WILD EARTH

The End of an Era

Our river of words for wild nature has run its course

Dear readers and friends,

As you are probably aware, the world of conservation funders has been shrinking in recent years. The Wildlands Project has not been immune to these changes. As a result, our board of directors has found it necessary to undertake a major restructuring of the Wildlands Project, directing more of our scarce resources to on-the-ground conservation programs.

In the next year, the Wildlands Project will focus on conservation planning and action in the Northern Appalachians of the U.S. and Canada, and the mountains and deserts of northern Mexico and the U.S. Southwest. This includes continuing our very successful campaigns in the Sky Islands region of Arizona and New Mexico and moving ahead on our Wildlands Network Design for the Northern Appalachians. We will also explore some promising developments for conservation planning in the Pacific Northwest.

At the same time, the board has had to make difficult decisions. We are deeply saddened to let you know that *Wild Earth* journal will stop publication with this issue.

We realize that this is a dramatic turn of events—and the end of an era. And we imagine that you'll agree with us: the closing of *Wild Earth* will leave a void in the global conversation on conservation. We hope that in future years there will be a rebirth of the journal or other effort made to meet its editorial mission. In any case, we are proud of the ways it has helped to forward the success of North American conservation over the last 14 years. We see the journal's vision living on through the land protection successes the Wildlands Project is now having—and through the many other efforts and organizations that are saving wild places. (We invite you to read Tom Butler's concluding column, "A Wilderness View," on page 2 for more on the legacy and outward-flowing ripples of *Wild Earth*.)

We, the editors, cannot adequately express our gratitude to the hundreds of contributing writers, artists, scientists, activists, and lovers of wild nature that have been the body of *Wild Earth*; nor can we properly acknowledge the thousands of readers who have taken our articles and artwork as food for the mind and inspiration for good work. To all, thank you, thank you, thank you.

The Editors

To make sure you stay informed about the Wildlands Project's ongoing work, we will update you through our newsletter, Wildlands Connection, *and other member mailings. And, later this winter, we will be launching a new website to promote our vision and projects to a wide audience—in a low-cost, paperless way. Stay with us at* **www.wildlandsproject.org.**

Now, more than ever, the Wildlands Project counts on your support for the vital work we do to protect and restore our shared natural heritage.

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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ON THE COVER
"Sierra White Wolf" (detail), oil on panel by Laura Cunningham ©1996

Crossing Over

connectivity, corridors, and links across the land

As long as I live, I'll hear waterfalls and birds and winds sing. I'll interpret the rocks, learn the language of flood, storm, and the avalanche. I'll acquaint myself with the glaciers and wild gardens, and get as near the heart of the world as I can.

JOHN MUIR

The Late, Great *Wild Earth*

Some Personal Reflections

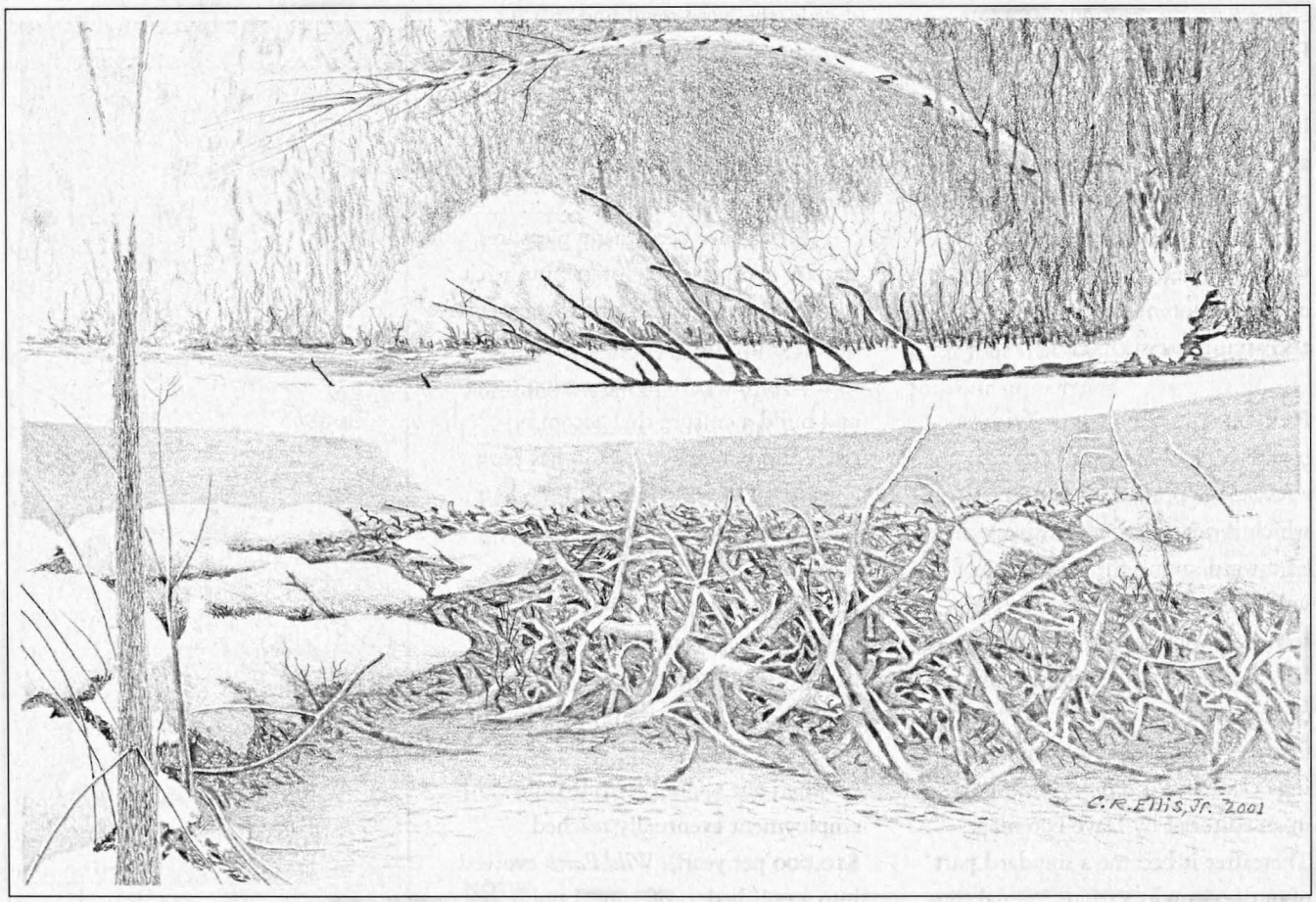
SINCE THE SPRING of 1991, when *Wild Earth* was launched by Dave Foreman and John Davis,[1] I've been affiliated with the journal, initially as a board member, and beginning with the third issue, as a staffer.[2] As editor for the last seven years, I've had the privilege of writing this column to introduce our editorial themes, on topics as varied as human overpopulation, wildlands philanthropy, citizen science, deep time, marine ecology, and snake conservation.

In this issue, I had expected to offer some thoughts on connectivity—both across the landscape and within the increasingly balkanized conservation community, where subcultures of wilderness advocates, animal rights activists, hunters and anglers, environmental justice proponents, sustainable energy boosters, and others scrap over turf while a techno/industrial growth economy everywhere devours wild nature and indigenous cultures.

Then, extinction intervened.[3] Of course, extinction and speciation are the way of the world. For all creatures that ever walk the earth, swim the sea, or soar the skies, the same fate awaits. After the light of life comes the long night of extinction. Similarly, in the evolution of ideas, publications arise and fall—and with this issue, we cease publishing *Wild Earth*.

Looking out upon the grey Vermont woods, where the trees are backlit by weak, late-afternoon light glinting off a dusting of snow, a person naturally may turn reflective, and even a tad melancholy. The days are short and getting shorter, the weather mostly overcast, the bears denning up. For us large mammals, the urge to hunker down is strong. And so I am camped this day by the woodstove, warming up after a walk in those autumnal woods to look for animal sign, to see where the deer moved last night into softwood cover, where fisher and coyote passed by on their rambles. My thoughts too are rambling, and I hope you'll forgive these personal reflections as I consider the *Wild Earth* era.

It seems to me that the best periodicals both reflect the zeitgeist of an era and introduce "memes," bits of cul-



tural information that are transmitted among people, to borrow Richard Dawkins's useful term. This has long been our goal with *Wild Earth*—to capture the tenor of the modern wilderness movement, and offer provocative new thinking that would help influence its continuing evolution. In large measure, I believe *Wild Earth* has succeeded, becoming the journal of record of the American conservation movement's wilderness wing. I like to believe that we filled the niche once occupied by *The Living Wilderness* during the Wilderness Society's early decades, when Bob Marshall, Aldo Leopold, Howard Zahniser, and others helped lay the intellectual foundations for wilderness preservation in the twentieth century.

From the outset, our goal was to build connections, particularly between activists and conservation biologists, and to advance a more expansive (both in space and time) agenda for North American conservation. Whereas more staid academic journals were crucial in disseminating the science that supports large-scale conservation planning and action, no other periodical has been more daring than *Wild Earth* about considering the full implications of those scientific insights. Imagine, we have said, wildlands networks of continental scope where wide-ranging animals find room to roam.

Where else but *Wild Earth* could such ideas be communicated to an audience of conservation professionals and activists in more than two dozen countries? What other magazine would have dared print Dave Foreman's consistently thought-provoking but sometimes controversial editorials? Would paleoecologist Paul Martin have found another venue for his paper that advocated reintroducing elephants to this continent, to replace their ecological analogues lost during the late Pleistocene? Where else might legendary Northern Forest advocate Jamie Sayen have published his comparison of contemporary forest activists with the radical abolitionist movement spearheaded by slavery opponent William Lloyd Garrison? These and similarly challenging essays

beaver dam, graphite by Bob Ellis

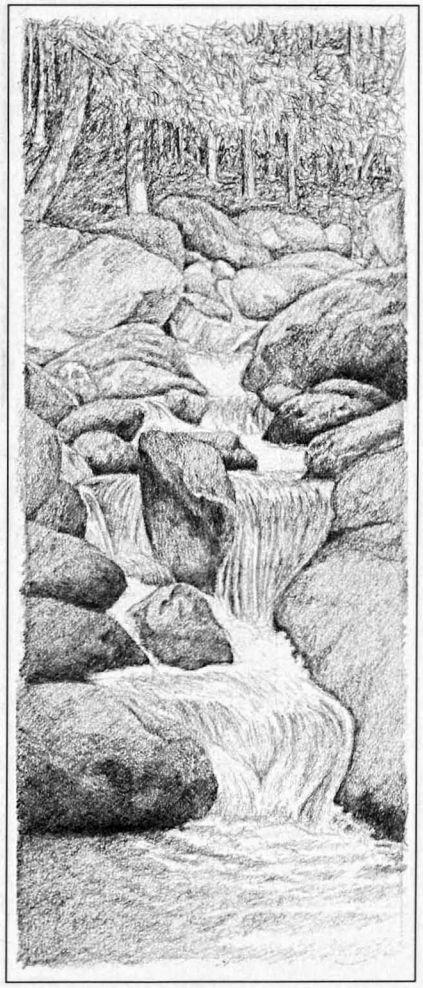
elicited strong reactions. The late David Brower, for instance, loved Sayen's piece; another movement luminary responded with a thoughtful critique, and a third offered a snide put-down.[4] Because we wanted to be a forum for the wildest of ideas, we were most delighted when *Wild Earth* editorial content got people thinking and arguing about issues.[5]

PERHAPS THE most gratifying success we've had has been promoting a *rewilding* approach to conservation which is not merely defensive, oriented toward saving the last scraps of wild nature, but offensive, actively seeking to help nature heal. I am happy to be corrected if an earlier occurrence can be identified, but the first use I know of the term "rewilding" came in *Wild Earth* in 1992, in an editorial by Dave Foreman. Thereafter it became a standard part of our lexicon as various journal contributors advanced a notion of ecological restoration writ large, including recovery of wolves, jaguars, and other "keystone" predators across large parts of their native ranges.

Within a few years, I noticed the word in articles by Wilderness Society president William Meadows and Defenders of Wildlife president Roger Schlickheisen, and even in a mass market direct-mail piece I received from the Sierra Club. Still abed and bleary-eyed one morning in the late 1990s, I was listening to a segment on National Public Radio about a conservation project in Asia, when one of the principals (from in-country, not an American) described their effort to "rewild" the landscape between two existing protected areas so that wildlife could move unimpeded. In less than a decade, the word rewilding that we introduced in *Wild Earth* had spread around the world, a memetic victory, and hopefully prophetic of the landscape that future generations of people and wolves will inhabit.

There have been many pleasures, literary and personal. Interacting with North America's preeminent thinkers on the central issue of our time—how to reverse the current extinction crisis and build a culture that accommodates and honors wildness—has been a great joy. Truly, I have had the best job in the American conservation movement, although one not without its disappointments. Producing *Wild Earth* for such a small audience has been frustrating. A scrappy, low-budget affair at the beginning (founding editor John Davis and I were delighted when our salaries for full-time employment eventually reached $10,000 per year!), *Wild Earth* evolved into a polished, professional publication over the years. The budget increased from minuscule to modest, but our marketing efforts remained consistently lame. Our business acumen never came close to matching our intellectual curiosity. We were wilderness advocates first. None of the editorial team, past or present, had much of a business background and fundraising was not our forté. The journal's paid circulation never exceeded 7,000, although we estimated readership at more than twice that. Such a narrow base of support was unsustainable, even after our 2000 merger with the Wildlands Project.

While not easy even in flush times, finding funding for idea work in the current political landscape, where vigilant defense of wildlands and wildlife is crucial, has been particularly difficult.



Periodicals with considerably larger circulations and better brand recognition, like *Whole Earth*, have also found nonprofit publishing a losing proposition in recent years, and closed shop. We are at least in good company.

IS THERE STILL a need for a periodical that serves as wilderness think tank[6] and forum for conservationists focused on saving life's diversity? My opinion is yes—perhaps not with an identical editorial purview, but with *Wild Earth*'s bold spirit and much more marketing muscle. Will such a publication be launched? Possibly. Is it fundable? I simply don't know, but I'll offer another opinion—it should be. It

graphite by Todd Cummings

has lately become acknowledged by left-leaning activists that conservatism as a political ideology is ascendant partly because the right has been so much better at "framing" issues[7] and because conservative foundations and individuals have, over several decades, invested heavily in an intellectual infrastructure (think tanks, magazines targeted at opinion leaders, books) that generates ideas, and a mass communications strategy (talk radio) that makes those ideas part of everyday discourse in the body politic.

There are current efforts, the Center for American Progress being one notable example, to develop an equivalent progressive infrastructure for generating and communicating new ideas, but the Democrats are decades behind. In our own movement (which, incidentally, was at the apex of its power to influence national policy in the 1970s when conservation was bipartisan, and not a few of its leading political lights were Republicans), I sense little current interest among funders to help build intellectual capacity for the future—which is problematic, but understandable.

Whether it's proposed drilling in the Arctic National Wildlife Refuge, petroleum development in Wyoming's Red Desert, rollbacks of endangered species protections, or any one of myriad assaults on the natural world orchestrated or emboldened by the current Bush Administration, when the Huns are about to plunder the village, one's mind naturally goes to short-term defense, not developing a long-term security strategy. But that long-term thinking is desperately needed in the conservation community. Ultimately, if security for the natural world is to be achieved absent some horrible pandemic, the necessary cultural transformation will come only when society embraces a Leopoldian land ethic, and people become "plain members and citizens of the biotic community." The means to that hopeful end are precisely the conversation we've long fostered in *Wild Earth*.

We have oft employed another metaphor for *Wild Earth*—a river of words for wilderness. Many, many people added force to that current, and I regret not being able to thank them all by name here. On behalf of the current editorial team—my extraordinary Vermont colleagues Jennifer Esser, Joshua Brown, and Kevin Cross, and our adjunct elders Dave Foreman and Reed Noss—we offer our gratitude to all who floated these waters with us through the years. Wild Earth board and staff members, past and present, Wildlands Project colleagues, that marvelous trio of volunteer poetry editors—Art Goodtimes, Sheila McGrory-Klyza, and Gary Lawless—and the hundreds of writers and artists whose collective contributions were *Wild Earth*, we thank you. To the individual and institutional funders[8] who believed enough in our mission to open your checkbooks, we are grateful for your support.

Most of all, we extend thanks to you—the journal's diverse and engaged readers—for sharing our explorations, and wish you many future rambles in the back of beyond, getting near to the heart of the world. We trust that this river of words has been helpful to the cause of conservation. May the wild places and creatures—and people—forever flourish.

~ Tom Butler

NOTES

1. The apocryphal creation story has grizzled wilderness warrior Foreman and strapping protegé Davis conceiving the new periodical around a campfire on a backpacking trip in northern New Mexico. While that trip did happen, it seems the real genesis of the journal was a conversation they had while sitting poolside in Tucson, when Foreman was laid up, recuperating from a bout of hepatitis. Once idea moved into motion, John's mother, the researcher and writer Mary Byrd Davis, did the bulk of the work securing nonprofit status, establishing the business infrastructure, and serving initially as publisher. David Johns, an attorney and another founding board member, was also central to the startup; he was also the longest-serving, hardest-working member of the board.
2. For their energy, insight, and invitation to join the *Wild Earth* team, I am forever indebted to Foreman and Davis, conservation mentors and friends nonpareil.
3. Readers will forgive, I hope, the use of this metaphor. It has been great fun producing *Wild Earth* and helping foster a conversation about conservation among people who love nature. Ultimately though, the journal is just words on paper, and its demise is trivial compared to the loss of actual wild places and creatures. Extinction, of course, is natural—but human-caused extinction is surely the greatest collective sin, the "greatest crime against creation" (to borrow Connie Barlow's phrase), that our species has wrought.
4. Discretion warrants the latter figures remain nameless until they join Brower on the ultimate wilderness trip.
5. Martin and Sayen's essays, and many other highlights of the journal's first decade are collected in the anthology *Wild Earth: Wild Ideas for a World Out of Balance* (Milkweed Editions, 2002) which has been widely adopted for use in college-level environmental studies courses.
6. The launch of The Rewilding Institute (www.rewilding.org) by Dave Foreman and others should partially fill this niche in the conservation community. See also Foreman's excellent new book, *Rewilding North America* (Island Press, 2004).
7. See linguist George Lakoff's cogent explanation of why liberals have been getting their butts kicked in the language wars, *Don't Think of an Elephant: Know Your Values and Frame the Debate* (Chelsea Green, 2004). Conservationists, too, are often clueless in the framing wars, getting pummeled by industry and anti-conservationists. Think, for instance, of the widespread and unthinking adoption by environmentalists of the industry-friendly term "working forest" for logging lands.
8. We would be remiss not to acknowledge in particular Doug Tompkins and his Foundation for Deep Ecology, an early and consistent funder of *Wild Earth* and the Wildlands Project. The foundation's friendship and support have been crucial to many of the most forward-thinking groups working to protect wilderness and wildlife.

"Sandia View II," woodcut by Lezle Williams

We have an opportunity unique to our generation: to halt a mass extinction.

REED NOSS

Rewilding North America

FROM MY EARLIEST DAYS, I have been drawn to the heart of wildness, to wild lands and wild rivers and wild things, to the places and beasts outside the rule of humankind. Long before I learned the ancient English meaning of wilderness—"self-willed land"—I looked up at the Sandia Mountains, rising above the city of Albuquerque, and saw a world where we were not masters of all. Long before I had heard of the Beowulf-time word *wildeor*—"self-willed beast"—I watched the horny-toads and bluetails scurry through the grama grass and rabbitbrush of the high desert and knew that they ran their errands on their own time in their own way, not on human-time or in human-way.

As I grew older, I began to sense a loss of what was no more, of once-upon-a-time wildernesses and once-upon-a-time wild animals, as I read Ernest Thompson Seton and Mark Twain, as I read about Kit Carson and Buffalo Bill. Unlike many other boys, I did not yearn for the smoking buffalo gun in my hands, but for the buffalo vast as summer cloud-shadows across the land.

Older still, I watched the high desert between Albuquerque and the Sandias gradually disappear under a carpet of asphalt and buildings. As a young man, I saw raw roads ripped into the wilderness, forests buzz-cut, rivers dammed, coal torn from the badlands—all where I sought will of the land. And I knew that if my wilderness—no, not mine, but its own—was to endure I had to fight for it.

Aldo Leopold called the essays in *A Sand County Almanac* "the delights and dilemmas of one who cannot...live without wild things." My new book, *Rewilding North America,* is no *Sand County Almanac,* but it is shaped by the horror and the hope of another who

cannot live without wild things.

Doug Scott, a peerless strategist and campaign leader for the wilderness movement for over 30 years, begins his inspiring and authoritative book on the history of the National Wilderness Preservation System with a vision for American wilderness: "a wilderness-forever future." But, of course, Scott is just sharing what he has already received. He writes, "This is not my phrase, it is Howard Zahniser's. And it is not my vision, but the one I inherited, and that you, too, have inherited, from the wilderness leaders who went before."

Scott quotes Zahniser, "The wilderness that has come to us from the eternity of the past we have the boldness to project into the eternity of the future." The 1964 Wilderness Act, largely written by Zahniser, embodies this vision in Section 2:

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

As settlement and mechanization yet grind away at wildlands 40 years after the passage of the Wilderness Act, the challenge for conservationists in the twenty-first century still is to protect *an enduring resource of wilderness.* But before we can boldly project wilderness from the eternity of the past into the eternity of the future, we must understand what an *enduring* wilderness is. What are its characteristics? What must be done to ensure that wilderness is enduring?

Since the Wilderness Act became law in 1964, our knowledge of what makes wilderness enduring has grown, as has our knowledge of what destroys the eternity of wilderness. And, thus, the task of wilderness areas and other protected areas has evolved. This deepened understanding comes from the ecological research and theory that, after 1978, became known as *conservation biology.*

Of all ecology has learned since 1964, the most important lesson is that Earth is now clearly in a mass extinction event—the Sixth Great Extinction in the last 500 million years. Although this mass extinction began 40,000 years ago when behaviorally modern humans spread out from Africa, it has reached catastrophic proportions at the beginning of the twenty-first century. Unlike previous mass extinctions, which were caused by physical forces (asteroid strikes and geological events), this Sixth Extinction is caused by the activities of *Homo sapiens.* Biologists widely recognize that direct killing by humans, habitat destruction and fragmentation, disease, pollution, and invasion and competition by alien species are the general causes of current extinctions. Stemming this alarming tide of extinction demands conservation vision and action at local, regional, continental, and global scales.

Both the traditional conservation movement and the recent science of conservation biology have recognized that protected areas are the best way to safeguard species and habitat. In 1980, conservation biology pioneers Michael Soulé and Bruce Wilcox wrote that protected areas were "the most valuable weapon in our conservation arsenal." Protected areas, such as national parks, wilderness areas, and national wildlife refuges, have been cornerstones for conservation strategy in the United States as have comparable areas throughout North America and the world for more than 100 years. Although the goals of protected areas have included the preservation of an enduring resource of wilderness and of self-regulating ecosystems, we now understand that protected areas systems in North America have not fully safeguarded all species and ecosystems, because of:

- direct killing of native species, especially highly interactive species, inside and outside of protected areas;
- poor ecosystem representation in protected areas, and degraded ecosystems both within and outside protected areas;
- isolation of protected areas and fragmentation of habitat between protected areas;
- loss or degradation of ecological processes, especially fire, hydrology, and predation;
- invasion by disruptive exotic species and diseases;
- pollution;
- and global climate change.

Drawing on Aldo Leopold's words, I call these causes of extinctions *wounds.*

It is important to understand that national parks, wilderness areas, and wildlife refuges have done much to protect and restore nature. Without existing protected areas systems in

North America and the rest of the world, the state of nature would be far bleaker. The problem is that not enough land has been protected, and political and economic forces have thwarted and weakened the establishment of protected areas. And, let's face it, science has only recently understood the depth of ecological problems and even more recently given guidelines for how to solve them.

To make protected areas more effective, conservationists must now (1) work on very large landscapes, probably continental in scope, and (2) undertake ecological restoration based on *rewilding*. Instead of the island-like protected areas currently in place, we need a continental wildlands *network* of core wild areas, wildlife movement linkages, and compatible-use lands to meet the habitat needs of wide-ranging species, maintain natural disturbance regimes, and permit dispersal and reestablishment of wildlife following natural events such as fires. Moreover, this network must be based on the scientific approach of rewilding, which recognizes the essential role of top-down regulation of ecosystems by large carnivores, and the need that large carnivores have for secure core habitats, largely roadless, and for landscape permeability (habitat connectivity) between core areas. Fully protected cores such as wilderness areas are at the heart of this strategy. The Wildlands Project summarizes this approach in its slogan, "reconnect, restore, rewild."

Although such a continental vision is bold, it follows in the footsteps of other conservation visionaries. In the 1920s and 1930s, eminent ecologist Victor Shelford and the Ecological Society of America called for a careful inventory and planning for a United States system of natural areas protecting all ecosystem types. Wilderness Society founder Benton MacKaye based his vision for the Appalachian Trail on regional planning. In developing the Wilderness Act, Howard Zahniser planned for a national system of wilderness areas cutting across agency boundaries. The peerless system of national parks, national wildlife refuges, national wild and scenic rivers, and wilderness areas in Alaska came from years of careful planning by government professionals, scientists, and citizens to protect entire ecosystems and represent all habitats in Alaska. More recently, conservation groups have undertaken huge, detailed, statewide inventories of potential wilderness areas in western states.

Much conservation work is urgent, responding to immediate threats to wildlands and wildlife, and opportunistic, taking advantage of new political alignments and such to protect certain areas. However, this work needs to be based on an overarching vision and careful long-term planning to be most effective. For example, Reed Noss proposed a conservation area network for the state of Florida in the mid-1980s. Florida state agencies and the Nature Conservancy then carried out detailed planning to refine the network. With this solid, scientifically defensible vision in place, the Florida state legislature was convinced to appropriate $3.2 billion to buy wildlife habitat. Without vision and careful planning, this would not have happened. Similarly, the 2000 release of the Sky Islands Wildlands Network Conservation Plan by the Wildlands Project, Sky Island Alliance, Naturalia, and other groups has led to conservation groups, outdoor recreationists, landowners, ranchers, and federal, state, and county agencies working together to protect and restore biological diversity across southeastern Arizona and southwestern New Mexico. Without the kind of detailed citizen conservation work that has pulled together wilderness area proposals since the 1960s, the current 106-million-acre National Wilderness Preservation System would be far smaller and less ecologically representative.

In *Rewilding North America,* I propose both a vision and a strategy to reconnect, restore, and rewild four Continental MegaLinkages that will tie North American ecosystems together for wide-ranging species and ecological processes, and accommodate climate change. These MegaLinkages are (1) the Pacific MegaLinkage, extending from Baja California to Alaska; (2) the Spine of the Continent MegaLinkage, extending from Central America to Alaska through the Rocky Mountains and other ranges; (3) the Atlantic MegaLinkage, extending from Florida north through the Appalachian Mountains to New Brunswick; and (4) the Arctic-Boreal MegaLinkage, extending from Alaska across Canada to the Canadian Maritime Provinces on the Atlantic coast. They are the basic architecture for a *bold, scientifically credible, practically achievable, and hopeful vision* of an enduring wilderness for North America.

~ Dave Foreman

Sandia Foothills, New Mexico

Dave Foreman is director of the Rewilding Institute. A founder of *Wild Earth,* he has served as executive editor, publisher, and publisher emeritus. The opinions expressed here are his own. This piece is adapted from his new book, *Rewilding North America,* which can be ordered from the institute's website: www.rewilding.org.

ARCHIE CARR'S article ["Utopian Bubbles: What are Central America's Parks *for?*" Spring/Summer 2004] was amusing, colorful, and presented very well the conundrum facing the larger-scale conservation efforts in the developing world. He particularly focuses on the Mesoamerican Biological Corridor project in Central America and Mexico, largely supported by the World Bank, where I would agree with Mr. Carr that little has been achieved for the approximately $100 million that has been invested.

Mr. Carr's view is that poverty alleviation and biodiversity conservation ought to be separate goals, carried out by different organizational entities, and that "muddling" the two together is a "disservice to the public and to nature." Yet Mr. Carr's own organization, the Wildlife Conservation Society, has accepted significant dollars from funding organizations to deal with (in Carr's own words) "people, poverty, and parks, year after year." So have the other large international conservation organizations such as The Nature Conservancy, World Wildlife Fund, and Conservation International: these three organizations invested $487 million in 2002 in conservation in the developing world—funding largely provided by multilateral and bilateral development institutions, philanthropic institutions, corporations, and individuals.* I suggest that much of this financial support posited the active involvement of local peoples in the conservation schemes.

Not specifically focused on by Mr. Carr is that the ecosystems of most interest for biodiversity conservation are also usually those inhabited by indigenous and local peoples. These groups—encouraged by civil society that has in recent years successfully wielded its power on the international political scene, and supported by human rights and other organizations—have increasingly asserted their political rights and claims to land. These rights, while often opposed by the national governments of the territories these peoples inhabit, are now often being upheld by regional and international bodies, such as the Inter-American Court of Human Rights.

The challenge we thus face is to achieve conservation goals while fully respecting human and territorial rights of those peoples inhabiting the lands that we wish to conserve. Rather than a simple choice between conservation and poverty alleviation, it is more a possible conflict between equity, social justice, and human rights on the one hand and conservation on the other. But conservation organizations *cannot* avoid dealing with this issue, as Mr. Carr wishes they could, since conservation and human rights concerns play out on the same landscapes.

Development and implementation of conservation plans therefore need to have the full participation and consent of local and indigenous peoples who live in places being conserved. We expect no less of conservation efforts in the U.S. or in Europe. I do not believe that the conservation community can avoid taking this path. It needs to work constructively with indigenous and local groups, as equal partners, to arrive at equitable solutions that are acceptable to all legitimate interests. The road will be difficult and time consuming, but in the end the goals

* "Study of Critical New Forest Conservation Issues in the Global South," Arvind Khare and David Barton Bray, final report submitted to the Ford Foundation, June 2004, page 5.

of all those involved will be more effectively met, for indigenous and traditional peoples can be excellent allies in the battle to preserve the Earth's natural heritage. I share Mr. Carr's frustration that easier solutions don't seem to exist. But it is not a "disservice to the public and nature" to take this difficult road and approach it with mutual respect and understanding.

Jack Vanderryn
Washington, D.C.

Jack Vanderryn is a Senior Fellow in Environment and Development with the Moriah Fund.

I READ WITH great interest the article by Andy Kerr in the Spring/Summer 2004 issue entitled "Mergers, Acquisitions, Diversifications, Restructurings, and/or Die-Offs in the Conservation Movement."

Some of the information Kerr provided is useful in deciding what type of group—501(c)(3) or 501(c)(4)—you want or how large that group should be. However, Andy's underlying philosophy that "the nonprofit conservation movement needs to follow examples in the for-profit world and do some serious merging, acquiring, consolidating, upsizing, downsizing, bankrupting, resizing, and reinventing" leaves me troubled.

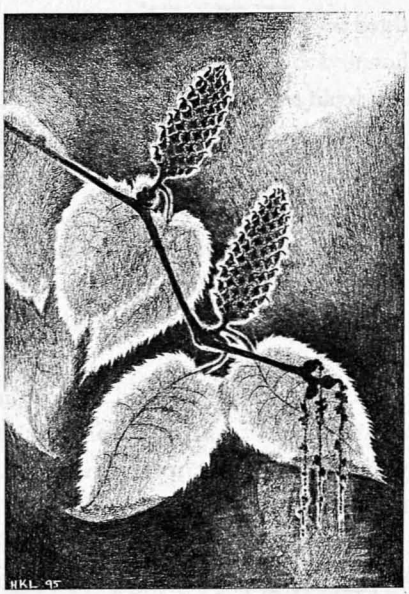
Certainly merging, acquiring, consolidating, upsizing, downsizing, bankrupting, resizing, and reinventing by corporations has not resulted in protection of the Earth or even better financial bottom lines. The philosophy that Kerr supports appears to be a combination of "let the buyer beware," "survival of the fittest," and "monopolies rule" more than anything that will save the Earth. Failed policies in the for-profit world should not be used as models for helping what ails the nonprofit world.

Kerr's article is in direct contrast to an article written by Bethanie Walder in the *Road-RIPorter* in Spring 2004 entitled "Back to Our (Grass) Roots." She states, "The current budget shortfalls in conservation organizations may provide just the catalyst we need to get the environmental movement back to its roots—to focus on building local, vocal, active grassroots support for conservation issues....It seems the professionals are starting to talk about how to connect with the volunteers again."

In my mind this philosophy will result in greater environmental progress than the failed policies of the for-profit corporate world.

Brandt Mannchen
Houston, Texas

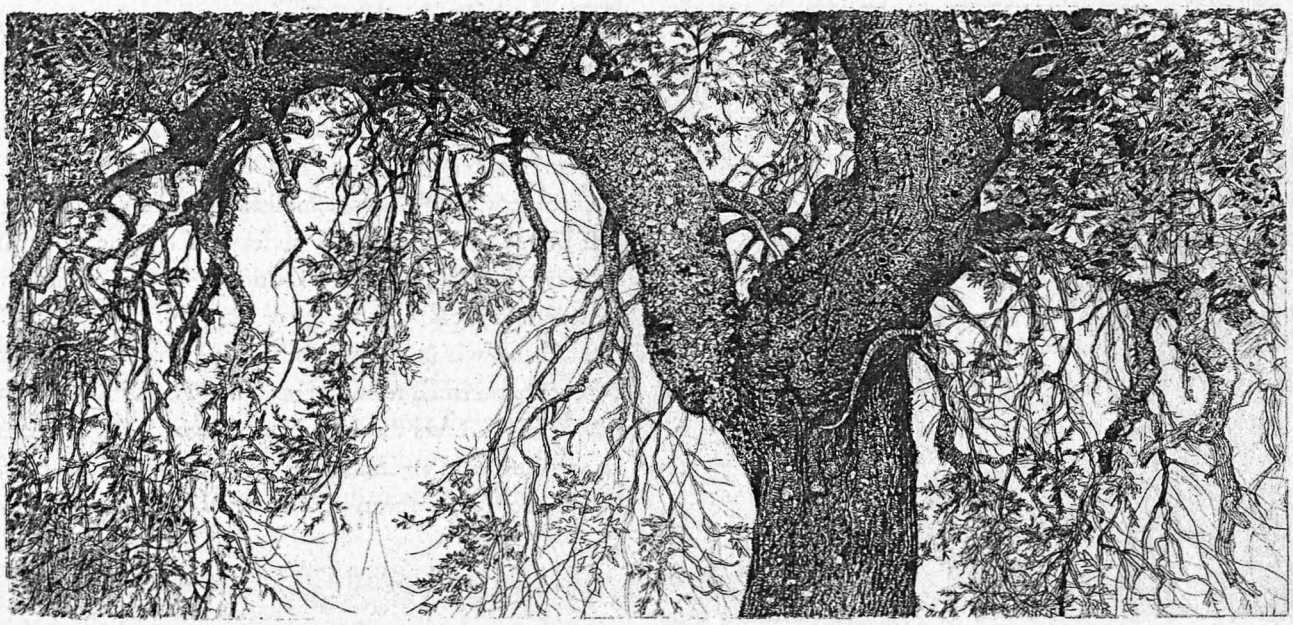
THE TWO ESSAYS on "Trapping on the National Wildlife Refuges" [Winter 2003–2004] were a much needed point and counter-point to the little discussed phenomenon of trapping in refuges. I remember reading the *Defenders* special feature edition on national wildlife refuges and never finding a mention of the fact that trapping is allowed on a large percentage of refuges, which struck me as a serious oversight.



However, I was deeply disturbed by [U.S. Fish and Wildlife Service Director] Steve Williams' essay as I felt that it utterly missed the mark in discussing the issue at hand. I have been involved in different capacities with the red fox situation in the Bay Area and have read most supporting documentation (quite a feat, let me tell you) on this topic. For the record, I was hired as a third-party objective ecologist by the City of Mountain View to evaluate agency and animal welfare proposals regarding the red fox in a local park, and also as an ecologist by the Bay Area Coalition of Animal Protection Organizations for a sticky situation regarding red fox trapping at Redwood City. I generally, however, work on issues surrounding threatened and endangered species in California, primarily the San Joaquin kit fox.

First, the red fox issue at the Don Edwards Refuge specifically and in the Bay Area in general is complex. The primary reason that there were only 300 clapper rails in the Bay Area is because they were hunted into oblivion. Over 5,000 clapper rails were killed a week for years in the early 1900s. In addition to that, there has been 80% alteration to existing habitat within the Bay (clapper rails rely on hiding for the most part to avoid predation—including aerial predators—and the associated reduced cover with habitat loss is a real problem—red fox or not). Finally, due to the large number of humans and their associated infrastructure, commensal species such

black birch staminate catkins, graphite by Heather Lenz



as possums, rats, skunks, raccoons, and, yes, to some extent red fox are finding it easier to live in numbers that are probably higher than historically.

There are other issues like changes in salinity levels, the presence of selenium (considered detrimental to egg development), and changes in high tide heights that also may be having an unknown effect on clapper rails' survival. The point that I am making is that the problem for the clapper rail is not so simply "the red fox"—it is a complex issue that needs to be addressed in a comprehensive way if we want to maintain clapper rails in such an altered ecosystem. (And I am not implying that we need to spend our limited resources year in and year out to trap and kill numerous other species in addition to red fox—but instead that we look at creating habitat in areas that can be either fenced or have a water barrier, enhance cover, and study the issue more carefully.) I do not have space here to go into a number of errors in Williams' statements regarding the effect of red fox trapping on wildlife reproduction.

While these issues are troublesome, what I find deeply problematic about Williams' essay is that it does not address the justification for the type of trapping and snaring that occurs in over half our refuges—the type of trapping that is so eloquently discussed in Camilla Fox's counter-point essay. Williams' appeals to the "big picture" are extremely vague, but they seem to have something to do with trapping being part our heritage and needed in restoring the balance of nature, as evidenced by comments such as, "As we mark the bicentennial of the Lewis and Clark exploration, we should not forget that it was trapping that helped open, discover, and map many of the wildest parts of the continent."

With regard to Lewis and Clark, much of their help came from the native peoples. The hunters and trappers of that era managed to drive an amazing number of subspecies to extinction (for example, the Great Plains grizzly, wolf, and beaver, among others), which of course was followed by the all-out slaughter of the buffalo and wolves as white settlers made their way west. Is that the (in Williams' words) "cultural heritage" that we "should not abandon"? (Of course, I would be remiss in not mentioning that European trapping and hunting eventually had a devastating effect on the native peoples who lived in North America.)

The outdoor activities that are, I hope, overtaking trapping (and hunting) require just as much skill, if not more: they include birdwatching, wildlife watching, filming, and photography. Why not encourage watching and enjoying the beauty and grace of living, breathing wildlife? Is not the need for refuges precisely because we trap and hunt things so that these activities are in part causing an imbalance? Then we end up justifying trying to control all levels of a trophic system. Is that really what it means to restore the balance of nature? I think not.

Susan E. Townsend
Oakland, California

Dr. Townsend is a wildlife ecologist and environmental consultant.

"Black Oak at Dry Creek," lithograph by Davis Te Selle

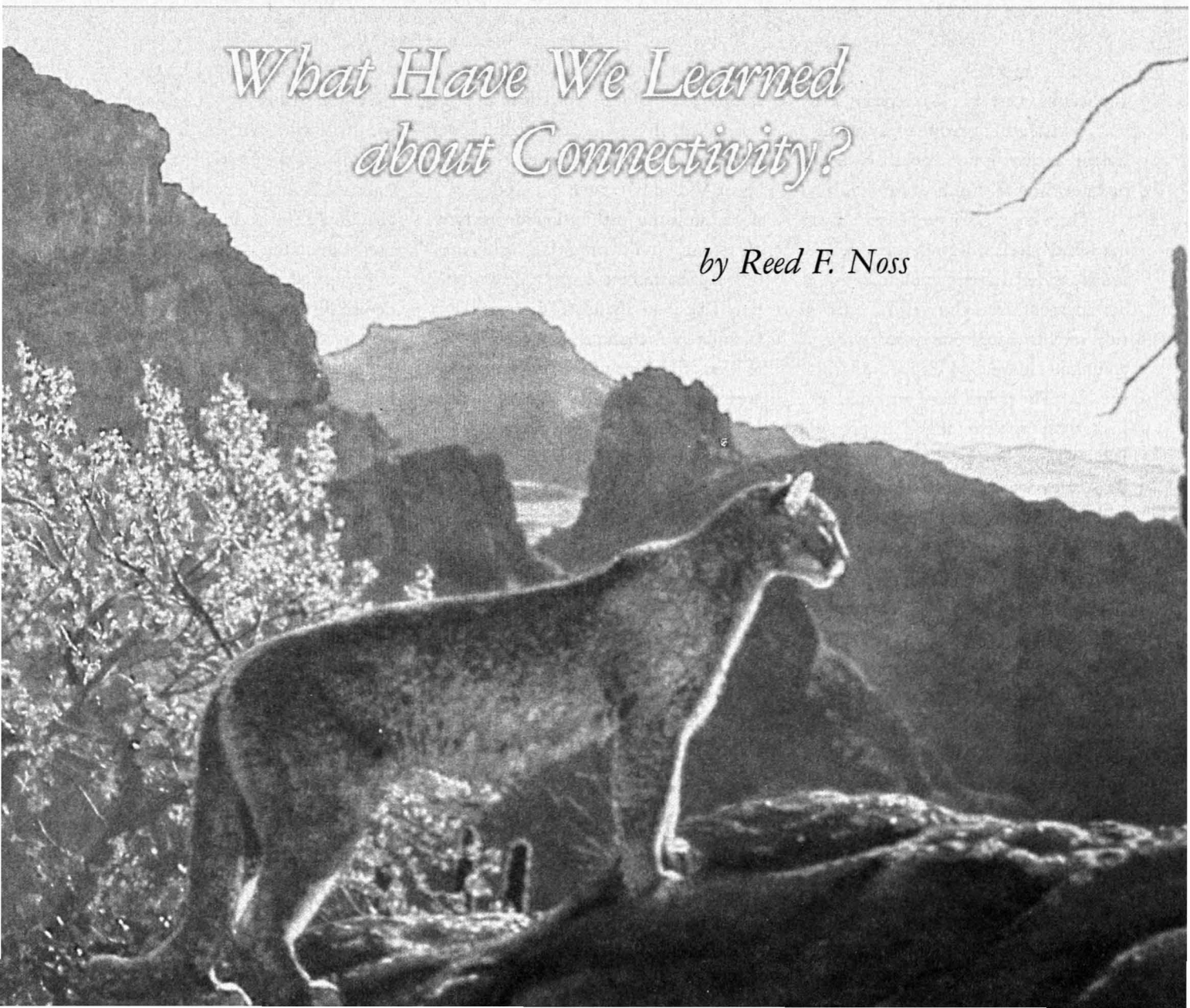
What Have We Learned about Connectivity?

by Reed F. Noss

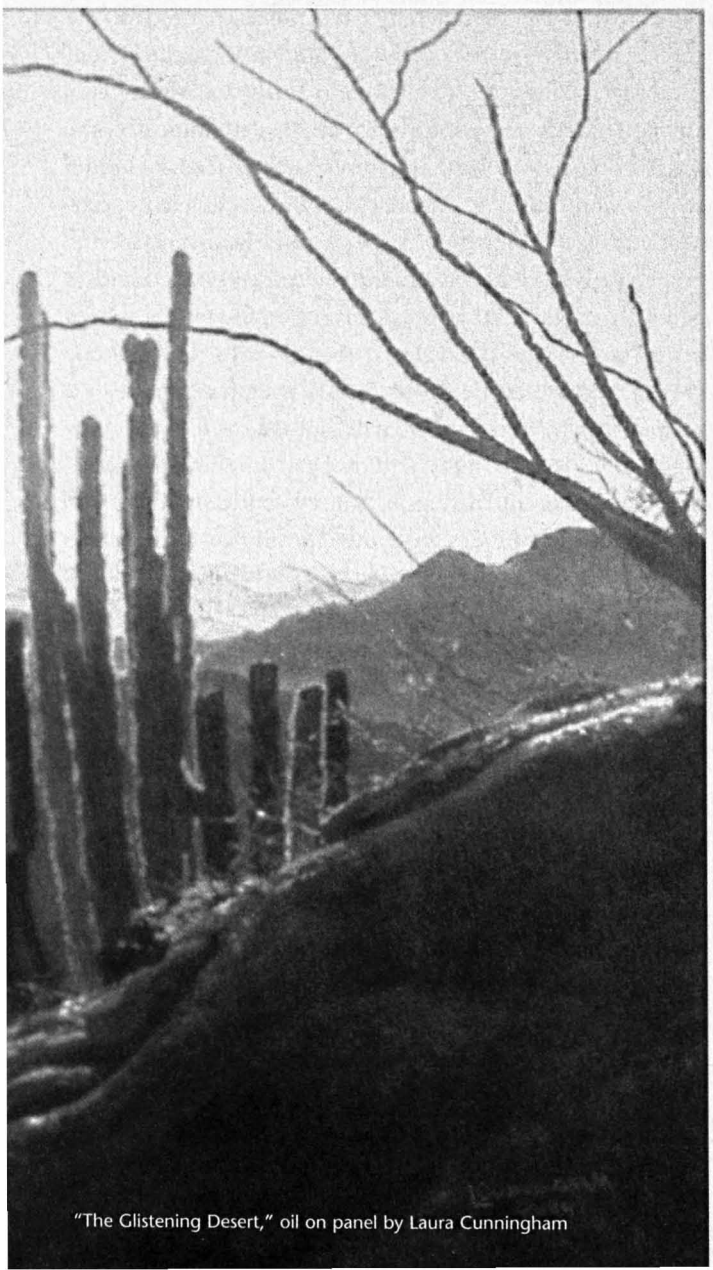
Connectivity is a feel-good concept.

We like to be connected to other people and to life. If we can maintain or restore the natural flows of animals and ecological processes across the landscape, if we can break the spell of fragmentation, we will have accomplished something special. Or will we? Is connected always better than disconnected? Are corridors or linkages an essential ingredient of any defensible conservation plan?

When I was in my first round of graduate school in the 1970s, the potential relevance of Robert H. MacArthur's and Edward O. Wilson's theory of island biogeography to conservation was being vigorously debated in the scientific literature. Basically, the theory stated that the number of species



found on islands and island-like patches of habitat is determined by the rates at which new species immigrate to the island and species already there go extinct. Islands that are large and close to the mainland, or some other source of colonists, would be expected to have more species than smaller or more distant islands. Several scientists, including Ed Wilson, Ed Willis, and Jared Diamond, drew on this theory to make recommendations about the design of nature reserves, emphasizing that reserves should be as large as possible and ideally should not be isolated from other reserves. They reasoned that habitat corridors between reserves are a good idea because they would be expected to increase the rate of immigration and, correspondingly, the number of species. Other scientists pointed out that corridors might not only increase the rate of immigration to reserves, but might also reduce extinctions by providing a "rescue effect," whereby new individuals of species already present arrive by traveling through corridors and bolster local population sizes.



"The Glistening Desert," oil on panel by Laura Cunningham

These reserve design "rules" were incorporated into the IUCN's World Conservation Strategy in 1980, but even before then had become quite popular among conservationists. However, extrapolations from unproven theory to conservation planning bothered some scientists, such as Daniel Simberloff and Lawrence Abele, who published a short paper in *Science* magazine in 1976 blasting the uncritical acceptance of design rules. *Science* published a series of responses to Simberloff and Abele in the same issue, all of which defended the application of island biogeography, biological field experience, and inference to the design of nature reserves. It made for entertaining reading.

Curiously, corridors were not a big issue in that mid-70s debate. More controversial was the principle that one large reserve is better than several smaller reserves of equivalent total area. This debate raged so fiercely that it acquired its own acronym in the scientific literature: SLOSS (i.e., single large or several small). The SLOSS debate finally fizzled out when it was recognized by most sensible biologists that, in the real world, reserve design would never boil down to such a simplistic question. It was not until 1987 that the corridor debate began in earnest when Simberloff and Jim Cox published a paper in *Conservation Biology* questioning the wisdom and cost-effectiveness of the corridor strategy. For instance, they argued, a corridor might spread wildlife diseases or be more expensive to purchase than an isolated but more valuable patch of high-quality habitat for rare species. Their paper was followed in the succeeding issue by a paper of mine defending the value of corridors in conservation planning, while acknowledging potential disadvantages and uncertainty. Basically, my argument went, most natural landscapes are highly connected; the corridor strategy is simply an attempt to retain or restore some of that connectivity. Moreover, as Larry Harris and I had argued previously, well-designed corridors could potentially create a whole greater than the sum of its parts—that is, although no single reserve might maintain a viable population of a particular species, a well-connected network of reserves might contain a viable population or metapopulation.

I offer this historical background to put the connectivity issue in context, and also to illustrate the propensity of academics to argue over seemingly trivial matters. In the case of corridors, the academics had not really done their homework.

It was not MacArthur and Wilson, nor even Diamond, who introduced the corridor idea in the ecological literature. Frank Preston, writing in 1962 in *Ecology* and applying much the same reasoning as the later work by MacArthur and Wilson, suggested that "the only remedy [to habitat isolation] is to prevent the area from becoming an isolate by keeping open a continuous corridor with other preserved areas." Furthermore, for many years before Preston wrote his article, wildlife managers and conservation-oriented scientists were demonstrating the use of corridors by wildlife and trying to protect corridors on the ground. For instance, as early as the 1930s, wildlife biologists were well aware of the use of wooded corridors by particular game mammals and birds, such as squirrels and quail, in agricultural landscapes. Victor Shelford, a pioneering American ecologist and conservation biologist (before the term was ever coined), had recommended the protection of corridors, such as forested riparian strips, between reserves in the 1940s.

My personal interest in corridors, then, began as a graduate student when I became deeply concerned about the effects of habitat fragmentation. A nature reserve in Ohio, where I did my master's research, was rapidly losing its connections to other surrounding forests as streamside corridors and wooded fencerows were being cut down. I worried about the effects on forest-interior species with small populations. So, I began to advocate the retention of corridors of natural habitat between reserves. Nothing new about that. What was fairly new, it seems, was incorporating broad corridors into the design of regional networks of reserves, which I initiated in the early 1980s with work in Ohio and Florida. The first issue of *Wild Earth* in 1991 included a reprint of an article I originally published in the *Earth First!* journal in 1985, laying out a conceptual plan and map for a statewide network of core areas and corridors in Florida.

So where are we now in the corridor debate? Corridors, also called linkages, have become well-accepted components of conservation plans, perhaps too well accepted—they have essentially become a fad. Conservation activists and planners sometimes incorporate corridors into their designs with apparently little thought to which species might benefit from corridors and which will not. Some kinds of corridors, such as utility or highway rights-of-way, are touted as greenways for wildlife, but are actually likely to have negative effects, at least on forest species. As noted by Australian biologist Andrew Bennett, "in many ways, the acceptance of corridors as a concept for biodiversity conservation has outpaced scientific understanding and the collection of empirical data." Don't get me wrong—Bennett, I, and probably most conservation biologists generally support the corridor strategy. Because most of the remaining natural areas in human-dominated landscapes are becoming increasingly fragmented, providing opportunities for animals and plants to move among areas makes abundant sense. But the devil is in the details.

Some conservationists continue to operate by simple rules of thumb, such as "bigger is better" and "connected is better than disconnected." The latter, however, is not universally true. For example, roads and roadsides are well documented as movement corridors, but the species they benefit—generally weedy species, including many invasive exotics—are not those that conservationists want to see moving across the landscape. What we should be interested in is not corridors per se, but rather functional connectivity for species sensitive to habitat fragmentation. Functional connectivity involves the flow of individuals and their genes among habitats and populations, and is determined by the intersection of a species' life history characteristics, including its behavior, and the structure of the landscape. Hence, connectivity is a highly species-specific and landscape-specific property. Well-designed studies of conservation corridors generally show that they provide connectivity for the species being targeted. Nevertheless, what is a corridor to one species may be a barrier to another. A river, for instance, is a barrier to many terrestrial animals, but is a corridor to aquatic species as well as those terrestrial and amphibious species that inhabit the riparian zone. What is critically important is that corridors be designed thoughtfully to consider the needs of the species most in need of conservation.

Data in support of the corridor strategy and the analytic techniques for designing corridors have improved tremendously over the last couple decades. As a case in point, my rather crude design for a statewide network in Florida has been enhanced greatly by subsequent work by Steve Gatewood, Jim Cox, Randy Kautz, Tom Hoctor, and other researchers. The new, but frequently revised, design for a "Florida Ecological Network" is used both for biological conservation planning and for recreational (greenways) planning, and "critical linkages" and other criteria from landscape ecology are applied in the evaluation and ranking of sites for acquisition in the state's unparalleled land conservation program. Land is still being developed in Florida faster than it can be protected, but acquisition of new lands, combined with construction of wildlife crossings under or over highways, should make habitat frag-

mentation less of a problem than it would be otherwise.

Conservation planning is a rapidly evolving science. New techniques being used to identify suitable corridors for species of concern include habitat and population modeling using a geographic information system (GIS). For example, "least-cost path analysis" can be used to identify potential travel routes, along which an animal would have the best chance of survival based on a habitat suitability model—the higher the suitability, the lower the predicted cost of moving through the landscape. Least-cost path analysis can help planners determine where to protect land for linkages and how and where to mitigate wildlife mortality within these areas. However, because they are static representations of habitat conditions, such models are poorly suited for consideration of population persistence over time. For that purpose, spatially-explicit population models are more useful. These dynamic simulation models can be used to examine potential patterns of population growth and dispersal over large areas and to predict the effects of changing landscape structure on the viability of populations. My former student (and continuing friend) Carlos Carroll has been using these modeling approaches to help the Wildlands Project and other organizations develop regional conservation plans and identify priority areas for linkages.

Of course, fancy models are only as good as the underlying data. In many cases today, progress is limited not by the availability of appropriate models or computational power, but by field-based knowledge of natural history. Species that have been poorly studied cannot be modeled with confidence, and even for well-studied species, new information from field studies is needed to test the validity of model predictions about what constitutes suitable habitat for both residence and movement by animals. Until such data are available, the best interim approach seems to be combining expert opinion (especially, but not solely, as represented in the peer-reviewed literature) with the results of models to allow interpretation to the real world.

What have we learned about connectivity? We have learned that it is a much more complex phenomenon than we originally thought, but without it many species in human-fragmented landscapes will likely perish. All in all, connectivity of natural habitat is indeed a good thing. ☾

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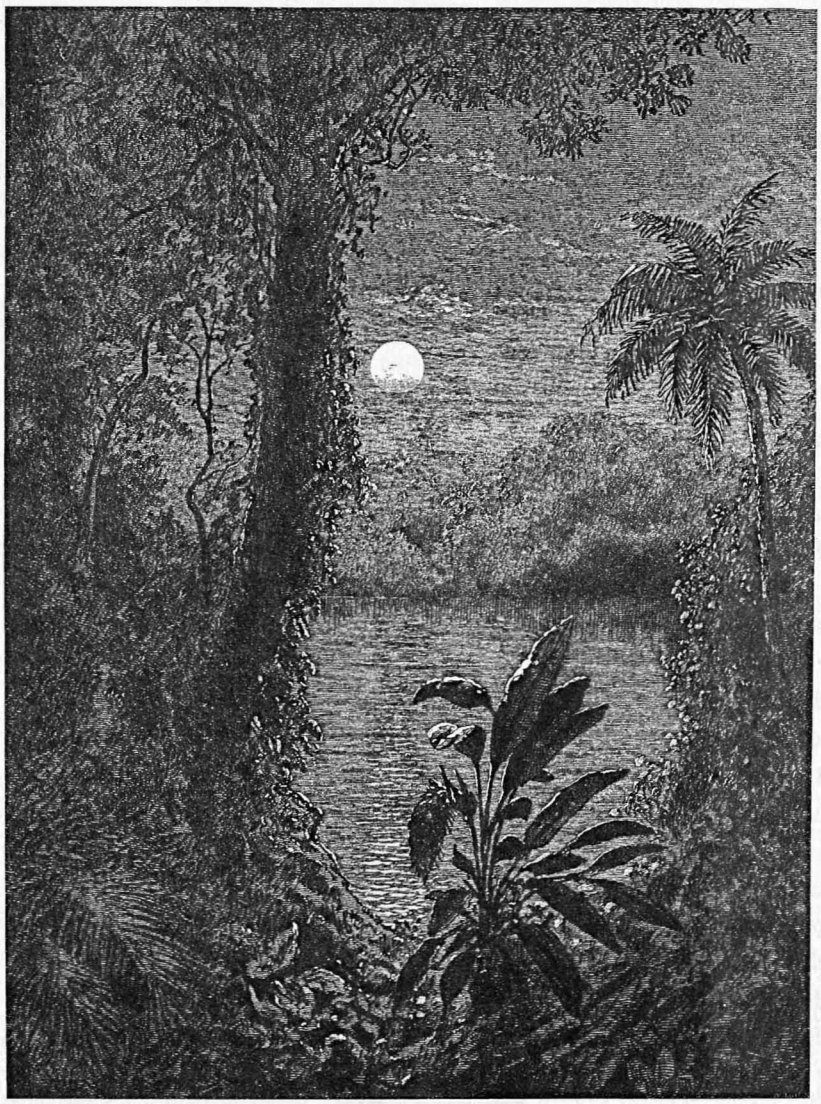
Bird in Hand

Whatever sound she makes, hold still.
Let the short-shafted feathers of the head
overlap your middle and index fingers.
You knew that trembling when you were small,
when you felt the urge to run in every open space.
And holler. When play was the same
as the rest of your life and there was no morality
because you hadn't yet discovered separateness,
the lack of words between you
and this bird pecking your fingertips,
ignorant of patience and every idea
but the desire you've interrupted
like a stationary god of migrations.

Maybe this bird expects to die now
or maybe the horror of expectation
is foreign to her as the south she wants to find,
the prospect of another moment real
right up to the instant you open your hand
and she hesitates before unleashing
a burst of wings unaccounted for
in your previous understanding
of flight: speed, gravity, drag
gone with the feel of life that leaves you
knowing you could have taken it.
You write her name, a shelter
like the willow she lands in.
But later, when you say *redstart,*
the bird does not appear.

Douglas Haynes

Footprints in the Forest



engraving ca. 1900

by MICHAEL GAVIN

THE PLUSH FOREST CARPET of the Amazon Basin thrusts abruptly skyward in the Cordillera Azul, the Blue Mountains of Peru. Four thousand miles from the mouth of the Amazon, the great jungle this river drains sits a mere six hundred feet above the sea. Then, within a mile or two, the land rockets to nearly eight thousand feet. The peaks' steep flanks are pocketed by landslides and water hurls over drops hundreds of feet high. Nestled in the folds of the mountains lie blackwater lagoons and palm-studded swamps. The tumultuous twists of the landscape give rise to a vast array of habitats and, in turn, a dazzling cornucopia of flora and fauna flourishes. Over three weeks in 1999 a team of Peruvian and U.S. biologists surveyed the Cordillera Azul and found evidence of one of the most biologically diverse locations on the planet. Even more impressive though was the near complete absence of one particular species, our own, *Homo sapiens sapiens*.

The scientists involved used the data they gathered to lobby successfully for the designation of the Cordillera Azul National Park, which the Peruvian president officially gazetted in May, 2001. The new protected area is the size of the state of Connecticut, over three million acres, and on the day of its formation was home to only a handful of human residents (Connecticut has 3.4 million). The park protects a vast tract of what could be called quintessential tropical wilderness, impressive biological richness free from the stain of human presence. The Cordillera Azul National Park sits on the edge of the core of what many consider to be one of Earth's last great wildlands, the Amazon rainforest. Even the language we choose to describe the Cordillera Azul National Park and the Amazon in general is laced with wild spice. We speak of these jungles as pristine, primeval, virgin, or, in an attempt to be objectively scientific, primary. All of these descriptors leave a sense of cleanliness, of an untouched, unblemished nature.

In fact, the team that set up the Cordillera Azul National Park was lucky. Finding wilderness is not so easy anymore. Amazonia is one of the few places where such large chunks of tropical wild are left. Recently, the Wildlife Conservation Society published results from their research into what they call the "human footprint." They found only 17% of the planet's land surface was free from human impact. But what is impact? The Wildlife Conservation Society defined the footprint as land with greater than one person per square kilometer, falling within fifteen kilometers of a road or major river or within two kilometers of a settlement or railway, occupied by agricultural or urban land use, or producing enough light to be visible consistently from a satellite at night. But not all footprints can be found on a map or seen from space. Such is the case in the Cordillera Azul.

DON PEDRO PIZANGO lives in a village one day's walk from the Cordillera Azul National Park. His mud-walled home looks down on the boulder strewn span of the Ponasa River. Don Pedro spends most of his days in the fields tending to his maize and manioc, but two or three times a year he ventures into the Cordillera Azul in search of bushmeat. One night after dinner on a visit to his home, Don Pedro asked me to wait at the table. He had something to show me. He returned a few minutes later with a black plastic bag. Pushing aside our dirty metal plates, he pulled the small kerosene lamp in close until it illuminated the wrinkles on his smiling face. From the bag he pulled two bundles, each wrapped in old cloth, and from these came two stones.

The rocks were from the headwaters of a river that tumbled out of the mountains on a route Don Pedro frequented during his hunting forays. He spoke of spots on the river's edge where stones in odd shapes were so numerous you could tread on them with every step. He had brought home just two.

"These stones are dangerous," he cautioned me. "They have a power, a power from the forest."

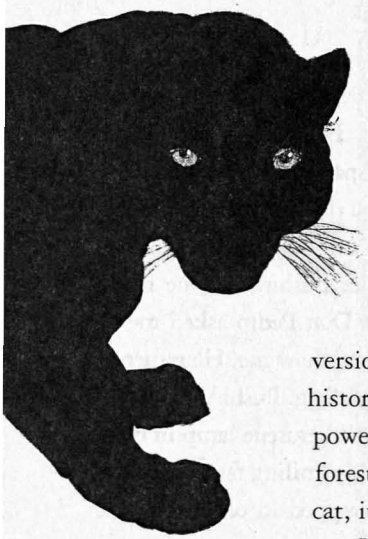
For Don Pedro, the two stones he kept hidden away whispered a warning. They told a story of mystical spirits and super-sized creatures. They were a sign of the forest's mystery. For me, the rocks spoke a history, an equally fantastic tale of dynamic landscapes and human movements. For both of us, the two lone stones were footprints which helped shape the forest.

The first stone was charcoal gray and a bit larger than my palm. It had two distinct sides, mirror images of each other, marked with long, undulating ridges. These ridges met at a small depression forming a dimple on both faces of the rock. From this point the ridges spread out like ancient fingers fanned wide for eternity. Where fingertips joined at the far end of the stone there was a smooth, narrow seam. A mortar left by some ethereal mason. Don Pedro turned the

stone around in his hand, his eyes drawn down to it by the gravity of his thoughts.

"This is the track of the jaguar," he told me. "Not the spotted one, but the black one. It is two or three times larger and black as night. This cat kills any animal it sees and wherever it steps the mud turns to stone."

Don Pedro had never been to the ocean. Up and over the Andes mountains and down through the coastal desert to the shores of the Pacific. The journey is long and expensive. Don Pedro was born in the jungle, and has passed all of his fifty years there. He has never seen an oyster. To me, the black stone was a fossilized oyster. In many ways though, Don Pedro's version cuts to the heart of the oyster's history. This stone was evidence of a powerful force, one that changed the forest forever. Only the force was not a cat, it was a plate, a tectonic plate.



Just thirty million years ago, long after the dinosaurs were gone and mammals began their rule of the terrestrial world, the Amazon River flowed west to the ocean. Then came the meeting of the plates, with such force the Andes Mountains began reaching for the sky. By twenty million years ago the mountain chain was one-third its current height, enough to block the river's western surge. An enormous basin formed, walled in to the west by the Andes and to the east by the Brazilian Highlands and the Guyanan Shield. The bowl held an inland sea filled with brackish water. What is now called a primeval forest was once floating in brine. Dolphins, sharks, rays, and oysters thrived where toucans, macaws, sloths, and jaguars now roam.

The Andes would continue to rise and later the water would flow east, breaking through the dam and reaching the Atlantic. By the time the Amazon had established its current course so much sediment had been laid down at the bottom of the inland sea that it was nearly level. The world's largest river now falls just a few hundred feet over its entire length, carving a wide path over an ancient sea bottom. Over time the salinity of the water also dropped; but today many signs of the basin's salty past can still be found. Rays, dolphins, sea cows, and tilefish have evolved to live in the freshwater. And on creek beds and forest floors are the fossils of shark teeth and big, old oysters, reminding us this forest has not always been as it presently appears.

Don Pedro's other stone, roughly the same size as the oyster, was muddy brown dotted in black flecks. The rock was thin, about the thickness of my wrist. One half formed a sweeping semi-circle along the circumference of which the stone tapered to a sharp edge. The other half squared off and two deep notches cut into its sides. The stone was a small hatchet head. Through the notches could be thread a cord to attach the cutting implement to a handle of the user's choice.

"This hatchet, it comes from the forest people," Don Pedro explained. "It is also dangerous to have too many in the house."

Don Pedro shared a story of one of his neighbors, a young man who loved to hunt. The man collected many hatchets, spear points, and other stone tools on his walks in the forest and kept them under his bed. Until the nightmares began. In his sleep the forest people would chase him. They threatened his life for stealing the stones. Only when the young man put the carved rocks back in the forest did his agonizing dreams cease to haunt him.

"But where are these forest people?" I asked.

"I don't know." Don Pedro shrugged. "We don't see them."

Don Pedro's stone hatchet could be of almost any age. His village and those closest to it are all less than 50 years old. Few hunters ever penetrate deep into the mountain range. At least theoretically, the hatchet, with its still sharp cutting edge, could be of recent origin. Much of the Cordillera Azul remains, in a sense, in the Stone Age. On the other hand, the hatchet could be thousands of years old, a relic of the rich pre-Colonial period in Amazonian history.

Recent research on pre-Columbian Amazonia retrodicts a basin-wide population of nearly seven million people at the time of first European contact. These same demographic studies indicate that population densities along some rivers may have been higher before Columbus than they are today. Even in some montane forests, like parts of the Cordillera Azul, that were beyond the reach of fertile floodplain soils, estimates are as high as 1.2 people per square kilometer. This would be above the Wildlife Conservation Society's threshold for a human "footprint." Then came the "discovery," exploration, and subsequent European colonization of the New World. The arrival of Columbus triggered a wave of disease and destruction that swept across both North and South America and through the Caribbean. Those Native Americans who escaped

jaguar, engraving ca. 1900

the sword-bearing horsemen succumbed to a rapid succession of epidemics—influenza, small pox, measles, mumps, pneumonia, plague, typhus, malaria, and yellow fever. The magnitude of the disaster is difficult to grasp. Up to 95% of the population in the lowland tropics was lost. Entire cultures gone, but, as far as the landscape was concerned, not forgotten.

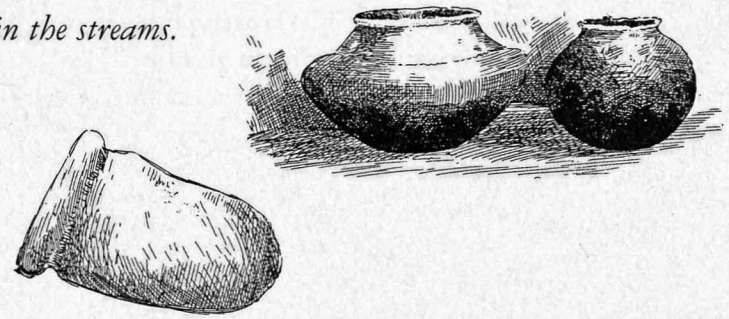
The impact of pre-Columbian people can be seen in varying degrees throughout the Amazon. Perhaps the most impressive changes were in the Llanos de Mojos of northern Bolivia, where one still finds a plethora of raised fields, canals, causeways, reservoirs, and mounded occupation sites. On Marajo Island at the mouth of the Amazon archaeologists have unearthed extensive mounds of shells, leftovers from shellfish-loving residents dating back eight thousand years.

Elsewhere the footprints of early Amazonian settlers are more subtle, concealed in the complexities of a forest's composition or the dark recesses of the soil. William Balee, an anthropologist working in the Brazilian Amazon, claims that 12% of the rainforests in Brazil, jungles usually referred to as primary, are actually of archaic cultural origin. Tree species with tasty fruits or other useful products dominate these forests, suggesting a high level of prior human management. In western Ecuador, soil cores are full of six-thousand-year-old pollen grains from maize. The rainforest there was someone's corn field. In eastern Brazil, a new soil type has been assigned. These anthrosols, locally known as *terra preta do indio* (literally "black earth of the Indian"), are blackened by a wealth of organic matter from old refuse piles and agricultural burning. Potshards often abound in this human-sculpted earth, while above it grows a rich, diverse tropical rainforest. Unfortunately, unlike other parts of Amazonia, precious little research has been conducted in the Cordillera Azul National Park. The region's historical ecology is completely unknown. All we have are hundreds of stones delicately carved and left sitting, waiting, on a river's edge or on a hunter's shelf.

WHAT STORY do the stones tell? With what message do they leave us? What should we conserve and why? The rocks first remind us of the ephemeral reality of our mythical Edens. The primeval forests of lore we strive to hold on to were once deep beneath an ocean's waves. No baseline exists to preserve, no before or after. Dynamic forces define the natural world, continually changing the look and shape of the land.

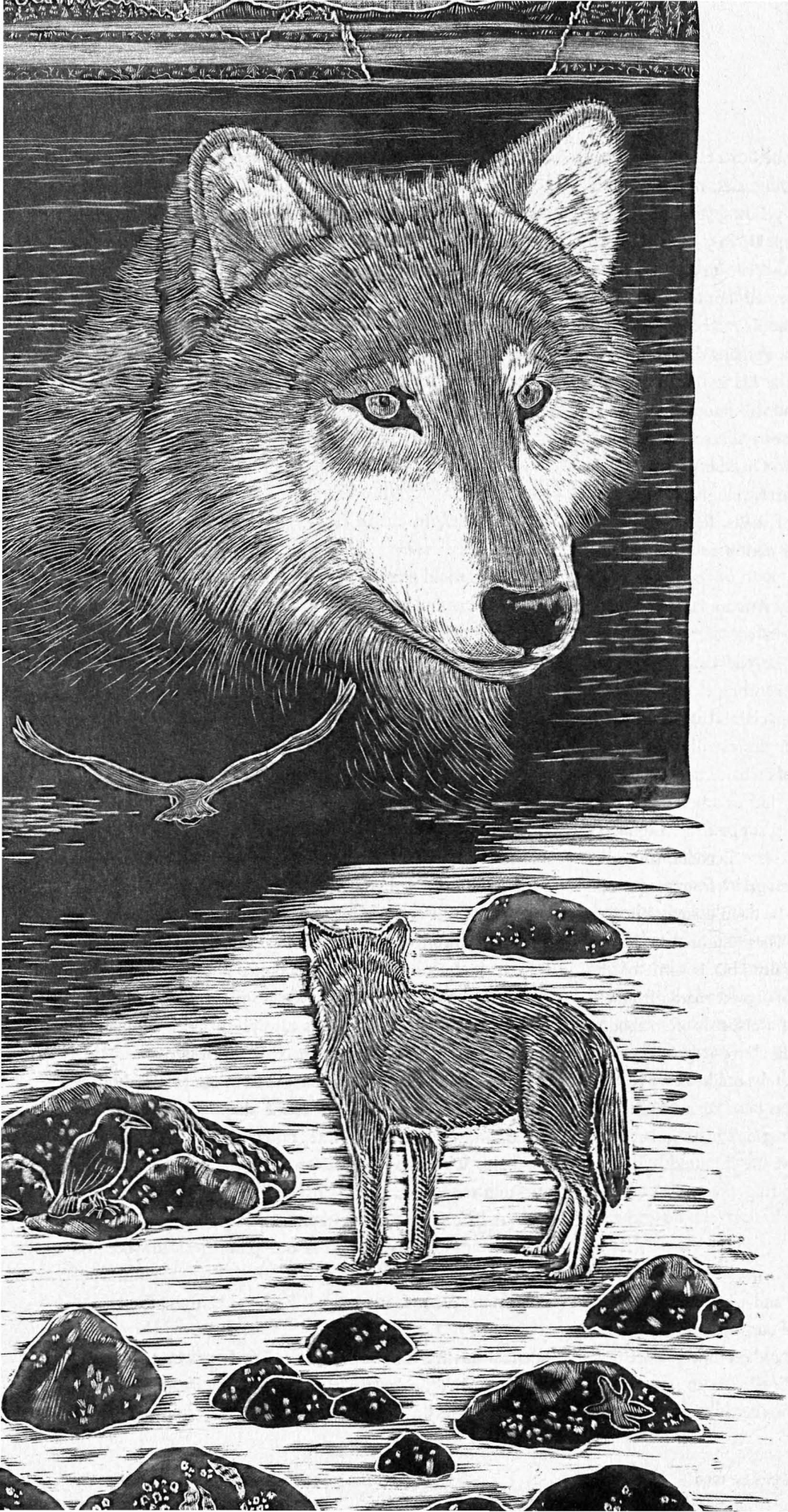
Don Pedro's rocks also give a glimpse of our species' many hidden footprints. Our impact is truly everywhere. This revelation can sting us with a feeling of doom and gloom. Is there no real wild left to save? What, indeed, is "wild"? But the stones also remind us not to forget the resilience of the natural. What was an Amazonian field, or even a New England sheep pasture, is now, once again, forested. Of course, we should also season our idealism with a healthy dose of realism. Over most of the planet our species has reached unprecedented densities and our impact on the land has grown to new, dangerous levels of intensity. Amidst this turmoil Don Pedro's stones point to our deep connections with the natural world. We are part and parcel of the landscape, of nature, and it is always changing. Our potshards are below the trees, our hatchets in the streams. These stones mark our place. They connect us to our past and to the wilds. We have participated in the shaping of the natural world, and we remain an integral component of nature, of the wild. We are part of the wild and it is part of us. The question that remains is: What will it all look like tomorrow? A bare foot is different from a boot, and an axe is far from a bulldozer. When does our part in nature become unnatural? Where we draw this line will shape the forests of the future. What footprint will we leave behind? ☾

We are part and parcel of the landscape, of nature, and it is always changing. Our potshards are below the trees, our hatchets in the streams.



Amazonian pottery and stone hatchet, engravings ca. 1900

Michael Gavin *is an ethnobiologist and freelance writer. He is currently a visiting faculty member in environmental studies at Hawaii Pacific University.*



clay engraving by Sarah McNair

In the Great Bear Rainforest

island-hopping gray wolves give new insights into island biogeography

by Paul Paquet, Chris Darimont, Chris Genovali, and Faisal Moola

THE GREAT BEAR RAINFOREST (see sidebar) is naturally fragmented by a network of waterways and mountains. To preserve the area effectively, conservationists are compelled to understand how this marine-dominated landscape influences wildlife patterns and movement. Therefore, research and protection efforts must consider connectivity—before resource extraction, mostly logging, starts to degrade and further fragment these precious forests.

Our research efforts have focused on wolves. Among regions of North America where wolves still roam, the North and Central Coasts of British Columbia and the associated archipelago of offshore islands are ecologically unique. It seems likely that this remote ocean archipelago shelters North America's most pristine wolf population (Darimont and Paquet 2002).

The complex physiography of the North and Central Coasts creates many different kinds of habitats in close proximity. Landmasses that limit movements of fish and marine mammals provide habitat and connectivity for populations of terrestrial mammals. Likewise, the waterways and open ocean that provide habitat and travel corridors for aquatic species often inhibit travel of mammals and birds. But for some species—like coastal wolves, known to swim up to 13 kilometers in the open ocean—land and water combine to provide travel linkages between islands. Small islands or non-productive islands act as ocean-bound stepping-stones, providing pathways that connect the larger landmasses. Some stepping-stones may be used as brief rest stops, whereas others that provide good foraging may be occupied for several days. Collectively, these linked islands can support the lifetime requisites of land-hopping wildlife. But changes in sea level on long timescales and tides and currents on short timescales conspire to produce tenuous and often ephemeral linkages. Many ecologists believe that oceanic archipelagos harbor species that are highly vulnerable to disturbance and prone to extinction because landscape connections there are chaotic.

Connectivity, theory, and archipelagos

Our understanding of wolves in the Great Bear Rainforest draws on the long series of ecological studies addressing birds, small mammals, and insects that have formed contemporary conservation theory. Central to these studies, and the subject of intense debate over the past two decades, has been the role

of connectivity in determining animal distribution, abundance, and persistence (Connor and McCoy 1979, Gilpin and Hanski 1991). This discussion has been fueled by the global impoverishment of natural systems through human-induced fragmentation and isolation of habitat. Accordingly, the equilibrium theory of island biogeography (MacArthur and Wilson 1967) and metapopulation theory (Gilpin and Hanski 1991, Hanski and Simberloff 1996) have postulated mechanisms explaining animal distribution and persistence of populations in patchy landscapes. These ideas provide much of the theoretical foundation for conservation biology. Although the original concept of a metapopulation as "a population of populations" has expanded to include other spatial population structures, including mainland-island (Hanski and Gilpin 1991) and source-sink metapopulations (Pulliam 1988, 1996), the focus remains on connectivity.

According to these theories, fragmentation decreases accessibility, availability, and productivity of secluded habitats, the remnants of which are often arranged across the landscape as island-like patches. Although island attributes such as size, distance from mainland, and accessibility to colonizing organisms clearly influence species composition, community structure, and community processes, the consequences of these for ecosystem functioning are little understood. If, however, we are to establish biological priorities for conservation, we need a firm understanding of how geography interacts with species to shape the evolution of species, ecological relationships, and landscape processes.

Very few studies have evaluated the response of large terrestrial predators to naturally discontinuous landscapes. In part, this is due to a lack of pristine sites to carry out such research. Nevertheless, clarifying the relationship between the geographic structure of true island systems, connectivity, and distribution of large mammals is a needed link between theory and application (Burkey 1995, Alcover et al. 1998). In that regard, the Great Bear Rainforest provides a valuable opportunity for scientists to study evolutionary and landscape processes in a true island environment under natural conditions. Documenting the responses to a naturally fragmented island environment provides a reference for comparison with similar studies conducted on land.

Coastal wolves and connectivity

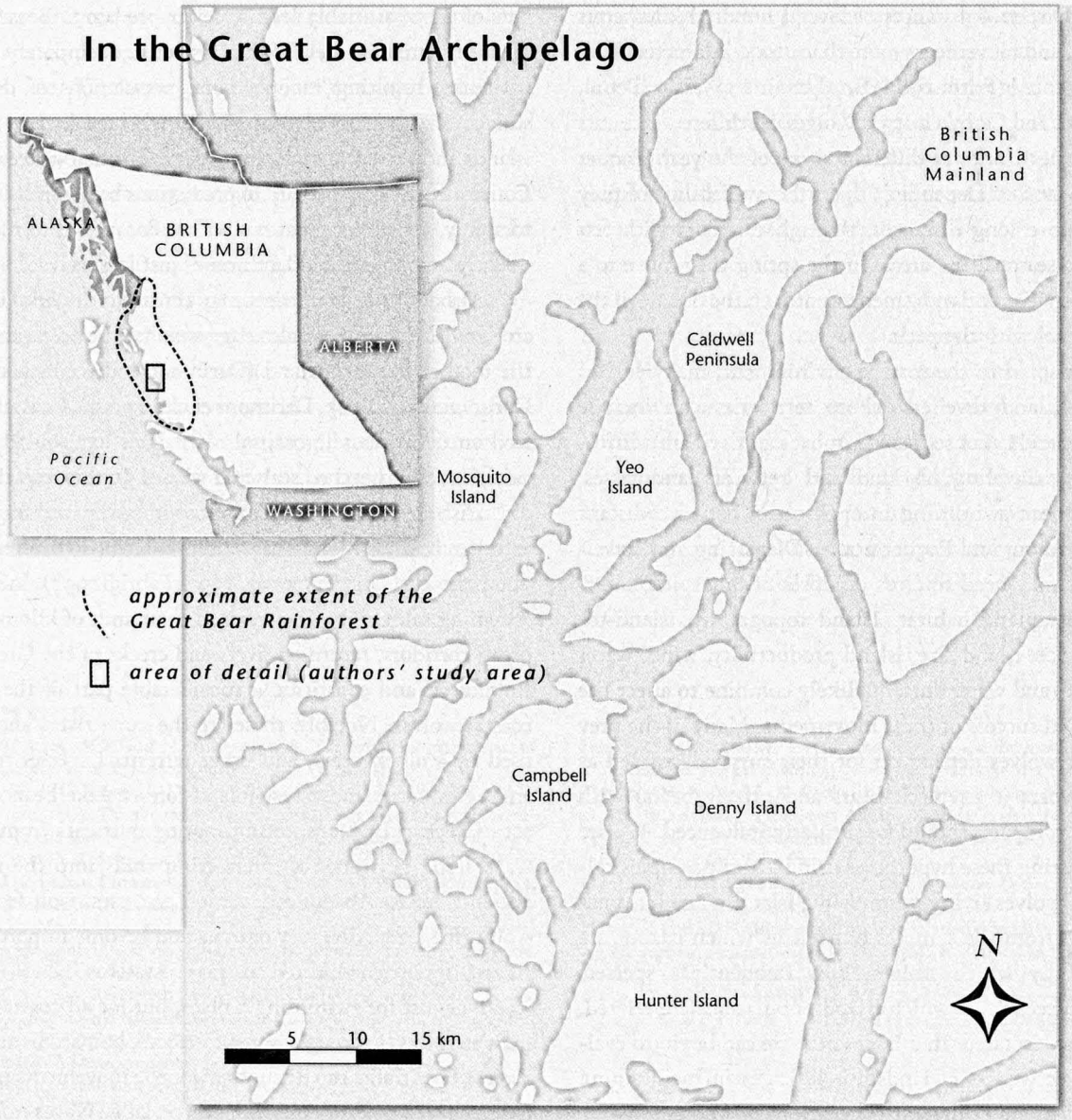
Our ongoing studies of the behavior and ecology of coastal gray wolves are helping conservation biologists evaluate and refine prevailing theories about connectivity. The wolf is the most vagile (capable of dispersal) of all large terrestrial predators. On land, they can travel distances of 50 kilometers in a

The Great Bear Rainforest

Where the land meets the sea on British Columbia's wild North and Central Coasts stands the Great Bear Rainforest. The Pacific Ocean overwhelmingly defines and influences this environment, which is rich in human culture and natural history.

Encompassing the mainland and adjacent archipelago, the rainforest spans from the northern tip of Vancouver Island to the Alaskan Panhandle. The region is approximately 60,000 square kilometers, of which 19,300 square kilometers is land (see map). This nearly roadless and mostly unsettled region is bounded by the Coast Mountains to the east and Pacific Ocean to the west, creating a unique ecological and evolutionary environment largely free from industrial development. The few human settlements consist primarily of First Nations communities. Climate is temperate and wet with most areas receiving more than 350 centimeters of annual precipitation, primarily as rain. The wet, remote, and biologically productive mountainous mainland, topographically complex inner islands, and flatter outer islands are separated by equally productive open ocean and waterways. Island sizes range from 5 square kilometers (Moore) to 2,295 square kilometers (Princess Royal), and inter-landmass distances range from 250 meters to more than 7 kilometers.

Coastal temperate rainforest dominates the mainland and islands. This type of rainforest is extremely rare globally, covering only a fraction of a percent of the Earth's surface on the coasts of Chile, Norway, Scotland, Tasmania, New Zealand, and the U.S. Pacific Northwest, Alaska, and British Columbia. The temperate rainforest of the Pacific coast once stretched from northern California to Alaska. Today, only Alaska and British Columbia still contain large undisturbed tracts. The Great Bear comprises the largest



remaining expanse of temperate rainforest in the world (Schoonmaker et al. 1997).

The North and Central Coasts show great variation and distinctiveness at the genetic, species, community, and ecosystem levels. Genetic analyses have identified distinct coastal and continental black bear lineages, which may have been isolated from each other for 360,000 years (Byun et al. 1997). Together with southeastern Alaska, the region supports the highest endemic species concentration for the temperate rainforest region of Pacific North America (Cook and MacDonald 2001). Mammalian distribution on nearby Alexander Archipelago of Southeast Alaska has been well described (MacDonald and Cook 1996) and notable patterns of biogeography (Conroy et al. 1999) and endemism (Cook and MacDonald 2001, Fleming and Cook 2002, Small et al. 2003) have emerged.

The North and Central Coasts are important to wide-ranging species such as grizzly bears, gray wolves, killer whales, humpback whales, salmon, and migratory birds, many of which are now exterminated from much of their former ranges. All these species depend on terrestrial and marine corridors for dispersal, reproduction, transport and distribution of food and nutrients, and communication among subpopulations.

single day. Dispersal distances of several hundred kilometers are common and movements more than 1,000 kilometers have been documented (Fritts 1983, Boyd et al. 1995, Mech et al. 1995, Paquet and Carbyn 2003). Wolves use different habitats within their territories at different times of the year (Paquet and Carbyn 2003). Depending upon the availability of prey they may move long distances, through corridors with few resources, to seasonal use areas. In the spring they move to a den site. Activities and movements center on the den until the pups can travel with the pack.

Well adapted to the marine environment, many coastal wolves are island dwellers whose territories can include groups of islands. Consequently, movement within territories requires traveling on land and between landmasses, which can mean swimming in open ocean between distant islands (Darimont and Paquet 2002). Dispersing and traveling animals may need to cross expanses of inhospitable terrestrial and aquatic habitat. Island topography, island-to-island distance, island size, island productivity, wind, water temperature, and water currents likely combine to affect the frequency and success of these movements. Many of the prey species that wolves depend on for their survival, as well as other carnivores (e.g., black bears and grizzly bears) with which they compete, should be similarly influenced. We are currently testing these hypotheses using genetic samples collected from wolves living on multiple islands. The information derived from the samples can tell us which islands are being used by which wolves, how frequently dispersers reproduce successfully, which island populations are related, and which are isolated. In other words, we can begin to evaluate the effectiveness of landscape linkages in maintaining connectivity among different populations of wolves.

As with other large carnivores, the energetic needs of wolves are substantial, particularly while raising young. Thus, demands for food could influence island-hopping behavior as much as the physical landscape. Movements might be regular and predictable, depending upon the species and the season, or random, depending upon varying climatic conditions and availability of food or other resources. We believe the relationship between use of food resources and connectivity is important but poorly understood. On isolated islands, our wolf foraging data suggest that predator-prey dynamics are inherently unstable and can result in declines in prey populations (Darimont et al. in press). Sitka black-tailed deer, the main prey of coastal wolves, cannot immigrate to remote islands fast enough to replace individuals killed by wolves. Reduced numbers of prey invariably lead to fewer predators. Because connectivity is restricted, these islands become temporary mortality sinks, resulting in ephemeral populations of deer and wolves. Without wolves, deer slowly recolonize isolated islands and the cycle of depletion repeats when wolves return. Consequently, and contrary to predictions based on abiotic factors only, we suspect that wolves are compelled to move frequently among isolated landmasses just to survive.

Although water barriers may constrain dispersal of predator and prey, our work also suggests that the ocean augments the food available on land (Darimont and Reimchen 2002, Darimont et al. 2003, Darimont et al. in press). Coastal wolves feed on deer, moose, goat, salmon, clams, crabs, and marine carrion such as beached seals and whales. In this respect, many of British Columbia's islands are not impoverished fragments, as other oceanic islands have been described (Brotons et al. 2003, see also Dunning et al. 1992, Fahrig 1997). In the fall, spawning salmon, having traveled thousands of kilometers in ocean corridors, return to rivers and creeks of the Great Bear Rainforest, and constitute a considerable part of the diet of coastal wolves. Notably, these are the same rivers and creeks used by wolves, bears, and other terrestrial species to travel among estuaries and access inland forests. Like bears, wolves act as vectors by transporting marine nutrients from waterways along networks of intersecting trails into the region's ancient forests. Abandoned salmon carcasses, wolf feces, and wolf urine feed a diversity of users and become important fertilizers in nutrient-limited coastal ecosystems.

Not just for swimming wolves, but for all coastal mammals that travel through water corridors, human disturbances such as boat traffic can disrupt or impede movements in much the same way that cars and trains do on land. Waves from large boats can overturn swimming animals, and humans harass and kill wildlife as the animals travel between islands. (Killer whales, which have been documented preying on moose and deer swimming between islands, can also pose a lethal threat.) More specifically, we believe that geography that allows islands to serve as useful habitat predisposes wildlife to exploitation by humans. Guide outfitters in the Great Bear Rainforest commonly use jet boats for river access to otherwise remote and secure wildlife habitat (Paquet and Darimont pers. obs.). In essence, coastlines and river systems are analogous to roads, providing humans access to remote areas and opportunities for disrupting connectivity. In southeastern Alaska, for example, humans who gained access by boat to areas otherwise secure were responsible for more than 50% of all wolves killed

by hunters and trappers (Person 2001). In this respect, long, narrow islands pose greater risk for wildlife than round islands of equal size. The latter provide more security because the interior of the island is more difficult to reach and the exposed coastline is proportionally less than narrow islands.

Because of its remoteness, unique landscape, and pristine condition, the Great Bear Rainforest is a valuable place for conservation research and protection. Insights gained here about the role of connectivity in sustaining the natural environment, and about those species whose survival depends on the intactness of that environment, can contribute to the design of conservation reserves worldwide. In the face of the ongoing threats of industrial logging, oil and gas extraction, aquaculture, mining, sport hunting, recreational activities, and marine traffic, we hope that caution prevails until knowledge is sufficient to make informed decisions about the destiny of the Great Bear Rainforest. Unfortunately, the putative land-use plans now being proffered by the government of British Columbia would protect a meager 24% and 21% of the North and Central Coasts, respectively. Full protection, within the context of outstanding aboriginal land claims, should be among the preferred options. Our hope is that the Great Bear Rainforest, sometimes called "the Last of the Best," can remain naturally fragmented and wholly wild. ☾

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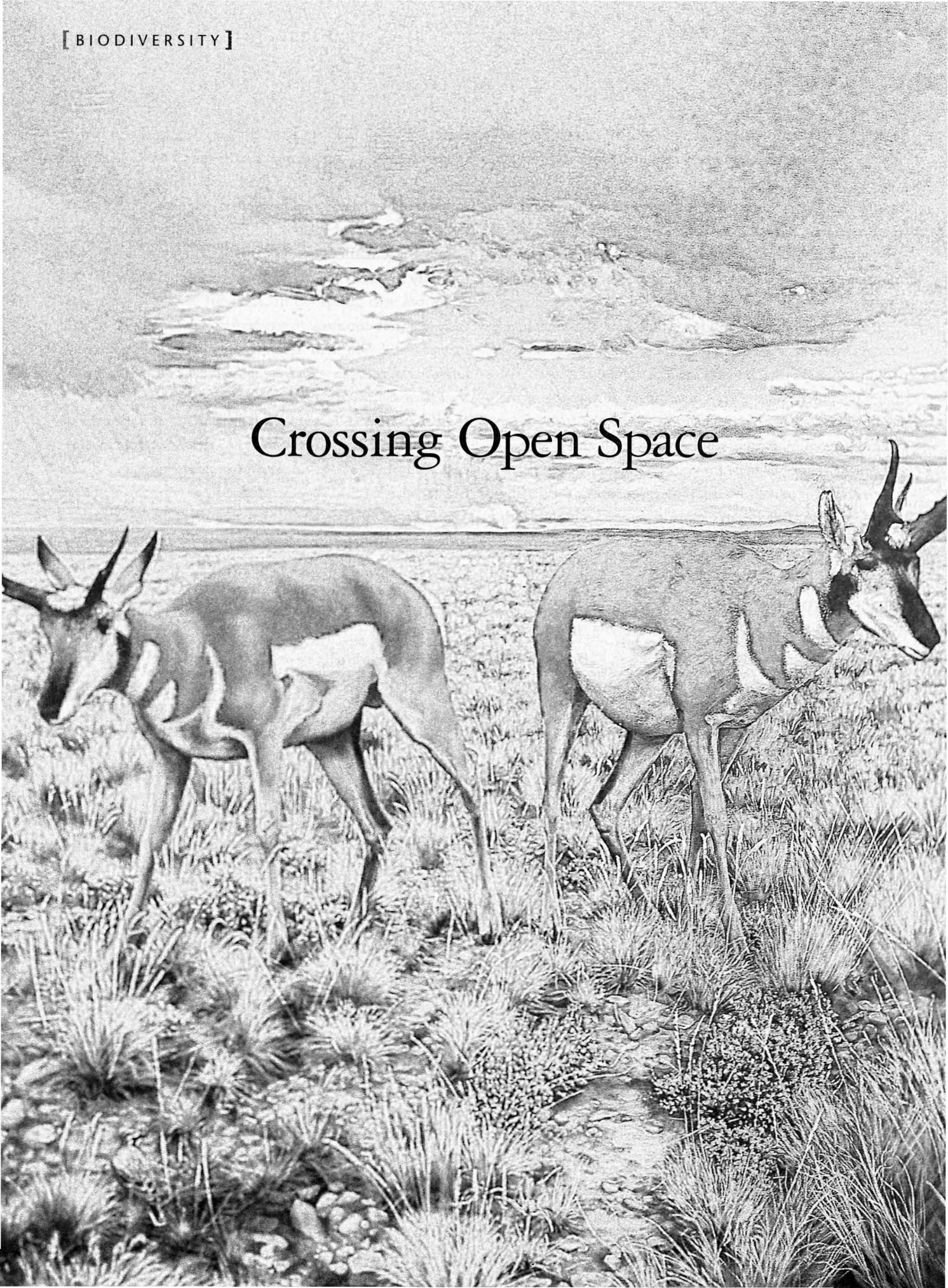
Crossing Open Space



CHIRU DO IT on the plateaus of western Tibet, saiga on the steppes of central Asia, and khulan out beyond the Gobi. These large mammals—like wildebeest in the Serengeti, pronghorn in Yellowstone, and caribou up in the northern barrens—have a threatened way of life. They move. Not only are distances great, but their round-trip movements take them across broad swaths of open space. But once bountiful terrain—devoid of humans and massive habitat alterations—has become rare. Little space still exists for most long-distance migrations (also called LDMs) across terrestrial landscapes.

Can we save the last of the great long-distance migrations?

BY JOEL BERGER

Many scientists, conservationists, wildlife enthusiasts, hunters, ranchers, travelers, and, yes, even a few enlightened politicians, hope that these stunning wildlife spectacles will persist. During the next decade or two we will, however, see many of the great migrations around the globe vanish unless we can accomplish large-scale conservation of travelways and habitat. Mere rhetoric will not work; if we continue down *our* typical path, then these traveling animals, and their associated ecological processes, will come to a dead end.

BUT FIRST, what are long-distance migrations? Migrations are seasonal treks that require movements away from a home area and back again. For instance, a mouse that moves from your house in winter to a shed in summer and then back again when the snow falls would fit the definition. But, for most people, images of migration are usually of larger species such as grey whales moving from Mexican to Arctic waters and back, or even of diminutive Monarch butterflies wintering in Mexican highlands and summering far to the north. Though no exact threshold has been established for a long-distance migration, they typically cover many kilometers, often across a range of habitat types and political jurisdictions.

Many long-distance migrations have been truncated during the last 100–150 years. Worse, it has been estimated that some 95–99% have been entirely lost during recent times. Among the most notable losses in the past 40 years are the vast treks of thousands of springbok and perhaps a quarter-million wildebeest from the Kalahari, Karoo, and Etosha pans of Botswana, South Africa, and Namibia. From Sudan, white-eared kob were possibly the longest migrators in Africa, traversing up to 700 kilometers. They suffered during Sudan's civil war and no longer navigate the marshes of the Sudd. In North America, bison are well known for their population losses, but less well-known is that none of their routes into and out of Yellowstone Park still exist. For pronghorn and elk, conservative estimates suggest that even within the 60,000-square-kilometer Greater Yellowstone Ecosystem some 80% and 60% of their respective migrations are gone. This is highly relevant because the Greater Yellowstone Ecosystem is touted as one of the most intact temperate systems in the world, and given the magnitude of losses there, they must be higher elsewhere.

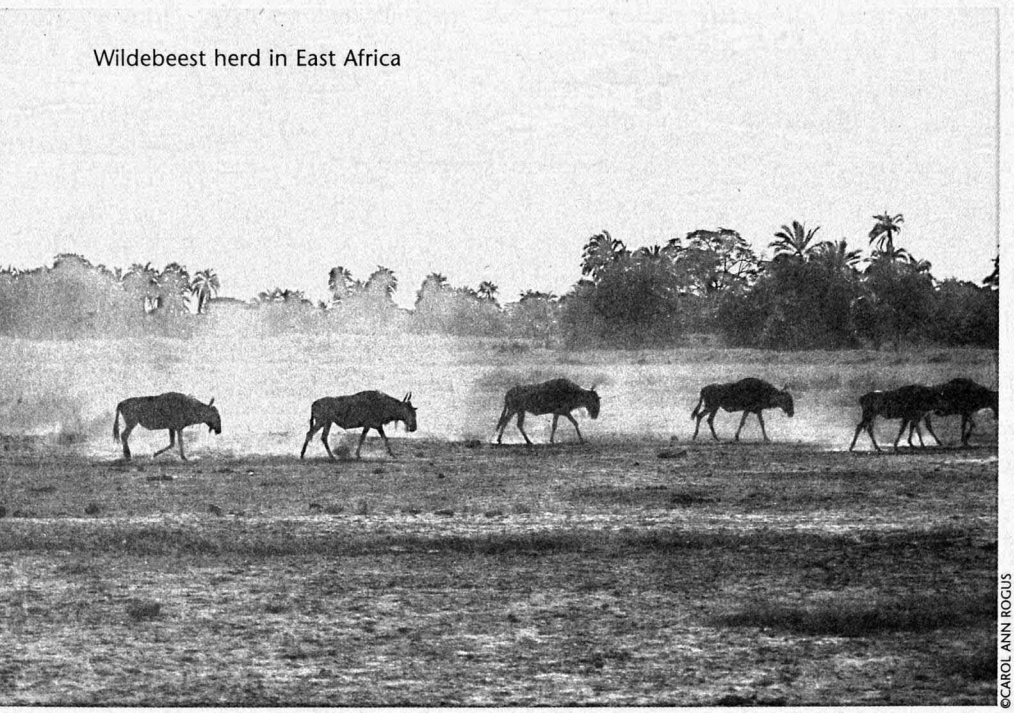
What remains globally, while but a tattered thread of the past, is still highly impressive. An analysis of 103 populations representing 29 species from all continents but Australia shows that the species with the greatest overall movement is barren-ground caribou. The population using Arctic National Wildlife Refuge in Alaska moves back and forth into the Yukon, a distance that staggers: some 4,000 or more kilometers round trip. (For more on the Porcupine caribou herd migration, see this issue's Field Talk interview, page 44.) Other caribou populations also migrate, but lesser distances, and in woodland caribou—a subspecies found in Canada's boreal forest—round-trip migrations average less than 100 kilometers. Other long-distance migrators in North America include more than ungulates. Wolves following Alaskan and Canadian caribou navigate tundra, moving between 300 and 750 kilometers round trip. Cougars tracking deer herds from the Sierras into the Great Basin move some 60 kilometers round trip. And, remarkably, not all terrestrial mammals that migrate are ungulates or carnivores. Black-tailed jackrabbits are known to migrate 12 kilometers round trip.

The variation on other continents is also great. African elephants average more than 200 kilometers round trip—when not fenced. Zebras are closer to 300 kilometers, and the mean for wildebeest is about 450, although the migratory portion from Serengeti traverse 700 kilometers round trip. In Asia, chiru move an estimated 600 kilometers round trip and Mongolian gazelles 500. In South America, the distances traversed by their wonderfully endemic mountain tapirs, taruca, pudu, guancoes, and vicunas are not great with no species moving more than 25 kilometers round trip. In Europe, the only

"Skylight" (pronghorn), oil on panel by Laura Cunningham

truly long-distance migrators emanate from Scandinavia where moose (known locally as elk) average 100 kilometers with the longest round-trip migration being in excess of 300 in Sweden.

Among the little-known facts concerning migration, two stand out. First, whereas most everyone knows that caribou, bison, and zebras migrate, few have appreciated the asocial or less charismatic mammals that do: moose, mountain tapirs, jackrabbits, cougars, and even coyotes. (On the other hand, many people might guess that musk ox are migratory, but they are not.) Second, it is startling how far these solo migrants will move; for example, moose are capable of traveling up to 300 kilometers, not only in Sweden but also in the Arctic National Wildlife Refuge. Unlike highly visible herd-dwelling species of open spaces, our lack of knowledge about many others stems in part from a lack of obvious herd movements, and from a lack of effort to document migration. (In addition to musk ox, another herd-dwelling, open plains species that might have been thought to be highly migratory are South America's camels; however, their migrations are very small.)



Wildebeest herd in East Africa

©CAROL ANN ROGUS

It is important to note some possible limitations in the reporting of movement distances from Asia, South America, and Africa as these may not accurately represent the full range of LDMs. What monies are spent on these continents for wildlife research and conservation pale relative to funding in the U.S. and Europe. The comparative riches of North America are nowhere clearer than in the western U.S. where perhaps the most complete data sets on movement exist. For example, no studies of radio-collared chiru or khulan have been conducted in central Asia—but there have been more than 15 on bighorn sheep, 30 (each) on elk and mule deer, and at least a dozen on pronghorn. Some studies in Wyoming radio-collar more than 100 individuals, whereas the resources to radio-collar animals in some less-developed countries simply do not exist.

Findings from studies in the U.S. and Canada are astounding and offer timely opportunities for the judicious placement of conservation efforts. Consider the Greater Yellowstone Ecosystem (GYE). Pronghorn at its southern tier in southwestern Wyoming have the second most extensive migration in the Western Hemisphere. They move between the Upper Green River Basin in winter to Grand Teton National Park in summer. This 500-kilometer round-trip route weaves through an ancient corridor that has been used for 6,000 years. Due to human developments like natural gas wells, these animals must now pass through topographic bottlenecks that narrow to as little as 100–300 meters. Although the round-trip migration for pronghorn populations throughout their entire range averages slightly more than 110 kilometers, those from the southern GYE—the geographical anchor for the Yukon to Yellowstone Conservation Initiative—exceed in migration distance the average for all African species, wildebeest included. Not only are Greater Yellowstone's pronghorn notable, but the migrations of three other ungulates from this ecosystem are also the most extreme for their species outside of Alaska. Moose from Grand Teton experience longer round-trip migrations than elsewhere in the contiguous U.S. (approaching 100 kilometers), as do elk (220 kilometers). Remarkably, mule deer from Wyoming's Upper Green River Basin make the third longest migration in the Western Hemisphere, moving almost 300 kilometers round trip.

For generations, Yellowstone has been known for geothermal distinctiveness, grizzly bears, and more recently as the

preeminent site to watch wolves. What has slipped notice is that the Greater Yellowstone Ecosystem harbors the greatest remaining migrations of four large mammals in the Western Hemisphere. Just as boundaries of the Serengeti ecosystem have been defined by its migratory wildebeest, so too should the Greater Yellowstone (at least along its southern terminus) by its migratory pronghorn.

Sadly, and perhaps understandably, given our American thirst for energy usage, both the pronghorn and mule deer migrations are being squeezed by short-sighted, poorly planned, and massive petroleum development on public lands in the Upper Green River Basin. While public lands are just that—lands for multiple public uses, as they should be—it is truly remarkable that, in a country nearing 300 million people, spectacles as wondrous as long-distance migrations still exist—and yet we Americans display such indifference to protecting them. Caribou of Alaska's Arctic National Wildlife Refuge reign as the poster species for environmental awareness and action, but pronghorn and mule deer of the Upper Green are being cast aside with hardly a murmur, sacrificial lambs to poor planning and industrial plundering.

All hope is not yet lost and several creative approaches are on the horizon. Wyoming's governor, Dave Freudenthal, is suggesting the development of a mandatory royalty, funded by gas producers, that will promote wildlife conservation. Additionally, the Wildlife Conservation Society is working toward the creation of a permanently protected corridor to assure connectivity for pronghorn migrating through the precarious bottlenecks linking summer and winter habitats in Grand Teton National Park and the Upper Green. Should this crucial corridor not be protected, extirpation will assuredly occur. The question that needs to be asked is simple: Will the people of the United States allow a species to go extinct in a national park?

If the answer is no, conservation steps must be implemented, and soon. Components of the Wildlife Conservation Society corridor plan include protection of habitats, wildlife-friendly fencing, and restrictions on leasing of lands for petroleum within the corridor. However, public access for hunting, hiking, and all-terrain vehicle (ATV) use would not be excluded. The strategy behind the corridor plan is to build a broad constituency that favors conservation while facilitating some economic development—in this case, for observing the migration spectacle. The pronghorn LDM could vanish—or it can become an icon of Wyoming's commitment to open space. By protecting crucial wildlife corridors, we move closer to assuring the migration of pronghorn into and out of the southern Greater Yellowstone Ecosystem in perpetuity and for all Americans.

To enlarge the scope and envision an even broader conservation picture for the long-distance migrations of other species throughout the GYE will require bolder action. State and federal statutes will have to be combined creatively to enable movements across landscapes with jurisdictions more complex than those connecting the Upper Green with Grand Teton National Park. Given that the human population surrounding the ecosystem will approach half a million in the next few decades, it is necessary to act now.

While long-distance migrations are not a phenomena that most people think about, nor saiga or chiru household words, it is clear that the many migration spectacles are approaching the cliff. No longer can we afford the luxury of lengthy planning processes. Not just in the Greater Yellowstone Ecosystem, but in many places around the globe it is clear that we need to take action to keep the way open for migrating species.

WHY CARE about long-distance migrations? There are a cadre of scientific answers: connectivity is important for wildlife population viability, populations will blip out if they cannot reach appropriate summer or winter range, migration plays a crucial role in the dynamics of healthy ecosystems. But I am moved by something more visceral. We all know the clock can't be turned back. I'll never see millions of bison migrate across unfettered prairies. But there are still places one can go—whether rural or urban, cowboy or banker, Argentine or African—where the poignancy of odors, the din of grunts and bleats and hooves, the cadence of movement, and the tireless harmony of a long, long trip still rule. ☾

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Nectar Trails

Migratory Pollinators Follow the North-Going Blooms

by Gary Paul Nabhan

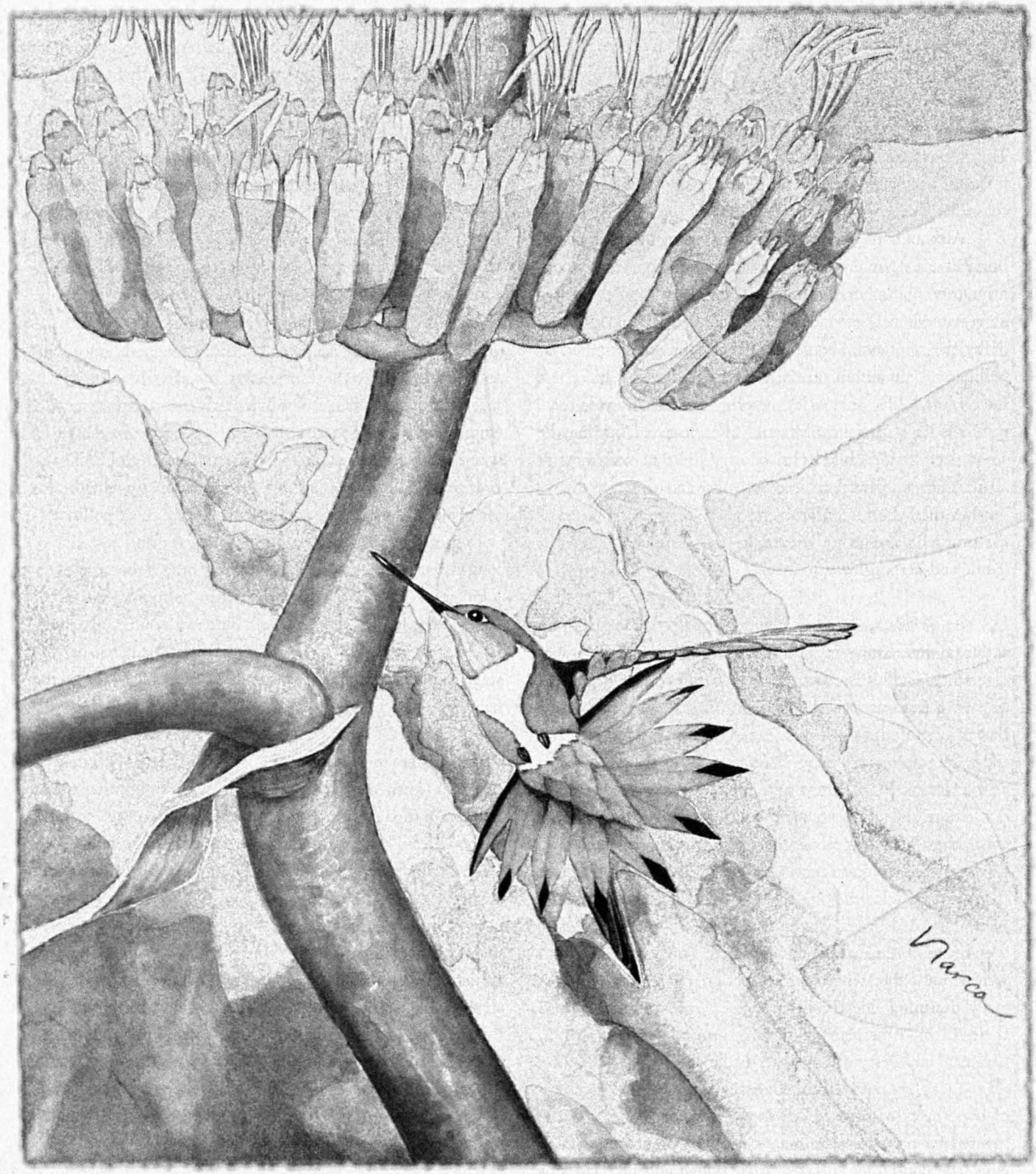
THE CONCEPT OF migratory corridors typically conjures up images of continuous linear habitats or greenways that provide for the movements of large predators and other wide-ranging species. In contrast, migratory corridors for winged pollinators in the Southwest might be more aptly described as a mosaic of stepping-stones within a larger matrix, with each stone a stopover that migrants use for "refueling" while in transit along 2,000–6,000 kilometer flyways. The "glue" providing the connectivity in this mosaic is the shared presence of certain flowering plant genera that these mobile pollinators consistently visit if in bloom.

For example, lesser long-nosed bats use dense stands of columnar cacti, agaves, and morning glory trees—usually, but not always, situated near cave roosts—as their stepping-stones on their northward flight from the Mexican state of Jalisco to southern Arizona. Many of the nectar-producing plants visited by long-nosed bats are patchily distributed succulents that favor hot, rocky hillsides and cliffs. The distances between these patches may be a limiting factor for nectarivorous bats, just as we know the availability of roosts in caves and rock shelters may be. If this hypothesis is confirmed, it may indicate that migratory pollinators such as long-nosed bats have always had to move considerable distances to find suitable stopovers, even before the intervening land was degraded.

Bat ecologist Donna Howell (1974) may have been the first to implicitly suggest the concept of a nectar trail—that is, a sequence of flowering plants situated around each stepping-stone along a migration route: "It is not uncommon to find several bat-pollinated species in association [with one another at the same site] exhibiting similar phenologies....It appears, superficially at least, that these species compete for the services of pollinating bats" (312). From winter through late spring, these clusters of bat-pollinated plants bloom sequentially from south to north, creating the effect of a blooming wave cresting northward (Fleming 2000). Near-simultaneous blooming of several nocturnally flowering species at the same site has the effect of presenting a concentrated energy source to nectar-feeding migrants, which keeps them at a particular stopover roost until the nectar resources there begin to decline. The pollinator population then moves northward to seek the next emerging bloom in the northward-reaching wave.

A "nectar trail" is now envisioned to be the entire circulation pattern that pollinators follow as they migrate from one sequentially blooming plant population to the next (Fleming 2000). The loosely co-evolved relationships between migratory pollinators and plant populations contributing to the blooming wave may be thought of as "sequential mutualisms." Should one or more of the plant mutualists be eliminated from the sequence by any factor—habitat destruction, aberrant weather, competition, pests, or disease—the nutritional status and movements of the pollinator may be disrupted to the extent that the animal cannot effectively visit other mutualists.

The concept of "sequential mutualisms" implies, for migratory pollinators, that an animal may be linked in space and time with several flowering plant populations. In the case of lesser long-nosed bats, a migratory population temporarily located at one roost may move pollen and fruit seeds between populations within a 100-kilometer radius of that roost. Because the plants are sessile but the pollinators are not, nectarivorous bats, hummingbirds, doves, butterflies, and moths



rufous hummingbird, watercolor by Narca Moore-Craig

serve as "mobile links" among plant populations in different landscapes, facilitating pollen and gene flow over considerable distances. Similarly, lesser long-nosed bats and white-winged doves also facilitate pollen and seed dispersal as well as spatial mixing of genotypes from geographically isolated populations. They too serve as mobile links between plant populations—in this case, during two different phases in the life cycle of columnar cacti.

Although migratory pollinators ensure landscape-level linkages among many different plant populations, many non-migratory pollinators (such as honeybees) visit these same flowers and benefit secondarily from genetic mixing stimulated by the migrants. Should the plant populations linked by pollinators fall within officially designated parks, biosphere reserves, wildlife sanctuaries, or other protected areas, these migrants have special conservation significance. They may be among the few "mobile links" of any kind that visit most or all units in a regional reserve network, and this fact distinguishes them from the carnivores that are often proposed as the umbrella species to be used in designing such networks (Soulé and Terborgh 1999).

IN THE 1980S, when many conservation biologists and activists were expressing deep concern that populations of migratory landbirds, bats, and butterflies were declining because of land-use changes in Latin America, it was assumed that deforestation was eliminating, degrading, or fragmenting these migrants' wintering habitats (Terborgh 1980, Pyle 1983, Heacox 1989). These warning cries generated a tremendous effort in field research and policy initiatives to positively affect the status of pollinators, insectivores, frugivores, and predators that migrate between Central and North America (Brower and Malcolm 1991, Nabhan and Fleming 1993, Stotz et al. 1996, Arita and Santos del Prado 1999). However, it soon became clear that not all Neotropical migrants of concern were actually threatened with extinction, nor were they necessarily declining due to anthropogenic vegetation change in their Latin American wintering grounds (Hutto 1982, Cockrum and Petryszyn 1991, Malcolm 1987).

Today, conservation biologists are entertaining a variety of hypotheses to account for the population changes documented for neotropical migrants: cowbird predation on bird eggs, the non-target effects of toxic pollen and herbicides of genetically engineered corn on monarch larvae, the dynamiting of nectarivorous bat caves by ranchers worried about vampire bat predation on their cattle, and global climate change, to name a few (Stotz et al. 1996, Nabhan 1999). Whether generated by climatic variability, herbicides, pesticides, or land conversion, stresses on pollinators during their migration are now being scrutinized just as much as those generated in their summering and wintering grounds.

One reason for paying more attention to the status of these species while they are in transit is that pollinators require a tight synchrony between the timing of their migration and the peak nectar availability of flowering plants along the corridors they travel (Fleming 2000). This synchrony can easily be disrupted by climate change or by anthropogenic vegetation change, leaving pollinators high and dry (Inouye et al. 2000).

IN ASSESSING THE stresses that may lead to declines in migratory pollinators, it is obvious that some are generated from a single point source (such as destruction of a roost site) whereas others have a more pervasive influence (global climate change, or the spread of invasive species competitive with nectar plants). The more pervasive stresses may affect pollinators with greater severity during one life stage (during gestation or long-distance migration) than during others, because energetic costs and reproductive risks may be more pronounced during that life stage. In short, an interaction exists between the relative vulnerability of a migrant during a particular life stage and the habitat quality or resource availability of the habitat it is occupying.

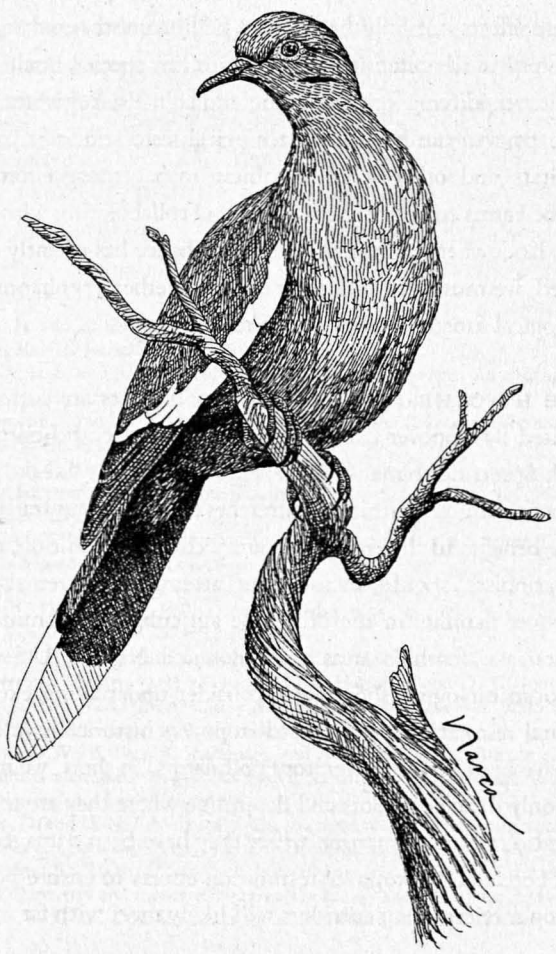
Migratory species vary somewhat in the life stage during which they are most vulnerable. Lesser long-nosed bats may be pregnant when they make their northward migration across the desert in the spring, whereas rufous hummingbirds and white-winged doves are not but still need to maintain both weight and speed to obtain adequate breeding territories and nesting areas in the spring. In each case, the additional energetic demands of long-distance migration place these species under further stress. Underscoring the relatively acute vulnerability of migratory birds, Moore and Simons (1992) concluded that "the single most important constraint during migration is to acquire enough food to meet energetic requirements, especially for long-distance migrants which must overcome geographic barriers" (348). When the geographic barrier is a desert of relatively low nectar productivity, long-distance migration across it may be particularly stressful.

UNDOUBTEDLY, the most irrevocable anthropogenic pressures on stopover habitats are the outright clearing, conversion, degradation, and fragmentation of wildlands habitats in

urban and agricultural areas within the Sonoran Desert and adjacent coastal thornscrub (Nabhan and Holdsworth 1999). Although all the migrants under consideration here do use secondary vegetation (Hutto 1982) and have been found in urban areas, we know little about the minimum patch size of nectar-providing vegetation that they need to survive under these conditions (Lavee and Safriel 1989). Nevertheless, ecological restoration of 5–50 hectare "stopover" patches of native vegetation may reduce these negative impacts, allowing recolonization of anthropogenically disturbed habitats by pollinators, as the case study below suggests.

Particularly in arid and dry subtropical landscapes, farmlands found between protected areas can serve either as oasis-like stopovers for these migrants (Lavee and Safriel 1989) or as barren, chemical-ridden sites that further stress pollinators during the most energy-intensive phase of their annual cycle (Lavee and Safriel 1989, Pyle 1999). Over the past half century, millions of hectares of desert and thornscrub vegetation in western Mexico and the U.S. Southwest have been converted to field crops or pasture grasses intensively managed with agrochemical grasses, creating 100–200 kilometer stretches of flyways of chemically fragmented habitat largely devoid of suitable forage and roost sites for nectarivores. We are only beginning to fathom the long-term effects on migratory bats, doves, hummingbirds, and butterflies of having fewer nectar plants for forage and fewer safe roost sites available as stopovers.

Migratory pollinators are not the only migrants affected by physical and chemical fragmentation of their flyways. More than 70% of all birds, bats, and butterflies that migrate between the United States and Mexico travel routes bounded by the continental divide in the Sierra Madre Occidental and Rockies to the east, and by the Colorado River and Sea of Cortes to the west (Nabhan and Donovan 2000). Because habitat loss has an impact on so many species of migrants, ecological restoration aimed at restoring stopover areas for migratory pollinators may also positively influence other migrants and other non-migratory pollinators. The following case study outlines one such effort.



white-winged dove, pen-and-ink by Narca Moore-Craig

THE BEST WAY to ensure adequate connectivity in regional reserve networks may be to better manage intervening private lands in a manner consistent with the needs of migratory wildlife. Yet, in their current state, many private lands are the weak links in the migratory chain. Restoring the ecological connectivity of these lands will require stronger stewardship collaborations among public agencies, private land owners, and rural ejido collectives.

Dr. Exequiel Ezcurra (formerly the lead scientist for Mexico's Instituto Nacional de Ecologia) echoed this point in a keynote address remembered for its political wisdom as well as its excellent science. In May 1998, at the International Conference on the Conservation of Migratory Pollinators and

Stopover restoration efforts to ensure pollination services along corridors will likely meet with far more acceptance among farmers and ranchers than advocating for corridors to increase the movements of carnivores.

Their Corridors, held at the Arizona-Sonora Desert Museum, he pointed to the increasing political difficulties of establishing additional large, federally protected areas in Mexico and the United States. He predicted that few new government-funded reserves are likely to be established in northwestern Mexico, so that restoring ecological connectivity through private lands between federally protected areas will be critical to binational regional conservation efforts.

One success story of public-private collaboration is the remarkable recovery of riparian corridors using treated sewage effluent along binational riverbeds in the Arizona-Sonora borderlands (Nabhan 2001). Because of its southeast-northwest alignment contiguous to north-south running rivers in Sonora, the Rio Santa Cruz is part of a 400-kilometer corridor of intermittent streams and associated riparian vegetation stretching across some of the driest portions of arid North America. This corridor and that of the San Pedro and San Simon Rivers have unparalleled importance to binational wildlife movements, given that only 10% of the historic riparian vegetation remains along the rivers and streams of southern Arizona (Nabhan and Donovan 2000).

In 1980, the Nogales International Waste Treatment Plant began to augment the historically diminishing instream flow with treated effluent. The plant now provides continuous flow and replenishment of the shallow aquifer below the floodplain for 40 kilometers north of Nogales, Sonora. By 1992, along a stretch of floodplain that had formerly lost most of its gallery forests, newly established stands of cottonwoods, willows, and mesquites covered more than 45% of the upper Rio Santa Cruz floodplain (Nabhan and Donovan 2000). Additional restoration efforts using treated sewage effluent along the Rio Santa Cruz are currently being implemented by Pima County as part of its Sonoran Desert Protection Plan—an ambitious multi-species Habitat Conservation Plan—which has strict guidelines for targeting and managing these waters to regenerate floodplain habitats for several species of conservation concern, including migratory pollinators.

In one well-documented effort, farmer-rancher Mark Larkin began to guide the "passive" ecological restoration of floodplain lands by using sewage effluent to establish riparian tree species, then seasonally reducing or increasing grazing in different patches to create healthy stands capable of long-term growth on the available water budget of treated effluent (Nabhan 2001). With his consent, the Arizona-Sonora Desert Museum staff began attempts at active restoration of pollinator habitat in 1997. While these efforts included wildflower plantings, artificial nest placements, and other pollinator population enhancement techniques described in detail elsewhere (Buchmann and Nabhan 1996, Nabhan and Donovan 2000), riparian restoration accounted for the greatest gains in pollinator abundance and diversity (Nabhan 2001). In addition to 32 species of migratory pollinators benefiting from these passive and active restoration efforts, we have documented some 322 species of invertebrate pollinators now in residence on Tubac Farms. There were potential seasonal population increases in other wildlife species as well. Within the past decade, ornithologists have recorded nearly 200 birds in the watershed's headwaters. Although it was not possible to assess population changes for so many species, certain neotropical migrants show clear signs of recovery.

Building on the successes realized at Tubac Farms in the upper Rio Santa Cruz corridor, the Sonoran Institute and Center for Sustainable Environments have begun collaborations with farmers and ranchers along the San Pedro and San Simon Rivers. These private-land experiments demonstrate the utility of promoting pollinators' "nectar trails" as a means to maintain wildlife corridors across private lands between protected areas. These efforts not only benefit the pollinators themselves but also provide habitat for numerous other species, including habitat-modifying keystone plants and animals, frugivores, and perhaps even carnivores. The ecological restoration of riparian habitats and other wildlife habitat management efforts at Tubac Farms convince us of the value of collaborating with private landowners. As the Wild Farm Alliance has recently proposed, we must now link their effects together to enhance the ecological functionality of an entire corridor.

THE HYPOTHESIS that migratory pollinators are currently limited by stopover habitat quality along hyperarid portions of their corridor remains viable; efforts to protect "weak link" stopover habitats within arid stretches of these nectar trails can have benefits to the entire migratory chain. In addition, conservationists should focus more attention on remaining stopover habitats in the otherwise agriculturally dominated coastal and foothills areas of Sinaloa and Nayarit. U.S. and Mexican biologists should also consider undertaking experimental restorations of degraded stopovers historically known to have been used by migratory pollinators. In short, we must not only define corridors and determine where they are intact but also initiate restoration where they have been damaged.

Fortunately, stopover restoration efforts to ensure pollination services along corridors will likely meet with far more

acceptance among farmers and ranchers than advocating for corridors to increase the movements of carnivores (Nabhan 2001). Moreover, government initiatives such as the U.S. Fish and Wildlife Service's Sonora Program, the U.S. Department of Agriculture's Wildlife Habitat Improvement Program, and the USDA's Sustainable Agriculture Research and Education Program can subsidize pollinator habitat restoration as a means to benefit both crop-yield stability and wildlife in general (Nabhan 2001). In Mexico, the Agostino Foundation, Ducks Unlimited/Mexico (DUMAC), the National Fish and Wildlife Foundation, and the National Wildlife Federation are subsidizing similar efforts to protect and restore habitats of migrants.

We do not yet know how well stepping-stone stopovers suited to migratory pollinators function for other ecological groups such as frugivores and carnivores. However, we do know that existing data on carnivore and frugivore movements will be insufficient—in and of themselves—to empirically confirm where natural corridors still function and where they are in need of restoration. In contrast, there are thousands of migratory bird, bat, and butterfly observations and flowering plant records available to empirically define nectar trails. DNA and isotope tracking techniques can empirically determine which faunal samples taken at different stopovers are from the same breeding populations. The observations about migratory pollinators' movements made by volunteer naturalists compiled on the Arizona-Sonora Desert Museum website (www.desertmuseum.org) may generate additional patterns regarding the location of functional corridor segments to determine which are in need of protection, restoration, or both. In addition, stopover habitats utilized by migrating pollinators capture and enhance other levels of biodiversity, such as the 322 species of non-migratory invertebrate pollinators on Tubac Farms. At the least, such collaborations between public and private sectors, and between Mexican and U.S. conservation professionals, may be the most rapid way of initiating restoration and stewardship of corridors useful for migratory (transboundary) species. It behooves all conservation biologists interested in bi- or tri-national migrants to promote private stewardship along corridors in a socially equitable and culturally sensitive manner. ☾

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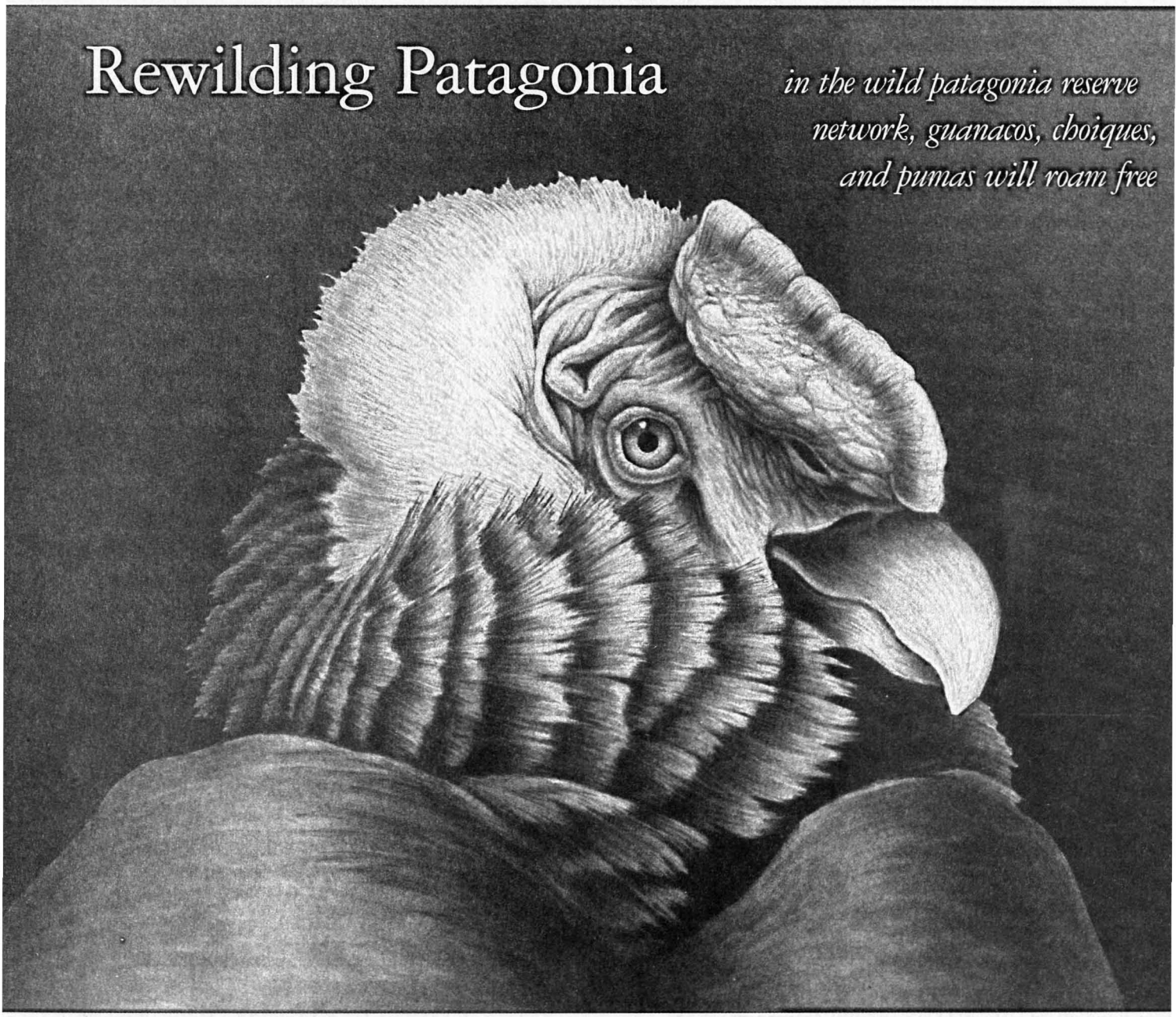
Rewilding Patagonia

in the wild patagonia reserve network, guanacos, choiques, and pumas will roam free



by SUSAN WALKER, ANDRÉS NOVARO, and co-authors

THE PATAGONIAN STEPPE of Argentina is a vast area—almost 750,000 square kilometers—of arid plains and scrub ecosystems in the rain shadow of the southern Andes, at the tip of South America. The name "Patagonia" evokes romantic images of a windy wilderness at the end of the Earth. Indeed, a recent article in *National Geographic* described Patagonia as the "wild, wild south," and Conservation International has identified the region as a wilderness and one of "Earth's Last Wild Places," based on its size, low population density, and purported lack of change in vegetation.

Andean condor, watercolor by Matt Bohan

But what is a wilderness or a wild place? It's an area dominated by natural processes, home to a complete life community, and, for the most part, undisturbed by human activity. Although Patagonia is vast and sparsely populated, and its climate and topography are as harsh and wild as ever, we argue that human activities over the past 100 years have deeply altered the structure and composition of Patagonian wildlife and vegetation communities, and that most of the region is no longer truly wild.

Wildlife of Patagonia

Since the Pleistocene extinctions of 10,000–15,000 years ago, the dominant herbivores of the arid Patagonian steppe and scrubland have been the guanaco (*Lama guanicoe*) and choique (*Pterocnemia pennata*, also know as Darwin's rhea). Guanacos, 100–120 kilogram camelids, are the wild ancestors of the more familiar domestic llama, and choiques are large-bodied, flightless, ostrich-like birds. Until the late 1800s, Patagonia was the domain of the Tehuelches, a nomadic hunter-gatherer people whose livelihood depended largely on the huge herds of guanacos and choiques that occupied this immense landscape. Early European explorers describe herds of guanacos that numbered in the thousands, large flocks of choiques, and even Andean deer (*Hippocamelus bisulcus,* also known as huemul)—which today are found only in rugged forested areas of the Andes—in some parts of the steppe.

The unique wildlife community of arid Patagonia also includes two species of armadillos and a wide variety of rodents that have evolved in niches filled by different taxa in other parts of the world, such as the antelope-like mara (*Dolichotis patagonum*), the rock-dwelling mountain vizcachas (*Lagidium* spp.), the burrowing tuco-tucos (*Ctenomys* spp.), and the cuises of the guinea pig family (Cavidae). Bird diversity is high, including the majestic Andean condor and many endemic species—southern Patagonia has been identified by BirdLife International as a crucial area of bird endemism. Endemism is also high among reptiles and amphibians, due to the proliferation of isolated *mesetas* (plateaus) and lakes.

The top Patagonian carnivore is the puma (*Puma concolor*), followed by the coyote-sized culpeo fox (*Pseudalopex culpaeus*). Smaller carnivores include the chilla fox (*Pseudalopex chilla*); the pampas cat (*Lynchailurus colocolo*), and Geoffroy's cat (*Oncifelis geoffroyi*); two weasel-like mustelids, the grison (*Galictis cuja*) and the smaller huroncito (*Lyncodon patagonicus*); and two hog-nosed skunks (*Conepatus chinga* and *C. humboldti*).

What took the wild out of Patagonia

After his epic journey, 150 years ago, Charles Darwin wrote that the plains of Patagonia "are boundless...and bear the stamp of having lasted, as they are now, for ages." However, within a few decades a monumental change began to take place in Patagonia, when the first few sheep were introduced by British colonists. After the Tehuelches were decimated by introduced disease and defeated by the Argentine army in the "Conquista del Desierto" in the late 1800s, Europeans and Argentines moved in with huge herds of sheep and also introduced many exotic wildlife species. These herds reached a peak population of 22 million in the 1950s. European red deer (*Cervus elaphus*), first introduced in the forest ecotone, are expanding steadily out into the steppe, and European hares (*Lepus europaeus*) and the introduced wild boar (*Sus scrofa*) are ubiquitous, while maras and mountain vizcachas are in decline. Thus the dominant fauna of most Patagonian landscapes in the twenty-first century are sheep, cows, goats, and European hares rather than guanacos, choiques, and maras. Native carnivores prey almost exclusively on introduced European species, since their native prey are present at such low densities that they no longer play a significant role in their ecosystems and are considered "ecologically extinct" throughout large areas. The few places where native wildlife communities remain largely intact are often the poorest lands where for many decades it has not been profitable to maintain livestock.

The decline of native wildlife in Patagonia has been brought about by the same processes that have produced similar losses all over the world: interactions with livestock and exotic species, habitat degradation, and unsustainable hunting. Livestock and other exotics have had a negative effect on native species through direct competition for resources. Guanaco and sheep diets overlap to a large degree, and movement of sheep into an area quickly excludes guanacos. The foraging of one sheep is equivalent to that of five choiques. Where European red deer and guanacos are sympatric, their diets overlap seasonally, and European hares have high dietary overlap with the similarly-sized mountain vizcachas and maras.

In addition to direct competition, the large populations of introduced species have probably had negative effects on native species through other processes. The impact of predation on native prey may have increased due to reduced native prey populations and to predator populations being subsidized by introduced prey. The role that introduced disease has

played in the decline of native herbivores is not known, but maras are known to contract diseases transmitted by sheep and European hares. Livestock and other exotics have also indirectly affected native species through overgrazing, which has resulted in severe desertification of at least 25% of Patagonian rangelands. In many parts of Patagonia the lands are so degraded that they can no longer support the stocking rates of sheep they once did, and carrying capacity for native herbivores has probably also been reduced.

Hunting of native Patagonian wildlife was intensive throughout the twentieth century. Guanacos were hunted to reduce their competition with sheep, and commercial hunting of guanaco young for their skins and of choiques for their feathers was heavy and widespread. Mountain vizcachas were also heavily hunted during the 1950s for their hides. All three species and the mara are still hunted for food for subsistence purposes, and choique eggs are collected for human consumption. Additionally, guanacos in the steppe and huemuls in the forest ecotone were heavily hunted as food for dogs brought in by sheepherders.

Pumas and culpeos were killed because they prey on sheep. Bounty hunting of pumas was carried out in many places (and is still practiced in one Patagonian province), and pumas were extirpated from most of their former range by the middle of the twentieth century. Poison was widely used to eradicate carnivores, and consequently severely depleted both avian and mammalian scavengers. The small cats and skunks were also hunted heavily for their furs until the export of their skins was banned in the 1980s. Hunting of the two fox species for fur was intensive, and continues today.

Patagonian carnivores and their prey

During the last 20 years, sheep density and the rural human population density have declined. Concomitantly, hunting pressure has decreased in many areas. As in North America, in Patagonia some native wildlife has begun to recover as some types of threats have lessened. Unlike in North America, however, the species that have recovered most are the top carnivores. Pumas have recolonized much of their former range throughout Patagonia, and culpeos have increased in number—their density doubled in southern Neuquén province between 1989 and 2002. The distribution of the culpeo actually expanded to the east, perhaps because of high availability of exotic prey, increased water availability due to artificial waterholes for livestock, or to the extirpation of the puma during several decades. The diets of pumas and culpeos are currently overwhelmingly composed of introduced species—the European hare, sheep, wild boar, and European red deer. In many places top carnivores are thriving on this enormous prey base provided by livestock and other exotics, even though populations of their native prey species have not recovered from the tremendous declines they suffered.

For most native herbivores there are no good data on either past or present population sizes, so the exact extent of population reductions over the last century remains unknown. Huemuls that once inhabited parts of the western steppe and steppe-forest ecotone disappeared completely from these habitats. Based on explorer accounts and analyses of plant productivity and forage consumption by guanacos, the number of guanacos in Patagonia prior to European colonization has been estimated at 7–20 million. In recent times, this number has been estimated at 400,000–600,000 individuals, representing 2–9% of the original population. Comparison of the few recent local density estimates for choiques with accounts of early explorers suggests a widespread collapse of populations of that species, a collapse which has continued over the last two decades. Because threats for other native herbivore and omnivore species were similar, it is likely that these have experienced declines of similar magnitude.

Putting the wild back into Patagonia

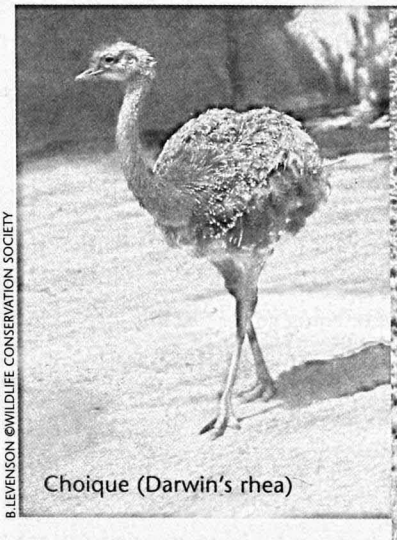
Wildness and wilderness are defined by wildlife. Patagonia cannot be truly wild without extensive areas where native wildlife species are present in large enough numbers to interact significantly among themselves and with their ecosystem. We hope for a future where the unique Patagonian wildlife communities and their habitats are valued, restored, and preserved, and given a permanent place alongside humans. Our vision is the "rewilding" of Patagonia. This requires a unified, proactive plan for region-wide conservation of native wildlife through a network of what we call "Tehuelche landscapes"—large, protected core areas with functional native wildlife communities as the Tehuelches knew them, and human-use areas that provide connectivity for native wildlife among those protected areas.

This Patagonian version of rewilding is distinguished from the North American version by the necessity of focusing on large-bodied herbivores, in addition to carnivores. This necessity derives from the drastic human-induced ecosystem changes that have altered the regulatory role of top carnivores in Patagonia. Here, carnivores persist and even do well in some areas where their native prey species have been extirpated. Our

challenge is to take advantage of this "gift" of carnivore recovery by re-focusing on native herbivores, which, at present, are more threatened. Carnivores, primarily pumas, must be included as conservation targets and protected in core areas that are large enough to support viable populations, but in order to restore a wild state of natural communities the reserve network must be designed on the basis of the needs of herbivores as well. Therefore we chose the guanaco and the choique, the largest-bodied and widest-ranging herbivore and omnivore, as the focal species for the Wild Patagonia Reserve Network. To restore wildness to Patagonia, these species must once again be numerous enough to be the principal prey of the puma throughout large areas.

Core areas and connectivity

Currently about 4% of arid Patagonia is designated as some type of protected area. However, most of these are reserves in name only, offering little real protection to wildlife, and less than 1% of the land has a permanently assigned warden or ranger. For example, the Auca Mahuida Provincial Protected Area in northern Neuquén province is over 75,000 hectares, contains a large population of guanacos, and represents a major link to the largest protected population of guanacos in the world, that of the Payunia Provincial Reserve in southern Mendoza province. The 2 million hectares encompassing the Auca Mahuida and Payunia reserves and the lands between them are a potential site for a Tehuelche landscape in the Wild Patagonia Reserve Network. Nevertheless, the Auca Mahuida reserve is the site of major commercial oil extraction. The single ranger responsible for the reserve must also patrol a large


Choique (Darwin's rhea)

B.LEVENSON ©WILDLIFE CONSERVATION SOCIETY


Guanacos

SUSAN WALKER

additional portion of the northeast of the province, although he often doesn't even have a working vehicle, or gas to run it. Thus, better protection and implementation of existing reserves that harbor, or could harbor, large populations of guanacos, choiques, and pumas are priorities. In addition, we must identify important areas that could be made into reserves and the means to convert them into protected areas. New and existing protected areas may have additional conservation and management goals, but management should ensure the persistence of functional populations of guanacos, choiques, and pumas, which will usually require working with owners and occupants of private lands around the reserves.

Between the Tehuelche landscapes would be lands under varying intensities of human use, ranging from towns and cities where most native wildlife is absent, to ranches or indigenous community lands managed for the co-existence of native wildlife and livestock production or other economic activities. These different land uses must be distributed in such a way as to allow for a high degree of connectivity for guanacos and choiques, ensuring that the Tehuelche landscapes do not become island refuges for isolated wildlife populations.

Landscape connectivity for guanacos, choiques, and pumas in Patagonia is probably determined more by human land-use practices and activities than by habitat structure or physical barriers to movement. Wildlife "corridors" in this case would likely be composed of contiguous wildlife-friendly ranches, where sheep density is not high, exotics are controlled, and hunting of native species is limited or not practiced at all. This requires development of economically viable alternatives to sheep ranching. In many parts of Patagonia ranchers have already turned to tourism, hosting fishermen and sport hunters who take mostly introduced species, or to live-capture and shearing of guanacos. These activities can be managed in ways that allow persistence of pumas, guanacos, choiques, and other native wildlife species, at least at low densities or as transients, providing connectivity between populations in protected areas. Indeed the presence of these species may enhance the experience of the tourist, fisherman, or hunter who has been drawn by the lure of a wild Patagonia.

The incorporation of numerous protected landscapes in an interconnected network is important because isolated preserves are often ineffective in conserving guanacos and choiques. For example, Laguna Blanca National Park is a small park (11,250 hectares) in the steppe of Neuquén province where choiques have been protected for over 55 years. However, this species is declining in the park as well as in the surrounding areas. And in Cabo Dos Bahias, a provincial protected area in Chubut, there was a recent die-off of guanacos. This is because Cabo Dos Bahías is surrounded by sheep ranches where guanacos are actively excluded. The guanacos appear to have died from starvation as they were unable to range beyond the confines of the preserve to forage. These examples illustrate how land use around a protected area can directly affect conservation of wide-ranging wildlife species, even if regulations inside the protected area are strictly enforced.

In contrast to arid Patagonia, a much greater proportion of the Patagonian forests of the Andes have protected area status (about 30%), largely due to the public appreciation of the scenic and recreational value of the montane forests. These protected areas can be linked with the reserve network for arid Patagonia, to provide complementary connectivity and refuge for species such as the puma that use both forest and arid habitats. This could also provide opportunities for the huemul to recolonize the steppe-forest ecotone and parts of the steppe as populations recover.

The path from vision to reality

We have initiated the Wild Patagonia Reserve Network project by mapping the distribution of guanacos and choiques throughout Patagonia, in order to determine which existing protected areas contain these species and where important populations outside of protected areas exist. Next we propose to use these wildlife distribution maps, maps of threats to wildlife, and a map of the existing protected areas to design a network of Tehuelche landscapes and identify where connectivity needs to be restored or maintained. The network design can be used by federal and provincial agencies, non-governmental organizations (NGOs), and other interested parties to prioritize areas for conservation and management interventions and determine appropriate types of action for different places. It will complement ongoing conservation efforts based on other criteria, such as representation, contributing to a comprehensive conservation portfolio for arid Patagonia.

The Wild Patagonia project is an ambitious vision developed collaboratively and shared by people from several different agencies in Patagonia. The obstacles to be overcome and the challenges for the development of the reserve network are great, but we believe they are surmountable. Obstacles include a lack of political will for wildlife conservation, and differences in values, opinions, and goals of different sectors of Patagonian society. Some Patagonian provinces and the federal govern-

ment are still offering subsidies to ranchers to maintain or increase sheep production. The greatest biological challenge is arguably the problem of ubiquitous exotic wildlife.

Opportunities and possibilities also exist, however. Perhaps the first and foremost possibility arises from the conditions that have led many to claim that Patagonia is a wild place: low human population density and limited and highly concentrated urban development. The habitat is still there, not completely intact, but present in large, open landscapes. Pumas have been able to recover throughout most of the region and guanacos have quickly moved back into some areas when sheep have been removed. Second, in many areas ranchers are already searching for and exploring productive activities that serve as alternatives or complements to sheep ranching, as declining carrying capacities and fluctuating world wool prices have made it a less-profitable activity. Finally, the popular conception of Patagonia as a wild place, and its promotion as such for tourism, hunting, and fishing, may provide an opportunity to build public consensus for a Wild Patagonia Reserve Network.

Michael Soulé and Reed Noss have said in this journal that the greatest impediment to rewilding is an unwillingness to imagine it. We invite politicians, ranchers, schoolchildren and their teachers, rural settlers, indigenous communities, tourists, fishermen, all of our colleagues in government agencies and NGOs, and the rest of Patagonian society in Argentina and Chile to join us in imagining a truly wild Patagonia, where the extraordinary native wildlife on which the Tehuelches depended until the nineteenth century can flourish in the twenty-first. ☾

Conservacion Patagonica

Conservacion Patagonica (formerly the Patagonia Land Trust) supports the preservation and restoration of land in the Patagonia region of Chile and Argentina. Started in the spring of 2000, Conservacion Patagonica's first project was the purchase of Estancia Monte Leon, a 155,000-acre ranch on the Atlantic coastline in the Santa Cruz province—for the express purpose of giving the property to National Parks of Argentina. In November 2002, Monte Leon was formally donated, forming the first-ever coastal national park in the country.

In July of 2004, after nearly a year of negotiations, Conservacion Patagonica purchased Estancia Valle Chacabuco, a 173,000-acre ranch in the Patagonia region of Chile. The purchase was motivated by the similar goal of establishing a new Chilean national park in a unique and biologically important area. We're now in conversations with the Chilean government regarding the potential donation of the property to Chile to be incorporated into a new national park that would include two other Chilean national reserves contiguous to the estancia.

***Kristine McDivitt Tompkins** started Conservacion Patagonica, a non-profit foundation. To learn more about the work of Conservacion Patagonica visit www.patagonialandtrust.org.*

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Blue Winters of Reptilian Nature

When the chaparral blooms
greasewood yellow to pioneer bees
and ragged-winged butterflies, flutters
of orange in shadowed canyons,
they sleep, burrow-tucked,
rattles and tails, scales
and claws, jaws and snouts
curled into barely breathing circles
beneath rocks, sheltered in roots,
lodged in layers of logs; outside,
in cool streams of sunlight,
the closest resemblance
to anything reptilian and alert
is the eye of a passerby
mockingbird perched atop a paloverde,
ash-hued head tilted and watching
suspiciously in silence
as I leave indentations
of identity, one foot after the other
crunching through the pink-grained
vein of wash bed.

I miss them in winter,
those quick motions or senses of shape
that signal, in warmer seasons,
the presence of a snake or tortoise,
whiptail, skink, Gila monster, or swift,
yet they still move,
not under this sad shade of sky,
but within the deepest part
of my brain, in crevices of gray matter
where forks in the desert
are never tongues of the living,
tips of organs sensing particles
floating in an arid breeze
above pebbled sand and shrub;
below, I rest in the substrate
somewhere in the complex path
between limbic system and cerebellum,
dreaming into their hibernation.

Yvette Schnoeker-Shorb

Where to Place Your Business in Tucson:

"Location, location, location..."
my real estate agent murmurs
and so I consider her mantra
believing she is not mistaken:

I look for where the stormclouds gather
hoping that somewhere below them
the shiniest mica must mound up in washes
and spadefoot toads must bleat nearby.

I search for this place where toads make love
and micaceous reflections make themselves
manifest in a world most newcomers see
as otherwise dry, dull and without daring music.

Let me locate my business where scents
of creosote are strongest, where winged ants
form spheres of flight on summer nights
where Hohokam petroglyphs say which way to go.

Let me place myself near all that drives
the ancient life of desert towns, in barrios where
neighbors still gather for las posadas where
masked chapeyekas rattle and dance.

Let me consult with coyotes about which stock
show the greatest gain, and ask the homeless
which old mesquites have greatest standing,
offering cover on cool winter nights.

Let me open my door along all the corridors
which keep the most traffic of migrant birds,
and make it my business to keep them amongst us.

Gary Paul Nabhan

"Ibex Dunes" (Mojave fringe-toed lizard), oil on panel by Laura Cunningham

Being Caribou

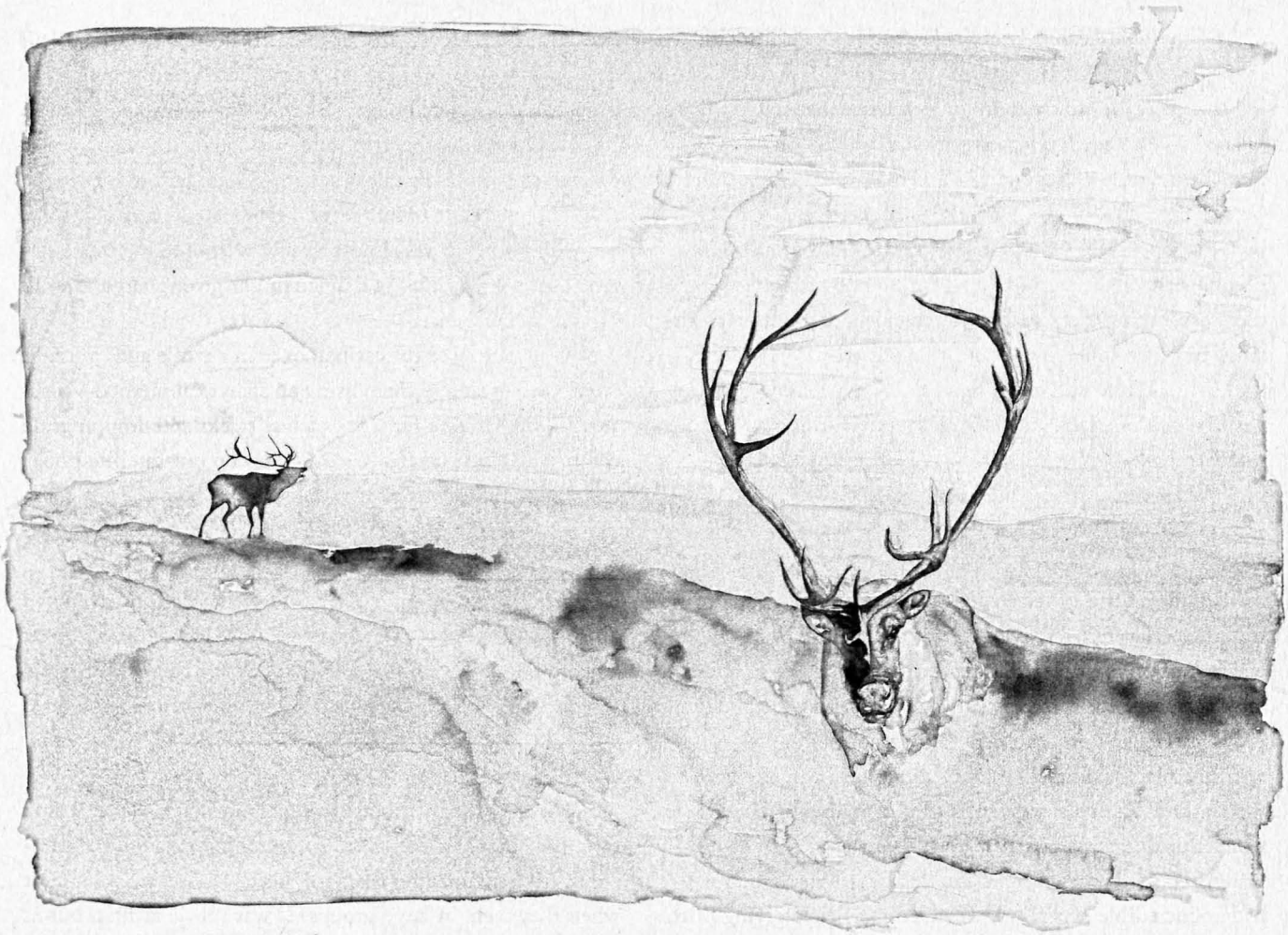
A Conversation with Karsten Heuer

Karsten Heuer has an urgent story to tell: that of the Porcupine caribou herd. These animals have persisted for thousands of years, moving with the seasons. Today, however, that way of life is threatened by oil and gas development in their calving grounds in Alaska's Arctic National Wildlife Refuge. The caribou find nutritious food, few predators, and relief from insects during their brief stay at this coastal sanctuary. In winter, they seek shelter in the more southerly boreal forests, where they can paw down through soft snow to eat lichen. When the days start to grow longer in the spring, pregnant cows initiate the migration back to the calving ground on the Arctic plain. This arduous annual trek of 2500 miles or more is North America's last great mammal migration. Determined to more deeply understand this ancient phenomenon, Karsten Heuer and his wife Leanne Allison decided to migrate—on foot—with the Porcupine caribou herd for five months.

Heuer's curiosity about wild creatures runs deep. An independent wildlife biologist, he has studied the movements of wolves, lynx, and cougars in Banff National Park, helped capture lions, cheetahs, and wild dogs in South Africa (to transport them among isolated reserves), and worked as a seasonal warden in national parks across Canada.

His mega-walk with the caribou was not his first long-distance trip in a remote northern realm. In 1998 and 1999, Karsten hiked (and skied and paddled) the wildest route along the spine of the Rocky Mountain chain—2200 miles from Yellowstone National Park in Wyoming to the small town of Watson Lake in the southern Yukon. His idea was to try "to get in the skin of a wolf or grizzly bear" and then travel the landscape as a wide-ranging species might. Along the way, Heuer recorded grizzly bear and wolverine sign as a "measure of wildness" and stopped in communities to educate people about the Yellowstone to Yukon Conservation Initiative (www.y2y.net). Karsten's book about his adventure, *Walking the Big Wild*, hit the Canadian non-fiction bestseller list and is now available in the U.S. from Mountaineers Books.

In April 2003, Karsten and Leanne set off from Old Crow, a Gwich'in community in north-central Yukon, to follow the Porcupine caribou herd on a 1,000-mile, 153-day expedition across snow and tundra. *Wild Earth*'s managing editor, **Jennifer Esser,** spoke with Karsten Heuer about this incredible journey on September 10, 2004.



JENNIFER ESSER: For five months, you migrated on foot with the Porcupine caribou herd. What inspired you to make this trip?

KARSTEN HEUER: I had a three-season assignment as a park warden in the extreme northwest corner of the Yukon in Ivvavik, a national park established to protect the Canadian portion of the Porcupine caribou herd's calving grounds. The Porcupine caribou herd—about 123,000 animals—is the same herd that uses the Arctic National Wildlife Refuge in Alaska for their calving grounds. Ivvavik borders the Arctic Refuge.

As I was experiencing this caribou herd coming through every spring on the way to the Arctic Refuge and coming back through every summer as they returned from their calving grounds, there was always a curiosity in my mind: Where exactly are they going? What were they doing? When they migrate through, they're coming through for days, and it's not just the caribou, there's a stream of life that's coming along with them, whether it's golden eagles or jaegers looking for calves to pick off—or the grizzly bears ambushing them in the willows along the rivers—or wolves and foxes trying to isolate individual animals as prey. I couldn't sleep when they came past: there's 24-hour daylight and the dramas are happening constantly. When they finally disappear over the ridge, it's pretty hard—the landscape that was full is suddenly silent, and you miss it.

I felt a yearning to keep going with them, which translated into a lot of research about the caribou. I learned more about the potential oil and gas development in the Arctic Refuge that could threaten their calving grounds. What bothered me about all the stories, documentaries, and articles was that none of them addressed what these caribou go through during their migration to the calving grounds and their return to the wintering grounds. The story of the caribou hadn't been told.

"Caribou Autumn," watercolor by Rod MacIver

So my wife Leanne (who had experience with migration as well while working on a film project) and I started hatching this crazy idea to try to migrate with the herd, to try to be caribou. We decided to try to bring the landscape alive, telling a story through the eyes and ears and movements of an animal. Our intent was to move with the caribou herd for anywhere between four and seven months as they migrated and to try to become part of the herd. Because caribou don't migrate along the same routes every year and don't depart or arrive at the same times each year, we couldn't really plan our route. We couldn't plan food caches, since we didn't even know how long we'd be out there. That was a really tough thing to get our minds around—to let go of the very human approach of having goals and objectives and a plan.

Besides letting go and just following the caribou, what were some of the other challenges you faced?

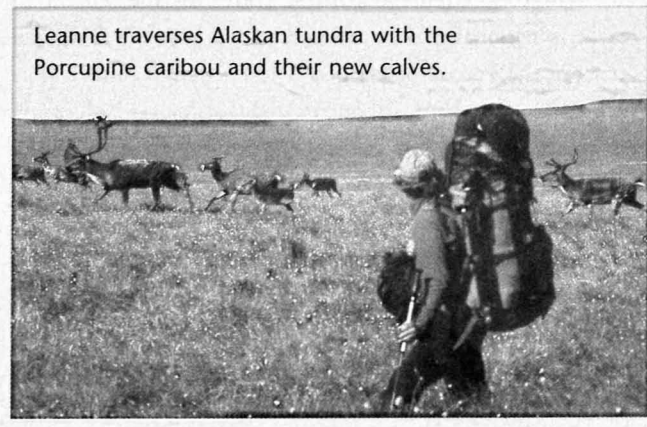
Initially we were overwhelmed with all the unknowns, and our lack of experience in Arctic environments. We have quite a bit of experience in mountains below treeline in more temperate regions, but here we were going into one of the remotest places on Earth, having to put our complete faith in the caribou. As we slowly surrendered to the caribou, some wonderful things started to happen.

After 52 days, when we got to the calving grounds we had an incredible experience where animals were giving birth outside of our tent. We couldn't move. They had become so skittish during that time that we couldn't even get out to go the bathroom. So we'd relieve ourselves in our cups. We would have to wait until the animals had moved off a little bit and crawl on our bellies to the river to get water for the next two days and then crawl on our bellies back, and talk in whispers. For 10 days we couldn't get out of our tent. They are extremely sensitive as they're having their calves and protective of their newborns when the calves aren't that mobile. We saw golden eagles come in and try to get some calves. Grizzly bears came in and caused complete havoc.

We followed the caribou as they left and got into the bug season. We were moving so fast, among a huge rush of animals, that we were sleep deprived, traveling all hours of the day and night. We'd nap for an hour or two, walk for five or six, nap for an hour or two. Our whole sense of time got messed up. We didn't know what day it was or even the time of day because of the 24-hour daylight. We were constantly surrounded by caribou or behind caribou or on their fresh trails. They're shedding their winter coats at that time, so we had hair in our food, hair in our sleeping bags, caribou hair everywhere, like you get sand everywhere when you're at the beach. And we were hungry. By that time we were two and a half months into the trip, and we couldn't possibly carry enough to replace the calories that we were burning. Between this perpetual state of hunger and the sleep deprivation, we're quite dizzy, and it was almost like we were entering into a different state—much like a shaman might go on a fast and work himself into a trance.

We would lose the caribou once in a while and, initially, we would try to find them using an analytical method—visual tracking, looking for signs such as tracks and droppings on the tundra, and sometimes calling up on our satellite phone to other biologists, trying to determine where the few satellite-collared animals were. But as the trip progressed and we got into this unique state of consciousness, we started to plug into different signs and signals and we started to have vivid dreams and visions—of where we would find caribou next when we'd lost them. We started following those dreams and visions. We would tell them to each other before we headed out and then exact scenes that we had described to each other would play out.

There was also a vibration in the landscape, and it wasn't from the hooves, it was more like a singing through the landscape. You felt it more than you heard it. We would hear it when they were in large groups. It was subtle at first, but as the layers of our lives dropped away, our senses were sharpened. We started to tune into this sound—which I call thrumming—and that began to inform our decisions about where we went when we had lost the caribou, and we would find them. It was a really magical development in the trip. In the span of five months, these two white people from the city of Calgary, which is where we both grew up, had another dimen-

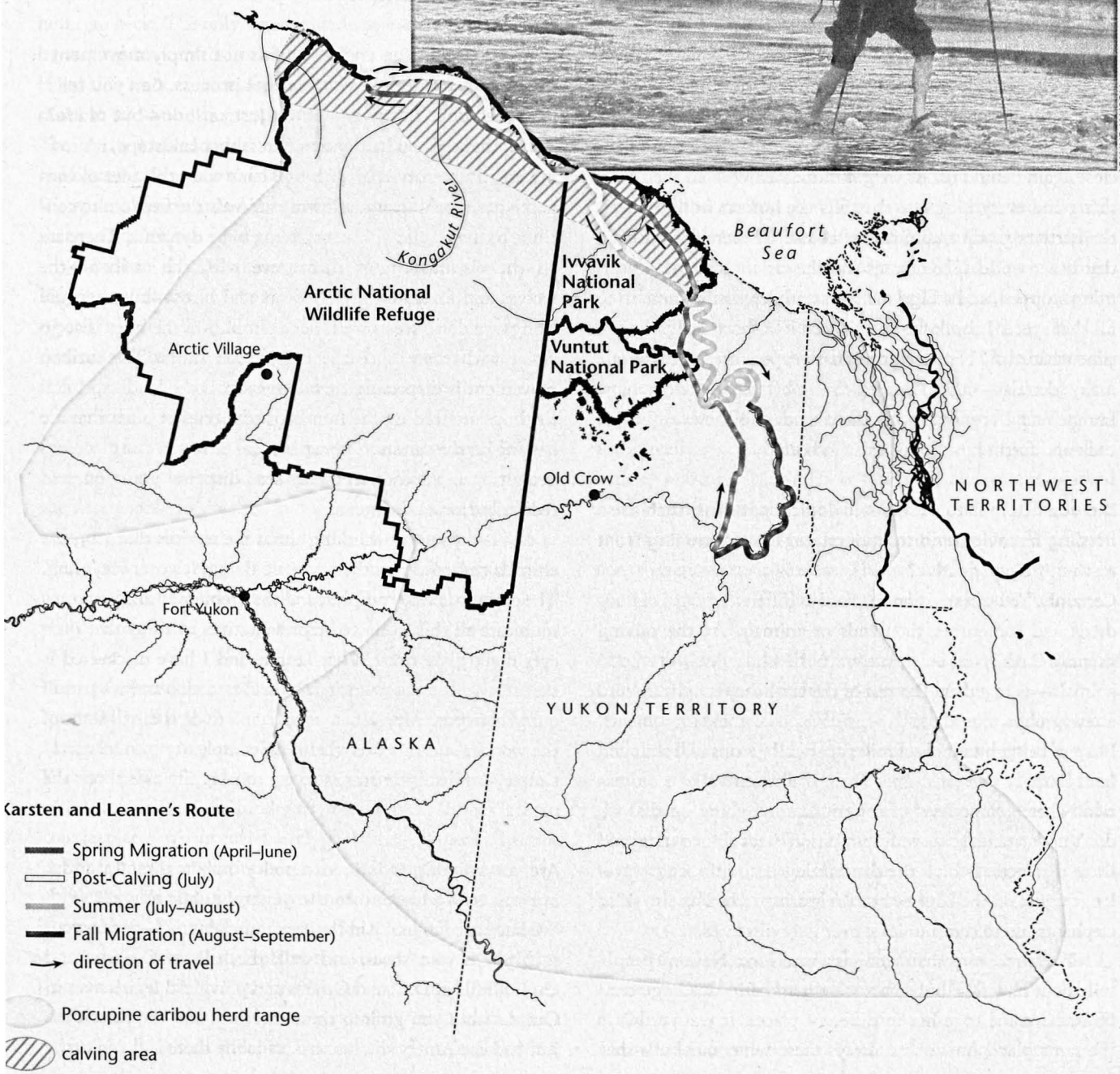


Leanne traverses Alaskan tundra with the Porcupine caribou and their new calves.

KARSTEN HEUER

Karsten leads the way across Alaska's Kongakut River in May 2003. At this crossing, Karsten and Leanne are more than six weeks into their journey with the caribou and will soon reach the main calving grounds in the Arctic National Wildlife Refuge. Protection of the refuge is key to the caribou herd's survival.

LEANNE ALLISON



sion opened up to them. Our experience matches the description Gwich'in people talk about, a distant time when people could talk to caribou and caribou could talk to people. And we felt that. It was unbelievable. How do you come back from a trip like that and go to Washington, D.C.—which is what we did—and communicate that to Congressmen and Senators and their aides? How do you explain what's at stake? I think that's what we're really struggling with even now in trying to capture our caribou experiences in a film and in another book.

I imagine that experience permanently changed your view of the world.

It's like Leanne and I are strangers in our old lives. Even the people that are closest to us, our parents, don't really understand that we're not the same people anymore. This other possibility opened up to us—and then we came back and felt it close again behind us. As we got inundated with all the advertising and everything else that fills the human world, we felt the barriers go up again, and of course we were cut off from that other world. The dreams and the visions and the thrumming stopped, and a big loneliness and depression came in to fill that space. I think we experienced in a shortened period of time what many Native cultures have experienced over the last many decades—it's a ripping from between worlds. Now Leanne and I are faced with the quandary of how we bridge back and forth: how do we exist in both?

Did you attempt to observe ecological patterns, such as herding behavior, and to understand the thrumming from a scientific perspective?

Certainly. You can envision the herd as different groups of hundreds and sometimes thousands of animals. At the calving grounds is really the only time when the whole herd—123,000 animals—is together. The rest of the time they're split up into a few groups, but those groups coordinate their movements. Despite being hundreds of miles apart, all groups will shift and head south at the same time. There is a huge level of coordination. There's some level of communication going on that we don't understand, some communication that's able to transcend those distances. I think the thrumming is an infrasonic wavelength, just on the edge of human hearing, which is also what elephants use to communicate over long distances.

There's a story that biologists and First Nations people tell about how four bulls that were marked in this huge caribou herd came together in different places. It wasn't always the same place, but it was always these same four bulls that came together at around the same time of year from hundreds of miles away from each other. There's no explanation for that. There's also no information about caribou communication in the literature, which is incredibly exciting to me as a scientist. I think some of the greatest discoveries in science are really mystical as well. They not only bring to light new facts about animals, but new dimensions about the world, and open up a new breadth of possibility. I talked about this thrumming to some caribou biologists and they were really excited, but I don't feel the need to know the mechanics of how it works; it does work.

Migration might be understood as not simply movement of animals, but as a flow of natural process. Can you tell us more about this river—of not just caribou—but of life?

When that caribou herd moves across that landscape, it's towing an entire ecosystem with it. That's what this idea of connectivity is getting at—allowing animals the freedom to continue to move, allowing ecosystems to be dynamic. There are all the obvious things that move with the caribou—the wolves and foxes and grizzly bears and birds—but there are things we don't see as well. For example, all the bugs that go along with them once the bug season starts. The caribou movement is dispersing these bugs across the landscape, and the bugs are feeding the hundreds of species of birds that are nesting on the tundra. The caribou are eating in one place and defecating in another, so there's seed dispersal going on, and redistribution of nutrients.

When you start thinking about the services that 123,000 animals constantly on the move are doing, it's overwhelming. The ecology is very complex, and the problem is to try to communicate all this to elected representatives in a way that their eyes don't glaze over. What Leanne and I have discovered is that story-telling is an ancient human tradition and it's part of our genetic makeup. What we're trying to do is distill some of the wonder and this overwhelming complexity into relatively simple and inspiring stories to try to re-ignite awe about the natural world.

Are you working to influence policy makers directly, and are you trying to educate the general public as well?

We have tried to lobby in the conventional sense—put on your suit, polish your shoes, and walk the halls of Congress and Capitol Hill in D.C. and Ottawa and provincial legislatures in Canada—but you go into those meetings and the person has just had the American Automakers lobby there and you're the

next meeting and you've got five or ten minutes to communicate your point. Leanne and I have come to the conclusion that that's not our strength. Our role is to inspire the masses and try to bring these stories to the bottom of the political process, if you will. We try to motivate and mobilize that constituency.

Is that what you're trying to do with the projects you're now working on—a film and a book, as well as ongoing speaking engagements?

On the calving grounds, Leanne and I had this terrible feeling we just shouldn't be there, that it wasn't right and we would never go back. The only way we could justify being there was by staying in our tent and by having a firm commitment to bring this story to a lot of people and to make a difference for caribou. We feel a huge responsibility to share our insights. The truth, which sounds kind of romantic and naïve, is that my heart is telling me to find a way to explore further what we felt with the caribou and the thrumming and the visions. But that wouldn't mean we'd go back to the calving grounds.

I believe that other dimension—whether it's what the Koyukon Indians in the Yukon call distant time or the Aboriginals of Australia call the dream time—exists. My desire is to access it more deeply and to learn from it, but that's selfish and meanwhile it's at risk. We scientists talk in terms of minimum viable populations and connectivity and these relatively formal terms, but there is so much mystery. Now we have to try to communicate that it exists. We're certainly not the first people to do this, but we might be able to help to bridge some distance between worlds—a mental distance. These are long journeys on the ground, but really they're journeys from the head down to the heart. Our role is to try to help people along those journeys for themselves.

Did you see evidence of oil and gas development, or was it relatively pristine? Were there any barriers across the caribou's migratory path?

We saw a bit of evidence of past oil and gas development: some old tracks on the tundra from seismic exploration, and a couple places where fuel barrels and firing wires and other debris from oil exploration was left. But, overall, you can probably count on your fingers how many times we encountered those things. We were in a huge wild area—you can probably count the number of such places that still exist in the world on your fingers as well. There were no trails, no roads, and apart from a couple cabins and a ranger station, no human structures. Yet there's all this history on the land: we're following the caribou across these mountain hillsides and passes where there are trails carved into scree, rock, and the earth that are like trenches. There's caribou dung in layers and some of it's covered in lichen. Archeologists have identified some of the crossings that the caribou use today as the same river crossings used by caribou and native people to hunt the caribou as long as 23,000 years ago. So, what Leanne and I experienced was this very short segment of a huge circle of life that's been going on for thousands of years. To describe it in numbers, to compare that kind of history to a six-month supply of oil for the U.S.—the highest estimate of oil and gas that could be under the ground in their calving grounds—it's just a ridiculous decision in our minds.

We know that the Arctic National Wildlife Refuge is at risk. What about the other places that the caribou use—are those mostly protected areas?

A lot of the caribou herd's territory is protected. Ivvavik National Park and Vuntut National Park in Canada are directly adjacent to each other and adjacent to the Arctic Refuge. All of it is wilderness except for the million and a half acres in the calving grounds. There are some other agreements in place for much of the rest of their migration route. While it's not the only one, the Arctic Refuge really is the biggest missing piece in the puzzle. We're not very far from having achieved something really special here and it hasn't come easy so far: Adolf Murie, Margaret Murie, Bob Marshall, and others worked hard for the establishment of the Arctic Refuge. The intent wasn't to have oil and gas development in the middle of it, in one of its most sensitive areas. This work has been going on for over eight decades and we really need to finish the job.

Are you hopeful that the refuge will be protected? Do you think it's a likely outcome?

It's a necessary outcome. When I talk to people and get feedback after lectures and after pieces have aired on television about the trip, my sentiment is that the majority of people feel the same. So if development happens on the refuge, it will be a huge tragedy, not only for the caribou and for everything else that depends on that area, but also for democracy—because if it happens then democracy doesn't work. ☾

"Being Caribou," an award-winning film directed and written by Leanne Allison, is now available through the National Film Board of Canada. To order, visit www.beingcaribou.com. A book about Karsten and Leanne's trek will be released in the fall of 2005.

Pinhook

Place that Holds the World Together

by Janisse Ray

IN THE SOUTH OF GEORGIA, endless pine flatwoods part to make way for a great swamp, Okefenokee, in whose thickets and bays live a population of black bear so healthy that the straight, sandy roads of that territory are crossed and crisscrossed by the imprints of their pads.

Often they are glimpsed at dusk, disappearing into titi thickets. The bears ignore a delineation drawn in 1821, after the Spaniards conceded, that marks the boundary of Florida. And they ignore Highway 94 that changes to Highway 2 at the state line, built to connect minuscule Fargo, Georgia to equally small St. George, Georgia, after passing briefly through a corner of Florida. The bears traverse freely through country mostly alien and uninhabitable for humans, where the world yet belongs to the processes of rain, sun, water, fire, and wind. The names of the places where they forage, they mate, they birth, and they nurse their young in the mysterious patterns of black bear society are not the names we have given these locales: Grand Prairie, Sego Bay, Sandy Drain, Sawgrass Head, Little Suwannee. Knowledge of these places is contained permanently in a vast and secret black bear culture.

Many miles south of the immense swamp, the one named Okefenokee, lie the pine flatwoods of north-central Florida, interrupted by branches and bays, that we know as Osceola.

Okefenokee Swamp, Osceola National Forest.

The areas of these two wildlands, which are owned by the people of the United States, total over half a million acres.

Between them occurs Pinhook Swamp—a pocosin—connected to Okefenokee by sluggish Breakfast Branch and to Osceola by Impassible Bay.

Pinhook Swamp. The land between.

It is 170,000 acres of dreary dismal. A giant piece of ground too deep for a human to wade, too shallow for a boat to draw. Too tangled for passage. Full of mosquitoes and yellowflies. Place that holds the world together. A natural feature full of natural features. Some of the last real wilderness in the South.

Pinhook's fate has been to be ignored, even unnamed. Not that it wasn't logged. Like most of the country, it was. But somehow Pinhook Swamp never lost its wild character, its mystery, its incomprehensibility, its elegance. The loggers logged and left. The trees returned.

Nobody knows much about it. Except the bears.

Holding the World Together

A pocosin is a tract of low swamp, usually wooded, a shrubby bog that inherits its name from the Algonquin word "poquo," meaning to open out or widen. It's also called a dismal, or a "swamp on a hill."

Most of Pinhook is dismal.

Walk out into the pocosin and you will sink to your knees in a peaty muck. Fetterbush, or hurrah bush, tugs at you, and the vicious smilax, or greenbriar, threatens to tear out your eyes and hair. For a while you can fight your way through gallberry, titi, more than one kind of native blueberry, and Virginia willow. Stop and lather up your hands with poor man's soap (sweet pepperbush), which foams when rubbed with wet hands.

Each step will leave a mark in the mats of sphagnum, which grow thick and wide, happy with constant inundation. Far above the shrubs you will see an occasional slash pine or the more unusual pond pine.

You won't go far before you have to beat a not-so-hasty retreat.

Pocosins are defined by a flat topography, a hydrology driven by rainfall, and organic, peaty soils. Waters typically flow outward from the center of pocosins, eventually forming headwaters of streams near the outer boundaries. Because organic soils tend to hold water longer than mineral soils, pocosins traditionally burned much less often than upland forests, or every 15–30 years. Even so, fire is essential to this community since it prevents the formation of a closed-canopy wetland. They are critical breeding sites for amphibians.

Pocosins and their counterparts, Carolina bays, the mystifying tear-shaped depressions oriented northwest-southeast that occur in the sandy soils of the southeastern coastal plains, originally made up about 3.5 million acres in North and South Carolina and Georgia. Less than a third of them are intact, another third have been irrevocably altered. Most pocosins and Carolina bays have been converted to

pitcher plants, graphite by David Williams

farmland, tree plantations (bedded pines), or peat mines. The southernmost Carolina bays can be found in the environs of Pinhook.

The southeastern United States has a higher number of endangered ecosystems than any region of the country. More than 30% are critically endangered.

Crisscrossed through the pocosin are strands, bays, and pockets of true swamp, forested by loblolly bay, blackgum, red maple, sweet bay, and pond cypress. Some of these are cypress domes, called so because older, taller trees grow in the middle, younger trees to the outside. Occasionally the pocosin pauses for savannas, which are wet, grassy prairies maintained by periodic fires in dry years.

Slash and pond pines grow in the wet pinewoods, above the familiar understory of saw palmetto, gallberry, fetterbush, scattered wax myrtle, tarflower, and dangleberry. In the highest and driest pinewoods, longleaf pine may be found, although it probably was never a common species here. The majority of Pinhook's pinewoods have been converted to slash pine plantations, and many portions were drained, logged, and re-planted with row crops of trees.

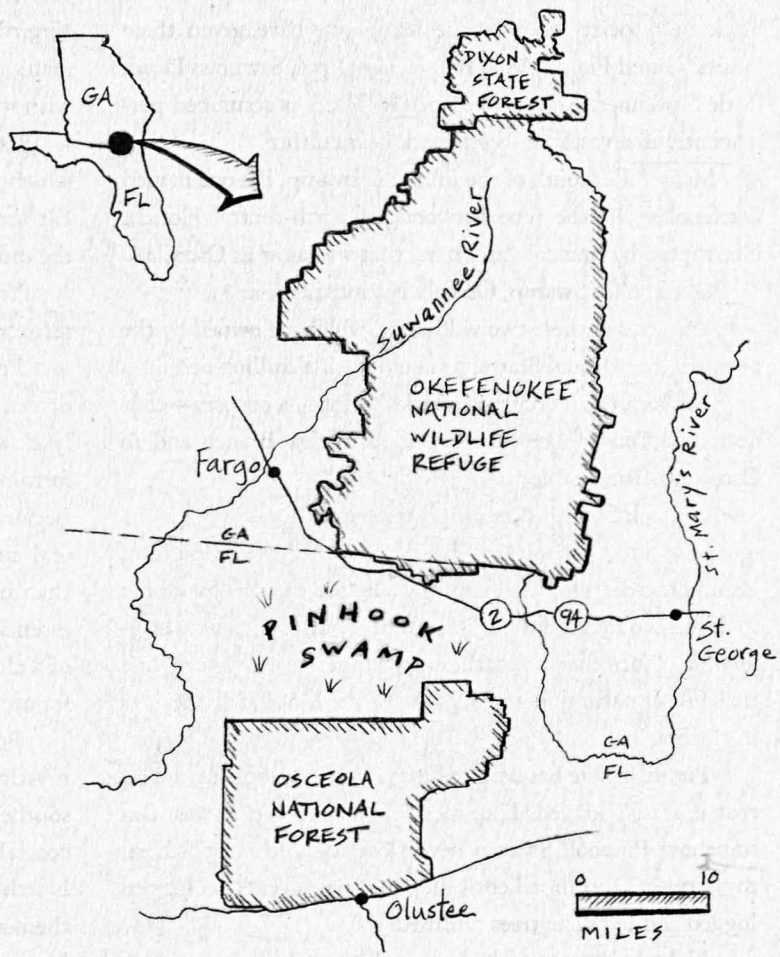
Unsurprisingly, Pinhook Swamp supports historic civilizations of river otter, bobcat, mink, weasel, gray fox, sandhill crane, migratory waterfowl, and swallow-tailed kite, species associated with the rich wetlands of the South. Most people, however, would wade a few feet into the muck and conclude that Pinhook Swamp isn't good for much besides holding the world together.

Lay of the Land

Osceola was proclaimed national forest on July 10, 1931. It is 158,225 acres, managed by the U.S. Department of Agriculture's Forest Service.

Okefenokee, the largest freshwater swamp in the United States (not counting the Everglades and Atchafalaya) currently covers 438,000 acres, or 660 square miles. In the late 1830s the last of its Creek and Seminole inhabitants were killed or ousted, and until 1889 it belonged to the people of Georgia. In that year Georgia sold the swamp to the Suwannee Canal Company for fourteen and a half cents an acre; Atlanta capitalist Harry Jackson intended to drain it. That project died with Jackson and in 1908 the swamp was sold to Hebard Lumber Company, which proceeded to log it. In the late 1930s, Jean Harper, wife of naturalist Francis Harper, who first entered the swamp with a Cornell University biological expedition in May 1912 and who returned to live for months at a time with his family there, beseeched President Franklin D. Roosevelt to purchase Okefenokee Swamp in order to spare it. Jean Harper was an acquaintance of the president, having tutored his children. In 1937 Roosevelt declared Okefenokee Swamp a national wildlife refuge, to be managed by the Department of the Interior's Fish and Wildlife Service. Ninety percent of Okefenokee, a portion of which extends into Florida, is official wilderness, one of the largest areas east of the Mississippi.

Connected to Okefenokee on its north end is 35,708-acre Dixon State Forest, encompassing 15,000 acres of the swamp, around the area of Cowhouse Island. Dixon, a wildlife management area, is managed by the Georgia



JANISSE RAY

Part of Pinhook Swamp flows into the Middle Prong of the St. Mary's River, shown here in spring flood. Pinhook supplies millions of Floridians with drinking water. Black bears are common in Pinhook Swamp, as are sandhill cranes, river otters, and wood storks.

JANISSE RAY

Shrub bogs, swamp forests, and wet flatwoods make up north Florida's Pinhook Swamp, which links Okefenokee Swamp in Georgia to Osceola National Forest in Florida. Could this wildland corridor be the key to survival of the endangered Florida panther and to the reintroduction of the red wolf?

Forestry Commission. The state forest, purchased in 1955, contains about 1,200 acres of natural pine stands, more than 2,000 acres of hardwood bottomland, and 18,000 acres of planted pine. The timber is cut in 40-year rotations, 250–300 acres a year, with no cut bigger than 70 acres. Laura S. Walker State Park, deeded to the Georgia Department of Natural Resources, is entirely within the boundaries of the state forest—it is devoted to recreation and includes a golf course.

So Dixon is cut. So it contains a golf course. Bear breed there in the heads and thickets. If Dixon State Forest is wild enough for bear, it's wild enough for me.

Osceola's 158,225 plus Okefenokee's 438,000 equals 596,225. Add Dixon's 35,708 and the total is 631,933. Count what's saved so far in Pinhook—about 120,000 acres—and we have a wildland corridor with a grand total of 751,933 acres.

751,933 acres. Heading toward a million. Bigger than the land area of Rhode Island. A million acres for river otters, black-crowned night herons, hoary bats, two-toed amphiumas, eastern chicken turtles, round-tailed muskrats, and Cooper's hawks. For sandhill cranes and black bears. For the possibility of red wolves, whooping cranes, and Florida panthers.

Day

The morning I first saw Pinhook was one of those tentative March days, before spring arrives in lustful earnest, when everything has a secret it bursts to tell. Some of the flora, unable to wait, has crept out of the tamped-down place it has been all winter, and, in the calmness of a risk successfully executed, skips and dances bright colors across the land.

Clouds of yellow jessamine float among the tops of sapling trees, flame azalea sweep pink through the floodplains, fields are washed in sheep sorrel burgundies and toad-flax lavenders. Red-shouldered hawks whistle over the bottomlands, and wild hogs root along the shoulders of the roads. Black willow catkins emerge yellow-green.

My husband, Raven, and I have driven from our family farm near the Altamaha River in Appling County, Georgia, about an hour north of Okefenokee Swamp, through the eagerness of spring. We have motored past houses and farms, one after another, past clearcuts strung like giant beads on an awful necklace, past churches with their parking lots devoid of trees. We have driven through the little towns of south Georgia, Alma and Waycross and Homerville, with their attempts at industry and their desires to grow. The entire route is so civilized, so humanized, so domesticated.

We are on our way to Olustee, Florida, where we are to meet Larry Thompson, activist and long-time ally of Pinhook Swamp, and William Metz, the current district ranger of the Osceola. We will enter the wild pocosin from the Florida side.

INTO THE LATE 1800S *the coastal plains of Georgia and Florida were a great plate, engraved with sandhill crane, fox squirrel, spotted turtle, panther, black bear. Diamondback rattlesnake, Suwannee bass, parrot pitcher plant. Dusky seaside sparrow, snowy egret, red wolf. As humans arrived, they dictated their patterns onto a landscape that had been designed by natural forces. Railroads came, trams were constructed into swamps. Trees were severed from their roots, ditches were dug. Forests disappeared. Savannas were plowed under.*

Fragmentation is what happens when a glass platter falls. In the moment the first tree fell did the plate begin to slip from our hands? At what point did it lay broken at our feet?

After meeting up with Larry and Will at U.S. Forest Service headquarters, we pack into Will's sea-green Forest Service jeep and travel a long way through the Osceola National Forest. We're really in the country, tall pines all around, no signs of human occupation. Oh, glory. This land is our land. We cross the St. Mary's River, which runs from Okefenokee Swamp to the Atlantic Ocean, we pass East Tower, used for spotting forest fires, then cruise through tiny Taylor, Florida, with its teensy Voting House, two soda machines out front, and its toy Fire Department, community playground out back. After many miles we veer onto Eddy Grade.

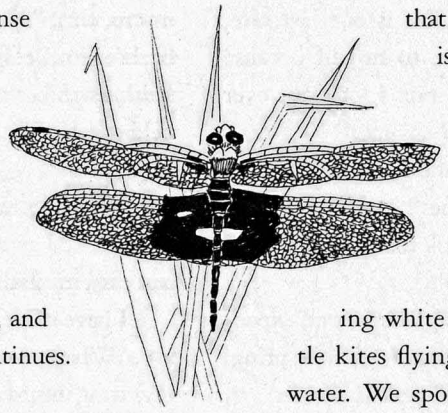
Although the maps call Eddy Grade an "improved road," it is sandy dirt and pitted with potholes. Frequently it is eroded by troughs of tannic water, created by overflowing swamp on either side. The full ditches are big enough to be called creeks. Now most of what we're passing through is Forest Service land that is not forest at all, but cutover pineland replanted in rows of slash pines, all about 12 feet tall.

"This was a recent acquisition," Will says.

"It has been logged many times," Larry says. By 1898

wax myrtle, pen-and-ink by Raven Burchard

the railroad connecting Valdosta, Georgia to Jacksonville, Florida was completed, and areas between Okefenokee and Pinhook were logged for the first time at the turn of the twentieth century. The view from the train then, I have read, was a landscape of stumps. Intense logging was taking place deep in Pinhook Swamp in the 1930s. It has continued to this day, since the landowners of Pinhook have been timber companies. Pinhook was company land. An industrial landscape superimposed on a rare wild one.



"Timber companies wanted to log, sell, and get the hell out of the lowlands," Larry continues. "We want to help them get out."

After some time we turn again onto a sodden road barely wide enough for the vehicle and drive out into the swamp along a tram, built to haul logs out of Pinhook. It is straight as a Southern Baptist deacon. The tram has not been used recently enough to wear tracks in the brown grass that grows along it, now waterlogged, nor to keep the flanking vegetation at bay.

A Suwannee cooter drops off a log protruding from a shallow pond.

"A turtle!" Will exclaims. "Did you see that?"

FRAGMENTATION IS THE *separation of habitat in a landscape. It means chopping a wild place into pieces, or slicing bites off its edges, or putting a road or other divider through the heart of it so that it becomes a conglomerate of smaller, less functional pieces. In simple math, fragmentation is long division.*

Fragmentation usually proceeds along a continuum that ranges from intact, functional habitat, to a fragmented forest, then an archipelago of forest-patches in a sea of development, and finally to a single isolated piece of natural habitat desperately salvaged. We see fragmentation mostly from airplanes. Fly over Orlando or Anchorage or Pittsburgh or Mexico City and you will see landscapes broken and pierced, so much so that almost none of them remain as they were. Flying over British Columbia, where logging is intense, the primeval forest, kept wild and unbroken until so recently, is down to naught in places. Double ought. Even flying at 20,000 feet the clearcuts are mammoth pocks.

"You've heard of greenbelts?" asks Larry. "Greenbelts make most folks happy. People want what they call 'open space' in urban areas, such as rails-to-trails, riverwalks, small parks. Pinhook is not a greenway. This is one large, functioning ecosystem, unparalleled in the Southeast."

"Corridors of the last resort," I say.

He pauses, and turns in the front seat enough that I can see his devilish grin. "A greenway is to a wildlife corridor what a Venetian is to a Venetian blind," Larry says. "This is habitat."

We're motoring slowly enough to hear a pig frog calling, *oink oink*. Duck potato, a native perennial, spears up through the ditches, blooming white triangles with yellow centers, like little kites flying on green tethers above the popping water. We spook a great egret. We see a slate-blue bird looking for an easy meal in a shallow pool. Larry calls it a "B.B. Kingbird."

"They're singing the blues," he says. It's a little blue heron.

Really, not many birds are flying and singing, since migration has not fully begun. But it's spring now and the songbirds will be coming back from even-more-southerly parts, hauling the sun on their backs. Pinhook has been designated an "Important Bird Area" by the American Bird Conservancy.

I spy an unusual patch of spangle far ahead on the tram, a quarter mile away. We journey toward it, slowly, on account of the state of the path. "Is that a deer?"

How many times have I longed for eyes of kingfishers, clarity despite distance, able to see minnows in the cloudy tides of salt creeks? Or for those of wild turkeys, that know which speck in the heavens is a hawk and not a buzzard? I rely deeply on binoculars. They are difficult to focus in motion but I bring them up now. It *is* a deer. Closer, we are able to ascertain, unaided, a doe's blurry outline blending with brush. She waves her flag of peace and disappears off the road. Wherever she is, her hooves are wet, and she presses greenery apart to make room for her body.

Will cuts the engine and disembarks. We pile out into the bright, early-spring sunshine, four people unleashed in an unscrolling, unbridled wilderness, onto one contiguous mat of green and water. The sunshine is not yet saffron, not even full lemon yellow, but a weak colorlessness, as if the Carolina jessamines extract most of the available gold from the air.

Will has been quiet so far, absorbed in driving and in his search for wildlife. He has answered any question I've asked, but has volunteered little to no information on his own. In open air, he transforms.

black-mantled glider, pen-and-ink by Raven Burchard

"This is the heart of the Pinhook," he announces grandly. He gestures excitedly, master of ceremony. "This is what Pinhook is all about." He becomes charged, buoyant, even oratorical. "It's functional. It's intact. The processes and structure are here as they should be. This is one last rare, intact, functioning ecosystem." I smile to myself because Will's argument sounds like a verse of rap. I look out over the forgotten pocosin.

"I love this place because it's not the Everglades," Will says. He bounces a few steps and stretches his arms wide. "It doesn't need to be restored." He gets a look that says, *That's all there is to say, really.*

Pinhook reminds me too of the Everglades—wet, expansive, savanna-like. I can see that the land, at least this spring, is one flowing sheet of water, like the Glades. The water moves east, I will learn, toward the Middle Prong of the St. Mary's River, which pours out its banks across the shady, lovely, palmetto-and-wild-azalea bottomlands, joining sheets of water. The water travels through the pine flatwoods like it hasn't done in at least a decade, with the cleansing avail of flood.

But Will is wrong. Pinhook does need restoration. Maybe not here, where the shrub-bog is intact, but to get here we have driven through miles of unnatural pine plantations, planted on raised beds of dirt. All that, the body of Pinhook, will have to be returned to the way it was.

Here in the heart of Pinhook the principal groundcover is a head-tall snarl of shrubs, instead of the sawgrass of the Glades. I climb atop the Jeep for a better look. Around us the vegetation—titi and myrtle and fetterbush and gallberry—is broken occasionally by a slash or a pond pine. Pond pines are new to me. They retain needles much further down their trunks than other pines. They're scrawnier, shorter. The sky is wide open, full of clouds, uninterrupted by power lines, buildings, and billboards, waiting for a painter. Larry has spotted a mockingbird.

"Mockingbird? I can see one of them in a parking lot," I tease him from the vehicle roof. "Where are the sandhill cranes and the wood storks?"

"I wish I could call them up," he replies. "But they're here, even if we don't see them."

Pinhook Swamp is serenely beautiful in an aloof kind of way. It's like a whale, so ancient and so colossal and so fulfilled by its own life that it cares nothing of yours. Pinhook does not sweep out its green arms to embrace you. It doesn't even look your way, though you turn and marvel and ooh and click your camera this way and that: more or less sky, trees framing the distance or taking center stage, more or less light. In the macro, time-lapse field of blindness, the white fists of fetterbush open. Bees lick pollen off the five stamens inside a jessamine's throat. Tongue of sundew closes around a gnat. A field of water flies eastward.

I HAVE BEEN writing as if to suggest that all of Pinhook has been tucked away inside a safe deposit box, and now we can rest easy, assured our retirement is secure.

I have misled you.

"When you say Pinhook Swamp, people either have never heard of it or they say, 'Oh, that's been saved already!'" says Larry. "It hasn't been saved. We have a contiguous corridor, but we figure only 70% of the area has been protected."

"Once you get 70% saved, between state and federal ownership," Larry continues, "the danger is, you think, 'This is wonderful' and you quit. You say, 'I'm so far ahead I'm going to take a rest.' You say, 'We've got over half. Let's not worry about the other half.' No. We have to worry about the other half. Pinhook is still easily purchasable. This is not hundreds of landowners. Only a few. Now's the time to buy it, while it's still relatively uninhabited."

I don't interrupt him. "I admit, this is a lofty goal," he says. "We have the chance here to do something really grand. Are we going to let this area die the death of a thousand cuts?" Larry is full of proverbs. "One more, one more, one more? No, let's protect one more, one more. The way to eat an elephant is one bite at a time."

I gaze around and around and around, then look back at Larry. He is focused far out in the distance, toward the scribbled horizon.

What can I know of Pinhook? Few have explored or studied this nether-country. There is little we can read about it. Visitors and locals have forayed into it, prospecting or moonshining or hunting or looking for lost dogs, but none have approached the heart of Pinhook Swamp. Neither can I. I can see it with my eyes, from the vantage of a car-top along a tram. I can hear its flies buzz and its red-bellied woodpeckers pound against fire-dead pines. But I can go no farther. I must stand, gazing at the tangled low-country, and

lizard tail, pen-and-ink by Raven Burchard

know it to be the unknown: a land yet of secrets, a place untamed. It is a continent beyond us.

PUTTING A LANDSCAPE *back together is a lot like doing a big jigsaw puzzle. For a landscape, though, you can't draw a rectangle on a map and start filling in from the edges. Restoration is more arbitrary. You start with what wildland you have. Then you look for spare pieces scattered about, that match what you already have. If one fits, you plug it in, and then find another with the same thread of stream, and another. Breakfast Branch. Run Swamp. Moorehead Bay. Moccasin Swamp. Middle Prong of St. Mary's River. Until you begin to see the shapes of the missing pieces, and you search for those shapes.*

The more pieces in a puzzle, the more fragmented a place, the harder to put it back together. In the case of Pinhook, the pieces have been large, and there aren't many of them, so the puzzle has been relatively easy, an intermediate puzzle. Easier, say, than reconstructing the tropical hammock that was the Florida Keys.

You connect one axis, until you build a wildland bridge. You close a gap. Then you fill in the rest of the frame. Piece by piece, the puzzle is assembled, reassembled, until it forms a picture.

Later, other pieces you didn't even remember were missing will come. Naturally. The trees every year grow taller and wider. The roads heal over. Ditches erode and fill. Fire returns. More land gets added along the sides, buffers and wildland and corridor. Songbirds rebound. Black bears reterritorialize.

The picture grows more beautiful.

Total, to date, 120,000 acres of Pinhook Swamp have been placed in public ownership for safekeeping.

When completed, Okefenokee Swamp to Osceola National Forest—O2O—will become the largest protected wildlife corridor east of the Mississippi. Give me a moment here to applaud, to whoop and holler, to skip out from behind my writing desk and do a little dance in the study.

I'd like to get to the middle of all that ground and lay down and rest awhile. ☾

Janisse Ray *grew up in a Georgia junkyard where she learned to love the vanishing longleaf pine ecosystem, a tale told in her award-winning book,* Ecology of a Cracker Childhood. *This essay is adapted from her forthcoming book,* Pinhook: Finding Wholeness in a Fragmented Land *(available from Chelsea Green Publishing, April 2005, www.chelseagreen.com). A naturalist, environmental activist, and winner of the 2002 All Georgia Reading the Same Book Award, she now lives in Vermont.*

Web

In sight of the cabin,
under brush by the path,
lies the carcass of a gray fox
devoured by maggots.

Brushing over the path,
swallows sweep for flies
spawned by the maggots
from rotting fur plush.

Swallows sweep for flies
over blackberry tangle
hiding rotting fur plush.
Blood waters the ground.

Roots suck in the tangle,
under violet and sumac.
Blood waters the ground
where moles blindly burrow

under violet and sumac,
leaving telltale trails
as blindly they burrow
searching soil for earthworms,

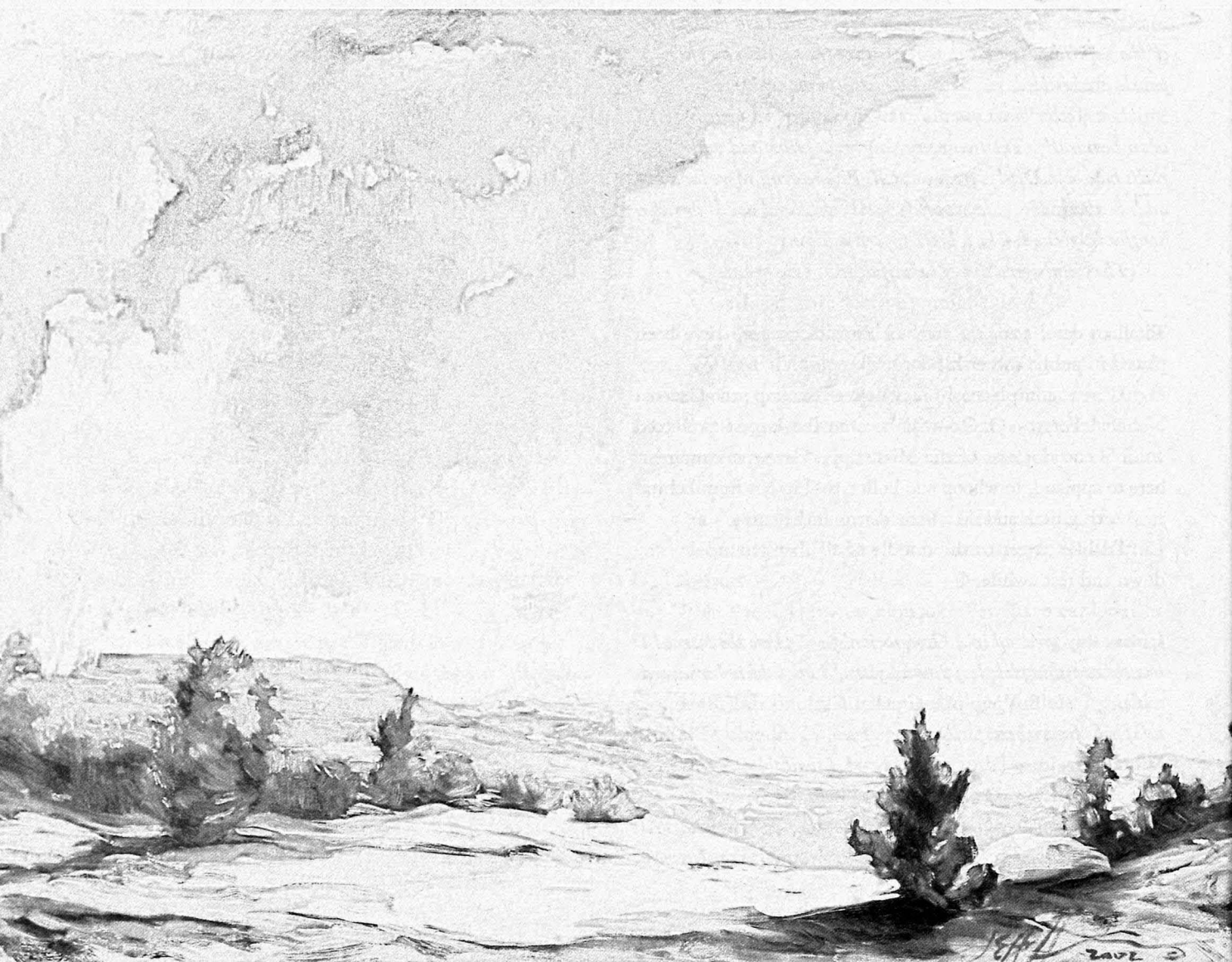
the web of their trail
torn open by a gray fox
showering soil with earthworms
in sight of the cabin.

Susan Edwards Richmond

ECOLOGICAL SECURITY ON THE BORDER

A Day of Reckoning for Wildlife Linkages Between the United States and Mexico

by Kim Vacariu



MILES OF FENCING, solid steel walls up to 15 feet high, all-night stadium lighting, multiple-layered vehicle barriers, an immense network of newly bladed roads, a 24-hour flow of patrol vehicles (including ATVs), constant low-level aircraft overflights, and foot patrols—all designed to curtail human travel—are also combining to create the ultimate barrier to wildlife movement in the U.S.-Mexico borderlands of southeastern Arizona and southwestern New Mexico.

One of the greatest challenges now facing conservationists is finding a means to protect cross-border wildlife linkages in this globally significant ecological region. The magnitude of the fragmentation threat facing this international habitat—which bridges the mountain ranges of northern Mexico's Sierra Madre Occidental with those of the Sky Islands on the U.S. side of the border—is difficult to imagine and even more difficult to address.

The fact of the matter is that connections between the Sky Islands and the Sierra Madre may well be the most endangered wildlife linkages on the continent. The current effort by the Department of Homeland Security and the U.S. Border Patrol to seal off the border as quickly as possible to protect against an increasing flood of undocumented immigrants is the primary force behind this unfortunate distinction.

If existing and proposed security infrastructure is maintained and built-out as planned, there can be no wildlife-friendly crossing structures, no conservation easement–protected open space corridors, no effective habitat mitigation plans, and no consideration for federally listed species. In short, these usually reliable conservation tools are being rendered useless by the overriding federal goal of stemming the flow of undocumented immigrants into the U.S.

Building such an unforgiving barricade through the heart of the Sky Islands–Sierra Madre region is painfully ironic. The Wildlands Project, the Nature Conservancy, and the World Wildlife Fund have each published independent conservation plans and maps for the region that come to similar conclusions: for sheer breadth of biodiversity there are few other places in North America that even come close.

The Wildlands Project's collaborative effort to define a healthy conservation future for the region—the Sky Islands Wildlands Network (SIWN) Conservation Plan—places strong importance on the preservation of wildlife linkages between protected areas to ensure that regional species, like jaguar, black bear, ocelot, Mexican gray wolf, cougar, pronghorn, and others, can continue to inhabit and move through their traditional habitat and range.

Although the SIWN design area terminates at the U.S. border, the plan's wildlife linkages are intended to seamlessly mesh with corresponding linkages in the proposed Sierra Madre Occidental Wildlands Network in northern Chihuahua and Sonora, Mexico. This vision for cross-border merging of conservation plans presumes that neither can reach its potential unless wildlife linkages allowing focal species movement between the ranges of the Sierra Madre Occidental and the Sky Islands are maintained. Due to the threat that border infrastructure now poses to large-scale conservation planning and survival of native wildlife, the Wildlands Project last year identified the Sky Islands borderlands as one of five wildlife linkages most at risk of being lost along the chain of the Rocky Mountains from Canada to Mexico.

Disruption of wildlife movement between northern Mexico and Sky Islands habitat in the U.S. presents serious survival challenges to jaguar, ocelot, black-footed ferret, southwest willow flycatcher—all federally listed as endangered species—and other regional species that are in decline. Cross-border wildlife linkages with a high potential for use by these fast-disappearing species include the Peloncillo Mountains–El Berrendo region; the San Bernardino National Wildlife Refuge–Sierra San Luis corridor; the San Pedro River corridor; the San Rafael Valley–Sierra San Antonio region; and relatively undisturbed Mexican habitats connecting to Coronado National Memorial, the Patagonia Mountains, the Pajarita Wilderness Area, and the Buenos Aires National Wildlife Refuge. Some of these linkages continue to remain highly intact, largely roadless landscapes, yet they lie directly in the path of ongoing or proposed border security projects. Many other linkages are already fully barricaded or fenced.

For a glimpse of the immediacy with which protection of these linkages must be addressed, look no further than the border security projects being proposed. In October of 2004, the U.S. Bureau of Customs and Border Protection released a second version of a previously withdrawn Draft Programmatic Environmental Impact Statement (DPEIS) for a massive borderlands security infrastructure project across southern Arizona. Through various means—including up to 150 miles of 15-foot-high solid steel walls, 1,000 stadium-style all-night lighting installations, up to 100 miles of additional fencing and other barriers, and the building of dual 10-foot-wide roads along the entire border—that project would impact virtually all of the agency's 280-mile Tucson Sector border in southern Arizona.

"Cedar Mesa," oil by Joan Hoffmann

Review of this DPEIS makes it clear that ecological concerns related to construction of security infrastructure are not a priority for the Border Patrol. The DPEIS, with a public comment deadline of January 29, 2005, provides little documentation of negative environmental impacts, and ignores specific effects of infrastructure development on critical cross-border wildlife linkages.

Previous to release of the DPEIS, the agency has been avoiding the EIS process completely through the use of Environmental Assessments (EA) covering much smaller project areas, most of which duplicate individual components found in the original DPEIS, withdrawn due to thousands of critical public comments regarding lack of ecological information. Some of these EAs, which require less rigorous justification than EISs, have moved rapidly through review, and projects are now being implemented with little or no public comment.

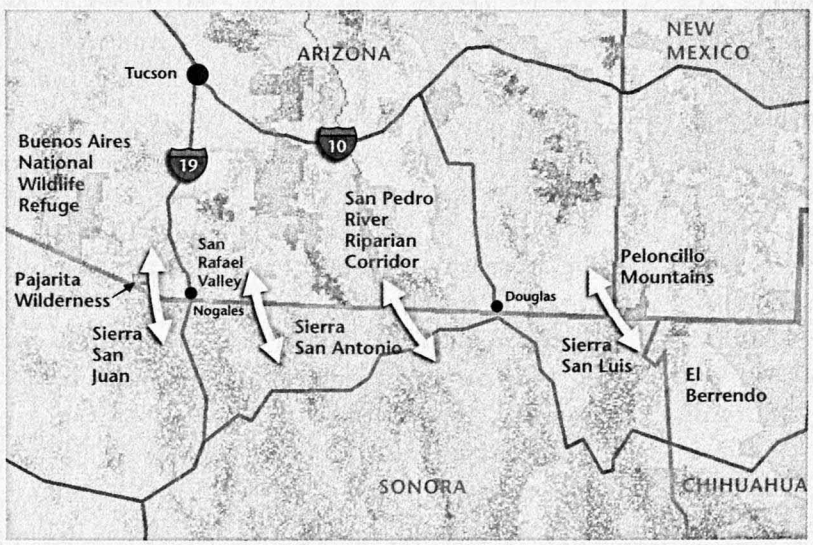
This fast-track approach concerns many conservationists. According to Jenny Neeley, Southwest Associate for Defenders of Wildlife in Tucson, "The agency has become increasingly unaccountable for its actions. Despite the undeniable adverse environmental impacts of its projects, the Border Patrol has systematically failed to comply with fundamental environmental protections, including those outlined in the National Environmental Policy Act, Wilderness Act, National Wildlife Refuge System Administration Act, Endangered Species Act, Clean Water Act, and National Park Service Organic Act. The limited environmental analysis that has been conducted has occurred only on a piecemeal, rather than a comprehensive, basis. As a result, the full extent of the Border Patrol's ecological impacts along the U.S.-Mexico border has never been revealed to the public."

At the same time, evidence that border security infrastructure can disrupt wildlife movements and threatens species survival is building. Researchers and scientists are finding specific linkages and identifying species that are at risk from Border Patrol activities.

The Northern Jaguar Project (NJP), an organization working to conserve the northernmost viable population of jaguars just south of the Arizona border in Sonora, Mexico, is using photographs and sign of several jaguars that researchers and hunters in southern Arizona have collected over the past few years to help document the dispersal range of the Sonora population. Based on this evidence, NJP's Rick Williams believes protecting cross-border linkages is essential, "if the jaguar is ever going to re-colonize any of its former range in the United States." Williams worries about the effects of Border Patrol activities on the endangered cats. "Fencing, high-intensity lighting, and high-speed patrol traffic along the border would be devastating to the jaguar's movements north," he says.

Further evidence of the need for protecting borderlands linkages is presented by ethnozoologist Steve Pavlik, who studies black bear in southern Arizona. His recently published paper, "*Ursus* in a Sky Island Range: The Ecology, History and Management of Black Bears in the Huachuca Mountains," indicates that bears often travel between the U.S. and Mexico. "Bears are believed to have historically used the San Pedro River as a riparian corridor to travel safely to mountain ranges south in Mexico," writes Pavlik, who also points out that black bears will travel long distances to search for food, particularly during drought conditions. Pavlik notes that a female black bear euthanized in Patagonia, Arizona, in 2000 had an ear tag of Mexican origin, providing more evidence of cross-border movement.

The U.S.-Mexico border may also present a challenge in the conservation and management of the Chiricahua leopard frog. According to Trevor Hare, a conservation



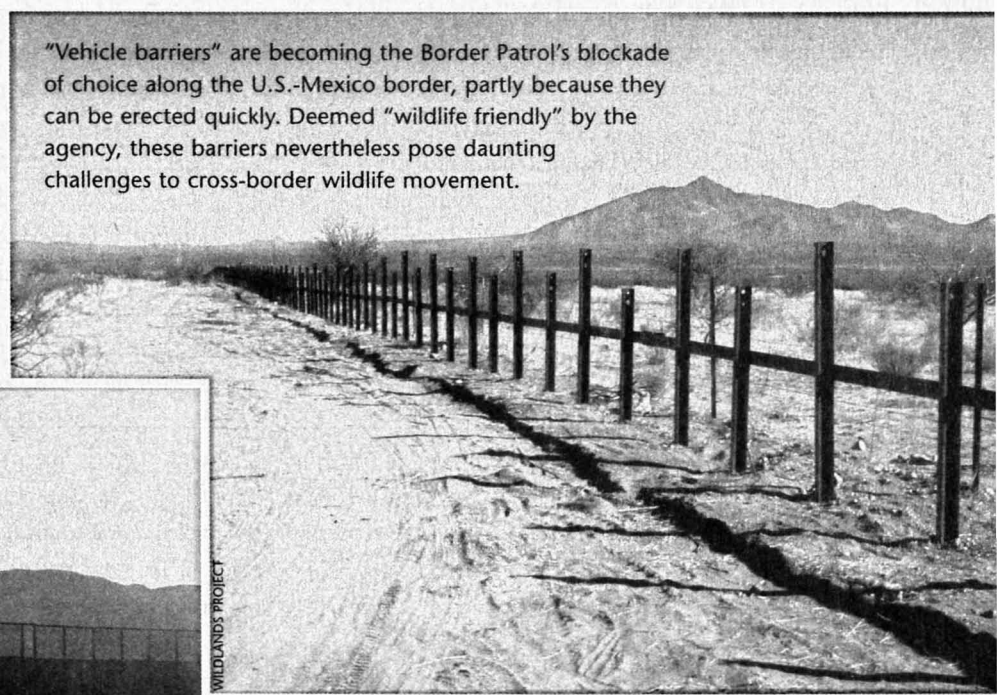
Some of the most important wildlife linkages (white arrows) connecting the Sky Islands of southeastern Arizona with the ranges of northern Mexico's Sierra Madre are now seriously threatened by proposed border security infrastructure projects.

biologist with the Sky Island Alliance currently studying frog populations in Arizona's San Rafael Valley just north of the U.S. border, security infrastructure is "probably impacting frog conservation and management...by interfering in dispersal of frogs and disruption of their meta-population structures." Hare notes that although frog populations exist on both sides of the border there is evidence that the southern population is "doing much better." This could be related to a number of habitat disturbances, he says, including Border Patrol activities.

Perhaps the most telling indication that ecological concerns relating to Border Patrol construction projects are valid comes from a surprising source. A soon-to-be-published paper prepared by Border Action Network—a Tucson-based human rights, civil liberties, and environmental protection advocacy group focused on Arizona-Mexico border issues—quotes the Bush administration's Secretary of the Interior, Gale Norton, often reluctant to voice environmental concerns, as stating, "I'm troubled by the whole concept of having to put a fence at the border, especially when you're talking about something that could impact wildlife being able to migrate in their usual patterns."

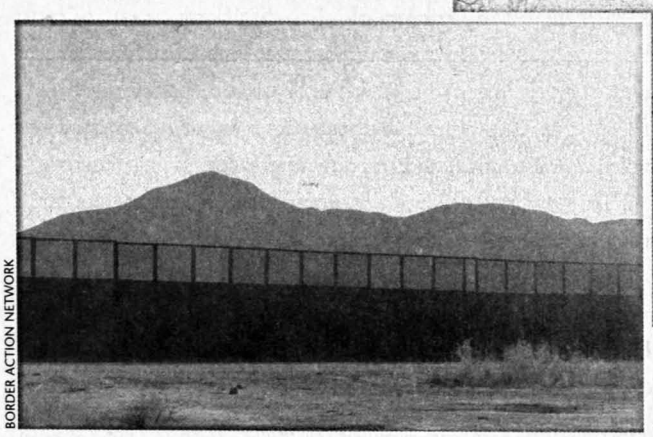
Unfortunately, mounting evidence of negative impacts to wildlife linkages along the borderlands continues to go unheeded by the agencies. Neither the Bureau of Customs and Border Protection (BCBP) nor other public or private entities have completed conclusive scientific research into the effects of border infrastructure on native plant or animal communities in the Sky Islands region. Nevertheless—in response to the federal government's decision to quickly complete border security projects—the BCBP continues to implement new infrastructure and policy through the use of EAs, and more recently through internal administrative orders from the Department of Homeland Security.

The Border Patrol's "Arizona Border Control" (ABC) initiative, quietly implemented without public review only a few weeks after it was announced in early 2004 by the BCBP, provides one example of how these fast-track projects will likely move forward. The ABC initiative grants the Border Patrol immunity to a number of existing environmental restrictions in protected Sky Islands habitat areas, including the Pajarita and Miller Peak Wilderness Areas, the Baker Canyon, Bunk Robinson, and Whitmire Canyon Wilderness Study Areas, and the San Pedro Riparian National Conservation Area. The relaxed restrictions would allow the Border Patrol increased off-road vehicle pursuit of undocumented immigrants on trails within those protected areas—activities that can further fragment key



"Vehicle barriers" are becoming the Border Patrol's blockade of choice along the U.S.-Mexico border, partly because they can be erected quickly. Deemed "wildlife friendly" by the agency, these barriers nevertheless pose daunting challenges to cross-border wildlife movement.

WILDLANDS PROJECT



Miles of solid steel barriers, like the one shown here near Naco, AZ, are already in place along the Arizona-Mexico border. Once installed, these barricades permanently block cross-border wildlife linkages.

BORDER ACTION NETWORK

wildlife corridors, and that could also lead to further dissolution of Wilderness Act regulations if left unchallenged.

Quickly and easily constructed "vehicle barriers" have become the Border Patrol's tool of choice in roadless terrain, with installation often occurring at the rate of miles per week. The Border Patrol promotes these barriers—consisting of vertical beams, posts, or rail segments connected horizontally by a second continuous rail, with horizontal strands of barbed wire above and below that rail—as wildlife-friendly simply because they are not solid walls. Vehicle barrier construction also requires construction of access roads alongside the barriers, and often leaves pre-existing secondary barbed-wire fencing in place, creating a double barrier. New roads can often fragment a wildlife linkage, and with an estimated 2,000 Border Patrol agents driving hundreds of patrol vehicles along more than 1,000 miles of such roads—around the clock—this alone could end cross-border movement for sensitive species like jaguar and ocelot.

The number of high-rise, all-night stadium-style and portable generator-style lighting installations along the border, many up to 1,000 watts, continues to increase. Although conclusive studies on the effects of all-night artificial lighting on bird, reptile, fish, and other animal behavior are not yet available, biologists believe that such illumination causes unnatural nocturnal activity for migrating birds, including disrupted rest cycles, collisions with light poles, and increased predation activity by a variety of other species.

Considering the BCBP's expedited approach, short public comment deadlines on proposed projects, and the attendant consequences for wildlife habitat, conservationists are faced with a fast-closing window of opportunity in which to scientifically document the threats to borderlands ecosystems posed by security infrastructure. Without this information, much-needed construction guidelines and recommendations for incorporation of wildlife-friendly alternatives in border security projects cannot be easily produced.

Research recommendations

If threats to cross-border habitat connectivity are to be properly mitigated, new research must be conducted and existing science documenting the environmental effects of proposed border security projects must be developed. In March of 2005, the Wildlands Project and Defenders of Wildlife will sponsor a "Border Ecological Symposium" to identify existing science, launch new research efforts in areas where data is lacking, and create a set of ecological guidelines for future security infrastructure projects. Research efforts could include:

- Impacts of fencing, walls, and other barriers on the movements and behavior of wide-ranging species.
- Locations of key cross-border routes currently used by various wildlife species.
- Potential increases in distribution of invasive plant species spread through the blading of previously undisturbed natural areas, and through vehicle transport.
- Environmental impacts and anticipated legal problems relating to proposed security infrastructure and operations within national conservation areas, national monuments, national parks, wildlife refuges, and wilderness areas.
- Effects on plants, animals, and fire regimes due to increased access by recreationists and hunters using newly constructed border roads.
- Impacts of all-night stadium lighting near watercourses, water bodies, and riparian areas on predation of fish and other aquatic species.
- Impacts of all-night stadium lighting on bird migration.
- Impacts of noise from equipment, regular vehicular traffic, and aircraft overflights on sensitive animal species.
- Effects of immigrant travel, such as trash, water hole encampments, and human waste, on habitat quality and focal species.
- Impacts of increased off-road motorized access by Border Patrol in federal protected areas on plants and wildlife, and associated legal precedents leading to further reduction of environmental regulations.

Socio-political recommendations

The challenge of maintaining undamaged wildlife linkages along the U.S.-Mexico border is particularly vexing because the long-term solution to borderlands fragmentation depends as much on socio-economics and international politics as on the science of conservation biology. There is little, if any, disagreement among conservationists that border security must be maintained. However, there is widespread disagreement over the best means by which to maintain that security. Add to this mix the new challenge of protecting cross-border wildlife movement, and the debate grows.

Prevention of illegal immigration through means other than construction of barricades could be achieved over a relatively reasonable period of time through earnest, creative immigration reform and economic cooperation between the U.S. and Mexico. However, the juggernaut of terrorism could easily dictate that even if immigration-related problems were largely eliminated through international diplomacy or new

immigration reform legislation, political pressure to maintain a physical barrier will likely remain. Considering the extent of current security infrastructure and the rapid pace of new barricade construction, conservationists should logically assume that successful immigration policy reform, if ever enacted, may not occur in time to offer a respite for cross-border wildlife.

The situation dictates that reforming immigration policies alone cannot be counted on to halt wildlife linkage fragmentation. Rather, focus and action must be immediately placed on a more urgent list of wildlife protection options:

- ➢ Work to legally uphold the provisions of the National Environmental Policy Act, the Wilderness Act of 1964, the Endangered Species Act, the Refuge Improvement Act of 1997, and the Clean Water Act, and oppose suspension of such laws in the borderlands region.
- ➢ Submit public comments whenever new environmental assessments or impact statements for border security projects are released by the BCBP, Border Patrol, or Department of Homeland Security.
- ➢ Encourage expanded use of technology that could help secure the border without additional fencing, including unmanned aerial vehicles, electronic ground sensor systems, remote video cameras, and surveillance aircraft operating at reasonable altitudes.
- ➢ Advocate strong protection from off-road travel and construction activities in existing roadless areas along the U.S.-Mexico border, including wilderness areas, national monuments, national parks, national wildlife refuges, and other protected conservation lands.
- ➢ Promote wilderness designation or other strict administrative protections for existing roadless areas contiguous with the border.
- ➢ Document the effects on wide-ranging wildlife of border security infrastructure occurring within or across international wildlife linkages.
- ➢ Legally challenge border security activities and policies that violate existing federal and state environmental laws.
- ➢ Determine the scientific compatibility of various fencing structures with wildlife permeability.
- ➢ Advocate for vehicle barriers that do not include cross-fencing with barbed wire or horizontal rails, and for elimination of solid barriers wherever practicable.
- ➢ Support the U.S. Border Patrol, BCBP, and Department of Homeland Security whenever these agencies incorporate wildlife-friendly components in border security construction projects, or refrain from blocking existing wildlife linkages with new infrastructure.
- ➢ Support new immigration reform policies that result in the majority of immigration occurring legally through established ports of entry.

IT IS LIKELY THAT, without relentless pursuit of new biological research and ecological advocacy regarding the protection of borderlands wildlife linkages, the survival of many regional species, both endangered and otherwise, will reach a day of reckoning in the near future. In order to achieve a positive outcome for wildlife, conservationists must not only continue to operate within their familiar realm, but also embrace the unfamiliar challenge of advocating for the social and political reform that lies at the heart of the solution to the borderlands immigration and security dilemma. ☾

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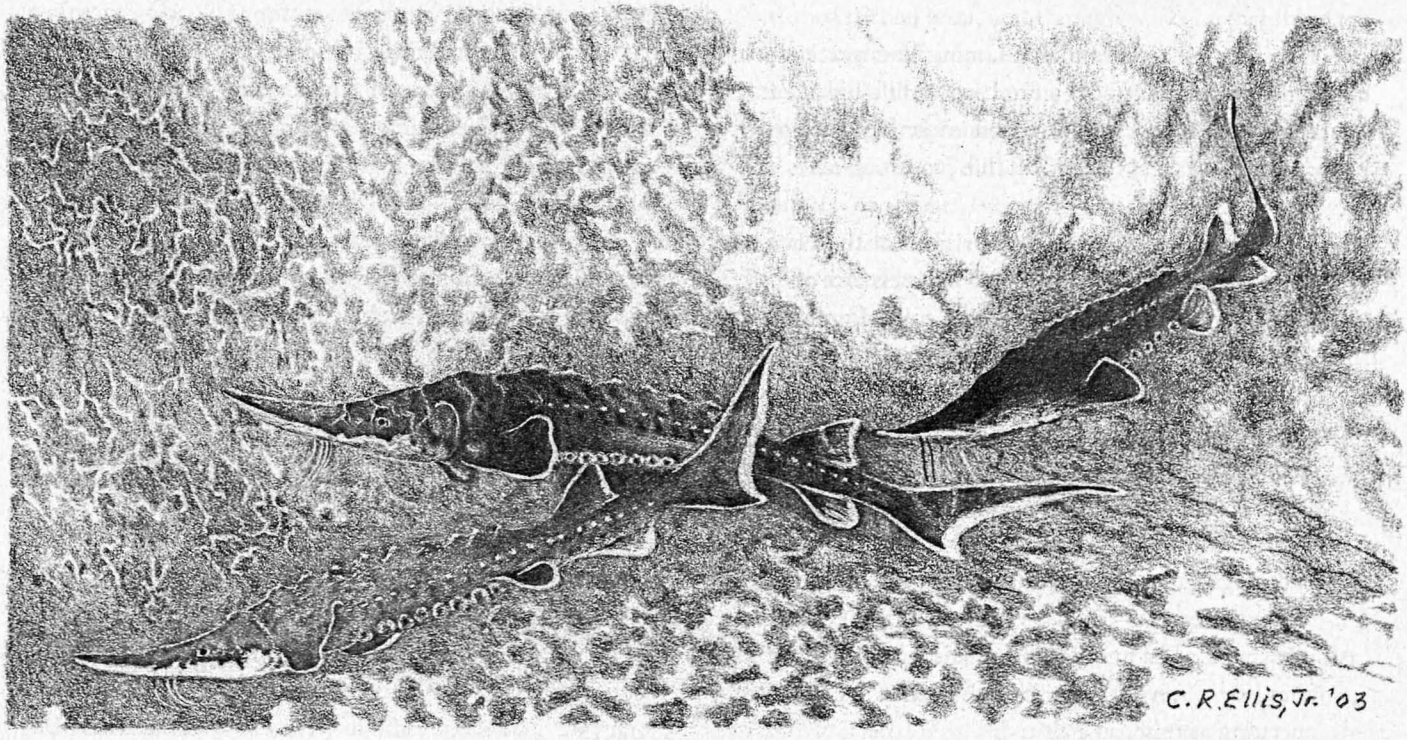


The Army Corps of Engineers counts some 75,000 dams on its National Inventory of Dams. This means that we have been building almost one dam a day, every day, since the Declaration of Independence (as noted by former Secretary of the Interior Bruce Babbitt). But the nation's dam building peaked in the 1970s, and according to the World Commission on Dams, since 1998 the rate of decommissioning dams in the United States has overtaken the rate of construction.

Today, two or three generations after the building of the nation's largest dams, the cost of this extraordinary engineering is acutely apparent. In some rivers, species of fish once so numerous as to be legendary are on the brink of extinction. In others, invasive exotics threaten native species. Deltas have been starved. And relying on dams for large-scale water storage and to deliver water to places where it does not naturally occur can have long-term effects on the balance between groundwater and surface water, and on the quality of the surrounding soil. Changing river and climate conditions have rendered some dams ineffective. Many aging dams have fallen into disrepair

young sturgeon, graphite by Bob Ellis

WATER
Reconnecting American Rivers
OVER
through Dam Removal
DAMS

by Elizabeth Grossman

and become safety hazards. Many cost more to operate and maintain than they generate in revenue.

With dams we have tried to mold rivers to suit human purposes. Americans are learning—at great cost—that rivers don't work that way. Rivers reach farther and last longer than perhaps we can imagine. And they are the arteries of a watershed; no land can be considered truly connected when its rivers are stopped.

ACCORDING TO THOSE who have been keeping count—primarily American Rivers, Friends of the Earth, and Trout Unlimited—close to 500 dams, and perhaps more, have been removed in this country since 1912. Well over 250 dams have been removed in the last 20 years. As of January 2000, dams had been removed and removals planned in over 40 states and the District of Columbia.

Communities across the country are now scrutinizing the efficacy of their dams in comprehensive analyses of ecology, economics, energy efficiency, water conservation, and public health and safety. They are identifying marginal and abandoned dams and questioning the relicensing of dams whose environmental and social impacts are too costly. Slowly, we are relearning what a river is and how to live with one.

And despite the Bush administration's campaign in the Pacific Northwest—with lawn signs that read "Save Our Dams"—and tight budgets everywhere, dam removal efforts continue to progress. As communities discover that dam removal reconnects a river, can enhance local quality of life, and often makes good economic sense, the rate of removal is accelerating. Since the end of 2000, over 100 dams have been removed or are scheduled for removal.

Some highlights...

In October 2003, the removal of two dams and the decommissioning of a third on the Penobscot, Maine's largest river, were announced. This will open 500 miles of river to endangered Atlantic salmon and other sea-run fish.

And it was in Maine, in July 1999, that the Edwards Dam, built across the Kennebec River at Augusta in 1837, became the first operating hydroelectric dam in the nation to be removed, opening a new future, not just for the Kennebec, but for rivers everywhere. In May 2000, I went to the Kennebec in hopes of witnessing fish history: to see the river's alewives—a native species of river herring—swim up a stretch of river to which they had not had access since the days when Henry David Thoreau wandered the woods of Maine.

The river had been dammed for so long, and for most of recent history had been so dirty that people who'd grown up around the Kennebec in the 1950s and '60s told me that in those days, "if you fell into the river, the first place they'd take you was the hospital." Many people were dubious about what good it would do to remove the dam. I got to see that first post-dam-removal spring run of alewives, and there were so many fish in the river it was hard to tell splashing water from fin. The alewives were followed by striped bass and later by sturgeon, which hadn't been seen in the Kennebec upstream of Augusta for nearly 200 years. The following winter, wild baby salmon hatched and swam in that newly freed stretch of river. With the dam gone, people have taken to the river as well, and once rarely spotted canoes and kayaks have become a common sight.

In her 2003 State of the State address, Montana's Governor Judy Martz—not known as an environmental advocate—declared her support for removal of Milltown Dam, which sits at the confluence of the Clark Fork and Blackfoot Rivers. The dam impounds a reservoir that, over the past century, has collected so much toxic sediment coming down the river from the mines at Butte and Anaconda, that it's now a Superfund site. For years, it's been leaching arsenic into the

adjacent drinking-water aquifer. Last April, the EPA released its plan for removing the dam as part of the Superfund clean-up. This is impressive considering that efforts to remove Milltown Dam began in earnest only about five years ago, when the county health commission, county commissioners, and other citizens joined environmental activists in calling for dam removal as an essential component of river restoration. A clean-up of exactly this kind has never been done before. It is an enormous and daunting project that's going to be undertaken because a community said: This can happen.

In Wisconsin, the state where more dams have been removed than any other, I canoed a bit of the Baraboo River. For most of the past 100 years there were four dams on the Baraboo. In 2001, the last of these dams was removed, making the Baraboo the longest mainstem of an American river now flowing freely thanks to dam removal.

In the central Wisconsin city of Merrill, a local family took me canoeing on the Prairie River, which, like the Baraboo, now—because of dam removal—flows freely for the first time in over a century. The residents of Merrill were bitterly opposed to removing the city's old paper-mill dam because it would mean the loss of a beloved millpond. That same community is now excited about the 99-acre riverside park—designed for quiet recreation, including paddling—that's being built around its newly restored trout stream.

In 1948, Aldo Leopold wrote in *A Sand County Almanac*, "It...seems likely that the remaining canoe-water on the Flambeau, as well as every other stretch of wild river in the state, will ultimately be harnessed for power. Perhaps our grandsons, having never seen a wild river, will never miss the chance to set a canoe in singing waters." Wouldn't he be gratified to know that some of these Wisconsin rivers are now being set free? And in February 2004, Embrey Dam was removed from the Rappahannock River in Virginia, allowing the Rappahannock to flow unimpeded from its headwaters in the Blue Ridge Mountains to its mouth at Chesapeake Bay. Plans have also been released for removal of the Matilija Dam on southern California's Ventura River in that will help restore the river to its now endangered native steelhead trout. Altogether over 50 dams are slated for removal in 2004.

IN A KAYAK, canoe, or raft, you learn quickly how much attention a river demands. You consider currents, stream banks, riffles, and rapids in a new light. Where a river comes from, where it goes, what shapes its flow, who and what lives along its shores takes on a new meaning. To be on a river is to learn its story, to feel it pushing from headwaters to the sea. As Roderick Nash said, rivers "can be managed, but not controlled." Increasingly, Americans are seeing the value of managing rivers as wild, free-flowing corridors for fish and other wildlife.

Where I live in the Pacific Northwest, nearly everyone has partaken of a river by eating salmon. I thought about this on a beautiful spring evening when friends had invited me to dine on wild chinook salmon caught by and purchased from tribal fishers in the Columbia River Gorge. It may have been the light or soft air, but I remember thinking it was the best fish I had ever tasted. "Quick get the camera," a friend joked. "Environmentalists eat endangered species!"

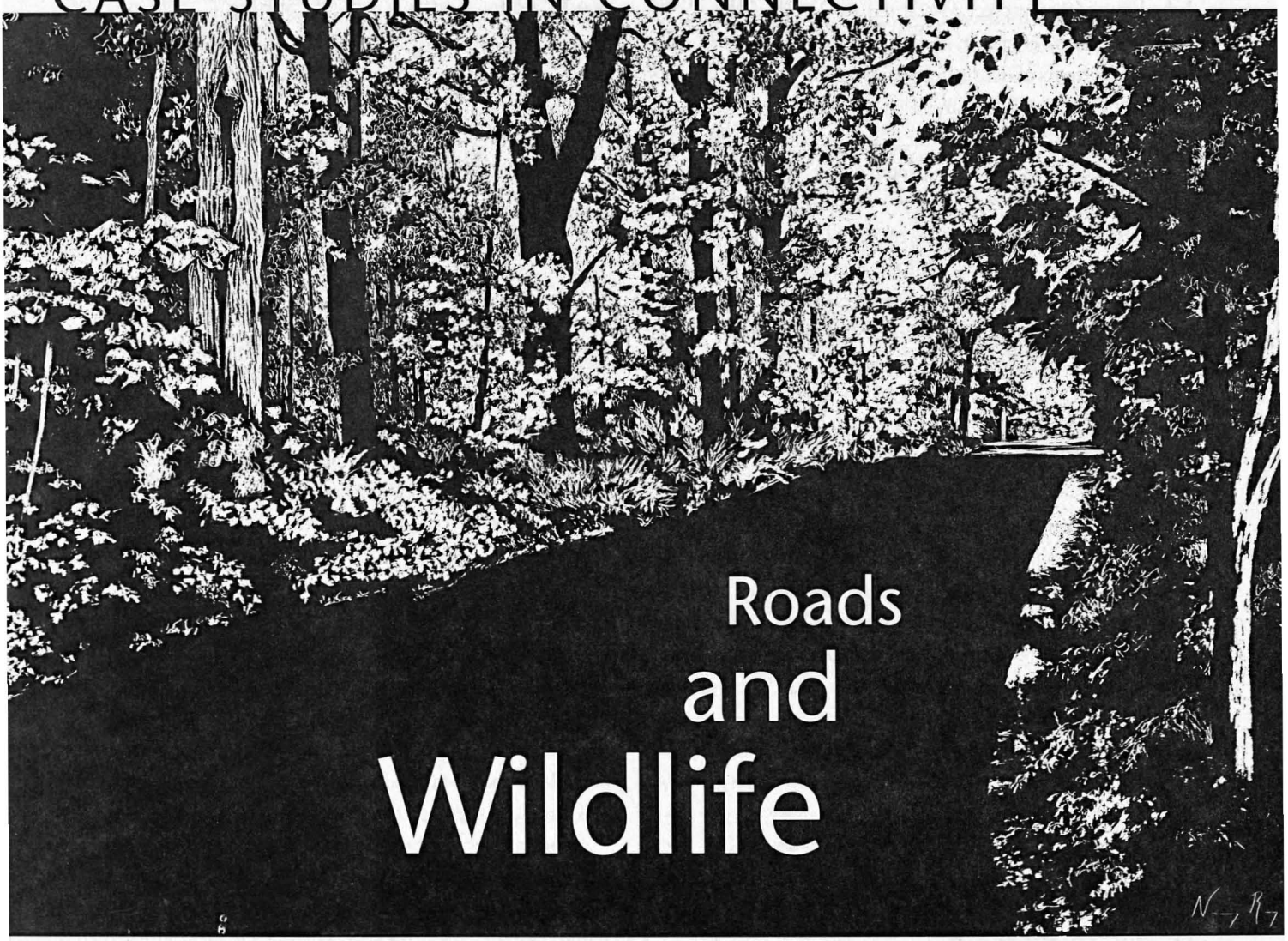
For a limited time each year—depending on guidelines set by NOAA Fisheries—tribal, commercial, and sport fishing are allowed on the Columbia. Some of these fish may be wild. Tribal fishers sell their catch directly to the salmon-hungry from coolers in the back of pickups at specified locations along the lower Columbia.

Most hatchery fish are marked by a clipped adipose fin. Our fish's fin was whole, so it most likely began life in stream-bottom gravel rather than in a cement pond. I wondered what its journey to the ocean was like. Our fish was caught near the Dalles Dam so it had to negotiate at least one dam on its way to and from the sea. But had it traveled by barge or truck? Had it climbed fish ladders or dodged churning turbines? Or had it swum freely in a push of spilled water?

Should we be eating this fish at all? Maybe not. But in this era of industrial food, there's an argument to be made for eating wild fish. A Native American friend assures me that a "harvestable surplus" is the tribal goal for restored salmon runs and that the tribes consider harvest a completion of the salmon's life cycle. I thought about how good this fish tasted. To know what wild fish taste like—what it's like to wait for their season—requires healthy and free-flowing rivers. If we allow our rivers to disappear and degrade so we can no longer eat their fish, we will have choked off one of the continent's life forces. Removing dams is an important step in restoring a watershed's vital connections. ☾

Elizabeth Grossman *is the author of* Watershed: The Undamming of America *and* Adventuring Along the Lewis and Clark Trail. *She lives a minute's walk from the Willamette River in Portland, Oregon. This piece is adapted from* Watershed *and a talk given to the Glen Canyon Institute.*

CASE STUDIES IN CONNECTIVITY



Roads and Wildlife

When noted conservation biologists Michael Soulé and Reed Noss were asked what three policy issues are most important to the rewilding of North America, they had one answer: "Roads, roads, and roads." Scientific studies conducted across the globe have clearly pointed out the profound impacts of roads in wild ecosystems: direct wildlife mortality, habitat fragmentation, stream sedimentation, and hydrologic changes, as well as increased access for invasive species, poachers, and motorized recreationists. The cumulative effects of roads are a loss of habitat and connectivity across many of North America's wildlands. Here we present a few examples of these impacts—and efforts to lessen the damage. ☛

scratchboard by Nancy Roy

Wildlands CPR

Road Removal in the West

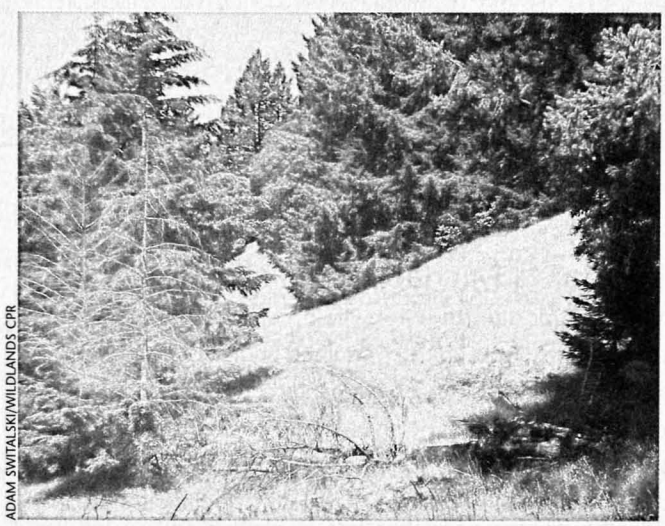
Redwood National Park in northern California was established in 1968 to protect coastal redwoods, trees that can live for 2,000 years. However, as logging continued upstream of the park, torrents of debris from a web of logging roads poured into Redwood Creek. Sediment choked out the park's salmon and threatened three of the six tallest trees in the world.

In order to protect Redwood Creek and the redwood groves, Congress doubled the size of Redwood National Park in 1978, adding 48,000 acres of land in the headwaters of Redwood Creek. Included with the park addition were more than 300 miles of logging roads, as well as guaranteed funding for restoration of this degraded landscape. Here, the science and art of road removal took its first tentative steps, and 25 years later, Redwood National Park and other land managers in northern California have removed hundreds of miles of roads to restore salmon habitat and aquatic connectivity.

The most common forms of road removal include ripping the roadbed, restoring stream crossings, and recontouring hillslopes. Road ripping involves decompacting the road surface two to three feet deep using ripper claws specially fitted to a bulldozer. Treatment of stream crossings involves removing culverts, excavating the fill down to the original land surface, recontouring streambanks, installing channel stabilization structures, and revegetating.

Although road removal appears to fully restore both aquatic and terrestrial habitat and connectivity, few peer-reviewed studies have measured the effects of road removal in this regard. Scientists have found that road removal decreases chronic sediment loss on roads and reduces the risk of road-triggered landslides, thus improving aquatic habitat, but no research has yet directly quantified road removal impacts on wildlife. Short-term, preliminary studies to address the potential for restoration of aquatic and terrestrial wildlife connectivity as a result of road removal are underway in Idaho and Montana. Thus far wolves, black bear, and elk have been documented using areas where road removal occurred in Idaho. The University of Montana and Wildlands CPR are currently conducting a first-of-its-kind study on the Flathead National Forest to assess how road removal affects and possibly restores aquatic connectivity for threatened bull trout.

To learn more about the work of Wildlands CPR—a national conservation group that targets off-road vehicle abuse of public lands and actively promotes road removal and the prevention of new road construction—visit www.wildlandscpr.org or contact Bethanie Walder (wildlandscpr@wildlandscpr.org).



ADAM SWITALSKI/WILDLANDS CPR

A recontoured and naturally revegetated road in Redwood State Park

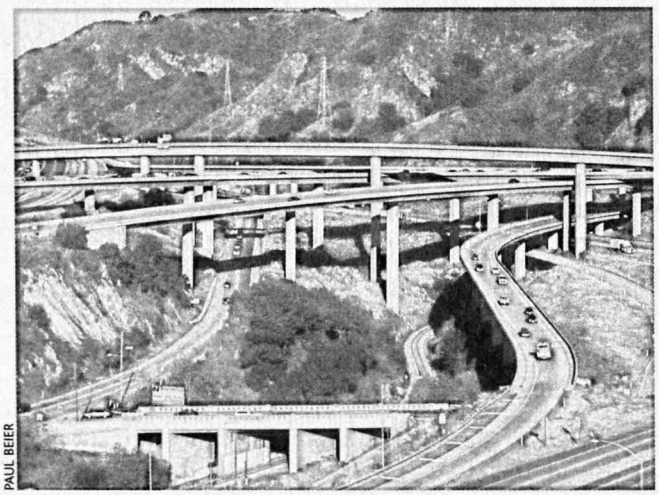
South Coast Wildlands

Rewilding Urban California

For the last two years, the conservation group South Coast Wildlands has spearheaded an ambitious effort—South Coast Missing Linkages—to restore connectivity to parts of southern California. Despite being the largest metropolitan area (19 million people) in the United States, the South Coast ecoregion is a global hotspot of biodiversity and has over a dozen large wildlands. South Coast Missing Linkages aims to connect these habitats into a true wilderness network.

South Coast Missing Linkages is a collaborative effort among 13 major land management agencies, conservation groups, state and federal transportation and regulatory agencies, sovereign Native American tribes, and others. South Coast Wildlands serves as a catalyst—developing synergy among much larger partners and keeping them focused on the task of protecting and restoring ecological linkages. Planners use rigorous scientific procedures in this process that include identifying 15 priority linkage areas; selecting 10–15 focal species per linkage; using GIS analyses to design linkages that serve those species; field reconnaissance to identify barriers and opportuni-

RON KRUEPER/CALIFORNIA STATE PARKS



PAUL BEIER

Top: The unpaving of the Coal Canyon interchange. In February 2003, California Department of Transportation began converting this interchange on the Riverside Freeway into a wildlife undercrossing, making it the first freeway interchange in the U.S. to be relinquished for conservation purposes and ensuring connectivity between the Santa Ana Mountains and the Chino Hills (on the horizon).

Bottom: The confluence of four highways, a railroad line, high-voltage power lines, and microwave communication towers, as seen from the edge of the California Aqueduct, which moves water 440 kilometers from the Sacramento River delta into the Los Angeles Basin. The Missing Linkages project will add a living layer of infrastructure to this scene by protecting and restoring the ridge in the background, which provides the only wildland link between the Santa Susana Mountains (left of the photographed area) and the San Gabriel Mountains (right of the photographed area).

ties; and making detailed recommendations for road crossing structures, stream restoration, and land uses in and adjacent to each linkage. According to Paul Beier, science advisor for South Coast Wildlands, "the exciting thing is that as we implement each plan, we will not merely slow the rate at which things get worse—we will actually improve wildland connectivity."

So far, plans have been published for 5 of the 15 priority linkages. Because 13 of these linkages are blocked by freeways up to ten lanes in width, the recommendations for freeway crossing structures are crucial. Each plan specifies locations and types of crossing structures needed, and how these will be integrated with land management. These plans ignore the location of existing culverts under highways—since none is located where wildlife cross or attempt to cross highways—and instead recommend the types and locations of new crossing structures that would best serve wildlife habitat-use patterns. According to South Coast's Executive Director Kristeen Penrod, "It makes more sense to create crossing structures where the animals want to cross than to encourage animals to cross inappropriate vegetation, topography, and urban areas. Crossing structures are landscape elements under human control, and they should respond to animal movement patterns, rather than vice versa." The crossing structures will be built over several decades (as transportation agencies upgrade each freeway), allowing movement patterns and gene flow of cougars, bighorn sheep, badgers, and other species to recover.

For more information visit the South Coast Wildlands website at scwildlands.org or contact Kristeen Penrod (kristeen@scwildlands.org; Box 1102, Idyllwild, California 92549).

Western Transportation Institute

Wildlife Crossings in Montana

In December 2000, the Confederated Salish and Kootenai Tribes, the Federal Highway Administration, and the Montana Department of Transportation agreed to reconstruct 90 kilometers of U.S. Highway 93 on the Flathead Indian Reservation in Montana. Driver safety and the natural and cul-

tural heritage of the tribes were a primary concern in the reconstruction plans.

The plans include 42 wildlife crossing structures and 24 kilometers of wildlife exclusion fencing, at an estimated cost of $9 million for these installations. This effort—unprecedented in North America—provides an opportunity to study the effectiveness of wildlife crossing and fencing structures in a landscape that accommodates not only wildlife, but also agricultural, residential, business, recreational, and cultural activities.

The Western Transportation Institute at Montana State University is evaluating the effectiveness of the U.S. 93 wildlife crossing structures and is developing best management practices that can be applied to future projects. The WTI will be investigating the effect mitigation efforts have on animal-vehicle collisions and wildlife movements across the highway, with a focus on deer species and black bear. Effectiveness will be defined *a priori* and will be determined based on comparisons of pre- and post-construction rates of animal crossings and animal-vehicle collisions.

Pre-construction measurements began in 2002; WTI is quantifying wildlife approaches and crossings of U.S. 93 by monitoring sand tracking beds randomly placed along sections of road that will have the most crossing structures and longest sections of wildlife fencing. In addition, Montana Department of Transportation continues to collect data on U.S. 93 wildlife mortalities to add to the existing 10-year dataset.

Construction will occur in phases from 2004 to 2008. Comparable data collection will continue for at least three years post-construction with the earliest reporting of results anticipated in 2010.

For more information contact Amanda Hardy (ahardy@coe.montana.edu) or Dr. Marcel Huijser (mhuijser@coe.montana.edu), or visit the Western Transportation Institute's website at www.coe.montana.edu/wti.

Banff National Park

How Helpful is Highway Mitigation?

Banff National Park is the most visited national park in Canada with more than five million visitors annually, many of whom are coming to see the wildlife. It is a profound irony that the major road that brings people to the park—the Trans Canada Highway—is also a primary threat to the ongoing survival of these animals.

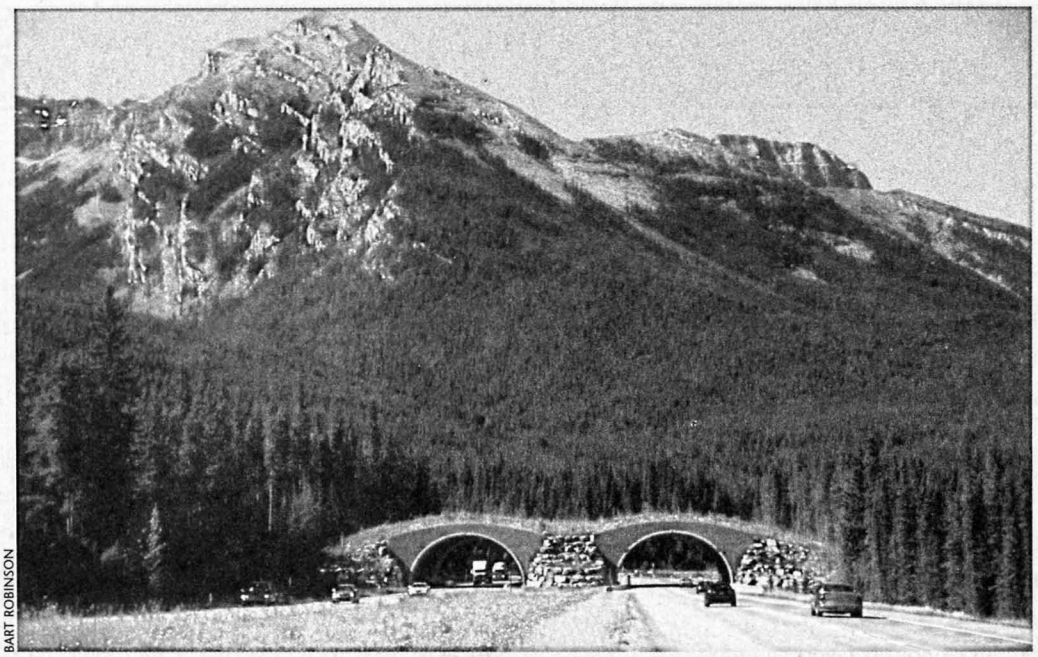
Banff is naturally fragmented into fingers of forest separated by ribbons of rock and ice; the Bow Valley watershed comprises more than 50% of the park. Wildlife generally avoid higher elevations and areas of deep snow, restricting usable habitat for mammals to about 25% of the watershed, which in winter decreases to about 15% owing to accumulation of snow. Thus, physiography and weather combine to concentrate wildlife into the low-elevation valley; most of the park's 381 species of birds and mammals live in flat valley bottom habitat.

The Trans Canada Highway—as well as Highway 1A, the Canadian Pacific Railway, and Trans Alta Power corridor—snakes through this valley. For more than 50 years, ecologists have raised alarms about destruction of wildlife and other ecological disruptions caused by the highway. Parks Canada has attempted to reduce highway mortality and improve connectivity by outfitting the highway with fencing and wildlife crossing structures.

These structures and fencing have been shown to reduce mortality of wildlife and facilitate movement. Most studies, however, focused only on the relative effectiveness of different types of crossing structures as compared with each other, rather than the entire mitigation effort relative to intrinsic connectivity. The true effectiveness of highway mitigation can be determined only by comparing connectivity across mitigated and unmitigated road segments with connectivity in areas that are undisturbed.

The results of recent research by Paul Paquet and Shelley Alexander strongly suggest that both mitigated and unmitigated sections of the Trans Canada Highway are barriers to the movements of wildlife, impeding the ability of animals to disperse naturally across their existing range. On unmitigated highways, they have documented a decline in highway permeability relative to increased traffic volume, which causes a community-level disruption of connectivity. As a group, carnivores showed significantly lower rates of crossing as traffic volume increases. Crossing rates of ungulates (elk, deer, moose) did not decline significantly with traffic volume.

The fragmented patchwork of habitats created by the highway has been shown to alter territorial movements of gray wolves and coyotes. High traffic volumes on the Trans Canada also appear to alienate wildlife from using portions of the Bow Valley they might otherwise use. Infrastructure associated with the Trans Canada occludes movement through the valley



BART ROBINSON

Wildlife crossing structure in Banff National Park

east of the town of Banff. Moreover, the highway is a primary cause of wolf, black bear, and grizzly bear mortality. The combined consequence of obstruction, alienation, occlusion, and mortality reduces the effectiveness of the Bow River Valley to support wildlife. Thus, the ecological patterns and processes that typify healthy ecosystems are absent or distorted in the Bow River Valley. Some species have already disappeared or been reduced to remnant populations that will likely not persist—for example, moose, badgers, otters, and foxes.

The success of highway overpasses, underpasses, and fencing in preserving natural ecological processes is difficult to measure. We can infer from observations elsewhere (including other areas of Banff National Park) that without physiographic constraints, wildlife typically move across valleys through a broadly diffuse network of trails. Thus, we would expect that many trails once intersected what is now the footprint of the highway. Second, in undisturbed areas, movements of wildlife across valleys are not selectively filtered—whereas in the Bow River Valley, some individual wolves and packs move freely through faunal passages, while others do not.

Thus, several potentially serious problems are not remedied by crossing structures. First, the placement of over- and underpasses may not reflect natural crossings, forcing wildlife to reluctantly modify travel patterns. Second, the number of natural crossings is dramatically reduced, depriving wildlife of crossing alternatives. Again, animals are forced to modify travel patterns to use over- and underpasses. Third, not all species or individuals are willing to use crossing structures, which creates a differential sieve that is selective for certain individuals. The ecological consequences of these disturbances are unknown. It is fair to conclude that highways, even when incorporating wildlife crossing structures, alter movements of wildlife, likely with adverse effects.

The Trans Canada Highway must be mitigated at a level that restores permeability at the wildlife community level, such that ecosystem functionality is restored. Mitigation should assure landscape permeability is equivalent to that of undisturbed or less-disturbed habitat, not simply maintain conditions in already compromised habitat. Appropriate mitigation includes fencing to reduce mortality, combined with suitable crossing structures, such as wildlife overpasses, culverts, tunnels, and elevated sections of highway or open-span structures. Most recent arguments reiterate the appropriateness of raising highways, for example as open-span bridges, as the most efficient approach to protecting corridors beneath the highway. This ascribes to "the Cinderella Principle"—making the road fit the movement corridor, rather than the corridor fit the road. This seems particularly apt in protected areas such as Banff National Park, where ecological integrity is mandated by law.

For more information on these research efforts, contact Paul Paquet (ppaquet@sasktel.net), Faculty of Environmental Design, University of Calgary or Shelley Alexander (shelleya@telusplanet.net), Department of Geography, University of Calgary.

Assisted Migration for

Bring *Torreya taxifolia* North—Now

by Connie Barlow and Paul S. Martin

TORREYA TAXIFOLIA (often referred to as T. tax or Florida torreya) is an evergreen conifer tree historically found only along a short stretch of the Apalachicola River of northern Florida and the adjacent sliver of southern Georgia. It favors the cool and shady ravines that dissect the high bluffs of the river's east shore. Despite its current extreme endemism, the species was once a prominent mid- and under-story member of its forest community, which includes an odd mix of northern and southern species: towering beech and hickory next to tall evergreen magnolia, and surrounded by stubby needle palm.

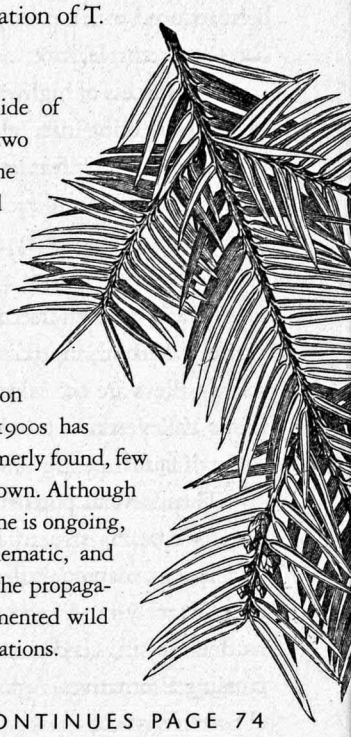
In the 1950s, the species suffered a catastrophic decline, the ultimate cause of which is still unexplained. By the mid-1960s, no large adult specimens—which once measured more than a meter in circumference and perhaps 20 meters tall—remained in the wild, felled by what seemed to be a variety of fungal pathogens. Today, the wild population persists as mere stump sprouts, cyclically dying back at the sapling stage, such that seeds are rarely, if ever, produced. T. tax thus joins American chestnut in maintaining only a juvenile and diminishing presence in its current range.

A 1997 Nature Conservancy pamphlet introduces *Torreya taxifolia* as "the world's most endangered conifer." It is no surprise that the Florida chapter of the Nature Conservancy, the State of Florida through Torreya State Park, a number of botanical gardens, and dispersed academic researchers are all actively involved in trying to restore this tree—guided by a U.S. Fish and Wildlife Service recovery plan pursuant to the Endangered Species Act.

Some, like Mark Schwartz and others, maintain hope for recovering T. tax in reproducing, self-maintaining populations in its current range. Since 1997, staff at the Atlanta Botanical Garden have been experimentally taking healthy T. tax grown from seed at the garden and planting these trees at the periphery of the existing range and somewhat further north in Georgia. The efficacy of applying fungicides and supplemental fertilizers to these transplants is now also being tested. The transplants are all progeny of "potted orchards" established from cuttings taken from wild specimens in Florida in November 1989.

Another *Torreya* expert, Rob Nicholson, conservatory manager at the Botanic Garden of Smith College in Northampton, Massachusetts, participated in the 1989 salvage of wild genotypes and their propagation as clonal stock. Nicholson presents a less hopeful view of resurrecting a healthy and self-maintaining population of T. tax in its current range. He writes:

> Mature trees in cultivation outside of Florida may number less than two dozen. At the beginning of the twentieth century, there were wild populations of *Torreya taxifolia* estimated at about 300,000 to 600,000. The estimated number of plants in the original habitat is about 500, which means that 99.3 to 99.6% of the population found at the beginning of the 1900s has died. Where 60-foot trees were formerly found, few individuals over 10 feet are now known. Although research into the cause of this decline is ongoing, *in situ* preservation appears problematic, and management efforts now include the propagation of rooted cuttings from documented wild stands to be grown in *ex situ* populations.



T. taxifolia, engraving ca. 1900

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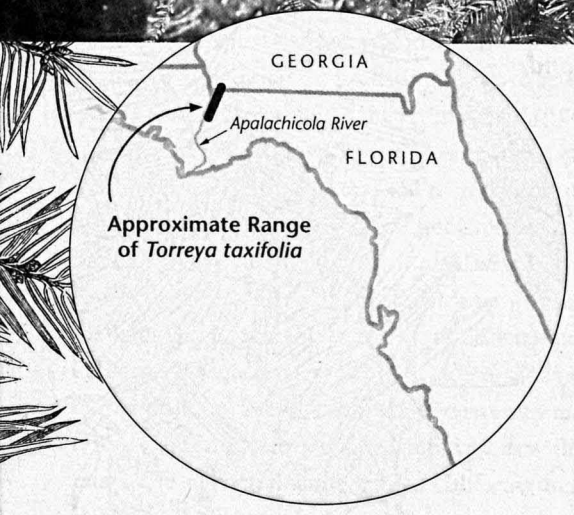
Conservationists Should Not Move *Torreya taxifolia*

by Mark Schwartz

CONNIE BARLOW



In 1988, I began a long-term study of the Florida torreya (*Torreya taxifolia*). I have followed natural populations across their distribution for more than 15 years and have, from the start, been focused on conservation efforts for this critically endangered coniferous tree. Rob Nicholson and I collected the material from approximately 150 trees that now constitute our *ex situ* plant material. My research has been focused on determining whether there is genetic differentiation across the distribution, understanding the magnitude of the population decline, understanding disease factors, and predicting the likelihood that the species will recover.

During this period, there have been occasional efforts to transplant the species northward on behalf of conservation. One justification for northward introduction may be that the population has suffered from disease within its current distribution and thus a northward movement may allow it to escape its pathogens. This justification is somewhat weak as current individuals do not appear to be overly susceptible to any particular disease, although the population is not recovering from a previous decline. Further, since the disease agent responsible for the original decline is a matter of conjecture, it is not clear what Florida torreya would be escaping from, nor where it should go. In short, I am skeptical of the disease escape arguments as we are, at present, unclear of the cul-

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➤ Bring *Torreya taxifolia* North—Now

Many botanists and climate specialists agree that at some point in the future, human-induced global warming will push many plants to the edge of viability; at that time, "assisted migration" (a term coined by Brian Keel, 2004) may be the only stay against extinction. We believe T. tax is already at that juncture. In a 1990 article, Rob Nicholson speculated, "Is *Torreya* an early victim of global warming and a precursor of a new wave of inexplicable extinctions?" We ask: Why wait until a hundred species are on the brink? Rather, let us undertake assisted migration for *Torreya taxifolia* today, in part, as a trial run for the decades to come. With Florida torreya we can explore the ecological and social dimensions of what seems likely to be a radically new era for plant conservation.

Moving endangered plants: Easy, legal, and cheap

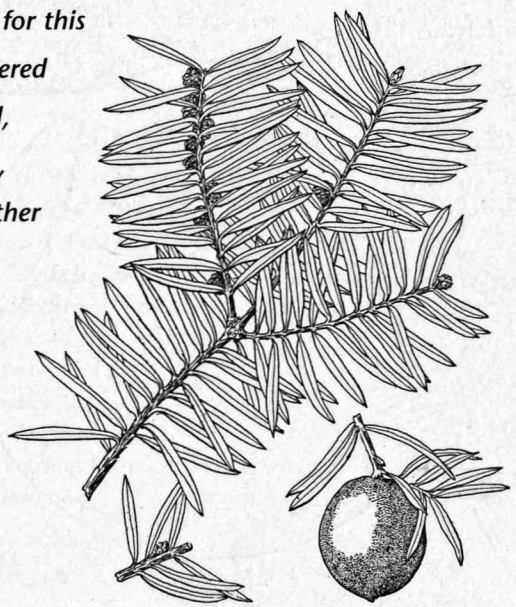
Assisted migration as a conservation tool is both fascinating and frightening for anyone focused on plants. It is fascinating because endangered plants can be planted by whoever so chooses, with no governmental oversight or prohibitions—provided that private seed stock is available and that one or more private landowners volunteer suitable acreage toward this end. This cheap-and-easy route for helping imperiled plants is in stark contrast to the high-profile, high-cost, and governmentally complicated range recovery programs ongoing for highly mobile animals, such as the gray wolf, lynx, and California condor.

Assisted migration frightens for precisely the same reasons it fascinates: anybody can do it, for good or ill, and with care or abandon. Its promotion could undermine decades of public education about the dangers of non-native plants, as well as more recent efforts to promote the concept of wildlands corridors and connectivity. Still, in an age of deforestation, severe habitat fragmentation, and rapid global warming, assisted migration as a plant conservation tool should not be ignored. As Peter Wharton, curator of the Asian Garden of the University of British Columbia Botanical Garden writes, "The *Torreya* question is a door to immense issues relating to how we facilitate global 'floraforming' of vegetational zones in a warming world. It is another layer of responsibility for those of us who have a passion for forests and wish to promote the ecologically sensitive reforestation of so many degraded forest ecosystems worldwide."

We are proposing test plantings of T. tax, using privately available seed stock, onto forested private lands of the southern Appalachians and Cumberland Plateau. Mark Schwartz and others who know the tree through years of professional engagement agree that it is very unlikely to become noxious in recipient ecosystems to the north. T. tax might, in fact, serve an ecological function similar to that of eastern hemlock: providing evergreen shade along streams and streamlets within deciduous forests. Overall, the ecological interactivity (for good or ill) of T. tax in recipient ecosystems will become apparent only when test plantings in natural forest habitats to the north are carried out and monitored.

In North Carolina, there is already evidence that Florida torreya is both benign and thriving. In 1939, Chauncey Beadle collected about a dozen specimens of T. tax from the Apalachicola and planted them along a streamlet as part of a grove of open pine forest within the vast holdings of the Biltmore Gardens in Asheville (elevation 2200 feet). Interestingly, today, hemlock is prominent on the north-facing slope of this slight ravine, and all the *Torreya* specimens (including self-propagated saplings, probably planted by squirrels) occur and are thriving on the south-facing slope. As to *Torreya*'s cold-hardiness, Bill Alexander, forest historian at the Biltmore Gardens, reports that in the winter of 1985 all *Torreya* specimens survived unharmed an episode of unusual cold; temperatures plunged to minus 16° Fahrenheit.

By assisting the migration of* Torreya taxifolia *now, we can help to shape a better next chapter for this beleaguered tree and, perhaps, many other plants.



T. taxifolia, engraving ca. 1900

Rewilding and deep time

Thus far, the arguments we have made in favor of assisted migration for *Torreya taxifolia* are grounded entirely in an ethic of biodiversity preservation: T. tax is in deep trouble in its historic native range, so let's give it a chance to establish in cooler realms. Biodiversity preservation is not, however, the only environmental ethic that should guide conservation choices. Increasingly, "rewilding" (Soulé and Noss 1998, Barlow 1999, Foreman 2004) is a powerful motivator. According to this standard, a network of "potted orchards" of T. tax tended in northern botanical gardens, though a good hedge against outright extinction, falls far short of the mark—potted is the botanical equivalent of caged.

Might it be possible for T. tax to take its place once again as a thriving member of some subset of Appalachian forest communities? We say *again* because we believe that northern Florida is more properly viewed not as native range for T. tax but as peak-glacial range. Helping T. tax establish in the southern Appalachians is thus not so much relocation for a plant struggling with global warming as repatriation of a once-native. It is a form of rewilding that uses a deep-time baseline for determining appropriate range.

Torreya is a member of the ancient gymnosperm family Taxaceae, whose ancestors were evolutionarily distinct from other conifers by the Jurassic, some 200 million years ago. Because *Torreya* pollen is indistinguishable from the pollen of yews (*Taxus*), bald cypress (*Taxodium*), and cypress (*Cupressus*), known fossil occurrences of this genus are limited to macrofossils (seeds, leaves, and secondary wood), and these are sparse. There are no known Cenozoic fossils of *Torreya* in eastern North America. The most recent macrofossils identified as the genus *Torreya* in eastern North America are upper Cretaceous, and these were unearthed in North Carolina and Georgia—hence, our suggestion that assisting T. tax to rewild in North Carolina would be assisting the return of a deep-time native.

Because worldwide climate during the Cretaceous was much warmer and far less seasonal than that of today, it is not surprising that *Torreya* macrofossils of Cretaceous age have also turned up along the Yukon River of Alaska. In western North America, there is Cenozoic fossil evidence of genus *Torreya* in the John Day region of Oregon (lower Eocene) and variously in California (Oligocene and late Pleistocene). Today, the genus is highly disjunct. *Torreya californica* survives as a rare tree, locally abundant in a score of isolated populations within the coastal mountains of central and northern California and on the west slope of the Sierras. It favors moist canyons and mid-slope streamsides, growing beneath a canopy of taller conifers and deciduous trees. *Torreya nucifera* is found in mountain habitats of Japan and Korea, and four other species of genus *Torreya* inhabit mountainous regions of China. We would not be surprised if one day a remnant grove of *Torreya* were discovered in the mountains of northeastern Mexico, in patches of mesic forest that still support sweet gum, beech, and yew (Martin 1957). *Torreya taxifolia* is the only one of the six known species that is highly imperiled, and we believe we know why.

Near-time obstacles to natural migration

Torreya taxifolia is a glacial relict, left behind in its pocket reserve of rich soils and cool, moist microclimates afforded by ravines along the east shore of the Apalachicola River. The current richness of North America's deciduous forests is, in large part, thanks to this and other glacial refuges—including the Tunica Hills of Louisiana and the Altamaha River of southeastern Georgia (Delcourt 2002). For some of the repatriated plants, relict populations still remain in one or more of these refugia, while the bulk of the range is disjunct much farther north—beech is a notable example. We infer that T. tax was unable to follow the other plant refugees north when the ice retreated, beginning some 15,000 years ago.

Consider that the last interglacial—110,000 to 140,000 years ago and preceded by many others of equal magnitude—peaked at a global temperature not much different from that of today. If *Torreya* is having trouble surviving in northern Florida now, it should also have had trouble in multiple interglacials. So what makes our own interglacial uniquely inhospitable for natural migration? There are two significant differences between this interglacial and the previous ones that could have posed grave problems for *Torreya*, and together they could have sealed the fate of this botanical refugee.

One difference is that our current interglacial is uniquely understocked in large herbivorous mammals, both in diversity and in numbers. By 10,000 years ago, the mastodons, the mammoths, the giant ground sloths, and other mammals that powerfully affected vegetation had vanished. Notably, we lost all our big browsers. Small trees would have been left untoppled by elephants; saplings and shrubs gone uneaten. Overall, the landscape would have become brushier, and thus more susceptible to fires reaching beyond the fire-adapted pinelands of sandy flats into the moist ravines through which fire-intolerant *Torreya* would have been edging north (Robinson 2003).

A second difference between this interglacial and the previous is that only in the current interglacial has North

America been home to a creature that can make fire on demand. Indeed, the migration of humans into North America is evidently the cause of the coinciding loss of megafauna by overkill (Martin and Klein 1984). Near the onset of the present interglacial, the first paleoindians arrived. Both accidentally and intentionally, and for thousands of years, wildfires would have been ignited to favor plant species that provided food (the acorns of oaks), to make land easier and safer to cross, to flush out game, and to lure game animals to patches of abundant new growth. This scenario may partially account not only for the suppression of *Torreya* (and Florida yew) but also for the extinction of a recently described new species of spruce, *Picea critchfieldii*. Late Pleistocene extinctions of plants, to match the devastation suffered by large mammals, are otherwise unknown.

There is yet a third way in which humans might have stressed local populations of T. tax in near time. The dispersal agents upon which T. tax depended for movement of its large, fleshy seed—squirrels, and perhaps also tortoises—would likely have been severely reduced in numbers, even extirpated, as these creatures are attractive foods, safely and easily killed by people (Barlow 2001, Martin and Szuter 1999).

T. tax may thus have been a victim of contact, relegated to a short stretch of moist, riverside ravines by anthropogenic loss of big browsers, anthropogenic and natural fires, and anthropogenic extirpations of seed dispersers. If these are indeed the causes of T. tax's troubles, then why have the other species of genus *Torreya* been spared? The other species did not have to move hundreds of kilometers north in order to keep pace with a warming climate. Rather, they shifted their ranges hundreds of meters upslope. Thus we believe that topographical differences are at cause.

Torreya californica resides in shady ravines and rocky gorges in isolated pockets of the Coast Range and the west slope of the Sierras, between 1000 and 2500 meters elevation. In China, *T. grandis* is found in mountain habitats of seven provinces, often alongside streams, at an elevational range of 200–1400 meters; it is common enough that the wood is used commercially. *T. fargesii* is also found in seven provinces, but at higher altitudes, 1000–3400 meters. The only Chinese species listed as "vulnerable" is *T. jackii*, which occurs in three provinces at an altitudinal range of 400 to 1000 meters. *Torreya nucifera* is found in mountainous terrain of Korea and Japan; more than 2500 ancient specimens of *T. nucifera* (500 to 800 years old), with trunks up to 1.4 meters in diameter and heights up to 14 meters, still survive in the wild in Korea's Pija-Rim National Park. For Florida torreya, in contrast, a journey of 400 kilometers (as the crow flies; far more as the ravine meanders) would have been required before it could take advantage of the quick elevational gain that mountains afford in a warming climate.

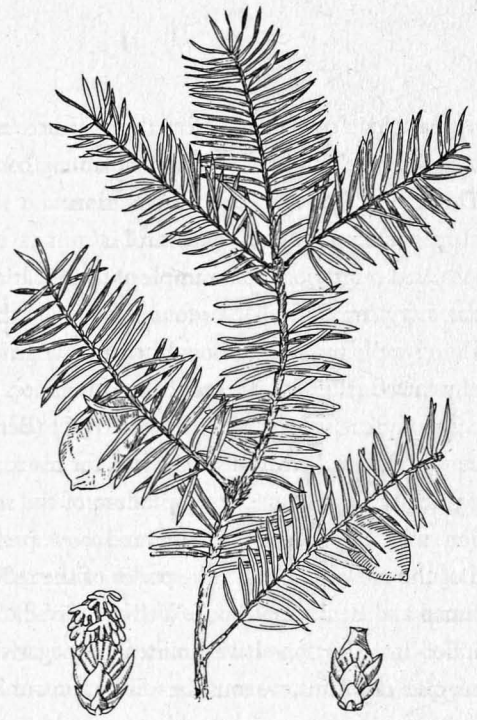
One final note in the story: because some other glacial refugees of eastern North America had to make do with mountainless terrain, *Torreya* was not alone in its troubles. Severe endemism of the Florida yew (*Taxus floridiana*, also only along the Apalachicola River), historic extirpation in the Altamaha of America's only big-blossomed relative of Asian camellia (*Franklinia*), and extinction in "near time" (that is, after paleoindian arrival) of the once-widespread Critchfield spruce may all be attributed to the advent of the fire-makers (Martin, in press). Given the sequence of loss in their pocket reserves, it would seem that Critchfield spruce was the least heat- and drought-tolerant of the bunch, followed by *Franklinia*, which now thrives in cultivation in the mid-Atlantic states. Next comes T. tax, followed by Florida yew, which is not yet sickly in its Florida refuge but is doing a poor job of reproducing.

"Left behind in near time" may thus be a syndrome that applies to a number of extinct, imperiled, and soon-to-be-imperiled plants, and perhaps to small, isolated populations of species that are not themselves in danger of extinction. How might this awareness alter our conservation options as climate shifts? By assisting the migration of *Torreya taxifolia* now, we can help to shape a better next chapter for this beleaguered tree and, perhaps, many other plants.

Let's get started

The first opportunity to begin collecting T. tax seed at the Biltmore Gardens of Asheville (supervised by the Biltmore's Bill Alexander and local activist Lee Barnes) will be autumn 2005. Those who would volunteer their time, their students, or their forested properties in this historic effort to rewild T. tax—and thus to test the efficacy and pitfalls of the first intentional assisted migration of an imperiled plant in a warming world—are encouraged to visit www.torreyaguardians.org. ☾

Connie Barlow *is the author of three books, including* The Ghosts of Evolution. *Paul Martin, emeritus professor of geosciences at the Desert Laboratory of the University of Arizona in Tucson, is the author of many articles and books including* Twilight of the Mammoths: What Caused the Extinctions of America's Largest Mammals? *(forthcoming from the University of California Press).*



T. taxifolia, engraving ca. 1900

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➤ Conservationists Should Not Move *Torreya taxifolia*

prit and thus the tree is not assured of any relief to the north.

Another rationale for northward introduction is that the species likely existed further north at some time in the past, although not during the current 10,000-year interglacial, and that it is more suited to a cooler climate. Range expansion efforts have begun with the assumption that the reason that the species declined to near extinction is at least partially because the species is trapped in a current distribution that is too far south, too warm, and that the species is now unable to disperse further north, where it is more climatically suited. Thus, the reasoning goes, if we assist migration northward, the species is likely to thrive, thereby assuring the persistence of one of this continent's most distinctive conifers. Based on my reading, research, and personal experience I find some merit in this argument; *Torreya taxifolia* is a glacial relict, quite likely on the edge of its climatic tolerance, and might do well in a cooler climate.

Recent research on global warming provides predictions of rates of tree species range shifts—driven by future climate change—and estimates the ability of tree species to migrate to new distributions (Iverson et al. 2003). One of the findings is that many species with narrow distributions, such as the Florida torreya, are projected to have future distributions that are wholly disjunct from their current distributions. In other words, global warming can put species in jeopardy as a consequence of disassociating the current distribution of a species from what we currently understand to be its envelope of appropriate climate (Schwartz 1992). If these climate-limited species fail to migrate, they can go extinct (Hannah et al. 2002, Midgley et al. 2003). In North America, Florida torreya, a trapped glacial relict, seems a plausible case for such a fate. In addition, this line of thinking goes, we are likely to witness more potential cases in the future as the climate warms, habitats are fragmented, and existing corridors are insufficient to allow species to move northward at a sufficiently rapid rate (Thomas et al. 2004).

SO WHY, THEN, am I opposed to assisted migration for Florida torreya and other similar cases? One reason, unfortunately, is that the arguments about range and climate rely on very important assumptions that are not well justified. We usually do not have empirical data from which to judge whether narrowly distributed species are, as assumed, limit-

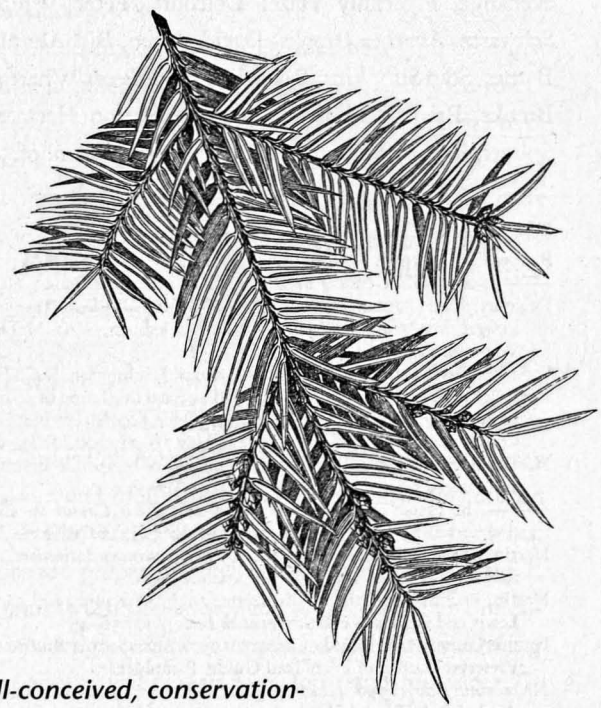
ed by climate and not other environmental factors, such as soils and disturbance regimes. As a consequence, I believe that we should exercise caution.

There is another, more important reason why assisted migration must be a management option of last resort. My logic is simple and based not on the biology of the target species, in this case Florida torreya, but on conservation concerns of the recipient ecosystem. Humanity has a long record of tinkering with natural ecosystems. Largely these have been successful from the perspective of the human endeavor—think agriculture. This tinkering, however, creates a series of ancillary non-target biological winners and losers. It has been argued that the majority of species introduced have had little effect on ecosystem structure, and most introductions do not cause undue ecological damage (Mack et al. 2000). Nevertheless, those few cases where introduced populations rapidly expand and threaten to endanger other species or damage ecosystems and ecosystem functions cost the U.S. billions of dollars each year (U.S. Congress 1993, Pimentel et al. 2000). As a consequence, I believe that conservationists should be very reticent about introducing species to novel environments as a conservation measure. Societal recognition of an appropriate reticence toward species introductions has been slow, but is emerging (Mack et al. 2000). If we are to now advocate species introductions on behalf of conservation, conservationists must have clear guidance as to when this action is warranted and when it is not. It is not an action to be taken lightly.

Assisted migration implies that we do not recognize the target species as native to the newly introduced locale. Local conservationists must then reconcile themselves as recipients of this novel species in their midst. In most cases we use historical records to establish a baseline forest community toward which we manage our current forests. Certainly, we do not want to return to a static view of forests and manage our natural lands as museum pieces, but then again we would like to retain an historical basis for the range of variability in composition of plant communities that are representative of the habitats we are trying to conserve (Landres et al. 1999). Without a baseline we have no target. Without a target, every kind of management, including those that result in lost native species, is arguably a success. I fear such success. Intentional introduction of species outside their current distributions in an effort to conserve them detracts from and trivializes this baseline and threatens to discount standards for conservation. From a visceral level, it seems likely that a range of people would say: Florida torreya has no place in southern Appalachian cove forests. As a consequence, assisted migration should, and will, result in rancor among conservationists. This rancor does not serve conservation.

Novel species becoming out of control is an issue of concern with assisted migration. An example of conservation tinkering gone awry comes from Newfoundland. Pine martens were not doing well, and it was thought that by augmenting their diet by introducing red squirrels, the population might do better. Red squirrels were introduced in 1963 (Benkman 1993). The squirrels and crossbills competed for black spruce cones as a primary food source. A by-product of the squirrel introduction was the dramatic decline and now presumed extinction of the Newfoundland sub-species of the red crossbill (Parchman and Benkman 2002). Well-conceived, conservation-minded introductions have unintended negative ecological consequences. Thus, we must be cautious in our enthusiasm to assist species that are in trouble.

The likelihood of *Torreya taxifolia* expanding out of control is low. Florida torreya is a slow growing, shade-tolerant,



Well-conceived, conservation-minded introductions have unintended negative ecological consequences. Thus, we must be cautious in our enthusiasm to assist species that are in trouble.

dioecious tree that requires relatively large canopy gaps for successful recruitment. The species does not spread clonally and the relatively few seeds that trees produce are a favorite food of squirrels. The tree carries all of the attributes of a species that will not spread and become a noxious weed. Nevertheless, assisted migration sets a risky precedent. Will control assurances and monitoring of problems be followed for future species that are deemed to be in need of assisted migration? I fear not. Thus, it is critical that we take a hard look at what criteria are to be used to justify assisted migration and develop guidelines for appropriate assisted migration in order to preserve biological diversity.

I share with others the dedication to favoring the preservation of biodiversity over the preservation of historical examples of what we perceive as natural communities. But conservationists must also be reluctant to advocate ecological tinkering. I would advocate assisted migration for plants only when there is a clearly imminent extinction risk. Some believe the Florida torreya is such a case. There are probably fewer than 1000 individuals extant in the current distribution and the numbers are dwindling (Schwartz et al. 2000a). At last count, there is a single known individual that is producing seeds in the wild (personal observation). Aside from this one individual and the approximately eight seeds it has produced, there has been no observed seedling recruitment for at least 20, and probably 40, years. The situation, indeed, seems critical. Nevertheless, our population modeling suggests that the species retains a very high probability of remaining extant for the next 50 years (Schwartz et al. 2000b). Further, there are no current disease symptoms that suggest that an augmentation of the population within its native distribution would not succeed. The germplasm currently housed in botanical gardens of the southeast could be used to augment natural populations. Local population augmentation of Florida torreya has not been adequately explored. All local options for conservation must be exhausted prior to assisted migration. Florida torreya fails this simple criterion.

The reality of the situation, however, bears mentioning: anyone who wants to plant Florida torreya can do so—wherever they want. The ownership and movement of plants are very loosely regulated. The species is commercially available in South Carolina. Anyone is free to venture to a dealer, buy the plant, and introduce it to their property. This is perfectly legal. Thus, if assisted migration is going to be used sparingly, and only in conditions where the need is dire, then the conservation community should begin now to specify and advertise a consensus view on when this may be appropriate.

In fact, Florida torreya has already been moved northward in a test planting in northern Georgia. Florida torreya is a native plant of Georgia, but of the approximately 30 trees within the native Georgia distribution, all are within 200 meters of the Florida state line. Planting the tree in northern Georgia as a species native to the state is somewhat of a stretch; this is a northward expansion of more than 10 times the distribution breadth of the species in its native range. Some current assisted migration efforts would like to move the species northward further still, across state lines. This is the sort of effort that should begin with a dialogue with conservation organizations and leaders from the recipient location. In some cases, the result will be no assisted migration and extinction of species in the wild. For *Torreya taxifolia*, with an *ex situ* population in several botanic gardens, and some years before we lose the native population, now is the time to fully explore local solutions—that is, local population enhancement—before taking rash action. ☾

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HERMAN

acrylic by Tim Yearington

"Let us apply the stomach pump to the doctrines of economic growth that we have been force-fed for the past four decades," writes **Herman Daly** *with a more pungent metaphor than is typical of the professional economist. But then Daly is a most unusual economist.*

Formerly at the World Bank, he is now a professor at the University of Maryland School of Public Policy, and an outspoken critic of mainstream economic theory and practice. A founder of the discipline of ecological economics, his slight southern drawl and gentle manner belie the keen edge of his critiques. Daly is convinced that conventional economics is adrift in a Neverland where promoting infinite growth on a finite planet is seen as not just reasonable but as incontrovertibly good. The resulting economic policies, he claims, are poisoning both the living world and the human economy to which it is connected.

So, what would he have us eat instead? Daly has coined the term "steady-state economics" and is actively promoting the idea of a dynamic economic system that rewards innovation while maintaining or reducing human consumption and population. This idea and others for a new economic direction are described in his several books, including Valuing the Earth, Steady State Economics, For the Common Good *(with John Cobb Jr.), and* Beyond Growth. *Daly has received many prizes and honors, including the Honorary Right Livelihood Award (Sweden's alternative to the Nobel Prize), and is the co-founder of the journal* Ecological Economics.

Wild Earth's senior editor and staff writer, **Joshua Brown,** *spoke with Herman Daly on September 3, 2004.*

JOSHUA BROWN: You have just put out a new textbook, *Ecological Economics*. What is the undergraduate in Econ 101 going to read in your book that is different from the standard texts?

HERMAN DALY: They'll get a different vision of what economics *is*. Ecological economics views the human economy as a subsystem of the larger world ecosystem—while conventional economics hardly acknowledges that there is an ecosystem.

There are three basic problems that economics must address: allocation, distribution, and scale. Allocation is the traditional economic problem: How are resources apportioned among different products? How many resources go to cars, how many to beans, to clothes, and so forth? Distribution is a measure of how these goods and resources are apportioned among people. How many of the cars and beans and clothes go to you, how many to me, how many to somebody else? And, finally, the problem of scale is captured in the question: How big is the human economy—how many cars, beans, and clothes—relative to the total system that it is a part of?

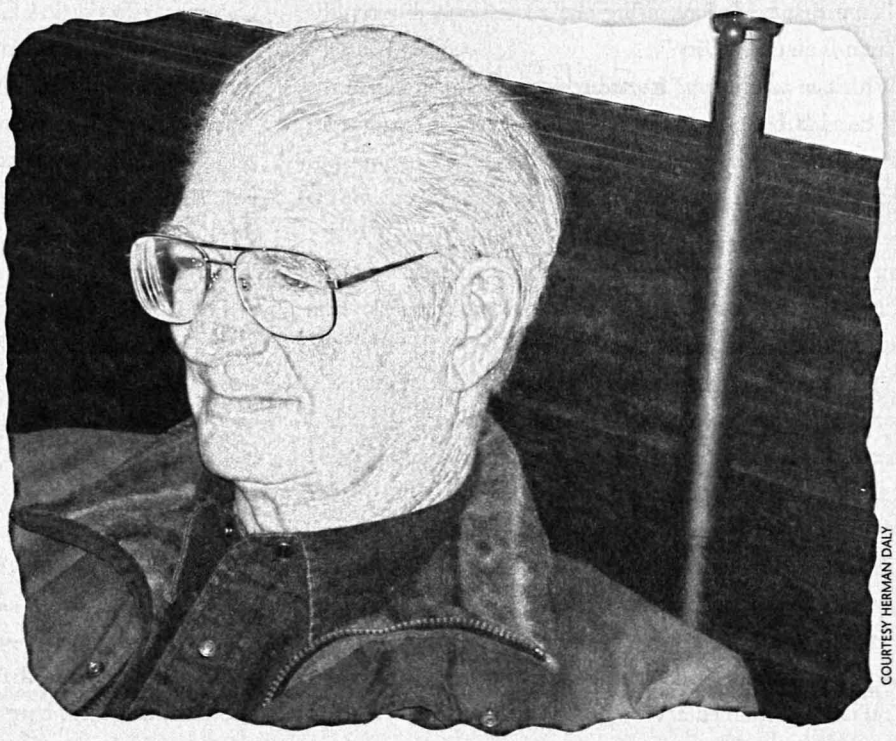
The measure for a good allocation is efficiency. Is it what people want and are willing to pay for? The measure of a good distribution is justice. Is it fair? And the measure of a good scale is sustainability. Does the scale of the economy impose on the larger ecosystem a "through-put" or depletion greater than can be regenerated?

Ecological economics does talk about efficiency of allocation—that's the overlap with standard economics—though we focus much more on distribution than standard economics, where distribution gets second fiddle. It's the problem of scale where we see a true parting of ways between ecological economics and conventional economics. Scale is the defining issue of ecological economics, because all other problems are conditioned by the scale of the economy, while standard economics doesn't even consider it.

Wouldn't many economists bridle at this characterization? Imagine, for a moment, what a mainstream, neoclassical economist *would* say about the issue of scale.

They don't usually think in those terms, but let me try to put on a neoclassical hat. They might say, "Scale is total. We don't conceive of the economy as a subsystem of the larger system. We conceive of the economy as everything. All your wildlife, down to every amoeba, is a part of the economy and we're going to hitch 'em up to pull the human wagon." So, for them, it is

DALY



COURTESY HERMAN DALY

not a matter of some things being outside of the human economy and other things being inside and setting the right boundary—there is no boundary—everything is the economy.

I get a bit queasy at the notion that "everything is the economy," but how would you articulate the deficiencies of that perspective?

Number one, that perspective is extremely arrogant. They want to manage the whole ecosystem and take it to market! Enormously intricate natural systems we don't understand at all—do you want to bring that all into the economic calculus?

So arrogance is one reason why conventional economists have forgotten about scale. Historically, it's quite the opposite answer. In the past, their approach has been to say, "Well, the scale of the economy is so small—it's tiny relative to the total ecosystem—that the ecosystem is a free good and doesn't enter into economic calculations because it is not scarce. If it's not scarce, its proper price is zero; if it doesn't have a price, it's not part of economics" and so on. That made sense in some periods of human history. It makes less sense everyday. In my lifetime—I'm 66 years old—the human population has tripled globally and energy and materials consumption has gone up a factor of 12 or 15. So what used to be an "empty" world is now a "full" world.

In this full world, the economy is a very large subsystem of the total, so the feedback between the ecosystem and the economy is very significant. Standard, neoclassical economics says, "just leave that aside," or, using the professional lingo, "the ecosystem is an externality."

What's an externality? It's something that doesn't fit in the theory but has become so important that you can't ignore it! When you have to classify the very capacity of the Earth to support life as an "externality" then it is time to rethink your theory.

Do you find that many economists are moving in your direction, moving toward seeing ecological economics as an insightful and powerful tool?

That's my hope, but I may be tainted by wishful thinking. We do have a society of ecological economics and a journal and chapters in major countries, including Brazil, China, and Russia, as well as Canada and the U.S., so I am hopeful. But if you look at economics curricula in major universities you don't see much acknowledgement of ecology and if you look at people at the World Bank and the training they get to come in, there is not a whole lot of new thinking.

At most, what is available at most universities is what has been called "environmental economics" or sometimes "resource economics." These are basically the application of standard neoclassical economics tools to allocation problems having to do with natural resources, pollution, or environmental contamination—instead of viewing the economy as a subsystem of the larger system and rigorously dealing with the issue of the total limits to growth.

For ecological economists, growth of the economy—in its physical dimensions—has to be limited, but for the neoclassical economist, growth is the end all and be all. They don't make much distinction between physical dimensions and monetary dimensions of the economy.

A growth-based, capitalist economy has dominated in the West for several centuries, and has come to dominate economic theories and economies around the world. Can you imagine a replacement for this system—without massive upheaval?

Yes, it's something we call a steady-state economy. I'd have your readers take a look at the work Brian Czech is doing [at the Center for the Advancement of the Steady State Economy, www.steadystate.org].

If nothing else, we should face the fact that economic growth and preservation of wildlife are on a collision course. The only way we are going to preserve wildlife—if you are really serious about it—is to limit economic growth. As long as the conservation movements fail to confront that issue they may be somewhat effective in a few minor skirmishes but will not come to grips with the real problem.

You recently wrote an article titled, "Population, Migration, Globalization." I imagine economists mostly would identify their realm in that third term—globalization—but not in the first two. How are they linked?

It is strange, but economists have a way of narrowing their discipline whenever something gets too difficult to deal with; they say, "Well, that's not really economics." If you look into an earlier era of economics, say 50 or 60 years ago, all textbooks—at least the classical texts up through Alfred Marshall—would have a chapter on population. That was just part of basic economic theory, and under the issue of population there would be a subheading on migration. Not any more.

Why?

First, the very popular—and convenient—demographic transition theory suggested that "population will take care of itself." In other words, just have economic development and by corre-

lation people will have fewer children. Well, unfortunately, that is a shaky proposition. There is some statistical support for it, but recent thinking, which has more support, goes like this: when people get richer they want more of everything—including children.

So along comes the demographic transition theory and, phew, planners and politicians breathe a sigh of relief because now we don't have to worry about population growth—as long as the economy grows. But you're saying it may be just the opposite.*

It's not that simple. Children have become more expensive as civilization has required parents to invest more in them to bring them to maturity. It's not just because you're getting richer that you have fewer children. That's kind of a dumb conclusion. There is a gross statistical correlation but when you break it down, and control for a variety of factors, that's not what drives people's decisions about reproduction.

The reason for the misleading correlation is that as people get richer, they only get richer in part; the price of children goes up even as total income goes up. As you can have more of everything, the relative price of children—because of educational standards, and general standards in civilizations moving from agrarian to industrial economies (where children are not economically useful until much later)—also goes up. There is a price effect and an income effect. As the price of children goes up, people have fewer children, and if income goes up they tend to have more children. If they expect that economic times are going to be good, they tend to have more children; if they expect bad times ahead, they tend to have fewer children. It's a rational response.

So a misplaced trust in the demographic transition hypothesis is part of why population control dropped out of the conversation. Why else?

Because it is so difficult to deal with! Across the ideological spectrum, people have a visceral problem of facing up to the challenge of human population growth. We don't really know how to deal with the problem and, making things worse, efforts in India and other places have been, at best, unhappy experiences, with a history of brutality and force.

The only way we are going to preserve wildlife—if you are really serious about it—is to limit economic growth.

When the Chinese wised up and said, "Good grief, we have a billion people, we can't continue growing like this," it was totally against the Maoist view that more mouths bring more hands. That ideology thought: the more people, the better; population is only a problem under capitalism, once you have socialism and sharing then there is no such thing as any scarcity of nature, no such thing as natural limits.

Mao and [unlimited growth proponent] Julian Simon saw the world somewhat the same.

Yes, Mao and the *Wall Street Journal* crowd might find it surprising that they are in bed together. At least on that. But the Chinese were pragmatists too, so they went for the one-child family policy. And, as we know, some of the things that happened under that policy were bad for human rights. For example, the one-child family policy led to selective abortion of females because of the preference for males in Chinese society.

That's a problem—it inflicts a hardship on future generations when you upset the sex ratio—but where does the problem reside? It resides with the preference for males, not with the need to limit population.

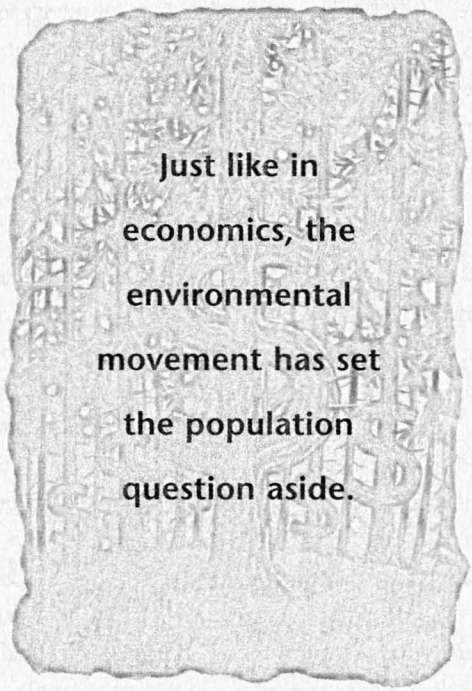
Population issues have fallen out of economics instruction and the mainstream economics debates—but perhaps even more so they have fallen out of the environmental mainstream. In this Madison Avenue era of "positive messaging" population has become a third-rail issue for conservation groups.

That's right. In the late '60s and into the '70s, the central focus of the environmental movement was population. Paul Ehrlich's *Population Bomb* drew on a line of thinking that went back into the '40s. But, just like in economics, the envi-

* Virginia Deane Abernethy's article in the spring/summer 2004 edition of *Wild Earth*, "Fertility Decline No Mystery," also addressed the weakness of the demographic transition hypothesis.

ronmental movement has set the population question aside.

Many environmental NGOs [nongovernmental organizations] do not want to alienate groups that contribute to them, and population is too hot. There is also a religious tie to this through the abortion controversy because population control leads you right next to abortion. But you don't have to be in favor of abortion to favor population control. Indeed, you can argue that voluntary birth control programs result in reduced rates of abortion, because most abortions are a result of absence of birth control. There are lots of reasons why population should be more part of the conversation in many political camps.



Then human migration comes in—and the issue gets really hot in the United States. Take the Sierra Club and their brouhaha about the club's stance on population. They had taken the position that the U.S. should limit its population growth—but that was thinking in terms of natural increase. Later on, with migration becoming the major source of population increase in the U.S., population control would mean limiting net immigration. That was a political issue they were unwilling to tackle because of historical associations of anti-immigration politics with racism. That's a complicated story, but, as a thought experiment, paint everybody the same color all over the world and we still have a huge problem of the increasing number of people.

OK, but the issue of absolute global population—with its impact on carrying capacity—is quite distinct from the specific issue of regional migrations and national immigration policies.

All countries have some immigration policy. That debate is over numbers. No nation has an absolute principle that "there shall be no immigration" or "there shall be totally free immigration." It's really a matter of numbers and the criteria for determining numbers. In our country there are legitimate arguments and points of view, but the dominant interest recently has been the cheap labor lobby that wants easy immigration to keep wages down.

But isn't the political left also a strong force for liberalizing immigration laws?

That's true. At its root, our immigration policy is a class issue which has created some unexpected bedfellows. The cheap labor lobby within the business world says, "We need to open up immigration because we have a labor shortage." What that means is a shortage of *cheap* labor. Just raise the wage rate and you'll find people to work, but if you raise the wage rate then profits go down. The *Wall Street Journal* wants the easiest immigration policy. For very different reasons, liberal NGOs, church organizations, and folks of good will have a visceral feeling that easy immigration is a good policy. This is an issue that needs a lot more hard thought.

What is the role of nations in our globalizing economy? It seems as if the idealistic vision of the 1960s radicals—"one world"—is, in a most unexpected way, being actualized by transnational corporations.

The institutions of community—of mutual caring for people and places—exist mainly at a national and subnational level. It's a grand phrase to speak of the "world community" but really the world community is a quilt of national communities. If you try to erase national boundaries, that corrodes communities. If you have thrown everything into a single global pot, you have smashed many of the institutions of community.

There is a reaction when I speak against globalization: folks say, "You're an isolationist, you're a xenophobe." No. I am in favor of internationalization. That's not isolationist, that's countries cooperating, getting together, having treaties and protocols, but they remain separate units of policy.

Globalization is to internationalization as marriage is to friendship. Marriage is a union, you're integrated; with friends, you're close but separate. The idea that we are going to have a multilateral economic marriage of all countries is disrespectful of very real differences in ideals and interests among countries. By all means let's be friends, but, hey, keep your distance!

Globalization makes friendly independence difficult for nations because with free mobility of goods and capital it's very hard to maintain national standards like industrial policy, minimum wage, and environmental standards—to name a few.

Do you think within economics, or at least ecological economics, there is a place for the intrinsic value of other life forms beyond people? Can you have an economic theory that gives standing to trees?

Yes, but that question has largely been excluded from standard economics. When the issue does rarely come up, economists have generally made what is considered the hardheaded argument that nature has nothing but instrumental value to people.

In contrast, John Cobb [with whom Daly co-authored *For the Common Good*] argues that all sentient creatures have intrinsic value by their capacity to feel and enjoy life. A consequence of that perspective makes some people angry: not all creatures have equal capacity to experience. It may have something to do with the development of a central nervous system, but in any case it is probably a mistake to equate the intrinsic value—in terms of the capacity to enjoy life—of a clam with a whale.

This idea of total species equality, which the deep ecologists have sometimes stated, is very problematic. They may say, "You think a whale is worth more than a clam, but then how many clams does it take to equal a whale?" I don't know and I am not going to think in those terms, but I do know that given a choice between doing something for whales and doing something for clams, I'd give more to the whales.

Now, when you go back to instrumental value, it may be that for the whole ecosystem the clams perform filtering services that are instrumental to all other species, and whales don't. There are tremendously difficult issues here, and I have thought about some of them but I can't claim any burning clarity—and I am wary of those who claim they can.

Here economics and conservation biology both bump into that most humbling and profound of questions: What does life mean?

There is a real problem in the environmental movement that I have written about in the journal *Conservation Biology*: If you take a pure materialist, determinist perspective—think of Richard Dawkins and *The Selfish Gene* and of some of the writings of E.O. Wilson—it cuts the legs out from under conservation. If everything is an accident, if everything is a kind of robot—your consciousness is simply a little picture show running in your head—if purpose is not causative in the real world, only atoms in motion—that is the death knell for any policy, including environmental policy. I raised that issue with some of my biologist friends, who are in the grip of a kind of deterministic materialism, but I haven't gotten very far. People don't want to talk about metaphysics very much.

It seems as if conservation biology has proudly staked out territory apart from the rest of the biological sciences—particularly molecular biology—by saying "We are an activist discipline; we do bring values to our science" and yet the underlying philosophical framework for defending those values, as you say, seems on shaky ground, if they stick with this kind of bleak materialism.

For many biologists, there is an enormous reluctance to reconsider anything that falls under the heading of Darwinian. Certainly there is a lot true there, but some implications of a rigid materialist Darwinism are awfully hard to square with other values we are not willing to give up. There is a lot of rethinking that needs to be done in the conservation biology community to free themselves from some of their inheritance from molecular biology and think a little more in terms of purpose and where it comes from or at least make room for it in their metaphysics.

I had a chance to interview Paul Ehrlich last year. He's deeply passionate about saving life forms and yet sticks by this pure materialism. He seemed to have an internal conflict about that issue.

He does. The same with E.O. Wilson, whose work I admire very much. Incidentally, I have a review of Ehrlich's new book [*One with Nineveh*] in *BioScience*. I have known Paul for a long time and he is wonderful person. I have had short meetings with Wilson and was prepared to dislike him, but he is such a nice man. He is really fine. And when I raised this question about purpose with Wilson he just said, "That's the mother of all questions."

What do you imagine the world is going to be like for your grandchildren?

Unlike my lifetime, I doubt that they will see the world population triple. I hope not. And I doubt that they will see a 15-fold increase in energy and resource consumption, although it may be close, the way things are going right now. I am concerned about the way things are going. I don't think the world will be an easy place to live in their lifetimes. I hope I am wrong, but I don't see things getting better and better.

We have to face up to some limitation on growth, which, right now, is politically beyond the pale. But that won't continue; it has to change. ❮

Against the Grain

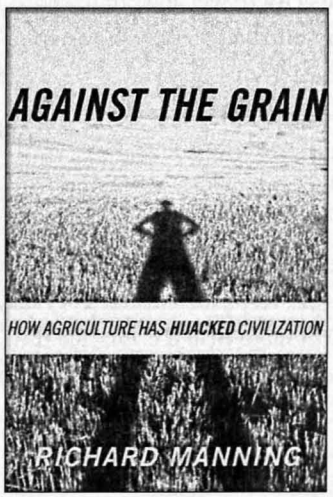
How Agriculture Has Hijacked Civilization

by Richard Manning
North Point Press, 2004
232 pages, $24

"THESE VEGGIES are agro!" enthused the smiling student at the college farm where I once worked. "Agro," I figured, must be a good thing. Richard Manning would disagree. Things agro aren't all peaches and cream, and his new book, *Against the Grain: How Agriculture Has Hijacked Civilization,* explains why. Like the fish that doesn't know it's wet, we don't know what we're in the middle of. Overpopulation, resource depletion, climate change, and extinction are but currents in the stifling sea of grass in which we swim: agriculture. Simply put, growing the food we need to survive has diminished us, and is killing the wild world. It's been that way for 11,000 years, and as "producing" replaces "growing," it's getting worse.

Why did hunter-gatherers "who spent their time running around the woods, hunting and fishing and trading meat for sex" decide to hoe weeds? How did agriculture blossom and spread so quickly and so far? The answers have much to do with our present predicament. Agriculture was (and is) an evolving process, of course, not an invention. Agriculture evolved because plants had already done most of the work. Spawned of end-of-an-ice-age flooding, it still depends on the large and repeated ecological catastrophes of human-directed irrigation and tillage. Importantly, it's a two way process. Between 40,000 and 10,000 years ago, our hunter-gatherer forebears reshaped the composition of the Earth's megafauna by hunting large mammals to extinction. "Think of this as proto-domestication," suggests Manning. Then, in some twisted turnabout, *we* became domesticated by a cohort of weedy, big-headed, annual grasses. Life, like soil, has eroded ever since.

As we all know, agriculture requires two things: workers and water. Lured by the promises of storable food, our hunter-gatherer ancestors rather quickly found themselves in a hard-working and hierarchical society. Irrigation's infrastructure spread. Granaries were built. The houses of the poohbahs grew larger. When resources ran out everyone moved—into someone else's turf.



After exploring farming's beginnings, *Against the Grain* traces the growth of "wheat-beef culture" and its spread around the globe. At first it encountered little resistance, but, explains Manning, "by and large farming spread by genocide." Archeological evidence in Europe shows a blitzkrieg of wheat-beef killers over the cave-painting Cro-Magnon. Spreading across temperate Eurasia, the coalition added horses to their growing stable of domesticated animals. They sailed to new lands, carrying weeds (plant and animal) and diseases. The exchange of smallpox for corn and rice made agriculture's advance through the tropics and the New World quick and easy.

The second half of *Against the Grain* takes the reader through crop hybridization and the Green Revolution of the 1960s, then the nearly complete global shift from traditional farming to industrial agribusiness and food processing. It's well presented and perhaps easier to digest than the preceding chapters, but not as filling. The trip to Archer Daniels Midland's corporate headquarters, the obligatory look at hog farms, fast food, obesity, and even farmers' markets and a visit with chef Alice Waters seem more snacks than meat and potatoes; this part of the book could have been richer. Biotechnology is barely mentioned (though it is in Manning's previous book, *Food's Frontier*). Certainly more could have been written on agriculture's effects on natural communities—for example, the soybean landscapes of Brazil or the sinking landscapes (from groundwater depletion) of China. Unfortunately, industrial agriculture's dependence on fossil fuels and fossil water is ignored (that book, how mining hijacked agriculture, should be on the shelves in time for the kids to read). Little attention is paid to the work in agroecology going on worldwide, though such efforts seem to address the author's concerns. (A few other bones to pick: It's time we call them pronghorn, and not antelope. The aquifer beneath the Great Plains is the Ogallala—Oglalla are Sioux. And quinoa is a chenopod, related to lamb's quarters, not a lupine.)

So how do we wrest the world from agriculture's grip? Manning sees lessons in our origins, and hope in local, small-scale farming. A farmer he

talks with offers one way to recover some of our primal sensuousness: grow tomatoes. Hunt for your supper. Patronize farmers' markets. Meet the many fine folks who grow and teach about and cook good real food. Savor it.

"Virtually every one of us faces the consequences of our ignorance of agriculture three times a day," Manning points out. Perhaps as our senses reawaken we can get to work on a less damaging "feral farming." For this life, as my collegiate friend knew, is surely agro. ☾

Reviewed by **Jake Vail,** *a librarian, arborist, field biologist, and member of the Land Institute's Prairie Writers Circle.*

Walden

150th Anniversary Edition

by Henry David Thoreau
Foreword by Terry Tempest Williams
Original wood engravings by Michael McCurdy
Shambhala, 2004
303 pages, $24.95

HERE WE GO AGAIN, with yet another repackaging of the quirky memoirs of a sullen intellectual's 26-month hiatus from the concourse and commerce of humanity, in search of nature, simplicity, and meaning in life. A marketplace flop when it was published in 1854, *Walden* went on to become the flagship of American nature writing. Befitting its 150th anniversary, this celebratory edition from Shambhala (distributed by Random House) boasts art-quality acid-free paper, a foreword by Terry Tempest Williams, and 50 original wood engravings by renowned woodcut artist Michael McCurdy. So proud are the publishers of this lovely package, they are offering a collector's run of 100 slip-cased first-edition copies, numbered and signed by the artist—at a hundred bucks a pop. Meanwhile, the mill-run edition is just as lovely and a bargain at $24.95.

Like countless other youngsters, I suffered through my first reading of *Walden* in high school without benefit of informed interpretation by the teacher who assigned it. Even so, I absorbed enough from my initial tour around Henry's pond to sense an empathy with the eccentric son of a New England pencil maker. I admired the young Thoreau's outspoken iconoclasm ("No way of thinking or doing, no matter how ancient, can be trusted without proof"), his gentle but sturdy civil disobedience ("Any fool can make a rule, and any fool will mind it"), and his poetic compassion for nature as integral to a healthy human soul ("A lake is the landscape's most beautiful and expressive feature. It is earth's eye; looking into which the beholder measures the depth of his own nature"). But what spoke most musically to me, a young contrarian in the making, was Thoreau's shameless celebration of individuality and simplicity in the face of a cultural current that, even in the mid-nineteenth century, flowed hard the other way.

Since that first go-round, I've come to consider an occasional armchair return to Walden Pond essential to the maintenance of a balanced life. I now find that *Walden* is a user-friendly guide to discerning between the essential and nourishing in life, and mere distracting dross.

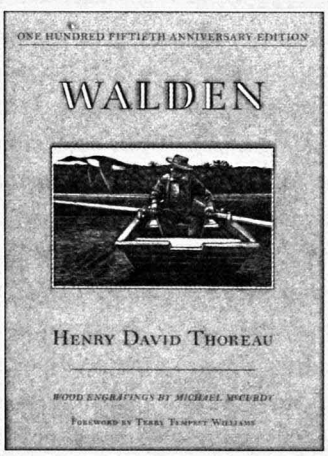
In one insightful paragraph early in her six-page foreword, Terry Tempest Williams caps both the book's external structure and its author's inner journey:

> *Walden* chronicles through the succession of the seasons Thoreau's awakening as a human being. "How much virtue there is in simply seeing," Thoreau records. The art of seeing becomes his practice. The act of writing becomes his meditation. The outer landscape is his teacher. And as his knowledge of the outer landscape expands, his inner landscape deepens. Walden Pond becomes a reflection of his own wild nature.

Aside from its timeless wisdom and quaintly poetical prose, *Walden* is also often a hoot. Through his ebulliently sourpuss observations of his fellow Concordians, delivered in the cocksure voice of a critical chanticleer and heretic herald, Henry makes us laugh, to wit: "Sunday is the fit conclusion of an ill-spent week."

But of course, you've read *Walden* too, and already know all of this.

What is new and notable this time around, in addition to the book's high production quality and Williams's gracious foreword, is Michael McCurdy's utterly kindred art. I've long been a fan of this widely celebrated yet modest New Englander's painstakingly hand-etched images, in whose white-on-black starkness resides a visual mystique that magically animates Thoreau's



inner ventures and outdoor adventures on and around Walden Pond.

Unfortunately, when Williams was asked to write a foreword, McCurdy had not yet had time to complete and deliver his woodcuts to the publisher—thus, unavoidably if disappointingly, Terry's tribute includes no mention of art. Months later, after she had seen the finished book, she sent me this addendum:

> Michael McCurdy's woodcuts are to Henry David Thoreau's *Walden* as Rockwell Kent's images are to Walt Whitman's *Leaves of Grass.* We experience a perfect conversation between the writer and the artist. There is a quiet restraint within each woodcut. Nothing extra. In the spare, raw beauty of Michael McCurdy's images, he takes Thoreau's philosophy, "simplify, simplify" and lays it bare. The sublime moments one holds in the companionship of solitude are captured: A man enters the sanctity of water; the clarity of a night sky is the contemplation of stars; we see the handwork of gardens, the movement of birds. If one can hold the grace of a good life in hand, Michael McCurdy's work makes that experience possible. Each print becomes a window where we can view those moments in a private life, a transcendence through beauty.

Indeed, even if you think you've read *Walden* for the final time (unthinkable!), the art alone earns the price of re-admission, not only by its mystical stand-alone beauty, but by adding a new, visually numinous layer to HDT's visionary explication of the importance of wildness as an icon of life in balance—a template for social responsibility and ecologically mindful living.

My only disappointment with this otherwise singular offering is its lack of an index. Even so, no more valuable gift than this book—and the encouragement to read it—could be given to young readers in these troubled and uncertain times. ☾

Reviewed by **David Petersen,** *author of 14 books, whose self-confessed "wannabe* Walden*" is* The Nearby Faraway: A Personal Journey Through the Heart of the West.

Been Brown So Long It Looked Like Green to Me

The Politics of Nature

by Jeffrey St. Clair
Common Courage Press, 2004
408 pages, $13.97

In 1992, overjoyed at the end of 12 years of Reagan-Bush environmental mismanagement, environmentalists hailed the new Clinton-Gore administration, and thereafter largely gave it a pass on environmental policy. This, as reported in *Been Brown So Long It Looked Like Green to Me: The Politics of Nature* by Jeffrey St. Clair, was a key error that has left U.S. environmental policy in shambles and set the stage for an all-out assault on nature by the George W. Bush regime. St. Clair is a co-editor of *Counterpunch Magazine* (along with Alexander Cockburn) and this book is a collection of columns on environmental policy written between 1995 and 2003, presumably for *Counterpunch*; regrettably, original citations are not given.

In the title essay, St. Clair reviews the heyday of environmental policy under Nixon, and its decline under all subsequent administrations. Since the passage of the Clean Air Act, Clean Water Act, and Endangered Species Act, a backlash by corporate capitalists has sought to undo, unravel, and subvert environmental restrictions on its activities. Some of this—especially the Reagan excesses—is well known in environmental circles, but the inside dealings of the "Clintonistas" with some of the largest environmental groups have received less attention. That Clinton and Gore were opportunists when it came to the environment is no secret, and St. Clair details their sell-outs to corporate interests, culminating in their steamrollering NAFTA with the connivance of Jay Hair, former president of the National Wildlife Federation, and 8 of the 10 largest environmental groups. But even in the first Bush administration some of the biggest environmental groups allowed themselves to be neutered in exchange for the dubious privileges of "access" and the more mundane considerations of fat salaries in the leadership. At that time, a split between grassroots activists and "Big Green" developed, which continues to this day.

Most of the essays deal with issues in the American West, reflecting a personal passion of St. Clair's, who moved with his family to Oregon only to find its environmental amenities rapidly being destroyed by greedy industries, corrupt politicians, and inept and compliant environmental organizations. Among the latter, the names of the Sierra Club and Wilderness Society come up with depressing regularity. One section of great interest is "Wild Matters." Here are exposés of a variety of assaults on the natural world—including a tale about the chairman of the Wilderness Society clearcutting old growth on his own ranch. In

"Ransoming Yellowstone," St. Clair dissects Clinton's order "saving" Yellowstone from a gold mine on its border, and finds a classic smokescreen whereby Yellowstone was saved from a threat that was pure bluff, while oil and gas companies got huge concessions for drilling on public land throughout the West. "Giving it All Away" is a hard look at western land swaps. Beneath the "win-win" rhetoric, St. Clair finds a morass of bogus assessments, sweetheart deals with developers, and case after case where federal officials (former Interior Secretary Bruce Babbitt, for one) gave away jewels and got chicken feed in return. The section ends with an essay on the current Bush administration's war on endangered species, noting that Babbitt's pusillanimous approach to designating critical habitat is now being legally exploited by Bush to make the ESA meaningless by disconnecting species from their habitats.

Three essays, "The Risky Business of Life," "Eve, Don't Touch that Apple," and "Dioxin for Dinner" (all written in 1995–96) detail how corporate interests engineered repeal of the Delaney Clause and its replacement with the rubbery Food Quality Assurance Act, which St. Clair predicts will result in increased cases of poisonings and cancer deaths. Again he asserts that the Clinton administration gave industry what it wanted for years, while major environmental groups—special mention to the Environmental Defense Fund and the Natural Resources Defense Council—caved or collaborated in the "spirit of cooperation."

A particularly disturbing essay is "Black Deeds in the Black Hills," which chronicles another depressing case of "environmental groups" and "environment-friendly" politicians behaving like the greedy exploiters they profess to abhor. The essay delves into Senator Tom Daschle's legal sleights of hand that opened the last wild areas of the Black Hills to logging. Carrying water for Daschle's pandering to his political contributors were (once again) the Sierra Club and the Wilderness Society. According to St. Clair, the deal was much worse than a case of local skullduggery; its real damage was opening up forests everywhere to indiscriminant chainsawing under the guise of "fire prevention."

St. Clair's essays display a combination of passion, outrage, and wit reminiscent of Carl Hiaasen's writing about the politics of Florida. He also has a knack for guiding his readers through the legal and financial underbrush. I found his passion for the land and wildlife combined with an unyielding "hard Left" attack on corporatism and market fundamentalism refreshing. The environmental movement is exhorted to broaden its concern to include social justice, but social justice advocates often show little inclination to broaden their own perspectives. St. Clair knows that both are important, and more importantly, both are often inextricably intertwined.

Been Brown So Long It Looked Like Green to Me may stir up anger and discomfort in some environmental camps. The harsh indictments of the recent performance of some of the largest environmental groups should trigger some soul-searching in those organizations, and with the rank-and-file members who contribute to them. St. Clair's personal preference for supporting local activists and ignoring their higher-ups comes through clearly in his writing. In the preface of the book, he admits that living in Oregon has led to a visceral dislike of the big environmental groups in their current Beltway manifestation, and to a conviction that radical grassroots action is increasingly important to today's environmental activism. If you are looking for recommendations, St. Clair has listed his favorite groups in the preface. ☾

Reviewed by long-time Wild Earth *contributor* **R. Wills Flowers,** *who is currently in Costa Rica on a National Geographic Society grant studying mayfly biogeography.*

Road Ecology

Science and Solutions

by Richard T. T. Forman et al.
Island Press, 2003
481 pages, $32.50

HIGHWAYS AND motor vehicles increase mobility of humans, but often at a high cost to nature: roads fragment wildlife habitat, create barriers to wildlife movement, and lead to mortality of animals attempting to cross. These and other pronounced ecological effects not only occur at the immediate border between highways and habitats, but also may extend thousands of meters beyond, creating "negative edge effects." Published accounts of the impacts of roads and vehicles on wildlife date back to the 1920s, yet not until the last two decades have public institutions and the scientific community recognized the extent of the impacts on ecological systems and started to devote more resources to address the problems.

The new discipline of landscape ecology has increased this knowledge, exploring very large systems such as

road and stream networks—and how these systems interact. From the beginning, Richard T. T. Forman, professor of landscape ecology at Harvard University, has championed research and practical application of this new science, writing definitive volumes on landscape ecology.

In his most recent effort, *Road Ecology*, Forman assembled an impressive group of 13 co-authors to produce an authoritative account of the science of roads and their ecological effects. This book was thoroughly researched and includes more than 1,000 citations in the bibliography. The authors approach the issues at scales ranging from individual road-kill sites, to impacts on watersheds, to continental- and global-scale problems like greenhouse gas emissions.

Road Ecology begins with the scientific foundations behind the ecological study of roads and ends with an effective synthesis that applies the emerging principles of landscape ecology to the planning and management of transportation systems. The book is divided into four major sections: roads, vehicles, and ecology; vegetation and wildlife; water, chemicals, and atmosphere; and road systems and further perspectives. The complex cascade of cause and effect between roads, vehicles, and natural systems is thoroughly addressed, and the authors also provide an excellent summary of the interlocking feedback relationships that explain the profound effects of road networks on whole landscapes. Detailed examples, mostly from North America, explore impacts and offer various remedies.

Combining ecological and engineering concepts results in a staggering number of statistics and units of measure. The use of so many different "metrics"—such as road densities, vehicles per two-lane equivalent kilometer, number of vehicles per household, road length per 1,000 persons, number of persons per kilometer, and so on—sometimes makes it difficult to compare areas from one chapter or example to the next. (To their credit, the authors offer broadly useful quantitative concepts such as *road effect zone* to determine the area of impact and *effective mesh size* to address the variability in measures of road network density.) As road ecology advances, a standardized set of comparable metrics would be useful.

Road Ecology highlights two key shortcomings associated with the transportation planning process. First, ecological considerations are typically glossed over at the early stages of planning new roads—particularly by local and state governments. Second, metropolitan planning organizations (local government commissions that determine and approve transportation projects) are not usually involved with issues related to mitigation of environmental impacts, land-use planning, and the effects of urban sprawl. Certainly public policymakers in these venues could benefit from the information in this book.

Forman and his colleagues have generated an indispensable volume for professional ecologists, engineers, and planners, as well as interested citizens. The authors do not offer to answer all the questions—rather, their intent is to present the state of the science, and to generate greater public awareness and additional scientific investigation of the ecological impacts of roads. At the least, this book should lead to improved transportation planning. It also has the potential to be a good tool in the broader work of raising societal standards to include environmentally sensitive road systems, economically viable vehicle technologies, better public transit, and fuel alternatives. ❨

Reviewed by **Daniel J. Smith,** *a scientist at the University of Florida's GeoPlan Center who conducts research on the ecological effects of roads.*

The Changing Mile Revisited

An Ecological Study of Vegetation Change with Time in the Lower Mile of an Arid and Semiarid Region

by Raymond M. Turner, Robert H. Webb, Janice E. Bowers, and James Rodney Hastings
The University of Arizona Press, 2003
334 pages, $75

IMAGINE THE information content of 98 sets of three pictures, each set taken at the same point in the same direction, matched carefully, each photo in a set separated by decades from the others, in all spanning more than a century. That is what *The Changing Mile Revisited* presents: the landscape in southern Arizona and northwestern Sonora—across the desert and grassland to the lower reaches of oak woodland, into the Sea of Cortez, and to the edges of the desert region in southeastern Arizona. These images were taken at sites from sea level to a mile above sea level. The goal of this work was to document through the objective eye of the camera lens the vegetation changes that have occurred here, and to provide an interpretation of causative forces.

This is a thoroughly revised and

augmented new edition of the original *The Changing Mile* by James Rodney Hastings and Raymond M. Turner, published in 1965 by the same press. That work has been a standard in southwestern ecology since its publication. Hastings, interested in human impact on the landscape, initiated the first round of rephotography that led to the publication of the 1965 edition and to the establishment of the extensive repeat-photography archive at the Desert Laboratory in Tucson. Though Dr. Hastings passed away in 1974, his co-author has been studying dynamics of desert vegetation since the mid-1950s and carries this work forward in the new edition. Two new authors bring added expertise: Robert Webb is involved in interdisciplinary work melding climate change, plant ecology, and aspects of ecology to understand long-term changes in the Southwest, and Janice Bowers has studied life history of woody plants and dynamics of plant populations in relation to climatic variability. Anyone who has been in the Southwest for an entire career will have seen landscape changes; thus, the authors decided enough change had occurred since the first edition to be detectable, and the new book was planned. The addition of excellent new photos by Tucson photographer Dominic Oldershaw provides marvelous comparisons.

So what do we have? The new book has 334 pages vs. the original 317, and 98 sets of three matched photos vs. the original 97. All text and captions have been rewritten. There is an added preface, and the final two chapters of the old volume are now merged as a concluding chapter, "Change and Cause." The book is eminently readable and does not in the least require a technical background. Additionally, the new book seems to be of better paper. Pages in the new are 17% larger, and contain three photos on facing pages rather than two, requiring a 33% reduction in size of photos—but the images are so well rendered that detail is much more evident.

The earliest photo is from 1880, the last from 2000. Those that comprise the first set range from 1880 to 1950, with 10% in the decade of the 1880s, 42% in the 1890s. In the second set 93% are from the 1960s, and the same proportion for the third set are from the 1990s. There are helpful appendices on climate stations, plant names, photographic stations, and miscellaneous notes and references. The book is well indexed and clean with regard to typos and mis-statements; I note one error on a graph in Chapter 8 where temperature is labeled as °C when °F is meant (whew, southeastern Arizona cooks!).

What do we learn? The authors argue that repeat photographs have their place in studying vegetation patterns and trends, for some purposes being more efficient than tedious repeat sampling of vegetation plots, and more accurate in terms of small-scale changes and plant identification than can be documented by aerial or satellite photography (both of which are also disadvantaged by having a shorter history than terrestrial photography). The authors summarize changes in the three vegetation zones, and also summarize trends for more than a dozen major plant species. The photos are fascinating, but perhaps the most interesting chapter is the final one on the causes of shifting vegetation patterns.

We may come to this book with preconceptions about the agents of change, but the authors caution us: watch out, things may not be as they seem. The correlation between the onset of grazing and changes in arroyo-cutting (an arroyo is a gully carved by an intermittent stream; new, deep, steep-walled channels were often cut to promote greater flow) and in vegetation in southern Arizona from 1880 to 1900 may not be direct, for there was also a severe drought at the time. In addition, fire suppression was initiated in the early 1900s. Certainly there has been a general trend toward increased brushiness, but this has also occurred where human impact is not so strong. The final paragraphs of the book provide a synopsis of the most plausible explanation of vegetation shifts. Climate change has effects, especially near the margins of ranges, and with regard to arroyo-cutting. Intense livestock grazing cannot be exonerated as a cause, but it probably works as much to reduce fine fuel as to directly and permanently deplete grasslands. Fires, once common, could no longer be carried once grass was removed, and woody plants were, therefore, no longer eliminated. Fire suppression augmented this effect. Mesquite and distasteful shrubs increased.

This fine volume provides an easily comprehended overview of the changes in vegetation in the Southwest following the arrival of European settlers. *The Changing Mile Revisited* belongs on the shelf of anyone interested in the Southwest and its natural history, ecologists and lay persons alike. The pictures alone are worth the price. ☾

Reviewed by plant systematist **Richard Spellenberg,** *professor emeritus at New Mexico State University and author of* Sonoran Desert Wildflowers.

[ARTISTS THIS ISSUE]

WILD EARTH has long occupied a unique niche in its coverage of conservation issues, and an equally unique niche in its visual presentation. The original art and illustration appearing in the journal has set it apart from the plethora of color glossies on the periodical shelf. With this, our final issue, we offer gratitude to all our contributing artists. Thank you for so generously sharing your works over the years, illuminating our pages.

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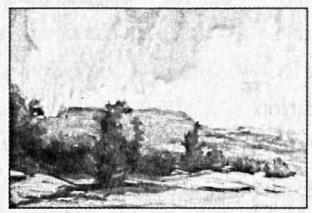

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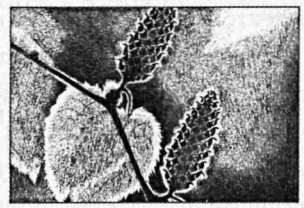

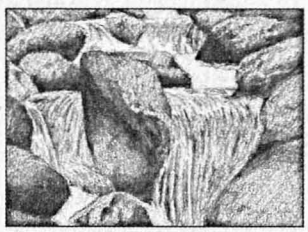

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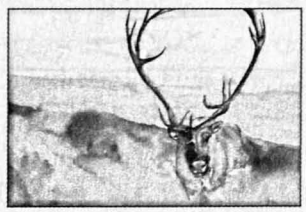

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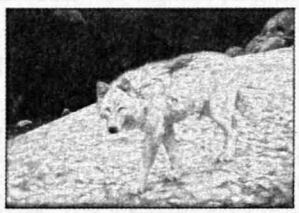

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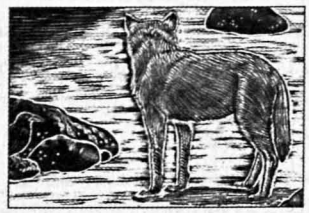

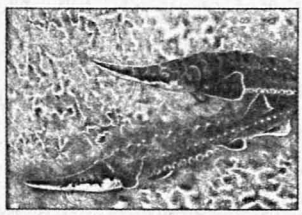

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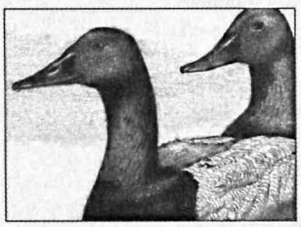

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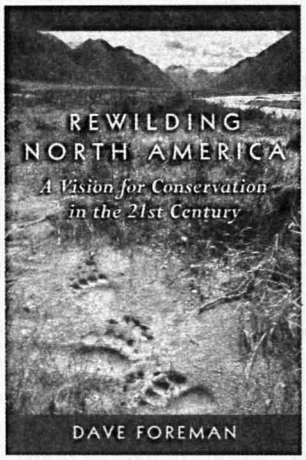
NEW FROM ISLAND PRESS



Dave Foreman is one of North America's most creative and effective conservation leaders, an outspoken proponent of protecting and restoring the earth's wildness, and a visionary thinker.

In *Rewilding North America,* Foreman takes on arguably the biggest ecological threat of our time: the global extinction crisis. He not only explains the problem in clear and powerful terms, but also offers a bold, hopeful, scientifically credible, and practically achievable solution for reconnecting, restoring, and rewilding the North American continent.

Foreman sets out the specific evidence that a mass extinction is happening and analyzes how humans are causing it. He describes recent discoveries in conservation biology that call for wildlands networks instead of isolated protected areas, and shows how wildlands networks are a logical next step for the conservation movement. The final section describes specific approaches and offers concrete and workable reforms for establishing them. Foreman closes with an inspiring and empowering call to action for scientists and activists alike.

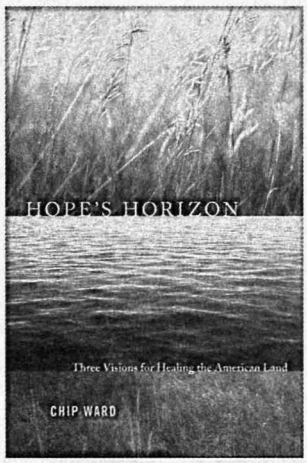
Paper: **$25.00** 1-55963-061-2
Cloth: **$50.00** 1-55963-060-4

"*Rewilding North America* is a must-read for anyone who cares about protecting our natural heritage for the benefit—for the very sustainability—of future generations. Dave Foreman's descriptions of mass extinctions, his distillation of the scientific evidence for this scary prospect, his contextual grasp of conservation history, and his hopeful plan for action illuminate the path we critters who share this continent must pursue. This vision of an enduring wilderness in *Rewilding North America* shows how saving every wild place we can is so imperative."

–**MIKE MATZ**, EXECUTIVE DIRECTOR, CAMPAIGN FOR AMERICA'S WILDERNESS

"Foreman has created a masterful blend of history, science, and vision. *Rewilding North America* takes the reader through the often gloomy history of conservation and destruction in North America during the last century, paints an inspired but achievable future for wildlife and wildplaces, and asks each of us to take deliberate action to secure this vision. This book offers practical lessons from one who has long been speaking (and acting) for the preservation of wilderness."

–**DEBORAH B. JENSEN**, PRESIDENT AND CEO OF WOODLAND PARK ZOO



At a time of widespread environmental pessimism, *Hope's Horizon* goes on an inspirational offensive. In this entertaining and thought-provoking book, author Chip Ward tells of his travels among a new generation of activists who are moving beyond defensive environmental struggles and advocating pioneering strategies for healing the land.

Ward's three-year odyssey took him behind the scenes of the effort to reconnect fragmented habitats and "re-wild" the North American continent. While the book's starting point is a hard-nosed indictment of humanity's failed stewardship of the earth, the stories tell of catalytic optimism and ecological wisdom in the face of self-destructive habit and blind pride.

Lively, literate and broad in its sweep *Hope's Horizon* will change the way readers see the world.

Cloth: **$27.00** 1-55963-977-6
Shearwater

"*Hope's Horizon* is a lively account and often downright poetic account of an emerging movement for conservation."

–**DAVID JOHNS**, PORTLAND STATE UNIVERSITY; PRESIDENT, THE WILDLANDS PROJECT

"Chip Ward, with a nice background in making toxic polluters and nuclear barons perspire and knuckle under and a wicked sense of humor, is exactly the right tour guide for this panoramic vision of American environmental possibilities and the geography of hope. The section on Glen Canyon Dam rises to pure prophetic power in the tradition of Thoreau and Martin Luther King."

–**REBECCA SOLNIT**, AUTHOR OF *WANDERLUST, RIVERS OF SHADOWS,* AND *SAVAGE DREAMS*

"Chip Ward has become a witness to the ongoing struggle between the inhabitants of the West Desert and those who seek to turn this land into a toxic graveyard for military waste, He is a voice we need to hear."

–**SANDRA STEINGRABER**, AUTHOR OF *LIVING DOWNSTREAM* AND *HAVING FAITH*

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Both books feature the work of the Wildlands Project

Siuslaw: An Oregon Solstice

Even here, at the bottom
of winter's deep pocket, the world
is alive with sound:

the draining wake of beaver
through half-sunk upcast fringe
banking a pool that pulses

ragged green in pine shadows;
the surface shred by wingtips
as canvasbacks ascend into

a mist hung out to dry;
the passing jabber of a sparrow
contra dance, wheeling out

from head-high ferns; staggered
rasp of frog yawns, hawk
roost squeal. And then

only the ocean
unfolding back of pines
and the breathy psalms

of sawgrass mingling.
This world is alive,
and all sounds are voices.

Laird Christensen

graphite by Todd Cummings

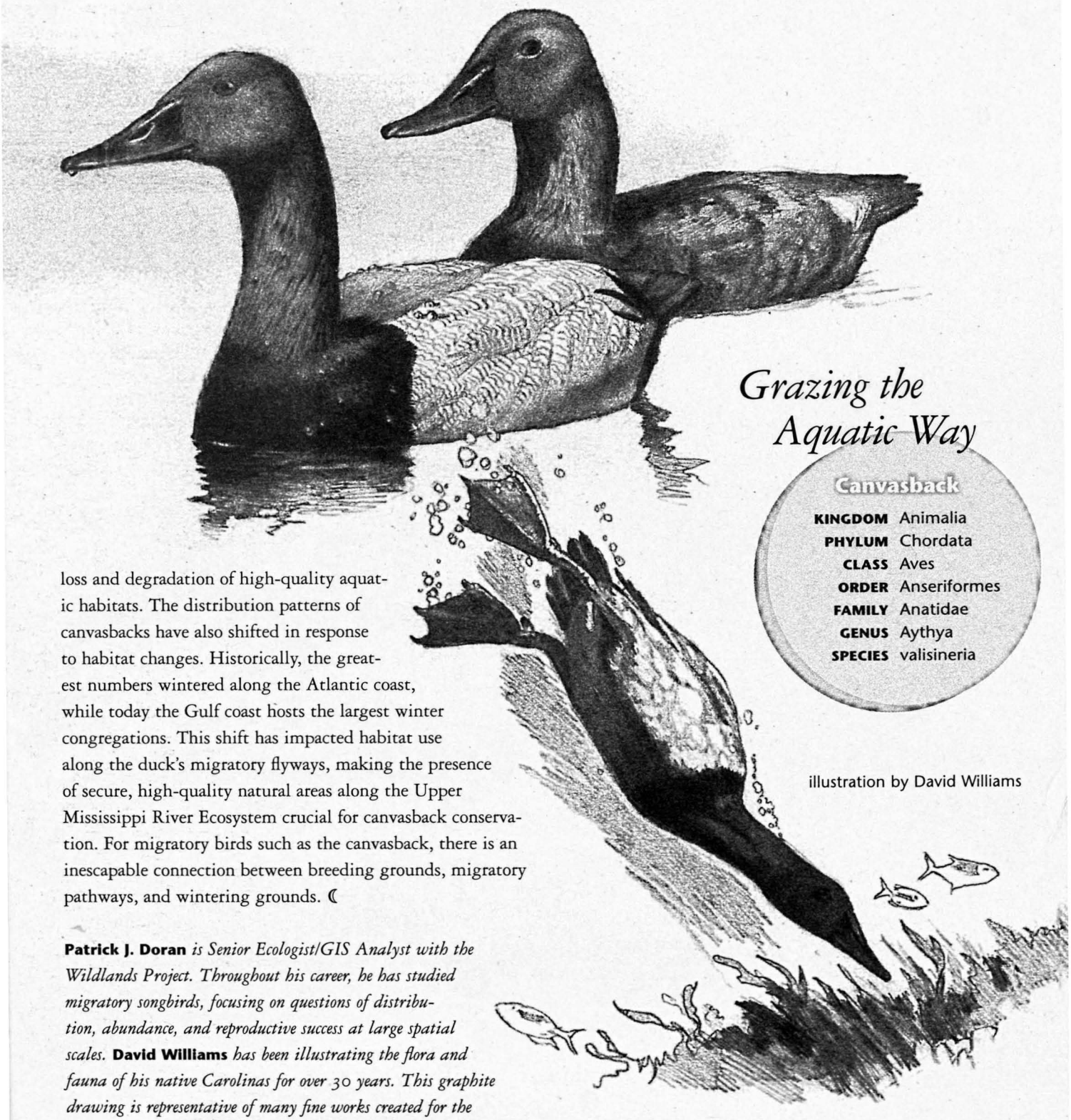
IMAGINE A PLACE where canvasback ducks congregate by the hundreds, then by the thousands, then by the tens of thousands. Imagine a place where, day after crisp autumn day, one hundred thousand canvasbacks patter along the water's surface during take-off, whirring their wings in flight, and splash down to rest and refuel for the final legs of a migratory journey.

Such a place does exist. Along a stretch of the Upper Mississippi River Ecosystem, from the Chippewa River in Wisconsin south to Davenport, Iowa, canvasbacks migrate in numbers that astound. Here, the canvasback duck, a species found only in North America, relies upon the open water and extensive marshes of the Mississippi River. Over 20% of the world's population of canvasbacks makes use of this flyway connecting their summer breeding grounds in the prairies of central Canada and the north-central United States with portions of their wintering grounds along the Gulf coast.

I first became acquainted with canvasbacks along this route, spying rafts of rust and white resting on the open water. Some of the birds were busy diving and dabbling for submerged aquatic plants; this vegetation lends two distinctive characteristics to the canvasback. First, one of these plants, American wildcelery (*Vallisneria americana*), a preferred food, is the source of the species' scientific name, *Aythya valisineria*. Second, this diet of submerged aquatic vegetation makes the duck excellent eating and therefore a preferred target for harvest. The bird's common name may come from the historic practice of shipping birds to market in recyclable canvas bags labeled "canvasback." An easy target, the species experienced significant declines in population size in the early 1900s.

Since the 1950s, the global population of canvasback ducks—which remains below the target population goal of the U.S. Fish and Wildlife Service's North American Waterfowl Management Plan—has been closely watched. Despite strict harvest regulations, including hunting closures, recovery of the canvasback population has lagged, likely as a result of the

Species Spotlight



Grazing the Aquatic Way

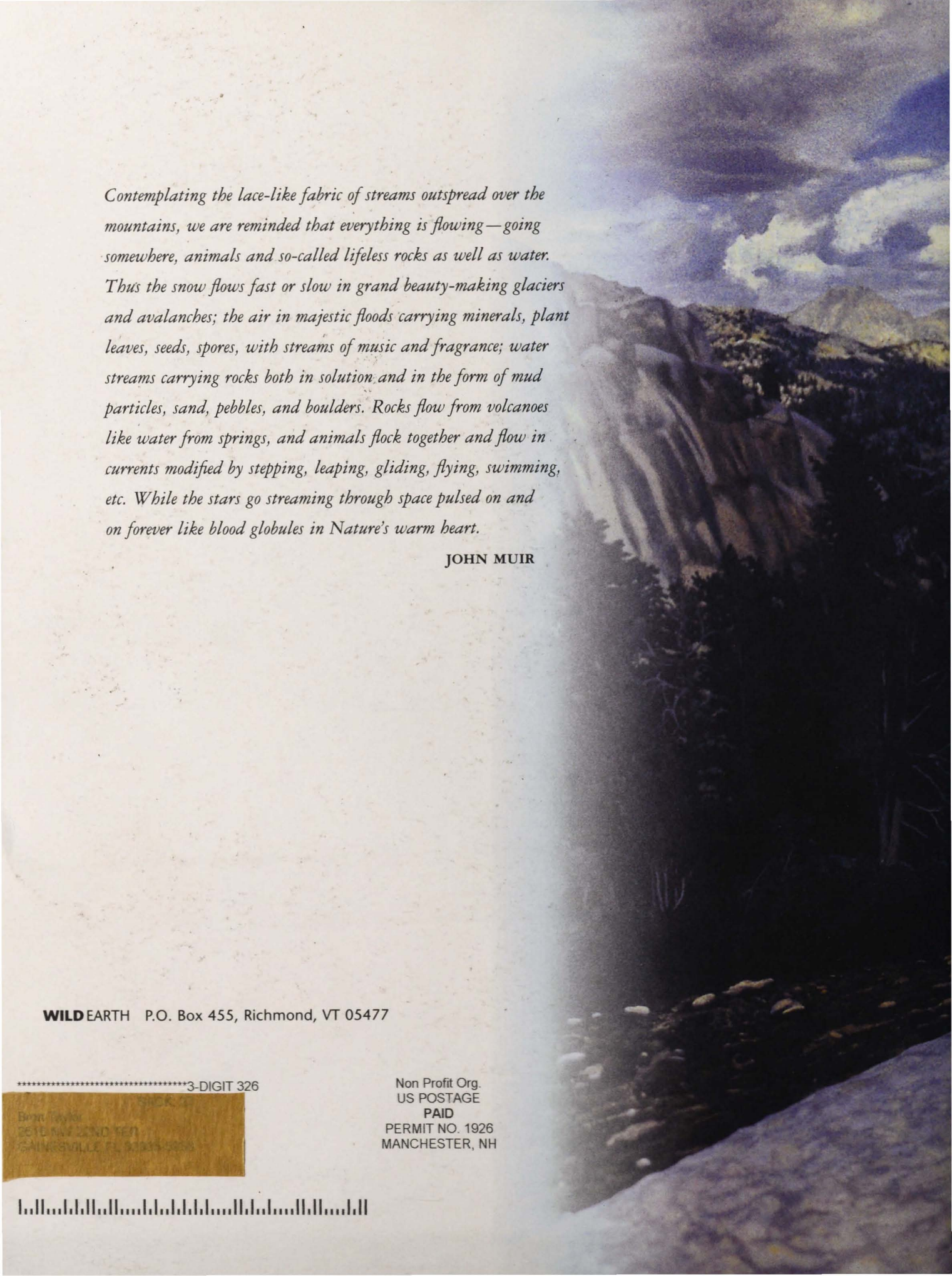
Canvasback

KINGDOM	Animalia
PHYLUM	Chordata
CLASS	Aves
ORDER	Anseriformes
FAMILY	Anatidae
GENUS	Aythya
SPECIES	valisineria

illustration by David Williams

loss and degradation of high-quality aquatic habitats. The distribution patterns of canvasbacks have also shifted in response to habitat changes. Historically, the greatest numbers wintered along the Atlantic coast, while today the Gulf coast hosts the largest winter congregations. This shift has impacted habitat use along the duck's migratory flyways, making the presence of secure, high-quality natural areas along the Upper Mississippi River Ecosystem crucial for canvasback conservation. For migratory birds such as the canvasback, there is an inescapable connection between breeding grounds, migratory pathways, and wintering grounds. ☾

Patrick J. Doran *is Senior Ecologist/GIS Analyst with the Wildlands Project. Throughout his career, he has studied migratory songbirds, focusing on questions of distribution, abundance, and reproductive success at large spatial scales.* **David Williams** *has been illustrating the flora and fauna of his native Carolinas for over 30 years. This graphite drawing is representative of many fine works created for the "Nature's Ways" column in* Wildlife in North Carolina *magazine, where he served as art director and illustrator for 10 years. Now a full-time freelance artist, David was awarded the Conservation Communicator of the Year Governor's Award (North Carolina) in 2002.*



Contemplating the lace-like fabric of streams outspread over the mountains, we are reminded that everything is flowing—going somewhere, animals and so-called lifeless rocks as well as water. Thus the snow flows fast or slow in grand beauty-making glaciers and avalanches; the air in majestic floods carrying minerals, plant leaves, seeds, spores, with streams of music and fragrance; water streams carrying rocks both in solution and in the form of mud particles, sand, pebbles, and boulders. Rocks flow from volcanoes like water from springs, and animals flock together and flow in currents modified by stepping, leaping, gliding, flying, swimming, etc. While the stars go streaming through space pulsed on and on forever like blood globules in Nature's warm heart.

JOHN MUIR

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