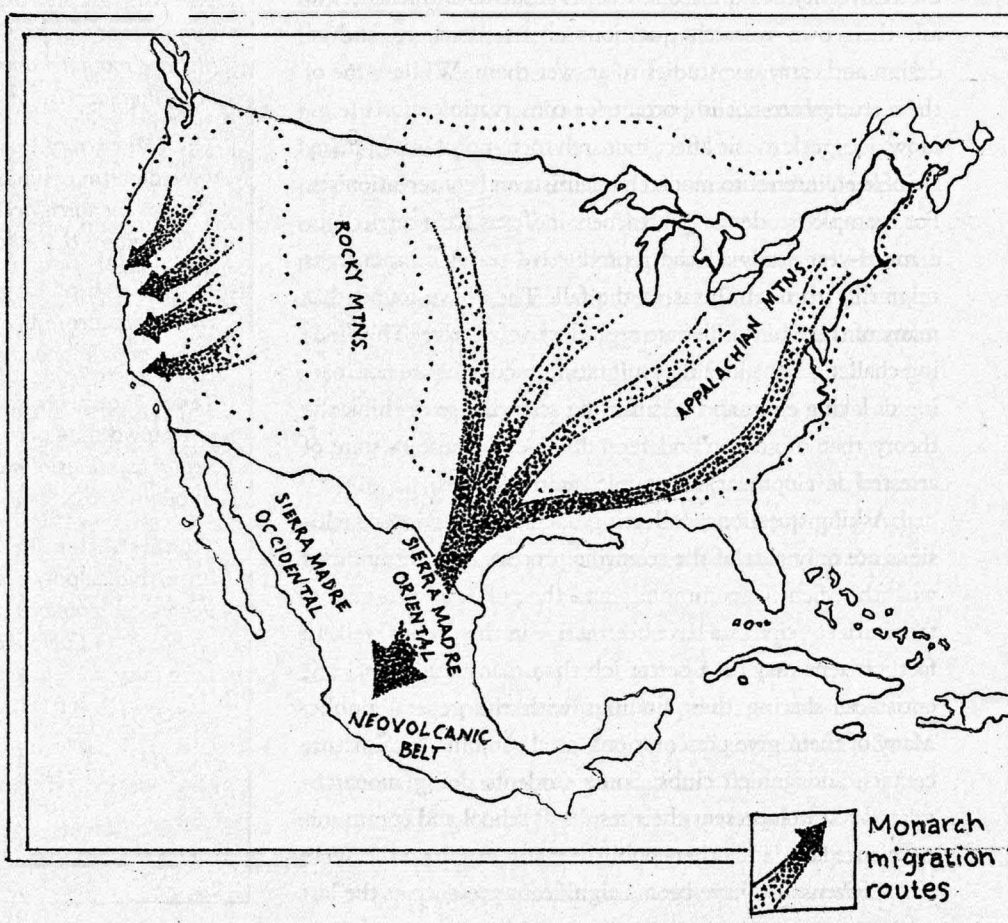
monarch butterfly caterpillar, pen-and-ink by Sonia Altizer

two major scientific meetings about monarchs. Citizen scientists from Canada, Mexico, and the United States attended the 1997 North American Conference on the Monarch Butterfly in Morelia, Mexico, and contributed and evaluated ideas for research and conservation priorities. At the 2001 Monarch Population Dynamics Meeting held in Lawrence, Kansas, students and teachers presented their research in a special poster session and helped scientists design policy initiatives for monarch conservation. And amateur monarch researchers can converse with each other and with professional scientists via D-plex, a listserv sponsored by Monarch Watch for anyone interested in monarch butterflies.

Why are monarch research and citizen science so intertwined? The history of monarch and lepidopteran research partly answers this question. Urquhart clearly demonstrated the utility of citizen science and set an example for future scientists. Amateurs historically have been active in the field of entomology; to this day, many members of the Lepidopterists' Society are amateurs rather than professionals. This presence of self-taught and self-motivated butterfly enthusiasts has made it relatively easy for monarch-related citizen science programs to recruit volunteers.

In addition to this history, monarchs make ideal study organisms for inexperienced researchers. They are relatively large and sturdy enough that even young children can handle them safely. Monarchs and their milkweed host plants are highly abundant, making it possible for rural, suburban, and urban dwellers to find them. The bright, distinct coloration of both the caterpillars and the butterflies make them easy to observe and identify. In addition, monarchs have a natural charisma and receive the necessary publicity to attract the interest of potential citizen scientists.

At the recent Monarch Population Dynamics Meeting in Kansas, scientists and citizens concerned about monarch conservation met to share research results and prioritize future research needs. The scientists were united in their



The fall and spring migration routes of monarch butterflies have been pieced together over several decades by tag return data and direct observation; much of this work has been undertaken by volunteers.

agreement that citizen science efforts should continue and are critical to answering many of the high-priority research goals that will inform future conservation efforts. Though the validity and relevance of data collected by citizen scientists remain a source of disagreement among scientists in some other fields, scientists at this meeting expressed acceptance and even enthusiasm for citizen science's potential. Fortunately, citizens throughout North America also seem to be maintaining a high level of enthusiasm for participating in monarch research. Their support and dedication has helped us achieve our current understanding of monarch population ecology and migratory behavior and will be crucial to the success of future research efforts. ☾

ACKNOWLEDGMENTS I would like to thank Kate Howe for her helpful comments on this manuscript. I also thank the many monarch butterfly enthusiasts with whom I have discussed the exciting potential of citizen science.

While at the University of Minnesota, **Michelle Prysby** *relied on citizen scientist data in writing her master's thesis exploring "temporal and geographical variation in monarch egg and larval densities." She lives in eastern Tennessee, where she codirects the Monarch Larval Monitoring Project and leads citizen science efforts at the Great Smoky Mountains Institute at Tremont.*

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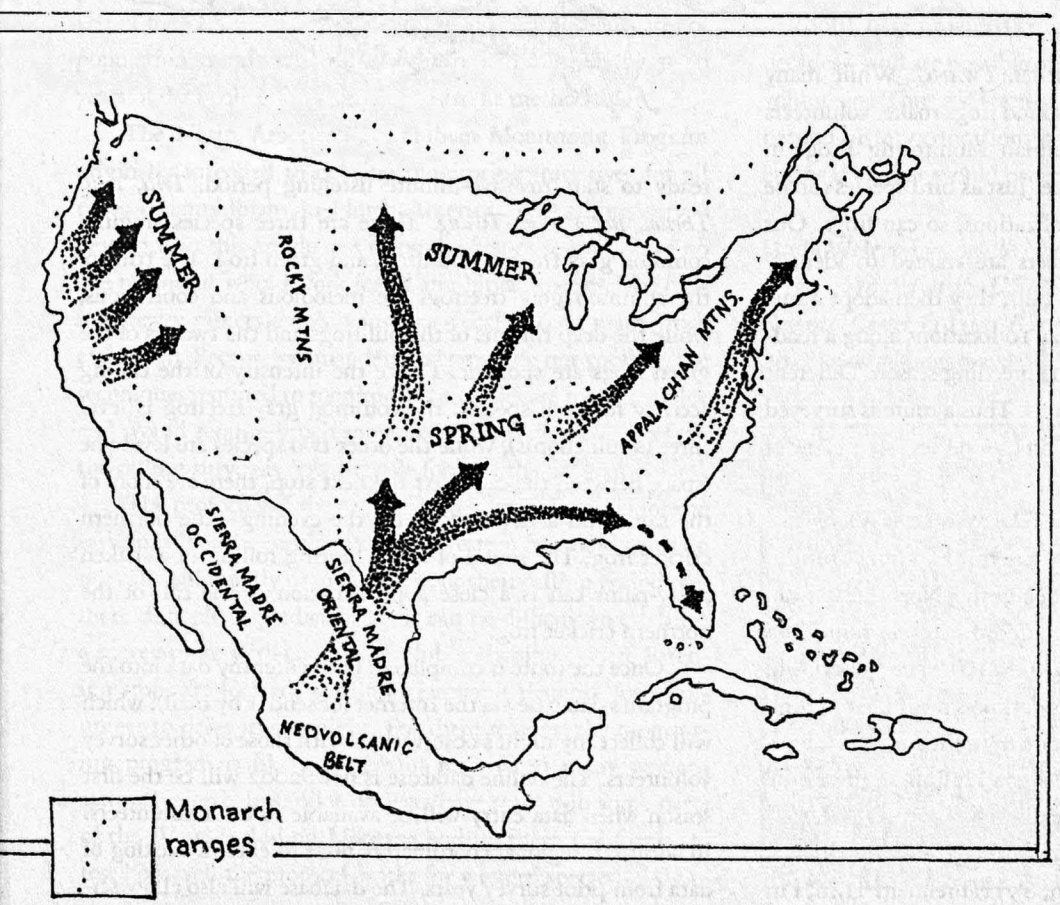
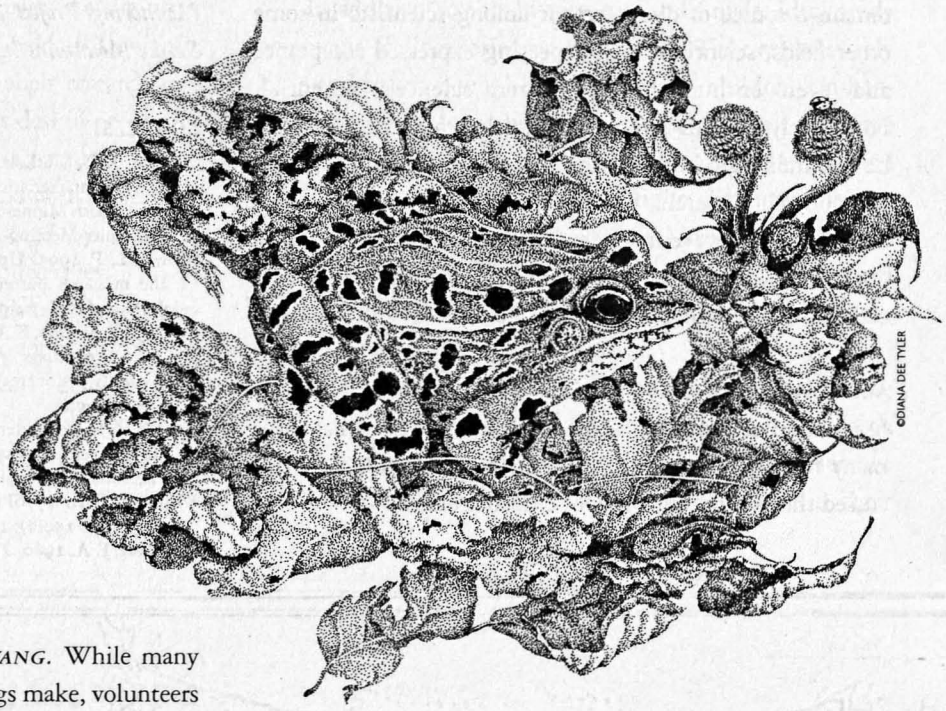


map by Todd Cummings

VOICES IN THE NIGHT

A Calling Frog Survey



by Linda Weir

TRILL, TRILL. THRUM, JUG O' RUM. TWANG. While many people may think of *ribbit* as the sound frogs make, volunteers for the North American Amphibian Monitoring Program know that not all frogs sound alike. Just as bird species can be determined by their unique vocalizations, so can frogs. Our program's calling survey volunteers are trained to identify frog species by listening to these calls; they then adopt a survey route, where they will listen at 10 locations along a roadside route several times during the breeding season. Different species have different calling seasons. Thus a route is surveyed three or four times per year based on the species assemblage of the region.

What is a calling survey like? Take tonight; it is late June in Maryland and time to conduct the third and final run for the year. (One of pleasures of being the North American Amphibian Monitoring Program Coordinator is running a regular survey route—to do is to know.) The sun goes down; the frogs will start calling more as darkness sets in. According to the survey protocol, I am to start my route at least a half-hour after sunset. It's going to be a good calling night, as the air is humid from the recent rainfall.

First, I record the time and weather conditions; it is a calm night with clear skies, warm, 85° Fahrenheit. Then, I'm ready to start my five-minute listening period. *Trill, trill. Thrum, jug o' rum. Twang.* There are three species singing: common gray treefrog, bullfrog, and green frog. The trills of the common gray treefrogs are melodious and continuous, while the deep thrums of the bullfrogs and the twangs of the green frogs are sporadic. I note the intensity of the calling activity for each species: the common gray treefrog is level three (a full chorus), while the other two species are level one (space between the calls). At the next stop, there are more of the same and a new species for the evening—the northern cricket frog. The sound of a ball bearing rolling in a shaken spray-paint can is a close approximation of the call of the northern cricket frog.

Once the route is completed, I can enter my data into the program's database via the Internet (or send it by mail), which will collect my night's observations with those of other survey volunteers. The online database is new; 2002 will be the first season when data entry will be available to most volunteers. In addition, regional coordinators need to enter a backlog of data from prior survey years. The database will also allow sci-

northern leopard frog, pen-and-ink by D. D. Tyler

PHOTO: The melodious trill of the common gray treefrog is often heard on amphibian survey routes.

entists and the public to view and download calling survey data collected by the program.

Since it began in 1997, the North American Amphibian Monitoring Program has been working to provide information on changes in the distribution and trends of amphibian populations at a variety of geographic scales, reflecting both political and biogeographic divisions of the continent. For instance, what are the amphibian population trends for Maryland? How has the distribution of northern cricket frogs changed in the Great Lakes region? Hopefully, our data will shed light on the answers to these questions and many others. The monitoring program now provides useful information on frog and toad species distributions. For example, in 1998 a Louisiana volunteer reported hearing the bird-voiced treefrog (*Hyla avivoca*), a species previously undocumented for Webster Parish (Louisiana has parishes, rather than counties) while conducting the calling survey. In this case, the survey volunteer also happened to be a biologist; he later searched the area and was able to collect a voucher specimen to document this new and as-of-yet still unpublished distribution record. Using the calling survey data to develop reliable estimates of population trends will likely require a minimum of 5–10 years of data collection using a consistent methodology.

The North American Amphibian Monitoring Program originally intended to develop monitoring initiatives for all types of amphibians in North America. The calling survey described in this article was to be the first of several, since no one technique would work for all amphibian species. The calling survey targets amphibians that vocalize (i.e., many frogs and toads). Because salamanders and newts do not vocalize, the techniques required to monitor these species are more complex and would require much more extensive training. Therefore, the calling survey is now the sole focus of the program.

The protocols of the calling survey were designed for the eastern half of the continent. Many western frogs and toads do not call, call quietly or underwater, or their calling periods are more difficult to predict. Also, it can be difficult to establish a survey route with enough amphibian habitat (where listening stops are located) within a reasonable distance for a volunteer to drive in one night. For these reasons, the monitoring program is likely to remain inactive in many western states. Nevertheless, pilot projects have started in some parts of the West, including Montana and southern California, to test how well the protocol works for western species.

The North American Amphibian Monitoring Program calling survey is a partnership among the U.S. Geological Survey and state, academic, and nonprofit groups. In each participating state, a regional coordinator manages the survey for the state, including volunteer recruitment and training, route assignments, and data review. In 2001 there are 26 states involved, mostly in the eastern half of the United States. The survey is active from Maine to Virginia, as well as in some of the Southeast and Midwest. Looking ahead, priorities for the program include increasing route coverage in active states and expansion into new states in the Southeast and Midwest.

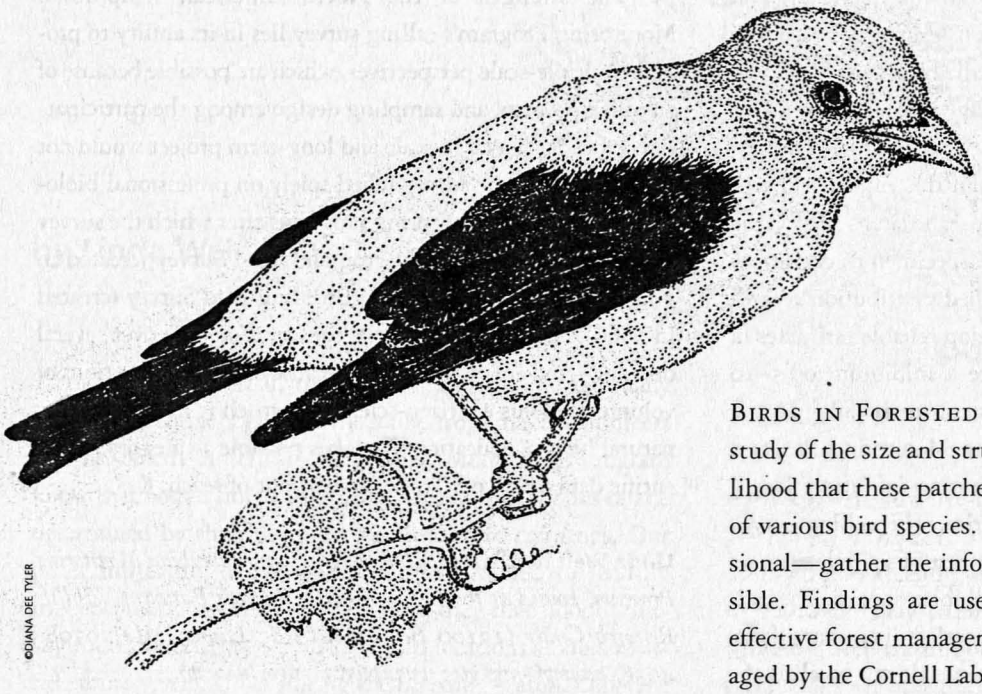
The strength of the North American Amphibian Monitoring Program's calling survey lies in its ability to provide multiple-scale perspectives, which are possible because of a unified protocol and sampling design among the participating states. Such a large-scale and long-term project would not be affordable if the survey relied solely on professional biologists. Indeed, the monitoring programs after which the survey is modeled, the Wisconsin Frog and Toad Survey (created in 1981) and the continent-wide Breeding Bird Survey (created in 1966), have provided crucial conservation data over several decades—and are possible only because of the contributions of volunteers. Thus a citizen-science approach is more than just natural history education; it makes possible a category of scientific data that would otherwise be out of reach. ☾

Linda Weir *coordinates the North American Amphibian Monitoring Program, housed at the U.S. Geological Survey's Patuxent Wildlife Research Center (12100 Beech Forest Rd., Laurel, MD 20708-4038; naamp@usgs.gov; www.pwrc.usgs.gov/naamp).*

ISAAC CHELLMAN

BIRDS IN FORESTED LANDSCAPES

The Cornell Lab of Ornithology monitors woodpeckers, warblers, and other woodland flyers



by Rick Bonney

BIRDS IN FORESTED LANDSCAPES is a continent-wide study of the size and structure of forest patches and the likelihood that these patches will contain breeding populations of various bird species. Birders—both amateur and professional—gather the information that makes this study possible. Findings are used to help land managers develop effective forest management strategies. Designed and managed by the Cornell Lab of Ornithology in partnership with the USDA Forest Service, Birds in Forested Landscapes currently is focusing on 48 species including several of high conservation concern, such as the prothonotary warbler of the southeastern United States, whose population has declined 32% over the last 30 years; the Canada warbler of coniferous northeastern North America, which has declined 40%; Lewis's woodpecker of the cool western mountains, which has dropped by 50%; and the oak titmouse of California's dry oak habitats, down 33%.

Criteria used to determine target species for the study are based on guidelines established by Partners in Flight, a huge coalition of public and private agencies working to protect birds and their habitats. The criteria include the size of a species' overall range, its abundance throughout its

scarlet tanager, pen-and-ink by D. D. Tyler

PHOTO: Like these birders, project participants scour the canopy for woodland flyers. By playing "mob calls"—recordings of birds flocking and squawking—volunteers can lure, identify, and count breeding pairs.

range, and threats to its breeding and wintering grounds. While 13 of the study species including the four mentioned above are declining in numbers, "high conservation concern" is not always synonymous with population decline. For example, while populations of the red-faced warbler currently are stable, the species occurs only in limited areas of the Southwest, so its status must be carefully monitored and its habitat needs clearly understood, in case it does begin to decline. "A major goal of [Birds in Forested Landscapes] is to give conservationists and land managers information that will help them sustain stable populations," explains Ken Rosenberg, director of conservation science at the Cornell Lab of Ornithology and northeast regional coordinator for Partners in Flight.

Project participants select at least one forest study site and survey the area two times during the breeding season. Following a standardized protocol, they play recordings of "mob calls"—that is, calls of birds flocking and squawking in response to approaching predators—that are designed to lure in birds. This procedure allows participants to locate target species and to determine if they are breeding in the area. Participants also record information about the habitat characteristics of the study site. Data can be submitted either on paper forms or online.

Birds in Forested Landscapes is one of the Cornell Lab of Ornithology's more challenging projects, but birders of all levels are welcome to participate. Says lab biologist Jim Lowe: "Because you're working with a limited number of species, you don't have to be an expert. In most places, people have one, two, or maybe three species they need to identify. If they can't identify the birds at the start, they can take our training tape and their field guides, and they can practice and learn just those few."

The habitat description procedure for Birds in Forested Landscapes is more challenging, because it involves procuring accurate maps or aerial photographs, measuring habitat patches, and measuring the distance to the next closest forest. But help is available to all who ask. "We start by giving participants a list of site coordinators, many of whom are employees of land management agencies and who have access to accurate maps or GIS mapping systems," says project coordinator Sara Barker.

Birds in Forested Landscapes picks up where Project Tanager, one of the Cornell Lab of Ornithology's inaugural citizen science projects, left off. That project focused on the four species of North American tanagers including the brilliantly colored scarlet tanager. Between 1993 and 1996, more than 1,500 groups of volunteers combed nearly 3,000 forest tracts across the United States and Canada to locate tanager breeding pairs and document their habitat. The project resulted in a landmark publication, "Improving Habitat for Scarlet Tanagers and Other Forest-Interior Birds," which contains guidelines helpful to managers of forests of all types and sizes (see http://birds.cornell.edu/conservation/tanager/).

Rosenberg says that data from Birds in Forested Landscapes also will be translated into conservation guidelines. "We'll recommend the minimum size habitat block needed to maintain forest birds, and how close the forest blocks should be. We may also make habitat recommendations—what kind of trees are required for nest sites, how tall the trees should be, and how smaller woodlots can be made suitable for forest birds." ☾

Rick Bonney *looks for scarlet tanagers and other woodland birds from his home high on a remote hilltop in Van Etten, New York.* ✍ *For more information on Birds in Forested Landscapes, contact the Cornell Lab of Ornithology (159 Sapsucker Woods Road, Ithaca, NY 14850; 800-843-2473; outside the U.S. 607-254-2473; forest_birds@cornell.edu; http://birds.cornell.edu/bfl/).*

JOSHUA BROWN

A CITIZEN SCIENCE SAMPLER

...on the World Wide Web

VOLUNTEERS HAVE BEEN RECORDING the weather, counting birds, measuring trees, and monitoring streams for more than a century. In the past decade, however, the number and diversity of citizen monitoring programs increased dramatically with the growing need for broad data on the environmental impacts of human activity and climate change. Here are a few samples—new and old.

National Weather Service Cooperative Observing Program

➤ www.nws.noaa.gov/om/coop/index.htm

For more than 100 years, the National Weather Service has relied on volunteers (now more than 11,000) for daily updates on local meteorological conditions to support weather forecasts and research.

Christmas Bird Count

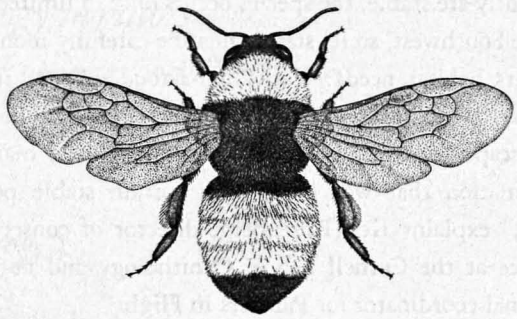
➤ http://birdsource.cornell.edu/cbc

Started on Christmas Day in 1900, the "CBC" is the world's largest bird survey. More than 45,000 volunteers participate each year in this all-day census of early-winter bird populations; their results are compiled into the longest running database in ornithology.

North American Bird Banding Program

➤ www.pwrc.usgs.gov/bbl

Since 1923, this program has been jointly administered by the U.S. Department of the Interior and the Canadian Wildlife Service. Trained amateurs and professional ornithologists band more than one million birds each year in North America and report about 65,000 band observations. This data—submitted to the Bird Banding Laboratory at the Patuxent Wildlife Research Center—is crucial in long-term ecological research and for setting hunting limits.



©DIANA DEE TYLER

American Littoral Society Fish Tagging program

➤ www.americanlittoralsoc.org/tag.htm

Since 1965, saltwater anglers have tagged and released marine fish. Tag return data are transferred to the National Marine Fisheries Service Laboratory each year and are used to study fish migration and growth, and for habitat protection planning. Membership is $25 for an individual or family and $30 for a fishing club.

The North American Breeding Bird Survey

➤ www.mp2-pwrc.usgs.gov/bbs

The "BBS" was initiated in 1966 to monitor the status of breeding bird populations across North America. This roadside survey program—run by the United States Geological Survey's Patuxent Wildlife Research Center—has more than 4,100 permanent active routes which are surveyed each summer by skilled amateur birders and professional biologists. These data are widely used by researchers and government agencies.

Wildlife Corridor Mapping Project

➤ www.vermontel.net/~vinstfs/wcmp.htm

➤ www.vinsweb.org

A Vermont Institute of Natural Science survey of possible wildlife corridors in the northern Taconic Mountains of Vermont, Massachusetts, and New York looks for the travel routes of moose, black bears, fishers, gray foxes, and bobcats. Recent sightings of live or road-killed animals, historical records, and tracking data will yield corridor maps for local planners and conservation scientists.

bumble bee, pen-and-ink by D. D. Tyler

FrogWatch Canada

➤ www.cnf.ca/frog/index.html

Frogs are particularly sensitive to changes in natural ecosystems making them an important indicator species. Their numbers have been declining worldwide since the 1980s; the Committee on the Status of Endangered Wildlife in Canada currently lists three populations of frogs as endangered, and six others as threatened or of special concern. Citizen monitors help scientists gather population trend data.

FrogWatch USA

➤ www.frogwatch.org

FrogWatch uses three-minute nighttime counts to record the presence of calling frogs and toad breeding sites. Registration and data entry occur online. Families are encouraged to participate.

National Butterfly Counts

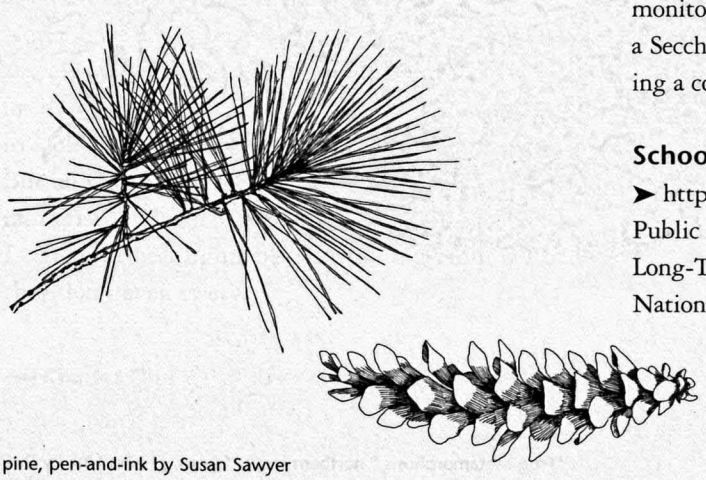
➤ www.naba.org/4July.html

North American Butterfly Association volunteers select a count area with a 15-mile diameter and conduct a one-day census of all butterflies sighted within that circle. The counts are held in the few weeks before or after July 4 in the U.S., July 1 in Canada, and September 16 in Mexico.

Environment Canada

➤ www.ec.gc.ca/science/sandenov99/relate6_e.html

Environment Canada uses standard methods for collecting and analyzing data from its numerous citizen initiatives including: climate and severe weather watches; marine debris research; Treewatch, Plantwatch, Wormwatch, and Lichenwatch; a bird migration monitoring network; and even the Doo Doo Festival which has volunteers searching for sources of fecal coliform bacteria.



white pine, pen-and-ink by Susan Sawyer

Minnesota Worm Watch

➤ www.nrri.umn.edu/worms

Exotic earthworms are damaging forests throughout the upper Midwest. Student volunteers in Minnesota Worm Watch are tracking the invaders and submitting data on the Web for University of Minnesota scientists.

Bumble Boosters

➤ http://bumbleboosters.unl.edu

Twelve public schools in Nebraska are collecting data on bumblebee distribution and abundance in collaboration with the University of Nebraska Department of Entomology.

Forest Watch

➤ www.forestwatch.sr.unh.edu

Forest Watch includes over 100 schools and study plots across New England, allowing University of New Hampshire researchers to assess the impact of air pollution on white pine health. Student data are compared to UNH spectral data, and these two data sets are compared to tropospheric ozone data collected from state and Environmental Protection Agency air quality monitoring sites.

GLOBE

➤ www.globe.gov

Nearly 7,000 schools around the world collect data on the atmosphere, hydrology, soil patterns, and land cover through the Global Learning and Observation to Benefit the Environment (GLOBE) program.

Great American Secchi Dip-In

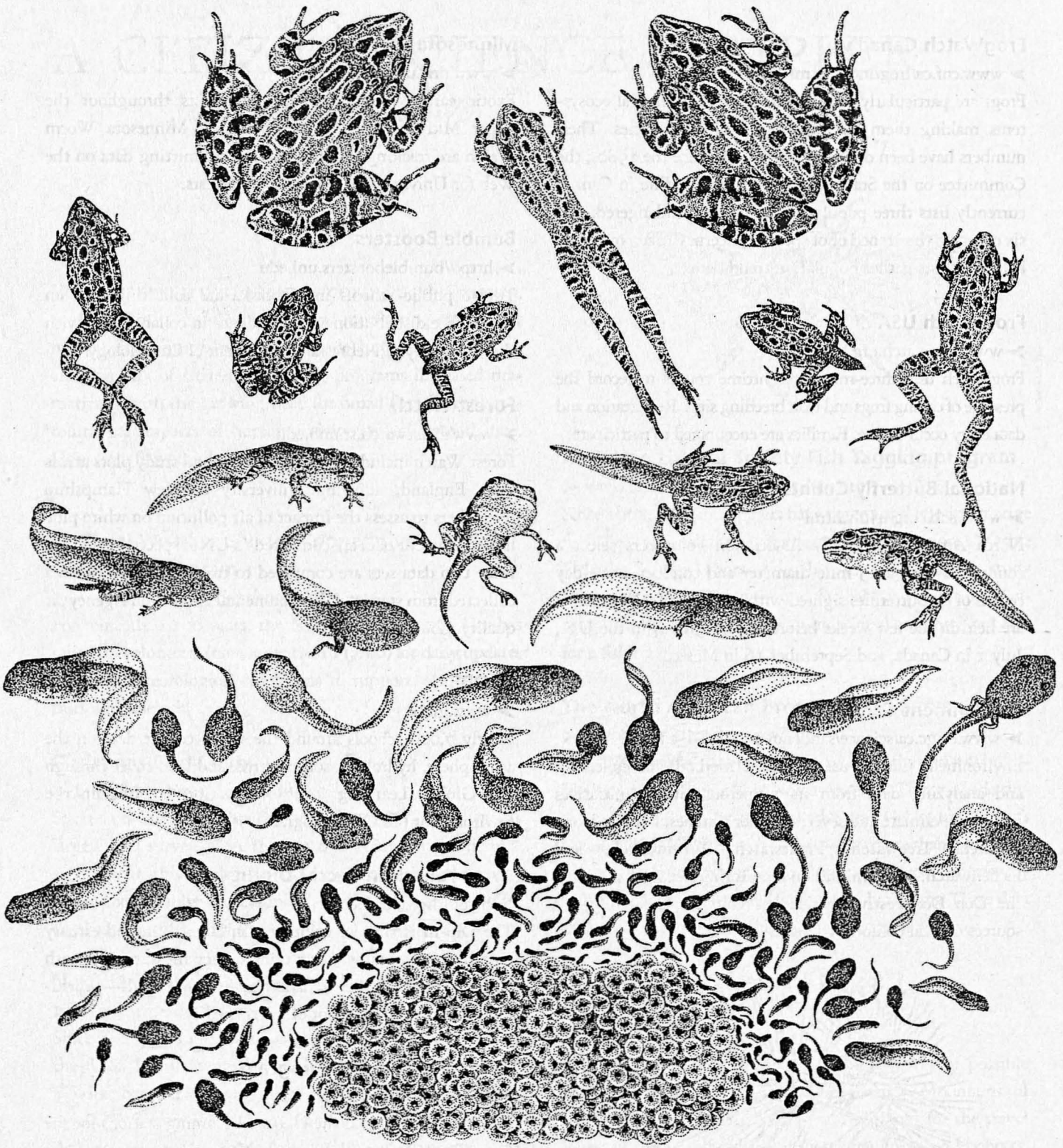
➤ http://dipin.kent.edu

The Dip-In is simple: volunteers in lake, river, and estuary monitoring programs take a transparency measurement with a Secchi disk on either Canada Day or July Fourth—providing a continental snapshot of water quality.

Schoolyard Ecology program

➤ http://schoolyard.lternet.edu

Public schools around the U.S. are becoming stations for the Long-Term Ecological Research Network, a project of the National Science Foundation.



"Frog Metamorphosis," northern leopard frogs, pen-and-ink by D. D. Tyler

A Hard Frost Softens the Look of Things

A hard frost softens the look of things
(fields like cloud gardens)
but a hard frost is hard.
Leaves fall all over each other
trying to get out of the way.
Under them
spring peepers' hearts have
stopped.
They have frozen
not to death
but to elude death
and come back peeping
in the spring.

~ Elizabeth Caffrey

Western Toad

Who loves the ugly things of the world?
Who loves the cuttlefish
or the slime mold, the warthog
or the creatures that live in our nose?
Who loves the toad? I mean, this toad
crossing the midnight road
like a swimmer.
It has eyes cowled like headlights
Popeye forearms and
skin that sags.
It could be a burp from a tuba
or an evolutionary bad mood.
Now I have a mother who loves me
and always will, and I once stood in line
for over two hours
to look at a panda.
But on nights like this
rain misting down
I watch car headlights bear down Frog Hollow Road
they don't even swerve.

~ Charles Finn

How Frogs Practice Silence

I wish I knew the determinate tone
That chooses, or selects, that sudden quiet.
How the chorus quits, en masse,
As if a leafy baton had fallen.

Is there a chord, or lilt, or lift of key,
That signifies to the pond community
A hush in unison.

I wish I knew when to be silent.

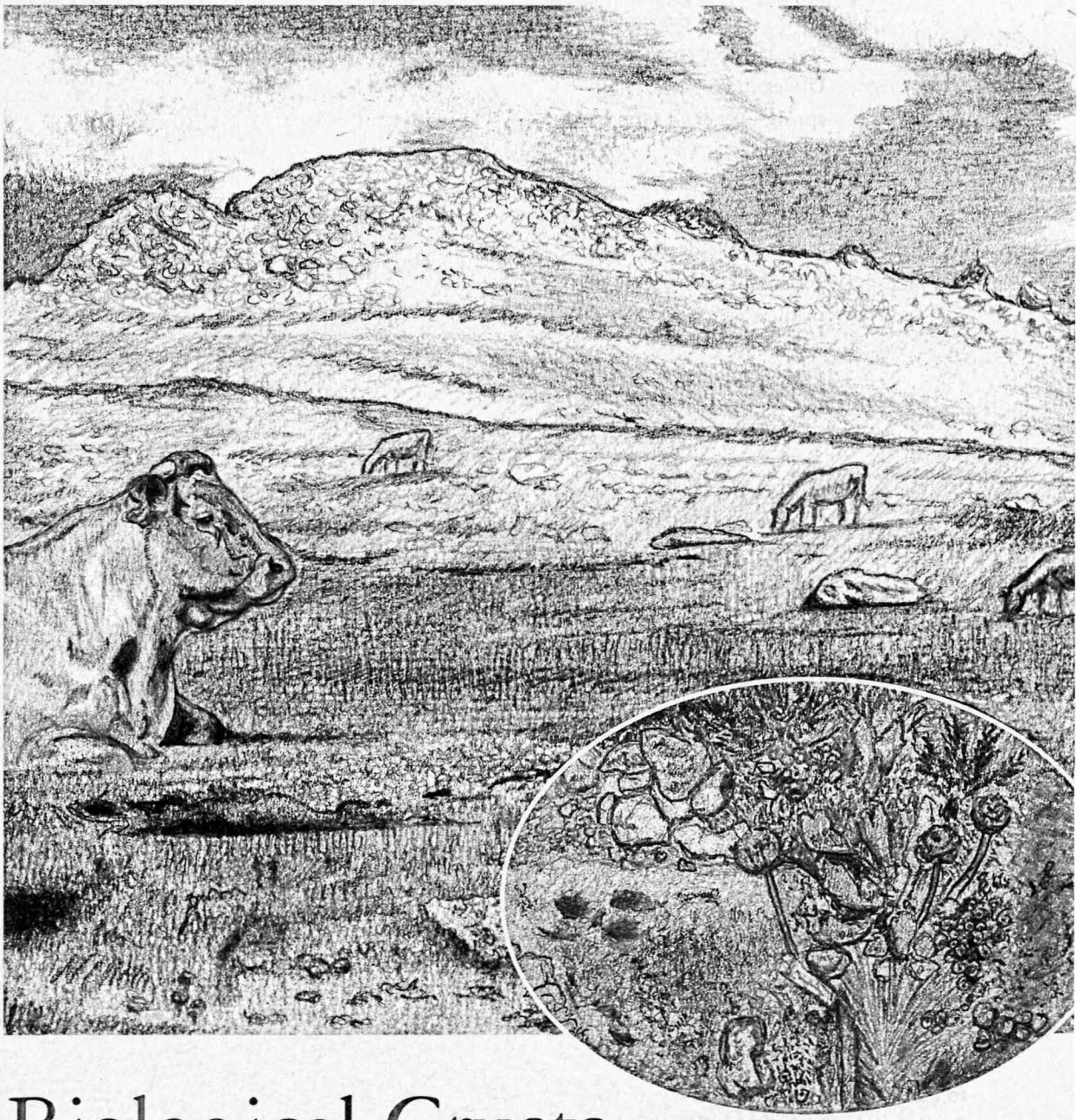
Could hear the moment before the saying,
And leave it so.

Then recommence in counterpoint,
A ratcheting, a rattling, a declension upscale
And down, but in place, and in tune,
With my fellows.

~ Judyth Hill

This poem also appears in Black Hollyhock, First Light, *by Judyth Hill (©2001), La Alameda Press, Albuquerque, NM.*

The Soil's Living Surface:



Biological Crusts

by George Wuerthner

graphite by Darren Burkey

THE PLANTS MOST PEOPLE THINK OF as characteristic of the arid West are the large, vascular types, such as sagebrush, rabbitbrush, bitterbrush, various grasses, cacti, and juniper. Few people are aware of one of the most important groups of plants found on arid lands: biological soil crusts. These are assemblages of tiny—often individually microscopic—organisms such as cyanobacteria, green algae, fungi, lichens, and mosses, living on or just beneath the soil surface, in the spaces between the larger, more prominent vegetation. While inconspicuous, biological crusts are critical to the productivity of many arid ecosystems, and in some places account for 70% of the living plant cover on soils.

Unfortunately, the value of biological crusts has been unnoticed or ignored by many people, including most range managers and livestock grazing proponents. Traditionally, the impact of livestock grazing on vascular plants has been the only concern in evaluations of rangeland health. Yet recent research suggests that even if vascular plant communities are not affected in any detectable way by livestock, there can be significant differences between grazed and ungrazed sites in the proportion of ground covered by biological crust. Over time, livestock damage to biological crusts can lead to declining health of the entire ecological system—from diminished water-holding capacity of the soil and increased soil erosion to less-favorable nutrient flows and greater vulnerability to invasion by exotic plants.

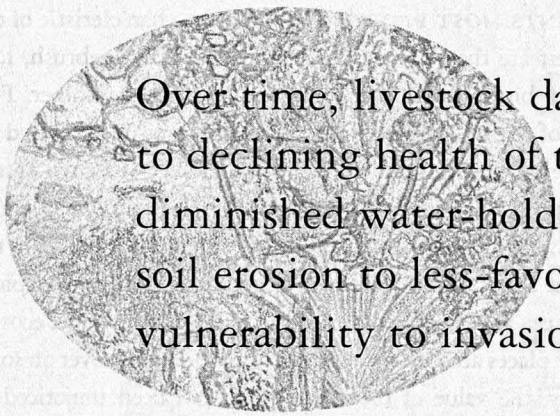
Biological crusts as part of arid ecosystems

Biological crusts, perhaps in keeping with their rather hidden nature, are known by many terms, including microbiotic crusts, cryptogamic crusts, or cryptobiotic crusts. They are particularly important components of the arid ecosystems in the Great Basin, Colorado Plateau, and deserts of the Southwest, although they can be found in rangeland ecosystems from alpine areas to the Great Plains. Biological crusts are native elements of most western public lands. As a group they are amazingly diverse, and often account for a far greater number of species than the vascular plants with which they are associated. For example, in southern Idaho, botanist Roger Rosentreter found 16 vascular plant species and 39 biological soil crust species in 140 plots placed throughout the rangeland plant community.

Biological crusts help to hold the soil surface together, and hence reduce soil erosion from wind and water. They play a key role in reducing the impact of raindrops; on unprotected soils (lacking biological crusts), heavy rain breaks up soil aggregates, which leads to the clogging of soil pores and reduces water infiltration rates, sometimes by as much as 90%.

The crusts also create small-scale roughness or depressions in the surface of the soil that catch water, allowing it to infiltrate and reducing sheet

This article is excerpted from the forthcoming book Welfare Ranching: The Subsidized Destruction of the American West, *edited by George Wuerthner and Mollie Matteson (©2002 by the Foundation for Deep Ecology, all rights reserved), and is used by permission of the Foundation for Deep Ecology and the author. To order the book, call Island Press at 800-828-1302 or visit www.islandpress.org.*



Over time, livestock damage to biological crusts can lead to declining health of the entire ecological system—from diminished water-holding capacity of the soil and increased soil erosion to less-favorable nutrient flows and greater vulnerability to invasion by exotic plants.

erosion. Some biological crusts have micro-filaments that weave soil particles together, again anchoring the soil against erosion. In addition, soil crusts act as mulch, reducing evaporative water losses.

Some biological crusts capture and fix atmospheric nitrogen, and all of them can contribute to carbon fixation, providing an important source of carbon for microbial soil populations. Since nitrogen and carbon are both limiting factors in arid environments, maintaining normal nitrogen cycles and carbon deposition is critical to soil fertility and prevention of desertification. Vascular plants growing in soils with intact biological crusts have been found to have a higher concentration of nitrogen than plants growing in soils lacking such crusts.

By occupying the spaces between perennial plants, biological crusts also prevent the establishment and spread of exotic weeds. Most native perennials found in North American deserts tend to have seeds with self-burial mechanisms, or that are cached by rodents—this ensures they will be covered by soil or plant litter and will be able to germinate. However, the seeds of most exotic species, such as cheatgrass, do not use these strategies; rather, they germinate on the soil surface. Where biological crusts are intact, seeds of exotics generally fail to germinate successfully. Indeed, the loss of crusts in the bunchgrass communities of the Intermountain West may be largely responsible for the widespread establishment of cheatgrass and other exotic annuals.

Another unexpected positive aspect of intact biological crusts is their role in creating favorable microclimates. Most biological crusts are dark, and can raise temperatures as much as 23° Fahrenheit above that of adjacent surfaces. Heightening soil temperatures can increase nutrient uptake and speed seed germination, photosynthetic rates, and nitrogenase activity for associated vascular plants. Foraging time of ants, arthropods, reptiles, and small mammals is also affected by temperature. Higher temperatures may be critical in many desert environments since soil moisture is typically higher during the cooler fall, winter, and spring months, and biological activity may be dependent on favorable soil temperature and moisture. When the dark-colored crusts are eliminated, the result can be lowered biological activity, with green-up pushed back to later in the spring and early summer. This can negatively affect vascular plants, since they are usually limited by soil moisture, and soils generally dry out as the season progresses into the warmer months.

Finally, biological crusts play a role in moderating fire frequency and intensity. Native plants in the most arid parts of the West are naturally widely spaced, and fires usually do not carry far due to the discontinuous and patchy distribution of fuels. By inhabiting the open spaces between the larger plants, the crusts impede the establishment of exotics such as cheatgrass, which allow fires to carry farther, and increase fire frequency. So long as the crusts help maintain these mini-firebreaks, fires are slowed, and intensity decreased. Furthermore, under low-intensity blazes, soil crusts remain intact, limiting potential erosion that can occur in the aftermath of a fire.

Effects of livestock production

Various human activities can damage biological crusts, including use of off-road vehicles and even hiking. However, no human activity is as ubiquitous on western public lands as livestock grazing.

Domestic cattle and sheep damage biological crusts primarily by trampling them. Except perhaps at the lightest stocking rates, the presence of livestock results in broken, degraded crusts. Livestock also tend to compact soils by walking on them repeatedly. Compaction can lead to changes in

soil moisture and nutrient flow, which in turn can alter the species make-up of crusts. These changes may occur before differences in biological crust cover are apparent at the macroscopic level.

Soil crusts need moisture for growth and reproduction. Livestock grazing in the spring, just prior to the beginning of hot, dry periods, limits opportunity for regrowth of crusts. The net effect of the loss of biological crusts is magnified in areas where high-intensity summer thunderstorms occur; heavy rains on unprotected soil surfaces lead to significant erosion. Livestock grazing in summer and fall is also detrimental since biological crusts are particularly susceptible to breakage and fragmentation when dry. Spring, summer, and fall are the primary seasons for livestock grazing on public lands.

Full recovery of badly trampled biological crusts typically requires more than a few years. Since most public rangelands are not allowed more than a season or two of rest, even under the best rest-rotation management plans, complete recovery is precluded under any livestock grazing regime. It is important to understand that biological crusts occur most prominently in ecosystems that did not evolve with large herds of grazing ungulates. Along with the grasses native to such areas as the Great Basin, Colorado Plateau, Mojave, Chihuahuan, and Sonoran deserts, the biological crusts lack adaptations to the frequent presence of big-bodied herbivores—making them particularly vulnerable to damage from grazing livestock.

Summary

The presence of livestock on soils with biological crusts contributes to lower productivity of western lands, accelerated invasion of exotics (particularly cheatgrass), changes in fire regime, changes in soil structure, reduction in water infiltration, higher soil erosion from wind and rain, and changes in energy pathways. These negative effects are nearly unavoidable when livestock are present, and thus the policy of allowing livestock grazing on public lands is in direct conflict with goals such as maintaining healthy ecosystems and limiting the occurrence of costly and ecologically damaging cheatgrass-fueled fires. ☾

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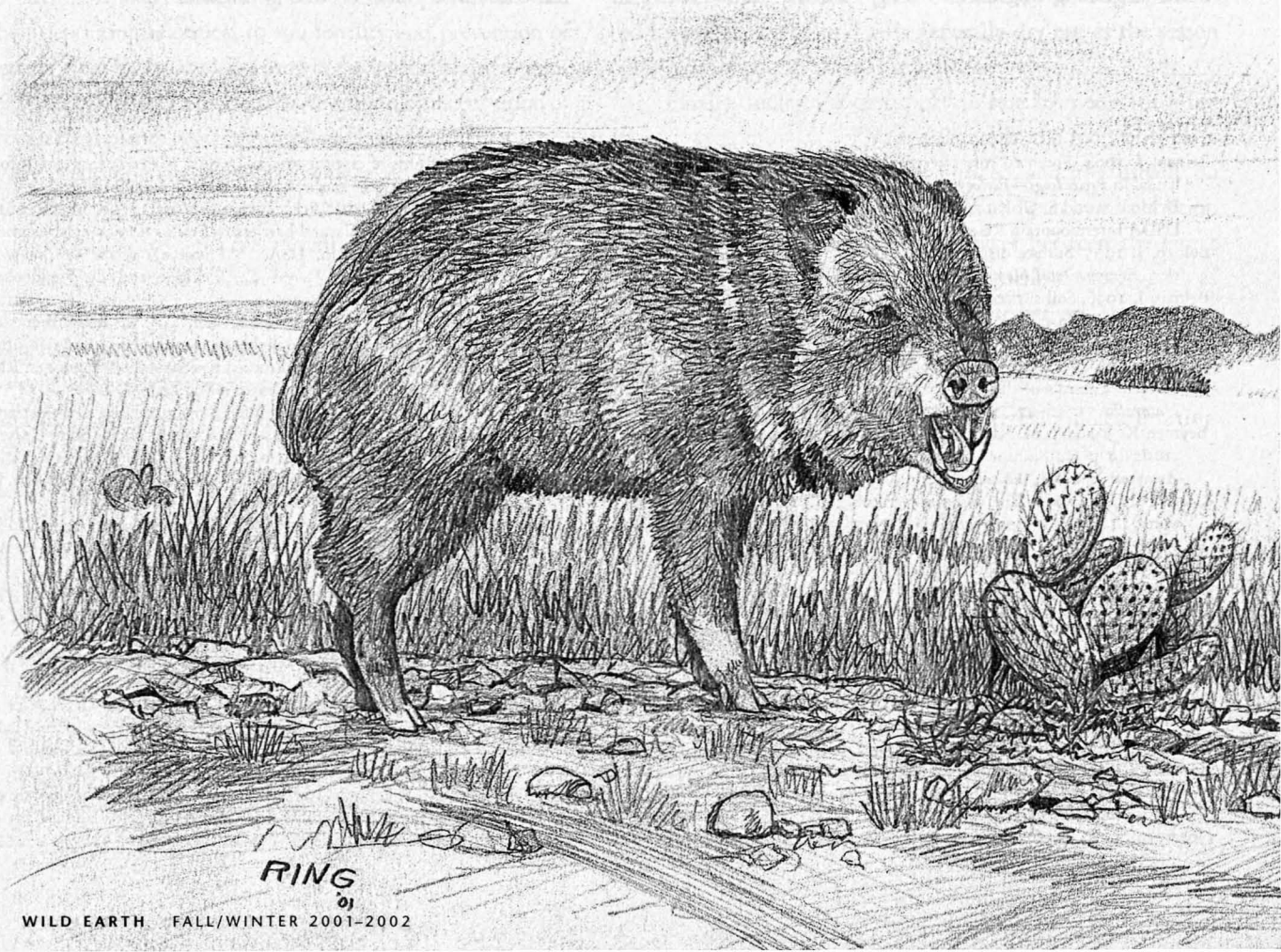
THE GRASSLAND ECOSYSTEM of the greater Sky Islands region of Arizona and New Mexico has been shattered, with healthy grasslands now existing mostly as isolated patches and fragments. Including these grasslands in a proposed wildlands network for the Sky Islands region holds the potential to protect and restore them. Spearheaded by the Wildlands Project, the conservation plan focuses on restoring native wildlife, particularly large carnivores and ungulates, and on protecting forest, woodland, and riparian ecosystems (Foreman et al. 2000a, 2000b). My purpose is to draw attention to the importance of the region's imperiled grasslands and propose including them as part of the wildlands network. I focus by way of example on desert grasslands of southeastern Arizona.

Desert grasslands

Desert grasslands occupy valley basins and some foothill and highland areas of the Sky Islands region. Positioned between desert scrub at lower elevations and evergreen oak or juniper woodland in the mountains, they originally occupied about half of southeastern Arizona (Bahre 1995) (see map page 58).

Compared with other types of grasslands in the United States, desert grasslands generally have greater diversity of grass species, more spacing between plants, and greater shifts over time in the composition and structure of the biotic community (McClaran and Van Devender 1995; Bock and Bock 2000). These shifts, as reflected by the relative prevalence of grasses, shrubs (mesquite, acacia, soaptree yucca, euphedra, etc.), and succulents (cacti and rosette plants), stem from variable patterns of wildfire frequency, precipitation, and feeding and burrowing activity of ants, kangaroo rats, desert cottontails, and other animals.

The desert grassland is the evolutionary theater for many warm-season grasses such as tobosa, black grama, and Arizona cottontop. Animal species whose evolution also appears tied to the desert grassland include scaled quail, Baird's sparrow, desert box turtle, Mexican hognose snake, western hooknose snake, desert kingsnake, desert grassland whiptail, southwestern earless lizard, western green toad, Chihuahuan pronghorn,



and Arizona prairie dog. Examples of other open-country wildlife that characterize desert grasslands of the greater Sky Island region are black-tailed jackrabbit, bannertail kangaroo rat, kit fox, coyote, badger, desert mule deer, collared peccary, Swainson's hawk, northern harrier, roadrunner, lark bunting, and Mojave rattlesnake.

A vanishing ecosystem

Comparatively open and intact grasslands in southeastern Arizona occupy only about a quarter of their former range (see map). The main reasons for grassland decline are:

LIVESTOCK GRAZING. The protean nature of the desert grassland community makes it especially vulnerable to desertification and conversion to shrubland. Overgrazing combined with elimination of natural wildfires has converted much grassland to shrubland (Dick-Peddie 1993; Brown 1994). The ecology of this conversion is complex: as livestock remove grass cover, the grassland's ability to carry fire, which controls shrub growth, is reduced or eliminated. That, combined with fire suppression, allows shrubs like mesquite and juniper to spread and grow to a point where they become resistant to all but the hottest wildfire. As they begin to dominate the plant community, shrubs outcompete grasses for moisture and space. In some areas, overgrazing results not only in the loss of soil-binding grasses, but also in fundamental changes in soil chemistry (Schlesinger et al. 1990). These impacts force an ecological shift to desert-like conditions, supporting mostly "survivalist" plants such as mesquite, creosote bush, tarbush, acacia, and snakeweed.

LAND DEVELOPMENT. Agriculture and urbanization driven by human population growth are eliminating some of the region's best remaining grasslands. Rural Santa Cruz, Graham, and Cochise counties, which house most of southeastern Arizona's grasslands, are projected to increase by some 35,000 people over the next 10 years (based on Arizona Department of Economic Security data, Phoenix). That, combined with metastasizing growth from Phoenix and Tucson into eastern Pinal and Pima counties, can be expected to further eliminate grasslands bordering the Sonoran desert.

Toward Grassland Recovery in the Sky Islands Region

by Tony Povilitis

collared peccary (javelina), graphite by Martin Ring

EXOTIC PLANTS. Grasslands, especially those that are overgrazed, are invaded by competing nonnative plants. Some invasive plants were intentionally introduced into Arizona by the Soil Conservation Service in the 1930s for erosion control and livestock forage. Chief among these is Lehmann's lovegrass, a native of southern Africa, now the dominant plant in many areas, often occurring in pure stands. It is more resistant to grazing than most native grasses (Bock and Bock 2000).

Grasslands are key to the wildlands network

Loss of desert grasslands will make it impossible to restore some endangered wildlife such as aplomado falcon and Arizona prairie dog to the greater Sky Island region (populations of these species still survive in northern Mexico). Moreover, without restoration of the grassland ecosystem, pronghorn, desert bighorn sheep, and black-tailed prairie dog—focal species for the Sky Islands Wildlands Network

(Foreman et al. 2000b)—face a dim future. All three depend on large areas of open, grass-dominated country. Other species whose existence in the region could be jeopardized by continued loss of grasslands include mountain plover, burrowing owl, short-eared owl, ferruginous hawk, loggerhead shrike, grasshopper sparrow, Baird's sparrow, and plains leopard frog.

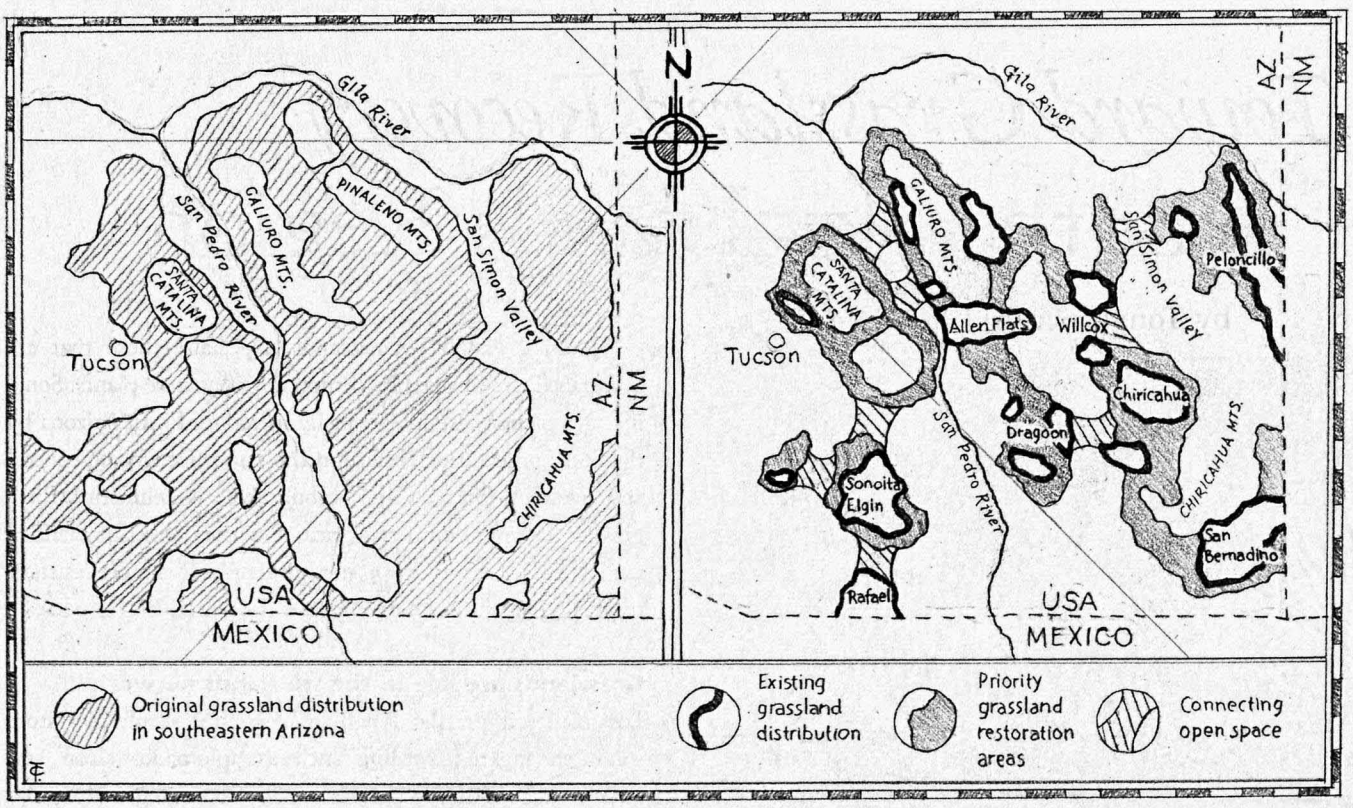
Desert grasslands are also important to many species that we typically associate with mountain and canyon habitats, including all of the large carnivores mentioned in the proposed Sky Islands Wildlands Network. Mexican wolf, grizzly bear, black bear, jaguar, and mountain lion need grassland hills, washes, and plains as dispersal corridors and as protective open-space areas surrounding their primary habitat.

With significant grassland additions, many of the proposed wildlife movement corridors and habitat core areas could better sustain both large carnivores and ungulates (Povilitis 1995). The integrity of some wildland core areas, such as that proposed for the Chiricahua Mountains (Foreman et al. 2000a, 2000b), would be severely compromised without a surrounding grassland or desert "buffer." We have already seen how the impacts of development from adjacent Tucson into the Santa Catalina Mountains have virtually eliminated a once thriving herd of desert bighorn sheep (Olding, pers. com.).

Finally, the Sky Island region's largest species—elk and bison—are grass-eating ungulates dependent, at least seasonally, on expansive grasslands. With desert grassland conservation, elk and bison could eventually return to the borderlands area of Arizona, New Mexico, and Mexico, once home to Merriam's elk (an extinct subspecies of elk endemic to the Southwest) (Matthiessen 1959; Hall 1981) and probably bison (Parmenter and Van Devender 1995).

Conservation proposal

I suggest that two large grassland areas of southeastern Arizona, the Chiricahua and San Bernadino, be considered priority conservation areas for the Sky Islands Wildlands Network. The former, a very scenic grassland just east of the Chiricahua Mountains, is hauntingly vulnerable to land sub-



LEFT: Historical distribution of grasslands in southeastern Arizona, based on Brown and Lowe (1980).
RIGHT: A grassland conservation proposal for southeastern Arizona. The areas referred to as "connecting open space" are desert scrub or woodland habitat, or grassland areas threatened by sprawl; conservation planning is needed to maintain their wildlife linkage function. Current distribution of grasslands based on Povilitis and Welsh (1999).

map by Todd Cummings

division and development. The latter, home to an important herd of Chihuahuan pronghorn, connects wildlands in New Mexico and Mexico with the Chiricahua Range.

Other important grasslands that could be included in the wildlands network are Allen Flats, Willcox, and Dragoon. In addition to providing ecological linkages between mountain ranges, these areas could potentially be reconnected as part of a restored grassland complex for southeastern Arizona (see map).

Several other important grasslands are already included in the proposed wildlands plan (Foreman et al. 2000a, 2000b) but their conservation status deserves upgrading. For example, all privately owned grasslands in the San Rafael and Sonoita-Elgin areas could be "compatible-use areas." Likewise, remnant grasslands along the Santa Catalina, Rincon, and Galiuro mountain ranges (northeast of Tucson) should be treated as compatible-use areas or study areas. Finally, much of the remote Peloncillo grasslands along the Arizona–New Mexico border could be upgraded to "wilderness core" status.

Clearly, grasslands are fundamental to a wildlands conservation network for the greater Sky Islands region. Conservation planners should include prairie grasslands—such as those occurring in the expansive plains of San Agustin in the Mogollon Highlands area of New Mexico—as well as desert grasslands in their recommendations for priority conservation areas in this diverse and beautiful landscape. ☾

Tony Povilitis *is a wildlife biologist who teaches and conducts field studies in the American West and in the Andes Mountains. In southeastern Arizona, he provides a home for himself, several turtles, and hundreds of endangered Yaqui topminnows.*

Some recommendations to public land agencies and private landowners for grasslands conservation in the Sky Islands region

- Manage grasslands for a mix of native grasses, forbs, and low shrubs (scattered taller shrubs and trees are desirable but should not dominate). This can best be done by restoring natural ecosystem processes.
- Keep grasslands as free as possible of roads and barriers (e.g., certain kinds of fencing that prevent movement of pronghorn), and advocate wildlife overpasses or underpasses for U.S. Interstate 10 (whose heavy day and night traffic splits the Sky Islands region).
- Minimize disturbance to grassland wildlife, especially by reducing road access.
- Control and manage domestic livestock in ways that promote grassland renewal and health.
- Advance grassland conservation through cooperative programs, such as that currently involving The Nature Conservancy, the Bureau of Land Management, and private landowners in the Muleshoe Ranch area near Willcox, Arizona.
- Promote grassland conservation by emphasizing the benefits of wildlife restoration, better livestock management, conservation of ground water (critical to riparian areas and other wetlands), control of urban sprawl, and various educational, scientific, and recreational values of healthy grasslands.

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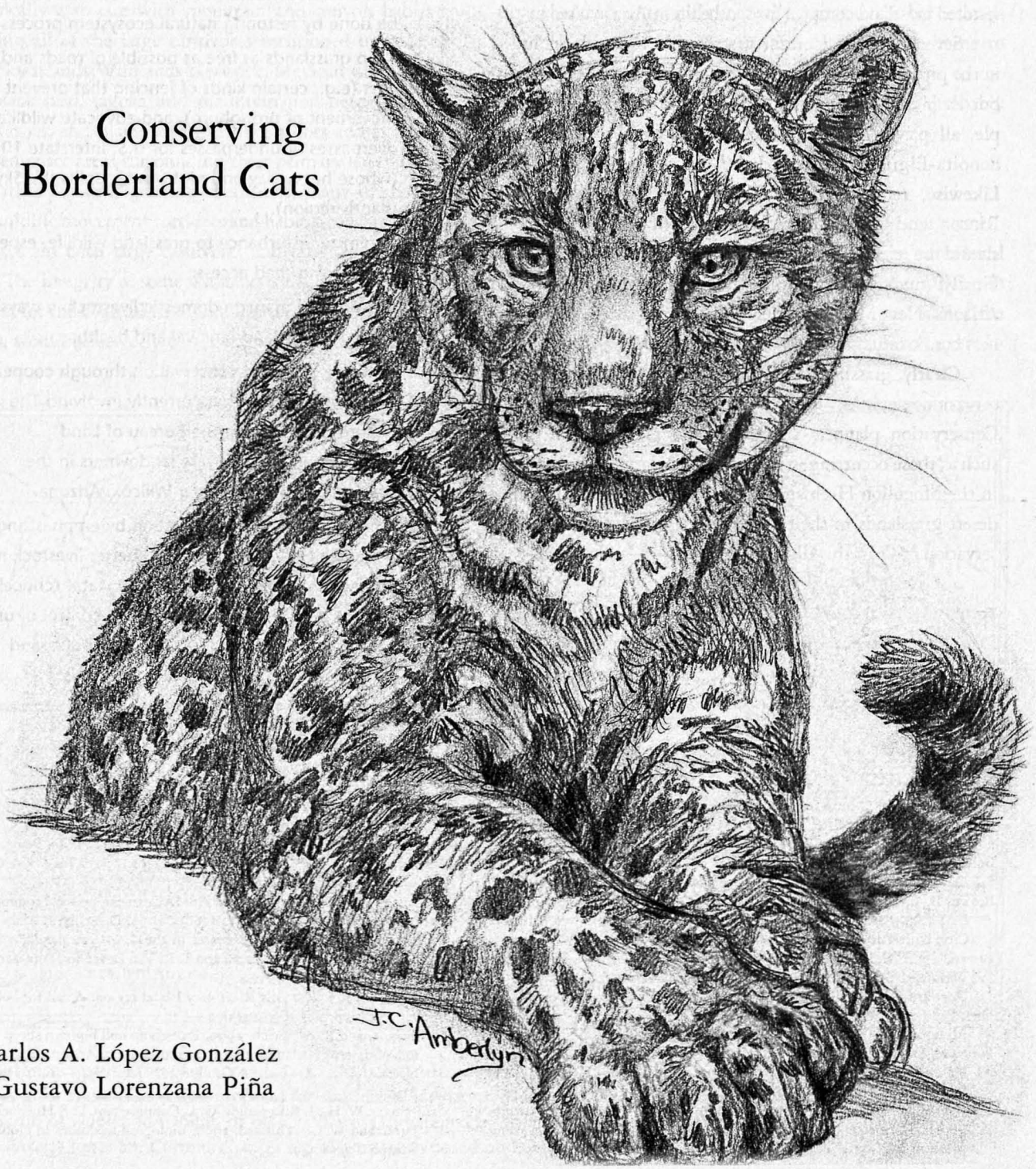
SONORAN JAGUARS

Conserving Borderland Cats



by Carlos A. López González
and Gustavo Lorenzana Piña

jaguar, graphite by J. C. Amberlyn

ONE LATE AFTERNOON in 1998 during a tropical monsoon in the town of Sahuaripa, we sat in the living room of a cowboy's house, while he showed us the skull of a male adult jaguar (*Panthera onca*). We were breathless because this was the first recent proof of a jaguar in the Mexican state of Sonora. It was also the first of many more encounters with dead jaguars as we sought to answer basic questions about conservation of these beleaguered big cats.

Jaguars are considered an endangered species throughout most of their current range; in 1997, they were declared an endangered species within the United States. There is no certainty as to how many jaguars were historically present in the American Southwest, but a declining trend in this population has been observed through the 20th century (Brown and López González 2000); jaguars are now considered extirpated from Arizona and New Mexico.

Distribution and habitat

In the fall of 1997, we began a survey of jaguar populations throughout Sonora, Mexico. Jaguar records from the state are clustered in the lower Sierras of Sonora's eastern portion, apparently in three metapopulations still connected to each other. The approximate jaguar range in Sonora is 70,000 square kilometers (see map next page). Both females and kittens have been observed in this region.

What is the habitat of jaguars? Our first image may be of tropical rainforest such as in the Amazon or Cockscomb Basin, but this is not the only landscape the species will inhabit. In the recent past, jaguars ranged from the mountaintops of the Sky Islands in the American Southwest (Brown and López González, in press) well into the Argentinean Pampas (Perovic, in press; Perovic and Herrán 1998). Further defying the lush jungle image, our study found that most of the jaguars in Sonora (85%) were associated with Sinaloan thornscrub (López González and Brown, in press), while only a few individuals (8%) were associated with tropical deciduous forest. Today, the most northern jaguars in Mexico are living in a mosaic of oak woodlands and Sinaloan thornscrub (see photo 1). Therefore, as we look ahead to the recovery of jaguars in the southwestern United States, we will need to understand how they use an oak woodland and thornscrub mosaic, such as that potentially present in the Peloncillos or the Nogales Mountains in Arizona and New Mexico.

Monster cats

In the southwestern U.S., the myth of monster jaguars lives on. Rare glimpses of jaguars in this region have led people to believe that these animals can weigh as much as 200 pounds (90 kilograms) (O'Connor 1939). As with many other things said about jaguars in the Sky Islands region of Arizona and New Mexico, there is no proof of these tales. Although we have seen many jaguar skins in Sonora, we have never come across a freshly killed animal. Measurements taken from skins and mounted specimens are more like southwestern mountain lions than the huge beasts of local lore. The largest jaguar skin measured from head to the tip of the tail was 7 feet (2.1 meters) (López González, unpubl. data). The only weights confirmed with a scale ranged from 137 pounds to 158 pounds (62 to 71.7 kilograms) for three males and 105 pounds (48 kilograms) for a female in Arizona (Brown and López González, in press). Nevertheless, we have observed that within an area, jaguars are more variable in size than mountain lions.

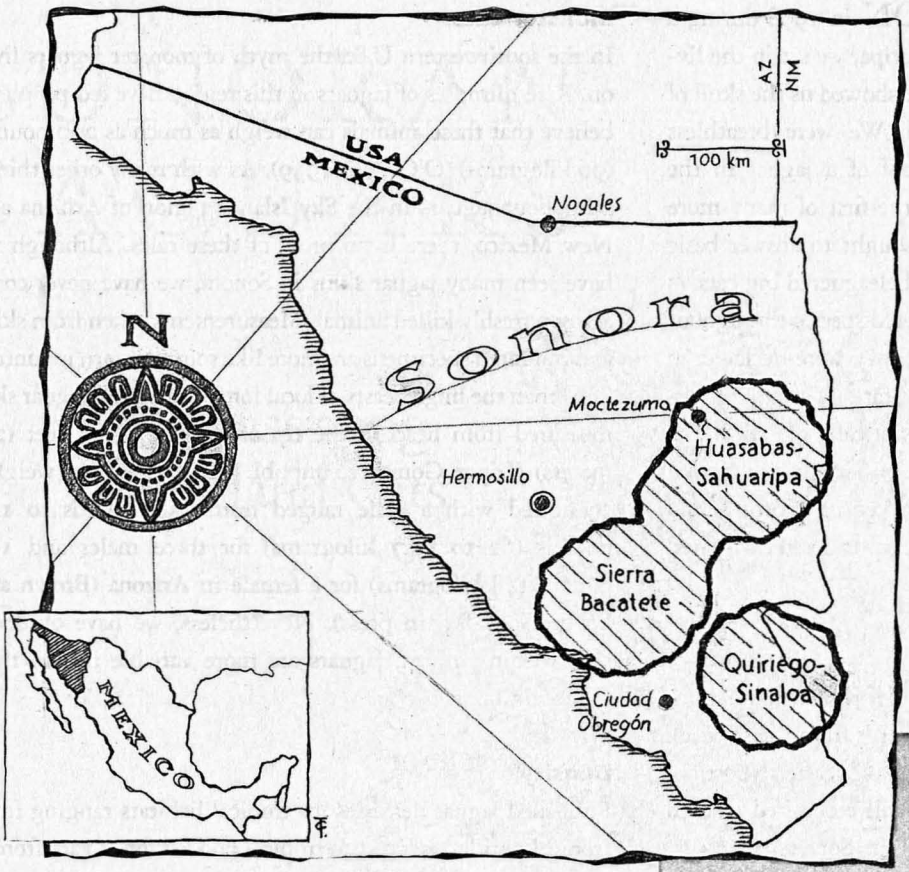
Density

Published jaguar densities for tropical habitats ranging from tropical deciduous forest to tropical flooded forest vary from 3 to 7 jaguars per 100 square kilometers (Nunez et al., in press; Rabinowitz and Nottingham 1986; Crawshaw and Quigley 1991). However, our estimates for northern Sonora using camera trap data (see photo 2) indicate lower densities than studies from tropical forests. Using photographic records per month as a measure of density (and under the assumption that jaguars are using these habitats according to their availability), our data yield between 1.3 and 1.9 jaguars per 100 square kilometers. (These numbers should be taken as preliminary and are not recommended for management purposes.)

Livestock conflicts

We have recorded extensive livestock predation by jaguars, from the southern tip of Sonora to the northern edge of current jaguar range. In some cases, jaguars have a natural prey source—often white-tailed deer and collared peccaries—but cattle are easier to capture, and exist in a more predictable distribution. As a result, some jaguars begin killing cattle,* and females can teach this behavior to their offspring. How livestock are raised compounds the issue. On a typical Sonoran ranch, cows are left on rangeland all year and calves are round-

*In Belize, most jaguars that killed cattle had suffered gunshot wounds that may have impaired their hunting ability.



Shaded areas represent approximate geographic range of jaguar populations in Sonora, Mexico, as of 2001.

PHOTO 1: Oak woodland–Sinaloan thornscrub mosáic found in Huasabas-Sahuaripa region.

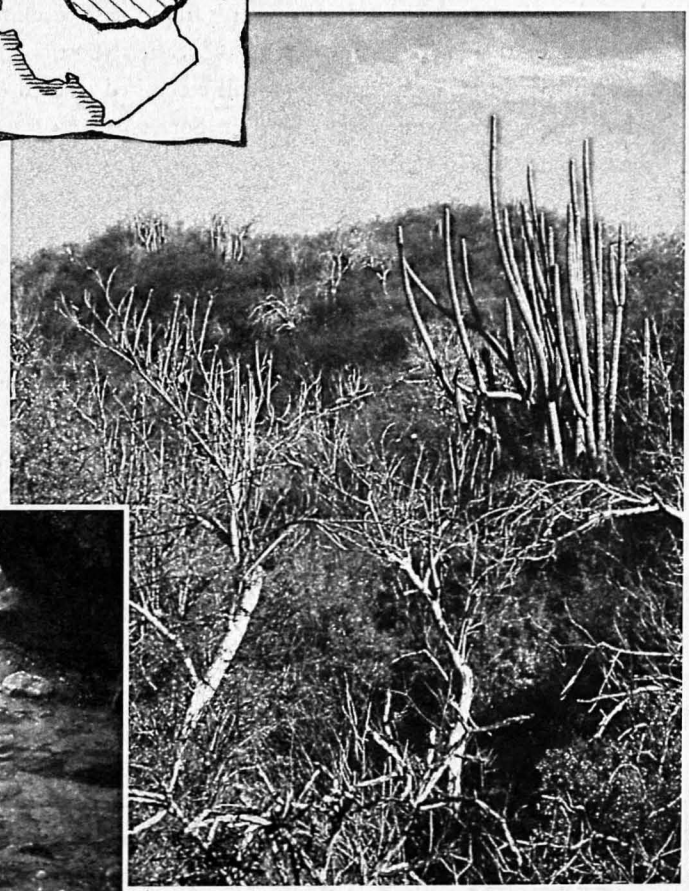
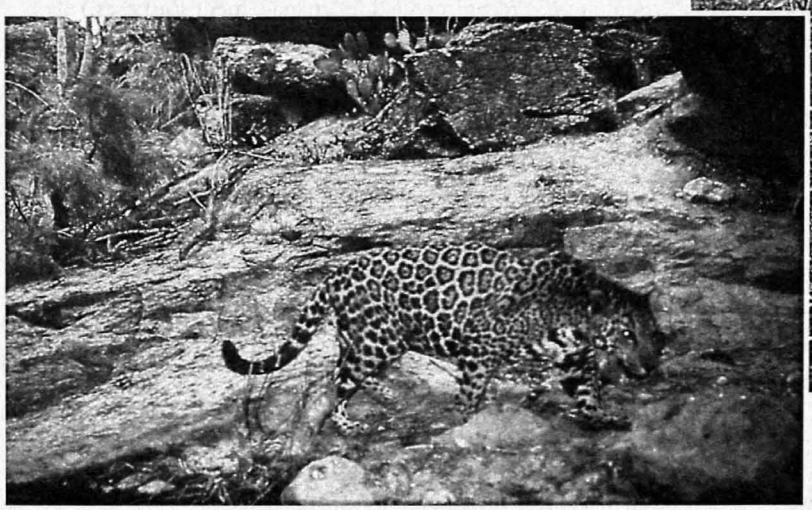


PHOTO 2: Jaguar in the Huasabas-Sahuaripa population, recorded by remote camera.



PHOTOS COURTESY C.A. LÓPEZ GONZÁLEZ

map by Todd Cummings

ed up during the month of December. In this type of cow/calf operation, different age calves are raised together. Additionally, in most ranches there are multiple calving seasons, which allows felids (both jaguars and mountain lions) to have access to different size prey items at any given time. The available calories these cattle represent is impressive: for northern Sonora, we estimated cattle biomass to be between 2,850 and 5,450 kilograms per square kilometer. (As a point of reference, a similar biomass sustains between 6 and 10 tigers [*Panthera tigris*] on 100 square kilometers in Asia; Miquelle et al. 1999.) In short, a significant management issue is dealing with jaguars that become habitual livestock killers.

Ecological extinction of natural prey adds to the challenge of jaguar conservation. Prey are present but in such low numbers that their ecological role is taken by another species (i.e., cattle). And even when natural prey return, cattle remain a meal of choice. Livestock have roamed the wildlands of Sonora for approximately 300 years (Challenger 1998). It appears that 75 jaguar generations are enough to become adapted to this non-native prey item.

Accounts describe jaguars, lions, and wolves as so detrimental that ranching activities had to be suspended in many regions of the Sierras (Montane 1999). In such areas, cattle management decreased and people became dependent on wildlife to provide meat. Because the Sierras of Sonora used to be more settled than they are now, wildlife populations decimated by poaching are, in most instances, recovering.

Livestock predation is still occurring in this region. Cowboys usually find cattle carcasses within two or three days of death (if at all), and when a predator's tracks are in the area, they often assume it was the perpetrator. We have gathered evidence that jaguars do take advantage of an easy meal; two different jaguars make use of cow carcasses for up to two weeks. The attitudes of ranchers, of course, have major implications for successful jaguar recovery.

Protected areas or multiple use?

Private ranches in this region of Sonora range from 500 to 15,000 hectares (1,235 to 37,000 acres). From an economic point of view, a large ranch can cope with a 5% cattle loss. However, smaller ranches cannot sustain a 5% or 10% loss—often this is their profit margin. Likewise, economics often drives how humans value wildlife. As an example, a Sonoran mule deer (*Odocoileus hemionus*) hunt can easily cost $5,000, while a Coues white-tailed deer (*Odocoileus virginianus*) hunt can range between $2,000 and $3,500. For both ranchers and hunters, a jaguar can mean economic losses. Ecotourism, however, can be an economic activity to offset predation losses and may improve the profitability of participating ranches. Birdwatching is a prime draw. For example, Ecotours Espiritu in Phoenix charges between $650 and $950 for a five-day birding trip to the mountains around Arizpe. A similar enterprise in jaguar domain would sell for a higher price because many bird species occur there that do not reach the United States.

Despite this ecotourism appeal, the wildlands of Sonora seem largely forgotten by the protective arm of the Mexican Ministry of Natural Resources and Fisheries (SEMARNAT, formerly SEMARNAP) (List et al. 2000). The Yaqui River watershed includes the core of the northernmost jaguar population in Sonora (see photo 3). The area is also an important breeding ground for bald eagles (*Haliaeetus leucocephalus*), and the home of military macaws (*Ara militaris*) and the northernmost breeding populations of neotropical otters (*Lontra longicaudis*). Military macaws and jaguars are priority species of conservation for the Mexican government (SEMARNAP 1997). Nevertheless, Mexican conservation laws protecting these species are not enforced (either for lack of resources or because of cattle industry influence) despite the apparent relative ease of doing so.

A protected area of 6,600 square kilometers in eastern Sonora would support between 60 and 100 jaguars. Land prices in this isolated part of Mexico range from $3,500 to $8,000 per square kilometer, making such a reserve affordable. Even today, using an estimated density of 1.5 jaguars/100 square kilometers, Sonora may have up to 1,050 jaguars—not bad for a species that until recently was considered eliminated from this Mexican state! Because not all jaguars present in a population reproduce, the effective population size is reduced to 60% or 70% of the actual population. Under full protection, this number of jaguars may be sufficient to maintain top-down effects on the ecosystems of Sonora. However, on the flip side of this ecological equation, jaguars cannot sustain much more consumptive exploitation if we are to recover a healthy population in Sonora—let alone bring the species back to the southwestern United States.

The large-scale thinking of the Wildlands Project provides an important model in this work. The only protected area in Sonora that has jaguars is the Reserve Sierra Los Alamos–Rio Cuchujaqui (92,889 hectares), in the southern tip of the state. The Reserve Cajon del Diablo (147,000 hectares) may also have jaguars—but neither of these areas is large enough to support a truly vibrant population.

(Unfortunately, priority regions for conservation in Sonora, as proposed by Mexican National Commission of Biodiversity [CONABIO],† do not consider most of Sonora's tropical ecosystems, and give more consideration to the temperate forests of the Sierra Madre and the upper Sonoran desert.) As a first step, an agreement should be reached between Mexican authorities and ranchers to reduce jaguar poaching and increase wildlife populations.

In order to make this protection last, a network of ranches and protected areas, similar to the one proposed for the Sky Island region (Foreman et al. 2000), should be considered, not only to maintain jaguars, but also to continue the ecological and evolutionary processes that formed the tropical realm of Sonora. We are currently working with several ranchers on creating a reserve system similar to the Sky Islands Wildlands Network Conservation Plan, where cattle remain a viable option through sustainable land use. At the moment, this reserve area encompasses seven ranches and one *ejido* for a total of 360 square kilometers (approximately 90,000 acres). Buying land to establish a core wild area will be critical to success. Easements on other ranches could help increase protection via the informal support of local people. And, of course, money from ecotourism could increase the options and the desire for better enforcement.

Needless to say, our knowledge of jaguar ecology and the species' conservation needs is still incomplete. But an effort that incorporates ranchers, the general public, government officials, and scientists seems to be the logical option to truly conserve the largest cat of the Americas. The successful protection of jaguars in Sonora is the key to their recovery in the southwestern United States. If we do not create a protected area in Sonora and reduce livestock-jaguar conflicts, occasional vagrant jaguars crossing into—and reinhabiting—Arizona and New Mexico will be just a midnight dream. ☾

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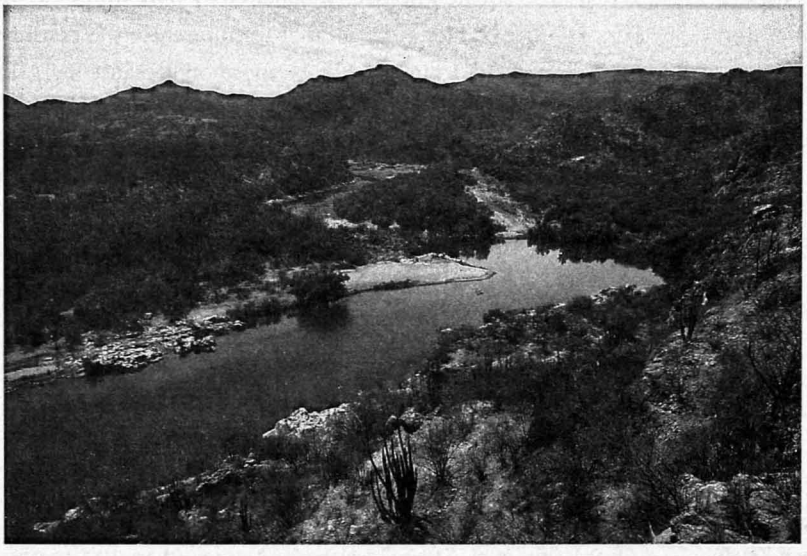

COURTESY C.A. LÓPEZ GONZÁLEZ

The successful protection of jaguars in Sonora is the key to their recovery in the southwestern United States.

PHOTO 3: View of the Yaqui River watershed, home to neotropical river otters, bald eagles, and jaguars.

† For more details of the CONABIO proposals visit: http://www.conabio.gob.mx

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Imagining the Whole Forest

Begin with the bone-work of autumn.

Acknowledge the immense bellies of candelabra-topped cedar
—how they make themselves from trapped, digested light.

Note—at the foot of basaltic cliffs—brittle, exploded
trunks, the air pungent with their protective fumes.

The crooked-limbed maples hold forests of their own,
moss-wrapped limbs wringing out the fog. True roots

branching into all places where water clings. From branch
to branch jays flick—raucous as cobalt flames. Each steals

his pinch of silence.

Affirm the stream, its twists and braids. Runs of dog-toothed
chum shudder in the shallows—humps exposed. Dark-backed,

they pant and idle side-by-side—wait where riffles open
from the mobile, bark-like cordage to a whitening flicker

of their bodies. These fish will not eat, but lift
their heads, to slide, almost familiar, by.

Feel the forest floor with your palm. It's shagged in moss.
Nearby, his eye still clear, the deer lies opened. Heart eaten.

Imagine how the tan cat will return.

~ **Bill Yake**

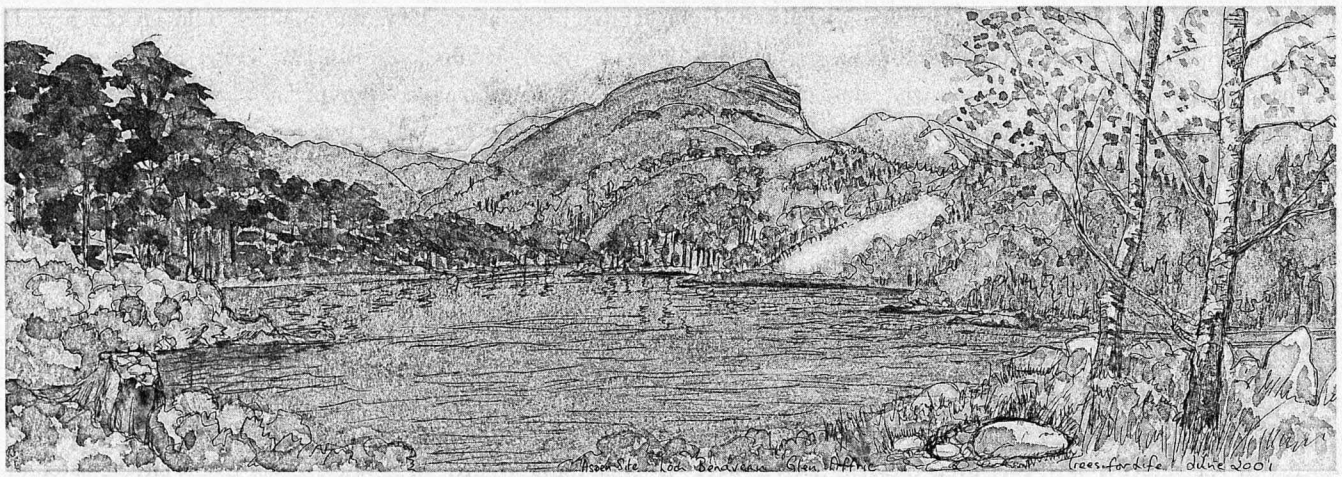
Restoring Scotland's Caledonian Forest

BY ALAN WATSON FEATHERSTONE

IT IS ESTIMATED that several thousand years ago, before humans had any substantial impact, 70–80% of Scotland's land area was covered in forest. However, several millennia of deforestation meant that by the 1980s, the natural forest cover had been reduced to just 2% of the land, and in the Highlands, in the north of the country, the native pinewoods, the boreal component of the Caledonian Forest, comprised just 17,000 hectares (42,000 acres) (Forestry Commission 1994)—a mere 1.1% of their original 1.5 million hectares (3.7 million acres) (McVean and Ratcliffe 1962).

Climatic change that occurred about 4,000 years ago, when Scotland became cooler and wetter, contributed to this loss, but the major cause was human action: clearing land for agriculture; utilizing wood for fuel, house construction, and boat building; burning forests to eradicate "vermin" such as the wolf; and, in the last 300 years or so, industrial timber exploitation, the introduction of sheep grazing on a massive scale, and the rise of so-called sporting estates. These are large private land holdings where the main activity is "sport" hunting of red deer (*Cervus elaphus*) stags for the trophy value of their antlers. With those landowners' incomes dependent on how many deer are available to shoot, red deer numbers have increased from 150,000 in the 1950s to over 350,000 today, and together with the estimated 5 million sheep in Scotland, they prevent any natural regeneration of the existing remnants of the original forest (Staines 1995). As a result, these remnants consist of isolated and fragmented patches of old trees—a "geriatric forest," with no new trees growing to replace the old ones as they die. With all the forest's native large mammals—

Scots pine by Sukanya McCauley



wolf, brown bear, European beaver, lynx, moose, and wild boar—long extirpated from Scotland (the wolf was the last to disappear, when the final individual was shot in 1743) (Ritchie 1920; Darling and Boyd 1973), and with the forest understory completely overgrazed by the massive herbivore population, the remnant forest ecosystems of Scotland are totally out of balance. Unlike North America, there are no old-growth forests left in the Highlands; the best that we have are small pockets of what is termed "ancient semi-natural woodland," and most of them are in serious decline.

The problems of forest destruction and species extinction—now rampant on every continent—have existed in Scotland for several thousand years. This country has the unenviable record of having been in the forefront of deforestation; now the onus is on Scotland to help show the way forward with the ecological restoration of highly degraded forest ecosystems.

The ecology of the Caledonian Forest

Located mainly in the mountainous heart of the Highlands, the native pinewoods of Scotland are the westernmost outpost of the boreal forest in Europe. Characterized principally by the Scots pine (*Pinus sylvestris*), the longest-lived and largest tree in the ecosystem, the forest also contains a range of broad-leaved trees including birch (*Betula pendula* and *B. pubescens*), rowan (*Sorbus aucuparia*), aspen (*Populus tremula*), alder (*Alnus glutinosa*) and willows (*Salix* spp.). These species occur singly or in small patches amongst the pines, and, in the case of the birches, sometimes as larger stands, thereby giving the forest an overall mosaic pattern.

Under the canopy of trees, a rich ground flora occurs, typified by berry plants of the genus *Vaccinium* and also including heathers (*Calluna vulgaris*, *Erica* spp.) and bracken (*Pteridium aquifolium*). In the western areas of the forest, the increased rainfall due to the prevailing westerly climatic systems supports large and diverse bryophyte communities; the forest floor is carpeted with mosses of many species, while a rich variety of lichens and liverworts grow on the trees and exposed rocks. Noted plants associated with pinewoods include the rare twinflower (*Linnaea borealis*) and orchids such as creeping lady's tresses (*Goodyera repens*) and lesser twayblade (*Listera cordata*) (Pitkin et al. 1995). The forest is also important for at least three species of birds: the capercaillie (*Tetrao urogallus*), the largest grouse in the world, which was exterminated in Scotland in 1785, but was successfully reintroduced from Scandinavia in the nineteenth century; the crested tit (*Parus cristatus*); and the Scottish crossbill (*Loxia scotica*), Scotland's only endemic bird, which has a specially evolved bill that enables it to open the cones of the Scots pine and extract the nutritious seeds.

Although Scots pine is the most widely distributed conifer in the world, with a natural range that extends from western Scotland to eastern Siberia and from the Arctic Circle to the Mediterranean, the pinewoods of the Caledonian Forest are unique because of the absence of any other conifers (Rodwell and Cooper 1995). Thus this vital part of Scotland's natural heritage also has considerable international significance, and this has led to it being listed as a priority habitat under the European Union's Habitats and Species Directive.

Glen Affric landscape by Joan Fairhurst

The beginning of the Caledonian Forest's return

Scientists first drew attention to the plight of the pinewoods in the late 1950s (Steven and Carlisle 1959), and experimental work to help them regenerate was begun in Glen Affric (MacRae 1980) and some other forest fragments in the 1960s. Deer fences were erected around some of the remnant stands of old trees to exclude grazing animals; inside these exclosures, healthy regeneration of the trees and other vegetation took place, thereby showing that the forest could recover if it were given a chance (Fenton 1985). Public awareness and conservation concern for the forest grew in the 1970s and particularly the 1980s, and the efforts to regenerate the forest increased (Callander 1995). However, these initiatives were generally small in scale and uncoordinated.

In 1986, Trees for Life was founded to help restore the Caledonian Forest to a large, contiguous part of its former range. We recognized that a substantial area of forest would be required to restore the ecosystem to a healthy, self-sustaining natural balance, with its full complement of species, including top predators. Working initially in Glen Affric, which contains one of the best remnants of the original forest, and the next valley north, Glen Cannich, our goal was to expand the forest outwards from these surviving fragments into a remote, virtually unpopulated area of 238,000 hectares (587,000 acres) (Watson Featherstone 1997). With a mountainous core, almost no economic activity apart from deer hunting, and no roads cutting right through it, this part of Scotland offers the best opportunity in the whole of Britain for restoring a substantial tract of land to a wild and natural state.

Our work began on a small scale with the erection of deer-proof fences around several stands of old trees to facilitate the successful regeneration of naturally occurring tree seedlings. Now, 12 years after the first of those exclosures was erected in partnership with the Forestry Commission—the U.K. equivalent of the U.S. Forest Service, and the government agency which owns some of the best old forest remnants, including Glen Affric—young Scots pines are over 3 meters (10 feet) tall, and the sequence of natural restoration of the ecosystem is well underway. Some of the pine saplings flowered for the first time in 1998, and after a two-year maturation period their cones released seeds in the spring of 2000, thereby moving the regeneration process forward. Ground vegetation such as bog myrtle (*Myrica gale*) and creeping lady's tresses orchids has flourished, and for the first time in over 150 years—reversing a centuries-long decline—new life is becoming successfully established throughout the 50-hectare (125-acre) exclosure. Each year, more young trees germinate and grow; for example, we knew of only a couple of junipers (*Juniperus communis*) when the fence was erected, but there are now several dozen growing well. Improved species richness and representation was suggested in the summer of 2001 when lesser twayblade—a species not seen there previously—was discovered during a botanical survey of the site.

A similar story is unfolding elsewhere in the Affric River watershed in a series of fenced exclosures we've initiated in conjunction with the Forestry Commission and the National Trust for Scotland, which owns 4,000 hectares (10,000 acres) of land in the Affric headwaters. Strategically situated around stands of old trees, either on the periphery of the forest or where a remote group of trees have survived the grazing pressure by virtue of their location in a steep gorge, these exclosures are providing a safe haven for the regeneration of the forest in an otherwise barren and degraded landscape.

In some of the exclosures, where their isolation and lack of an adequate seed source from parent trees mean that natural regeneration would be extremely slow to occur, we have been planting trees as the primary method of forest restoration. The planting is done in a manner that copies the pattern of self-regenerating seedlings elsewhere, with the trees being planted in the soil conditions they naturally occur in, and in groupings that avoid straight lines and regular spacings. The seedlings themselves are grown wherever possible from seed collected from the nearest surviving trees, seeking again to mimic the natural process of regeneration, and also to maintain the geographic variation in genetic diversity within species such as the Scots pine. Since 1991 we've planted more than 410,000 trees in this way, even though our planting, most of which is carried out by volunteers, is done at about one-tenth the rate of commercial planters working on tree plantations. Meanwhile, a larger but uncounted number of young trees are regenerating naturally inside the exclosures.

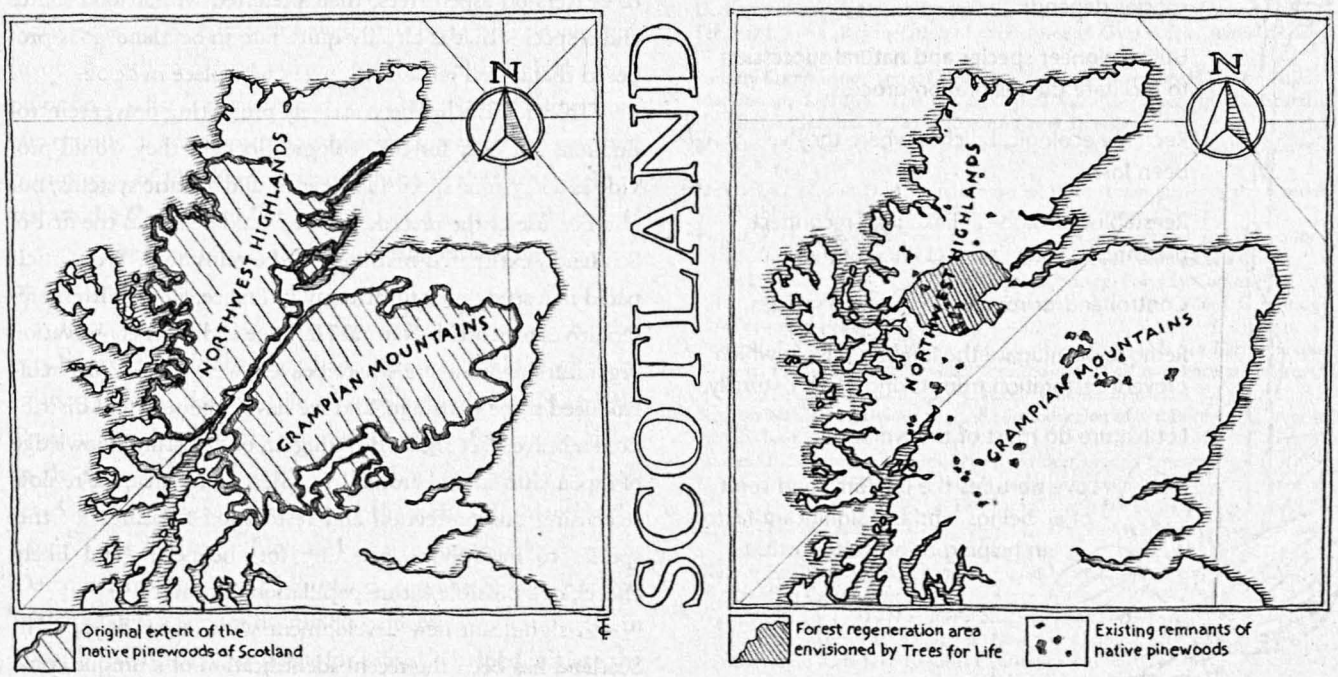
As these young trees grow, they will form discrete patches or "islands" of new forest throughout the watershed. In the years until they reach seed-bearing age, we will be working closely with landowners to promote a substantially increased cull of the red deer (sheep have already been removed from Glen Affric) to get their number down to a level at which they are in ecological balance with their habitat once more. In the longer term, the return of Scotland's missing large predators—wolf, lynx, and brown bear—will be essential to maintain such a balance. Natural regeneration of the trees will then

become successful again without the need for fences, which can be dismantled, as they will have fulfilled their current emergency measure function. The forest restoration process should become self-sustaining, and then the land will be another step closer to a truly wild condition.

Deepening the restoration process

When we began work in the late 1980s, our efforts, and those of most other organizations working to help restore the Caledonian Forest, were concentrated on the Scots pine. As the principal tree in the ecosystem it is a critical species, and by assuring its regeneration, we reasoned that much of the other flora and fauna would also benefit. This focus on the pinewoods resulted in a massive upsurge of public awareness and concern for the forest, and led to a number of very significant developments. In 1994, for example, the Forestry Commission declared 9,000 hectares (22,200 acres) of their land in Glen Affric as a Caledonian Forest Reserve, to be managed primarily for nature conservation. This reversed much of their previous policy for their landholdings in that region and resulted in hundreds of hectares of nonnative trees, which had been planted as a commercial crop amongst the remnant Scots pines being felled and left to decompose *in situ*. Trees for Life volunteers carried out some of this work, and we also began the process of removing fencing from areas where the original regeneration experiments had been instigated in the 1960s; the young trees that have successfully grown since then are now large enough that deer can no longer damage them. Thus, reduced numbers of deer are now able to live in balance with the returning forest, and with the Forestry Commission now implementing a much heavier deer cull on their land in Glen Affric, this success should be repeated throughout much of the watershed in the years ahead. More recently, Scottish Natural Heritage, the government conservation agency in Scotland, approved the designation of almost 15,000 hectares (37,000 acres) of Forest Enterprise–managed land in Glen Affric as a National Nature Reserve—the highest level of conservation protection currently available for land in Scotland.

Over the years, we have expanded our focus from the Scots pine, and from Glen Affric, to embrace a longer-term goal: the restoration of the Caledonian Forest and all its native species. The present-day remnants are too small to support the large, extirpated mammals whose reintroduction we call for. We've begun work to help the forest recover in several other locations within our target area, and have made proposals to other landowners, which, in some cases at least, they have implemented themselves. We've also been increasingly focused on other species in the forest ecosystem, and have initiated specific programs of mapping, protection, and propagation for under-represented and threatened trees such as aspen, hazel (*Corylus avellana*), and holly (*Ilex aquifolium*). The data are being loaded into a GIS (Geographical Information



map by Todd Cummings

System) mapping application, and will be used to identify priority areas for restoration work, facilitating the expansion and connection of isolated forest remnants in our target area.

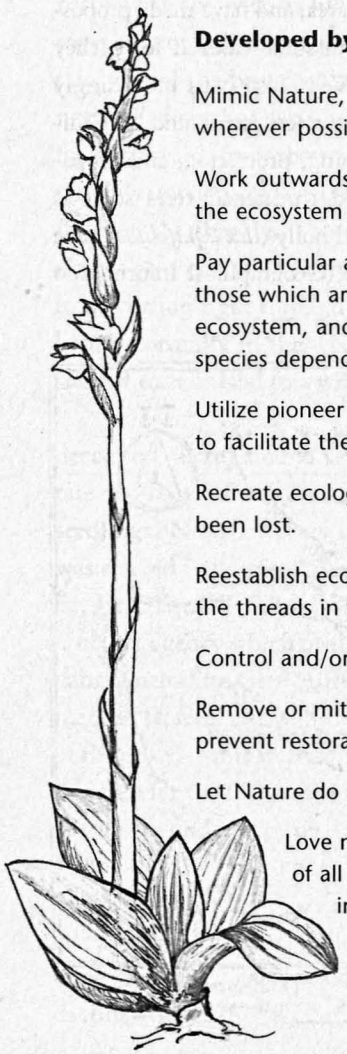
Other work focuses on some of the key components within the forest ecosystem, such as the riparian woodland zone and the tree-line shrub community, both of which have suffered greatly from past deforestation. Initially, we are conducting surveys to locate the presence of any trees or seedlings; for example, eared willow (*Salix aurita*) in the case of riparian woodland, and dwarf birch (*Betula nana*) for the montane shrub community. From the baseline data collected, we make proposals for site-specific regeneration measures, which can include small-scale stock fencing, larger deer-fenced exclosures, and planting of trees in key locations. To provide the seedlings for such plantings we've established our own nursery, so that we can grow trees from seed of the nearest possible provenance, matched for each specific site where they'll be planted. Such restoration is a central part of our strategy, as healthy riparian zones and montane shrub communities will form the "stepping stones" in the return of the forest to a large contiguous area.

Trees for Life is the main organization in Scotland publicly advocating the return of all our missing mammal species, such as the lynx, wolf, wild boar, European brown bear, moose, and beaver. Proposed reintroduction for most of these species is controversial and unlikely to happen in the near future; wide-ranging public education initiatives and the reform of current agricultural practices such as extensive sheep grazing will be necessary before the return of predators such as the wolf will have a chance of success. However, there is increasing interest amongst the public in wildlife recovery, and the British government is required, under the terms of the European Union's Habitats and Species Directive, to investigate the feasibility and desirability of reintroducing extirpated species. Scottish Natural Heritage has recently completed such an investigation for the European beaver (Scottish Natural Heritage 1998), and has concluded that even our existing degraded and fragmented riparian ecosystems could support up to 1,000 beavers and that the majority of Scottish people support their reintroduction. Although some concerns have been expressed about the possible impact of beavers on aspen trees, their preferred winter food source and a species that is already quite rare in Scotland, it is proposed that a trial release of beavers take place in 2002.

Trees for Life has been actively promoting beaver reintroduction, not only for the ecological benefit they would provide as a keystone species in riverine and aquatic systems, but also because of the precedent that would be set, as the first of Scotland's extirpated mammals to be reinstated. We participated in a study tour to Brittany in France, along with representatives of Scottish Natural Heritage and other conservation organizations, to a site where beavers were successfully reintroduced some years ago, and we have produced and distributed a beaver fact sheet. Building on our existing knowledge of aspen sites in and around the Glen Affric area, we're now refocusing our protection and restoration measures for this species to incorporate planning for the needs, and likely effects, of a possible future population of beavers.

A significant new development with regard to aspen in Scotland has been the recent identification of a unique com-

PRINCIPLES OF ECOLOGICAL RESTORATION



Developed by Trees for Life

Mimic Nature, and natural processes, wherever possible.

Work outwards from areas of strength, where the ecosystem is closest to its natural condition.

Pay particular attention to "keystone" species—those which are key components of the ecosystem, and on which many other species depend.

Utilize pioneer species and natural succession to facilitate the restoration process.

Recreate ecological niches where they've been lost.

Reestablish ecological linkages—reconnect the threads in the web of life.

Control and/or remove introduced species.

Remove or mitigate the limiting factors which prevent restoration from taking place naturally.

Let Nature do most of the work.

Love nurtures the life force and spirit of all beings, and is a significant factor in helping to heal the Earth.

creeping lady's tresses by Sukanya McCauley

munity of saproxylic insects which are dependent on aspen (MacGowan 1993; Watt 1998). A total of 31 insects, including several species of flies which had not previously been recorded in Scotland and one fly new to science, live in the sap runs and dead wood of aspen trees, but this community requires aspen stands greater than 4.5 hectares (11.4 acres) and only 14 such stands are left in Scotland today. None of those are in the Glen Affric area, although a survey we commissioned by specialist entomologists in the spring of 2001 found evidence of a few of the insect species. Based on the results and recommendations of that survey, we are now working to expand and link the aspen stands to provide adequate habitat for the full saproxylic community.

Underpinning and complementing our practical work, we've enlisted the involvement of several universities in Scotland and England to carry out research into the ecology of the Caledonian Forest and the effectiveness of our restoration measures. Over the past decade, a series of studies have focused on subjects such as the volume of coarse woody debris in remnants of the original forest; the difference in mycorrhizal fungal infection between naturally regenerating Scots pine seedlings and those planted from nursery grown stock; and an analysis of the distribution of scarce trees such as aspen and hazel, including factors limiting their regeneration.

From such research and the experiences we've accumulated through our practical fieldwork, Trees for Life developed a simple list, "Principles of Ecological Restoration," which guides our work (see sidebar). Based on the premise that Nature knows best, most of these will be familiar to anyone involved with restoration work elsewhere, although the final point on the list is perhaps unique to our work. Arising from our origins in and continuing relationship with the spiritual community of Findhorn, we have observed that as we help to restore the Caledonian Forest, the trees and the land respond in a positive way to the amount of human love and care we bring to our work.

In the last few years a number of other restoration projects have been initiated that have been inspired (in whole or in part) by Trees for Life. These include the Carrifran Project, which is working to restore native forest to a valley in the southern uplands of Scotland, a region that has suffered even greater deforestation than the Highlands; the Moor Trees project, which seeks to restore native forest to Dartmoor in the south of England; and the Matatu project, which plans to restore highly endangered Araucaria trees in Brazil's Atlantic Forest. Trees for Life also helped initiate the Yendegaia project in Tierra del Fuego in Chile (see article in *Wild Earth,* summer 1997).

We envision the rewilding of a substantial part of the Highlands in Scotland. Our target area, although large in a Scottish context, will be inadequate to support genetically viable populations of large, wide-ranging mammals such as the wolf and bear, so it will need to be linked via natural habitat corridors to other core areas of wild land in the Highlands. With conservation organizations such as the John Muir Trust, the Royal Society for the Protection of Birds, and the National Trust for Scotland all having recently purchased tracts of private land in the Highlands, a real opportunity exists to develop a coherent strategy to achieve this goal and reverse the long history of ecological decline in Scotland. Serious challenges still exist of course, not least the grossly inequitable distribution of land in the Highlands—most of it is owned in large parcels by absentee (and increasingly foreign) landowners. However, the prospects for Scotland's Caledonian Forest and all of its constituent species look brighter than they have for hundreds of years. ☾

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"Untrammeled," "Wilderness Character," and the Challenges of Wilderness Preservation

by Douglas W. Scott

IMPRECISION IN THE MEANING of the word *wilderness* plagued the wilderness movement during its early decades. Efforts to define wilderness in a practical way—usable in land management—began in the 1920s as the first formal wilderness preservation policies were formulated by Aldo Leopold and the Forest Service, and continued in the 1930s, notably in the work of Bob Marshall, the Forest Service, and a New Deal interagency task force. Wilderness Society and Sierra Club leaders and wilderness conference participants struggled with definitional complexities in the 1940s and 1950s. High-level government panels—a Library of Congress study in 1949 and a major federal commission in 1962—also probed these questions.[1]

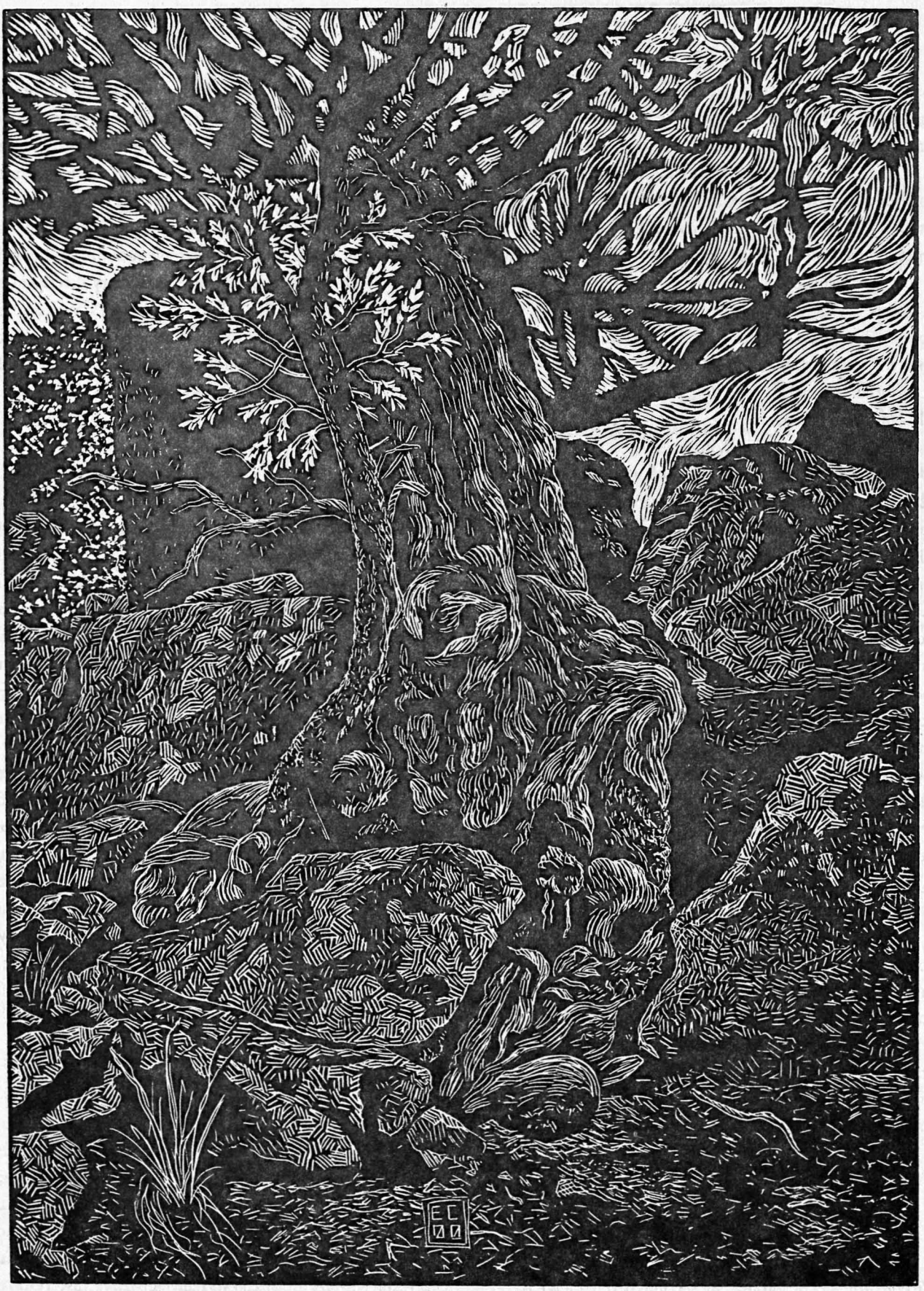
The culmination of all this effort was the Wilderness Act itself. As Howard Zahniser, executive director of The Wilderness Society, drafted the bill in the spring of 1956 that became the Wilderness Act of 1964, he was well aware of the complexities in usage of the word *wilderness* in post–World War II America. He had spelled out the problems in a masterful memorandum submitted to the Library of Congress as a contribution to its 1949 study of wilderness preservation issues:

> It is not surprising that the use of the same word "wilderness" both as a description and as a designation should result in some confusion, when it is realized that cultural values have only comparatively recently been placed on the quality of wilderness and that attempts to apply this sense of values to practical land management is much more recent. The terminology of both the philosophy and the land-management technic [sic] is still formative. It is still necessary to be aware of context in using precisely the vocabulary of the movement. It is not yet feasible to insist on limited usage of the term "wilderness," nor is it expedient to restrict one's own use of the word.[2]

Zahniser himself led the way in resolving this long-standing confusion about the word's definition: it was successful advocacy of the Wilderness Act that finally made it "feasible to insist on limited usage of the term" *wilderness,* because the act established a statutory definition and mandated its use by the four federal agencies that administer wilderness areas.

Designation and stewardship of wilderness

The Wilderness Act definition is an important guide as citizens, agencies, and Congress consider which lands to designate as wilderness. Yet even an act of Congress is not immune



bristlecone pine, Lost Creek Wilderness Area, Colorado, scratchboard by Evan Cantor

from misinterpretations by federal agencies that can lead to application of the word in ways informed neither by ecology nor by the original intent of the statute itself. Thus, it remains important for wilderness advocates and Congress to step in, as has often been necessary over the 37 years since the enactment of the law, to correct the agencies when they stray into misinterpretations. These misinterpretations—still too often voiced by local spokespeople of the agencies—can mislead the public into believing that the definition sets criteria stricter and more limiting than the act actually allows. As Congress has repeatedly asserted in a long line of precedents, the act's definition accommodates protection for significant expanses of wild land with various histories of past use.[3]

The definition in the Wilderness Act, correctly understood, also guides the stewardship of wilderness areas once designated. Whatever the differences in the other statutory mandates of the four federal land management agencies, once wilderness areas are designated the overriding mandate in the Wilderness Act is that each shall preserve the "wilderness character" of the areas. This command appears in both the declaration of congressional purpose in subsection 2(a) of the act, and in the management direction in subsection 4(b). In 1983 the Committee on Interior and Insular Affairs[4] of the House of Representatives reemphasized this mandate, noting that: "The overriding principle guiding management of all wilderness areas, regardless of which agency administers them, is the Wilderness Act (section 4(b)) mandate to preserve their wilderness character."[5] In issues of wilderness management, too, Congress and wilderness advocates must remain vigilant against misinterpretations that would frustrate the goal of preserving an enduring resource of wilderness.

BUT WHAT IS THE ESSENCE of the wilderness character the agencies "shall" protect? Where in the act do managers look to understand the goal for their stewardship?

The framers of the Wilderness Act intended that the first sentence of subsection 2(c) establish the meaning of "wilderness character":

> 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 untrammeled by man, where man himself is a visitor who does not remain.[6]

These words animate the act's wilderness concept. Without this definition, the subsection 4(b) mandate to preserve "the wilderness character of the area" would be cast adrift, left floating without clear and practical meaning on which administrators can base stewardship decisions.

At the heart of this goal for wilderness stewardship is the word *untrammeled*. No other word in the Wilderness Act is as misunderstood, both as to its meaning and its function in the law. The Oxford English Dictionary traces *trammel* to Latin and eleventh-century Old French roots meaning a kind of net used to catch fish or birds. Current dictionary descriptions of the word *untrammeled* include "unrestrained," "unrestricted," "unimpeded," "unencumbered," "unconfined," "unlimited."[7] At the command of the Wilderness Act, we preserve wilderness character—by definition—by leaving "the earth and its community of life untrammeled by man."

Too often, this word has been misread as *untrampled,* or misinterpreted as some synonymous variation of untrampled, with the erroneous connotation that it describes the present physical or ecological condition of the land or its past land-use history. The word was frequently misused in this way in disputes over designation of particular lands as wilderness in the years immediately after the Wilderness Act became law.

In the most blatant case, in the late 1960s, the Forest Service fostered a "purity" concept that distorted the intent of the Wilderness Act, perverted its definition, and threatened—had it become accepted—to circumscribe the extent of lands deemed qualified for designation.

The Forest Service's fundamental misunderstanding—intentional or not—began at the highest levels, exemplified in 1968 Senate testimony of Chief Edward P. Cliff on the proposed Mount Jefferson Wilderness in Oregon. Citizen groups advocated that Congress override the agency's recommendation to exclude Marion Lake and its surroundings, which would have left a deep indentation in the western boundary of the narrow wilderness area. Chief Cliff resisted, pointing to growing public use of the area:

> It is not an untrammeled area. It is being heavily trammeled, and we need to get in there and provide sanitation facilities, and water and fire grills, and other recreational improvements, to accommodate the use that is already being made there, and to protect the resources of the area.[8]

Contrary to Cliff's statement, an "area" cannot be "trammeled" in the sense he sought to convey. The act applies the word untrammeled not to an "area" or its present condition, but to "the earth and its community of life," that is, to the forces of Nature. Both the formal legislative history of the Wilderness Act (in the limited sense a judge or legal scholar

would use) and the history of Zahniser's word choices as its draftsman provide clear guidance on the intended meaning of the word *untrammeled* and its function in the act's carefully designed structure. The congressional champions of the act, abetted virtually every step of the way by Zahniser, went to great pains through eight years of hearings, debates, and committee reports to make their intent clear. Looking back, the leading Senate opponent of the act, Senator Gordon Allott (R-CO) confirmed: "...there is not a word in the Wilderness Act which [was] not scanned, perused, studied and discussed by the committee. Perhaps there is no other act that was scanned and perused and discussed as thoroughly as every sentence in the Wilderness Act."[9]

The ideal of wilderness for the future of wilderness

As the draftsman, Zahniser was careful to avoid having the ideal definition of wilderness focus on the present physical or ecological condition of an area of land, or its land-use history. He chose *untrammeled* as the uniquely best word to express a forward-looking perspective about the *future* of land and ecosystems: once designated, wilderness is to be allowed to express its own will—with the forces of Nature untrammeled into the future.[10]

This is just how Congress has applied the definition. For example, during the controversy in the early 1970s over whether once-disturbed areas on national forests in the East could be designated under the Wilderness Act definition, then-Senator James L. Buckley (R-NY), a member of the Senate Interior Committee, expressed a view consistent with Zahniser's:

> Of course, we begin from the ideal, just as the Wilderness Act does. But, if we are to have a national system of wilderness areas, as the drafters of the Wilderness Act obviously intended, less than pristine standards would be necessary for practical application. As a basis for public policy I believe it would be a mistake to assume that the Wilderness Act can have no application to once-disturbed areas.[11]

Zahniser's precision in choosing the word *untrammeled* is well documented. As he worked with congressional staff to refine the Wilderness Bill for reintroduction in 1959, several conservation colleagues urged him to drop the word. One asserted that this word was "hackneyed, relatively meaningless."[12] Another commented that *untrammeled* was a "remnant negative now never used in its positive sense," and that a word in current usage should be substituted—he suggested the word *undisturbed*.[13]

To these entreaties, Zahniser replied that he had chosen the word *untrammeled,* when drafting the bill in the spring of 1956, only after "dissatisfaction with almost every other word that had been suggested," and that he selected it as "a word that fitted our need both as to denotation and connotation."[14] He explained why the word *undisturbed* did not express his intent:

> The problem with the word "Disturbed" (that is, "Undisturbed") is that most of these areas can be considered as disturbed by the human usages for which many of them are being preserved; that is, temporarily disturbed. *The idea within the word "Untrammeled" of their not being subjected to human controls and manipulations that hamper the free play of natural forces is the distinctive one that seems to make this word the most suitable one for its purpose within the Wilderness Bill.*[15]

A close confidant of Zahniser's on these questions was Harvey Broome, a founder of The Wilderness Society and an attorney. In a 1966 letter, Broome recalled that:

> Zahnie and I had this matter up about five years ago when the Forest Service was proposing a heavily [logged-over and] burned-over area in North Carolina as part of the Shining Rock wilderness area. We concluded that under the definition in the Bill, as then drafted, there was no conflict provided roads and mechanical and other uses were prohibited. Congress apparently accepted the same understanding since the Shining Rock Wild Area was incorporated in the wilderness system....[16]

Distinguishing the ideal and practical definitions

The context in which *untrammeled* is used in the Wilderness Act is all-important, for it circumscribes how Congress intended the word (and the entire sentence) to function in the structure of the act. The word appears in the first of two sentences in subsection 2(c) of the act. Congress (and Zahniser) intended each sentence to have a distinct definitional purpose—the first states the *ideal* while the second is the more *practical* characterization. Yet, intentionally or not, the Forest Service initially acted as if there were no such distinction.

In its written response to questions raised during the 1967 Senate hearing on the proposed San Rafael Wilderness—the first area added to the wilderness system after enactment of the Wilderness Act—the Forest Service asserted that:

> the law describes wilderness, in part, as "...an area where the earth and its community of life are untrammeled by man..." which is "...managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature...."[17] [ellipses in original]

Compare this assertion of how the law describes wilderness with the actual words and punctuation of subsection 2(c) of the act and the sleight of hand becomes obvious; they mashed into one the two distinct sentences Congress deliberately separated in order to serve two different functions.

Commenting on the two-part structure of the definitions during the final Senate hearing in 1963, Zahniser noted that:

> In this definition the first sentence is definitive of the meaning of the concept of wilderness, its essence, its essential nature—*a definition that makes plain the character of lands with which the bill deals, the ideal.* The second sentence is descriptive of the areas to which this definition applies—a listing of the specifications of wilderness areas; it sets forth the distinguishing features of areas that have the character of wilderness.... *The first sentence defines the character of wilderness,* the second describes the characteristics of an area of wilderness.[18]

We need not rely solely on Zahniser's expression of intent, for the formal legislative history repeatedly emphasizes Congress's intention to distinguish between two very distinct functions for the two sentences in subsection 2(c).

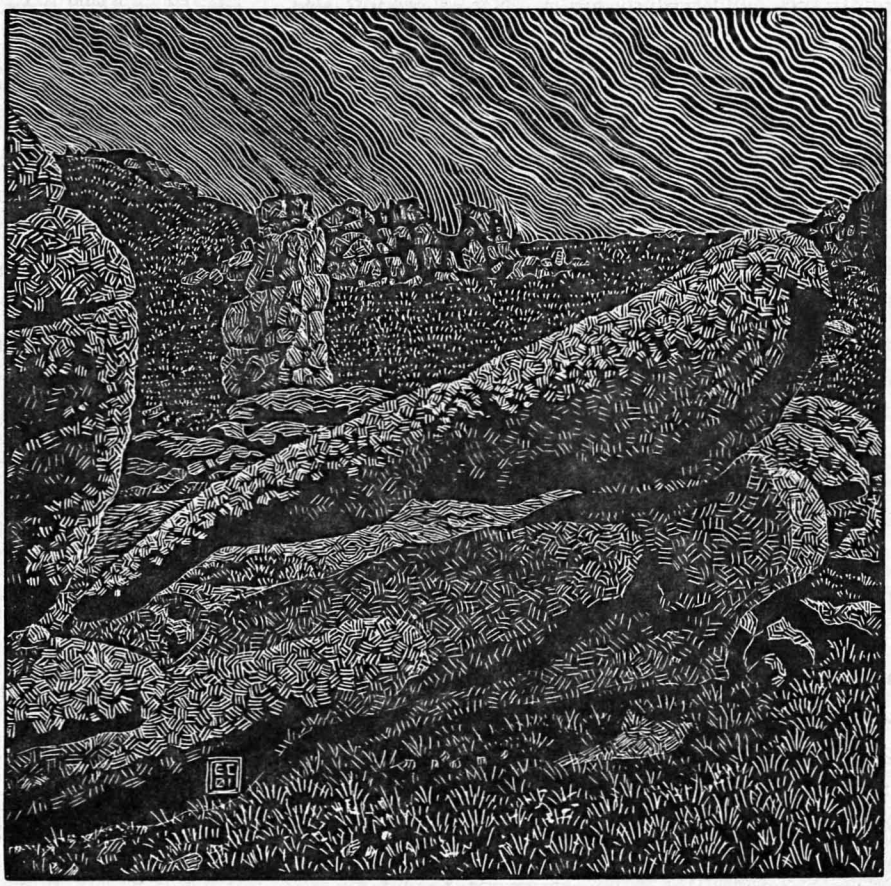
The first of these sentences originated in the Wilderness Bill introduced in the Senate on June 7, 1956.[19] Slight word changes were made elsewhere in that sentence, but the clause embracing the word *untrammeled* did not change over the ensuing eight years. However, changes were made to the structure of the subsection around it, and these further clarified the function Zahniser and the sponsors intended from the outset.

What Congress intended in the definition of wilderness

When he introduced the original Wilderness Bill, Senator Hubert Humphrey (D-MN) included a detailed section-by-section interpretation of the bill in his introductory speech. He stated: "The opening section defines the term 'wilderness' both in the abstract and as used specifically in this bill...."[20]

In 1960 Senator James Murray (D-MT) reintroduced a refined version of the Wilderness Bill intended "to clarify and revise the measure" on the basis of earlier hearings, agency comments, and committee discussions.[21] As the new lead sponsor and as chairman of the Senate committee handling the bill, his explanation is the authoritative expression of legislative intent, includ-

Whatever level of ecological "purity" characterizes portions of an area when it is designated, each is to be managed thenceforth toward the wilderness ideal.



Lost Creek Wilderness Area, Colorado, scratchboard by Evan Cantor

ing why he added what became the second sentence in the subsection enacted four years later. Murray explained to the Senate: "The added detail in the definition of wilderness is in response to requests for additional and more concrete details in defining areas of wilderness."[22] The new second sentence Murray added was:

> An area of wilderness is further defined to mean in this Act an area of undeveloped Federal land 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 rugged, primitive, and unconfined type of outdoor recreation; (3) is of sufficient size as to make practicable its preservation and use in an unimpaired condition, and (4) may also contain ecological, geological, archeological, or other features of scientific, educational, scenic, or historical value.[23]

As distinct from the abstract, ideal definition, this second sentence defines what Jay Hughes called "institutional wilderness"—specific areas of land that "society has called 'wilderness' in terms of definitely bounded, named, managed, and legally identifiable tracts of public land."[24] The bill's congressional sponsors repeatedly emphasized that the two sentences serve two distinct functions.

In 1961, Senator Clinton P. Anderson (D-NM) succeeded Murray as chairman of the Senate committee and lead sponsor of the Wilderness Bill. In opening hearings that year, he explained his interpretation in a detailed section-by-section analysis:

> Section 2(b) contains two definitions of wilderness.[25] The first sentence is a definition of pure wilderness areas, where "the earth and its community of life are untrammeled by man...." It states the ideal.
>
> The second sentence defines the meaning or nature of an area of wilderness as used in the proposed act: A substantial area retaining its primeval character, without permanent improvements, which is to be protected and managed so man's works are "substantially unnoticeable."
>
> *The second of these definitions of the term, giving the meaning used in the act, is somewhat less "severe" or "pure" than the first.*[26]

The Senate passed the Wilderness Bill twice, in 1961 and in the following Congress, in 1963. On both occasions, the formal reports of the Committee on Interior and Insular Affairs[27] included a section-by-section analysis, which noted the nature of the two-part definition:

> Section 2(b) defines wilderness in two ways: First, in an ideal concept of wilderness areas where the natural community of life is untrammeled by man, who visits but does not remain, and second, as it is to be considered for the purposes of the act: areas where man's work is substantially unnoticeable, where there is outstanding opportunity for solitude or a primitive or unconfined type of recreation, which are of adequate size to make practicable preservation as wilderness, and which may have ecological, geological, or other scientific, educational, scenic, and historical values.[28]

Representative John P. Saylor (R-PA) was the original sponsor and leading champion of the Wilderness Act in the House of Representatives. He explained the distinction between the two definitional sentences in his analysis as he introduced a refined version of the Wilderness Bill on November 7, 1963:

> Section 2(b) defines wilderness in three sentences.[29] The first states the nature of wilderness in an ideal concept of areas where the natural community of life is untrammeled by man, who visits but does not remain. The second sentence describes an area of wilderness as it is to be considered for the purposes of the act—areas where man's works are substantially unnoticeable....[30]

AS TRACED HERE, *every one* of the lead sponsors of the Wilderness Act explicitly intended the first sentence of subsection 2(c) to express the "abstract" (Humphrey) or "ideal" (Anderson, Saylor), distinct from the "more concrete details in defining areas of wilderness" (Murray) which are spelled out in the second sentence.

As Zahniser had noted in 1949, it was important to recognize that the same word "wilderness" is used both as a description and as a designation. The two-part definition in the Wilderness Act follows that distinction. Of course, the distinction between an ideal definition and a less-than-ideal set of details for practical implementation was and is common.[31]

The non-degradation principle in wilderness stewardship

Given the precise word choices and the care taken in structuring the two-sentence definition in the Wilderness Act, it is beyond dispute that:

- Designation questions of whether a specific area of land meets the definition of wilderness in the act are *not* about whether that land is "untrammeled" (or untrampled). The word *untrammeled*, which applies once an area is des-

ignated, appears only in the "pure," "ideal" definition that serves a quite different function in the act. For its part, the Forest Service correctly defines untrammeled in the current version of the Forest Service Manual.[32]

- The *only* criteria for designation of an area is the "somewhat less 'severe' or 'pure'" (Anderson) defining details set forth in the second, non-ideal definition "for the purposes of the act." A number of very clear qualifiers—"*generally* appears to have been affected *primarily* by the forces of nature, with the imprint of man's work *substantially* unnoticeable"—provide practical, workable criteria for entry of areas into the National Wilderness Preservation System. This is how Congress intended and has consistently applied the Wilderness Act, and it is how a federal judge read it as well, in one of the few cases where these issues arose.[33]
- The ideal definition has an equally important, but different function; it is not mere congressional poetry, for the canons of statutory interpretation forbid such an interpretation.[34] The function of this sentence—with its careful use of the word *untrammeled*—is to define the "ideal" (Anderson), the "essence" (Zahniser) of the wilderness character it is the duty of conservationists and land managers to protect.

There is a supreme logic to this careful structure of the two definitions. Applying the practical criteria of the second sentence in subsection 2(c), the 1964 act itself designated numerous areas with a fading history of the "imprint of man's work," and many others have been designated in subsequent acts of Congress. But, however less-than-pure such areas may have been when designated, once designated, the command of the act is to preserve the "wilderness character" of each area, restraining human influences in order that the earth and its community of life are untrammeled by man.

This is, at its heart, a non-degradation principle. Just as the non-degradation principle in the Clean Air Act does not allow polluting purer air down to minimum-level, health-based air quality standards, but requires that areas of pristine air quality be protected, so the acceptance of past human imprints and disturbances in some lands being designated as wilderness does not mean such imprints and disturbances may therefore be allowed to invade other, wilder wilderness lands already designated.[35] Whatever level of ecological "purity" characterizes portions of an area when it is designated, each is to be managed thenceforth toward the wilderness ideal.

Zahniser was adamant that "management" of the ecosystem in each wilderness area should occur almost entirely by restraint on human influences from its boundaries, rather than by manipulation within. He gave us his admonition about wilderness management in the epigrammatic title he chose for an editorial in *The Living Wilderness* in 1963: "Guardians Not Gardeners." The guardian philosophy, he wrote, is one of "protecting areas at their boundaries and trying to let natural forces operate within the wilderness untrammeled by man."[36] A federal judge, writing in 1975, echoed Zahniser's analogy: "Nature may not always be as beautiful as a garden but producing gardens is not the aim of the Wilderness Act."[37]

By stating the ideal of "pure wilderness," its "essential nature," Zahniser's ringing first sentence of subsection 2(c) breathes ecological life into the phrase "wilderness character." He and the Congress thus set the goal toward which our stewardship of wilderness areas is to strive: To free Nature within these special places, as best we can, from the fetters and trammels of man's influence, so that wilderness may be—through our own self-restraint—areas "where the earth and its community of life are untrammeled by man." ☾

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NOTES

1. The broad history of this evolution in wilderness concepts and policy is traced in my recent Pew Wilderness Center Briefing Paper: Douglas W. Scott, 2001, A wilderness-forever future: A short history of the National Wilderness Preservation System (Washington, D.C.), which is available at www.pewwildernesscenter.org. See also: Aldo Leopold, 1921, The wilderness and its place in forest recreational policy, *Journal of Forestry* 19(7): 720; Robert Marshall, 1930, The problem of the wilderness, *The Scientific Monthly* (February): 148; Marshall (undated), Preliminary statement on terminology, suggested definitions of outdoor recreational areas, attached to Minutes of the Second Meeting of Recreation Committee, February 11, 1936, Natural Resources Committee, copy in author's files; C. Frank Keyser, 1949, The preservation of wilderness areas: An analysis of opinion on the problem, Subcommittee on Wildlife and Fisheries Conservation, Committee on Merchant Marine and Fisheries, U.S. House of Representatives, Committee Print 19, August 24; and Wildland Research Center, 1962, Wilderness and recreation: A report on resources, values, and problems, a report to the Outdoor Recreation Resources Review Commission (Washington, D.C.: Government Printing Office): esp. 25–26.
2. Zahniser, 1949, A statement on wilderness preservation in reply to a questionnaire, March 1. Reprinted in *National Wilderness Preservation Act*, hearings before the Senate Committee on Interior and Insular Affairs (85th Congress, 1st session) on S. 1176, Washington, D.C., June 19 and 20,

1957: 169. Zahniser returned to this point during discussions at the Sierra Club's 2nd Biennial Wilderness Conference in 1951: "Howard Zahniser thought the use of the same word, 'wilderness,' for both recreational and land-management problems (which are not the same) must be confusing; but even if we are not yet ready to restrict ourselves with too strict a definition, we must not lose sight of the necessity of preserving primeval environment, freedom from mechanization, a sense of remoteness, and those characteristics that impress visitors with their relationship to nature." Sierra Club, 1964, Summaries of the "Proceedings of the First Five Biennial Wilderness Conferences," in *Wildlands in our Civilization* (San Francisco: Sierra Club), 144.

3. The legislative history and precedents relating to designation criteria for wilderness are reviewed in my article, 2001, Congress's practical criteria for designating wilderness, *Wild Earth* 11(1): 28–32. A series of Pew Wilderness Center Briefing Papers provides detail on legislative history and precedents for many topics involved in wilderness designation and management; see www.pewwildernesscenter.org. I welcome inquiries about issues and precedents not yet covered in this series, as well as suggestions of precedents I may have missed.
4. Now renamed the Committee on Resources.
5. U.S. House, 1983, *California Wilderness Act of 1983*, H. Rept. 98-40 (98th Congress, 1st session), March 18: 43.
6. Wilderness Act, 1964, *U.S. Code* Vol. 16, sec. 1132(c).
7. Webster's 1913 unabridged dictionary defines *untrammeled* as "Not hampered or impeded; free." The transitive verb form derives from the noun antonym, "trammel." The online dictionary Wordsmyth provides considerable additional detail. Here is a condensation of the full Wordsmyth entry found at www.wordsmyth.net:

   TRAMMEL PART OF SPEECH NOUN Definition 1. (usu. pl.) a restraint or impediment to free movement. Definition 2. a restraint used on a horse's feet to teach it to amble; fetter. Definition 3. a device used to gauge and adjust the alignment of machinery parts; tram. Definition 4. a net for catching fish or wild birds.
   PART OF SPEECH TRANSITIVE VERB Inflected Forms *trammeled, trammeling, trammels.* Definition 1. to impede, restrict, or confine; hobble. Definition 2. to ensnare with, or as if with, a net. Related Words *encumber, enthrall, confine, circumscribe, shackle, enslave, limit.*

8. Statement of Edward P. Cliff, 1968, Chief, Forest Service, *San Gabriel, Washakie, and Mount Jefferson Wilderness Areas*, hearing before the Senate Subcommittee on Public Lands, Committee on Interior and Insular Affairs (90th Congress, 2d session) on S. 2751, February 19: 11. Congress did designate Marion Lake as part of the wilderness established in 1968.
9. U.S. Senate, 1972, Committee on Interior and Insular Affairs, hearings on designation of wilderness areas, S. 2453 and related wilderness bills (92nd Congress, 2d session) May 5: 64.
10. A contrary view was expressed eight years after the enactment of the Wilderness Act by one of Zahniser's coworkers on the Wilderness Bill, Joe Penfold, conservation director of the Izaak Walton League of America: "A crucial point is that every effort made by conservationists in the half century leading to the Wilderness Act was premised on obtaining recognition and acceptance of wilderness as a natural ecosystem, untrammeled by man *in the past* and permitted to continue untrammeled and undisturbed by man's activities *in the future*." J. W. Penfold, 1972, Wilderness east—A dilemma, *American Forests* 78(4): 24 (emphasis in the original). This idea of statutory wilderness being limited to natural ecosystems "untrammeled by man *in the past*" was not, contrary to Penfold's after-the-fact assertion, ever used by Zahniser, who disclaimed exactly that idea, as documented here.
11. *Congressional Record*, 1973, January 11: 757. Buckley is now a senior judge on the Federal Court of Appeals for the D.C. Circuit. The history of the eastern wilderness controversy is told by James Morton Turner, 2001, Wilderness east: Reclaiming history, *Wild Earth* 11(1): 19–27.
12. C. Edward (Ned) Graves, 1959, letter to Howard Zahniser, February 13, quoting Philip Hyde. Wilderness Society files and author's files.
13. Weldon F. Heald, 1959, letter to C. Edward Graves, February 12. Wilderness Society files and author's files.
14. Howard Zahniser, 1959, letter to C. Edwards Graves, April 25. Wilderness Society files and author's files.
15. Howard Zahniser, 1959, letter to C. Edwards Graves, April 25 (emphasis added).
16. Harvey Broome, 1966, letter to Robert W. Jasperson, September 10. Papers of The Wilderness Society, 7: 173 (Tennessee: Great Smoky Mountains National Park), Denver Public Library. I am grateful to James Morton Turner who found this correspondence and called it to my attention. It supplements the history of Broome's role in on-the-ground assessing of the qualification of the Shining Rock Wilderness provided in my article, 2001, Congress's practical criteria for designating wilderness, *Wild Earth* 11(1): 28–32.
17. Unsigned letter, 1967, from the Forest Service to Hon. Frank Church, April 26, reprinted in *San Rafael Wilderness*, hearings before the Senate Subcommittee on Public Lands, Committee on Interior and Insular Affairs (90th Congress, 1st session) on S. 889, April 11: 81.
18. Howard Zahniser, 1963, Executive Director of the Wilderness Society, supplementary statement in *National Wilderness Preservation Act*, hearings before the Committee on Interior and Insular Affairs, United States Senate (88th Congress, 1st session), on S. 4, February 28 and March 1: 68 (emphasis added).
19. U.S. Senate, 1956, Subsection 1(c) of S. 4013, 84th Congress, 2nd Session.
20. Sen. Hubert Humphrey, 1956, Wilderness preservation, *Congressional Record*, June 7. The cited version is from page four of a booklet reprint of Senator Humphrey's speech and the text of the bill, which was printed for widespread distribution by Humphrey and The Wilderness Society.
21. Sen. James Murray, 1960, *Congressional Record*, July 2: 14453.
22. Murray, 1960, 14454.
23. This is the second sentence of subsection 1(d) of Murray's bill, S. 3809; it became subsection 2(c) of the final act. This wording was somewhat modified between 1960 and enactment of the act in 1964, but not in any material way. *Congressional Record*, 1960, July 2: 14455.
24. Jay Melvin Hughes, 1964, Abstract of wilderness land allocation in a multiple use forest management framework in the Pacific Northwest, unpublished Ph.D. dissertation (East Lansing: Michigan State University), quoted in Ronald Lee Stewart, 1968, The Wilderness Preservation Act, unpublished master's thesis (Eastern New Mexico University): 48.
25. This became subsection 2(c) of the act.
26. Sen. Clinton P. Anderson, 1961, in *Wilderness Act,* hearing before the Senate Committee on Interior and Insular Affairs (87th Congress, 1st session) on S. 174, February 27–28: 2, emphasis added.
27. Now renamed Committee on Energy and Natural Resources.
28. U.S. Senate, 1963, S. Rept. No. 88-109, April 3: 7–8. Subsection 2(b) referred to here became subsection 2(c) in the act.
29. This subsection, which became 2(c) of the act, ended up comprised of only two sentences.
30. Rep. John P. Saylor, 1963, *Congressional Record*, November 7: 20354. Saylor's remarks came as he introduced H.R. 9070, the version of the Wilderness Bill that became the vehicle for House passage of the act the following summer.
31. For example, "all men are created equal," says the ideal in our Declaration of Independence, leaving the less-than-ideal details—no equality for women, no equality for slaves—to our pre-amendment U.S. Constitution.
32. The Forest Service Manual provisions on wilderness management define *untrammeled*: "In the context of the Wilderness Act, an untrammeled area is where human influence does not impede the free play of natural forces or interfere with natural processes in the ecosystem." Forest Service Manual 2320.5(2). For this and the entire manual chapter concerning wilderness management, see www.wilderness.net/nwps/policy/fs_manual_policy.cfm.
33. *Parker v. United States*, 1970, 309 F.Supp. 593, U.S. District Court for the District of Colorado, Memorandum Opinion and Order, February 27. This is the "East Meadow Creek" decision that assured protection of roadless lands contiguous to national forest "primitive areas" until Congress completed the review of each of those areas as required by the Wilderness Act.
34. "It is, of course, a cardinal rule of statutory construction that effect should be given to every provision of a statute." Court of Appeals for the 10th Circuit, 448 F.2d 797.
35. The "prevention of significant deterioration of air quality" (PSD) provisions of the Clean Air Act prevent clean air areas from being polluted to the worst levels allowed by the health-based National Ambient Air Quality Standards. *U.S. Code,* Vol. 42, secs. 7470–7492 (Part C, Title I).
36. Howard Zahniser, 1963, Guardians Not Gardeners, *The Living Wilderness* 83: 2.
37. *Minnesota Public Interest Research Group v. Butz,* 1975, 401 F.Supp. 1276, esp. 1331, U.S. District Court for the District of Minnesota, Memorandum and Order, August 13. This is one of serveral court opinions concerning logging in the Boundary Waters Canoe Area.

Worlds Apart

FLORIDA IN THE PRESENT TENSE

article and photographs
by Joel B. McEachern

THE REAL FLORIDA IS GONE. It's been moved out, replaced by constructs of myth and presumption. Our great trees are all but gone, mowed down like the lawn grass that replaced them. Our great birds—the white pelican, egret, ibis, and wood stork—poisoned by the thousands, died in the sky. Our bears, panthers, and foxes are summarily slaughtered on our crowded autobahns, forced from their ranges by yet another nature-inspired golf course community. Our manatees are hacked by boat propeller blades and speeding watercraft, their habitats broken by intense shoreline development. Their earth taken from them, they are angels all, looking homeward. Soon, the sweet winter sky will be all we have left, now that we have surrendered our citizenship for consumption. No one seems to mind.

A. E. "Bean" Backus, the noted landscape pictorialist, painted the faces of Florida's skies best, adorning his canvasses with large amounts of reds, pinks, and yellows. They glowed, just like the real thing. Un-Disneyfied and un-hyperrealized, Beanie's paintings of Florida places were, if anything, modest records of the familiar—pinelands, shorelines, and palm islands awash in the magic of the light. Florida light, water-made light. The luminous work of his fellow "Highwaymen," a curator's tag for pictures made by a loose confederation of itinerant black artists, is as simple and as honest. Each was faithful to the light and to the feel of open, watery places, places shamelessly peddled by a century of tourist postcards and now trapped in the pictures of a concrete to commerce development-dependent economy. Taken first by logging and then the latest gated agglomeration of doorknobs marketed to affluent seniors who want the active adult lifestyle, Beanie's big-eyed skies have no feet—nothing to ground or attach them to, except the constant whine of the interstate and the clumps of shiny new houses stapled across a fading horizon.

Welcome to the new Florida.

THE STORY OF FLORIDA is no longer about the madness of manifest destiny but an intricate and deceitful tale of manifest subdivision. From the builders of New World colonies to the developers of Old World Resorts, we have come full circle, our sense of place now fully borrowed and abandoned, abstracted and contrived, our place-names a sick remembrance of what came before. From DeLeon's belief that Florida would lead to the enchanted land of China, that its earth would give gold and its pristine waters eternal youth, to the northern retiree who came to build a home in the pines and the oaks, just like the picture in the brochure but found instead only swampland and bad jokes, ours is a state of reckless invention and reclusion by an array of magnates, mobsters, hucksters, socialites, and marketeers. We have become a model of the vulgarization of the American dream.

Lacking monument and range, Florida's wild lands competed with the vanity of the West, yet mirrored the western story in many ways. A succession of protracted and expensive boundary wars with its native Indians—a fight to expand

Not long ago in either geological or human time, Florida's woods were as ancient and as vast as any attraction's fabrication; its cypress groves comparable to California's magnificent stands of sequoia.

ground and increase ocean access—delayed statehood until 1845 when the last Seminoles were deported to Oklahoma. These events greatly accelerated the state's land grant and public works programs, resulting, more than once, in the granting of more land to rail and canal companies than the state actually held and setting the moral and political tone for the state's future development. Little has changed. Florida remains a society of sycophants whose mission was eloquently contained in the words of a south Florida city redevelopment board member (and land speculator) who covered his microphone in a public hearing and said, "You don't mind if we make a little money, do you?"

NORTH OF ORLANDO, forty-plus miles from Disney's fantastically created and sited "Tree of Life" exhibit in its new Animal Kingdom theme park, a bald cypress tree called the Senator stands in an isolated county park which sits like the island of Alcatraz in a sea of subdivision behind a chain-link fence. The Senator was dedicated in 1929 by President Calvin Coolidge.

Recently opened, Disney's "Tree" is 145 feet tall, 20 feet taller than the Senator, over twice as wide (50 feet) and features a large theater (430 seats) inside its trunk which tells the Disney Nature Story like it has never been told before. An Ozymandian monument to metaphor for all things great and well-intended, the "Tree" took thousands of people and 18 months to build. The Senator took between 3,000–3,500 years to grow, the old-fashioned result of a small seed—plucked from one of the smallest pine cones found in Nature, and a bit of luck. The "Tree" is immensely popular with its animation and high fidelity. The real one is not. No lines. No waiting.

Not long ago in either geological or human time, Florida's woods were as ancient and as vast as any attraction's fabrication; its cypress groves comparable to California's magnificent stands of sequoia. The place that was Florida held some of the most diverse temperate and sub-tropical forests in the world; its oaks, pines, cypress, and mahogany were highly valued by an expanding nation. Who would believe that Florida's forests hoisted the sails and built the bows of the world's greatest sailing ships?

For nearly two centuries it was the naval store to the world, but by the end of the nineteenth century, all that remained were the poorest and the palest. Except for a few like the Senator, Florida's great trees, and the ancient forests they represented, were gone. They fell, and are falling still, to a culture of convenience and dreams of the good life, without end.

With them has fallen our memory and sense of wild and wooded places, our connections to deeper time. In the culture of self-absorption and speed, there is no deep time—no before and no after, only the now and the new. By design, its spaces are timeless and clockless places where each tick of our all-consuming lives is planned and programmed down to the smallest detail. In a state of increasing heat, density, and crime, Florida's malls and strip centers are the roomiest, coolest, and safest places to be. There, our burdens and worries are lifted. They are places of peace and comfort. In them, we can be happy and safe, as long as we never leave the building.

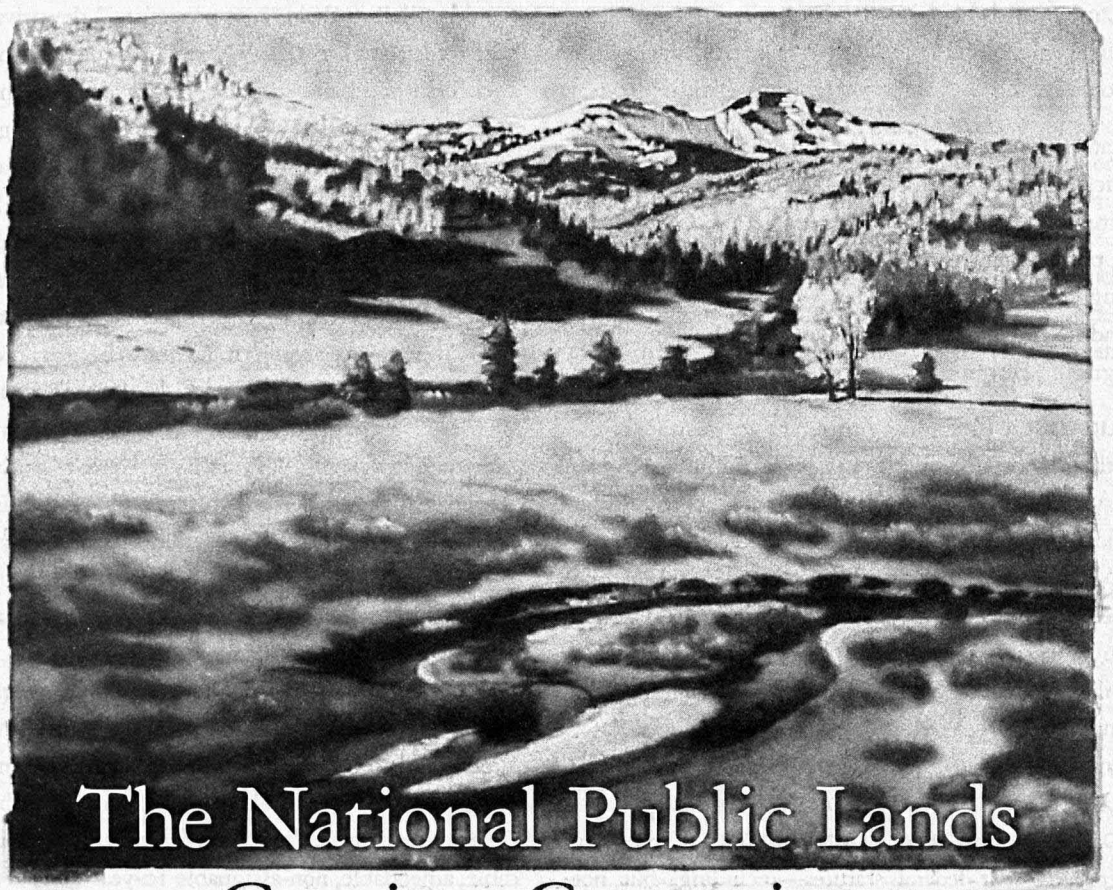
BEFORE DAWN, a sliver of a newborn moon rises over the lake. Cypress frame the shore. A thin, soft light washes through the opening branches. Fall has nearly ended. The air bites like winter. A hoot owl warms the wind with its call, sounded in a series of short dots and one long dash. First one and then another. And then the woods are still again, as deep as the darkness. The tiny moon comforts like a nightlight in a child's room.

The moon purrs from orange to white. A brightening glow hums below the horizon, painting the clouds pink and purple above the shoreline as the lake softly drums bluish-gray like an open kettle. Fog whispers above the surface and through the trees taps a trio of pileated woodpeckers. Over the basin, a stretched chevron of sandhill cranes make their ancient wooden calls, one to another. The night's work is done. Soon, the sun will rise.

Morning has come.

In the sharpening light, the effects of three years' drought on the lake are stark. The shore is wider now, exposing the stumps of old, forgotten forests. In this sweet and still Florida place, described by John Muir as "full of influences," I discovered the bones of an ancient cypress. Buried beneath a century of mud and detritus, its base measured nearly three steps across. It rivaled the Senator. And then I found the bones of another. And then another, taken all by logging and the cornucopian presumption that there will always be more. Standing on the edge of a graveyard in the garden of deep time, I knew there was not. There were only bones and the sliver of a newborn moon. ☾

A third-generation native, photographer **Joel McEachern** *is completing work on his first book of Florida's vanishing landscape entitled* Picturing Grace, Florida at First Light. *Widely published, exhibited, and collected, his images are made without filter or effect. A sampling of his work may be seen at www.itheo.com (keyword search: Florida).*



The National Public Lands Grazing Campaign

by Mark Salvo and Andy Kerr

DOMESTIC LIVESTOCK have done more damage to western federal public lands than the bulldozer and chainsaw combined. Not only have livestock been degrading the landscape longer than developers, miners, and loggers, they have also grazed nearly everywhere. Cattle, sheep, horses, and goats chew and defecate their way through grasslands, deserts, and forests managed by the Bureau of Land Management (BLM), U.S. Forest Service, U.S. Fish and Wildlife Service, and the National Park Service. A huge body of scientific literature describes how these livestock threaten sensitive species, trample vegetation, steal forage from native wildlife, accelerate soil erosion, spread noxious weeds, alter natural fire regimes, and reduce water quantity and quality.[1]

The federal grazing program operates at a loss, costing taxpayers at least $500 million annually.[2] This figure includes direct program costs and millions of dollars spent each year—on emergency feed, drought and flood relief, and predator control—to support public lands grazing.

In addition to being ecologically destructive and economically irrational, federal public lands grazing makes negligible contributions to western state economies and domestic beef supplies. Less than 3% of livestock producers in the United States (approximately 27,000) have permits to graze federal public lands.[3] These lands supply less than 2% of total feed for livestock in the United States[4] and provide less than 3% of American beef.[5] Public lands ranching jobs represent only a fraction of 1% of employment in eleven western states, while income from public lands ranching is less than half of 1% of total income for those states.[6]

Challenging the status quo

The National Public Lands Grazing Campaign is a multi-year, multi-organization effort to end abusive, fiscally wasteful live-

watercolor by Amy Grogan

stock grazing on federal public lands. A steering committee representing conservation activists and organizations across the West is coordinating the campaign, which is working to:

- educate the American people about the ecological, economic, and social harm caused by public lands livestock grazing;
- hold public lands graziers accountable for their activity through full enforcement of environmental laws; and
- amend federal law to allow the voluntary buyout of federal grazing permits.

PUBLIC EDUCATION. Most Americans are unaware of the damage that livestock grazing causes to public land and resources. Among other educational activities, the campaign will promote and help distribute a book, *Welfare Ranching: The Subsidized Destruction of the American West* (to be published by Island Press in 2002), featuring nearly 400 pages of articles and photographs that provide a portrait of public lands grazing from its historical roots in the cowboy myth to its present burden on taxpayers, ecological impacts, and social harms. [A pre-publication excerpt from *Welfare Ranching* appears on page 52 of this issue.]

ENFORCEMENT AND ACCOUNTABILITY. If properly administered, current federal statutes—including, but not limited to, the Endangered Species Act, Clean Water Act, National Forest Management Act, and the Federal Land Policy and Management Act—would dramatically reduce or possibly even eliminate public lands grazing. Member organizations in the campaign and other conservationists are increasing enforcement efforts through administrative appeals, litigation, species listing efforts, and by participating as interested parties in new federal land management planning processes.

LEGISLATIVE AND ADMINISTRATIVE REFORM. The National Public Lands Grazing Campaign is advocating for legislation to allow permanent retirement of federal grazing permits voluntarily relinquished by public land grazing permittees in exchange for compensation. The campaign is also seeking administrative reform to allow third parties to facilitate permanent permit retirement.

Federal grazing permit buyout

Central to our effort is the creation of a federal grazing permit buyout program: we support legislation that authorizes—and funds—the federal government to purchase current grazing permits from willing sellers, retire the permits, and reallocate forage to wildlife and watersheds. Participants in the program would still own their "base properties," the private lands to which the federal grazing permits are attached, and could use their cash windfall for any purpose. Some might choose to reinvest in ranching by purchasing more private grazing land elsewhere, some might start new businesses such as a hunting guide service or bed and breakfast, and some might retire.[7]

Current law generally requires agency managers to transfer grazing permits to other ranchers upon the resignation or retirement of the previous permittee. (Permits are cancelled without permittee consent in rare cases by court order or when Congress so directs, such as within a national park.) However, there are examples where conservation organizations, livestock operators, and land managers have worked creatively within the bounds of current law to retire permits. In some cases, Congress has also passed legislation that explicitly authorized permit retirement on specially designated land.

Grazing permits issued under the Taylor Grazing Act of 1934 allow permittees the *privilege* to use publicly owned forage. The permits do not convey a *right* to graze federal lands. This distinction was intended by Congress in the act,[8] articulated in agency regulations,[9] restated in federal grazing studies,[10] confirmed by scholars,[11] and upheld by the Supreme Court as recently as 2000.[12] Federal grazing permits are revocable, amendable, non-assignable 10-year licenses that do not convey property rights.

Despite their indefinite (and sometimes volatile) nature, grazing permits have carried a market value since the passage of the Taylor Grazing Act, which created exclusive grazing allotments out of the public commons. Permit value is recognized by the real estate market,[13] Internal Revenue Service,[14] banks,[15] and economists[16] (and, of course, permittees). The value of grazing permits is sustained by a preference system that advises federal agencies to reissue grazing permits every 10 years to the same permittee if the operation is in good standing. The expectation that public lands livestock operations will retain their permits for as long as desired—and that such permits will be routinely transferred to any new owner of the base property (as long as the new owner agrees to graze the public allotment)—has encouraged ranchers to rely on their value for financial planning purposes. For better or worse, permits have become part of ranch value. Presently, many public lands ranches are burdened by long-term debt, poor debt/equity ratios, and limited income.

To encourage participation in a voluntary permit buyout program, the National Public Lands Grazing Campaign proposes compensating grazing permittees and leasees at a very

generous $175 per animal unit month (AUM). (Livestock use is measured in animal unit months, which is the amount of forage necessary to feed a cow and calf for one month.) Although this rate is more than the fair market value for grazing permits,[17] over time it would still deliver tremendous savings to the federal treasury (taxpayers), financial liberation for many public lands ranchers, and incalculable ecological benefits. At this rate, the payback to the taxpayers would take seven years. Considered another way, if voluntary permit buyout legislation is enacted, livestock grazing can be ended for an average of $13.45 for each public lands acre retired by the program.

Some conservationists argue that taxpayers should not have to pay ranchers to stop abusing, and profiting from, public lands. This is a good point. But we shouldn't have to pay to *continue* that abuse either, and that's what taxpayers are doing—at over half a billion dollars annually. We believe it is preferable to offer a one-time lump sum payment to public lands ranchers to leave the public domain rather than to continue to pay them forever to stay.

Support for permit buyout is increasing, and not only in the conservation community. There is some interest from the Bureau of Land Management and upper echelons of the Bush administration. Some land managers are retiring permits now, although the law discourages it. Free-market think tanks are supportive of the concept, although conservationists and libertarians differ on the details. Recognizing the limited success of our past strategies regarding public lands livestock grazing, the National Public Lands Grazing Campaign invites the conservation community to support and actively work for passage of legislation that creates a voluntary permit retirement program. We believe such a strategy is a socially compassionate, administratively efficient, politically expedient, and ecologically responsible way to end abusive livestock grazing on federal public lands.[18] ☾

Mark Salvo *(mark@americanlands.org) is grasslands and deserts advocate for American Lands. He has been detached to the National Public Lands Grazing Campaign to serve as legislative counsel.* **Andy Kerr** *(www.andykerr.net) is the director of the National Public Lands Grazing Campaign. A pragmatic conservationist, he believes there is no limit to the good that can be done with other peoples' money.* *More information on the National Public Lands Grazing Campaign may be found at www.publiclandsranching.org. To subscribe to a campaign listserv, send an e-mail message to: campaign-subscribe@yahoogroups.com.*

NOTES

1. To review the most pervasive and destructive use of the public domain, see Debra L. Donahue, 1999, *The Western Range Revisited: Removing Livestock from Public Lands to Conserve Native Biodiversity*, Norman, OK: University of Oklahoma Press (history of BLM public lands grazing); Lynn Jacobs, 1991, *Waste of the West: Public Lands Ranching*, Tucson, AZ: Lynn Jacobs (environmental, economic, and social impacts of federal grazing program); A. J. Belsky, 1987, The effects of grazing: Confounding ecosystem, community, and organism scales, *American Naturalist* 127: 870–892 (ecosystems); A. J. Belsky and D. M. Blumenthal, 1997, Effects of livestock grazing on stand dynamics and soils in upland forests of the interior West, *Conservation Biology* 11: 315–327 (upland forests, soil); A. J. Belsky, A. Matzke, S. Uselman, 1999, Survey of livestock influences on stream and riparian ecosystems in the western United States, *Journal of Soil and Water Conservation* 54(1): 419–431 (streams, riparian areas); T. L. Fleischner, 1994, Ecological costs of livestock grazing in western North America, *Conservation Biology* 8: 629–644 (ecosystems, riparian areas); D. Wilcove, D. Rothstein, J. Dubow, A. Phillips, E. Losos, 1998, Quantifying threats to imperiled species in the United States, *Bioscience* 48(8): 607–615 (endangered species); J. L. Gelbard and A. J. Belsky, 1999, Contributions of livestock grazing to exotic plant invasions in rangelands of the Intermountain West, *Conservation Biology* (in press) (invasive species); J. Horning, 1994, Grazing to extinction: Endangered, threatened and candidate species imperiled by livestock grazing on western public lands, Washington, D.C.: National Wildlife Federation (sensitive species).
2. K. Hess and J. H. Wald, 1995, Grazing reform: Here's the answer, *High Country News* 27(18).
3. Grazing permits for BLM and Forest Service allotments (includes sheep growers and accounts for permittees who operate on both BLM and Forest Service allotments). USDI-BLM, USDA-Forest Service, 1995, Rangeland reform '94 final environmental impact statement, Washington, D.C.: USDI-BLM, 3, 26; see also P. Rogers, 1999, Cash cows, *San Jose Mercury News* (Nov. 7): 2S (reporting 26,300 permittees on BLM and Forest Service allotments).
4. USDI-BLM, 1992, Grazing fee review and evaluation: Update of the 1986 final report, Washington, D.C.: USDI-BLM, 2.
5. These jobs represent 0.06% of total employment for the western states containing the bulk of federal grazing allotments (AZ, CA, CO, ID, MT, NV, NM, OR, UT, WA, WY). P. Rogers, 1999, Cash cows, *San Jose Mercury News* (Nov. 7): 1S; L. Jacobs, 1992, *The Waste of the West: Public Lands Ranching,* Tucson, AZ: Lynn Jacobs, 354.
6. Federal grazing income represents 0.04% of the aforementioned states' total. T. Power, 1998, *Lost Landscapes and Failed Economics: The Search for a Value of Place,* Washington, D.C.: Island Press, 184–185.
7. See A. Kerr, 1998, The voluntary retirement option for federal public lands grazing permittees, *Rangelands* 20(5): 26–29 (simultaneously published in *Wild Earth* 8[3]: 63–67).
8. 43 U.S. Code, sec. 315b.
9. See, e.g., 36 Code Fed. Reg. 222.3(b).
10. USDI-BLM, USDA-Forest Service, 1995, Rangeland reform '94 final environmental impact statement, Washington, D.C.: USDI-BLM, 125.
11. D. Donahue, 1999, *The Western Range Revisited: Removing Livestock from Public Lands to Conserve Native Biodiversity.* Norman, OK: University of Oklahoma Press, 38.
12. Public Lands Council v. Babbitt, 2000, 529 U.S. 728, 741.
13. J. M. Fowler and J. R. Gray, 1980, *Market Values of Federal Grazing Permits in New Mexico,* Las Cruces, NM: New Mexico State University, Cooperative Extension Service, Range Improvement Task Force.
14. L. A. Torell and J. P. Doll, 1991, Public land policy and the value of grazing permits, *Western Journal of Agricultural Economics* 16(1): 174–184.
15. M. Salvo, 2001, Forest Service escrow waivers: Collateralizing federal grazing permits for private debt, in *Welfare Ranching: The Subsidized Destruction of the American West* (in press).
16. J. R. Winter and J. K. Whittaker, 1981, The relationship between private ranchland prices and public-land grazing permits, *Land Economics* 57(3): 414–421.
17. Approximately $75 per animal unit month across the West. A. Kerr, 1998, The voluntary retirement option for federal public lands grazing permittees, *Rangelands* 20(5): 26–29 (simultaneously published in *Wild Earth* 8[3]: 63–67).
18. See M. Salvo and A. Kerr, 2001, Permits for cash: A fair and equitable resolution to the public land range war, *Rangelands* 23(1): 22–24.

Pedaling Conservation Biology Across America

by Christopher Pyke
and Britta Bierwagen

A CLASSIC CALIFORNIA EVENING on Wilshire Boulevard: Golden sun shimmered through the exhaust of six lanes of bumper-to-bumper traffic and an additional eight lanes of interstate roared above our heads. Riding our loaded tandem bicycle, we clung to the ragged shoulder of the road, heads pivoting, jaws clenched, eyes drawn to narrow slits, tense. Despite our defensive maneuvers, a simple thought swept through our minds: "We're going to die here!" To our surprise, we didn't die, and, instead, we went on to pedal 3,300 miles while visiting over 5,000 students across 11 states. The question is, why were two conservation biologists riding a tandem bicycle in the middle of Los Angeles?

During the summer of 1998 we had a crazy idea: we wanted to ride our bicycle across the country talking to kids about conservation biology. The sum of our experiences with outdoor education, the adventures of friends, and lessons in the classroom had left us feeling that despite the biodiversity crisis, people remain stunningly unaware of either the fundamentals of biology or the tools that can be applied to protect and recover species. We felt that we might make a little difference by sharing our knowledge and passion about conservation biology with school children across America. Two years later, our crazy idea found us in the heart of Los Angeles during rush hour: scared, exhausted—and exhilarated. The idea had evolved into a national education and outreach project—which we called Spinning toward Solutions—with the goal of spreading the word about conserving endangered species.

We found sponsors and made preliminary contact with teachers, but needed to firm up our route and lock in some audiences. Common sense suggests that finding students shouldn't be so hard. Our neighborhoods are full of schools, each teeming with kids and teachers that presumably are longing for a visit from a conservation biologist. Although we quickly realized that things aren't so simple, we did discover one efficient strategy for finding students. By using an existing network of schools that would provide contact information and a connection with teachers, doors opened that seemed closed when we simply knocked on our own. We ended up working with an international environmental education program called GLOBE (Global Learning and Observation to Benefit the

Environment), which coordinates a network of over 9,000 schools in the United States and 75 other countries. By visiting their website and contacting GLOBE administrators, we were able to contact environmentally motivated teachers across the country. We received a letter of introduction from the GLOBE program, encouraging teachers to invite us into their classrooms—and they did. We sent out mass mailings to GLOBE schools along our route. The return rate was about 15%, and surprisingly, those that replied stayed with us throughout the project. We ended up visiting over 95% of the schools that responded to our initial mailings.

On September 6, 2000, we rolled out of Santa Barbara, California, weaving down the road with a daunting load. We traveled without vehicular support, only a cell phone and a repair kit to bail us out. At first, we were nervous and "green," intimidated by rooms full of kids, car-filled streets, and deserted desert roads. Despite its ungainly performance in traffic, the tandem proved to be an exceptional conversation starter, and it certainly caught kids' attention. In the classroom, we would begin the show with a travelogue of our route, a show-and-tell tour of the bike, and a basic geography lesson as a segue to start talking about ecoregions, geographic ranges, and sources of ecological rarity. Next, we would share a set of regional conservation success stories, including the recovery of sea otters and California condors in the West, Mexican gray wolves in the Southwest, Atwater's prairie chicken in Texas, and Florida panthers and bald eagles in the Southeast.

We felt that introducing conservation biology as a series of successes would capture students' attention. One could quibble about the definition of success for any of these examples, but each served as an upbeat entrance for talking about general ecological concepts and threats to biodiversity: habitat loss and fragmentation, exotic species, pollution, and so forth. The goal was to give a sense of ecological cause and effect, while also leaving a sense of hope—a sense that it is possible to use biology to help imperiled species.

We didn't pick an easy start for our trip. On day two, we hit Los Angeles. Diving in, we visited L.A. High and Rossmoor Elementary before heading south toward San Diego. These first schools gave us an idea of the diversity of educational environments that we would encounter: industrial chain-link fencing encloses downtown L.A. High; green lawns surround suburban Rossmoor Elementary. The consistently warm receptions were amazing, and soon the thought of audiences ahead pulled us down the road. We visited affluent elementary students in La Jolla, recent immigrants in San Diego, and, after a brutally hot trip across the desert, suburban kids in Phoenix.

Early on, we started seeing a pattern in our teachers. Some were uncomfortable with biology, dodging it if they could. Others were well informed and motivated, but short on time or resources. Beyond that, many teachers worked under the heavy hand of state educational standards. Those interested in a national strategy for conservation education should take heed: If conservation biology is not in the standards, it won't be taught in most classrooms. The exceptions to this rule were notable. We met teachers who include biodiversity and endangered species education in their curriculum because they have a personal interest, personal knowledge, or a personal sense that it's important for their students. Note the emphasis on "personal"; most of these teachers are covering these topics in addition to their existing responsibilities, often skillfully filling cracks in standards with conservation content.

Those interested in a national strategy for conservation education should take heed: If conservation biology is not in the standards, it won't be taught in most classrooms.

Moving east, we crossed the Rockies and spilled into the mid-continent along the Rio Grande. In the El Paso suburbs, we met motivated teachers and middle-class kids you might expect in "Anytown," U.S.A. In downtown El Paso, we met motivated teachers and low-income kids living lives that straddle the border. With the contrast in cultures, we were forced to ask just what our message meant to these audiences. At one El Paso school, we were thoroughly confused by an audience of fifth graders that kept asking us strange but sincere questions, such as, "Have you seen a rhinoceros or a giraffe on your bike ride?" After the students left, one of the teachers took us aside to explain. She said her students experience wildlife only through glossy books in the library and National Geographic on TV. The kids really wanted to participate in our discussion, and this was as close as they could get. We were shocked. These kids, some almost teenagers, couldn't come closer to identifying their local wildlife than the plains of Africa!

In the end, we felt that the effects of our presence at a school fell into two categories: (1) *Reinforcement*. As fresh faces with an aura of legitimacy, we repackaged things they already knew. (2) *Inspiration*. For some students, issues like endangered species and biodiversity are pretty ethereal—no matter how hard we tried to push their immediacy. However, these audiences took home other messages. Hopefully, they had a positive encounter with a pair of young, motivated scientists. They saw two people doing something tangible in support of the natural world. In our experience with Spinning toward Solutions, the well-resourced, high-achieving schools took home a reinforcing message, while schools with more challenged populations latched onto our project for its potential to inspire students. Appreciating both of these components of our project helped us adapt to sometimes-unfamiliar audiences.

Rolling out of Texas put us on the home stretch. The distribution of GLOBE schools essentially parallels that of the population at large, so as we moved east, schools became closer together. We pedaled into autumn with schools in Baton Rouge, Jackson (Mississippi), Birmingham, Atlanta, Gainesville (South Carolina), and Chapel Hill. Despite many positive experiences, we sometimes felt that we were traveling through "enemy territory." The liberal tendencies of the West Coast slipped away, and we encountered more skepticism and less general knowledge about biodiversity and endangered species. One middle school teacher asked us to visit her students, but she quickly emphasized that her church-affiliated school didn't permit the teaching of evolution. Initially, we weren't sure how to present the concept of extinction in the absence of evolution, but we ended up giving the talk. The experience felt tense and guarded as we skirted around the (to us) obvious implications. Sometimes we did the best we could with the "inspiration" component of our ride.

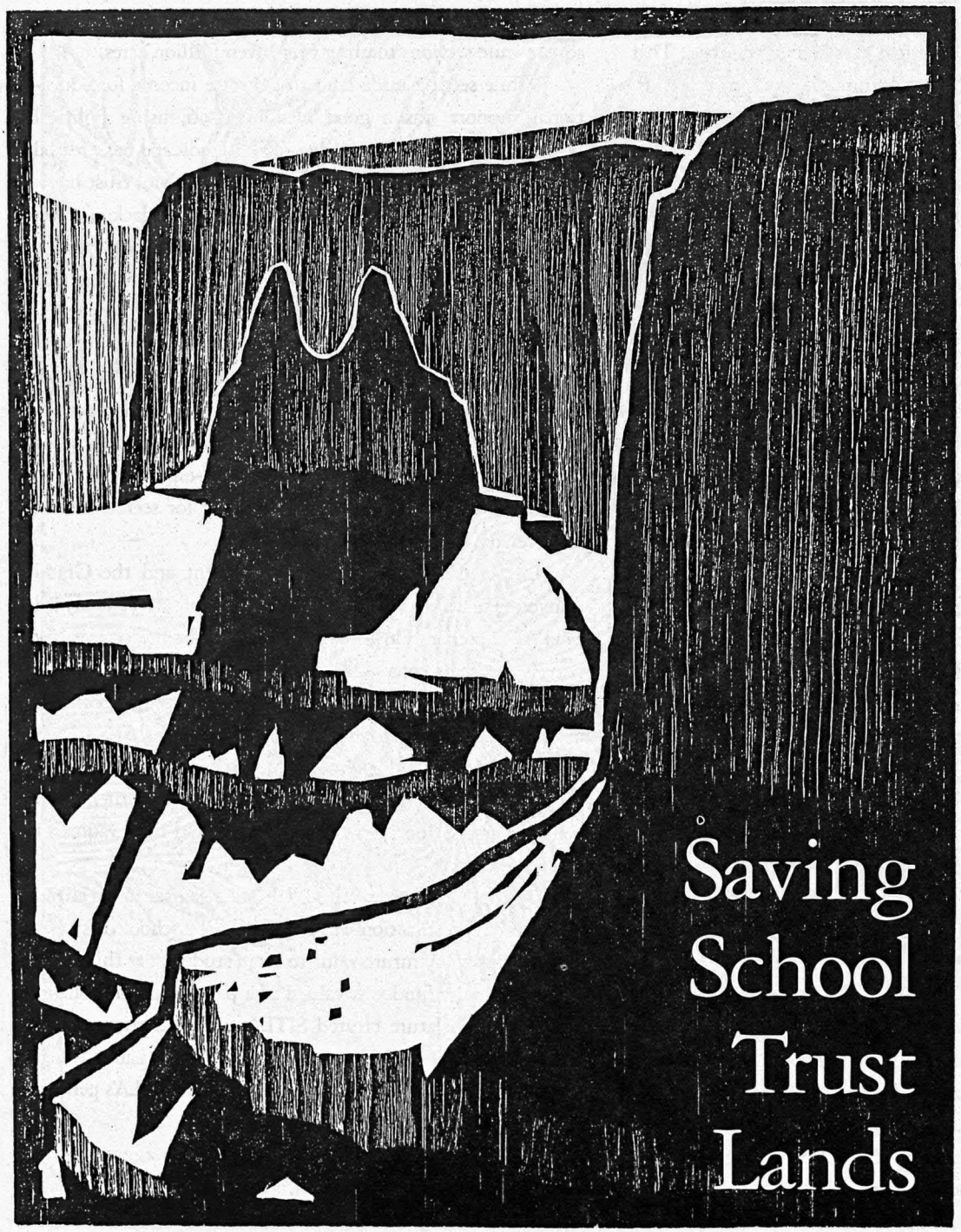
Happily this trend had exceptions. In Atlanta, seventh and eighth grade students at Salem Middle School have knowledge of biodiversity that would make a college professor smile. In Gainesville, inspired teachers help students with endangered species case studies. And, in the educational enclave of Chapel Hill, even second graders know the basics of ecosystems and their role in protecting watersheds. We finished the expedition with a day-long marathon of talks to over 500 students at Jamestown Elementary School in Arlington, Virginia. The enthusiastic students at Jamestown had followed our ride from the start on the Web and met us with stories, pictures, and even a song about our trip.

After 3,300 miles on the road, 5,600 kids, 45 schools, and 80 days, what did we learn about conservation education? We now recognize the importance of "events" in education; our project fits in a class of activities that might be called "event-based outreach and education." These projects complement and reinforce such programs as GLOBE or other scientist-in-the-classroom programs, and, perhaps, energize more sustained contacts with students. Our ride maximized the return on our investment: We directly reached a large number of kids in a short amount of time, supplemented these contacts with indirect exposure through media and the Internet, and created a situation that attracted attention and exploited it to convey our message. This scenario is common in the world of marketing and communications, but an unusual tactic for scientists. The endeavor might be seen as part of a process of foundation building, with a long-term goal of creating an ecologically informed citizenry and a constituency for conservation. When specific issues arise, conservationists will then be able to draw on these existing assets, rather than attempting to educate people in the heat of the moment—when positions are most polarized and minds the least open to new ideas. In a time when sense of place and knowledge of natural history are waning, we believe that conservationists can take individual action to inspire students and adults with our passion about biodiversity and endangered species. This process of grassroots foundation building provides exceptional opportunities for investing in long-term conservation success. ☾

Chris Pyke *is a doctoral candidate in the Department of Geography at the University of California, Santa Barbara. He is interested in wetland ecology and conservation planning.* **Britta Bierwagen** *is a doctoral candidate in the Bren School of Environmental Science and Management at the University of California, Santa Barbara, and works as the outreach coordinator for the National Center for Ecological Analysis and Synthesis. Her research interests include the movement and evolutionary adaptation of butterflies under conditions of landscape change.*

RESOURCES

Spinning toward Solutions www.spinningsolutions.org
The Society for Conservation Biology www.conbio.net
The National Center for Ecological Analysis and Synthesis
Kids Do Ecology program www.nceas.ucsb.edu/nceas-web/kids
The GLOBE program www.globe.gov
See a specific example of GLOBE student data in action *"Young Students, Satellites Aid Understanding of Climate-Biosphere Link" by Michael A. White, Mark D. Schwartz, and Steven W. Running* www.agu.org/eos_elec/99199e.html



Saving School Trust Lands

A Utah Community Chooses Conservation and Education

by Brooke Williams

EARLY ONE MORNING in late June, 1999, I noticed something peculiar while driving the Loop Road through my home region of southeastern Utah. The Loop Road runs from the Colorado River up through Castle Valley into the Lasal Mountains and down into Moab the back way. The one hundred homes that make up the town of Castle Valley spread west of the road. My wife and I live in one of those homes and drive the Loop Road

southern Utah canyon, woodcut by Patrick Dengate

frequently to access the canyons cutting into the huge Windgate sandstone mesas on the east side of the road. That morning, the sun was just rising through a gap in the cliffs, tossing broad shadows like blankets over most of the valley as I passed by one of the only pieces of private land on the east side of the road—60 acres at the base of Parriot Mesa. I noticed that the For Sale sign that had been there for over a month was gone.

That same morning, an Arches National Park employee was opening the visitor center entrance when two German tourists approached her.

"We would like to inquire about buying the arch," one of them said in broken English. The park employee didn't have any idea what they were talking about. No arches were for sale, then or ever.

"The North Window," the tourist said. By this time the park employee was thinking about adding this story to her collection of weird things tourists say. "No arches are for sale," she said.

"Yes. There is a sign. We have a number to call."

Before the day was over, the mystery had been solved.

Someone had moved the For Sale sign from Castle Valley to Arches to make a point. Over the past several years, residents of this region have discovered that what we thought were public lands may be up for grabs to the highest bidder. While most of the land on the east side of the Loop Road is federal public land under the jurisdiction of the Bureau of Land Management, the Utah division of School and Institutional Trust Land Administration (SITLA) owns a number of parcels. Castle Valley residents had believed that SITLA lands were safe from development and in the same category as national parks, BLM lands, and other public lands—until May 19, 1999, when SITLA held its first auction for a piece of their holdings in Castle Valley. Those 60 acres on the Loop Road at the base of Parriot Mesa sold to a developer from Aspen and his Moab partner. The buyers immediately put the parcel up for sale thinking that they might double their money before beginning any development plans. The sign lasted a month before it was stolen. We never saw it there again.

CERTAIN UTAH MAPS are peppered with blue squares, each representing a square mile of SITLA land. Close inspection reveals a regular pattern to the placement of those squares. Utah is divided into six-mile-square townships and divided again into 36 square-mile sections. At statehood, the U.S. Congress gave the state the same four sections in every township—sections 2, 16, 32, and 36. This amounted to 9,000 square-mile sections totaling over seven million acres.

While setting aside land to generate income for educational support was a good idea in 1896, using political boundaries with no knowledge of the landscape has created problems. First, a significant percentage of school trust holdings is land with limited economic value due to lack of water and access or impossible terrain. Second, many holdings are found within areas considered valuable for their wilderness, scenic, or wildlife resources. These include wilderness study areas, national parks and monuments, wildlife corridors, and refuges. The first problem has left the trust with land they may never be able to sell. The second has created serious public relations problems for SITLA as they consider selling for development lands which Utah residents—especially those in rural areas—and global tourists count on for scenic beauty, biodiversity, and wildness.

Bill Hedden, a Castle Valley resident and the Grand Canyon Trust's southeastern Utah representative, analyzed SITLA in preparation for making a case for preserving key parcels for their conservation values. He has found that by 1983, more than half of the land allocated to the school trust at statehood had been sold at prices averaging $16.50 per acre. Not only have the keepers of the school trust practically given away half of their legacy, but they have sold their most valuable assets, those within a one-hundred-mile radius of Salt Lake City.

By the early 1990s, the Utah state legislature realized that some reorganization was required if the school trust was going to have any future value to Utah students; at this time, the school trust fund was valued at a paltry $42 million. In 1994, the legislature created SITLA, a new department of state government, replacing the Division of State Lands. With this new legislation, the goal was set to build SITLA's permanent fund to $1 billion by the year 2007.

To reach this goal, SITLA became more aggressive in leasing trust holdings for oil, gas, and mineral exploration and extraction. The agency began trading inholdings in national parks and monuments for more productive and less controversial parcels. It scheduled regular auctions to sell parcels with development potential. Recently, new legislation enabled SITLA to enter into limited liability relationships with private individuals and corporations to develop housing, tourism, and industrial developments. Due to this restructuring and a booming stock market, the fund balance showed $377 million in June of 2000.

dead juniper, southern Utah, woodcut by Patrick Dengate

CASTLE VALLEY IS TEN THOUSAND acres of intermittent creeks, sagebrush flats, and grassy knolls formed when a subterranean salt dome collapsed millions of years ago. It is surrounded on two sides by nearly impenetrable sandstone cliffs. The Lasal Mountains form one end of the valley and the low Chinle Hills dropping into the Colorado River the other. Because of the vertical barriers making up most of the area's geography, Castle Valley is a key wildlife corridor between the Lasal Mountains and the Colorado River. As residents, we witness cougar tracks; we keep our cats inside in the late summer when the coyote pups are learning to hunt; and we know which plants to protect from the large deer herds passing like graceful brown tides through our yards morning and night.

The town proper—a cattle ranch subdivided in the late 1960s into five-acre rectangles—covers approximately one-quarter of the valley. There is one paved road, no municipal water or sewer, and no commercial development. People buy lots in Castle Valley for two reasons—its seclusion or its mind-numbing beauty. Castle Valley landowners fall into every category—from those who consider themselves environmentalists and have gained a reputation throughout Grand County as being "anti-everything," to anti-government, godfearing people practicing their private property rights, home-schooling their children, and growing their gardens.

The threat of development on school trust lands has been the most unifying issue in the town's history; most Castle Valley residents feel that selling any of the scenic property surrounding the town is akin to selling off Arches National Park an arch at a time. For a small, motivated group of residents who have been unwavering in the belief that a community can control its own future, the moving of the For Sale sign marked the end of activism and the beginning of advocacy.

Activists work to stop bad stuff. Advocates work to promote good stuff. Both are important. Upon first hearing that SITLA would be selling a piece of Castle Valley land, the local "activists" began exploring ways of stopping the sale. After a series of discussions, numerous phone calls, and a serious reading of the state's constitutional mandate for SITLA, we determined that stopping the sale of school trust lands would not be possible using typical activist techniques.

Thus, the Castle Rock Collaboration (CRC) was formed to advocate for—to promote—Castle Valley's wonder and beauty in hope of convincing SITLA to leave their 4,500 acres in our valley alone. Rather than start from scratch, CRC became a branch of Utah Open Lands, a land trust under the directorship of Wendy Fisher that has preserved over 7,000 acres of Utah's open space. Although Wendy's knowledge and fundraising experience combined with the commitment, persistence, and belief of the Castle Valley community is a potent brew, CRC learned early that achieving its goal would not be simple. The fact that SITLA cannot take beauty to the bank is something that they not only firmly believe, but flaunt.

Since SITLA's job is to watch over the "interest of the school and institutional trust beneficiary regardless of any conflicting public use or purpose," and since the beneficiaries of this "sacred trust" are public schools, state colleges and universities, state hospitals, and schools for the deaf and blind, any efforts to actively oppose SITLA would be seen as being against educating the state's students.

Since its inception, the Castle Rock Collaboration has asked the question, "what can we advocate for?" and worked to create the proverbial win/win situation from which other communities might take heart. The community damage and sprawl that SITLA has created elsewhere (on desert tortoise habitat in Washington County, for example), plus the level of control they seem to have on the future of many rural communities, has been the subject of many high-level state government meetings. CRC knows that SITLA needs a good story to offset its reputation and, by working to ensure protection for the land as well as funding for schools, we are trying eagerly to create that story.

It hasn't been easy. Ric McBrier, a former real estate attorney and the director of SITLA's development division, is spending a lot of his time on the Castle Valley project. He's tough and focused on one thing: increasing SITLA's permanent fund. He knows that CRC is committed to a 100% conservation solution, but insists that development is the highest value, and will not acknowledge our belief that enough money can be raised to pay SITLA what the land is worth and preserve it.

By the end of 1999, the Castle Rock Collaboration had created a two-pronged approach. On one hand, we developed a program to raise awareness of the SITLA issue by planning slide shows and talks, scheduling spring evening programs with world-class climbers Kitty Calhoun and Greg Childs, and wildlife photographer Jeff Foott, all Castle Valley residents. Terry Tempest Williams, also a Castle Valley resident, convinced her publisher to unveil her new book, *Leap,* at Moab's Back of Beyond bookshop, which donated part of the proceeds from its sale to CRC. On the other hand, CRC

On good days, Castle Rock Collaboration members are confident we'll be able to raise the money. On bad days, we're sure that SITLA has developers waiting in line to surround our town with new subdivisions.

focused on Ric McBrier with the immediate goal of convincing him to temporarily suspend the sale of future school trust lands in Castle Valley.

Since the Parriot Mesa parcel sold at a price that seemed high for land values in the area, SITLA was planning the auction of two additional sections totaling 220 acres at the base of Castleton Tower for May of 2000. Castleton Tower (Castle Rock to the locals) is the valley icon, star of numerous television commercials and rock videos, and one of America's Fifty Classic rock climbs. After months of negotiation, SITLA acknowledged that an overall plan for their Castle Valley holdings was necessary. In exchange for CRC's participation in an extensive planning process and the agreement to keep the proceedings out of the political arena, SITLA placed a moratorium on Castle Valley sales.

The Castle Rock Collaboration is nearing completion of the first step toward accomplishing the envisioned "win/win" situation: Castle Valley residents now have some say in determining which SITLA parcels have development potential and which should be protected. We are also working out the details that will allow us to have the first option to buy SITLA land. As we work through the planning process, we hope to get reasonable and accurate appraising and a sale schedule for the parcels that will allow time to raise the necessary funds. SITLA's goals for the process are to determine the non-developable areas and to create development zones, including determining the type and style of development to be used, which can help establish land value.

After an exhaustive search, SITLA and CRC agreed to hire Conservation Partners, Inc., from Boulder, Colorado, to oversee the planning process. CRC insisted on paying half of the $80,000 fee in order to have equal say. Thanks to private money from Kimery Wiltshire of Resources for Community Collaboration and John Shepard and Luther Propst from the Sonoran Institute, and public money from a planning grant offered by the state's Office of Planning and Budget, we have met that obligation.

After a year of planning, SITLA's Castle Valley land has been divided into seven parcels ranging in size from 141 acres to over 600 acres. These parcels include cliffs and arroyos and other "undevelopable" areas. CRC is working on a draft agreement that will determine when these parcels will go on the market, how long we will have to raise the required money to purchase them, and what will happen to the land if we fail.

On good days, Castle Rock Collaboration members are confident we'll be able to raise the money to meet the commitments resulting from the planning process. On bad days, we're sure that SITLA has developers waiting in line to surround our town with new subdivisions.

Whoever moved the For Sale sign from Parriot Mesa to Arches has stayed anonymous. It no longer matters. Just hours before bulldozers were scheduled to begin scraping residential lots into that land, Adair Bonsal and Wendy Fisher from Utah Open Lands convinced their board of directors to sign an option agreement, and thanks to generous donations from two private individuals and an intense fundraising effort, that property is close to being protected forever.

I go back to Parriot Mesa with my dog at least twice a week. Without the sign, it now blends in with all the land. There are cliffs and canyons full of deer and rabbits and red penstamon, and early this summer, if I squinted, the mules ear turned entire hillsides yellow. There are no interruptions. Now, since the purchase, the land there goes on forever, not just in space, but in time. ☾

Brooke Williams *writes magazine articles about conservation issues, travel, and wild places. In 1999, Island Press published his book,* Halflives—Reconciling Work and Wildness, *about who we really are and the price we pay for not acting that way. He also works on issues of sustainable development in rural Utah towns.* *For more information about the Castle Rock Collaboration, visit www.castlerockcollaboration.org.*

Precious Heritage

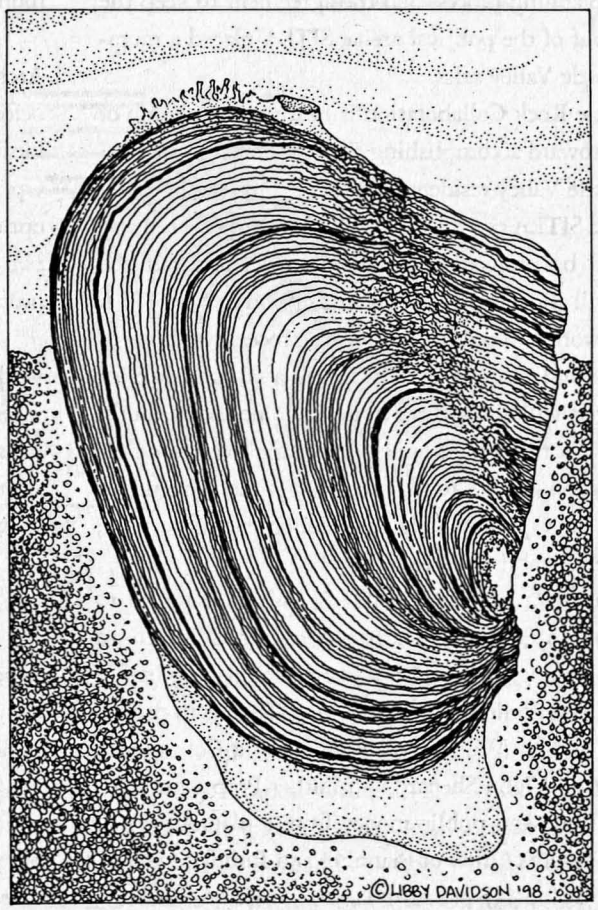
The Status of Biodiversity in the United States

edited by Bruce A. Stein, Lynn S. Kutner, and Jonathan S. Adams
Oxford University Press, 2000
416 pages, $45

MOST AMERICANS concerned with the loss of biodiversity have a favorite threatened species or habitat from the United States, such as the timber wolf, the peregrine falcon, the Everglades, or even the diminutive snail darter (which temporarily halted construction of a dam on the Little Tennessee River). Still, we know that most of the Earth's biodiversity as well as most of the global biodiversity "hotspots," as identified by high numbers of endemic plant and vertebrate species, lie in the tropics. What a pleasant surprise it is, therefore, to learn in this assessment from The Nature Conservancy (TNC) and the Association for Biodiversity Information how remarkable the biodiversity of the United States is compared to the world as a whole. Twenty-eight conservation biologists contributed to the 11 chapters in *Precious Heritage,* an informative and visually appealing survey.

This assessment began 25 years ago with the vision of Bob Jenkins, whose task was to provide scientific guidelines to TNC's priorities in acquiring land. Jenkins wanted synthetic information about biological diversity in the United States so that TNC's acquisitions would protect the ecologically richest places. He established the network of state natural heritage centers, and this book is a tribute to him. The natural heritage network developed its own system of evaluating the status of species and communities. For species, the status categories differ in details but are broadly similar to those of the World Conservation Monitoring Center (IUCN), which maintains the Red List of extinct and threatened species of the world. Data about the status of species for all 50 states have been compiled by natural heritage programs for 25 years. Over 200,000 species are estimated to inhabit the 50 United States; the status of over 30,000 species and subspecies has been assessed by the programs. Remarkably, for 14 major groups of plants and animals (totaling about 21,000 species), all U.S. species have been assessed, including all of the vertebrates, vascular plants, and several groups of invertebrates. That is the good news.

The bad news is that about one-third of these 21,000 species are extinct or at risk. It is sobering that the list of extinct and missing (possibly extinct) species occupies 13 pages of fine print. One hundred species are presumed extinct and 439 species are possibly extinct since European colonization began. By state, the greatest number of extinct species occurs in Hawaii (29 presumed extinct, 220 possibly extinct), Alabama (22 presumed, 74 possibly), and California (11 presumed, 24 possibly). The surprise here is Alabama, which gains this eminence from the diversity and vulnerability of its freshwater biota. Among the 14 groups assessed, freshwater animal groups are the most vulnerable, including freshwater mussels



pink heelsplitter mussel, pen-and-ink by Libby Davidson

(69% of species at risk), crayfishes (51% at risk), stoneflies (43% at risk), and freshwater fishes (37% at risk). Moreover, these aquatic groups have unusually high species numbers in the U.S., so the high percentages also reflect large numbers of species. The greatest number of species at risk for any of the 14 groups is over 5,000 at-risk flowering plant species. The groups with the smallest proportion of species at risk are birds (14%) and mammals (16%). Ironically, these groups receive the most public attention and conservation funding.

Precious Heritage gives considerable attention to geographic patterns and ecoregions. A rarity-weighted, species richness index reveals U.S. hotspots with high numbers of endemic species. The highest peaks on this richness landscape occur in Hawaii, two coastal regions of California, Death Valley, the southern Appalachians, and the Florida panhandle. Illustrated profiles of these hotspots summarize their natural history and conservation status.

A section on watersheds and aquatic biodiversity presents effective graphics. It is immediately clear that the southeastern U.S. holds a global treasure-house of aquatic biodiversity, much of it imperiled.

One chapter summarizes the transformation of ecological communities and biomes. Among the 13 major biomes present in the U.S., the most disturbed is the temperate deciduous forest of the East, with 94% of the original area disturbed, while tundra and arctic desert are the least disturbed, with about 1% of the original area disturbed. More than half of the ecological communities found in the United States are imperiled or vulnerable. These communities are concentrated in the eastern U.S. and Hawaii.

Threats to biodiversity across America include a familiar litany of proximate causes—habitat destruction, introduction of exotic species, pollution, overharvesting, and disease (in that order by percent of species affected). Habitat destruction affects 85% of the 1,200 species evaluated for causes of decline. Agriculture and commercial development of land are the leading components of habitat degradation.

On a more positive note, strategies for protection are reviewed. These include federal and private land acquisition and management, conservation easements and leases (under adoption in many areas), and other federal, state, and local regulations that apply to protection of species and habitats. Fewer than 10% of imperiled and federally listed species are on lands with the highest level of biodiversity protection, whereas about 75% of imperiled and listed species occur on lands that are open to intensive uses.

This pragmatic book emphasizes sound science as the foundation for conservation. I would have appreciated a section on the ethics of protecting biodiversity and a discussion of the cultural, political, and economic systems in which the threats to biodiversity are embedded. It will take systemic changes in values and politics, in addition to sound science and regulations, to safeguard even what currently remains of American (or global) biodiversity.

Precious Heritage is worth owning and is satisfying to read. The writing is interesting, the layout is attractive, the photographs are excellent (although I wish that some had been larger), and the paper is of high quality. The history and spatial analyses offer new perspectives to the conservation professional, while the "state of the states" chapter, the description of species monitoring and risk categories, and the causes of imperilment will be most valuable for the novice. The generalizations about U.S. biodiversity are well documented with tables, figures, appendices, and references, for anyone wanting to delve further into this subject.

Finally, *Precious Heritage* echoes several recurrent themes in *Wild Earth*—the emphasis on geographic patterns and connections, on conserving ecosystems in order to conserve species and ecological processes, and on the conflict between agriculture and biodiversity. I highly recommend this book for general reading, for college courses, and for persuading legislators of the opportunities for protecting unique, wonderful, and vulnerable species and ecosystems in the United States. ☾

Reviewed by **Catherine Badgley,** *director of the Environmental Studies Program at the University of Michigan.*

Borderland Jaguars

Tigres de la Frontera

by David E. Brown and Carlos A. López González
The University of Utah Press, 2001
170 pages, $14.95

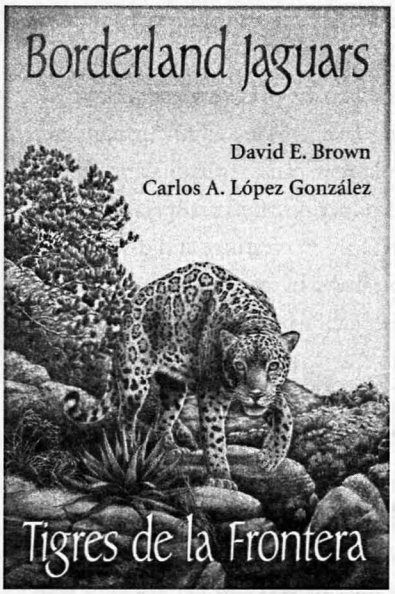
JAGUARS REPRESENT tropical rainforests in the common imagination. Few people know that the stocky cats are native to the southern United States as well. This realization grew dramatically in 1996, when photographs of jaguars brought to bay by hounds in two separate mountain

ranges of southern Arizona awoke the conservation community to the presence of borderland jaguars. Now, a new book provides a much fuller picture of jaguar ecology and occurrence at its current northernmost periphery.

David E. Brown and Carlos A. López González, Ph.D., explore the natural history, human interaction, and status of *Panthera onca* on both sides of the U.S.–Mexico border. Most interesting, of course, are accounts of encounters, and not surprisingly, most of these are the narrations of those trailing the big cats with dogs, and of the final shots that collectively contributed to the species' decline. We learn that jaguars are likely to seek refuge not just in trees and rocks, as mountain lions do, but in caves and mine shafts as well. We learn of the jaguar's greater stamina than lions when pursued, its able truculence when cornered by hounds, and its comfort with slogging through wetlands—again, in contrast to the habits of cougars.

Borderland Jaguars is rich in photographs of live jaguars, of those killed and proudly displayed in the field, and of pelts and other remains. Jaguar iconography, from prehistoric times to the present, also illuminates the human perception of the animal, and is accompanied by a discussion of the jaguar in religion, myth, art, and other cultural expression.

Borderland Jaguars does not only consist of historical and anthropological accounts, however. Dr. López has pioneered field investigation in Sonora, Mexico into what comprises the northernmost remaining breeding population of jaguars. The center of this population is about 140 miles south of the Peloncillo Mountains.



(One of jaguars photographed in 1996 was in the Peloncillos, the rugged country where Mexico, Arizona, and New Mexico converge.) Between López's backcountry work and the extensive interviews conducted by both authors, the most up-to-date map of occupied jaguar habitat in Sonora emerges—vital information in the effort to prevent further shrinking of that range.

The central question in current controversies over the jaguar's future in the United States is what constituted the species' range prior to European settlement. This would seem to be fundamental to all discussion on range decline and conservation status, and would provide necessary context to the narrower subject of jaguars in Arizona and New Mexico—to which Brown and López devote much of their investigations.

Previous wildlife writers have addressed the range issue. Marc Reisner, in *Game Wars* (1991), suggested that jaguars were once the most populous large carnivore in the state of Louisiana. Peter Matthiessen, in his classic *Wildlife in America* (1987), described the jaguar's range as "north to central California and east to Louisiana," and established as far north as the Red River in Arkansas. Matthiessen even noted a credible report from the mountains of North Carolina in 1737.

Unfortunately, Brown and López frame this question narrowly, phrasing it as follows: "Was the jaguar a resident animal during historical times in the American Southwest, or has it always been a transient from Mexico?" Of course, "historical times" and "always" are not quite the same, and this formulation skews subsequent discussions on the possibility of repopulating much of that lost range; if the starting point for jaguar recovery is attenuated by the very factors that contributed to its decline, we will not investigate the full range of those possibilities.

Nobody disputes that jaguars sighted in the U.S. in recent times are almost invariably itinerant males searching out new territories. The last known wild female jaguar in this country was killed in 1963 in the White Mountains of Arizona (in an area now occupied by Mexican gray wolves). On the other hand, as Brown and López point out, as recently as 10,000 years ago, a now-extinct close relative of today's jaguars was found throughout almost all of the contiguous United States.

Brown and López rightly point to the unreliability of jaguar reports unaccompanied by physical evidence, and people's tendency to "see" spectacular animals that are on their minds already. To guard against the possibility of such errors, they ignore or marginalize jaguar sightings in the United States not accompanied by the ani-

mal's pelt, carcass, or photograph—a seemingly higher standard of proof than they use in crediting some jaguar reports from Mexico. But this epistemology does not allow the full weighing of subjective evidence that Matthiessen and earlier observers found persuasive.

For example, in his 1931 book *Mammals of New Mexico*, U.S. Biological Survey investigator Vernon Bailey, one of the premier naturalists of the twentieth century, cited two jaguar sightings—relayed to him by the New Mexico state game warden—in northeastern New Mexico (on the Great Plains) from 1902 and 1903. Bailey found the reports credible, but because the animals weren't recorded as killed, Brown and López omit any mention of the sightings, and express doubt about a jaguar from the same region that was reported in the *Journal of Mammalogy* as having been killed in 1938 and the pelt preserved (but not available to them for inspection). Similarly, they omit mention of a jaguar seen and pursued by a government hunter and his dogs, but not captured, in New Mexico's San Andres Mountains in 1937.

This methodology leads Brown and López to label incontrovertible physical evidence of jaguars significantly north of the border, particularly in New Mexico, as aberrations. They regard a record backed by extant photos (also from Bailey's research) of a jaguar poisoned in 1902 in the Datil Mountains north of the Gila National Forest as "an extreme location." They mention a female jaguar killed near the Grand Canyon the winter of 1907/1908, for which a photo exists, but omit mention of her kittens reported to have died with her. However, they do document cubs captured alive in 1906 in the Chiricahua Mountains of southern Arizona, and acknowledge reports of young jaguars killed on the Mogollon Rim of Arizona.

The bias in this book against crediting all but a small portion of New Mexico and Arizona as fully within the jaguar's past breeding range mars a fascinating and otherwise informative work. Although it cannot stand as the sole basis for the ambitious task of recovering the jaguar in the United States, *Borderland Jaguars* is definitely a worthwhile read. ☾

Reviewed by **Michael J. Robinson,** *who works for the Center for Biological Diversity in Pinos Altos, New Mexico.*

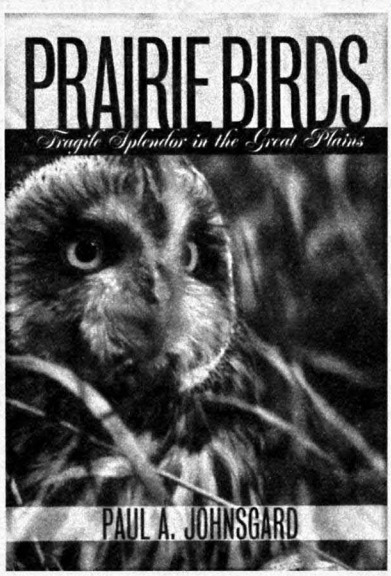
Prairie Birds

Fragile Splendor in the Great Plains

by Paul A. Johnsgard
University Press of Kansas, 2001
359 pages, $29.95

DECLINING POPULATIONS of migratory land birds is a conservation issue that continues to attract widespread interest. The plight of migratory birds in eastern deciduous forests was first brought to national attention by John Terborgh's *Where Have all the Birds Gone?* Presently, some of the best information on population trends of North American land birds is provided by the Breeding Bird Survey program, a long-term effort supported by volunteers across the United States and southern Canada. Recent data show that some of the most alarming declines are not among forest species but are in the birds of grassland ecosystems. Grasslands are in peril worldwide; major threats include conversion to agricultural land use, encroachment by woody shrubs, and exotic invaders. Dramatic losses are commonplace; less than 0.01% of the original prairie of Illinois persists today. Recognition of the problems facing grassland plants and animals has been growing, spurred on by two recent volumes: *Ecology and Conservation of Great Plains Vertebrates*, edited by Fritz L. Knopf and Fred B. Samson, and *Ecology and Conservation of Grassland Birds of the Western Hemisphere*, edited by Peter D. Vickery and James R. Herkert.

To this list can be added Paul A. Johnsgard's most recent book, *Prairie Birds: Fragile Splendor in the Great Plains.* Part personal recollection and part scientific review, this book is a comprehensive summary of the natural history of grassland birds in North America. *Prairie Birds* is dedicated to Aldo Leopold and Annie Dillard, and Johnsgard retraces their footsteps by using his own lyrical prose to describe a lifetime spent observing prairie birds



in Nebraska and the Dakotas. The text of the book is complemented by beautiful pen-and-ink drawings that carefully illustrate the morphology and behavior of his subjects—no mean feat given the subtle plumage markings of most grassland birds.

The introductory chapters set the stage for the book, providing necessary background information on the geological history of the Great Plains, interactions among the plant and avian communities, and current threats to grassland birds. The tone of these chapters is more summary than synthesis. What is a prairie bird? Johnsgard handles this fundamental question by reviewing lists compiled by Kendeigh, Mengel, Knopf, and other authorities. Objective criteria are not presented, leaving the reader to wonder what ecological attributes are shared among the species included in the book. What are the most important threats to grassland birds? The usual suspects—fire, livestock grazing, land use practices, and cowbirds—are systematically reviewed, but the relative importance of such perturbations is not evaluated.

The bulk of the chapters of *Prairie Birds* are devoted to describing the natural history of 33 species of grassland birds. One of the great strengths of the book is that Johnsgard has used a comprehensive review of the scientific literature to prepare the highly readable species accounts. The formalities of scientific writing are dispensed with by dropping citation of scientific papers in the text and by using English units in place of the metric system. Abbreviated citations follow each chapter with complete references collected at the end of the book.

The result is that the text is approachable for a layperson but also contains enough information to be of use to a scientist. Reading through the main chapters, it quickly becomes apparent that the species accounts follow the same template: chapters open with a personal anecdote, and continue with discussions of the etymology of birds' names, habitat, and diet, followed by details of social system and reproductive behavior, fecundity rates, and survivorship. The formulaic structure allows specific details to be found quickly but also becomes somewhat repetitive. Some chapters conclude awkwardly, dribbling off into minor details of demographic rates.

Prairie Birds concludes with a conservation perspective. Given his deep affection for grassland birds, Johnsgard could have used his final chapter to aggressively argue for new conservation measures. Innovative ideas are certainly needed. Instead, this chapter simply presents the evidence for habitat loss and population trends from the Breeding Bird Survey program. An additional appendix compiles a list of protected sites with significant grassland habitats. Inspection of the map of protected sites serves as a sharp reminder of how little land has been set aside for prairie ecosystems. Clearly, effective conservation of grassland birds will require economic incentives, appropriate recommendations for the management of private lands, and expansion of protected natural areas in America's heartland. The details of natural history condensed in *Prairie Birds* provide a compelling reason to take up this challenge. ☾

Reviewed by **Brett K. Sandercock,** *an assistant professor of avian ecology at Kansas State University.*

The Wild East

A Biography of the Great Smoky Mountains

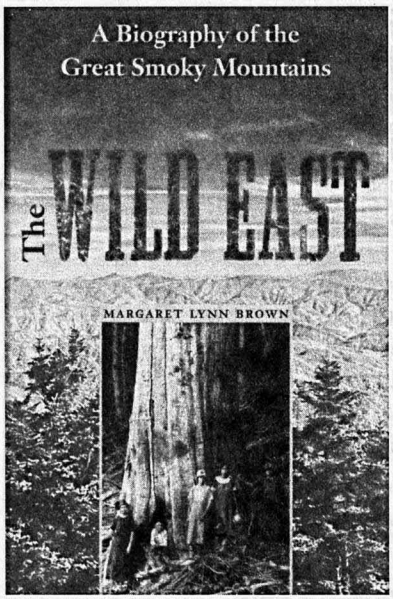
by Margaret Lynn Brown
University Press of Florida, 2000
479 pages, $55 cloth, $19.95 paper

DO NOT BE MISLED by the subtitle of *The Wild East: A Biography of the Great Smoky Mountains* (part of the University Press of Florida's *New Perspectives on the History of the South* series). This "biography" offers no geology, paleontology, or prehistory of the Smokies, and only a cursory treatment of natural history. *The Wild East* is principally a history of the region as affected by commercial exploitation and the reactions it engendered, roughly from 1900 to the present. Above all, it is a history of Great Smoky Mountains National Park, established in 1934.

prairie falcon, pen-and-ink by Narca Moore-Craig

As such, it is an instructive record of the often contradictory human forces that have shaped one of the largest wild areas in the eastern United States. The author, Brevard College historian Margaret Lynn Brown, carefully analyzes the motives behind the creation of the park: dismay at forest destruction, a romantic appeal to a frontier past, state and local government's desire for income from tourism, the depression-era need for public employment projects. She shows how residents of areas condemned for parkland were displaced though eminent domain and other means of coercion, and how their resentment has colored local relations with park administration to this day. Her account is especially useful in making clear the often-ignored distinction between the needs of individual landowners and the wishes of the locally powerful, as represented by county governments, chambers of commerce, and "eminent" citizens. By documenting the evolution of park policies on bear management, trout fisheries, and roads, she illustrates the blundering progress of wildlands conservation under the burdens of ignorance and mistaken goals.

There are no happy endings in this story, but some heroes do emerge, among them Susan Power Bratton, the researcher who introduced science-based conservation to the park, and short-term Park Superintendent Boyd Evison, an exemplar of 1970s government idealism. Brown seems more neutrally disposed toward such independent wilderness advocates as Harvey Broome and his close ally Ernie Dickerman. At the end of the book she writes of Broome's "mistakes," meaning, as far as I can make out, his



romantic enthusiasm for the Smokies' scenery, along with his inadequate appreciation of the human history (and, by extension, the human right of continued use) it represented. Lovers of wilderness, considering these men's success in protecting the Smokies, will be tempted to echo my prayer that we might all make such mistakes.

Indeed, ecologically astute readers are likely to be dissatisfied by Brown's lukewarm allegiance to wilderness conservation. She has adopted the deconstructionist view of wilderness promoted by William Cronon, and though disgusted by the commercial vulgarities that mar the park's gateways, she persists in wanting the park to embody Cronon's ideal of "a middle ground in which responsible use and non-use might attain some kind of balanced, sustainable relationship": to be, in her words, "a world where both bears and human beings live."

This vision ignores the ecological and social need for areas substantially *unused* by humans. Parks and preserves should never and probably *will* never again be created in the high-handed manner used to establish Great Smoky Mountains National Park. But that is no sound argument for roads and other development within its borders. Nor should the Smokies' history of human disturbance impede appreciation of its present wildness, or hopes for yet greater wildness in the future. Wilderness protection begins today, with the decision to allow a patch of land, no matter how previously burdened by use and occupation, to live henceforth without human domination.

As a historian, the author should perhaps be forgiven her occasional displays of biological naiveté. On page 64 she writes of "salamanders" as if they were a single species (surely a simple oversight, since she elsewhere refers to the rich diversity of salamanders in the Smokies); on the next page, she praises residents' stocking of streams with exotic rainbow trout as a remedy to habitat losses caused by logging, though she later recognizes the rainbows' threat to native brook trout. At times her grasp of history seems uncertain, too. "Unlike his father," she writes, "John D. Rockefeller Jr. rejected the idea that wealth was to be used only for personal gain." Those familiar with the senior Rockefeller's philanthropic record, amounting to some $530 million in benefactions, will find this disconcerting. Such errors undermine the reader's confidence, but could be corrected in future editions. A more serious defect is the dearth of maps. The single small map provided is inadequate in a book that treats the details of parkland acquisition and construction projects. ☾

Reviewed by **Jay Kardan,** *a writer and conservationist from Palmyra, Virginia.*

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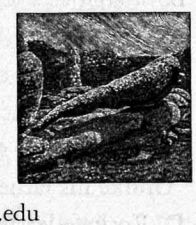

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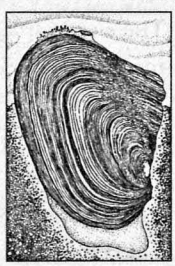

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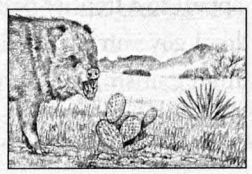

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If we look closely enough, there are no more "pristine" wilderness areas on Earth, free of effects of human activity. If, however, we expand our idea of "wilderness" to include the process of the Earth's own recovery from human insults, then wilderness is widely available, even in vacant lots in the inner city.

Human impacts are everywhere. Human-induced climate change has altered ecosystems in subtle ways the world over. In Bandelier National Monument's designated wilderness lands, heavy livestock grazing in the late nineteenth century, followed by a century of fire suppression and predator elimination, have dramatically changed forest structure. The resulting calamities of greatly lowered plant and animal diversity, extreme soil erosion, and radically altered fire behavior all lead to deteriorating "wilderness" conditions, a downward spiral where fragile soils wash away to bedrock, and simplified, distorted plant populations are a shell of diverse systems that once thrived there. Humans began this accelerating downward spiral and Nature will not correct it in a way that will serve diverse wildlife and plant life or which will protect soils and hydrology.

In places of ecological collapse, even if an area is designated wilderness, our goal should be to help reestablish fully functioning hydrological and biological systems according to our best understanding of what those places were like before Europeans arrived in North America. If we can't conduct honest, rigorously reviewed restoration activities, then wilderness areas become ecologically unimportant Disney fantasies—just places where naive people can enjoy their "belief" in wilderness.

Tom Ribe
Santa Fe, New Mexico

AS SOMEONE who teaches about the relationship of humans to their natural environment, I found Faith Campbell's article "Battling Bioinvasion" (summer 2001) troublesome, as it raises the issue of how humans describe the course of nature.

It seems that if we are to give thoughtful and dispassionate study to the relationship of animals and plants to each other, writers like Campbell should refrain from indulging in emotional rhetoric, such as "battling...invasive...plague...under attack," all of which descriptors leap out at us like some ad for a Grade B science fiction movie, whose chief villain is the overblown, menacing Asian longhorned beetle depicted in the article.

I certainly agree with Campbell that prevention is important when it comes to importing life forms that may be opportunistic and detrimental to ecosystems already under stress by human-induced causes. Education is the key, though certainly without rhetoric that portends a "War of the Worlds" between animals and plants. The fact of the matter is, however, that there are just too many humans around to control when it comes to checking their baggage at travel terminals for possible infestation, whatever the form.

As one of my conservationist friends likes to remind me: "It seems, like most critters, humans are by nature seed-bearers." What comes of those seeds is hard to determine. Or as another friend of mine involved in the factious native versus non-native plant controversy has said: "One person's weed is another's wild flower."

David Graves
San Francisco, California

David Graves is a professor of consciousness studies at John F. Kennedy University in Orinda, California.

Faith Campbell responds:
I am sorry that David Graves objects to my language. Of course, the problem of ecological damage caused by bioinvasion—and how conservationists should minimize that damage—remain major issues. Exotic species are a leading cause of the extinction crisis, second only to habitat loss.

I fully agree with Mr. Graves that there are too many people traveling, and too many goods being imported, for inspection of baggage and shipments to be a successful strategy. In the article, I outlined several weaknesses in the "inspection/detection/ interdiction" approach, then went on to describe the Animal and Plant Health Inspection Service's incomplete shift to a "pathway" approach. Space prevented a fuller discussion of my conception of a "pathway" approach, and of the obstacles that international trade agreements put in the way of wholehearted adoption of it. Readers wishing to know more can either contact me to obtain a copy of my forthcoming report on forest pests, or read my critique of the World Trade Organization's Sanitary and Phytosanitary Agreement in the February 2001 issue of BioScience *(Vol. 51, No. 2, F. T. Campbell, The Science of Risk Assessment for Phytosanitary Regulation and the Impact of Changing Trade Regulations).*

I GREATLY APPRECIATED Dave Foreman's column on "The Cornucopian Myth" in the summer 2001 issue of *Wild Earth*. Reading articles by people like Julian Simon could drive a person insane. Dave's editorial restored my sanity.

However, I am disturbed by the article in the same issue by Beck and Kolankiewicz, "Whatever Happened to U.S. Population Stabilization?" They state that "no national environmental group today works for an end to U.S. population growth." Huh? Where have these guys been?

Two of the groups that I belong to have active population programs. John Flicker, President of the National Audubon Society, has said: "Human population growth is the most pressing environmental problem facing the U.S. and the world." See www.audubon population.org/ and www.sierraclub.org/population/.

No doubt conservation and environmental groups could do more but to say that "no national environmental group today works for an end to U.S. population growth" seems to be an error. Could you explain?

David E. Bedan
Columbia, Missouri
[Authors' response follows next letter.]

I'VE BEEN READING *Wild Earth* since 1992. I love the movement and the insight and thoughtfulness behind it. However, Beck and Kolankiewicz's article "Whatever Happened to U.S. Population Stabilization?" (summer 2001) was the last bit of anti-immigration rhetoric I could take. The language was thoughtless and seemed to come from a very sheltered life. What is meant by the inference that "the quality of life for Americans...will continue to erode unless...illegal immigration is halted"? How would the authors suggest we "halt" it? I grew up on the U.S.–Mexico border and can tell you that innocent civilians have died or have been harassed because of Immigration and Naturalization Service militarization along the border. Besides that, what about the part of "American" wildlands that exists outside the U.S. border? How can we actually think that isolating ourselves to preserving and restoring only U.S. wildlands will work without protecting those regions that function as summer habitat? And why dismiss the "third leg" of the modern conservation movement and blame it for the suppression of population issues? I value all three "legs" of the movement. There is no reason to alienate a major part of it. A two-legged chair don't stand up!

I am a firm believer in the overpopulation crisis and agree that our wildlands are headed to a dismal end if human population is not reduced. I appreciated many articles in *Wild Earth*'s last population theme issue (winter 1997/98). And while I disagree with anti-immigration sentiment within the conservation movement, I am eager to listen and consider realistic solutions. I realize that there are valid concerns about immigration into the United States. I also realize that the U.S. is in many ways responsible for much of the poverty and destruction of Central American economies. This is basic sociology.

A comprehensive solution must include U.S. reconciliation in Central America and elsewhere, ending corporate dominance of the U.S. political agenda, and looking at "overimmigration" as a symptom, not a cause, of the problem. I don't know precisely what such a solution will look like, but I hope it won't look like INS agents in guerrilla fatigues with automatic rifles. And, finally, let's not assume that someone with whom we disagree about these matters is under-educated, inexperienced, or less passionate about wilderness.

Christopher Wilhite
Austin, Texas

Roy Beck and Leon Kolankiewicz respond: *To Mr. Bedan, we would respond that we did not mean to suggest that all groups are completely ignoring the latest U.S. population boom. (Please see our full study at: http://www.numbersusa.com/about/bk_retreat.html.) As we have noted in our longer articles and studies, several national environmental groups (a small minority) still publicize the need to stabilize the U.S. population. Among them, the Audubon Society appears to be doing more than any other and is increasing its efforts.*

We are aware of only two national organizations that have a policy dealing with the numerical immigration level which the Census Bureau shows is the overwhelming cause of U.S. population growth. The Wilderness Society and Izaak Walton League state that immigration should be reduced. But when it comes to actual work to persuade Congress to reduce immigration, we find no group engaged. Former President Clinton's Council on Sustainable Development (chaired by Tim Wirth) and other environmental commissions have determined that it is not possible for the United States to be environmentally sustainable without population stabilization, and that it is

not possible to stabilize it this century without immigration reductions. From all of that, we find no logical conclusion except to state that "no national environmental group today works for an end to U.S. population growth."

We would assure Mr. Wilhite that to make that statement is not to attack anybody or to be "anti-immigration." It is a statement of fact. We understand that there are many institutional reasons why environmental groups have found it difficult to divert resources to try to carry out the Wirth council's recommendation on stabilization. But unless citizens find some way to express our population concerns collectively, overimmigration will almost surely continue—and the resulting, never-ending U.S. population boom will foreclose a future that leaves enough room for Nature.

We agree with Mr. Wilhite that much needs to be done to improve conditions in immigrant-sending nations. But if we wait for those needed changes to slow down the immigration flow, America's natural environment will be suffocated under another 300 million people. For example, while population growth rates in many developed nations in recent decades plummeted by around 50% and while the world is on a trajectory to stabilize, immigration to the United States has quadrupled. We are free to make a choice, but we are not free from having to choose between two options: either reduce immigration or give up hope for environmental sustainability in our country this century.

THANKS TO A long association with *Wild Earth* and the Wildlands Project, I've learned that our continent functions as an ecological unit. Grizzlies and jaguars and migratory songbirds neither know nor care about international borders. Indeed, one of the primary roles of the Wildlands Project is to create and protect wildlife linkages between nations.

Therefore, recent *Wild Earth* articles and columns bemoaning *U.S.* population growth are filled with unintended irony. Considering North America as one ecosystem, when people move from densely populated places, such as Mexico and Guatemala, to less densely populated regions, such as the United States, doesn't that reduce habitat pressure in their home countries? Given the rich biodiversity down south, might U.S. in-migration create a *net benefit* for our continent's wildlife?

To ask a larger question, why shouldn't borders be open to all species, including ours?

Let me anticipate the response: because human beings *consume* habitat. To paraphrase Roy Beck and Leon Kolankiewicz (summer 2001), who advocate for reduced immigration, poor workers and their families cross national borders to improve their standard of living. Putting aside for a second the substantial issues of human rights, an improved standard of living means more resource consumption. They want the things that U.S. conservationists take for granted: a plentiful food supply, adequate housing, cheap and reliable electricity, etc., not to mention the right to free expression.

I am no cornucopian. I understand that the world contains too many people, and for that reason I have chosen not to have children. By U.S. standards, I live a fairly low-impact lifestyle, but my consumption would make me a wealthy man in most parts of the world. This raises the key point: advocating U.S. population control while ignoring our orgy of consumption is like promoting birth control without talking about sex. It doesn't work.

As Beck and Kolankiewicz write, "By working on *both U.S. population and consumption* [my emphasis], the movement of the 1960s and 1970s had a comprehensive approach toward environmental protection and restoration." Over the years, *Wild Earth* has devoted substantial space to population concerns, but very little to issues of consumption. Why?

Nearly all new immigrants are at the bottom of the "consumption chain," while people who advocate for reduced immigration tend to consume a lot more stuff, and therefore have a bigger impact on the biosphere. The U.S. accounts for less than 5% of the world's population, yet we consume one-third of the world's resources. Those of us who *already live here* are the problem. Even if we capped U.S. population at the present level, we would continue to chew up habitat—both in our own nation and overseas, thanks to our importation of resources—for years to come.

Promoting population control is politically difficult, but advocating for a lower standard of living (or redefining "standard of living") is even more dangerous. Those who work to reduce immigration for ecological reasons are, comparatively speaking, taking the easy way out. Until we get real about aggressively challenging and reducing U.S. consumption patterns—gasoline at $6 per gallon, anyone?—we will continue to come across as the spoiled, rich nation that we are.

Andy Robinson
Tucson, Arizona

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Spring 1994 • Ed Abbey posthumously decries The Enemy, David Clarke Burks's Place of the Wild, Ecosystem Mismanagement in Southern Appalachia, Mohawk Park Proposal, RESTORE vs. Whole-Tree Logging, Noss & Cooperrider on Saving Aquatic Biodiversity, Atlantic Canada Regional Report, Paul Watson on Neptune's Navy, The Restoration Alternative, Intercontinental Forest Defense, Failures of Babbitt and Clinton, Chris McGrory-Klyza outlines Lessons from Vermont Wilderness

Summer 1994 • Bil Alverson's Habitat Island of Dr. Moreau, Bob Leverett's Eastern Old Growth Definitional Dilemma, Wolke against Butchering the Big Wild, FWS Experiments on Endangered Species, Serpentine Biodiversity, Andy Kerr promotes Hemp to Save the Forests, Mapping the Terrain of Hope, A Walk Down Camp Branch by Wendell Berry, Carrying Capacity and the Death of a Culture by William Catton Jr., Industrial Culture vs. Trout

Fall 1994 • BC Raincoast Wilderness, Algoma Highlands, Helping Protect Canada's Forests, Central Appalachian Forests Activist Guide, Reconsidering Fish Stocking of High Wilderness Lakes, Using General Land Office Survey Notes in Ecosystem Mapping, Gonzo Law #4: Finding Your Own Lawyer, The Role of Radio in Spreading the Biodiversity Message, Jamie Sayen and Rudy Engholm's Thoreau Wilderness Proposal

Winter 1994/95 • Ecosystem Management Cannot Work, Great Lakes Biodiversity, Peregrine Falcons in Urban Environments, State Complicity in Wildlife Losses, How to Burn Your Favorite Forest, ROAD-RIPort #2, Recovery of the Common Lands, A Critique and Defenses of the Wilderness Idea by J. Baird Callicott, Dave Foreman, and Reed Noss

Spring 1995 • Christopher Manes pits Free Marketeers vs. Traditional Environmentalists, Last Chance for the Prairie Dog, interview with tracker Susan Morse, Befriending a Central Hardwood Forest part 1, Economics for the Community of Life: Part 1, Minnesota Biosphere Recovery, Michael Frome insists Wilderness Does Work, Dave Foreman looks at electoral politics, Wilderness or Biosphere Reserve: Is That a Question?, Deep Grammar by J. Baird Callicott

Winter 1995/96 • ***Wildlands Project Special Issue #2*** Testimony from Terry Tempest Williams, Foreman's Wilderness: From Scenery to Strategy, Noss on Science Grounding Strategy and The Role of Endangered Ecosystems in TWP, Roz McClellan explains how Mapping Reserves Wins Commitments, Second Chance for the Northern Forest: Headwaters Proposal, Klamath/Siskiyou Biodiversity Conservation Plan, Wilderness Areas and National Parks in Wildland Proposal, ROAD-RIP and TWP, Steve Trombulak, Jim Strittholt, and Reed Noss confront Obstacles to Implementing Wildlands Vision

Summer 1996 • McKibben on Text, Civility, Conservation and Community, Eastside Forest Restoration Forum, Grazing and Forest Health, debut of Landscape Stories department, Friends of the Boundary Waters Wilderness, Foreman on Public Lands Conservation, Private Lands in Ecological Reserves, Public Institutions Twisting the Ear of Congress, Laura Westra's Ecosystem Integrity and the Fish Wars, Caribou Commons Wilderness Proposal for Manitoba

Fall 1996 • ***Religion and Biodiversity*** Eastern Old Growth: Big Tree Update, Gary Nabhan on Pollinators and Predators, South African Biodiversity, Dave Foreman praises Paul Shepard, NPS Prescribed Fires in the Post-Yellowstone Era, Alaska: the Wildlands Model, Mad Cows and Montanans, Humans as Cancer, Wildlands Recovery in Pennsylvania

Winter 1997/98 • ***Overpopulation Issue*** explores the factors of the I=PAT model: Gretchen Daily & Paul Ehrlich on Population Extinction and the Biodiversity Crisis, Stephanie Mills revisits nulliparity,

We list here only each issue's major articles, by partial title or subject. For a more complete listing, visit our website (www.wild-earth.org). To order, use reply form insert. See form for additional publications.

Alexandra Morton on the impacts of salmon farming, Sandy Irvine punctures pro-natalist myths, William Catton Jr. on carrying capacity, Virginia Abernethy considers premodern population planning, Stephanie Kaza on affluence and the costs of consumption, Kirkpatrick Sale criticizes the Technological Imperative, McKibben addresses overpopulation One (Child) Family at a Time, Foreman on left-wing cornucopianism, Interview with Stuart Pimm, Resources for Population Publications & Overpopulation Action, Spotlight on Ebola Virus

Summer 1998 • *Wildlands Philanthropy* tradition discussed by Robin Winks, John Davis on Private Wealth Protecting Public Values, Doug Tompkins on Philanthropy, Cultural Decadence, & Wild Nature, Sweet Water Trust saves wildlands in New England, A Time Line of Land Protection in the US, Rupert Cutler on Land Trusts and Wildlands Protection, profiles of conservation heroes Howard Zahniser, Ernie Dickerman, & Mardy Murie, Michael Frome recollects the wilderness wars, David Carle explores early conservation activism and National Parks, and Barry Lopez on The Language of Animals

Winter 1998/99 • *A Wilderness Revival* perspectives from Bill Meadows on the American Heart, Juri Peepre on Canada, Jamie Sayen on the Northern Appalachians, and John Elder on the edge of wilderness, Louisa Willcox on grizzlies, politics from Carl Pope, Ken Rait's Heritage Forests, Jim Jontz's Big Wilderness Legislative Strategy, Debbie Sease & Melanie Griffin's stormy political forecast, Dave Foreman on the River Wild as metaphor, Mike Matz's Domino Theory, Wilderness campaign updates from Oregon, California, Nevada, Grand Canyon, New Mexico, Colorado, and Utah, NREPA, focal species paper by Brian Miller et al.

Spring 1999 • *Coming Home to the Wild* Flo Shepard, Paul Rezendes, Glendon Brunk, and Kelpie Wilson imagine rewilding ourselves, Paul Martin and David Burney suggest we Bring Back the Elephants! and Connie Barlow discusses Rewilding for Evolution, Freeman House on restoring salmon, John Davis on Anchoring the Millennial Ark, Chris Genovali exposes risks to Canada's Great Bear Rainforest, Madsen and Peepre on saving Yukon's rivers, Bryan Bird on roads and snags, George Wuerthner on population growth, Brock Evans uses wild language, Dave Foreman studies the word wilderness, and John Terborgh and Michael Soulé's "Why We Need Megareserves: Large-scale Networks and How to Design Them"

Summer 1999 • *Carnivore Ecology and Recovery* "The Role of Top Carnivores in Regulating Terrestrial Ecosystems" by Terborgh et al., Todd Wilkinson on the Yellowstone Grizzlies Delisting Dilemma, Wolves for Oregon, Carnivores Rewilding Texas, fire ecologist Tim Ingalsbee suggests we Learn from the Burn, David Orr continues the Not-So-Great Wilderness Debate, Tom Fleischner on Revitalizing Natural History, Jim Northup remembers Wildlands Philanthropist Joseph Battell, the Continuing Story of the American Chestnut

Fall 1999 • Nina Leopold Bradley, David Ehrenfeld, Terry Tempest Williams, and Curt Meine celebrate Leopold's legacy, wildlands philanthropy saves forests in Washington & California, Thomas Vale dispels the Myth of the Humanized Landscape, articles on Indigenous Knowledge and Conservation Policy in Papua New Guinea and threats to northwest Siberia's cultural & biological diversity, Janisse Ray takes us to the Land of the Longleaf, Robert Hunter Jones critiques NPS fire policy at Crater Lake, State of the Southern Rockies and the Grand Canyon Ecoregions, Sizing Up Sprawl

Winter 1999/2000 • *Vision* Jamie Sayen compares abolitionism and preservationism, Winona LaDuke rethinks the Constitution, Donella Meadows on shaping our future, Deborah & Frank Popper explore the Buffalo Commons, and Michael Soulé on networks of people and wildlands; Dave Foreman puts our extinction crisis in a 40,000-year context, Gary Paul Nabhan update on monarch butterflies and transgenic corn, David Maehr on South Florida carnivores, Michael Robinson discusses politics of jaguars and wolves in the Southwest, Reed Noss reserve design for the Klamath-Siskiyou, Andy Kerr's Big Wild legislative strategy, George Wuerthner on local control, Roger Kaye explores the Arctic National Wildlife Refuge

Spring 2000 • *The Wildlands Project Special Issue* E.O. Wilson offers a personal brief for TWP, Harvey Locke suggests a balanced approach to sharing North America. Sky Islands (AZ, NM) section: 4 articles on the Sky Islands Wildlands Network by Dave Foreman et al. address the elements of a conservation plan, healing the wounds, and implementation, color map of the draft proposal, Wildlands Project efforts in Mexico's Sierra Madre Occidental, David Petersen's "Baboquivari!", Leopold's legacy in New Mexico; Wildlands networks proposals for the Central Coast of British Columbia by M.A. Sanjayan et al. & the Wild San Juans of Colorado by Mark Pearson; Mike Phillips on conserving biodiversity on & beyond the Turner lands, the economy of Y2Y, roadless area protection by Jim Jontz

Summer 2000 • *American Parks and Protected Areas* Foreman on resourcism vs. will-of-the-land, historical perspectives from John Muir & Gifford Pinchot, Richard West Sellars on the history of national park management, American environmentalism 1890–1920, David Carle calls for expanding national parks by shrinking national forests, Andy Kerr & Mark Salvo critique livestock grazing in parks and wilderness, Sonoran Desert National Park proposal, David Rothenberg and Michael Kellett debate on Maine Woods National Park, wildlands proposals for Maine and connectivity between Algonquin and Adirondack parks, Brad Meiklejohn retires cows from Great Basin, southwest New Hampshire wildlands, a Maine land trust, viewpoints on biodiversity conservation and "nature as amusement park," Thomas Berry interview

Fall 2000 • *Little Things* Resurrection Ecology by Robert Michael Pyle, Tom Eisner interview, Microcosmos, Return of the American Burying Beetle, Forgotten Pollinators, Laurie Garrett on the Coming Plague, Tom Watkins tribute by Terry Tempest Williams, Hunting & Nature Conservation in the Neotropics, Rockefeller's Philanthropy and the Struggle for Jackson Hole, critique of land exchanges, A Wilder Vision for the Texas Hill Country, Central Texas Forest Restoration, Fiction Folio: Dave Foreman's Lobo Outback Funeral Home

Winter 2000/2001 • *10th Anniversary Edition* Exceptional excerpts from *Wild Earth*'s first decade, the wilderness legacy of Robert Marshall, philanthropy aids rewilding in Florida, Michael Soulé asks if sustainable development helps Nature, Dave Foreman & Kathy Daly's ecological approach to wilderness area design, Connie Barlow sees ghosts of evolution, the dilemma of ecological restoration in wilderness, Sprawl vs. Nature by Mike Matz

Spring 2001 • *Wild, Wild East* Dave Foreman on "Pristine Myths," an Eastern turn for wilderness, Eastern Wilderness Areas Act legislative history, Doug Scott reviews Congress's criteria for wilderness, David Foster interview, biotic homogenization in the Northwoods, eastern cougar recovery, David Carroll on turtles and trout, Tom Wessels on beaver recovery, lichens and ancient forests, biodiversity on the Appalachian Trail, wildlands philanthropy in Maine

Summer 2001 • Dave Foreman on cornucopianism, Tom Butler on smart growth and sapsuckers, David Olson calls for conservationists to speak with one voice, long-nosed bats and white-winged doves, saving the sagebrush sea, Lyanda Haupt delights in the winter wren, Cascades Conservation Partnership, battling invasive fungi and insects, genetically engineered trees, farming with the wild, ecolabeling, wilderness restoration forum, US population stabilization

PUBLICATIONS AND PROJECTS

Predator Film *On Nature's Terms: Predators and People Co-existing in Harmony*, a 25-minute video, links carnivore conservation with the need to protect large, connected expanses of land. Produced by John de Graaf, this film uses dramatic footage and inspirational stories to explore myths about predators and illustrate how citizens can co-exist with these animals. Copies are $20 and are recommended for public forums, school groups, and fundraisers. Contact Sharon Negri, WildFutures/ Earth Island Institute, 206-780-9718, snegri@igc.org.

Wilderness Documents Wanted Letters, reports, testimonies, interviews, and other documents are being sought by the Wilderness Policies History Project to create an archive and detailed narrative of federal wilderness policy from the 1964 Wilderness Act to the present. To contribute to the collection or learn more, visit www.wilderness.net/carhart/policy or contact Sue Matthews, Arthur Carhart National Wilderness Training Center, 32 Campus Drive #3168, Missoula, MT 59812-3168, 406-243-4627, Sue_Matthews@fws.gov.

Allagash River Report "Losing Paradise: The Allagash Wilderness Waterway Under Attack" has been updated and re-released by Maine Public Employees for Environmental Responsibility. A narrative report, it describes the ongoing threats and degradation of this extraordinary 92-mile state-designated wilderness river. Contact Tim Caverly, Maine PEER, 207-723-4656, mepeer@peer.org or to download a free PDF file of the report visit http://www.peer.org/publications/wp_losing.html.

Conservation Easement Report The Northern Forest Alliance has released "Principles and Recommendations for the Development of Large-Scale Conservation Easements in the Northern Forest." In response to the unprecedented scale of easements being applied in New England and beyond, this report defines standards to develop effective easements. For a copy, contact NFA, 802-223-5256 x12, mgiammusso@nfainfo.org.

GATHERINGS

Wilderness Conference The North American Wilderness Conference 2002, May 2–5, 2002, Seattle, Washington, will assess the effects of national and jurisdictional borders on the preservation of North American wildlands and waters. For a list of sponsors, sessions, and speakers visit www.speakeasy.org/~nwwpc, or contact NWWPC, 12730 9th Avenue NW, Seattle, WA 98177, osseward@juno.com.

Prairie Conference Promoting Prairie!, the 18th North American Prairie Conference, will be held in Kirksville, Missouri, June 23–27, 2002. Sessions explore prairie biodiversity, restoration, and preservation. Contact 660-665-3766, www.napc2002.org.

SCB Meeting The 16th annual Meeting of the Society for Conservation Biology, cohosted by the British Ecological Society, explores "People and Conservation," July 14–18, 2002, Durell Institute of Conservation and Ecology, University of Kent at Canterbury, Canterbury, UK. Contact Nigel Leader-Williams, scb2002@ukc.ac.uk, or visit www.ukc.ac.uk/anthropology/dice/scb2002/.

International Restoration Conference Restore the Earth!, a conference to build UN support for declaring this the Century of Restoring the Earth, will be held March 30–April 5, 2002, at the Findhorn Foundation, Scotland, UK. The conference will feature ecological restoration projects that are achieving significant results and also launch several new international restoration initiatives. Speakers include David Bellamy, Vandana Shiva, Alan Watson Featherstone, and Carlos Martinez del Rio. Contact conference@findhorn.org, www.restore-earth.org/conference.html.

THE GOLIATH GROUPER is the largest Atlantic member of the sea bass family (Serranidae). These giants have a lifespan of 30 to 50 years and have been known to reach 8 feet in length and weigh more than 700 pounds. Beyond their size, distinguishing characteristics for the goliath grouper are a head and fins covered with small black spots and rounded pectoral and caudal fins.

In general, grouper species inhabit shallow tropical seas. Grouper are top-level predators and possess well-developed swim bladders, allowing them to effortlessly hover or maneuver through caves and overhangs. They are ambush predators who feed during the day on fishes, crustaceans, and cephalopods. Grouper, along with the majority of serranids, are protogynous hermaphrodites; that is, individuals reproduce first as females, and later, at a larger size, change into males. (This remarkable transformation is triggered by poorly understood social and environmental factors.) Most of the large grouper species reproduce annually in huge spawning aggregations. Individuals travel 60–350 miles during a one- or two-month time frame to historical breeding grounds. The predictable timing and location of these spawning runs has allowed fishermen to decimate grouper populations. Prior to over-harvesting, aggregations numbered in the tens of thousands. Today, many historical aggregations have disappeared and most others are significantly depressed in numbers.

Goliath grouper were a relatively common sight for divers until the late 1960s, when they began to fall victim to spearfishers and were increasingly targeted by anglers.

Species Spotlight

The fish was fully protected by the state of Florida in January of 1990 and later in all U.S. state and federal waters. The moratorium on taking goliath grouper has helped the species make a comeback, and their numbers are increasing throughout the Gulf of Mexico and Florida.

In a rare move early in 2001, the committee responsible for naming fish in the Americas, the Committee of Names of Fishes of the American Fisheries Society, changed the common name of this species from jewfish to goliath grouper. The committee has resisted altering common names of fish unless the names "violate the tenets of good taste," according to society rules. The origin of the name jewfish is unknown; however, the committee felt that a name change was warranted given that some may find it offensive. In any case, the new name fits this giant predator. ☾

Christy Pattengill-Semmens *wrote about the REEF project in this issue of* Wild Earth. *There are no grouper off the coast of Seattle where she lives, but she looks for them whenever she travels to warmer waters. Artist* **Janet Fredericks** *of Lincoln, Vermont, draws inspiration from her local waters, lake fish, wildflowers, vines, and trees. She teaches art and exhibits her work internationally. Her grouper was created in watercolor.*

Text source: DeLoach, Ned. 1999. *Reef Fish Behavior: Florida, Caribbean, Bahamas.* Jacksonville, FL: New World Publications.

An aptly named giant

Goliath Grouper

KINGDOM	Animalia
PHYLUM	Chordata
CLASS	Actinopterygii
ORDER	Perciformes
FAMILY	Serranidae
GENUS	Epinephelus
SPECIES	itajara

The wild things of this earth are not ours to do with as we please. They have been given to us in trust, and we must account for them to the generations which will come after us and audit our accounts.

—William T. Hornaday
(1854–1937)

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