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—John C. Hendee, *IJW* Editor-in-Chief

On the Cover

FRONT: Green parakeet flock (*Aratinga holochlora*) at the Sotano de las Golondrinas cave, San Luis Potosi, Mexico. Image courtesy of Jaime Rojo © —International League of Conservation Photographers

INSET: Zapotec woman from the sustainable coffee cooperative in the Sierra Norte of Oaxaca, Mexico. Image courtesy of Jaime Rojo © —International League of Conservation Photographers

International Journal of Wilderness

The *International Journal of Wilderness* links wilderness professionals, scientists, educators, environmentalists, and interested citizens worldwide with a forum for reporting and discussing wilderness ideas and events; inspirational ideas; planning, management, and allocation strategies; education; and research and policy aspects of wilderness stewardship.

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EDITORIAL PERSPECTIVES

Wilderness in a Word … or Two … or More

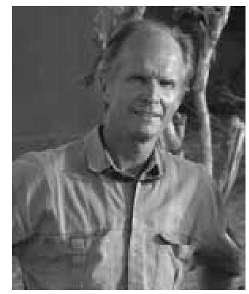
BY VANCE G. MARTIN

During 30 years of negotiating, cajoling, persuading, and otherwise verbally wrestling about wilderness with people from more than 80 nations, I long ago came to a basic operating reality—the word is important in so much as it gets the job done. What's more important is the goal of protecting and sustaining wild nature.

In many cases the word is extremely important, for example in those nations and jurisdictions that have a legal construct for the word *wilderness* (United States, Canada, South Africa, Australia, Sri Lanka, New Zealand, The Confederated Salish and Kootenai Tribes, etc.) (Kormos 2008). Further, in the context of the International Union for Conservation of Nature's (IUCN's) World Commission on Protected Areas and its protected area categories, the word *wilderness* is very important because it acts as an international standard.

But when advocates, policy makers, planners, and managers apply the standards and criteria to new jurisdictions or locales, they need to have an interest in communication, an ear for language, and a heart for culture. The goal of protecting and sustaining wild nature—its qualities, services, solitude, and serenity—is achieved through finding common ground with people of different cultures, religions, politics, persuasions, and employment.

When considering wilderness, I marvel at some of the linguistic differences. *Zapovedniki* in Russian literally means "forbidden area," clearly a product of a Marxist, central-state era of thinking and policy making. It wouldn't play well in California, but it gets the job done in Russia. In Iceland, the words are *ósnortið víðerni*, which mean something like "untouched land." This is used in spite of the fact that most of Iceland has been or is still impacted by sheep grazing. But it gets the job done in Iceland, where the awesome landscapes clearly communicate wilderness quality, convey a wilderness experience, and contain biologically important characteristics.



VANCE G. MARTIN in Mali. Photo courtesy of The WILD Foundation.

Latin countries, despite sharing a similar root language, clearly are not bound by it.

The "Old World" shows wide variation … after all, it's Europe! In French, *area sauvage* rather speaks for itself. In Romania, as Erika Stanciu told us in the December 2008 *IJW*, the word is *salbaticie*, capturing in one word both the sense of wild animals as well that of a deserted, isolated place unaffected by human civilization. The root of that word comes from the Latin adjective *silvaticus*, itself originating from the word *silva*, or forest. And in Italy, the mother-state of Latin itself, guess what? *Area wilderness* is used freely, has even made it into provincial law *and* the dictionary, thanks to the lifetime dedication of Franco Zunino and his Associazione Italiana per la Wilderness.

What of the new world, outside Canada and the United States? Virtually all the other countries speak Spanish—with the notable exception of Brazil, plus a smattering of countries here and there that speak French and English. Simply importing the word *wilderness* from the large, gringo neighbor *al norte* has never been an option for the countries *al sud.* Despite that, the wilderness concept is on the move in Latin America. The name of choice settled on by practitioners is *tierras silvestres*—you can figure that one out by yourself—and it is the lead term as WILD9—the 9th World Wilderness Congress—convenes in Mexico's Yucatan, November 6–13, 2009. (www.wild9.org)

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SOUL OF THE WILDERNESS

The Hidden Wildness of Mexico

BY JAIME ROJO

As a child I was filled with images and ideas of the biodiversity and culture of Mexico. Jaguars, bighorn sheep, blue whales, or harpy eagles harmoniously blended with the ethnic groups of Lacandons, Huichols, or Seris in a collage whose main theme was diversity. As I studied this country more, I dreamed the sounds of its primeval forests, the endless stars of its desert nights, and the burning heat of the mountain escarpments. At that time, I didn't have a name to describe that force, or presence, which kept me aware and dreaming through many nights. Today, I do, but it was a couple of decades before I understood what this was all about.

I grew up in Spain, and during my childhood's endless summers, the torrid olive groves or the ancient *dehesas*—cattle-managed Spanish oak woodlands—in which I would wander for hours in search of insects or birds seemed to me the ultimate wilderness, the last frontier. I was raised in Madrid, the capital city of Spain, but was lucky enough to have parents who were passionate for nature and allowed me to experience the rural world and the wildest side of my country. Those wonderful years shaped my life, and I will never forget them.

Figure 1—Morning mist in a pine forest at the Neovolcanic Axis, Morelos. Photo © by Jaime Rojo.

Figure 2—White-eared hummingbird (*Hylocharis leucotis*), Neovolcanic Axis, Mexico. Photo © by Jaime Rojo.

Relative Landscape Scale

Years later I had the opportunity to come to Mexico and fulfill my childhood dreams. I have now lived in Mexico for five years, and I am still humbled by the untamed nature that is hidden in every corner of this incredible country. The best part is that, after having traveled through much of its lush forests and scarped sierras, I feel I have only seen "the tip of this iceberg." Certainly, the size of the country has much to do with that impression. Call it a matter of perspective, but when you have grown up in a region in which 1,000 hectares (2,500 acres) is a huge hunting *finca* (ranch)—or where Doñana National Park, the crown jewel of protected areas in Spain, has 53,000 hectares (131,000 acres) and is one of the biggest wintering sites for birds in Europe—it is overwhelming both to learn that Mexico's Vizcaino Biosphere Reserve is more than 2.5 million hectares (6.3 million acres), about 5% of Spain's total land area, and to spend your first Christmas in this new country with a group of ranchers in northern Mexico whose properties together account for 0.5 million hectares (1.2 million acres).

Imagine my surprise when I discovered that many Mexican conservation colleagues don't think that wilderness still exists in Mexico. It is true that the country has had many millennia of human occupation. Some of the most outstanding civilizations of Mesoamerica have flourished here, and its modern, still-increasing population is more than 110 million habitants. Let's do basic math: almost one-third of the total population is crowded into just three cities—Mexico City, Guadalajara, and Monterrey—that together account for less than 0.6% of the national territory. That leaves more than 99% of the country to the other 75 million people—almost all of whom reside in numerous smaller cities. But, forget about these calculations, because my most important point is the concept of relativity.

The more I learn about the concept of wilderness the better I understand its flexibility and adaptability. In Mexico, I have met people for whom camping on one of the surrounding little volcanoes, with the glow of the immense Mexico City underneath, is the wildest experience they dream about. I have met others for whom Mexico is not enough and constantly dream of the open spaces of Africa or Alaska. And you would be surprised to find out how often people yearn for the "real nature" that we have in Spain.… I've actually been told that!

Wilderness Policy in Mexico

All these perspectives are valid. But sometimes there is a need to be strict when considering wilderness, especially now when Mexico is doing an important job as it develops its national wilderness policy. Under the leadership of Ernesto Enkerlin, head of the National Commission for Protected Areas (CONANP), Mexico has embarked on a pioneering crusade to establish and consolidate a legal framework to protect its many and diverse wilderness areas.

Mexico has embarked on a pioneering crusade to establish and consolidate a legal framework to protect its many and diverse wilderness areas.

But the challenges to doing this can sometimes seem overwhelming. First, the wilderness concept does not actually exist in the Spanish-speaking world—numerous possible translations are used, and their meaning or acceptance varies according to the audience. Second, not everyone in the conservation world is happy with the new look of the protected area policy in Mexico. There remains in some sectors an attitude of "why burden ourselves with another imported *gringo* concept such as this?" And finally, and probably most important, Mexico's land tenure is complicated, with more than 90% of its land under private or communal property regime. This creates tough

Figure 3—Volcano rabbit (*Romerolagus diazi*), La Cima, Distrito Federal. Photo © by Jaime Rojo.

Figure 4—Coatimundi (*Nassua narica*), El Triunfo Biosphere Reserve, Chiapas State, Mexico. Photo © by Jaime Rojo.

Figure 5—Monarch butterfly (*Danaus plexippus*), Santuario de la Mariposa Monarca "Piedra Herrada," Mexico State. Mexico. Photo © by Jaime Rojo.

Figure 6—Local *ejidatario* trained as guide and reserve warden, Monarch Butterfly Sanctuary, Michoacan State. Photo © by Jaime Rojo.

Figure 7—Emma Díaz Gutierrez, Oaxacan biologist, originally from the indigenous communities of Sierra Norte, and supervisor of the sustainable shade coffee plantations, San Juan Yagila, Oaxaca. Photo © by Jaime Rojo.

conditions for wilderness advocates, including CONANP, when policy decisions are required.

Nevertheless, after the government of Mexico announced at the 8th World Wilderness Congress (Alaska 2005) its commitment to develop its wilderness policy, a series of events favored a new wilderness paradigm in Mexico. For example, for decades Mexico has had a powerful but obsolete agrarian reform program that considered nonfarmed or nonranched lands as "idle lands" and, therefore, subject to distribution for the use of the people. In the past few years, colleagues have worked to modify the Mexican Constitution so that "conservation" is considered a legal use of the land. If this is finally approved, it will open up many more opportunities for protected areas and conservation land use in Mexico. Also, for those who don't know, WILD9, the 9th World Wilderness Congress, will take place from November 6–13, 2009, in the city of Mérida, Yucatan—*el corazón del mundo Maya*—and it is already gaining momentum that will certainly enhance the political and social conditions to make things easier for wilderness advocates in Mexico.

Coming is the day when the majestic mountains and canyons of the western Sierra Madre will no longer be seen just as the home for the narco; the high-biodiversity Sonoran and Chihuahuan Deserts will no longer referred to as "hostile and barren lands"; and the scarce, critically important mangroves of the Gulf of California will be easily off-limits to resort or shrimp farm development. The day is coming when Mexicans will proudly speak of their *tierras silvestres*—using the term promoted by WILD9 to refer to the wilderness of Mexico and Latin America—as a valued part of their rich national heritage, an irreplaceable gift to their children, and an asset admired by the entire world.

JAIME ROJO is the executive director for the WILD9 Secretariat.

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El Noveno Congreso Mundial de Tierras Silvestres, as it is called, will be the first completely bilingual WWC, and it's about time. For wilderness to win, and continue with its role in mitigating climate change, providing irreplaceable ecosystem services, and providing its singular sense of wild spirit in our world, it needs to be in many different languages. After all, diversity is a key element of wilderness.

The *IJW* greets and welcomes delegates to WILD9, where this issue will be available free to all participants. To mark the occasion we have a Soul of the Wilderness on Mexico's remarkable wilderness characteristics, and a pioneering feature article on the important role of wilderness in mitigating climate change (a central theme of WILD9). In addition, other articles from North America and Asia combine with articles on science and stewardship to round out a diverse issue.

After all we've mentioned here about wilderness words, here's something else that's interesting. The word *wilderness* is not happening in Latin America, true. But when Spanish speakers talk about the WILD9, they always refer to it as WILD Nueve! It does the job....

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The Nature of Climate Change

Reunite International Climate Change Mitigation Efforts with Biodiversity Conservation and Wilderness Protection

BY HARVEY LOCKE and BRENDAN MACKEY

For the good of the climate, the time has come for a major initiative to reunite climate change mitigation efforts with biodiversity conservation and wilderness protection. Recent scientific research has shown clearly that protecting primary ecosystems such as forests, wetlands, and peatlands (whether they be tropical, temperate, or boreal) keeps their carbon stocks intact, avoids emissions from deforestation and degradation, and is a necessary part of solving the climate change problem (Lyssaert et al. 2008; Lewis et al. 2009; Phillips et al. 2008; Keith et al. 2009). This new understanding provides a way to make important advances to mitigate both climate change and the biodiversity extinction crisis.

Climate change has emerged as the leading environmental issue of our time with good reason (IPCC 2007a). The rapid rise in Earth's temperature threatens human well-being in several ways: rising sea levels will render millions homeless, populations of malaria-bearing mosquitoes will reach millions of African people who live in areas that were once too cool for these insects, and there will be an increase in the frequency of extreme climatic events such as droughts, fires, floods, and hurricanes. Freshwater will get scarcer in some areas, which will lead to increasing tensions and potentially armed conflict about access to this basic resource. It is even possible that we could experience "climate surprises"—rapid, large-scale, and difficult-to-predict changes in the climate system that we know have occurred in the geological past. For example, ocean currents such as the North Atlantic Gulf Stream could change, rendering the climate of western Europe cooler and less agriculturally productive.

Climate change also threatens other forms of life with which we share Earth. Coral reefs are bleaching, thus destroying critical fish habitat; climate shifts will result in the extinction of populations of many temperature-sensitive species such as mountain-dwelling pikas; and the habitats of other species such as cold-water trout and polar bears will shift or disappear. These changes are already underway, and they threaten many wildlife species.

Carbon Dioxide

The general problem that has led to rapid climate change is that we humans are releasing carbon dioxide (and other greenhouse gases) into the atmosphere faster than natural processes can remove it. A certain amount of heat in the atmosphere is good and gives us a livable climate, but now the increasing concentration of carbon dioxide in the atmosphere is causing a rise in global temperature with disastrous consequences.

The cause of the rapid climate change we are now experiencing is primarily the result of two main kinds of human actions: burning fossil fuels and clearing or degrading natural ecosystems. These activities release carbon dioxide into the atmosphere from places on or under the Earth's surface where it was previously stored harmlessly or sequestered as one of a number of forms of carbon we call fossil fuels. The burning of carbon-dense oil, coal, and gas stocks is widely known as the primary source of carbon dioxide.

Figure 1—Boreal forest in the Nahanni, Canada. Photo by Harvey Locke.

Figure 2—Increased fires from human activities will make natural forests more vulnerable to climate change. Photo by Vance G. Martin.

The second human action that releases large amounts of carbon dioxide into the atmosphere is the conversion and degradation of natural forests and other carbon-dense ecosystems. A substantial amount of carbon dioxide is stored in natural ecosystems, especially forests, wetlands, and peatlands, which act as a vital buffer regulating the atmospheric level of carbon dioxide. There is the equivalent of more than 7 trillion tons of carbon dioxide stored in forests and other terrestrial ecosystems such as wetlands and peatlands. Humans are depleting these green carbon stocks (Mackey et al. 2008a) and releasing the carbon dioxide into the atmosphere at an alarming rate: about half the world's forests have already been cleared, and rates of land conversion and degradation continue to increase (Millennium Ecosystem Assessment 2005; Shearman et al. 2009). Similarly, about half of the world's wetlands have been degraded in the last century (Finlayson and Davidson 1999). Unfortunately, around 25% of the carbon dioxide released from burning fossil fuel or clearing and degrading natural ecosystems will continue to interact with the atmosphere for many thousands of years before it is incorporated into the sediment at the bottom of the ocean through deposition and weathering processes (Archer 2005).

It is obvious that efforts to address climate change should go toward identifying sources of carbon release and then rapid action to prevent or reduce such release. We need to do two things simultaneously: (1) achieve deep cuts in emissions from using fossil fuel as a major source of energy, and (2) protect the carbon stored in forests and other ecosystems by leaving them undisturbed. Both tasks are important, as about 70% of the total historic increase in greenhouse gas levels in the atmosphere due to human activity is from burning fossil fuel, and about 30% is from deforestation. And, on an ongoing basis, about 18% of annual global emissions comes from disturbing forests (IPCC 2007b).

Despite the scientific evidence, there is no coordinated attack on both root causes. The ongoing destruction of the world's remaining natural habitats and associated biodiversity, and the climate change problem are being treated as two distinct and largely unrelated problems. This current state of affairs is clearly off course. But it was not always so.

Global Conventions for an Integrated Solution

The United Nations Framework Convention on Climate Change (UNFCCC) and the Convention on Biological Diversity (CBD) were both negotiated at the Earth Summit in Rio de Janiero in 1992. UNFCCC seeks to limit emissions of carbon dioxide and other greenhouse gases that cause dangerous levels of climate change. The CBD seeks to halt the loss of biodiversity through protected areas and other means. Both conventions have been charged with development goals for poorer countries. Their respective implementation mechanisms include the Kyoto Protocol and the Program of Work on Protected Areas.

Figure 3—Central highlands forest, Victoria, Australia. Photo by Peter Halasz.

Figure 4—High altitude mammals such as this pika in Yoho National Park, Canada, have few options as their habitat warms. Photo by Harvey Locke.

Sixteen years after these two treaties were developed together as complementary strategies to safeguard the future of life on Earth, a strange thing has happened—they have become separated. Politicians, policy experts, technicians, financiers, entrepreneurs, scientists, Nongovernmental organizations (NGOs), and the general public consider the two conventions as addressing unrelated problems. Whereas the importance of forests is acknowledged by both treaties, the UNFCCC process has yet to accept the significance of the carbon stored in natural forests and other ecosystems such as wetlands and peatlands, the resilience provided by their biodiversity, and the need for whole-of-ecosystem carbon accounting. Consequently, programs can occur under the Kyoto Protocol that actually harm the goals of the CBD—such as clearing natural forests to plant palm oil for biofuels. And no credit is given under the Kyoto Protocol for protecting wildlands and the vast stocks of biomass carbon they store.

Unlike UNFCCC and the Kyoto Protocol, the CBD gets scant attention. Governments that are signatory to both conventions often assign responsibilities for the conventions to different departments, with CBD efforts being under-resourced and ignored compared to much better resourced climate change programs that are focused on fossil fuel emissions. Since the United States is not yet a signatory to the CBD, many U.S. NGOs are either unaware of it or simply ignore its potential. Ironically, the same NGOs make much of the fact that the United States has yet to ratify the Kyoto Protocol. Even in Canada, which is a signatory to both conventions and which houses the CBD Secretariat, the CBD has a very low profile. Further, many environmentalists working on climate change are fearful that allowing for the protection of nature in the Kyoto Protocol rules will undermine efforts at reducing emissions from wealthy countries that burn fossil fuels.

The separation of the UNFCCC and CBD is bad for the goals of both conventions, but current structures and mindsets are preventing them from working together. Both climate change and the extinction crisis are getting worse, and to date efforts have failed to meet even modest goals of slowing the rate of change and loss, let alone turning things around. Science has now made clear that the protection of natural ecosystems—and especially primary forests and other wildlands such as wetlands and peatlands—will help achieve climate change goals. This separation of the conventions must end.

Figure 5—Lowland forest in the lower Kikori catchment, Gulf Province, Papua New Guinea. Photo by Rocky Roe Photographics and UPNG Remote Sensing Centre.

Figure 6—Mt. Albert Strickland Ridge, North East Highlands, Tasmania. Photo by Geoff Law.

Nature Protection for Climate Change Mitigation and Adaptation

There is widespread agreement that to address climate change, both mitigation and adaptation are necessary. In climate change parlance, *mitigation* means efforts to prevent or reduce release of carbon dioxide into the atmosphere, and *adaptation* means coming to grips with the fact that climate change is underway and that some harmful climate change is now unavoidable. Adaptation involves doing what we can to adjust to the changes, as well as doing our best to anticipate what things will be like in the future, and putting plans in place with that in mind.

In a forest ecosystem, carbon is stored in living and dead biomass and in the soil. In the tropics, more of the organic carbon is stored in the living trees. In boreal forests, there is proportionally more found below ground due to slower decomposition rates. Temperate forests store large amounts of carbon in living trees, dead biomass, and the soil. Most of the living biomass carbon is found in big, old trees. Protecting mature, primary forest in all biomes (tropical, temperate, or boreal) from human activities that deplete carbon stocks by removing, in particular, large, old trees and disturbing dead biomass and soil carbon, must be recognized as part of the climate change solution in economically developed as well as developing countries. Similarly, wetland conservation is important to prevent release of greenhouse gases (CUIBA 2008). And the vast peatlands in northern boreal ecosystems have been shown to be cooling the climate through the uptake of carbon and will continue to do so if left undisturbed (Frolking and Roulet 2007). Wilderness and intact habitat conservation efforts are good for the climate as well as for biodiversity and associated ecosystem services.

In addition to mitigation, intact natural ecosystems and wildlands are critical to adaptation efforts. In different regions and in different ways, climate change will place stress on ecosystems and the environmental services they provide, especially the provision of food and freshwater. Many communities, especially in poorer countries, will be affected. Intact, natural ecosystems with their biodiversity fully functioning are more resilient to stresses than degraded lands. Healthy ecosystems will prove an invaluable resource for helping communities adapt to unavoidable climate change. Leaving extensive wild areas intact will enable those natural processes to operate by which species can adapt and persist through changing conditions (Fischlin et al. 2007; Mackey et al. 2008b). Connectivity conservation initiatives—vast systems of protected areas connected by conservation management in the intervening lands that span elevations and altitudes—are the best strategy to allow terrestrial species to adapt and ecosystems to remain resilient to climate change (World Conservation Congress 2008; Heller and Zavaleta 2009). The Program of Work on Protected Areas under the CBD recognizes these tools.

Unfortunately, attempts to educate people about the important roles played by healthy natural ecosystems in mitigation and adaptation are being undermined by various climate change myths. One widespread myth is that old growth forests are not helpful in mitigating climate change because they are sources rather than sinks of carbon dioxide. This view of primary forests has led some commentators to argue that they should be cut down and replaced with younger trees that absorb carbon dioxide from the atmosphere at a faster rate than old trees. This argument is wrong for a number of reasons. For a start, it ignores the fact that old forests have very large stocks of carbon in place. Mobilizing and releasing this carbon into the atmosphere through deforestation and degradation creates a carbon debt that takes hundreds of years to recover through new plantings (Righelato and Spracklen 2007). Furthermore, the underlying assumption is simply incorrect because mature and very old natural forests in boreal, temperate, and tropical forests have been shown to be more likely to be sinks than sources (i.e., actively sequestering more carbon dioxide than they emit) (Luyssaert et al. 2008). In other words, primary forest, and especially old growth forest, should be kept intact for the good of the climate.

Biodiversity and Natural Ecosystems

Efforts under the climate change convention will have perverse effects unless they recognize biodiversity and natural ecosystems. Under the UNFCCC process at present, the role in mitigation of natural ecosystems and wildlands, including primary forests and wetlands, is not acknowledged. This worldview is manifested in several of the key decisions and rules that have been developed since this convention came into effect. The Kyoto Protocol definition of forest is blind to biodiversity and does not distinguish between a natural primary forest, a heavily logged forest, and a monoculture plantation. This is self-defeating because the current carbon stocks of a forest ecosystem vary enormously depending on its condition as the result of land-use history (Gibbs et al. 2007; Mackey et al. 2008a.).

There is the potential for perverse outcomes from active mitigation efforts. Some renewable energy technologies could fragment wilderness areas, leading to further deforestation, degradation, and associated emissions. Road infrastructure designed to serve windmills, or new hydroelectric reservoirs and associated power-line corridors, perturb natural ecosystems, release green carbon, reduce the resilience of ecosystems, and disrupt the natural processes that enable species to adapt to and persist in the face of climate change. Such outcomes would be self-defeating. Renewable energy facilities should be located in already disturbed areas of which there is no shortage.

Similarly, there is increasing talk of "geoengineering" to address climate change (Victor et al. 2009). Instead of relying on emissions reductions only, geoengineering would endeavor to cool the climate by human intervention on a planetary scale. One idea is to attempt to increase oceanic uptake of carbon dioxide from the atmosphere by fertilizing the ocean with nutrients to stimulate plankton growth. Another idea involves sending particles into the upper atmosphere as "albedo enhancers" to reflect the sun's warming rays back into outer space. These kinds of solutions assume Earth is a simple, linear system—like a clock—amenable to conventional engineering thinking. But, Earth is a complex adaptive system, driven by nonlinear feedbacks, and full of climate surprises. The risk to biodiversity and the goals of both the CBD and climate change treaty from such large-scale meddling with natural systems is great. If these activities had unanticipated negative effects it would be nearly impossible reverse them. The real solutions—reducing emissions from burning fossil fuel and prevention of deforestation and degradation of natural ecosystems and wilderness areas—are more prosaic but have a high probability of success with no negative consequences to Earth's natural systems.

Wilderness and intact habitat conservation efforts are good for the climate as well as for biodiversity and associated ecosystem services.

Nature Conservation

The UNFCCC process needs a fundamental reorientation that integrates CBD goals. The word *biodiversity* does even not warrant a mention in the Bali Action Plan. Although biodiversity does get a mention in the decision text to some of the Kyoto Protocol, that process is very clearly not designed to focus on its conservation (see discussion below). The concept of ecosystem-based management—which implies biodiversity—is on the adaptation agenda. But when nature is discussed during climate change negotiating sessions, it is usually in the context of impacts, not mitigation.

Figure 7—Old growth forest, Haida Gwaii, British Columbia, Canada. Photo by Harvey Locke.

The lack of focus on mitigating impacts through protecting natural carbon-rich ecosystems can be seen in the approach taken to land management in wealthy countries. Under the Kyoto Protocol, land management issues for such countries are considered under the policy theme of "Land Use, Land-Use Change and Forestry" (LULUCF) (Kyoto Protocol, Article 3.3). Wealthy countries are required under Article 3.3 to report on emissions from deforestation, but under Article 3.4 reporting on emissions from forest management is optional. The definition of *forest* adopted by the Kyoto Protocol is very general and allows for outcomes such as permitting a biodiverse natural forest to be converted to a monoculture plantation, even though in reality deforestation and degradation (i.e., depletion) of carbon stocks has occurred (Mackey et al. 2008a).

Consistent with the Kyoto Protocol's focus on reporting changes in emissions, current rules do not emphasize the mitigation value of protecting intact carbon stocks in natural ecosystems in either wealthy or poor countries. Indeed the current rules tend to the opposite in wealthy countries—"The mere fact of carbon presence [shall] be excluded from accounting" (LULUCF Decision 16/CMP. 1). However, if we are serious about mitigating the second largest source of emissions then we need to find ways of avoiding emissions and maintaining carbon stocks in all countries. This can be done through public policy with no exchange of funds because it is in the interests of wealthy nations to act by protecting their own natural ecosystems to prevent climate change, or it can be done through financial incentives such as "payment for ecosystem services" (Costa 2009; Costa and Wilson 2000).

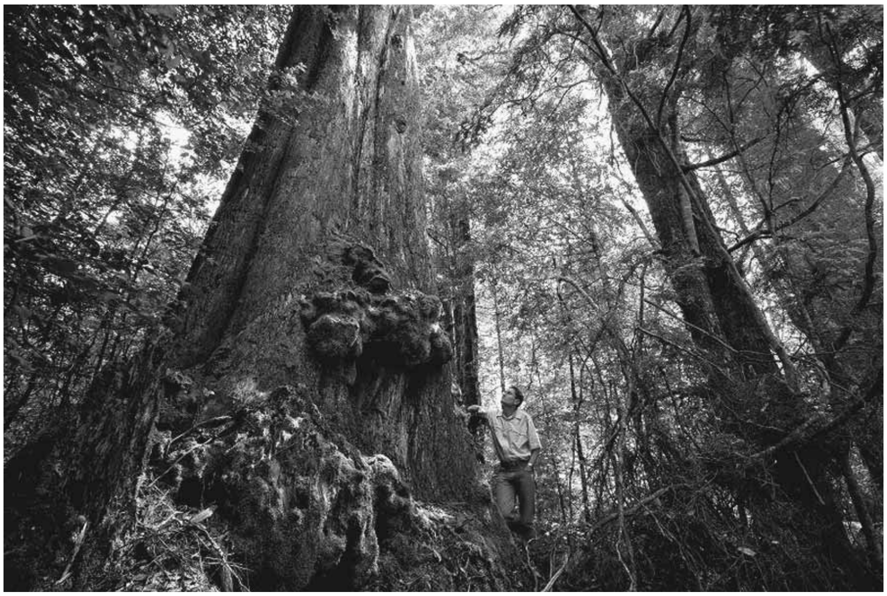

Figure 8—Upper Florentine, Australia. Photo by Rob Blakers.

REDD—A Necessary but Insufficient First Step

Recently a fledgling effort has been launched that recognizes the mitigation value of reducing the rate at which emissions are released from deforestation and degradation in tropical forests (i.e., United Nations Collaborative Program on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries [REDD]). This is an important step in the right direction to protect carbon stored in the natural ecosystems of poorer countries. However, discussions to date are focused on a narrow subset of issues such as how current rates of emissions can be reduced, implying that significant deforestation and degradation must occur before financial rewards can be received. Such deforestation and degradation is clearly important to reverse. But, where are the rewards for nations who have already been doing the right thing by protecting their primary forests? Often they struggle to adequately resource their protected areas with adequate enforcement that is critical to prevent their carbon stocks from being disturbed by illegal activities such as logging.

A key issue being debated is which approaches and mechanisms should be adopted to fund REDD action. Very prominent are discussions concerning the potential to use carbon credit schemes whereby wealthy countries can offset some of their industrial emissions through the transfer of funds from rich to poor countries—the proposition is that emitters from wealthy countries will be able to offset a percentage of carbon dioxide emissions from factories and utilities by paying poor countries to keep an equivalent amount of green carbon in place through reducing the rate of deforestation and degradation. Although it is essential to find mechanisms that can finance nature protection in developing countries, it is not clear that such purchased offsets will be the most efficient, fair, and ecologically appropriate. We need to reduce fossil fuel emissions and green carbon emissions simultaneously—one is not really a substitute for the other.

In developing countries that are struggling to eliminate poverty and provide the basic needs for all their people, rich countries could and should be helping by exploring all options, including through integration of the UNFCCC and CBD as part of their international cooperation activities. For example, wealthy countries could use the Program of Work under the CBD to transfer funds to poorer countries for programs aimed at protecting their natural ecosystems. This can be justified because of the other multiple and reinforcing benefits to climate, biodiversity, and sustainable livelihoods that result. Tradable "carbon credits" is but one of a range of approaches that should be tested as we work toward finding sustainable solutions.

A major concern with current discussions of REDD is the narrow focus on the tropics. The result is that the large amounts of carbon stored in undisturbed temperate and boreal ecosystems are not being considered in the REDD process because most of these forest biomes are located in wealthy countries. We need immediate global action to protect carbon-rich ecosystems wherever they occur.

The Convention on Biological Diversity (2009) process has established an Ad Hoc Technical Expert Group on Biodiversity and Climate Change that is exploring the relationships between actions under the two conventions. Although this is an important initiative, it is a technical working group informing the CBD and through it the UNFCCC process, and needs to be complemented by new thinking in the policy arena.

Current activities such as REDD and the CBD Ad Hoc Technical Expert Group are necessary but not sufficient. There is a pressing higher level need for politicians and NGOs in all countries to show leadership in recognizing that the climate change problem, the biodiversity extinction crisis, and the destruction of wilderness have the same root cause and that coordinated, holistic solutions are required.

A Call to Action

Large-scale nature conservation is a first-order climate change strategy for both mitigation and adaptation. Keeping green carbon stored in large intact natural landscapes is a mitigation strategy. Connectivity conservation is an adaptation strategy. Both are needed. Such action is necessary to address the biodiversity extinction crisis and preserve the ecosystem services such as freshwater on which all humans rely. It is time to take a holistic view of the CBD and UNFCCC by bringing them back together to ensure that actions under the one help the other, rather than cause harm. We must ensure that the carbon already stored in primary forests, wetlands, peatlands, and other intact ecosystems stays there. The UNFCC and the CBD should be seen as two parts of an inseparable whole.

The need for a coherent strategy to address climate change that simultaneously keeps in place the green carbon stored in natural wild ecosystems and meets emissions reduction goals will be a major focus of WILD9, the 9th World Wilderness Congress in Mérida, Mexico, in November 2009.

We have no illusions that the message from WILD9 alone will be sufficient to return international efforts to protect our environment to their Rio Earth Summit origins. But, we can all add our voices to the growing international call for a more integrated approach. We encourage anyone interested in the future of our climate and the fate of wild nature to begin disseminating and debating these ideas now and to join us at WILD9 (www.wild9.org).

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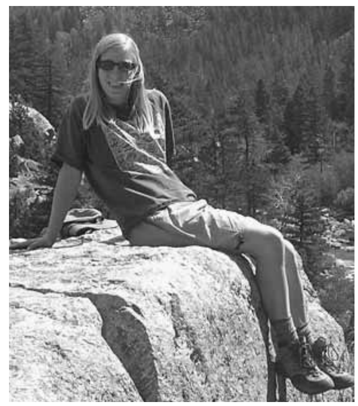
Key Biodiversity Areas in Wilderness

BY AMY UPGREN, CURTIS BERNARD, ROB P. CLAY, NAAMAL DE SILVA, MATTHEW N. FOSTER, ROGER JAMES, THAÍS KASECKER, DAVID KNOX, ANABEL RIAL, LIZANNE ROXBURGH, RANDAL J. L. STOREY, and KRISTEN J. WILLIAMS

Given that the primary threat to biodiversity is the destruction of natural habitats, the foremost conservation response must be to protect the places where threatened biodiversity is found. Indeed, the establishment of protected areas has long been a cornerstone of conservation, and this cornerstone was recently reinforced by a specific mandate from the Convention on Biological Diversity's Program of Work on Protected Areas (Secretariat to the Convention on Biological Diversity 2009). However, this raises the question of how to identify places as targets for such site-level conservation. More than two decades ago, techniques for the identification of Important Bird Areas (BirdLife International 2009; Osieck and Morzer-Bruyns 1981) were developed to address this question, implicitly based on vulnerability and irreplaceability, the core principles of systematic conservation planning (Margules and Pressey 2000; Sarkar et al. 2006). Over the last decade, as comprehensive assessments of biodiversity beyond birds have become available (Stuart et al. 2004; Schipper et al. 2008), these techniques have been generalized to facilitate the identification of key biodiversity areas as targets for site conservation for additional taxa (Eken et al. 2004; Langhammer et al. 2007).

The identification of key biodiversity areas in wilderness regions presents a number of specific challenges. First and foremost, the low sampling intensity of biodiversity in these often remote areas means that biological data are sparse, biased geographically toward access routes such as roads and rivers, and in some cases taxonomically based on research preferences. These data are also globally dispersed among natural history institutions. Moreover, extensive tracts of intact habitat and biophysical homogeneity, combined with a lack of formal land management structures in many regions, means that the delineation of site conservation targets in wildernesses presents particular difficulties. Nevertheless, work on the identification of key biodiversity areas in wilderness regions, including the five high-biodiversity wilderness areas (see article in this issue on Conservation International), has been proceeding apace for several years now, and key biodiversity areas have recently been defined in the Amazon, the Guiana Shield, New Guinea, the Mexican section of the North American deserts, and in parts of the Miombo-Mopane wilderness in southern Africa.



Amy Upgren courtesy of Amy Upgren

Symposium Summary

In June 2008 we organized a symposium entitled Site Level Conservation Targets in High-biodiversity Wilderness Areas: Progress with Key Biodiversity Identification at the Association of Tropical Biology and Conservation annual meeting in Paramaribo, Suriname. The goals of the symposium were to review and draw comparative lessons from efforts to identify key biodiversity areas in the world's wilderness areas. Here, we summarize the major findings from this symposium.

The symposium addressed several of the main challenges in identifying key biodiversity areas in wildernesses and potential solutions to those challenges. One of the larger challenges is data scarcity, which has been managed through the validation of all existing data. This was accomplished by collecting, cleaning, and compiling datasets from multiple sources, as well as by documenting locality point and habitat decisions, which local experts then reviewed. Data accuracy issues are also a concern in wildernesses because many collections only have generalized descriptions of species localities. In New Guinea, this issue was handled by establishing a protocol in which vague species points without a clear locality, as well as those older than 50 years, were only considered to identify *potential* habitat for a species, as opposed to *known* habitat triggering a key biodiversity area. Reliable species locations and natural history descriptions were used to generate "ecological logic" (the hypotheses of species-habitat relationships) for relating point locations to maps of vegetation, altitude, soil, landform, and other criteria to characterize and delineate proximal areas of *known* and *potential* habitat. In other cases, such as in the Venezuelan section of the Guiana Shield, biological data from museums and scientific collections were geo-referenced and used to analyze gaps and threats (www.simcoz.org.ve). Imprecise data and data gaps also highlighted survey and research priorities for future work. Data scarcity and accuracy remain challenges for conservation in wilderness areas, but through the aforementioned techniques we can at least partially compensate for these data issues and proceed with the identification of sites for conservation.

Figure 1—Pitaya cactus and sea, Isla Danzante, Gulf of California. Photo © by Patricio Robles Gil.

It makes good conservation sense that key sites for biodiversity protection in wildernesses are large.

The existence of large tracts of intact habitat in wilderness areas poses another challenge to drawing site boundaries for key biodiversity areas. In more fragmented areas, key biodiversity areas often protect remaining intact habitat. In wilderness areas, contiguous habitat makes it difficult to delineate site-scale conservation targets, and a lack of formal land management units can add to this challenge. One approach to overcoming these obstacles, employed in the Amazon and the Guiana Shield, was to combine species data with maps of soil types, topography, forest types, and logging concessions to delineate key biodiversity areas. In addition, socioeconomic data were used to guide the delineation process, to avoid areas that are already heavily utilized or sociopolitically complex, and to incorporate existing protected areas into the key biodiversity area network. As another example, the Miombo-Mopane wilderness of Zambia has an extensive protected areas network, with 36% of the land area in 19 national parks and 33 game management areas. This vast network of protected areas was used for the initial selection of key biodiversity sites, since it represents existing land management units in the contiguous wilderness. Protected areas are often a useful starting point for identifying key biodiversity areas, since they frequently have the best species locality data in a region. From this beginning, the key biodiversity areas network in Zambia is being expanded to include sites for the conservation of all species of significance in the country's wilderness. By incorporating anthropogenic and physical features of the landscape, in addition to biodiversity data, in wildernesses throughout the world, we were able to delineate distinct sites for conservation in areas of contiguous habitat.

One example of how to identify key biodiversity areas where species data are extremely sparse was in New Guinea, where we carried out habitat delineation for each species in the

Figure 2—School of common dolphin (*Delphinus delphis*), Gulf of California. Photo © by Patricio Robles Gil.

region categorized as Critically Endangered or Endangered on the International Union for Conservation of Nature (IUCN) Red List, refining extent of occurrence with ecological data. In this way, key biodiversity areas were identified near collection points where we are confident that the species occurs, and also in areas where the species probably occurs. Additional complications relating to site delineation and manageability arise from communal ownership of most land. Actual management units in New Guinea are vague and often based on the local ethnic group or community, but these areas cannot be mapped satisfactorily and are too small to allow for the conservation of key biodiversity area trigger species. We therefore developed a fine-scale planning unit based on watershed subcatchments. As a partial solution, draft boundaries based on planning unit clusters were refined through comparisons with language groups and other sociopolitical contexts (e.g., land use intensity, village locations, administration units) within which some ties of kinship and common interest may exist, thus creating manageable units of an adequate size for the conservation of trigger species and a starting point for consultation. These and other innovative solutions were required to identify key biodiversity areas in New Guinea.

As progress has been made on identifying key biodiversity areas in wildernesses, we have recognized that the spatial extent of "sites" in wilderness regions can often be much larger than traditionally conceived elsewhere in the world, a scale of conservation to which the recent establishment of the 4.25 million hectare (10.5 million acre) Grão-Pará Ecological Station in Pará, Brazil, bears testament. In an analysis of the size of key biodiversity areas in wildernesses compared to those in biodiversity hotspots, our results showed a general trend of fewer but larger site-scale targets in wilderness areas. Looking at key biodiversity areas for birds, for example, demonstrates that there are 29 sites in the Congo Basin wilderness, covering 9.3% of the region, with a mean size of 5,586 sq km (2,156 sq. mi.). By comparison, the Guinean Forests of West Africa hotspot holds 91 sites, covering 9.6% of the region, with a mean size of 660 sq km (255 sq. mi.). These differences result from the much greater ecological and socioeconomic uniformity of wilderness areas. The "first cut" delineation of areas in the mid- to high-altitude regions of New Guinea, based on the highest priority

Figure 3—Panoramic view of El Cajon, Northern Sierra Madre, Sonora. Photo © by Patricio Robles Gil.

trigger species (critically endangered and endangered), contrasts with this trend, where high levels of endemism and extreme habitat diversity in parts fragmented by human land use preferences supports small-scale targets. As data for additional trigger species are incorporated (i.e. vulnerability, restricted range, and other irreplaceability criteria), these areas may be amalgamated into larger areas. As discussed earlier, survey efforts are much more biased in wilderness areas, and survey densities are much lower, which we would expect would result in the identification of smaller Key Biodiversity Areas (KBAs). That our results reveal wilderness KBAs to be larger than expected suggests that this is less of a problem than feared. It makes good conservation sense that key sites for biodiversity protection in wildernesses are large.

Figure 4—Jaguar (*Panther onca*), Mayan forests of Calakmul, Campeche. Photo © by Patricio Robles Gil.

> The foremost conservation response must be to protect the places where threatened biodiversity is found.

These lessons from the identification of site-scale conservation targets in wilderness areas will be useful as conservation planners seek to strategically protect the most important sites within the world's surviving wildernesses. Identifying key biodiversity areas in wildernesses provides an opportunity for proactive conservation investments by protecting the most important sites for biodiversity conservation before threats to these areas intensify and more habitat and species are lost. Working with local communities and stakeholders on such proactive conservation is fundamental. In the Guiana Shield of Venezuela, for example, Rapid Assessment Programs were conducted on five key biodiversity areas, with important consequences for the conservation of these sites in alliance with indigenous communities, mining companies, and governmental institutions. Protecting biodiversity, however, is not the only benefit of conserving key biodiversity areas. The benefits of conserving these areas are also critical to people. These include provisioning services, such as commerce based on nontimber forest products and the safeguarding of clean water sources; regulating services, including climate regulation through the reduction of emissions from tropical forest destruction; and cultural services, which can range from the maintenance of spiritual practices to educational opportunities. By initiating proactive conservation in wilderness areas, we can ensure that both biodiversity and human well-being are preserved in these extraordinary places even if or when development encroaches upon their wilderness status.

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Alien and Invasive Species in Riparian Plant Communities of the Allegheny River Islands Wilderness, Pennsylvania

BY CHARLES E. WILLIAMS


Charles Williams

Introduction

Riparian areas are ecotones—transition areas—between terrestrial and aquatic ecosystems. As such, riparian areas possess features and processes influenced by adjacent ecosystems as well as those unique to riparian habitats (Naiman and DeCamps 1997; Verry et al. 2000; Naiman et al. 2005). Riparian areas are among the most diverse, dynamic, and productive of ecological systems, performing many valuable ecological functions in the landscape (Naiman et al. 1993, 2005; Naiman and DeCamps 1997). In many regions of the world, riparian areas are hotspots of biodiversity: species richness of certain organisms, such as vascular plants, often far exceeds that of adjacent upland habitats (Naiman et al. 1993, 2005; Stohlgren et al. 1998). The important ecological functions of riparian areas, and their value in biodiversity conservation, have made riparian area conservation and restoration high priorities for ecosystem managers in many landscapes (Verry et al. 2000; Naiman et al. 2005).

As in numerous ecosystems worldwide, a major challenge to the conservation and management of riparian areas is invasion by alien plant species, which can alter ecosystem structure and function in undesirable ways (Williams 1996). High native plant diversity in riparian habitats is largely associated with natural disturbance, particularly flooding and scour by seasonal and storm-related flood pulses, which creates regeneration micro-sites and mediates resource competition among species (Naiman et al. 1993, 2005; Naiman and DeCamps 1997). Frequent natural or anthropogenic disturbances, however, can also create conditions conducive to alien plant establishment (DeFerrari and Naiman 1994; Pyle 1995; Planty-Tabacchi et al. 1996; Stohlgren et al. 1998). At the other extreme, alien plant invasions of riparian areas can be facilitated by altered hydrologic regimens caused by dams and diversions, which diminish flooding and scour and stabilize geomorphic surfaces, allowing some invasive species to not only establish but to dominate.

Allegheny River Islands Wilderness

The Allegheny River Islands Wilderness (ARIW) in the Allegheny National Forest of northwestern Pennsylvania was established in 1984 (United States P.L. Law 98-585) to provide river-based recreational opportunities and to protect the unique vegetation and riparian environments of the islands. Several of the larger islands within the ARIW support riverine forests dominated by large-stemmed silver maple (*Acer saccharinum*) and sycamore (*Platanus occidentalis*) (Walters

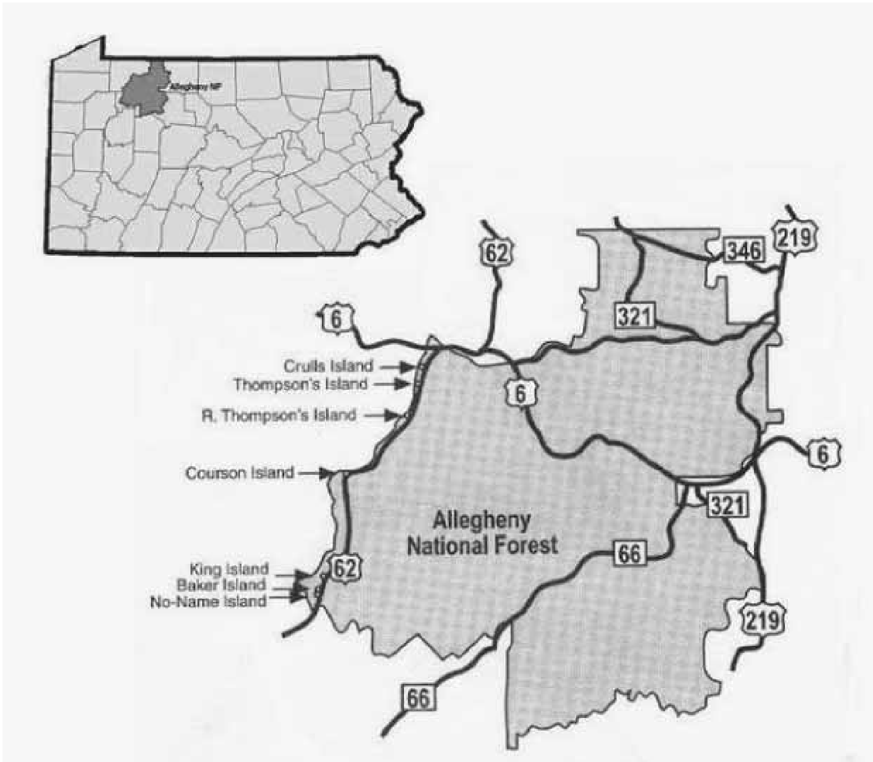

Figure 1—Location of the Allegheny National Forest in Pennsylvania and the seven islands of the Allegheny River Islands Wilderness.

and Williams 1999; Cowell and Dyer 2002). These ARIW forests are considered to be among the finest examples of mature riverine forests in Pennsylvania and the northeastern United States (Smith 1989). To date, few studies have been done on the vegetation of the ARIW, but most have suggested that alien and invasive plant species are an important threat to the integrity of the plant communities of the ARIW and are a significant management concern (Walters and Williams 1999; Cowell and Dyer 2002; Colwell and Stoudt 2002; Williams 2008).

The ARIW consists of seven islands (368 acres; 149 ha) located in Pennsylvania's Middle Allegheny River watershed between the city of Warren (Warren County) to the north and the borough of Tionesta (Forest County) to the south (see figure 1). Relief across the islands ranges from 3 to 10 feet (1 to 3 m), and soil types vary in texture and drainage with elevation. Kinzua Dam, 15 miles (25 km) upstream, began flood control operations in 1966 and has altered the hydrologic regimen of the Allegheny River in the study area, diminishing seasonal peak flows and creating more stable flows across the year (Walters and Williams 1999; Colwell and Stoudt 2002).

Previous research identified three broadly defined plant community types in the ARIW (Williams 2008): (1) a floodplain scour community dominated by native herbaceous plants such as blue vervain (*Verbena hastata)*, small-spike false nettle (*Boehmeria cylindrica*)*,* and straw-colored flatsedge (*Cyperus strigosus*); (2) a silver maple–(*Acer saccharinum*) sycamore (*Platanus occidentalis*) floodplain forest dominated by native herbaceous plants such as white snakeroot (*Ageratina altissima*), Virginia creeper (*Parthenocissus quinquefolia*), and ostrich fern (*Matteuccia struthiopteris*); and (3) a sycamore–bitternut hickory (*Carya cordiformis*)–slippery elm (*Ulmus rubra*) floodplain forest community dominated by native herbaceous plants such as southern broadleaf enchanter's nightshade (*Circaea lutetiana*), white snakeroot, and Virginia knotweed (*Polygonum*

Figure 2—A view looking upstream from No Name Island toward the foot of Baker Island, Allegheny River Islands Wilderness, Pennsylvania. Photo by Charles E. Williams.

Figure 3—A large silver maple (*Acer saccharinum*) on King Island, Allegheny River Islands Wilderness, Pennsylvania. The invasive reed canarygrass (*Phalaris arundinacea*) dominates the herbaceous layer in this image. Photo by Charles E. Williams.

virginianum). The floodplain scour community is typically associated with low-lying heads, toes, and flanks of islands where flooding and scour are common disturbances. Tree cover in this community is sparse to absent, resulting in a relatively open, light-rich environment. The silver maple–sycamore floodplain forest and the sycamore–bitternut hickory–slippery elm communities generally occur on more elevated geomorphic surfaces, such as low terraces, that are located above high-energy scour zones. Tree cover is moderate in these two communities, creating medium to light shade.

A series of studies were conducted August of 2000 through 2006 to provide baseline data on the composition and distribution of the alien and invasive flora of riparian plant communities within the ARIW, and a summary of the study is presented here as an example of the threat of alien and invasive plant spread in riparian ecosystems.

Study Summary

Six survey sites were located in a stratified random manner on each of the seven river islands of the ARIW: one site each on the head and toe of an island; one each on the flanks of an island; and two in the island interior, for a total of 42 sites across islands. Plants within survey sites were inventoried using a time-constrained search method (Goff et al. 1982; Williams et al. 1997, 1998; Williams 2005). Scientific and common names follow NatureServe (2008). Native or alien status for plant species follows Rhoads and Block (2000).

One-way analysis of variance was used to examine differences in alien plant species richness across community types using sample sites as observations. Data were transformed (square root (X + 0.5) for count data) prior to analysis to ensure homogeneity of variances. Fisher's exact test was used to examine potential differences in the frequency of common alien and invasive plant species (those with > 30% occurrence across sample sites) across community types. For all statistical analyses, significance was accepted at $P \leq 0.05$. Statistical analyses were conducted using SYSTAT version 7.0 (Wilkinson 1997).

A major challenge to the conservation and management of riparian areas is invasion by alien plant species, which can alter ecosystem structure and function in undesirable ways.

The relative invasive status of all alien and invasive plant species encountered during surveys of the ARIW was determined from ranks given to the species using the U.S. Invasive Species Impact Rank or I-Rank (NatureServe 2008). I-Ranks are derived from evaluating a species's ecological impact, its current distribution and abundance, its trend in distribution and abundance, and its management difficulty (Morse et al. 2004). Additional data on invasive status, plant growth form (e.g., graminoid, herb, shrub, vine, or tree), and life history characteristics (e.g., annual, biennial, or perennial) were obtained from the USDA Plants database (USDA, NRCS 2008).

A total of 41 alien and invasive plant species was tallied from the 42 sample sites across the seven islands of the ARIW. Alien and invasive species accounted for 17.8% of the total surveyed flora. The floodplain scour community supported the greatest number of alien and invasive plant species (36 species; 18.9% of the community flora), followed by the silver maple–sycamore forest community (23 species; 16.8% of the community flora), and the sycamore–bitternut hickory–slippery elm forest community (14 species; 12.4% of the community flora). Ten alien and invasive plant species (24.4% of the alien and invasive flora) occurred across all three of the community types. Mean alien and invasive plant species richness did not differ significantly among community types (floodplain scour community: mean = 7.8 species per site; silver maple–sycamore forest community: mean = 6.5 species per site; sycamore–bitternut hickory–slippery elm forest community: mean = 5.1 species per site).

Five of the eight most widespread alien and invasive plant species differed significantly in frequency of occurrence across the three river island communities. Reed canarygrass (*Phalaris arundinacea*) and climbing bittersweet (*Solanum dulcamara*) occurred most frequently in the floodplain scour community; reed canarygrass was also prevalent in the silver maple–sycamore forest community. Both dame's rocket (*Hesperis matronalis*) and garlic mustard (*Alliaria petiolata*) occurred most frequently in the two floodplain forest communities. Multiflora rose (*Rosa multiflora*) was most prevalent in the sycamore–bitternut hickory–slippery elm forest community. Japanese knotweed (*Polygonum cuspidatum*), touch-me-not bittercress (*Cardamine impatiens*), and creeping Jenny (*Lysimachia nummularia*) were present but were not significantly associated with any specific river island plant community.

Figure 4—A young sycamore (*Platanus occidentalis*) forest on R. Thompson Island, Allegheny River Islands Wilderness, Pennsylvania. Photo by Charles E. Williams.

The summary of I-Ranks for alien and invasive plant species encountered during surveys of the ARIW includes 26 species with high to low I-Ranks and 15 species whose status was unknown or not yet assessed. Ten species had a high I-rank (24.4% of the surveyed flora), 9 species had a medium I-Rank (22.0% of the surveyed flora), and seven species had a low I-Rank (17.1% of the surveyed flora). Four species are listed as noxious weeds in Pennsylvania (USDA, NRCS 2008).

Management Implications

The alien and invasive plant assemblage of the ARIW includes a range of species with varied ecological impact potential, distribution across plant communities, and difficulty of control. Grouping species by their frequency of occurrence across ARIW plant communities and by I-Rank produces three categories of species differing in abundance, ecological impact potential, and possible success in control.

1. Widespread alien and invasive plant species—found in all three ARIW plant communities—with high potential for ecological impact and the greatest difficulty for control, such as reed canarygrass and garlic mustard.
2. Abundant species—found in most or all ARIW plant communities—with medium to high ecological impact potential and high to moderate difficulty for control, such as dame's rocket and creeping Jenny.
3. Species with high ecological impact potential found in a single ARIW plant community, such as purple loosestrife *(Lythrum salicaria)* vary in difficulty of control but their limited abundance and distribution within the ARIW provides an opportunity for targeted control within specific plant communities. This category should not be considered a watch-list but instead as a group of species for which early containment may be possible.

Several factors will complicate control efforts for alien and invasive plant species in the ARIW. Perhaps the most daunting is the large reservoir of alien and invasive species within the Allegheny River corridor that can serve as sources for reinvasion of treated sites (Williams et al. 1997). Rhizomes and stem frag-

Figure 5—The alien invasive herb, purple loosestrife (*Lythrum salicaria*) is largely confined to floodplain scour communities in the Allegheny River Islands Wilderness. Photo by Charles E. Williams.

Figure 6—Japanese knotweed (*Polygonum cuspidatum*) is one of the most widespread and difficult to control of the alien and invasive plant species that occur in the Allegheny River Islands Wilderness. Photo by Charles E. Williams.

ments of species such as Japanese knotweed can be dispersed long distances by water and provide a continuous source for reinvasion of islands (Bimova et al. 2004). Other species have seeds that are dispersed by water (e.g., purple loosestrife) or are contained in fleshy fruits dispersed by birds (e.g., multiflora rose) (LaFleur et al. 2007). A control strategy that focuses only on sites within the ARIW without addressing alien and invasive species sources or invasion foci in the Allegheny River corridor will not succeed (Williams 1996). Other key issues affecting control strategies include restrictions on the type of control efforts that are permitted on the islands of the ARIW due to wilderness designation, logistic constraints associated with island access, and environmental restrictions on herbicide use due to close proximity to water.

Finally, it must be recognized that the ARIW exists in a hydrologically altered riverscape (Walters and Williams 1999; Colwell and Dyer 2002; Colwell and Stoudt 2002). The historic flow regimen of the unregulated Allegheny River consisted of seasonal spikes, especially in the spring, high flows associated with storm events, and low flows occurring from June to October (Walters and Williams 1999; Colwell and Stoudt 2002). The relatively stable flows of today's regulated river have diminished the potential for extensive and intensive scouring and flooding. A possible effect of altered flow regimen is the spread of invasive and alien plant species whose populations may have been held in check by past flooding and scouring. For example, stable flows may have promoted the dominance of certain invasive species, such as reed canarygrass, to the exclusion of disturbance-dependent native species (Walters and Williams 1999; Colwell and Dyer 2002). Therefore, integrated control strategies for alien and invasive plant species in the ARIW must address the influence of present-day hydrologic regimen on target species as well as control protocols for specific species on the islands and surrounding river corridor.

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Displacement in Wilderness Environments

A Comparative Analysis

BY JOHN G. PEDEN and RUDY M. SCHUSTER

Abstract: *A comparative analysis was conducted to determine how previous experience and stress appraisal influenced the potential for displacement in two wilderness environments. Visitors in the High Peaks and Pemigewasset Wilderness Areas were surveyed by mail in the summer of 2004. Stress appraisal scores were low, as was the likelihood of displacement. However, inter-site displacement was more likely among first-time Pemigewasset visitors than repeat Pemigewasset visitors. Social and managerial stressors exhibited a significant and positive influence on intra-site, inter-site, and temporal displacement in both study areas. Managerial stressors exhibited the strongest overall influence on displacement.*

Introduction

Wilderness has long served as a refuge for those seeking to escape the stresses of daily life. Visitation in the National Wilderness Preservation System has increased dramatically since the Wilderness Act was passed, and direct human impacts are now considered a viable threat to wilderness character (Cole 2001; Hendee and Dawson 2002; Oye 2001). Concerns about increasing rates of visitation and associated impacts on biophysical and social conditions have resulted in numerous attempts to measure visitor satisfaction (Manning 1999). Inconsistent results led to questions about the dominant paradigms employed in recreation satisfaction research (Stewart and Cole 2001; Williams 1989). Williams argued for a transactional approach that accounted for the participant's role in creating quality experiences. Researchers have responded by applying a transactional stress-coping framework (Lazarus and Folkman 1984) to wilderness environments (Miller and McCool 2003; Peden and Schuster 2008; Schneider and Hammitt 1995; Schuster, Hammitt, and Moore 2006). These studies assume that (1) personal and situational factors influence the appraisal of wilderness environments; (2) the appraisal process results in coping responses designed to mitigate sources of stress; and (3) coping responses influence the short- and long-term outcomes that impact future human-environment transactions.

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Stress-coping research provides wilderness managers with a better understanding of the personal and situational factors that influence visitors' perceptions of biophysical, social, and managerial conditions. For example, White, Virden, and van Riper (2008) reported that visitors with higher levels of experience use history (EUH) were more sensitive to recreation impacts. Peden and Schuster (2008) found no relationship between EUH and stress appraisal but reported that place attachment was associated with higher levels of social and managerial stress. Such findings raise questions about the effects that personal and situational

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characteristics may have on other aspects of the wilderness experience. Stress-coping research also provides insights regarding behavioral and emotional responses to the wilderness environment. The latter is particularly important since visitors often indicate high levels of satisfaction despite the presence of crowding and other stressful conditions (Hall and Cole 2007; Johnson and Dawson 2004; Manning 1999; Williams 1989). Such findings seem to suggest that visitors are able to cope with negative impacts. However, personal and situational characteristics may result in favorable experience outcomes despite the presence of stress in the wilderness environment (Cole 2004; Schuster et al. 2006). The use of coping strategies serves as a warning that management intervention may be necessary in order to maintain the quality of the wilderness experience (Hall and Cole 2007).

Displacement

The term *displacement* refers to altered patterns of visitation that result from negative appraisals of biophysical, social, and managerial conditions (Becker 1981). As stated by Becker, "displacement is a move away from an unacceptable situation rather than a move toward an optimal one" (1981, p. 262). Wilderness managers have expressed concerns that increasing visitation rates and associated impacts to biophysical, social, and managerial conditions will lead to displacement (Hall and Cole 2007; Hall and Shelby 2000; Oye 2001; Schneider 2007). Of particular concern is the possibility that unsatisfied visitors will abandon more heavily used sites in favor of lesser known and more pristine areas (Hall and Cole 2007; Oye 2001; Schneider 2007). In such instances, relatively undisturbed areas begin to lose their wilderness character, an experience outcome that often results in use limitations and other forms of direct management that can further perpetuate the displacement of visitors (Cole 2001; Spring 2001).

A review of the literature revealed that displacement is generally spatial or temporal in nature (Hall and Cole 2007; Hall and Shelby 2000; Schneider 2007). Spatial displacement refers to changes in location of use, and may occur within the respective area (intra-site) or between areas (inter-site). For example, visitors that appraise a designated campsite as crowded may move to another campsite within the area or leave in favor of another wilderness with fewer people. Temporal displacement refers to changes in the timing of use; visitors respond to undesirable conditions by hiking earlier or later in the day, returning at a different time of the week, or a different time of the year. Absolute displacement occurs when visitors leave an area and do not return (Hall and Cole 2007; Miller and McCool 2003). Hall and Cole (2007) reported that absolute displacement is rare, and that visitors are likely to respond to negative appraisals of wilderness environments through emotion-focused coping responses or temporal displacement.

Previous studies have suggested that temporal displacement occurs more frequently than spatial displacement (Hall and Shelby 2000; Johnson and Dawson 2004, Manning and Valliere 2001). Although Hall and Cole (2007) claimed that there has been insufficient research to conclude that one form of displacement is more common than another, results of a recent study in Oregon and Washington were consistent with previous research. Hall and Cole explained their findings by arguing that spatial displacement is dependent upon the availability of suitable substitutes. In the absence of alternative sites, visitors must change the timing of their visit or find another way to cope with undesirable conditions. Despite the frequency of temporal displacement, changes in the location of use appear to be a common response to negative appraisals of wilderness environments. Schneider (2007) noted that rates of spatial displacement may be as high as 86%.

Although the literature clearly distinguishes between intra-site and inter-site displacement, previous studies have typically employed a substitution typology that does not account for differences between these strategies (Hall and Shelby 2000; Miller and McCool 2003; Shelby and Vaske 1991). Distinguishing between intra-site and inter-site displacement will allow managers to determine where new impacts are occurring and where they are likely to be concentrated. Furthermore, different wilderness conditions are likely to result in different types of displacement (Hall and Shelby 2000). Biophysical impacts, for example, occur early in the succession of use and tend to be unevenly distributed throughout the site (Blahna and Reiter 2001). Although temporal displacement would be unlikely to mitigate most biophysical impacts, both intra-site and inter-site displacement would seem like logical responses to such conditions. Understanding when specific types of displacement are likely to occur, and the underlying reasons for such behavior, will help agency personnel develop more effective management strategies.

As previously noted, displacement implies a move away from undesirable conditions. Such changes can occur during the on-site visit, or as an anticipatory response that is based on the evaluation of previous wilderness experiences. Displacement that occurs on-site represents an attempt to cope with undesirable conditions. Displacement that occurs after the conclusion of the on-site visit represents an experience outcome that influences future appraisals of the wilderness environment. This distinction is important because on-site opportunities for temporal displacement and inter-site displacement are limited; visitors can travel earlier or later in the day, or they can leave the site entirely. Personal and situational factors such as previous experience, place attachment, and the availability of substitute sites may limit the feasibility of such responses.

Purpose and Methods

The current study used a stress-coping framework to determine how previous experience and stress appraisal influenced the potential for displacement in two wilderness environments. In contrast to previous studies, displacement was conceptualized as an outcome as opposed to a coping response. The following research questions were addressed:

1. Are first-time visitors more likely to be displaced than repeat visitors?
2. Does stress appraisal influence the likelihood of displacement?
3. Does the likelihood of displacement vary between study areas?
4. What types of displacement are likely to occur with the respective study areas?

Data collection took place in the High Peaks and Pemigewasset Wilderness Areas during the summer of 2004. The High Peaks is a 192,685 acre (79,010 ha) wilderness managed by the New York State Department of Environmental Conservation. The Pemigewasset is the largest federally protected wilderness area in the state of New Hampshire. This 45,000 acre (18,220 ha) wilderness is surrounded by an additional 77,000 acres (31,170 ha) of public land managed by the U.S. Forest Service. The High Peaks and Pemigewasset are characterized by mountainous terrain that is popular with hikers and backpackers.

Wilderness visitors were systematically contacted by the researchers at trailheads and designated campsites within each study area. The sampling frame included both weekdays and weekends. The purpose of the study was explained and contact information was obtained from those who agreed to participate. The survey was distributed by mail according to a modified Dillman procedure (Dillman 2000).

> Wilderness has long served as a refuge for those seeking to escape the stresses of daily life

Respondents rated 20 stressors on a scale from 0 (Not a Problem) to 5 (Serious Problem). Potential stressors were identified through interviews with visitors in both study areas. Respondents were also asked to indicate whether they were likely to alter future visitation patterns in response to sources of stress experienced during the visit. Intentions were measured with a nine-item scale that ranged from -2 (Strongly Disagree) to 2 (Strongly Agree). Questions that pertained to temporal and inter-site displacement were adopted from previous research (Hall and Shelby 2000; Manning and Valliere 2001; Miller and McCool 2003). Those that addressed intra-site displacement were developed through a review of the literature and interviews with visitors in both study areas. Visitors were also asked to specify age, gender, number of previous visits and hours traveled to reach the site.

Results

Of the 533 visitors contacted in the field, 508 (95%) agreed to participate in the survey study. A total of 396 mail questionnaires were returned for a response rate of 78%. Twenty-four questionnaires were omitted due to incomplete responses, and six questionnaires were returned as nondeliverable. An additional 31 respondents reported that they did not experience stress during their visit, and were excluded from participation in the remainder of the study. The final adjusted response rate was 66% for the combined data set (n = 335). There were 176 respondents in the High Peaks (69%) and 159 in the Pemigewasset (63%) who were used in the following analyses.

The average age of respondents was 36 in the High Peaks and 40 in the Pemigewasset. There were more repeat visitors (75% in the High Peaks and 79% in the Pemigewasset) than first-time visitors. Males were more prevalent than females in both study areas (66% in the High Peaks and 70% in the Pemigewasset). High Peaks visitors traveled longer to reach the site (41% > 4 hrs.) than Pemigewasset visitors (22% > 4 hrs.). Stress appraisal scores were low in both study areas. Mean scores ranged from .13 (disagreements among the group) to 1.16 (trail conditions) (see table 1). The likelihood of displacement ranged from -1.65 (I am unlikely to return to the High Peaks/Pemigewasset at all) to -0.10 (I am likely to return to the High Peaks/Pemigewasset at a different time of the year) (see table 2).

Stress appraisal indicators[a]	Combined	High Peaks	Pemigewasset
Trail conditions	1.16	1.51	.77
Insects	.97	.99	.96
Weather	.97	1.11	.81
Too many people	.94	.93	.96
Difficulty finding site	.74	.76	.72
Impacts (litter, fire rings, etc.)	.63	.60	.67
Designated sites too close together	.59	.68	.50
Difficulty hanging food	.59	.86	.30
Campsite/parking fees	.56	.59	.54
Behavior of other visitors	.51	.56	.46
Poorly marked trails	.50	.48	.52
Bear encounters	.38	.68	.05
Concerns about accidents	.36	.42	.30
Confusing rules/regulations	.31	.30	.33
Fitness/health/injuries	.30	.31	.29
Lack of Water	.26	.22	.31
Rules not adequately enforced	.25	.27	.22
Concerns about getting lost	.24	.29	.18
Negative interaction with mgmt. staff	.19	.20	.18
Disagreements among the group	.13	.18	.09

Table 1—Means for stress appraisal in the High Peaks and Pemigewasset Wilderness Areas

[a]Measured on a six-point scale; 0 = Not a Problem/Not Applicable to 5 = Serious Problem.

Displacement indicators[a]	Combined	High Peaks	Pemigewasset
I am likely to return to (wilderness area) at a different time of the year.	-.10	-.14	-.06
I am likely to use a different access point on my next visit to (wilderness area).	-.14	-.15	-.12
I am likely to avoid certain trails/ summits within (wilderness area).	-.17	-.13	-.23
I am likely to avoid certain campsites within (wilderness area).	-.20	-.15	-.26
I am likely to go to a different wilderness area in (name of region).	-.28	-.36	-.19
I am likely to return to (wilderness area) at a different time of the week.	-.33	-.40	-.24
I am likely to go to a different wilderness area outside of (name of region).	-.38	-.39	-.36
I am likely to return to (wilderness area) at a different time of the day.	-.44	-.45	-.42

Table 2—Means for displacement variables in the High Peaks and Pemigewasset Wilderness Areas

[a]Measured on a five-point scale; -2 = Strongly Disagree to 2 = Strongly Agree.

Principle components factor analysis was used for data reduction purposes and factor scores were computed according to the procedure recommended by Watson and Niccolucci (1992). Stress appraisal variables factored into five dimensions, two of which were consistent between study areas (see table 3), and the other three dimensions were dropped from further analysis. The two-dimension scale accounted for 57% of the total variance, and reliability scores were acceptable for both dimensions. For additional information refer to Peden and Schuster (2008).

Factor analysis of the nine-item displacement scale resulted in a three-factor solution that accounted for 77.5% of the variance, and Cronbach's alpha was .77 or higher for all three factors (see table 4). However, one variable *(I am likely to use a different access point on my next visit*) cross-loaded on the intra-site and inter-site factors and was dropped from subsequent analyses.

Kruskall-Wallis tests indicated that inter-site displacement was more likely among first-time Pemigewasset visitors than repeat Pemigewasset visitors. Intra-site displacement and temporal displacement did not vary between comparisons groups in either study area (see table 5).

Spearman's correlations suggested that stress appraisal increased the likelihood of temporal, intra-site, and inter-site displacement in both study areas. Stress appraisal exhibited the strongest influence on intra-site displacement. Correlations were greatest in the Pemigewasset, and managerial-related stressors exhibited the strongest overall influence (see table 6).

Mann-Whitney tests revealed no significant differences in the potential for displacement between study areas. However, Friedman tests indicated that displacement strategies varied within the High Peaks Wilderness (p = .000) and suggested that intra-site displacement was more likely to occur than inter-site displacement and temporal displacement (see table 7).

Table 3—Factor loadings for stress appraisal variables in the High Peaks and Pemigewasset Wilderness Areas						
Stress appraisal indicators[a]	Social factor			Managerial factor		
	Both	High Peaks	Pemi	Both	High Peaks	Pemi
Behavior of other visitors	.763	.760	.708			
Rules not adequately enforced	.666	.682	.582			
Too many people	.666	.553	.706			
Impacts (litter, fire rings, etc.)	.660	.571	.737			
Designated sites too close together	.520	.530				
Negative interaction with mgmt. staff				.823	.791	.788
Confusing rules/regulations				.760	.699	.586
Campsite/parking fees				.563	.417	.706
Disagreements among the group				.463		.594
Difficulty finding site				.452		
Cronbach's Alpha	α=.73	α=.74	α=.67	α=.64	α=.57	α=.60
Eigenvalue	2.54	3.03	2.40	2.32	2.24	2.17
% variance explained	16.91	15.93	12.64	15.44	11.77	11.44

[a]Measured on a six-point scale; 0 = Not a Problem/Not Applicable to 5 = Serious Problem.

Discussion

The current study used a stress-coping framework to determine how previous experience and stress appraisal influenced the potential for displacement in two wilderness environments. Inter-site displacement was more likely to occur among first-time Pemigewasset visitors than repeat Pemigewasset visitors. Previous experience did not influence the likelihood of inter-site displacement in the High Peaks Wilderness. Furthermore, temporal and intra-site displacement strategies did not vary between first-time and repeat visitors in either study area. These findings may be partially attributable to the geographic characteristics of the Adirondacks and White Mountains. High Peaks visitors traveled longer to reach the site and may have had fewer available substitutes than Pemigewasset visitors. The High

Table 4—Factor loadings for displacement variables in the High Peaks and Pemigewasset Wilderness Areas									
	Temporal factor			Intra-site factor			Inter-site factor		
Displacement indicators[a]	Combined	High Peaks	Pemi	Combined	High Peaks	Pemi	Combined	High Peaks	Pemi
I am likely to return to (wilderness area) at a different time of the day.	.841	.816	.876						
I am likely to return to (wilderness area) at a different time of the week.	.870	.859	.879						
I am likely to return to (wilderness area) at a different time of the year.	.840	.861	.696						
I am likely to avoid certain trails/summits within (wilderness area).				.826	.859	.780			
I am likely to avoid certain campsites within (wilderness area).				.839	.874	.756			
I am likely to use a different access point on my next visit to (wilderness area).				.547		.664	.530	.621	
I am likely to go to a different wilderness area in (name of region).							.834	.832	.820
I am likely to go to a different wilderness area outside of (name of region).							.911	.926	.893
Cronbach's Alpha	α=.85	α=.84	α=.86	α=.77	α=.76	α=.75	α=.84	α=.83	α=.88
Eigenvalue	2.35	2.32	2.38	1.98	1.91	1.98	1.87	2.05	1.86
% variance explained	29.36	28.99	29.75	24.72	23.84	24.80	23.43	25.60	23.76

[a]Measured on a 5 point scale ranging from -2 (Strongly Disagree) to 2 (Strongly Agree)

Table 5—Differences in displacement factor scores between first-time and repeat visitors

Factor	EUH	n	Mean rank	p
High Peaks				
Temporal	First-time repeat	44 132	94.95 86.35	.332
Intra-site	First-time repeat	44 132	86.90 89.03	.810
Inter-site	First-time repeat	44 132	94.36 86.55	.378
Pemigewasset				
Temporal	First-time repeat	34 125	81.32 79.64	.850
Intra-site	First-time repeat	34 125	85.94 78.38	.396
Inter-site	First-time repeat	34 125	99.24 74.77	.006[a]

[a]Significant at $\alpha \le .05$.

Table 6—Rank correlations between stress appraisal factors and displacement factors

Stress appraisal indicators	Both	High Peaks	Pemi
		Social factor	
Temporal	.275[a]	.222[a]	.331[a]
Intra-site	.308[a]	.283[a]	.340[a]
Inter-site	.238[a]	.223[a]	.245[a]
		Managerial factor	
Temporal	.318[a]	.217[a]	.423[a]
Intra-site	.389[a]	.329[a]	.461[a]
Inter-site	.353[a]	.303[a]	.404[a]

[a]Significant at $\alpha \le .000$.

Table 7—Differences in displacement factor scores within the High Peaks Wilderness

Factor		Mean rank	p
Intrasite—temporal	Negative ranks Positive ranks	161.5 151.0	.001[bd]
Intersite—temporal	Negative ranks Positive ranks	162.9 148.9	.149
Intersite—intrasite	Negative ranks Positive ranks	146.7 168.1	.012[cd]

[b]Based on negative ranks.
[c]Based on positive ranks.
[d]Significant at $\alpha \le .05$

Peaks is the most well-known and heavily visited wilderness area in the Adirondacks, due in part, to the presence of Mt. Marcy—the highest peak in the state of New York. The Pemigewasset is one of six wilderness areas on the White Mountain National Forest. The nearby Great Gulf and Presidential Range–Dry River Wilderness Areas are adjacent to Mt. Washington—the highest peak in the state of New Hampshire. Unlike many of the wilderness areas in the Adirondacks, the Great Gulf and Presidential Range–Dry River Wilderness Areas are well-known and easily accessible to day hikers and overnight backpackers.

Social and managerial stressors influenced the likelihood of temporal, intra-site and inter-site displacement in both study areas. Although these relationships appeared to be stronger in the Pemigewasset, subsequent analyses found no significant differences in the likelihood of displacement between study areas. However, intra-site displacement was more likely than temporal displacement and inter-site displacement within the High Peaks Wilderness; a finding that is inconsistent with previous research (Hall and Cole 2007; Hall and Shelby 2000; Manning and Valliere 2001). This discrepancy is not surprising given that the current study was designed to measure differences between intra-site and inter-site displacement; furthermore, multiple indicators were used to compute stress appraisal and displacement factor scores for use in subsequent analyses—a method that has not been used in previous research.

In general, the evidence suggests that existing wilderness conditions within the High Peaks and Pemigewasset Wilderness Areas were unlikely to result in displacement. When displacement does occur it is likely to take place within the boundaries of the High Peaks Wilderness. Managerial stressors such as negative interaction with agency staff, parking fees, and confusing regulations appear to be the primary concerns. High Peaks visitors were more likely to avoid problematic access points, campsites, and trails on future visits than to change the timing of use or the site itself. Although this may indicate that High Peaks visitors are capable of coping with existing conditions, a lack of suitable substitutes my limit the feasibility of temporal and inter-site strategies. Although there is some evidence to suggest that first-time Pemigewasset visitors may rely on inter-site displacement as a response to stressful appraisals of the wilderness environment, the percentage of first-time visitors within the Pemigewasset is relatively small (21%).

The current findings appear to be attributable to low levels of stressors within the High Peaks and Pemigewasset Wilderness Areas. However, effective coping strategies may have influenced the results (Hall and Cole 2007; Schuster et al. 2006). A noted limitation of this research is that visitors were asked about the likelihood of displacement as opposed to actual displacement behaviors. Furthermore, the study employed a post-hoc assessment that allowed visitors to cope with on-site conditions before the questionnaire was administered. If coping efforts were successful, it follows that stress appraisal scores should be low, along with the necessity for displacement. As a result, it will be important to continue monitoring visitors' perceptions of conditions in the High Peaks and Pemigewasset, along with the potential for displacement as an outcome of the wilderness experience. Future studies should employ a repeated measures design that documents displacement that occurs due to an on-site coping response, along with anticipated changes in future visitation patterns (i.e., an experience outcome). This can be accomplished through intercept surveys that occur within the wilderness boundary and a follow-up mail survey that investigates actual changes in visitation. Researchers should also investigate the influence of personal and situational factors such as previous experience and place attachment. Peden and Schuster (2008) reported moderate levels of place dependence, place identity, and place familiarity within the High Peaks and Pemigewasset Wilderness Areas. Attachment to these sites may have been great enough to limit the likelihood of displacement as an outcome of the wilderness experience.

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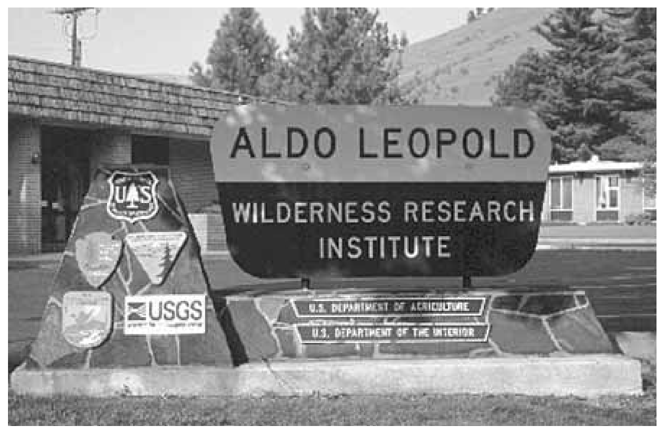
PERSPECTIVES FROM THE
ALDO LEOPOLD WILDERNESS RESEARCH INSTITUTE

WILD9 and Wilderness Science

BY GEORGE (SAM) FOSTER

The U.S. Forest Service recognizes the leadership responsibility it has had in wilderness stewardship science since the mid-1960s. I am the director of one of seven research stations within the Forest Service, and the one with national responsibility for wilderness science. The Rocky Mountain Research Station has responsibility for a broad science program to support public lands stewardship across 12 interior west states. Our wilderness science program extends across the station, and is centered at the Aldo Leopold Wilderness Research Institute (ALWRI) in Missoula, Montana.



We are excited to be participants and leaders in planning and facilitating the 9th World Wilderness Congress in Mexico later in 2009. Although several of our scientists will be present at the Congress in a variety of roles, it is our scientific leadership that is our calling. Dr. Alan Watson of the ALWRI is on the Congress Executive Committee, representing science and public lands stewardship, among his many talented and diverse international peers. Alan is also co-chair, with Dr. Joaquin Murrieta-Saldivar of the Sonoran Institute, of the Symposium for Science and Stewardship to Protect and Sustain Wilderness Values at the Congress. This is a task Alan has taken on before. We're helping to ramp up the science part of the symposium.

Dr. Dave Parsons, our ALWRI director, reported in the December 2007 issue of *IJW* that in early 2007 Forest Service wilderness research and development had been subjected to a peer panel review by outside experts. Although our role in generating four decades' of science to support managers was commended, there is a need for additional work.

The peer review panel realized that for many compelling reasons, our wilderness research program has crept into new areas over the past 10 years. This was due to expressed demand from the wilderness community, beyond the traditional applied science related to developing management tools and monitoring protocol. Among these expanded areas of research and coordination of knowledge was science to understand the role of wilderness in larger social and ecological systems, as well as understanding relationships people have with and values people place on wilderness. The panel brought focus on science that improves understanding of the contributions of wilderness to the ecological processes, services, and integrity of larger landscapes. In addition, science can use wilderness and similarly managed lands as laboratories to understand the causes and consequences of environmental change, minimally confounded by other influences.

This brings us to the 9th World Wilderness Congress. It is our sincere hope to continue facilitating the sharing of knowledge about new and important science to support management decision making and protection activities in wilderness and create science information and application tools that help us understand the role of wilderness in larger landscapes. We hope to demonstrate the scientific

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A Profile of Conservation International

BY RUSSELL A. MITTERMEIER, CLAUDE GASCON, and THOMAS BROOKS

Conservation International (CI) is a global conservation organization with a twist. Uniquely, the organization is committed to predicting, measuring, and holding itself accountable for the benefits to human well-being—across a wide range of dimensions—of all the biodiversity conservation work that it conducts or supports. The rationale is that although biodiversity conservation as a human enterprise is successfully making small-scale gains in a number of places, the aggregate global trend remains negative because most of human society does not realize why preventing biodiversity loss is so important to themselves, their families, and their nations; to future generations; and to the global eradication of poverty.

In terms of global strategy, CI works in those regions holding the greatest concentrations of biodiversity (specifically, regions holding more then 1,500 plant species found nowhere else in the world); in all of these, we demonstrate that conservation delivers great benefits to human well-being. Many of these regions are highly threatened and have already lost 70% or more of their historical habitat cover. These regions are known as biodiversity hotspots, based on a concept developed by the British ecologist Norman Myers

(l to r) Russell A. Mittermeier, Claude Gascon, and Thomas Brooks

Figure 1—A buriti palm swamp (*Hypsiboas buriti* [DD]) in Amazonas State, Brazil. Photo by A. Upgren.

in 1988. There are 34 such hotspots globally, typified by regions such as Madagascar and the Indian Ocean Islands, the Philippines, the South American Atlantic Forest, and Mesoamerica. The reason why conservation in the hotspots provides disproportionately high human well-being benefits is that the hotspots are home to many of the world's poorest people, who are most dependent on the maintenance of "free" services from nature, such as the flow of clean water. In addition to the biodiversity hotspots, CI works in the five regions that hold similar concentrations of biodiversity, but still remain largely intact as wilderness (see below).

CI was established in 1987. It now has about 1,000 staff members, of whom perhaps 300 are based at a global headquarters in Arlington, Virginia, USA, with the rest distributed among about 30 field offices through the biodiversity hotspots and high-biodiversity wilderness areas. We have presence on the ground in 18 of the hotspots and four of the high-biodiversity wilderness areas. The organization's annual budget is around $150 million annually. Of this, maybe a third is actually invested in partner organizations outside of the regions where CI works on the ground, notably in 10 hotspots where CI has no field presence itself. Examples of such regions include the Caucasus, the Caribbean, and the Mediterranean.

Such investment in partners is possible by the presence within CI of two major conservation finance mechanisms.

Figure 2—The Miombo woodland, a two-storied woodland with an open or lightly closed canopy. Photo by L. Roxburgh.

The first, the Critical Ecosystem Partnership Fund, was launched in 2000 and is a partnership among six organizations: the governments of France and Japan, the Global Environment Facility, the World Bank, the John D. and Catherine T. MacArthur Foundation, and CI itself. The fund invested $150 million across 18 hotspots over its first decade of operation, using these resources to mobilize civil society around biodiversity conservation. The six partners have recently renewed their commitment to a second phase of the fund. The second major financial mechanism, the Global Conservation Fund, is a $100 million fund established by the Gordon and Betty Moore Foundation in 2002, and invests in developing sustainable financing for protected areas of particularly high priority for conservation. CI also hosts Verde Ventures, a loan facility for supporting private enterprise for conservation, and is developing several new finance mechanisms, including a Global Marine Fund and a Carbon, Conservation, and Community Fund, which aims to mobilize climate change mitigation finance for conservation.

Figure 3—A waterfall in the Guiana Shield. Photo by A. Rial.

How does CI measure its success on the ground? We develop our targets for conservation outcomes—and the human well-being benefits that would be delivered by meeting these—at three interlinked levels of ecological organization. The finest of these is the species level: extinction rates have been driven by human activities 1,000 times above the natural level through Earth's history, and so we strive to reduce these as far as possible. To guide our species level targets we rely wholly on the authoritative International Union for Conservation of Nature (IUCN) Red List of Threatened Species. Second, because the predominant threat to biodiversity is the destruction of natural habitats, we aim to safeguard sites of global biodiversity conservation significance, known as "key biodiversity areas." Finally, we know that although the establishment of protected areas is the essential foundation for conservation, we also know that it is not sufficient, and so we develop a third level of targets at the scale of landscapes and seascapes, known as "biodiversity conservation corridors," to maintain the broad ecological processes on which biodiversity depends.

Each of these levels of conservation delivers distinct and massive benefits to human well-being. Species level conservation provides sustainability to numerous provisioning services to people: timber, fisheries, bushmeat, medicinal plants, pets, and ornaments. Species conservation also delivers a tremendous option value: the retention of features from which human well-being benefits have not yet been identified (e.g., potential cures for cancer) and for which the phylogenetic diversity among species maybe a surrogate. Meanwhile, site and corridor level conservation deliver enormous regulating benefits to humanity. These include the storage of carbon (e.g., 20% of greenhouse emissions are caused by tropical deforestation); maintenance of water quantity and quality; pollination of crops by insects, birds, and bats; amelioration of natural disasters such as floods, mudslides, and tsunamis; and regulation of disease (e.g., malaria transmission is much higher in deforested regions). Finally, cultural values—ecotourism, national symbols, corporate logos, sacred sites—are provided across all three levels of conservation outcomes.

High-biodiversity Wilderness Areas

From the beginning, CI has had a two-pronged strategy for global biodiversity conservation, working not just in the irreplaceable and threatened biodiversity hotspots, but also in the equally irreplaceable but still largely pristine high-biodiversity wilderness areas. In 2002 the organization invested in a major analysis of our high-biodiversity wilderness area conservation strategy (Mittermeier et al. 2002, 2003). Here, we summarize these findings.

In total, ecoregions that retain at least 70% of their natural habitat in an intact state cover 76 million sq km (29 million sq. mi.), 52% of the Earth's land area. The fully intact portions of these ecoregions alone cover 65 million sq km (25 million sq. mi.), 44% of the land area. The reason that this vast wilderness survives is simple: very few people live in these regions. The rural areas of these regions hold only 83 million people, just 1.4% of the global total, yielding an average rural population density of just 1.1 persons per sq km (2.8 per sq. mi.).

However, only five of these regions not only retain their natural habitats largely intact, but also hold exceptional concentrations of biodiversity, defined as more than 1,500 plant species only found in the region. Three of these are tropical humid forests. Far and away the greatest concentration of biodiversity lies in Amazonia, with no fewer than 30,000 plant species only found within the region, 10% of all plant species on Earth. Also highly significant are New Guinea (with 10,000 species unique to the island) and the Congo forest (3,000 species). One high-biodiversity wilderness area comprises tropical dry forest and savanna: the Miombo-Mopane woodlands of southern central Africa, which holds nearly 5,000 plant species occurring nowhere else on the planet. The last high-biodiversity wilderness area is the North American desert complex, which holds more than 3,000 unique plant species. In all five regions, processes are now underway to identify site conservation targets on the ground.

We examined the status, significance, threats, and conservation responses of each of these five high-biodiversity wilderness areas. Amazonia is the most biodiverse but also the largest area, covering more than 6.5 million sq km (2.5 million sq. mi.), and spanning nine countries. Approximately 64% of the region lies in Brazil, with the remainder in the Guiana Shield of Venezuela, Guyana, Suriname, and French Guiana, and in the Andean foothills of Colombia, Ecuador, Peru, and Bolivia. The Amazon is renowned for being home to numerous indigenous groups, including the Kayapó, Yanomami, and Trio Indians, although its overall rural population density is only one person per sq km (2.6 per sq. mi.). Although still 80% pristine, the Amazon forests face increasing pressures, in particular from commercial logging, ranching, and road development around its southern "arc of deforestation." In response to these threats, more than 8% of the region has been formally protected; in some Brazilian provinces this is much higher, approaching (Amazonas Province) and even exceeding (Amapá Province) 50%.

Figure 4—A victoria crowned pigeon—*Goura victoria*—a lowland forest species of northern New Guinea. Photo by R. James.

Conservation of the other two high-biodiversity wilderness tropical forests—the Congo (1.7 million sq km; 0.6 million sq. mi.) and New Guinea (0.8 million sq km; 0.3 million sq. mi.)—is also of great significance. The Democratic Republic of Congo holds just under 60% of the Congo forests, with the remainder distributed across Angola, Cameroon, the Central Africa Republic, Congo, Equatorial Guinea, and Gabon. The island of New Guinea is split roughly equally between two countries:

> Biodiversity conservation in the high-biodiversity wilderness areas provides for human well-being and benefits, including climate change mitigation.

Figure 5. Oya Mada Wa'a (Goodenough Island). Montane forests are the only known locality of the black forest wallaby (*Dorcopsis atrata*). Photo by R. James.

Indonesia (Papua Province) and Papua New Guinea. Both regions have higher rural population densities than does Amazonia, at around five people per sq km (13 per sq. mi.), and as a result more of their natural habitat has been lost—approximately 70% in both cases. Nevertheless, extensive conservation efforts are underway in both regions. In the Congo these are largely coordinated through major multinational initiatives such as the Congo Basin Forest Partnership, whereas in New Guinea they are necessarily much more local, implemented through local protection by tribes and villages.

The other two high-biodiversity wilderness areas are in much drier regions. The Miombo-Mopane spans 1.2 million sq km (0.5 million sq. mi.) across nine countries: Angola, Botswana, the Democratic Republic of Congo, Malawi, Mozambique, Namibia, Tanzania, Zambia, and Zimbabwe. The North American deserts straddle the border of the United States and Mexico, made up of the Chihuahuan, Sonoran/Baja California, Colorado Plateau, and Mojave deserts and totaling 1.4 million sq km (0.5 million sq. mi.). Both regions have human population densities of around three people per sq km (8 per sq mi). The expansion of dryland agriculture and grazing are probably the most significant threats in both regions, directly in terms of habitat use, and indirectly through the erosion of their hydrological resources. Nevertheless, the conservation outlook is quite bright in both cases, with 23% of the North American deserts and no less than 36% of the Miombo-Mopane safeguarded in formal protected areas.

Effective conservation in these regions is an imperative for biodiversity but also for the numerous benefits that such conservation would provide to humanity. Above all, conservation in the high-biodiversity wilderness areas is essential for effective climate change mitigation, given that 20% of greenhouse gas emissions come from tropical deforestation. Exciting potential now exists for incorporating a mechanism for compensating tropical forest countries for "Reducing Emissions from Deforestation and Degradation" into the global agreement to mitigate climate change currently under negotiation (see article in this issue by Locke and Mackey). This especially will be the case if compensation benefits not just countries with historically rapid deforestation (e.g., Indonesia), but also those with remaining high levels of forest cover but low deforestation (e.g., Guayana Shield countries).

The benefits that biodiversity conservation in the high-biodiversity wilderness areas provide to human well-being go much beyond climate change mitigation. Maintenance of water quality and quantity is important, although rather less so than in hotspots simply because there are so many fewer people in wilderness areas to use this water. Extraction of wild products such as timber is a major industry, although it is currently largely unsustainable and so tragically undermines its own benefits. Much more encouraging are local enterprises in nonconsumptive use, such as ecotourism, that harness the cultural values of high-biodiversity wilderness for human well-being. Maybe most significant of all is the fact that half of the world's languages are inextricably bound up with the conservation of the high-biodiversity wilderness: the conservation of the biodiversity of these regions also maintains humanity's cultural diversity.

Conservation International's Future

What is the long-term prospect for CI? We have delivered numerous local conservation successes on the ground, and in some cases it has been possible to amplify these to national levels. One example is Madagascar, where

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Mountain Ungulates of the Trans-Himalayan Region of Ladakh, India

BY TSEWANG NAMGAIL

The Trans-Himalaya is a vast expanse of cold and arid land encompassing the entire Tibetan Plateau and its marginal mountains, with an estimated area of 2.5 million sq km (965,000 sq. mi.). Ladakh is located at the western tip of this huge plateau, and is the least inhabited area in India, with fewer than three persons per sq km (0.4 sq. mi.). The region supports an intact assemblage of Pleistocene large herbivores (Schaller 1977). These herbivores underwent an adaptive radiation in the late Miocene, occupying the mountainous niches created in the aftermath of the collision of the Eurasian and the Indian plates and the consequent rise of the Himalaya (Schaller 1977).

Ladakh's mammalian herbivores (20 species), belonging to six families, include eight wild ungulates: Tibetan gazelle (*Procapra picticaudata*), Tibetan antelope (*Pantholops hodgsoni*), blue sheep (*Pseudois nayaur)*, Ladakh urial (*Ovis vignei vignei*), Asiatic ibex (*Capra ibex siberica*), Tibetan argali (*Ovis ammon hodgsoni*), Tibetan wild ass (*Equus kiang*), and wild yak (*Bos mutus*). The populations of these mountain ungulates have declined in the last century due to poaching and habitat loss associated with human endeavors.

Most of the aforementioned herbivores are currently listed on the Schedule I of the Indian Wildlife (Protection) Act of 1972 and Appendix 1 of the Convention on International Trade in Endangered Species (CITES). The Ladakh urial and Tibetan antelope are also listed as endangered species on the Redlist of the International Union for Conservation of Nature (IUCN). Although several parts of eastern Ladakh, known as Changthang, have remained undisturbed wildland areas, others are being encroached upon by humans in recent years, and the herbivores inhabiting them face an array of threats associated with an increasing demand on natural resources (Fox et al. 1994).

Cashmere wool, or Pashmina, is the mainstay of the economy of the people of the harsh environment of eastern Ladakh, where any other form of land use is less profitable. However, as the needs and aspirations of the people have increased, they have tended to increase the livestock population (Namgail et al. 2007a), which makes the survival prospects of many wild ungulates sharing resources with them questionable. The western part of Ladakh, however, is lower and fertile, and people there practice agriculture complemented by livestock production, but wild ungulates in this region are not welcomed by farmers, whose crops are damaged by the animals.

Although more localized surveys (often within protected areas) were carried out in the past to determine the status and threats to these mountain ungulates, there has

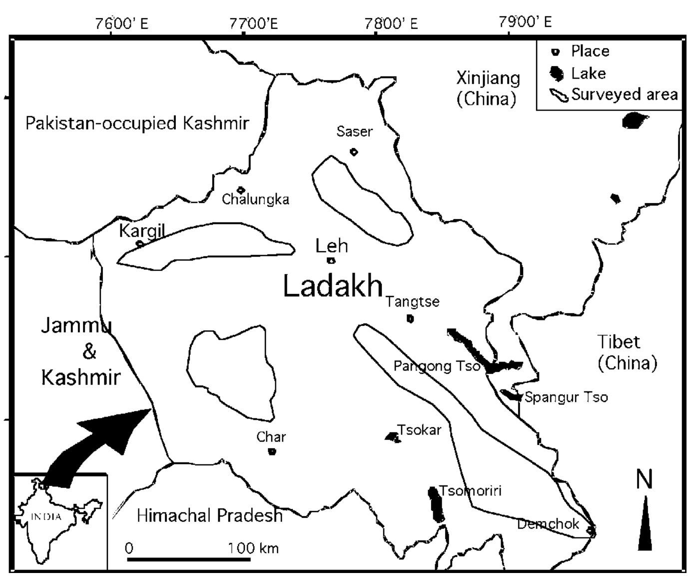

Figure 1—Ladakh area of the Indian Trans-Himalaya, with the surveyed areas demarcated.

Figure 2—A subadult male blue sheep observed in the Zangskar Mountains. Photo by Tsewang Namgail.

been no apparent effort to understand the patterns at a geographical scale, which is crucial for prioritizing larger ecologically sustainable areas for the conservation of these threatened animals.

Field Surveys

Surveys were carried out between March 2005 and August 2006. The entire Ladakh region (see figure 1), encompassing almost 80,000 sq km (30,888 sq. mi.), was divided into four geographical zones: Nubra in the north, Zangskar in the south, Changthang in the southeast, and Sham in the west. Within Nubra, the surveys largely focused on the areas between Khardong and Hundar along the Shayok River, and Kyagar and Panamik along the Nubra River (see figure 1). Within Zangskar, Hanumil, Pishu, Pidmu, Rinam, Karsha, Padum, Photoksar, Lingshed, Dibling, Yulchung, and Nyaraks were surveyed. Time was also spent gathering information from the areas between Padum and Pensi Pass. In Changthang surveys mainly focused on Hanle, Chumur, Kuyul, and Demchog areas. The surveys in the Sham zone covered Panikhar, Sangkoo, Umba, Bodkharbu, Dha-Hanu, Lamayuru, Hemis Shukpachan, Domkhar, Skurbuchan, and Wanla.

The surveys were carried out in two phases. During the first phase, Changthang (March 2005) and Sham (April 2005 and June 2006) areas were surveyed, and the second phase covered Zangskar (July 2006) and Nubra (August 2006). The surveys largely involved driving to different areas and observing mountain ungulates, and also interviewing local people to find out the presence/absence of animals. All the animals observed on the way to different places were also recorded. Given the huge geographical area of Ladakh, driving from place to place was the only practicable way to survey the region for mountain ungulates. The presence of an animal's horns in an area was also taken as the evidence of its occurrence there, which was further confirmed by interviewing people in a nearby village. Nature and extent of threats to various species were determined by interviewing villagers throughout the region.

Figure 3—A full-grown male blue sheep in its winter coat in the Shun Gorge of Zangskar. Photo by Tsewang Namgail.

Mountain Ungulates

There are eight wild ungulates in Ladakh, out of which only six were observed during the surveys. Secondary information was gathered on the other two species, namely the wild yak and Tibetan antelope. Due to the extinction and colonization dynamics, currently there is a spatial variation in the species richness of the mountain ungulates in the Indian Trans-Himalaya, with some valleys supporting four to five wild ungulate species, whereas others support only one species. Below are the species-wise accounts of status and distribution of mountain ungulates in Ladakh.

The Tibetan gazelle is a small antelope weighing about 15 kg (33 lbs.). It has a grayish-brown body and a short, black-tipped tail in the center of a heart-shaped white rump-patch. The animal is endemic to the Tibetan plateau (Schaller 1998). Within Ladakh, the species had a wide distribution in the early 20th century (Stockley 1936), but its range underwent a marked contraction in the last several decades due largely to illegal hunting and habitat degradation (Fox et al. 1991; Bhatnagar et al. 2006). During the present survey, I counted 36 gazelles in six groups in and around

Figure 4—Two full-grown male Asiatic ibex in their rocky habitat in western Ladakh. Photo by Tsewang Namgail.

the Kalak Tartar plateau, the last stronghold of gazelle in Ladakh. Competition with domestic sheep and goats was found to be the most important threat to the long-term survival of the animal (Namgail et al. 2008). The current estimated population of the species in Ladakh is fewer than 100 animals (Namgail et al. 2008).

The Tibetan wild ass, or kiang, is the largest wild ass in the world, with some stallions standing 1.4 m (4.6 ft.) tall and weighing up to 400 kg (880 lbs.). It occurs all across the Tibetan Plateau and peripheral areas. Presently, the eastern part of Ladakh is the major stronghold of this animal in India. During the present survey, I carried out repeated transect counts between Rongo and Hanle in eastern Ladakh. On the first transect count, I tallied 136 kiangs in the sedge meadows along the Hanle River, and during the second transect, I counted a maximum of 133 kiangs. The now-sedentary nomadic pastoralists, who currently practice agriculture, fence off land for growing crops, which seems to be the most significant threat to the animal. It is estimated that presently there are about 2,000 kiangs in Ladakh.

The blue sheep is a unique mountain ungulate that is somewhere between sheep and goat, as it displays characteristics of both. The blue sheep is widely distributed on the Tibetan Plateau and the peripheral areas (Namgail et al. 2004). During the surveys, I observed 89 individuals in seven groups in the Rong area between Liktse and Mahe. In addition, I observed three groups near Omachhu and Pishu village in Zangskar, and five groups in western Ladakh.

Several species of large herbivores inhabiting Ladakh are facing a precipitous decline in their populations.

Conflicts with farmers due to crop damage and poaching for meat seem to be the major threats to blue sheep in Ladakh. It is the most abundant wild ungulate in Ladakh, with an estimated population of 11,000 individuals.

The Tibetan argali is the largest wild sheep in the world, standing just over 1 m. (3.5 to 4 ft.) at the shoulder, with the horn measuring 90 to 100 cm (35 to 40 inches). The Tibetan argali occurs widely on the Tibetan Plateau, but in small populations scattered throughout the area (Schaller 1998). In some areas, the population may be stabilized, whereas it is declining in others (Namgail et al. 2004; Namgail et al. 2007b). The species was thought to have gone extinct from the Hanle Valley 20 years ago, but the present survey in eastern Ladakh reported its occurrence there. Historically, the species was affected negatively by trophy hunting, as the argali has huge horns, but currently competition with domestic livestock has emerged as the single most important threat to the animal (Namgail et al. 2007b). The most current estimate suggests that there are not more than 400 argali left in Ladakh (Namgail et al. 2009).

The Ladakh urial is a small wild sheep that is about 80 cm (31 in.) high at the shoulder, and that weighs an average of 65 kg (143 lbs). The species is endemic to Ladakh, where it has a peculiar distribution, occurring only along two major rivers: the Indus and the Shayok. The population of the animal declined in the last century due to trophy and meat hunting (Mallon 1983). During the surveys, I observed the animals near Hemis Shukpachan and Lamayuru villages in western Ladakh. Owing to its occurrence near human habitations, the animal has born the brunt of human onslaught. The two major valleys where urial occur are also the areas with the highest human density, due to the fertile land along the river banks (Namgail 2006a). The urial often descend to the agricultural fields and damage crops, especially in spring, and the farmers often retaliate. The current estimated population of the animal in Ladakh is 2,000 individuals.

Figure 5—Two adult Tibetan argali rams grazing in the Tsabra catchment of Gya-Miru, Ladakh. Photo by Tsewang Namgail.

The Asiatic ibex is a majestic wild goat that is about 80 to 100 cm (31 to 40 in.) high at the shoulder, and that weighs an average of 60 kg (132 lbs). The species is partial to rugged areas, as it has strong and muscular legs that help it negotiate steep cliffs (Namgail 2006b). The species is the second most abundant wild ungulate in Ladakh after the blue sheep (Namgail 2006b). The Asiatic ibex was hunted heavily in the past by both trophy and meat hunters (Fox et al. 1992), and the present population is very sparsely distributed. During the present surveys carried out mostly during summer, I saw 15 individuals near the Hemis Shukpachan and a group of 13 individuals near Hanupatta before the Singge Pass. It is estimated that there are about 6,000 individuals in Ladakh.

Figure 6—A herd of Ladakh urial in the western part of Ladakh. Photo by Yash Veer Bhatnagar.

The Tibetan antelope is a graceful animal adapted to the highlands of Tibet (Schaller 1998). The animal is confined to Aksai Chin and the Chhang Chhenmo areas of northeastern Ladakh. These areas are relatively inaccessible; however, interviews with local people and wildlife officials suggested that moderate numbers of antelope, not more than 200 individuals, occur in these areas. The Tibetan antelope is being slaughtered on the Tibetan plateau for its much-valued wool, known as Shahtoosh, which is one of the finest natural fibers in the world. Shahtoosh is smuggled out from Tibet to Kashmir in India and woven into exquisite scarves and shawls, which are exported to the developed countries. There are 250 individuals of this endangered species in Ladakh.

The wild yak is a sturdy and bulky ungulate with high lung capacity and a thick coat, which are adaptations to the high-altitude environment of Tibet. The males have imposing, stately horns. Although in the past the animal occurred in a wider area of Ladakh, presently it is confined to the Chhang Chhenmo Valley. The historical distribution of the species was spread as far west as the Gya-Miru area, as indicated by the presence of several pit traps, targeted at wild yak, in the area. Species in the past suffered at the hands of trophy hunters, but competition with domestic livestock for the scarce rangeland resources is presently threatening the animal's population in Ladakh. There is an estimated population of about 200 wild yaks in the region.

Recommendations

Several species of large herbivores inhabiting Ladakh are facing a precipitous decline in their populations. They face an array of threats from modern developmental initiatives, poaching, and increasing human and livestock populations. Some species, such as the Tibetan gazelle, Tibetan argali, wild yak, and Tibetan antelope, are rare and need immediate attention from conservationists. Among these the former three had wider distributions in Ladakh, but presently they are confined to small pockets. The causes of their local extinctions are not known, and need to be studied so that further declines might be stemmed.

During the present surveys it became apparent that there are fewer species in the western part of Ladakh and Nubra Valley and greater numbers in the Changthang region. Ecological studies need to be designed and executed to understand such spatial variation in species richness, so that area-specific conservation strategies can be developed. The populations of the mountain ungulates should be monitored regularly, which will enable us to record the rate of decline or recovery in their populations, and prioritize our tasks as we work to save these unique and threatened animals. Moreover, there is also an urgent need to study the conditions and carrying capacity of the rangelands in the region.

The wild ungulates in the Sham area cause crop damage. Although compensation to farmers may serve as an immediate solution, preventive measures should be worked out to reduce the overall level of crop damage in the long run. The wild ungulates in eastern Ladakh, in contrast, were mainly threatened by increasing livestock population. This is especially so after the increase in livestock population in the wake of increased demand for cashmere wool (Namgail et al. 2007a). The current rate of increase in the livestock population is unsustainable, and as such is detrimental to both livestock and wildlife. Identifying critical wildlife habitats and freeing them from livestock grazing could reduce pressure on the wild ungulate populations in the region.

Figure 7—A typical blue sheep habitat with rugged terrain that is secured from predators such as the wolf and the snow leopard, which are less agile in steep cliffs. Photo by TR Shankar Raman.

Creating conservation awareness through special education programs is urgently needed. The local people need to be educated about ecosystems and their functions so that they appreciate and conserve them. Since the younger generations, especially the school children, are the future potential stewards of the wild animals, they should be the prime focus of environmental education programs. From a commercial point of view, the local people need to realize that the unique biodiversity of Ladakh, if preserved in its entirety, will attract wildlife enthusiasts from across the world, thereby providing tourism business.

Several developmental projects, such as building roads to remote areas and dams for electricity, are underway, but the impact of these projects on the wildlife is not being assessed. Since Ladakh is increasing its number of development projects every year, it is imperative to conduct environmental impact assessments, and projects should be allowed only if receiving no objection certificates from the conservation agencies.

A network of protected areas was established in Ladakh in the late 1980s. Unfortunately, most of these do not harbor viable ungulate populations, and most of them have permanent snowfields or glaciers, which are not usable by ungulate wildlife. The limited labor force within the wildlife protection agencies is a major problem. The current strength of the staff at the Department of Wildlife Protection, Leh, is not more than 30, and this team has the responsibility of patrolling about 30,000 sq km (11,583 sq. mi.). Under such circumstances, it is imperative that the local communities provide help in protecting wildlife. Furthermore, given the region's environmental and geographical characteristics, it is desirable to target smaller, ecologically significant areas for protection of the most endangered species.

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Announcements

COMPILED BY GREG KROLL

The National Wilderness Preservation System Grows by Two Million Acres

On March 30, 2009, President Barack Obama signed into law the largest conservation legislation in a generation, the Omnibus Public Land Management Act of 2009. The 1,200-page law is a collection of 170 separate lands, parks, and conservation bills. It adds 2 million acres (810,000 ha) of land to the National Wilderness Preservation System in nine states. The following bills, included in the legislation, designated new wilderness areas (new wilderness acreage is listed):

- Eastern Sierra and Northern San Gabriel Wild Heritage Act (California) with 450,000 acres (182,000 ha)
- California Desert and Mountain Heritage Act (California) with 190,000 acres (76,900 ha)
- Sequoia and Kings Canyon National Parks Wilderness Act (California) with 85,000 acres (34,000 ha)
- Dominguez-Escalante National Conservation Area and Dominguez Canyon Wilderness Area Act (Colorado) with 66,000 acres (26,700 ha)
- Owyhee Public Lands Management Act (Idaho) with 517,000 acres (210,000 ha)
- Beaver Basin Wilderness Act (Michigan) with 11,739 acres (4,750 ha)
- Sabinoso Wilderness Act (New Mexico) with 15,000 acres (6,070 ha)
- Copper Salmon Wilderness Act (Oregon) with 13,700 acres (5,500 ha)
- Lewis and Clark Mount Hood Wilderness Act (Oregon) with 128,600 acres (52,000 ha)
- Cascade-Siskiyou National Monument Voluntary and Equitable Grazing Conflict Resolution Act (Oregon) with 23,000 acres (9,300 ha)
- Spring Basin Wilderness Act (Oregon) with 8,600 acres (3,480 ha)
- Oregon Badlands Wilderness Act (Oregon) with 31,000 acres (12,500 ha)
- Washington County Growth and Conservation Act (Utah) with 256,000 acres (103,600 ha)
- Virginia Ridge and Valley Wilderness and National Scenic Area Act (Virginia) with 55,000 acres (22,300 ha)
- Wild Monongahela Act (West Virginia) with 37,000 acres (15,000 ha)

In addition to the wilderness initiatives, the act provides for the following:

- Establishes three new units of the National Park System, a new National Monument, and four new National Conservation Areas
- Codifies the Save America's Treasures and Preserve America historic preservation programs
- Designates more than 1,000 miles (1,600 km) of new additions to the National Wild and Scenic Rivers System
- Designates four new National Scenic or National Historic Trails and enlarges the boundaries of several existing units of the National Park System
- Establishes 10 new National Heritage Areas
- Formally establishes the National Landscape Conservation System
- Addresses critical water resource needs on both the local and national level
- Ratifies water settlements in California, Nevada, and New Mexico

In spite of the act's huge benefits to the National Wilderness Preservation System, some conservationists have expressed dismay over a few provisions, especially as they pertain to compromises in the Idaho, Utah, and Alaska wilderness legislation. Perhaps of greatest concern, the act provides for an access road through designated wilderness in Izembek National Wildlife Refuge, Alaska (see the related Digest article in the December 2007 *IJW*). The road project requires an environmental impact statement by the Interior Department, and the interior secretary could still block the proposal. Taxpayers have already spent $41 million addressing alternatives to the Izembek road, including the purchase of

Submit announcements and short news articles to GREG KROLL, *IJW* Wildernss Digest editor. E-mail: wildernessamigo@yahoo.com a hovercraft, which can transport 56 passengers in 10-foot waves. (Sources: *New York Times,* March 31, 2009; *Washington Post,* March 20, 2009; www.leaveitwild.org)

Grazing Allotments Retired in Forest Service Wilderness

Thirty grazing allotments on Forest Service lands surrounding Yellowstone National Park (Wyoming, Montana, Idaho) have been retired, thanks to the Wildlife Conflict Resolution Program sponsored by the National Wildlife Federation (NWF). Three of those allotments are in designated wilderness. Conflicts between livestock and wildlife on public lands are one of the leading sources of mortality in wolf and grizzly bear populations in the Greater Yellowstone Ecosystem. Whereas some environmental groups have tried to compel federal agencies to administratively cancel troublesome leases, NWF has taken a different approach.

Federal grazing leases have economic value to ranchers who frequently sell these permits to one another. The concept of taking away a lease without compensation has caused controversy and ill will. Under the NWF program, agreements to retire grazing allotments are strictly voluntary. In areas that have prolonged and seemingly irresolvable conflicts with wildlife, it's often difficult for ranchers to profitably run livestock; hence, they may be amenable to retiring these "conflict" allotments. NWF contacts ranchers who hold leases on these allotments, and if the rancher is interested, NWF negotiates a price based on the amount of forage available in the unit. The rancher then waives his or her grazing permit back to the Forest Service, the Forest Service writes a decision letter permanently closing the allotment, and NWF provides the rancher with a check. According to NWF, although one might surmise that getting livestock producers to agree to allotment retirement is the greatest challenge, persuading agencies to retire allotments presents its own set of challenges. Allotment retirement has gone most smoothly where specific forest plans provide direction in dealing with threatened and endangered species such as wolves and grizzlies.

NWF considers sheep allotments to be a higher priority than those for cattle because they create more conflict with wildlife. Allotment retirements also benefit elk, deer, and bighorn sheep through additional forage; sensitive alpine meadows that contain rare plants face reduced risk; and hunters and hikers no longer encounter domestic livestock in retired areas. Since 2002, 552,000 acres (223,400 ha) have been retired in the Greater Yellowstone Ecosystem, including allotments in the Absaroka-Beartooth Wilderness, the Washakie Wilderness, and the Jedediah Smith Wilderness. (Source: www.nwf-wcr.org)

Google Earth Identifies Marine Protected Areas

Internet users can now travel in three dimensions through the vast and largely unknown underwater world of the planet's oceans, flying over and around underwater seamounts or following scientific research expeditions as they explore ocean depths. The International Union for Conservation of Nature (IUCN) has collaborated with the Ocean in Google Earth project to create the Marine Protected Area Layer, which contains information on more than 4,500 protected sites spread around the globe. According to IUCN director general Julia Marton-Lefèvre, "While on other maps all you see of the oceans is a blue surface, here you can see that Hawaii is actually the top of a massive undersea mountain and take a breathtaking three-dimensional flight over its underwater peaks and troughs." To access Ocean in Google Earth, download the latest version of Google Earth at earth.google.com. It's free.

The companion website, www.protectplanetocean.org, the global web portal for ocean conservation, was developed by IUCN and its partners to complement the Marine Protected Area Layer in Ocean in Google Earth. It provides an easy-to-use interface for the public to upload their own photos, videos, and stories about the oceans. The uploaded content will be included in the Google Earth Marine Protected Area Layer, meaning that users can directly contribute to the world's first multimedia map of the oceans. (Source: www.iucn.org/news_events/news/?2612/Dive-into-the-oceans-with-Google-Earth)

Wild and Scenic Rivers Council Facilitates Interagency Coordination

The National Wild and Scenic Rivers System was created by Congress in 1968 to preserve certain rivers with outstanding natural, cultural, and recreational values in a free-flowing condition. Rivers are classified as wild, scenic, or recreational:

- **Wild River Areas**—Those rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted. These represent vestiges of primitive America.
- **Scenic River Areas**—Those rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads.

- **Recreational River Areas**—Those rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past.

For the first 25 years of the National Wild and Scenic Rivers System, designated rivers were managed differently by each federal agency. In 1993, conservation organizations issued a challenge to the land management agencies to establish an interagency council to address wild and scenic rivers administration. This was accomplished in 1995. The council, consisting of representatives of the Bureau of Land Management, National Park Service, U.S. Fish and Wildlife Service, and U.S. Forest Service, addresses a broad range of issues, from management concerns on rivers presently in the national system to potential additions listed on the Nationwide Rivers Inventory, from state designations to the provision of technical assistance to other governments and nonprofit organizations.

As of 2008, the national system protected more than 11,000 miles (17,700 km) of 166 rivers in 38 states and Puerto Rico; this is a little more than one-quarter of 1% of the nation's rivers. By comparison, more than 75,000 large dams across the country have modified at least 600,000 miles (965,000 km), or about 17%, of American rivers. (Source: www.rivers.gov)

Visitor Management a Major Concern in Tatranskỳ National Park

Tatranskỳ National Park is the oldest national park in the Slovak Republic and protects the High Tatras Mountains. Founded in 1949, the park encompasses an area of 286 square miles (741 sq km), incorporating dense forests on the mountains' lower slopes, as well as glacial lakes and mountain streams. The High Tatras, the only alpine mountain range in eastern Europe and one of the smallest in the world, provides habitat for chamois (mountain goat), bear, and marmot.

The park's visitation has increased a hundredfold over the last 60 years, and there is concern that unregulated tourism will negatively affect critically endangered vertebrate and invertebrate species. The park currently lacks a year-round monitoring system for visitor use in the most popular areas. Juraj Švajda, Ph.D., of the Institute of High Mountain Biology, University of Žilina, assisted park staff in studying visitor use patterns. To test the effectiveness of a proposed monitoring system, an Eco-Twin pyroelectric sensor was installed along a trail in the Mengusovská Valley. Consisting of a lens sensitive to infrared radiation emitted by the human body, the Eco-Twin logger detects each time a person passes, discerning between two people following each other closely. The Eco-Twin functions even when the ambient temperature is higher than that of a passing body, and avoids false counts generated by vegetation movement, rain, or sun.

The monitoring program exposed violations of seasonal closures as well as illegal nighttime intrusions into the valley. Furthermore, it was determined that trail use was 50 times higher than the established carrying capacity. Based on these findings, the park has proposed decreasing daily visitation in the valley by 80%. As a result of this preliminary study, the park proposes to install additional counters, set up video cameras to assess forms of transport utilized by park visitors, and to initiate a survey at park entrances to better understand visitors' attributes and motives for visiting the park. (Sources: Juraj Švajda, Ph.D. at juraj.svajda@uniza.sk; www.iexplore.com/attractions/Tatras_National_Park_(Tatransky_narodny_park).jhtml; www.eco-computer.com)

General Public Unaware of Activities Allowed in Wilderness

According to a study published in 2000 by J. Mark Fly, Robert Emmet Jones, and H. Ken Cordell, the general public does not appear to be very knowledgeable about activities allowed in federally designated wilderness areas. The researchers surveyed 2,829 households in the Southern Appalachian Ecoregion of the United States, a seven-state area stretching from Virginia to Georgia. The region contains 49 separate wildernesses totaling 476,654 acres (192,895 ha). About half the area's residents live in rural communities and maintain "active outdoor lifestyles." The purpose of the study was to assess public knowledge of wilderness practices and current sentiment toward the need to designate more wilderness areas.

Along with other questions, researchers asked whether timber harvesting and motor vehicles are allowed in designated wilderness. Less than 10% of those interviewed answered both questions correctly, regardless of their income, education, gender, ethnic origin, or rural/urban residence. When asked if more public lands should be set aside as wilderness, however, 69% agreed, whereas one in four did not. But only 14% strongly agreed that more wilderness areas were needed. Unlike wilderness knowledge, this category demonstrated a number of significant differences across sociodemographic groups. People with some college education, Caucasians, urban residents and those whose job was not related to natural resources were more likely to support setting aside more wilderness than their counterparts. (Source: www.fs.fed.us/rm/pubs/rmrs_p015_2/rmrs_p015_2_201_204.pdf)

Graduate Certificate in Wilderness Management Now Available

The University of Montana is now offering a Graduate Certificate in Wilderness Management, providing students and professionals with training and expertise in key topics related to managing wilderness. Courses cover the history and philosophy of the wilderness system, wilderness law and policy, wilderness recreation management, wilderness ecosystem conservation and resource monitoring, and wilderness planning. Taken together, these courses provide the necessary foundation for students to pursue careers in wilderness management. Courses are offered as traditional correspondence courses or interactive online courses through the Wilderness Management Distance Education Program in the College of Forestry and Conservation at the university. Each of the four courses costs between $675 and $875, including books. Students desiring academic credit must pay an additional $135 credit fee per course. For more information, visit wmdep.wilderness.net/.

Southern Africa's Freshwater Species in Danger

Many freshwater fish, crabs, dragonflies, mollusks, and aquatic plants are at risk of extinction in southern Africa if its rivers and lakes are not protected from developers, according to the International Union for Conservation of Nature (IUCN). A study by the IUCN Species Program, in collaboration with the South African Institute for Aquatic Biodiversity and the South African National Biodiversity Institute, shows that 7% of species are known to be regionally threatened or extinct. But this figure will skyrocket unless freshwater species conservation is considered in development planning.

The results from the assessment of 1,279 freshwater species in southern Africa show that the more developed a country is, the more species are threatened with extinction. Of the 94 species threatened in southern Africa, 78 of these are found in South Africa, the most developed country in the region. Freshwater species provide food for local people, and some of them, such as the mollusks, help purify the drinking water. The study shows that although 77% of species are not threatened with extinction, there is not enough information for 16% of them to determine their threat status.

Three hotspots of species diversity are highlighted in the report, including the area where the upper Zambezi meets the Kwando and Chobe Rivers above Victoria Falls, the Komati and Crocodile River tributaries of the Incomati system in Mpumalanga, South Africa, and the Mbuluzi River basin, also in Mpumalanga, South Africa, and in Swaziland. Many of southern Africa's coastal drainages have sites that contain species that only occur in that area, including the Kunene and Kwanza Rivers on the west coast of Angola, and the Rovuma and Pungwe and Buzi systems on the east coast of Mozambique. (Source: cmsdata.iucn.org/downloads/the_status_and_distribution_of_freshwater_biodiversity_in_southern_africa)

Book Reviews

Roadless Rules:
The Struggle for the Last Wild Forests

By Tom Turner. 2009. Island Press. 192 pages. $27.50 (paperback).

Since the passing of the Wilderness Act in 1964, American land management agencies have occasionally been asked by Congress to evaluate the existence of roadless areas for designation as wilderness areas. The first Roadless Area and Review and Evaluation (RARE I) process was completed by the Forest Service in 1972. Conservation groups were outraged by the agency's omission of millions of acres of potential roadless areas, and after legal challenges, the Forest Service completed the RARE II process in 1979. The result of RARE II was equally controversial, and battles among the Forest Service, Congress, and special interest groups continued to rage.

Roadless Rules tells the story of the next major process to gauge roadless areas in the United States: President Bill Clinton's Roadless Area Conservation Rule (RACR) of 2001, and subsequent efforts by the George W. Bush administration to overturn this decision to ban road building in roadless areas of the national forests. Turner, a journalist and editor for Earthjustice, a nonprofit law firm focused on environmental issues, faithfully describes the book as "a story of the interplay between litigation and public policy, with plenty of politics and vast dollops of community organizing thrown in for good measure" (p. xiii–xiv).

Turner discusses the role of the Pew Foundation and other nongovernmental organizations (NGOs) in helping convince government bureaucrats and politicians to support a nationwide protection of nonroaded areas (i.e., the RACR). The legal battles resulting from the RACR, the rise of the Bush administration's Roadless Rules plan (which attempted to give states the decision-making power over roadless areas), and the legal battles arising from the Bush proposal are also described. Turner uses interviews with various stakeholders to buttress his account of the legal, bureaucratic, and political machinations surrounding the roadless area issue in the 21st century.

Turner suggests the campaign for the Roadless Rule "has been the most extensive national environmental campaign yet waged in the United States, combining grassroots organizing in nearly every state; massive infusions of philanthropic support; support from hunters, and anglers, religious leaders, scientists, and the outdoor recreation industry; relentless lobbying of Congress and the executive branch; and complex and extremely long-lived litigation that kept the [Clinton] rule in place in the face of hostile opposition" (p. 3). This sustained legal and lobbying battle seems to be the norm in the 21st century, and in many ways is deeply disturbing. More comforting is the fact that the general public—Democrats and Republicans alike—strongly and consistently supported the protection of wilderness via the roadless rule, and their views were eventually accepted—after much political and legal action (which still continues today)—in both the judicial and political arena. *Roadless Rules*, although ultimately a success story for wilderness, also reminds us that intense, long-term lobbying and legal challenges are required to succeed in certain political climates, and that challenges to "old" rules and regulations are always just around the corner in a new political administration.

Review by JOHN SHULTIS, IJW book editor; email: shultis@unbc.ca.

Yellowstone Wolves: A Chronicle of the Animal, the People, and the Politics

By Cat Urbigkit. 2008. McDonald and Woodward Publishing. 373 pages. $29.95 (paperback)

The dedication and passion that the author demonstrates toward the central issue of this book—the introduction of wolves in Yellowstone—very quickly become evident in *Yellowstone Wolves*. She and her husband felt so strongly about the issue that they sued the government over their plans, and as they couldn't afford lawyers, studied law and took the case on themselves. Indeed, such passion is in evidence throughout the book that the objectivity of the author is often compromised, especially when she goes beyond documenting published evidence and uses personal stories to buttress her arguments. However, notwithstanding the bias often shown—ironically, the same complaint the author has toward the U.S. government—the book provides a fascinating glimpse at the nexus of politics, emotion, science, legal challenges, and entrenched positions of various special interest groups that emerged over the decision to reintroduce wolves in Yellowstone National Park.

The central position taken by the author is that the "reintroduction" of wolves in Yellowstone was deeply flawed, as a subspecies of wolf (*Canis Lupis irremotus*) native to the area had never been exterminated. Therefore, the introduction of wolves from Canada (subspecies *Canus Lupis occidentalis*) was a grave error by the U.S. government. The author, a newspaper reporter/farmer, accessed historic and government records that do seem to provide evidence that low numbers of wolves continued to exist in Yellowstone before and during the reintroduction. However, there doesn't seem to be clear proof that the wolves existed in large enough numbers to maintain a coherent population, or that is was indeed the *irremotus* subspecies.

It does seem evident that the U.S. government had no interest in acknowledging the existence of any subspecies, and indeed in 1977 reclassified four subspecies of wolves into two species (*Canis lupis* and *Canis refus*), meaning that the *irremotus* subspecies was removed from the endangered species listing of 1973. Urbigkit suggests that this action, and the later redefinition of the term *population* later, was to allow for an experimental population of Canadian wolves to be introduced into the areas: the experimental designation (created in 1982) allowed the government to manage the wolf population on their own terms (i.e., with greater control and flexibility). This increased control was needed due to the controversial nature of wolf reintroduction in the region.

Yellowstone Wolves provides a wonderful example of how wilderness management issues such as the reintroduction of a predator quickly become "wicked" problems, involving multiple truths, conflicting science, bureaucratic and political pressures, special interest groups, concerned members of the public, and the legal system. On the wolf issue in Yellowstone, Urbigkit notes the government agencies have their own agenda, and change their policies and procedures to ensure this agenda is met. Although her passion for the topic may sometimes obscure her impartiality, Urbigkit provides a valuable service by highlighting the political nature of decision making and the troubling self-selection of science to serve bureaucratic and political ends in wilderness, park, and wildlife management.

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value of wilderness to understand the causes and consequences of environmental change and identify gaps in knowledge worthy of focus. The call is out for abstracts for the Symposium on Science and Stewardship to Protect and Sustain Wilderness Values. Following the highest priorities identified for this Congress, the request specifically solicits presentations on wilderness as a strategic element in the global response to climate change, including scientific, mitigation, and adaptation roles, with broad subtheme examples of advancing our knowledge related to freshwater contributions of wildland protection, transboundary connectivity benefits and threats, risks and benefits of natural and prescribed fire, land and seascape disturbance issues, and human communities in transition in relation to nature.

We are excited and looking forward to facilitating new and far-ranging wilderness science and sharing this science with other scientists, managers, invested parties, old wilderness hands, those only now considering such protection, and the public. This symposium, as well as other essential elements of the Congress, will provide opportunities for government representatives, managers, concerned citizens, scientists, photographers, and youth to exchange ideas, hopes, and commitments during "Seven Days That Will Change the World." See you in Mérida.

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CI's strong presence was a key factor in facilitating and delivering the "2010 Vision" of tripling the country's protected area coverage. But political turmoil in the country indicates just how fragile such gains may turn out to be: in order to ensure the sustainability of such gains, and to amplify them globally, we need continual proof of why they are so important for humanity. By providing this, we are confident that CI, along with partner organizations such as The WILD Foundation, will eventually staunch the biodiversity crisis, and as a result also contribute to the solutions to numerous of the other challenges facing humanity.

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